SOUTHEASTERN BIOLOGY

Volume 63 July, 2016 Number 3

ASB 77TH ANNUAL MEETING
MARCH 31 – APRIL 3, 2016

Davidson College, Davidson, North Carolina
Queens University of Charlotte, North Carolina
Charlotte Teachers Institute, North Carolina
University of North Carolina at Charlotte

Meeting Site: Convention Center at the Embassy Suites Hotel, Concord, North Carolina

Abstracts of Papers and Posters Presented at the Annual Meeting

Meeting of the Charlotte Teachers Institute (CTI) Teacher Leadership Council made up of classroom teachers in the Charlotte-Mecklenburg, North Carolina Schools. From left to right: Matt Kelly, Connie Wood, Teresa Strohl, Alexandra Edwards, Deb Semmler, Annie Calloway, Robin McLennon, Jackie Smith, Connie George, Gloria Brinkman, Miesha Gadsden, Nikki Guevara, Stephanie Misko, Jennifer Ladanyi, Katelyn Gardepe, Calen Clifton, and Julie Ruziska Tiddy. Photograph taken at the University of North Carolina Charlotte Center City by CTI Executive Director Scott Gartlan.

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SOUTHEASTERN BIOLOGY

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All contributions, inquiries about missing back numbers and other matters should be addressed to the Journal Editor. Send books to be reviewed to the Book Review Editor.

PURPOSE

The purpose of this association shall be to promote the advancement of biology as a science by encouraging research, the imparting of knowledge, the application of knowledge to the solution of biological problems, and the preservation of biological resources. The ASB has representation in Section G Committee of the AAAS. Varying types of membership are available to individuals and institutions. See inside back cover.

TIME AND PLACE OF FUTURE MEETINGS

2017 March 29-April 1: Featured Institutions – To be determined. Meeting site is the Convention Center at the +Renaissance Montgomery Hotel and Spa, Montgomery, AL.

CALL FOR NON-COMMERCIAL WORKSHOP AND SYMPOSIUM PROPOSALS FOR THE 2017 ANNUAL MEETING OF THE ASSOCIATION OF SOUTHEASTERN BIOLOGISTS

Deadline for Receipt of Proposals: September 1, 2016

Proposals for non-commercial Workshops (hereafter referred to as Workshops) and Symposia to be offered at annual meetings of the Association of Southeastern Biologists must be prepared and submitted for review as described in this Call for Proposals; the same criteria for proposal preparation, submission, and review apply to proposals originating from internal leadership bodies within ASB (such as standing committees) and from individuals or groups outside of ASB. **Commercial workshops are arranged through the President, and they are subject to separate guidelines that can be obtained from the President.** Written proposals for Workshops and Symposia must be submitted to the Chair of the Program Committee, the ASB Meetings Coordinator, and the ASB President no later than two weeks prior to the fall interim meeting of the ASB Executive Committee. Proposals for Workshops must clearly describe their structure (including maximum number of participants) and concept, as well as prerequisites, space and other facilities requirements, and request for funding from ASB (if any). Proposals for Symposia must clearly address all five of the criteria listed below and be accompanied by letters of endorsement (if any). All proposals will be peer-reviewed and ranked by the Program Chair of the LAC and the ASB Executive Committee. Decisions to accept or reject proposals will be made at the fall interim meeting of the ASB Executive Committee, and proposers will be contacted shortly thereafter.

Workshops

Structure & Concept: Workshops are flexible in their structure. They can be a half-day, full day, or two days in length. Lunchtime Workshops are also offered. Workshop structure is determined by the organizers. Workshops typically have maximum enrollments, and they may specify prerequisites for participation (Workshops should be open to all meeting attendees, first-come first-served, who meet these prerequisites). Workshops often have a registration fee to cover A/V equipment and preparation. Workshops are intended to convey specific knowledge or skills; they are not intended for the presentation of research papers. Workshops are frequently more interactive and informal than sessions within the formal scientific program, and they are not scheduled concurrently with Symposia, contributed oral sessions, or poster sessions. Workshops may involve one or several teachers/presenters, and they may include computer-based or other 'hands-on' training. Weekend Workshops may be linked with a scientific field trip. A Workshop proposal should make clear what participants might expect to gain, and how the Workshop furthers the overall goals of the Association of Southeastern Biologists (these two aspects are the major criteria for Workshop acceptance). Limits of space and time may make it impossible to accommodate all worthy submissions.

Symposia

Structure & Concept: Symposia are a half-day or a full day in length. The number of speakers and the length of each talk are determined by the session organizers; talks should be between 15 and 30 minutes long, and presentation times can vary between speakers. Each session should include at least one 30-minute break that will be synchronized with the coffee break of all concurrent sessions. Generally, Symposia should be focused, integrated presentations assessing current understanding regarding a particular research problem, concept, application, or educational theme. Symposia should have broad appeal to members of ASB or involve integration across sub-disciplines.

Symposium proposals will be assessed under the following criteria. Weighting of particular criteria may vary depending on the nature of proposals, but proposals should explicitly address these criteria, as appropriate. There is typically room for only three Symposia at the annual ASB meeting.

Criteria for Evaluation of Symposium Proposals

1. **Scientific strength:** Symposia are the scientific centerpieces of the meeting, and should:
   - offer significant contributions to biological understanding,
   - present innovative or interdisciplinary approaches, including novel collaborations or syntheses across subdisciplines, and
   - have broad enough appeal to generate large audiences (>100 people) at the meeting.
2. **Structure and organization:** Symposia should be more explicitly integrated than other sessions, and should be structured to:
   - provide overall synthesis or overview; they should not be simply a set of related case studies,
   - avoid taking a narrow perspective on the Symposium topic; organizers should carefully avoid appearance of biases toward their own perspectives, and
   - build a well-integrated whole; each talk should have clear relevance to overall synthesis.
3. **Speakers:** Invited speakers should bring new contributions to the session, not simply reviews of previous work. Inclusion of experienced or particularly engaging speakers can strengthen a proposal, but new voices are also important. Proposals with a larger proportion of confirmed speakers will be favored.
4. **Funding:** Workshop and Symposium proposers must certify that they have sufficient funding available to cover all costs of the program as proposed, including expenses (travel, meals, lodging, honoraria) for all invited speakers. If additional funds are needed beyond those available to the proposers, such funds must be identified and may be requested from the ASB Executive Committee (EC), which has some funding available for Symposium proposals, usually reserved for proposals that come from ASB standing committees. If requesting funds from the EC, the Symposium proposers must specify an amount and justify that amount. If the EC provides funds requested by the Symposium proposers, it is assumed that the Symposium is fully funded as described. If partial funding is offered by the EC,

the Symposium proposers must subsequently secure the additional funds required to cover all costs.

5. **Integration:** Proposals may receive higher priority if they are clearly linked to the meeting's overall theme, or if they offer particular value or insight in the context of other sessions proposed for the meeting or of Symposia at recent ASB meetings.

Endorsements

Workshops and Symposia are often endorsed by various groups, agencies, and organizations including international societies, private non-governmental organizations, governmental agencies, or internal leadership bodies within ASB, such as standing committees. These endorsements will be considered in review of proposals, particularly if they emphasize why the group finds merit (in terms of evaluation criteria above) in the proposal. **Each of these groups, organizations, or agencies is allowed to endorse only one Symposium proposal**. If a group submits a proposal, that group is considered to be endorsing its own proposal, and it cannot endorse another. Symposium proposers, in requesting endorsements, should make this policy clear. There is NO guarantee that a proposal endorsed by any group or organization will be accepted. Individuals preparing letters of endorsement should send them directly to those preparing the proposal for inclusion as part of the proposal package.

If Your Proposal Is Accepted

After proposals are accepted and the scheduling for the meeting is underway, cancellations and schedule changes are very disruptive to meeting planning. Hence, organizers of Workshops should obtain firm commitments from their teachers/presenters and organizers of Symposia should obtain firm commitments from as many of their invited speakers as possible before submitting their proposals. **Requests for additional funding will not be considered by the ASB Executive Committee.**

If a proposal is accepted, the organizers must submit a final summary description of the Workshop or Symposium to the Program Committee Chair at the same time abstracts are due. This summary will appear on the meeting website and should be written so as to stimulate interest and promote attendance. This description must include a complete and current listing of organizers' names and their affiliations, addresses, telephone and fax numbers, and email addresses; a 400-word narrative description of the session; a 50-word sentence description of the session; and a final, confirmed speaker list.

It is the responsibility of Symposium organizer(s) to see that each speaker submits an individual abstract of his/her talk using ASB's abstract submission criteria by the abstract submission deadline. It is not permissible to submit abstracts by any other means. Contact the Program Committee Chair if your situation precludes use of the abstract submission website.

It is suggested and encouraged that a written summary of the Workshop or Symposium be submitted to *Southeastern Biology* for publication.

Non-Commercial Workshop/Symposium Proposal Submission Form

Title:

Submitters' Contact Information (address, phone, and e-mail address):

Session Description: In 400 words or less and in sentence form, describe the theme and purpose of this session.

Session Justification: In 250 words or less and in sentence form, provide the justification for this session.

One-sentence Summary: Summarize your proposal in 50 words or less.

Speakers and Titles: List all teachers/presenters (Workshops) or speakers and their titles (Symposia). Next to each participant, indicate if they are confirmed or only contacted and have not yet decided (unconfirmed). Do not list individuals who have not yet been contacted.

Funding: Explain how the Workshop or Symposium as proposed is to be funded. Symposium proposers may request needed funds from the ASB Executive Committee.

This form must be submitted to the following individuals no later than two weeks prior to the fall interim meeting of the ASB Executive Committee (deadline is September 1, 2016).

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Bylaws of the Association of Southeastern Biologists

Article I - Membership and Dues

Section 1. Annual dues shall be set by the membership on recommendation by the Executive Committee for the following categories of regular membership: Individual, Student, Sustaining, Contributing, Family, Life, Emeritus, Patron, and Library.

Section 2. Any member who has been a regular member of the Association for 10 or more consecutive years and who has retired from professional duties may be elected to Emeritus membership by the Executive Committee. An Emeritus member shall have the same rights and privileges as a Regular Member.

Section 3. Any individual or organization that contributes funds each year, in an amount set by the Executive Committee and approved by the membership, to sponsor an ASB award or otherwise support the Association shall be known as a Patron Member of the Association.

Section 4. Any organization with a focus on the biological sciences may become an affiliate of the Association of Southeastern Biologists upon recommendation of the Executive Committee and approval of the membership attending the annual meeting. Affiliation does not confer individual membership in the Association on the members of the affiliated organization.

Section 5. Annual renewal of membership shall require the payment of dues by the first of January. Any member with dues in arrears on the first of July shall be dropped from the membership roster. Members must pay past dues to maintain continuous membership.

Article II - Election of Officers

Section 1. The Nominating Committee shall select annually at least one nominee for each office to be filled. Members may recommend to the Nominating Committee persons for any office.

Section 2. The slate of nominees shall be presented to the membership prior to the Annual Meeting, and **shall be accepted or modified by nominations received from the floor during the business session of the Annual Meeting.** Each candidate must verify a willingness to serve if elected.

Section 3. **The close of nominations from the floor will establish the final slate of nominees which will be sent to the membership by the Secretary in the week following the Annual Meeting**

Section 4. All ballots shall be **collected one month later by** the Secretary who **shall report the election results to the Executive Committee and** shall retain **the ballots** for 1 year.

Section 5. After the election results have been determined, those elected will fill expired terms on the Executive Committee.

Section 6. A President-Elect shall be elected every other year and shall serve a 1-year term, then a 2-year term as President and a 2-year term as Past President.

Section 7. A Vice President shall be elected annually. Neither the President nor the Vice President shall be eligible for reelection for the year following her/his term of office.

Section 8. A Secretary shall each be elected for a 3-year term and shall be eligible for reelection.

Section 9. The Treasurer and an Associate Treasurer shall comprise the Treasury Office. An Associate Treasurer shall be elected for a 3-year term. At the close of her or his term of office, the Associate Treasurer shall become Treasurer, serve a 3-year term, and then may elect candidacy for the office of Associate Treasurer. The Associate Treasurer shall become Treasurer in the event that the Treasurer can serve no longer.

Article III - Duties of Officers

Section 1. The President shall be the executive officer of the Association and chair of the Corporation Board of Directors, for a 2-year term, and shall perform the duties usual to the office. He/she shall appoint, with the advice of the Executive Committee, regular committees, special committees authorized by the Executive Committee, and where appropriate, Association Representatives to other organizations. The President shall approve and sign the internal and external audits at the annual meeting. The President shall notify Emeritus members of their election. The President shall co-chair the Annual Meetings Arrangements Committee with either the President-Elect or with the Past-President.

Section 2. The President-Elect shall serve a 1-year term during which her/she will keep in close contact with the President and Past President and in effect study the Presidency. In the event that the President-Elect cannot complete her/his term of office, the person who received the next highest number of votes shall become President-Elect. If this person is unable to serve, the Executive Committee shall nominate two candidates for the office, one of whom would be elected by the membership by mail ballots.

Section 3. The Past President shall serve a 2-year term, and in order to provide continuity in the governance of the Association, shall serve as advisor to the President on matters of past policy. He/She shall serve as Chair of the Resolutions Committee, Nominating Committee, and of the Past Presidents' Council.

Section 4. The Vice President shall serve a 1-year term and shall be the public relations officer of the Association. He/ she shall organize the program for the plenary of the Annual Meeting. In the absence of the President from any meeting, the Vice President shall discharge the duties of the office, and in the event that the President cannot complete her/his term of office, the Vice President shall become President of the Association.

Section 5. The Secretary shall keep records of the meetings of the Association and of the Executive Committee, conduct routine business pertaining to the office, prepare and distribute ballots, serve ex officio as Associate Editor of *Southeastern Biology,* and report the activities of the office to the Association at the Annual Meeting. In the absence of the Treasurer, the

Secretary shall assume the duty to authorize by signature any financial transactions belonging to the Treasurer's office.

Section 6. The Treasurer shall receive and disburse all funds of the Association, keep records of dues received and funds expended, serve ex officio as Business Manager of *Southeastern Biology*, and report the activities of the office annually to the membership. He/she is authorized to reimburse the Secretary for expenses incurred in attending the Annual Meeting and interim meetings of the Executive Committee and may be authorized by the Executive Committee to reimburse other officers for expenses incurred in attending one Executive Committee meeting per year. The Treasurer shall keep the Associate Treasurer advised of all transactions of the office.

Article IV - Southeastern Biology

Section 1. *Southeastern Biology,* the official publication of the Association, shall be published quarterly online or at other regular intervals as may be determined by a vote of the membership upon recommendation by the Executive Committee.

Section 2. The Journal Editor, responsible for editing and online publishing of *Southeastern Biology,* shall be a member of the Association appointed by the Executive Committee for a term of 3 years. He/She shall be eligible for reappointment for successive 3-year terms.

Section 3. Upon the recommendation of the Journal Editor, the Executive Committee may appoint an Associate Editor who would assist the Journal Editor in matters related to the online publication of the journal, a News Editor who would assist the Journal Editor in obtaining news of biology in the Southeast, and other editors as needed."

Section 4. *Southeastern Biology* shall be available online to all members of the Association.

Section 5. Major changes in editorial policy proposed by the Journal Editor shall be subject to approval by the Executive Committee.

Article V - ASB Web Page

Section 1. The Association shall maintain an official ASB Web page on the Internet. The ASB Web page shall contain information about ASB officers and the Executive Committee, information concerning the Annual Meeting, news of ASB activities, information of interest to biologists in the southeast, and links to Internet sites of interest to the membership.

Section 2. The Association Web page will be developed by a Web Administrator. The **Administrator** shall be a member of the Association, responsible for web development, membership database administration, and software updates associated with the Association's web presence. Information posted on all social media will be monitored and updated by the Web Editor. The Editor shall be a member of the Association and shall serve as the contact person between the Web Administrator and the Executive Committee. The Web Administrator and Editor shall be selected and appointed by the Executive Committee for an indefinite

term, and shall be eligible for reappointment for any number of successive 3-year terms.

Article VI - Executive Committee

Section 1. The Executive Committee shall be in charge of the affairs of the Association and shall direct the expenditure of the Association's funds. The committee shall establish the policies for the Association with the approval of the membership and shall record all policies in effect in the "Leadership Guide for Officers and Committee Members."

Section 2. The Members-at-Large are eligible for reelection. Should a Member-at-Large leave office prior to expiration of the term, the Executive Committee shall appoint a replacement to serve until the next election.

Section 3. The President with approval of the Executive Committee shall establish an Archives Office consisting of an Archivist, Associate Archivist, and assistant Archivist each serving a 2-year term. At the close of the Archivist's term, the Associate Archivist assumes that position, and the Assistant becomes the Associate Archivist. The President and Executive Committe**e** can reappoint the former Archivist to the position of Assistant Archivist or appoint someone from the membership to fill that position.

Section 4. The Archives Office shall be custodian of the permanent records or archives and, with the approval of the Executive Committee, make appropriate arrangements for the collection, care, and maintenance of such records.

Section 5. The Executive Committee shall appoint a Membership Officer who shall work closely with the Treasury Office and be in charge of all membership-related duties and records including maintaining a membership database. The Membership Officer shall serve a term of 3 years and shall be eligible for reappointment for successive 3-year terms.

Section 6. For all meetings of the Executive Committee seven voting members shall constitute a quorum.

Section 7. Serving as the Corporation Board of Directors, the committee shall report to the North Carolina Department of State any changes in specific articles of the Constitution, viz., Article I, Section 2., Article VI, and Article VII that treat the Association's Purpose, Disposition of Property, and Incorporation, respectively. The Board may change its registered office or registered agent by notifying the North Carolina Department of State within 60 days after such change takes effect.

Article VII - Standing Committees

Section 1. The following standing committees shall serve the Association:

A. Auditing Committee ***(Deleted 4/16/2004)***
B. Committee on Human Diversity ***(Editorial name change, April 18, 2008)***
C. Conservation Committee
D. Education Committee
E. Finance Committee
F. Graduate Student Support Award Committee
G. Annual Meeting Arrangements Committee
H. Meritorious Teaching Award Committee
I. Nominating Committee
J. Patron Member and Exhibitor Committee ***(Deleted 4/15/11)***
K. Past-Presidents' Council
L. Place of Meeting Committee ***(Deleted 10/1/2011)***
M. Poster Awards Committee
N. Publications Committee
O. Resolutions Committee
P. Senior Research Awards Committee
Q. Student Research Awards Committee
R. Microbiology Awards Committee
S. Membership Benefits Committee
T. Program Committee
U. Affiliate Societies Committee
V. John Herr Lifetime Achievement Award

Section 2. Committee members, except for those who serve ex officio, shall be appointed by the President upon the approval of the Executive Committee. The composition and duties of the standing committees shall be as follows:

A. The Auditing Committee ***(Deleted 4/16/2004)***

B. The Committee on Human Diversity shall promote career opportunities in the biological sciences for women, minorities, and individuals with disabilities and implement programs to eliminate barriers that restrict the access of underrepresented groups to biological careers. The committee shall consist of three members appointed for terms of 3 years, with a member appointed annually and serving as Chair in the third year.

C. The Conservation Committee shall accumulate facts about environmental issues; shall, where it deems appropriate, disseminate such information to the membership; and shall bring resolutions addressing issues of significance to the Executive Committee for presentation to the membership through the Resolutions Committee. The committee shall consist of three members appointed for terms of 3 years, with a member appointed annually and serving as Chair in the third year.

D. The Education Committee shall explore ways and means by which the Association might contribute to improve biological education at all levels. Where feasible, the committee shall organize symposia and workshops for the Annual Meeting designed to acquaint the

membership with new pedagogy and critical issues in biological education. The committee shall have the responsibility for identifying an outstanding teacher to receive the Lucrecia Herr Outstanding Biology Teacher Award. The committee shall consist of six members appointed for terms of 3 years, with two members appointed annually and serving as Co-Chairs in the third year.

E The Finance Committee shall review the finances of the Association, prepare budget projections for future years, and recommend actions regarding dues structure and other financial matters to the Executive Committee. The committee shall consist of the ASB Treasurer (Chair), Past President, President-Elect **or Vice President**, and a member of the Executive Committee.

F. The Graduate Student Support Award Committee shall make monetary awards to assist graduate students to attend the Annual Meetings of ASB. The committee shall consist of three members appointed for terms of 3 years, with a member appointed annually and serving as Chair in the third year.

G. The Annual Meeting Arrangements Committee in consultation with the Executive Committee shall propose to the Executive Committee the site and venue for the annual meeting, provide for meeting space needs in consultation with the Program Committee, and negotiate the costs for space, food, and services. The Committee will engage in meeting audiovisual needs, arranging field trips, and managing the silent auction. The committee shall consist of the President, all six Members-at-Large, and the President-Elect or the Past-President.

H. The Meritorious Teaching Award Committee may each year select for the award a member of the Association who has taught biology for at least ten years in any college or university represented in the Association and has been a member of the Association for at least ten years. The committee shall consist of three members appointed for terms of 3 years, with a member appointed annually and serving as Chair in the third year.

I. The Nominating Committee shall, with due consideration of suggestions received from the membership, select annually at least one nominee for each office to be filled. The committee shall consist of three members, one of whom is a recent past president who shall serve as the Chair.

J. The Patron Member and Exhibitor Committee ***(Deleted 4/15/11)***

K. The Past Presidents' Council, composed of the Past Presidents attending the Annual Meeting with the current Past President serving as Chair, shall review and discuss major issues under consideration by the Executive Committee and, where appropriate, shall share its consensus view with the Executive Committee on the resolution of these issues.

L. The Place of Meeting Committee ***(Deleted 10/1/2011)***

M. The Poster Awards Committee may each year select a recipient of the Association Poster Award for the meritorious presentation of original research by members at the Annual Meeting. The Committee shall consist of six members appointed for terms of 3 years, with a

member appointed annually and serving as Co-chairs in the third year.

N. The Publications Committee shall provide oversight of the Association's publications, consider requests for special publication activities, and recommend any alteration of publication policy to the Executive Committee for approval and subsequent approval by the membership. The committee shall consist of three of the Members-at-Large of the Executive Committee and the Editor (ex officio).

O. The Resolutions Committee shall formulate and, with approval of the Executive Committee, present to the membership such resolutions as may be considered worthy of action by the Association. The committee shall be served by the Past President as Chair and two additional members with terms of 1 year.

P. The Senior Research Awards Committee may each year select a recipient of the Association Senior Research Award for the meritorious presentation of original research by a senior member at the Annual Meeting. The recipient must have been a member of the Association for at least four years. The committee shall consist of three members appointed for terms of 3 years, with a member appointed annually and serving as Chair in the third year.

Q. The Student Research Awards Committee may each year select the recipients of the Association Student Research Prizes for the meritorious presentation of original research by a student member at the Annual Meeting. The committee shall consist of three members appointed for terms of 3 years, with a member appointed annually and serving as Chair in the third year.

R. The Microbiology Awards Committee may each year select a student or senior member of ASB to receive the Microbiology Award for the meritorious presentation by a senior member at the Annual Meeting. The recipient must have been a member of the Association for at least four years. The committee shall consist of three members appointed for terms of 3 years, with a member appointed annually and serving as Chair in the third year.

S. The Membership Benefits Committee shall assist the Membership Officer in the development and implementation of member benefits, and in the recruitment and retention of members. The committee shall consist of the Membership Officer (Chair) and three (3) members appointed for terms of three (3) years, with one a member appointed annually.

T. The Program committee shall solicit abstract submissions for the annual meeting in the October issue of Southeastern biology, provide a mechanism for the electronic submission of abstracts, establish appropriate sessions for presentations, and prepare the program for publication on the webpage and in Southeastern Biology. The committee shall consist of three members, appointed for indefinite terms, with the President appointing one member to serve as Chair.

U. The Affiliate Societies Committee shall bring all proposals, problems, and concerns of the Affiliate Societies to the Executive Committee for action. The committee shall consist of three members appointed

for terms of 3 years, with a member appointed annually and serving as Chair in the third year. The member appointed annually shall be selected from a new affiliate society, one that has not currently furnished a member for the committee.

V. The John Herr Lifetime Achievement Award Committee shall consider proposed recipients of the award and shall notify the Executive Committee of their selections. The committee shall consist of Three Past Presidents appointed for terms of 3 years, with a member appointed annually and serving as Chair in the third year.

Article VIII - The Annual Meeting

Section 1. An Annual Meeting, with colleges, universities, or scientific institutions throughout the Southeast recognized as featured institutions, shall be convened each spring for the purposes of conducting Association business; sharing scientific information through symposia, paper and poster sessions, and workshops; and strengthening social and professional ties among Southeastern biologists.

Section 2. All titles and abstracts of papers and posters submitted for the program shall be in the offices of the Annual Meeting Arrangements Committee and the Program Committee by the date set by the Journal Editor and shall be presented according to the guidelines in the published Call for Papers.

Section 3. The maximal time period for the presentation of papers shall be established by Program Committee, and the Chairs of the paper sessions will enforce the established time period.

Section 4. Papers presented at the Annual Meeting shall be read by members or persons introduced by members.

Article IX - The Enrichment Fund

Section 1. The Association shall maintain an Enrichment Fund to support long- and short-range objectives to advance biological education through teaching and research. The specific objectives to be supported shall be designated by the Executive Committee and approved by the membership.

Section 2. The Enrichment Fund shall be under joint management of a Board composed of the Executive Committee and Finance Committee and guided by a Chair appointed by the President for a term of 3 years. This Board shall be responsible for the: prudent investment of all Endowment Funds of the Association and for planning and directing the recruitment of funds from the membership and external sources. The Chair shall report the current status of the Enrichment Fund to the Association at the Annual Meeting.

Section 3. The Board shall receive and administer bequests and other property from any source and shall have the authority to buy, sell, exchange, lease, transfer, or otherwise dispose of any property, real or personal, with respect to the Enrichment Fund.

Section 4. Bequests and gifts without specific designation (General Fund) shall be designated by the Board for any established educational objective of the Association. Bequests and gifts received for specific purposes shall be

either applied directly to the intended purpose (Restricted Funds) or placed in an Endowment with only the annual earnings applied to the intended purpose in accordance with the wishes of the donors. Endowments may be named in honor or memory of individuals or for the intended purpose and may be established for existing educational objectives or others approved by the Board.

Section 5. Income Allocation - The General Fund, Restricted Funds, and Endowments shall be allocated income at the end of the fiscal year based on the average balance of each fund in the total amount of Enrichment Funds invested for that year.

Section 6. Investment Policy - In order to protect the contributions to the Enrichment Fund for their intended objectives, the Board shall strive to invest funds only in conservative investment vehicles offering the highest interest rates or earnings at the time of purchase. Since changes in the economy and other factors greatly affect interest rates and earnings, funds shall be invested up to a period of 5 years unless otherwise approved by the Board.

Section 7. An audit of the Enrichment Fund shall be made at the close of each fiscal year by an external auditor and which audit will then be approved and signed by the president at the annual meeting in April.

Article X - Amendements

Section 1. These bylaws may be amended at any Annual Meeting of the Association by a two-thirds majority vote of those present. **Amendments adopted at the Annual Business Meeting shall be submitted to the membership-at-large for final adoption which shall require a three-fourths majority of those voting.**

Section 2. Amendments to these bylaws shall take effect at the close of the meeting at which they were adopted.

Revised April 2, 2016.

Constitution of the Association of Southeastern Biologists

Article I - Organization

Section 1. The name of this organization shall be The Association of Southeastern Biologists.

Section 2. The purpose of this Association shall be to promote the advancement of Biology as a science by encouraging research, the imparting of knowledge, the application of knowledge to the solution of biological problems, and the preservation of biological resources.

Section 3. Notwithstanding any other provision of these Articles, the corporation shall not carry on any other activities not permitted to be carried on (a) by a corporation exempt from Federal income tax under section 501(c)(3) of the Internal Revenue Code of 1986 (or the corresponding provision of any future United States Revenue Law) or (b) by a corporation contributions to which are deductible under 170(c)(2) of the Internal Revenue Code of 1986 (or the corresponding provision of any future United States Revenue Law).

Article II - Membership and Dues

Section 1. Membership shall be open to all persons interested in the biological sciences.

Section 2. Membership shall be granted to any eligible individual, institution, or corporation upon receipt of a written application and dues payment for the current year.

Section 3. Each member shall pay annual dues in accordance with her/his category of membership. Annual dues include online access to *Southeastern Biology* and eligibility for subscriptions at reduced costs to other journals sponsored by the Association.

Article III - Officers

Section 1. The Officers of the Association shall be the President, Vice President, President-Elect, Past President, Secretary, Treasurer, and Associate Treasurer.

Section 2. The term of office is 3 years for the Secretary ~~and~~ Treasurer, and Associate Treasurer, 2 years for the President and Past President and 1 year for the other offices.

Article IV - Executive Committee

Section 1. The officers of the Association, six ~~(6)~~ Members-at-Large elected by the membership, the Journal Editor of *Southeastern Biology,* the Membership Officer, the Web Editor of ASB, and Members of the Archives Offi**ce** shall constitute the Executive Committee. The Journal Editor, Web Editor, Membership Officer, Associate Treasurer, and Members of the Archives Office shall be ex officio, nonvoting members with the right to discuss all issues

and to propose motions. Members-at-Large shall serve terms of 3 years with two members elected each year.

Section 2. The Executive Committee shall meet in the fall of each year and in the spring during the Annual Meeting of the membership.

Section 3. The Executive Committee shall serve additionally as the Corporation's Board of Directors.

Article V - Annual Meeting

Section 1. The Annual Meeting of the Association shall be held in April at such place as may be recommended by the Executive Committee and approved by the membership. The date of the meeting shall be determined by the Executive Committee.

Section 2. The Executive Committee may change the time and place of the Annual Meeting and may call special meetings of the Association.

Section 3. Notice of all special meetings shall be sent to each member at least two (2) weeks before the dates on which such meetings are to convene.

Section 4. Fifty (50) members of the Association shall constitute a quorum for the transaction of business at the Annual Meeting or at any special meeting.

Article VI - Disposition of Property

In the event of the dissolution or termination of this corporation, after paying or adequately providing for the debts and obligations of the corporation, the remaining assets shall be distributed to a non-profit fund, foundation, or corporation which is organized and operated exclusively for charitable, educational, and/or scientific purposes and which has established its tax exempt status under section 501(c)(3) of the Internal Revenue Code or shall be distributed to federal, state or local government for a public purpose.

Article VII - Incorporation

The Association of Southeastern Biologists is incorporated as a non-profit scientific, and educational organization without capital stock and one solely engaged in lawful activity as permitted by Section 501(c)(3) of the Internal Revenue Code of 1954, as amended, and by Chapter 55A-86 of the General Statutes of the State of North Carolina. No member shall have any title or interest in the property of the Association, and no dividends or profits shall be declared or paid to any member. ***Pending approval by the Internal Revenue Service. Approval received from the Internal Revenue Service April 24, 2015 retroactive to May 10, 2010.***

Article VIII - Audit

Section 1. The fiscal year for the Association is January 1 through December 31.

Section 2. The financial records of the Treasurer and of the Board of Trustees of the Enrichment Fund shall be audited by the Finance Committee at the close of the fiscal year at least 30 days prior to the annual meeting with the results included in the committee's annual report to the Executive Committee. An audit shall also be conducted at

least 30 days before the annual meeting in the third year of the Treasurer's term by an external auditor approved by the Executive Committee and which audit will then be approved and signed by the president at the annual meeting.

Article IX - Archives

Section 1. Documents to be archived shall be collected by the Archives Office consisting of an Archivist, Associate Archivist, and Assistant Archivist. The Archivist shall serve a 2-year term and may at the President's Section 1. Documents to be archived shall be collected by the Archives Office consisting of an Archivist, Associate Archivist, and Assistant Archivist. The Archivist shall serve a 2-year term and may at the President's discretion, and Executive Committee's concurrence, be reappointed as Assistant Archivist as the present Assistant assumes the office of Associate Archivist and the present Associate becomes the Archivist.

Section 2. The Archives of The Association of Southeastern Biologists shall be maintained permanently at the University of Georgia, Athens, Georgia.

Article X - Amendments

Section 1. This Constitution may be amended at any Annual Business Meeting by a three-fourths majority of those voting provided due notice has been sent by the Secretary to the membership at least 30 days in advance of the meeting, provided the amendment has been proposed either by the Executive Committee or otherwise by a committee authorized by the Association at a previous Annual Meeting, and provided that so long as the Association shall be or remain an organization exempt under Section 501(c)(3) of the Internal Revenue Code of 1954, as amended, no amendment shall be made to Article I, Article VI, or Article VII of this constitution without consent having been obtained from the Internal Revenue Service and having been reported to the North Carolina Department of State.

Section 2. Amendments adopted at the Annual Business Meeting shall be submitted to the membership-at-large for final adoption which shall require a three-fourths majority of those voting.

Revised April 2, 2016.

ASB

Paper and Poster Abstracts

From the 77th Annual Meeting

Hosted by Four Featured Institutions

Davidson College, Davidson, North Carolina
Queens University of Charlotte, North Carolina
Charlotte Teachers Institute, North Carolina
University of North Carolina at Charlotte

Meeting Site:

Convention Center at the Embassy Suites Hotel, Concord, North Carolina

March 31 - April 3, 2016

77th Annual Meeting

Association of Southeastern Biologists

Charlotte, NC • March 31 – April 3, 2016

ASB Presentation Abstracts

Poster Abstracts follow on page 336.

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1 Emily Ann Galloway, David B. Vandermast
Biology, Elon U, NC

Setting Ecological Parameters for Defining a Forest of Continuity

Most eastern forest habitat has been cutover at least once and significant patches of old-growth forest are found only in some of the most remote and inaccessible areas. However, historic land-use practices of farmers and other landowners left small patches of forest that were never clearcut. We call these small patches of remnant old-growth forests “forests of continuity” (FOC). FOCs are not pristine examples of old-growth forest, but are woodlands that have been continuously forested. Elon University Forest (EUF) is a 22.5 ha research forest, about 6 ha of which is a putative FOC. The purposes of this study were to collect data to estimate the age of forest types on EUF, and to compile what is currently unique about the forest patch on EUF thought to be an FOC. To estimate forest ages we collected increment cores from five trees on each of eight permanent vegetation plots (N=40). We found that trees on the two plots in the FOC had significantly higher estimated ages (121.2 and 118.3 years vs. 63.1; $p<0.01$). Old forests should have trees with a wide range of ages but younger forests should have more even-aged trees. Using standard deviation (SD) as a measure of this variation, we found that the FOC plots had a higher SD (46.7 vs. 15.2 years) than the younger forests, though the difference was not significant ($p=0.1$). Previous studies have found that the FOC has larger tree species that are typically found in late-successional forests, is less susceptible to invasive plants, has soil deeper O and A soil horizons and reduced soil fertility, and was less damaged by a recent ice-storm than were younger forests. The characteristics of the old forest on EUF fit the expectations of an FOC.

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2 Dennis D. Tarasi
Curriculum for the Environment and Ecology, UNC Chapel Hill

Biotic and Abiotic Community Changes With Species Invasions

Invasive exotic species are often managed with the assumption that they cause significant detrimental changes to the communities they invade. Unfortunately, the data quantifying these interactions remain limited. Here I report the results of an empirical study comparing NC forested communities communities dominated by a focal exotic species to communities of similar biotic composition, land use and topography, but not yet dominated by any exotic species. Communities experiencing invasion do not differ in abiotic composition from comparison sites, though invasion does correlate with quantifiable changes in multiple community-level biotic measures. These biotic changes differ in both direction and magnitude depending on the focal invader, providing context for management practices throughout the region.

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3 Thomas G. Green, Laura E. DeWald
Biology, Western Carolina U, Cullowhee, NC

Relationships Between Woody Species Functional Traits and Structure With Distance Into Harvested Openings

Early seral habitat and its associated fauna have been declining in the southeastern United States due to changes in land use and disturbance regimes. Forest management strategies to create and maintain early seral habitat can be improved through better understanding of how

opening size is related to vegetation composition and structure. Our study quantified woody species composition, structure and functional traits along transects from edges into the center of harvested openings in the Nantahala National Forest, North Carolina. Openings were harvested 5-9 years before sampling and ranged 2-14 ha in size. Preliminary results indicate proportion of shade tolerance, wood density, seed mass, and seed dispersal mechanism traits changed with distance from the forest into openings, with traits associated with early successional species more frequent toward the center of even the smaller openings. Analysis also showed vertical distribution of vegetation was denser closer to the ground as distance into the opening increased. These findings are likely related to increased overall light and light penetration to the ground with increasing distance from the edge of intact forest. These results suggest that even small openings can provide early seral habitat across the landscape.

4 Michael S. Hooker
Biology, Western Carolina U, Cullowhee, NC

The Effect of Road on Community Structure by Changing Seed Dispersal Patterns

Logging activities create roads and patches of young forests that can affect movemnt of wind, animal, and plants through the landscape. I compared soil, litter, and seed trap samples from road edge and interior understories of recent (last 15 years) and older harvests to determine if harvesting changes seed dispersal and vegetation patterns. Preliminary results for trees and ground layer vegetation show differences between the interior of the more recently harvested and older sites. Younger forests had more small trees of shade intolerant species, older sites have fewer, but larger of shade tolerant species associated with closed canopy habitats. Density, but not species compostion of ground layer vegetation also differed between older and more recently harvested sites. The younger forest had greater ground layer density within each age category, edge had similar species compostion, but greater ground layer density, than forest interiors. Seed patterns and the litter and soil, and distribution of seed trees are currently being analyzed to determine if differences in dispersal over the road-interior gradient between older and more recent harvests might influence ground layer vegetation composition or density.

5 Nicholas P. Flanders[1], Eric L. Walters[2], Christopher P. Randle[3], Lytton J. Musselman[4]
[1] Biological Sciences, Old Dominion U, Norfolk, VA; [2] Biological Sciences, Old Dominion U, Norfolk, VA; [3] Biological Sciences, Sam Houston State U, Huntsville, TX; [4] Biological Sciences, Old Dominion U, Norfolk, VA

The Role of Generalist Avian Frugivores in Determining the Distribution of the Mistletoe *Phoradendron leucarpum*

Mistletoes are a taxonomically diverse group of hemiparasitic shrubs that typically parasitize the branches of host trees and rely on avian frugivores for seed dispersal. Because most mistletoes are restricted to a narrow range of suitable recruitment sites and avian frugivores are more visible than other guilds of seed dispersers, mistletoe-frugivore systems offer good opportunities for the study of seed dispersal and the impact of frugivores on plant distributions. The oak mistletoe (*Phoradendron leucarpum*) is a stem parasite found across the southern United States (US) that is dependent on avian frugivores for seed dispersal and serves as the sole larval host plant for the great purple hairstreak (*Atlides halesus*) in the eastern US. Mechanisms driving observed oak mistletoe habitat relationships are unclear. Here we present results from occurrence models using presence-absence data on oak mistletoe shrubs and avian seed dispersers from forested habitats in eastern Virginia and North Carolina collected during winter (Jan-Mar) 2016. We also discuss methodology and implementation of oak mistletoe planting experiments in the field and the collection of great purple hairstreak occurrence data to begin in 2016.

6 Christopher J. Payne[1], Robert K. Peet[2]
[1] Curriculum for Environment & Ecology, UNC Chapel Hill; [2] Biology, UNC Chapel Hill

Analyzing Long-Term Forest Dynamics in a North Carolina Piedmont Forest Using Permanent-Sample Plots

For more than a century, succession has been a focal point in plant ecology. Long-term studies are uncommon but critical for understanding forest succession due to the complexity of ecological change through time. We used 80 years of permanent-sample plot data in the Duke Forest to examine the long-term patterns of population and community dynamics of trees across a successional sequence. Specifically, we examined the long-term trends of species composition and whether successional trajectories empirically support classical predictions about the transition from even-aged, old-field pine stands to mature, mixed-age hardwood forests dominated by oaks and hickories. Our permanent plots document species identity, height, and diameter of every tree in thirty-four 400-1000 m^2 plots every 5 years spanning a successional sequence from 1934-2013. We calculated basal areas for each species, plot and year and used these data to map samples into a reduced ordination space using Nonmetric Multidimensional Scaling. Using a suite of non-parametric distance-based statistical analyses, we concluded that composition of Duke Forest is becoming more homogenous and shifting toward a 'wetter' suite of species. This trend appears to be driven by 40 year-long trends of canopy oak and hickory mortality, lack of regeneration of oaks and hickories in the understory, and a large surge in red maple (Acer rubrum), American beech (Fagus grandifolia), and sweetgum (Liquidambar styraciflua) in the understory. The results seemingly contradict the predictions of classical models or indicate a regional shift in successional patterns, necessitating further correlational studies to indicate what is driving observed trends. This study provides an updated, directly-informed understanding of long-term successional patterns in Southeastern U.S. forests to allow for continued and enhanced utility of succession as a predictive model in the face of land-use and climate change.

7 Jaclyn N. Inkster[1], Claudia L. Jolls[1]
Biology, East Carolina U, Greenville, NC

A Federally Threatened Great Lakes Dune Endemic Thistle Is an Important Floral Resource for Insect Visitors

Pitcher's thistle (*Cirsium pitcheri*, Asteraceae) is a federally threatened species, endemic to the western Great Lakes sand dunes and cobble shores. It produces flowers in heads from late June to early August, a time when other floral resources in the dune ecosystem may not be present or as abundant. Although rare and limited in its distribution, we hypothesized that *C. pitcheri* is a valuable floral resource to the insect fauna of the local dune ecosystem. To test this hypothesis, we performed 10 minute observations on all the insect pollinated species in 10 m by 10 m plots in the Sturgeon Bay dunes of Wilderness State Park, Emmet County, MI. Observations were performed 26 June-5 August 2015. A total of 14,090 minutes of observation with 600 insect visits were recorded in 44 plots. The plant-insect visitor network consisted of 21 plants species and 59 insect species. Pitcher's thistle had a total of 22 (37.3%) insect visitors, and 109 (18.2%) visits out of the whole network. The two species with the second greatest number of visitors (11, 18.6%) were shrubby cinquefoil (*Dasiphora fruticosa*, Rosaceae) and Lake Huron tansy (*Tanacetum bipinnatum*, Asteraceae). Spotted knapweed (*Centaurea stoebe*, Asteraceae) had the second greatest number of visits (68, 11.3%), roughly half that of Pitcher's thistle. We concluded that, although rare, Pitcher's thistle is indeed an important floral resource for the insect visitors of the Sturgeon Bay dunes.

8 Mary Ann McBrayer, Kimberly A. Hays
Natural Sciences, Dalton State College, GA

Effects of Anthropogenic Habitat Disturbance on Small Mammal Community Diversity

Small mammals, the most diverse group of mammals, strongly influence ecosystem dynamics. Differential responses to habitat disturbances are both distinct and rapid in small mammal populations, which make them suitable indicators of the impact of anthropogenic disturbances on biodiversity. The objective of this study is to assess the biodiversity of small mammal communities on the Dalton State College campus using two study sites with different levels of disturbance. The control site is located off a campus trail system in a mixed hardwood forest and the experimental site is located on the main campus. Habitat parameters were analyzed seasonally using four endpoints, including canopy cover, ground cover, vertical obstruction, and noise. Sampling occurred for three consecutive nights each month beginning in August 2015 and continued monthly until February 2016 using Sherman live traps. Preliminary results show distinct differences in all habitat parameters between the two sites in all seasons. Species diversity at each site was estimated using the Simpson's diversity index (D') and analyzed using one-way ANOVA. Species diversity is greater in the control site. The dominant species present at both locations is *Peromyscus leucopus.* Final results will be discussed during the oral presentation.

9 Melissa D. Caspary
Science & Technology, Georgia Gwinnett College, Lawrenceville

Plant Pollinator Networks of the Coosa Valley Prairies

The Coosa Valley Prairie ecosystem is a unique and diverse community of flora and fauna in northwestern Georgia with a relatively high proportion of known rare plant species. The purpose of this project is to characterize Hymenopterea (specifically bee) and Lepidoptera (specifically butterfly) pollinators associated with the Coosa Prairie plant community complex to identify monolectic, oligolectic, and polylectic species interactions and determine species associations that are critical to the persistence of the native prairie plant network. Sustaining rare plant populations requires knowledge of their distribution, population structure, and associated pollinators. We hypothesize that rarity of plant species in the Coosa Valley Prairies will correspond to rarity in associated pollinators. Vegetation was sampled in the fall of 2014 and 2015, and spring of 2015. It will continue to be sampled for the spring of 2016 and 2017 and the fall of 2017. Vegetation is being sampled for species identification, cover class, and number of flowering stems. Hymenoptera (bee) and Lepidoptera (butterfly) species will be sampled, pinned, and identified through morphological analysis. Preliminary results suggest that while the majority of plant pollinator interactions are dependent on generalist bees, the presence of some specialist genera including Svastra, Paranthidium and Andrena are important pollinators in the Coosa Valley Prairie. Given the abundance of rare flora and pollinator diversity, further research into this system is important to ensure its continued persistence. The findings from this research effort will be critical for natural resource managers who are trying to sustain remaining populations and important in understanding ecological community networks in specialized habitats.

10 Zachary B. Griffin, Rachel L. McAlister, A. Joseph Pollard
Biology, Furman U, Greenville, SC

Accumulation of Cobalt in Nyssa sylvatica From the Buck Creek Serpentine Barren (Clay County, NC)

Hyperaccumulation of heavy metals is a rare phenomenon involving storage of metals in plant leaves at high concentrations that would ordinarily be toxic. Sporadic reports have suggested that the common southeastern tree *Nyssa sylvatica* (black gum) hyperaccumulates cobalt, but are unclear about the localities and soil chemistry of sites where cobalt hyperaccumulation might occur. We collected leaves from *N. sylvatica* in two contrasting habitats. The Buck Creek site in Clay County, NC overlies serpentine (dunite) rocks, and its soils are geologically enriched in cobalt, chromium, and nickel. A reference site in Greenville County, SC is a successional

piedmont forest on schist-derived soils expected to have low cobalt concentration. We collected leaves from three *N. sylvatica* trees at each site. At each collection point we also sampled topsoil, and collected leaves from nearby trees of *Acer rubrum* (red maple) and *Quercus alba* (white oak). Leaves were dry-ashed at 500 °C, digested in 10% nitric acid, and analyzed for cobalt using atomic absorption spectrophotometry. Soils were digested with nitric and hydrochloric acids and analyzed similarly. Buck Creek soils contained more cobalt, as expected. Leaves of *A. rubrum* and *Q. alba* had very low cobalt concentrations, near or below the limits of instrumental detection, at both sites. Cobalt concentrations in *N. sylvatica* were 36.0 μg g^{-1} at Buck Creek and 22.5 μg g^{-1} in Greenville County (on a dry leaf mass basis). These are remarkably high cobalt concentrations for any plant, confirming the anomalous cobalt uptake in *N. sylvatica* reported in other studies. However, these values fall far short of the recognized criterion for cobalt hyperaccumulation, which is 300 μg g^{-1}. Possible reasons for discrepancies from earlier studies will be discussed, but at this time we regard claims of cobalt hyperaccumulation in *N. sylvatica* as questionable.

11 Mary Jane Carmichael, William K. Smith
Biology, Wake Forest U, Winston-Salem, NC

Growing Season Ecophysiology of *Taxodium distichum* (L.) Rich. (Bald Cypress) Saplings in a Restored Wetland: A Baseline for Restoration Practice

Wetland restoration is a common practice in the southeastern United States, where changing land use patterns have resulted in the widespread degradation of valuable coastal ecosystems. Re-establishment of indigenous vegetation is a fundamental component of restoration practice. In freshwater wetlands, this often includes planting flood-tolerant species such as *Taxodium* distichum (bald cypress). While much is known regarding the ecology of this foundational species, research establishing the ecophysiological signature of bald cypress is limited. Therefore, a study was undertaken in 2015 to monitor the growing season ecophysiology of a bald cypress stand in the Timberlake Observatory for Wetland Restoration, a restored wetland located in Tyrrell County, North Carolina. Net photosynthesis ranged from 5.3±0.4 to 5.5±0.3 μmol CO_2 $m^{-2}s^{-1}$ and was relatively constant in the early to mid-growing season, declining steadily in the late growing season. Patterns in transpiration matched those observed for photosynthesis, while stomatal conductance and chlorophyll fluorescence tracked expected patterns associated typically with leaf aging. These data provide an ecological signature, or stress-free baseline, for evaluating the success of restoration efforts based on responses to future stressful events. We advocate for the inclusion of ecophysiological-based vegetation monitoring within wetland restoration projects, as changes in plant ecophysiology can be sensitive (and early) indicators of ecosystem stress.

12 J. Melissa Hernandez-Moreno[1], Nicole Bayeur[1], Harold Coley[2], Nicole Hughes[1]
Biology, High Point U, NC

Clouds Increase Within-Crown Light Penetration and Homogenize Shoot Temperatures, Evapotranspiration, and Photosynthesis in *Abies fraseri*

Multiple studies have examined the effects of increased diffuse light associated with cloud cover on canopy-level microclimate and physiological processes; yet, none have examined these factors on the scale of individual tree crowns. In the current study, we compare incident photosynthetically active radiation (PAR), shoot temperatures, photosynthesis, conductance to water vapor, and evapotranspiration of shoots located in different spatial regions of individual *Abies fraseri* crowns on sunny versus overcast days. Sunny conditions corresponded with dramatically (5-10x) higher sunlight incident on south-facing outer (S_{outer}) shoots compared to south-facing inner (S_{inner}) and north-facing outer (N_{outer}) shoots, which were shaded and received only diffuse light. Overcast conditions increased percent diffuse PAR to nearly 100%, resulting in complete or near complete homogenization of light incident on S_{outer} and N_{outer} shoots, and similar shoot temperatures, photosynthesis and evapotranspiration accordingly; these effects were observed in Sinner shoots as well, but to a less dramatic extent. There was no significant difference observed in mean leaf conductance between different on a clear days or overcast days, suggesting that spatial differences in evapotranspiration within the crown on clear days

were more likely due to differences in leaf temperature. In conclusion, our study supports the general idea that increased diffuse light increases light penetration and homogenization of associated physiological parameters not only within forest communities, but within individual tree crowns as well.

13 Tyler J. Pyle, Kristen R. Content, Lynn M. Siefferman
Biology, Appalachian State U, Boone, NC

Similarity of Pair Behavior Influences Reproductive Success in Wild Breeding Tree Swallows

Personality differences similar to those seen in humans occur in wild animals (e.g. aggression, boldness, parental care behaviors). Recent work demonstrates that personality of individuals, and that the combination of personalities of breeding pairs, can influence fitness. However, why assortative mating for personality influences fitness is not well understood. We test the hypothesis that assortative mating for personalities better enables pairs to coordinate parental care behaviors and leads to increased offspring growth. We studied breeding tree swallows (*Tachycineta bicolor*), a highly aggressive species with bi-parental care. Past research demonstrates that individual swallows display repeatable consistent aggressive phenotypes (personality). During the 2014 and 2015 breeding seasons, we assessed parental behaviors and measured nestling growth. We measured parental defense aggression in response to a mock predator (crow presentation) and found that paired birds behave similarly. Next, we measured provisioning rates to offspring. We found that mated pairs with similar aggressive phenotypes contributed more equally to offspring provisioning. Finally, pairs that behaved similarly produced larger, faster growing offspring. When pairs displayed dis-similar aggressive phenotypes, females tended to contribute more to offspring provisioning. These data suggest that the benefits of assortative mating for personality in species with bi-parental care may be a consequence of better coordination of parental care duties. These data shed light on the evolution of parental conflict. Because parents stand to gain the most fitness when their mate works harder, conflict over parental care is expected. Recent models of how parents resolve conflict over parental care have gotten quite complex involving plasticity of individuals in response to their mate's behavior and rules of reciprocity. However, our data suggest that mating according to personality types allows parents to be successful via a simple "sealed bid" approach to bi-parental care.

14 Kristen R. Content, Tyler J. Pyle, Lynn M. Siefferman
Biology, Appalachian State U, Boone, NC

Repeatability of Stress Physiology and Nest Defense Behavior in Tree Swallows (*Tachycineta bicolor*)

Differences in personalities similar to those in humans have been documented in wild animals; individuals differ consistently in suites of correlated traits within and across contexts. Little is known about how hormones profiles may be related to animal personality. Because animals face ecological challenges, how an individual's endocrine system responds and adapts to stressors can affect their survivorship and reproductive output. Although stress hormones might mediate behavior, researchers have rarely tested whether stress hormone profiles are consistent within individual animals. In the summer of 2014, we studied a breeding population of wild tree swallows (*Tachycineta bicolor*) to address the following questions: 1) Do individuals express parental defense aggression that is consistent when measured multiple times during the breeding season? 2) Are blood glucocorticoid levels consistent within individual animals when measured multiple times during the breeding season? 3) Is the bird's personality (i.e. aggression) correlated with glucocorticoid levels during breeding season? We predicted that personality and glucocorticoid levels would be consistent (statistically repeatable) and correlated with parental defense aggression. We measured parental defense behavior towards models of nest predators twice during the nestling rearing season. We found high repeatability of female aggression; females that were aggressive toward mock predators during the first trial were also aggressive one week later. Moreover, we found that baseline glucocorticoid levels were repeatable and that females with lower baseline glucocorticoid

levels defended their nestlings more vigorously. These data suggest that stress hormone profiles are predictable within females and that females may experience hormone-mediated tradeoffs between self-preservation and caring for young. Finally, our research suggests that baseline glucocorticoid levels may be an important proximate determinant of animal personality.

15 Amanda S. Williard, Stephanie C. Nadeau, Leigh Anne Harden
Biology and Marine Biology, UNC Wilmington

Effects of Temperature on Metabolism and Osmotic Balance in the Estuarine Diamondback Terrapin

The diamondback terrapin (*Malaclemys terrapin*) is the only North American turtle entirely restricted in distribution to estuarine habitats. Terrapin population declines have been documented over the past several decades, and terrapins are currently listed as a Species of Special Concern throughout their range. An understanding of the environmental factors that affect the physiology and ecology of this species is essential for crafting sound management plans. We conducted a series of laboratory experiments to investigate the effects of temperature on metabolism and osmotic balance of terrapins. Responses to an acute increase in salinity from 12 ppt to 35 ppt were measured in terrapins acclimated to either 10°C or 25°C. An acute increase in salinity did not result in a significant increase in blood inorganic ion concentration at either 10°C or 25°C. For terrapins acclimated to 10°C (N=6), the average oxygen consumption (VO2) after 3 days exposure to 35 ppt (0.008 mlO2 g^{-1} h^{-1}) was approximately 20% lower than VO2 at 12 ppt (0.010 mlO2 g^{-1} h^{-1}), although this difference was not statistically significant. In contrast, VO2 after 3 days exposure to 35 ppt (0.132 mlO2 g^{-1} h^{-1}) was significantly higher than VO2 at 12 ppt (0.113 mlO2 g^{-1} h^{-1}) for turtles acclimated to 25°C (N=5). Preliminary results suggest that physiological mechanisms of salt excretion (i.e. active secretion via lachrymal salt glands) may be activated during high salinity exposure at warm temperatures, but that behavioral means of maintaining water balance may prevail at cooler temperatures.

16 Cancelled

17 Craig M. Lind, Terence Farrell
Biology, Stetson U, DeLand, FL

Hormonal Regulation of Maternal Care Behaviors in a Viviparous Pitviper

Several snake lineages have evolved maternal care behavior including egg brooding and offspring defense. Maternal behaviors likely represent independent evolutionary events and may, as is the case for many better-studied vertebrate groups, be critical to fitness. Yet almost nothing is known regarding the neuroendocrine pathways that regulate complex maternal-offspring social behavior in this diverse vertebrate lineage. In other vertebrates where such regulation has been studied, hypothalamic peptide hormones of the oxytocin and vasopressin family play a primary role in mediating both maternal and paternal care. To test the hypothesis that hypothalamic peptides mediate maternal care behaviors in a viviparous snake, we pharmacologically blocked the action of arginine vasotocin (AVT) in postparturient Pigmy Rattlesnakes, *Sisturus miliarius*, and monitored mother-offspring spatial relationships over time relative to controls. The intensity of maternal care behaviors (estimated by the spatial relationships between mother and offspring) was positively related to maternal postparturient energetic status (i.e. body condition). Furthermore, pharmacological blockade of AVT receptors disrupted maternal attendance. Our results provide the first evidence of that both energetic status and hypothalamic peptides may regulate mother-offspring social behavior in *S. miliarius*. Further research is required to elucidate the complete neuroendocrine pathway involved in these behaviors.

18 Glenn A. Marvin, Kayla Davis, Jacob Dawson
Biology, U North Alabama, Florence

Effect of Acute Low Body Temperature on Predatory Behavior and Prey-Capture Efficiency in a Plethodontid Salamander

The low-temperature limit for feeding in some salamander species (*Desmognathus*, Plethodontidae) has been inferred from field studies of seasonal variation in salamander activity and gut contents, which could not determine whether feeding is more dependent on environmental conditions influencing salamander foraging behavior or prey availability and movement. We performed two controlled laboratory experiments to examine the effect of short-term (acute) low body temperature on predatory behavior and prey-capture efficiency in a semiaquatic plethodontid salamander (*D. conanti*). In the first experiment, we quantified variation in the feeding responses of cold salamanders (at 1, 3, 5 and 7^{o}C) to a video recording of a walking, warm (15^{o}C) cricket to determine the lower thermal limit for predatory behavior, independent of any temperature effect on movement of prey. Experimental-group salamanders exhibited vigorous feeding responses at 5 and 7^{o}C, large variation in feeding responses both among and within individuals (over time) at 3^{o}C, and little to no feeding response at 1^{o}C. Feeding responses at both 1 and 3^{o}C were significantly less than at each higher temperature, whereas responses of control-group individuals at 15^{o}C did not vary over time. In the second experiment, we quantified feeding by cold salamanders (at 3, 5, 7 and 11^{o}C) on live, warm crickets to examine thermal effects on prey-capture ability. The mean feeding response to live crickets was significantly less at 3^{o}C than at higher temperatures, however 50% of salamanders captured and ingested prey with high efficiency at this temperature. We conclude that many individuals stalk and capture prey at very low temperature (down to 3^{o}C). Our results support a growing body of data that indicate many plethodontid salamanders feed at temperatures a few degrees above freezing.

19 Olivia A. Howell[1], Joseph Taylor[1], Justin M. Doran[2], Pieter A. P. deHart[2], Lawrence E. Hurd[1]
[1] Biology, Washington and Lee U, Lexington, VA; [2] Biology, Virginia Military Institute, Lexington

Stable Isotope Analysis Reveals Differences in Trophic Niche of Arachnids in Field and Forest Sites

Spiders (Aranae) and harvestmen (Opiliones) are the most abundant arachnid predators in terrestrial successional ecosystems from open fields to mature forests. Although these are all generalist predators, primary productivity and potential herbivore prey for these arachnids is close to the ground in early successional fields and higher in tree leaves of forest sites. Therefore, ground-dwelling cursorial spiders are expected to encounter more herbivore prey in fields and more detritivores on forest floors. Spider webs occur in herbaceous vegetation in fields and higher up among tree and shrub leaves in forests, so are able to feed on herbivores in both habitat types. Harvestmen may feed more generally on both detritivores and herbivores given their access to a larger portion of the vertical strata in both habitats. To test these expectations of differential foraging, we examined the stable isotope ratios of nitrogen (δ^{15}N) in these three arachnid guilds in forest and field habitats. Mean δ^{15}N in cursorial spiders from fields (7.69‰) was significantly higher than in forests (4.72‰), indicating a trophic level difference between the sites. Harvestmen showed a similar trend: mean field δ^{15}N (4.90‰) was significantly higher than in the forest (2.77‰). Web spiders fed at the same trophic level in field (δ^{15}N = 3.13‰) and forest (δ^{15}N = 3.75‰) sites, lower on the food web than all but cursorial spiders found at the forest site. All of these arachnid guilds exhibit signatures consistent with feeding on more than one trophic level, but it is likely that cursorial spiders ate other carnivores as well as herbivores in the field and detritivores in the forest, accounting for their relatively high δ^{15}N values at both sites. Harvestmen probably consumed mostly herbivores in the field and detritivores in the forest, while web spiders may have fed mainly on herbivores at both sites.

20 Juan P. Aristizabal, Gina V. Amariles, Alicia M. Flood, Manuela Gallego Builes, Ivan Magana, Kerami D. Moss, Stefano R. Rosillo, Catherine G. Schlueter, Mark A. Schlueter
Science & Technology, Georgia Gwinnett College, Lawrenceville

Experimental Biology in Vietnam: A Survey of Pollinating Flies and Bees around Flower Resources Using Multiple Trap Methods

Insects play critical roles in the environment, both as pests and beneficial insects. For example, bees pollinate over 30% of the human food supply. A bee pollinates every vegetable, fruit, and nut that you eat. Bees also pollinate most plants including wildflowers and trees. Honeybees are commonly used by farmers to pollinate crops and boost agricultural yields. Without these "domesticated honeybees", crop production would dramatically decline. In the United States alone, bees contribute $15 Billion in pollination services. However, honeybee populations are in crisis and are suffering critical declines. In the United States, some beekeepers have lost over 50% of their bees each year due to colony collapse disorder (CCD). It is critical that scientists discover alternatives to the honeybee if we are to safeguard human agriculture for the future. The best alternative to honeybees is the thousands of quite abundant native bee species that exist in the world. Besides bees, flies and butterflies are also useful pollinators. However, butterflies occur in low numbers, making them a poor candidate to become commercial level pollinators. On the other hand, flies, particularly hoverflies, are beneficial and very effective pollinators. The first step in identifying possible alternatives to the honeybee is to survey native bee and fly species in order to determine their species diversity and abundance. The following project was performed by GGC students in Vietnam (June 2015) and assessed bee and fly diversity at and between a patch of yellow flowers and a patch of blue/purple flowers over a 3-week period.

21 Josiah S. Williams, James E. Russell, Keval Bollavaram
Science & Technology, Georgia Gwinnett College, Lawrenceville

Female Sexual Function Among Parthenogenesis-Inducing *Wolbachia*-Infected *Trichogramma* Wasps

For many invertebrate animals, intracellular bacteria in the genus *Wolbachia* feminize male offspring and induce facultative parthenogenetic (asexual) reproduction. This extreme manipulation of animal reproduction and sex determination has significant evolutionary consequences. For most infected species and populations males are absent and female sexual function has been completely lost. Theoretical models have been developed that attempt to explain the loss of sexual function as a result of selection on genes associated with the female egg fertilization process. One of the assumptions of these models is that infected females in populations with low infection frequencies are capable of sexual reproduction — prior to losing sexual function as *Wolbachia* infection spreads through the population. This assumption has not been empirically tested. Using molecular markers developed for cultured infected *Trichogramma* wasps, we have attempted to test this assumption. Specifically, we test the hypothesis that infected females are capable of sexual function through controlled mating and molecular analysis (DNA fingerprinting) of offspring.

22 Peter M. Schlueter[1], Mark A. Schlueter[2]
[1] U of North Georgia, Oakwood; [2] Georgia Gwinnett College, Lawrenceville

An Assessment of Apple (*Malus domestica*) Pollination by Native Bees

Apples (*Malus domestica*) are one of the most important and common fruits grown in the world. Each year, U.S. consumers eat an average of 46.1 pounds of fresh apples and processed apple products. Apple farmers rely heavily on honeybees to pollinate their apple orchards, in order to insure a good harvest. However, apple production, as well as worldwide agriculture, may be in jeopardy due to significant declines in honeybees as a result of colony collapse disorder (CCD) and other factors. Some scientists question the wisdom of relying on a single species, the honeybee, to pollinate such a large portion of the human food supply. Over the past six years, we have assessed native bee diversity and abundance, as well as apple production in apple

orchards in North Georgia. In the following study, native bees were examined to determine if they could be an effective alternative to the honeybee. Apple trees in four different orchards were selected for this experiment. On each tree, two similar branches (e.g. similar bud numbers and length) were selected. Netting enclosures (cages), which kept out honeybee-size and larger bees, were placed over one of the selected branches (experimental group), while the other branch (control group) was left uncovered. The mining bee *Andrena crataegi* accounted for 72.5% of the native bees collected in the netting enclosures' pan traps. In August, mature apples were collected from both the control and experimental branches. Each apple was measured for size (weight, circumference, and diameter), and each apple's seeds were counted. Seed count was the most important measurement, since it was a direct measure of pollination success. Statistical analyses indicated that there were no differences between the control and the experimental groups in any of these measurements. These results suggest that native bees can be effective pollinators in commercial apple production.

23 Edward B. Mondor
Biology, Georgia Southern U, Statesboro

Insects and Death: Forensic Entomology in Georgia

After 72 hours, entomological evidence from a death scene is the most accurate method for determining the minimum post-mortem interval (i.e., the approximate time elapsed from death to discovery). For this insect evidence to be of value, however, it must be properly collected, preserved, and identified. Here, I will outline some basic experiments conducted in my lab, using animal models, and explain how this information is vital for understanding death scenes and dating human remains. I will then present an actual case conducted with local law enforcement personnel in southeast Georgia. In sum, this talk will provide a better understanding of the field of forensic entomology, and knowledge of how forensic entomologists assess, collect, and interpret insect evidence.

24 Victor R. Townsend, Jr., Maynard H. Schaus, Tatyana Zvonareva
Biology, Virginia Wesleyan College, Norfolk

Leg Injuries and Wound Healing in the Arboreal Neotropical Harvestman *Cynorta marginalis* (Opiliones, Cosmetidae)

Harvestmen belonging to the suborder Laniatores do not typically autotomize legs in encounters with predators, but instead use evasive tactics (i.e., thanatosis, fleeing) or aggressive behaviors (e.g, pinching with chelicerae, release of volatile chemical secretions). Anecdotal evidence suggests that these harvestmen infrequently suffer leg injuries during encounters with predators. In this study, we examined the legs of 363 adults of the arboreal harvestman *Cynorta marginalis* (Laniatores, Cosmetidae). Individuals were observed and collected from forested habitats near the La Selva Biological Station, Costa Rica in August 2015. Individuals with leg injuries were preserved in 70% ethanol for examination with scanning electron microscopy (SEM). In an attempt to describe the process of wound healing, we also collected 40 uninjured adults. For each of these individuals, we severed one femur IV (mid-segment) with a scalpel. We preserved 3-4 individuals for each of the following post-injury time intervals (0, 12, 24, 48, 72, 96, 144, 196, 240 hrs). For our field data, we observed an overall leg injury rate of 8.2% with no significant sexual variation. Only two individuals exhibited injuries to multiple legs. Legs I, II and IV were the most commonly injured appendages (33%, 30% and 30%, respectively). Our SEM study revealed an interesting pattern in would healing, with injuries from 12-144 hrs featuring smooth scabs with relatively little surface detail. The healing stumps of leg Injuries that were 196 and 240 hrs old had more surface heterogeneity and cellular structure. Comparing injured individuals collected in the field with those injured in the lab (with known time intervals post injury), we were able to classify field injuries as fresh (within 7 days of injury), healing (8 days or older), or fully healed (often with regenerated claws or cuticle covering the stump).

25 Lori Tolley-Jordan[1], Thomas A. Hess[1], Jessica A. Wooten[2], Roger Holt[3]
[1] Biology, Jacksonville State U, AL; [2] Biology, Centre College, Danville, KY; [3] National Wildlife Refuge System, US Fish and Wildlife Service, Decatur, AL

A Survey of Freshwater Snails and Their Trematode Parasites in the Wheeler National Wildlife Refuge, AL

Wheeler NWR is a 14,000 hectare habitat along the Tennessee River that is home to more than 300 species of waterfowl and 100 species of fishes. Yet, the distribution diversity of aquatic snails is not well understood and the types of parasitic Trematode worms carried by these snails is unknown. The complex life history strategies of these worms often includes both fish and avian hosts. Thus, collecting data on snail and parasite diversity in the refuge is necessary as many species of trematode worms are pathogens in both fishes and birds. During fall 2015, freshwater snails were sampled from four habitat types including five backwater sloughs of the river, two swamps, a spring-fed pond, and two streams. Snails were transported live to the laboratory where they were dissected to determine parasite presence. Parasite types were determined based on gross external morphology. Three species of pulmonate snails (*Micromeneutus*, *Pseudosuccinea sp*., *Planorbella trivolvis*, and *Physella sp*.) and seven species of Caenogastropod snails (*Campeloma decisum*, *Viviparus subpurpurea*, *V. georgianus*, *Pleurocera pyrenella*, *P. striata*, *P. excurata*, *P. pyrenella*, and *Marstonia arga*) were collected. Of these, the Pulmonate (lung-breathing) snail species were widely distributed across all habitat types while Coenogastropods (gill-breathing) were restricted to the riverine sloughs and the spring. In total, 11 types of trematodes were found in eight snail species with infection levels ranging from 3 to 30 percent. The highest diversities of parasites were found in *P. trivolvus* (n =4) while *V. subpurpurea* had the highest percent infection. All habitat types harbored infected snails. Further sampling efforts in 2016 as well as identifications of worms using genetic analyses will further the understanding of the diversity of snail and parasite fauna and the implications of these species to fish and waterfowl health.

26 Tatyana Zvonareva, Victor R. Townsend, Jr., Maynard H. Schaus, Nathaniel J. Schaus, Sarah Locke, Ashley N. Shrives, Cynthia L. Richardson
Biology, Virginia Wesleyan College, Norfolk

Natural History of the Arboreal Cosmetid Harvestmen *Cynorta marginalis* (Arachnida, Opiliones) in a Neotropical Forest

Relatively little is known about the natural history of most species of cosmetid harvestmen that inhabit the forests of Central America. The primary objective of this research project was to investigate habitat use and social interactions among adults of the arboreal cosmetid harvestman *Cynorta marginalis* under field conditions. This study was conducted from 11-24 August 2015 in the forests surrounding the La Selva Biological Station in Costa Rica. We established 15 transects (40 m in length) and sampled them repeatedly in the morning (0830-1100 hrs) and after dusk (1800-2300 hrs). Over the course of two weeks, we captured and uniquely marked 258 adults (with paint), including 146 males and 112 females. Only three individuals were recaptured over the course of the study. Heavy rains occurred during several sampling periods (13 out of 80 transect samples) and appeared to reduce significantly the surface activity of adults (0.9 individuals per transect during heavy rain vs. 3.6 individuals per transect when dry or lightly raining). Harvestmen were most commonly observed using leaves as perches (64% of captures), but they also occurred on the exposed surfaces of tree trunks, buttresses, branches and, rarely, the leaf litter (1.5%). Most individuals (85%) were found alone, however, we observed several harvestmen in male-female pairs (8%), same sex pairs and heterosexual groups (7%). Of the 258 individuals captured, 18 exhibited injuries to their legs. There were no significant differences in the size or heights of perches used by injured or uninjured males or females. Our results indicate that the population size of this species at the field site is relatively large and active individuals make extensive use of perches in the understory.

27 Suzanne E. Allison, Benjamin Colligan, Joshua Mata, Idelle A. Cooper
Biology, James Madison U, Harrisonburg, VA

Variation in Female Mating Success and Behavior of the Ebony Jewelwing Damselfly, *Calopteryx maculata*

Traditionally, the study of sexual selection has focused on the evolution of elaborate male traits and how they enhance the ability to out-compete other males directly (access to females) and indirectly (access to desirable territories or resources). Female trait studies have focused most on evolved preferences for male traits. While we know much about how sexual selection acts on males, there is a deficit of equivalent study on females. In insects, including damselflies, male size and pigmentation are positively correlated with fat reserves and immune abilities, and therefore with male competitive ability. Here, we show that phenotypic variation that has been well-documented in males of the Ebony jewelwing damselfly, *Calopteryx maculata*, is also present in females of the species. We measured female mating success and behavior of *C. maculata* at Smith Creek in Rockingham County, Virginia. Males were marked with multiple colors of fluorescent powder that was transferred to females when mating. Uniquely-numbered females were digitally scanned and repeatedly observed throughout the summer. We determined the extent of variation in female mating frequency, body morphometrics, and wing pigmentation. The study of trait variation within females, and thus the opportunity for selection to act on those traits, is essential in understanding how evolution on females may have contributed to sex differences, and may change the way we think about the role of females in sexual selection.

28 Mary K. Murray, Donna R. Weinbrenner, Dorota Abramovitch, Diana S. Ivankovic
Biology, Anderson U, Anderson, SC

Cytotoxic Effects of *Amorpha fruticosa* Leaf, Stem, and Root Extractions on PC-12 Adrenal Neural Cells from Male *Rattus norvegicus*

The present study sought to examine the cytotoxic properties of the extractions from various *Amorpha fruticosa* structures as applied to carcinogenic PC-12 adrenal neural cells. Leaf, stem, and root extractions from *Amorpha fruticosa* were retrieved via soxhlet extractor, using methanol as the chosen solvent. Sterilized extractions of each plant component were applied in increasing concentrations of 0.25, 0.5, 1, 2, 5, 10, and 20 mg/ml. MTS assay was utilized to view absorbency readings at 450 nm in an ELISA plate reader. Data from the experimental trials were collected, demonstrating a steady increase in death rate of the PC-12 cells. Particularly, when exposed to leaf and root extractions, the cells exhibited similar absorbency readings as compared to the cell death controls produced from the addition of either cyclohexamide or 3% hydrogen peroxide. Moreover, the leaf, stem, and root extractions underwent lyophilization and further chemical analysis utilizing GC/MS. The study concluded that the leaf and root extractions of *Amorpha fruticosa* provided the greatest potency in their cytotoxicity against PC-12 adrenal cells. These results could encourage additional exploration of other segments of *Amorpha fruticosa*, including the plant's seeds and fruit, in relation to their anti-carcinogenic effects on the PC-12 adrenal neural cell line.

29 J. Logan Bowling, Andrew Nolin, David E. Nelson
Biology, Middle Tennessee State U, Murfreesboro

Filtering of Transient and Low-Level Mitochondrial Damage Signals by the PINK1: Parkin Mitophagy Pathway

PTEN-Induced Kinase 1 (PINK1) and the ubiquitin ligase Parkin are well-described regulators of ‘mitophagy’, a mitochondria-specific form of macroautophagy that identifies and destroys damaged mitochondria. This pathway is thought to be particularly important in the dopaminergic neurons of the substantia nigra pars compacta with genetic defects in both genes being associated with autosomal recessive juvenile onset forms of Parkinson’s disease. While the activity of the pathway under conditions of complete mitochondrial failure are well understood, how it interprets and responds to transient and low-levels of mitochondrial stress have yet to be fully explored. Using a

live cell imaging approach, we show that PINK1 is rapidly recruited to both fully and partially depolarized mitochondria with similar kinetics. However, we find that relatively small increases in mitochondrial membrane potential are sufficient to cause dissociation of PINK1 from the mitochondria and its subsequent degradation in the cytoplasm, effectively terminating the mitophagic response. Full recovery of mitochondrial membrane potential was not necessary for this to occur. Based on these data, we conclude that the PINK1 component of the mitophagy pathway acts as a 'hair-trigger', responding to even minor mitochondrial stress or damage but if these stresses are short lived, the process is capable of aborting at this early stage to prevent inappropriate loss of mitochondrial mass.

30 Nelly Grigorian, Christopher E. Barton
Biology, Belmont U, Nashville, TN

A Study of the Role of P53 in the Regulation of MARCKS Expression

p53 is an important transcription factor, and can activate the transcription of apoptosis promoting genes. MARCKS is an apoptosis-promoting gene ubiquitously expressed in human cells. A previous study indicated that MARCKS expression was 4-7 fold higher in unstressed HCT116 colorectal cancer cells expressing wt p53 when compared to the same cells lacking p53 expression. In this study, we stressed cells with 5- fluorouracil to investigate the effect of this stressor on p53-mediated upregulation of MARCKS transcription. Two potential p53 binding sites were initially determined near the genomic locus containing MARCKS, suggesting that p53 might function to directly regulate MARCKS expression. Our results suggest that p53 might potentially have a role in MARCKS upregulation, but further analyses are needed to confirm this regulation.

31 Jeff King, Christopher E. Barton
Biology, Belmont U, Nashville, TN

Effect of p53 Status on S100A13 Expression in Response to Oxidative Stress

Cancer is one of the leading causes of death in the United States each year. The tumor suppressor protein p53 is a transcription factor that, in response to stress, controls the expression of downstream genes that induce cell cycle arrest and apoptosis. S100A13, a protein known to promote cellular proliferation through controlling the release of FGF-1, was investigated in this study to determine its potential link to p53 under oxidative stress in isogenic HCT 116 cell lines (p53 +/+, p53 -/-). It was found that S100A13 was not transcriptionally regulated by p53, but it was shown that S100A13 was nonetheless repressed. Bioinformatics software (p53MH) indicated that there is a 91.62% match for a p53 binding site on intron 3 of the S100A13 gene. These results show that p53 does not directly regulate S100A13 under oxidative damage, but could potentially regulate S100A13 under another type of cellular stress.

32 Jasmin Mohn, Christopher E. Barton
Biology, Belmont U, Nashville, TN

Investigation into the Regulation of CST6 by P53 Following Cellular Stress

Cystatin E/M *(*CST6) is a protease inhibitor that has previously been implicated in the transition from benign to metastatic cancer. p53 is a transcription factor that is well-known for its tumor-suppressing functions. Since CST6 was found to be upregulated by p53 under normal, unstressed, conditions, the interaction between p53 and CST6 during cellular stress was investigated. In order to determine whether CST6 was upregulated by p53, HCT116-p53+/+ and HCT116-p53-/- cells were exposed to 5-fluorouracil (5-FU). RNA was isolated, converted to cDNA and PCR amplified to analyze CST6 expression levels. Our data suggest that, while CST6 expression is correlated with p53 status in unstressed conditions, p53 is likely not a regulator of CST6 expression following exposure to 5-FU. Further research is needed to test the role of p53 in CST6 expression using different forms of cellular stress.

33 Taeler Dahm, Christopher E. Barton
Biology, Belmont U, Nashville, TN

p53 Mediated Regulation of CCNH in Response to Paclitaxel-Induced Mitotic Stress

The p53 transcription factor is one of the most active tumor suppressors in the genome and functions most notably to regulate the transcription of genes involved in apoptosis, DNA repair, and cell growth. The gene *CCNH*, encoding for protein cyclin H, has been previously identified as a potential target of p53. Cyclin H functions to promote the cell cycle by contributing to the CAK complex, and it is known that in times of cellular stress p53 will downregulate the expression of genes involved in cell cycle progression. We sought to identify the potential of p53 to target and regulate *CCNH* expression under mitotic stress. Isogenic HCT-116 cells were treated with the chemotherapeutic drug paclitaxel, and transcript levels of p53 and *CCNH* were measured over forty-eight hours. Our results suggest p53 potentially targets and downregulates *CCNH* expression during times of mitotic stress.

34 Vian Pulous, Christopher E. Barton
Biology, Belmont U, Nashville, TN

Transcriptional Regulation of RGS2 by P53 in Colorectal Cancer Cells

p53 is, arguably, the most important tumor suppressor found in human cells. As a transcription factor, many downstream targets of p53 have been identified in response to cell stress and apoptosis. Regulator of G-Protein Signaling 2 (RGS2) is a protein implicated in multiple types of tumorigenesis. Here, the p53-mediated transcriptional regulation of RGS2 was analyzed in isogenic HCT116 colorectal cancer cells following exposure to the chemotherapeutic molecule 5-FU. Given previous studies, we hypothesized that p53 would upregulate RSG2 expression levels in response to 5-FU exposure. Our PCR-based analyses suggest that, while RGS2 was upregulated in HCT116 cells harboring wild-type p53, we observed a similar upregulation in isogenic cells lacking p53. These data suggest, while p53 might not be directly responsible for RGS2 expression following cellular stress, other proteins may regulate the activity of RGS2. Further studies are needed to analyze the role of p53 in RGS2 expression in additional cell lines, or in response to alternate forms of cellular stress.

35 Cancelled

36 Emily F. Campbell, Brianna H. Dyar, Donna R. Weinbrenner, Dorota Abramovitch, Diana S. Ivankovic
Biology, Anderson U, Anderson, SC

Cytotoxic Effects of *Phytolacca americana* Berry, Root, Leaf, and Stem Extractions on PC-12 Adrenal Neural Cells From Male*Rattus norvegicus*

Because of the known cytotoxic properties of pokeweed (*Phytolacca americana*) that are associated with its pokeweed antiviral protein that inhibits the translation of proteins, pokeweed extracts, both crude and lyophilized, were used as treatments on PC-12 pheochromocytoma cells, a cell line harvested from rat adrenal glands that have a neural cancer. Pokeweed plants were obtained from the southern Piedmont area of North Carolina and subsequently deconstructed for their berries, roots, stems, and leaves. Each component was extracted via the soxhlet method into methanol. Ultimately, the individual extracts underwent rotary evaporation and were used to prepare stock solutions of pokeweed extracts in complete growth media. One trial was then performed by applying dilutions of these stock solutions at concentrations of 0.25 mg/mL, 0.50 mg/mL, 1.0 mg/mL, 2.0 mg/mL, 5.0 mg/mL, 10 mg/mL, and 20 mg/mL to several 96-well plates containing the PC-12 cells and complete growth media. A second trial was then conducted in the same manner and with the same concentrations using stocks of lyophilized extracts. MTS assays were applied to the plates containing the pokeweed treatments and incubated for approximately 3 hours, then read by an ELISA plate reader. The data from the ELISA plate reader indicate that lower concentrations of the pokeweed extracts have a mitogenic effect on the

PC-12 cells, with concentrations between 5 mg/mL and 10 mg/mL generally marking the extracts' shift from exhibiting mitogenic to cytotoxic effects. While most extracts exhibited this general trend quite well, the lyophilized leaf extracts demonstrated a more drastic drop-off in mitogenic activity between the concentrations of 2 mg/mL and 5 mg/mL. The data reveal that pokeweed may be an avenue of further research for cancer treatments. However, dosage may prove to be a problem since doses that are too low may cause tumor growth instead of tumor decay.

37 Whitaker M. Hoskins, Karen W. Hughes, Patrick B. Matheny
Ecology and Evolutionary Biology, U of Tennessee, Knoxville

A Study in Cinnabarina-Scarlet: Novel Collection of *Trametes* fungus from Tennessee

Fungi constitute a vast kingdom of organisms in our world and our knowledge of fungal diversity expands as we detect genetic differences between seemingly similar species. This study seeks to establish a new species of polypore fungus within the genus *Trametes*, formerly known within the genus *Pycnoporus.* A novel specimen was collected from central Tennessee, DNA was analyzed, and comparative morphology was performed with available herbarium specimens. The novel specimen shows at least a 5% difference in gene regions analyzed (*rpb2*, ITS, LSU) and forms a well-supported clade within North American *Trametes* species. Phylogenies were then formed using available NCBI data for the group as a whole. Future work on this specimen could prove useful as ligninoytic, laccase enzymes are produced by this group of white-rot fungi. Additionally, a whole genome is available for a white-rot polypore that could possibly serve as a reference genome.

38 Andrew P. Hart[1], Kristian Theqvist[2], Kathleen Kron[3], Emily Gillespie[1]
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Molecular phylogenetic analysis of the north-temperate Labrador teas (*Rhododendron* Subsection *Ledum*) reveals a likely East Asian biogeographic origin and North American taxa of hybrid origin

The Labrador Teas are a small group of circumboreally distributed sub-shrubs. They are collectively distinguished by a suite of characters that include abaxial leaf scales and white, separate petals. Although historically accepted as the genus *Ledum*, the latest classification recognizes the Labrador Teas as Subsection *Ledum* within *Rhododendron.* Historically, delineation of species in Subsection *Ledum* has proven difficult due to morphological similarity across the group, and recent treatments by North American botanists have merged some previously recognized species, such as *R. columbianum* in North America and *R. tomentosum*, mostly in Asia. However, recent investigations have led researchers to once again recognize greater species-level diversity. To date, no phylogenies have been constructed to identify the relationships among the Labrador teas. To address this, three chloroplast and two nuclear markers were used in Maximum Likelihood, Bayesian, and Maximum Parsimony analyses to generate a phylogeny. All species recognized by the Flora of North America were included as well as some population-level sampling in an attempt to represent past species delineation. In our analyses of chloroplast data, the North American taxa *Rhododendron groenlandicum* and *R. columbianum* s.l. did not cluster with the ingroup, but were instead resolved within another lepidote *Rhododendron* lineage. This suggests that these two taxa may be of hybrid origin and raises questions about the frequency of hybridization within the larger lepidote *Rhododendron* lineage. In contrast to the chloroplast data, nuclear data resolve Subsection *Ledum* as monophyletic and S-DIVA analysis suggests an Asian origin of the Subsection with two dispersals into North America. This work lays the foundation for further studies investigating species delineation within clades that have been difficult to differentiate, such as *R. columbianum* s.l. Ongoing research in our lab is focusing on identification of hybrid parentage using additional DNA markers and broader taxon sampling across *Rhododendron*.

39 Lane D. Gibbons, Conley K. McMullen
Biology, James Madison U, Harrisonburg, VA

A Morphometric Analysis Offers Additional Insights on Infraspecific Variation in *Eleocharis tenuis* (Cyperaceae)

North America contains a large portion of the most problematic and least resolved array of diversity in the genus *Eleocharis* (Cyperaceae). Of noteworthy significance, are lasting taxonomic uncertainties involving plants referable to the *Eleocharis tenuis* species complex (subg. *Eleocharis*, sect. *Eleocharis*, ser. *Eleocharis*, subser. *Truncatae* Svenson). Consisting of six species, as currently circumscribed, three of these taxa (*E. compressa* Sullivant, *E. elliptica* Kunth, and *E. tenuis* (Willdenow) Schultes) exhibit broad geographic distributions, and consist of entities intermediate between currently recognized taxa. Confusion between taxonomic entities stems primarily from the variable vegetative structures, and diminutive morphological characters available for comparison and analysis within the genus. A morphometric reexamination of *E. tenuis* and its associated varieties, in light of cytological and environmental factors, offers additional insights on the morphological variability present in *E. tenuis*, as well as other taxa included in the *Eleocharis tenuis* complex.

40 Samantha J. Worthy[1], Jennifer M. Cruse-Sanders[2], Alex Reynolds[3], Alvaro Pérez[4], John A. Barone[1], Kevin S. Burgess[1]
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Phylogenetic Analysis of Andean Tree Communities Along an Elevational Gradient in Ecuador

Tropical forests are known for their high levels of biodiversity around the world. About 68% of the known plant species on the planet can be found in the tropical forests of South America, Africa, and Asia (Rios et al. 2007). One way to grasp the megadiversity in these areas is to focus on tropical forests' communities along elevational gradients. Recently, interest has been shown in studying tropical plants along elevational gradients with the idea that these areas will likely show large effects caused by global warming (Clark et al. 2015). Tropical elevational studies are also important as these areas contain high biodiversity and endemism, much of which has yet to be explored. The goal of this research is to evaluate the magnitude of DNA barcode diversity among Andean tree species. The two main objectives for this research are to evaluate community phylogenetic structure across an elevational gradient and to correlate phylogenetic analyses with diversity indices. This research is focused in the high altitude Andean forest of Siempre Verde Preserve, Imbabura, Ecuador. Siempre Verde is 3.34 km^2 of pristine upper montane cloud forest with an elevation range of 2000 to 3500 meters above sea level. A transect containing 15 plots (5m x 50m) was censused for every tree with a dbh of ≥ 5 cm, for a total of 625 specimens. Of these specimens, 160 are being DNA sequenced in this study. The specimens include 33 families, 47 genera and 71 species. The number of families and species decreased steadily with increasing elevation. Shannon's and Simpson's diversity indices also decreased with increasing elevation. Phylogenetic clustering at different hierarchical levels was compared with these diversity trends. This project will help populate DNA barcode libraries that can be used for comparative measures of phylogenetic diversity.

41 M. Taylor Perkins, J. Hill Craddock
Biology, Geology & Environmental Sciences, U of Tennessee at Chattanooga

Phylogeographic Examination of *Castanea* Morphotypes in the Eastern United States

Systematics of the North American *Castanea* has long been a topic of disagreement for botanists. As many as seven North American *Castanea* species were recognized in the early 20th century, but currently either two or three species are thought to exist. Underlying the taxonomic problems in this group are the high degree of morphological variation within the

chinquapins (*C. pumila sensu lato*) and putative interspecific hybridization between *C. dentata* and *C. pumila sensu stricto* in regions of sympatry. These issues have resulted in descriptions of the following problematic taxa: *C. alabamensis*, *C. floridana*, *C. alnifolia*, *C.* x *neglecta*, and many others. Previous attempts to understand genetic structure, evolutionary relationships, and gene flow in North American *Castanea* have been hindered by limited sampling of this widely distributed group, lack of phylogenetic resolution, and equivocal results. In particular, it has been difficult to distinguish between hybridization and shared ancestry as the cause of shared chloroplast haplotypes. We are attempting to answer these evolutionary questions by analyzing a sample set comprised of extensive new collections and collections of taxonomic authors, using an informative number of molecular markers, and employing statistical methods for quantifying lineage sorting.

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42 Kylie Bucalo[1], Kevin S. Burgess[2], Jennifer M. Cruse-Sanders[1], Alvaro Pérez[3], Alex Reynolds[4]
[1] Research and Conservation, Atlanta Botanical Garden, GA; [2] Biology, Columbus State U, GA; [3] Biological Sciences, Pontificia Universidad Catolica del Ecuador, Quito, Ecuador; [4]The Lovett School, Atlanta, GA.

Evaluating the Evolutionary and Genetic Relationships of the Andean Orchids of Northwestern Ecuador

With over 4000 orchid species, representing over 240 genera, Ecuador has the highest orchid species diversity in the world. Orchids are found in many regions of the country, however the largest concentration of diversity is found at high elevations, in the Andean cloud forests. Present in these environments are orchid genera that are considered to be taxonomically complex, where traditional morphological based taxonomy has been challenged, or failed to discriminate between species well. As a phylogenetic tool DNA barcoding can solve some of these issues using standardized loci to delimitate species, identify ambiguous taxa, investigate species complexes, and explore evolutionary relationships. The first goal of this project was to develop a DNA Barcode library of the orchid flora of Siempre Verde Research Station in Imbabura, Ecuador, in order to assess the demarcation efficacy of traditional and non-traditional plant barcoding loci. Secondly, the project aimed to evaluate the evolutionary and genetic relationships among the taxonomically complex groups *Lepanthes, Stelis, Pleurothallis* and *Epidendrum*, via deep sampling of these genera. Lastly the project investigated *Oncidium heteranthum* for possible cryptic speciation, via targeted sampling of this species. To date the project has collected 176 samples (~70 species), representing both epiphytic and terrestrial orchids across 32 genera. The sampling protocol allowed the collection to have both a wide taxonomic dispersion, and a deep focus on target groups by collecting at multiple site locations, during two different flowering periods, and varying site elevation from 1500 – 3,300 meters. Molecular samples were collected from leaf tissue, and associated metadata, images and herbarium vouchers were processed for each specimen. Sequence analysis and phylogenetic analysis are currently being completed. As many Orchid taxa are under threat due to deforestation, this project contributed to an immediate conservation need to research, identify, and document the endemic flora in Andean cloud forest habitats.

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43 Cassandra H. Karlsson, Derick B. Poindexter, Alan S. Weakley
Biology, UNC Chapel Hill

Taxonomic Re-Evaluation of *Eryngium yuccifolium* (Rattlesnake-Master; Apiaceae)

The discovery of morphologically, ecologically, and phenologically unique populations of “button-snakeroot” in eastern Louisiana has initiated an evaluation of *Eryngium yuccifolium* sensu lato. It appears based on morphologic, molecular, and biogeographic evidence that three entities are taxonomically distinguishable in what has generally been considered a single taxonomic entity, *Eryngium yuccifolium*, but has in the past been often recognized as two species or two varieties of a single species. This finding is significant as a free-standing result relative to the taxonomy of *Eryngium* in the southeastern United States, but also has implications as an example of the poorly studied, and therefore hidden and obscured, biodiversity of the region.

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44 Derick B. Poindexter, Alan S. Weakley
Biology, UNC Herbarium and NC Botanical Garden, UNC Chapel Hill

Understanding *Carex* sect. *Acrocystis*: The use of Traditional and Contemporary Systematic Methods to Disentangle a Taxonomically Complex Group

The genus *Carex* is a hyperdiverse group of monocots. At present, historical circumscriptions of sections within the genus are under investigation by the Global *Carex* Group. In contrast, studies of finer species-level phylogenetic relationships within sections are intermittent and often of limited resolution. This is particularly true for larger groups, including *Carex* sect. *Acrocystis*. In this study we employ current nextRAD sequencing techniques as well as traditional systematic methods including cytogenetics and morphology to corroborate our circumscription of members of this group. We use the collective data in a "forensic-like" manner to guide sampling and ultimately to detect species crypsis in this clade. At least 5-7 new taxa require recognition, many of them narrowly endemic, but clearly delimited by multple lines of evidence. This research demonstrates the power of uniting both old and new methods to address alpha and beta-level systematics.

45 Rebecca Dellinger-Johnston, Bruce K. Kirchoff
Biology, UNC Greensboro

Experimental Test of a New Visual Plant Identification Key to the Genus *Quercus* in the Southeastern US

Taxonomic keys are essential tools for species identification, yet most keys are difficult to use for both novices and experts alike. This difficulty is in sharp contrast to an expert's ability to quickly recognize even very difficult species at a glance. Taxonomic experts can often even recognize hybrids, and assess their potential parentage merely by sight. Students in field botany courses rapidly gain these skills, but often still have difficulty using keys. To address these problems we created and tested a completely visual key to the 43 species of the genus *Quercus* in the southeastern United States. Sets of standardized photographs of the 43 species were taken, and used to create pairwise similarity matrices based on novice and expert similarity assessments of the photographs. For each assessment a user was shown a pair of standardized photographs of leaves (for instance) and asked to rate their similarity on a 7 point scale. Ten novice, and 10 expert ratings were collected for each pair of leaves (903 pairs). The similarity matrices were then used to a construct dendrograms, which served as a model for the visual key. The key was created in html and deployed on the biology department webspace at the University of North Carolina at Greensboro. The key was tested against an existing dichotomous key: The Forest Service *Field Guide to Native Species of Oaks of Eastern North America*, which was converted to html for this purpose. Both keys were tested by both UNCG undergraduate students and experts from the International Oak Society. Each participant was asked to key out 10 species using each key. The students were tested in control (Forest Service) and experimental (our visual key) groups, while a within subjects design was used for the experts. Both experts and novices identified between 20-30% more species correctly while using the visual key ($p<<0.001$) – demonstrating the effectiveness of our approach. Using this method, innovative keys could be constructed for students and professionals in both botany and in other fields of research.

46 Adam J. Ramsey, Jennifer R. Mandel
Biological Sciences, U of Memphis, TN

Patterns of Cyto-Nuclear Disequilibrium and the Influence of Heteroplasmy in Wild Carrot, *Daucus carota* (Apiaceae)

Cyto-nuclear linkage disequilibrium (LD) is the non-random association of alleles in the nuclear and cytoplasmic organellar genomes. Patterns of cyto-nuclear LD can indicate admixture of two hybridizing species or divergent populations, evidence of positive or negative cyto-nuclear selection or inheritance of organelles in a non-traditional fashion and the occurrence of more than one mitochondrial or plastid genome within an individual, termed heteroplasmy. Cyto-nuclear

interactions have been shown to play a role in cytoplasmic male sterility (CMS) which occurs in gynodioecious plant species. These species are also implicated in instances of paternal inheritance of organelles. We used the gynodioecious species, *Daucus carota* ssp. *carota*, or wild carrot, to investigate cyto-nuclear LD. We genotyped a total of 237 individuals from two North American regions, 95 from the Olympic Peninsula, Washington State, and 142 from Nantucket Island, Massachusetts. We used 15 nuclear microsatellites, two mitochondrial SNPs and one plastid insertion/deletion polymorphism to calculate nuclear-nuclear LD, cyto-nuclear LD and LD between organelles both among regions and within regions. We were further able to identify over 100 individuals heteroplasmic for at least one of the organellar loci. Thus we were able to calculate the same sets of LD values for heteroplasmic and homoplasmic (non-heteroplasmic) individuals. Differences were found between several of the LD calculation sets. Further goals of this project are to include crop carrots (ssp. *sativus*) to determine if gene flow between wild and crop carrot may play a role in the patterns of LD investigated here.

47 Zack E. Murrell
Biology, Appalachian State U, Boone, NC

Update on SERNEC: Key to the Cabinets, History, Progress and Challenges

The SouthEast Regional Network of Expertise and Collections (SERNEC) grew out of annual gatherings of regional curators at the Association of Southeastern Biologists meeting. The inclusion of “Expertise” in the SERNEC acronym was utilized to acknowledge that the taxonomic and curatorial capabilities were as undervalued as the herbarium specimens themselves. The SERNEC NSF-supported Research Coordination Network (RCN) provided support from 2005-2011 for training and idea exchange among the curators in the Southeast. Our more recent NSF-supported Thematic Collection Network (TCN), with funding from 2014-2018 for 94 herbaria and six Information technology entities, provides us with a technical infrastructure to capture herbarium images and transfer them to various portals, where they can be transcribed and georeferenced. This effort includes Symbiota, GEOLocate, Notes from Nature, Specify and iPlant as web and software based entities that provide our “data pipeline”. There are currently 61 collections serving data through the SERNEC portal, providing 945,518 specimens records with 84,601 (9%) of those records georeferenced. Of the total records, 91,830 are skeletal or partial records and 114,622 specimen images are available. During year 1, the project provided mentoring for 5 graduate students, 43 undergraduates, 2 post baccalaureates, 1 technician (collections manager), and 1 postdoctoral student -- all trained in museum protocols. The ultimate goal of the NSF TCN effort is to use this pipeline to link the scientific expertise of the curators with their affiliate users, such as state and federal agency scientists and consulting biologists in the private sector, with the greater public through the World Wide Web. Our concept is to build synergy among the curators and affiliates and interface this collaboration with the greater public. Together, our intention is to engage this human infrastructure in building a specimen-based research engine that can generate regional scale research capabilities.

48 Emily L. Gillespie
Biological Sciences, Marshall U, Huntington, WV

The Marshall University Herbarium: A Model for Engaging Student Curators in Small Herbarium Digitization Efforts

Digitization efforts are now well underway by the SouthEast Regional Network of Expertise and Collections (SERNEC) with support from an NSF-TCN entitled “Key to the cabinets: Building and Sustaining a Research Database for a Global Biodiversity Hotspot.” This multi-state collaborative is providing opportunities to not only draw on student labor as a way to facilitate efforts to mobilize herbarium data, but to also provide a unique job-training environment for students interested in museum informatics. In the first 1.5 years of the SERNEC TCN, Marshall University herbarium (MUHW), a collection of approximately 50,000 vascular plant specimens, has trained nearly 20 students in the digitization of herbarium specimens, beginning as early as freshman year. In addition to working with student employees and biology Independent Study students, we

have successfully partnered with the Federal Work Study program to supplement limited resources and faculty curatorial time. Retention of students for multiple years has permitted us to establish best practices and robust, error-reducing protocols for digitization efforts and to provide a work experience for students that results in transferrable professional skills. Our students have not only participated actively in photography and other technical aspects of the project, but they have also been instrumental in managing the project, including workflow and protocol development. Our organizational model 1) fully acknowledges the strengths and training needs of students, 2) meets the need for faculty to document their effort in the form of student benefits, 3) addresses the need to be creative in an increasingly budget-limited environment, 4) reduces the need for direct PI oversight, and 5) provides students with strong management and peer-training skills while facilitating rapid completion of this important collaborative research effort. This model demonstrates that students at all levels can and should be included as equal partners in our emerging and continuing biodiversity informatics efforts.

49 Carol Ann McCormick
UNC Herbarium, NC Botanical Garden, UNC Chapel Hill

DWG's, Poor Penmanship, and Posthumous Slaps: Georeferencing Herbarium Specimens With Cryptic Labels

Geolocating herbarium specimens can be complicated by poor penmanship, use of abbreviations, or complete lack of locality information on a label. It can be impossible to ascertain information from an isolated specimen, but by cataloging in the various portals (mycoportal, lichenportal, sernecportal, etc.) one can glean information from sets of labels which illuminate cryptic labels. Delving into a collector's life can yield clues as to collecting localities, as well as their relationships with other collectors. Using outside resources -- other herbarium collections, college alumni records, and census documents -- can be helpful in elucidating the life (and therefore collecting locations) of many botanists. Depending on the Kindness of Strangers (*e.g.*, Curators of European herbaria) can be invaluable when reading labels in languages other than English. Employing a variety of strategies may be needed to read, to interpret and ultimately to geolocate a single specimen.

50 Jason H. Best
Research, Botanical Research Institute of Texas, Fort Worth

Digitization Workflow Automation at BRIT

Automated solutions not only save time by performing work that would otherwise need to be done manually by a human, they also can be replicated in other workflows, scaled up, and utilized for reliable, repeatable results. The digitization workflow at the Botanical Research Institute of Texas (BRIT) incorporates a number of automated phases in concert with human-driven phases. By utilizing automation where appropriate, BRIT has created a workflow which allows the human participants to focus on the tasks that only they are capable of performing. BRIT has incorporated a number of automation components into its workflow including barcode reading, metadata generation and management, file format conversion, file backup, and productivity tracking. The most costly and valuable component of the workflow is the time invested by humans. BRIT's automation efforts have contributed to increased productivity and attaining aggressive goals within tight budget constraints.

51 Brad R. Ruhfel
Biology, Eastern Kentucky U, Richmond

The “Key to the Cabinets” Opens Many Doors

The SERNEC digitization efforts will liberate data from ~3 million specimens from over 100 herbaria in one of the most floristically diverse regions in North America. These efforts will create an invaluable data set for research on the response of vegetation to climate change, human development, and rapid migrations of introduced species. At Eastern Kentucky University (EKU)

this grant has inspired several other related projects which we will review here. These projects include i) compiling the flora of EKU's three natural areas in easily maintainable lists on the SERNEC Symbiota Portal, ii) the creation of species lists of the KY State Flora on the SERNEC Symbiota Portal based on two major floras of the state, iii) student collection projects, iv) increased collaboration with the Kentucky State Nature Preserves Commission through the digitization of their collection of rare species, v) the input of vertebrate collections at EKU (mammals, herps) on other Symbiota based portals, and vi) fostered collaboration among faculty from several institutions that teach plant diversity courses to develop new and innovative teaching resources. A summary of the digitization efforts at EKU will also be provided.

52 Andrea Weeks
Biology, George Mason U, Fairfax, VA

Data Redaction for Virginia-Collected Herbarium Specimens on Symbiota: Developing a Consensus among Stakeholders

Detailed locality data about vascular plant species are now widely accessible to the public via online databases of herbarium collections, such as the SERNEC Symbiota portal, which has engendered debate in the curatorial community about data redaction. Some detailed locality data cannot not be released to the general public; some specimens may refer to private land whose owners have expressly requested remain confidential or to culturally significant sites whose stewards have requested the same. However, the most numerous data requiring protection relate to rare, threatened or endangered plant species. Some curators argue for very little redaction of locality data to speed scientific research and others for extensive redaction to protect the most species. Symbiota, as a shared resource among many curators, attempts to strike a balance on automatic data redaction in its current list, which contains 1,696 species and infraspecific taxa including all federally-listed threatened and endangered taxa as well as common species known to be the target of over-harvesting (e.g., ginseng). My presentation will describe our efforts in Virginia to understand and manage these risks for Virginia-collected taxa as a community of stakeholders including curators of Virginian herbaria, botanists of the Virginia Natural Heritage Program and federal agencies. I will cover lessons learned and conclude with recommendations for how we might manage data redaction with greater ease and flexibility – and less angst.

53 Alexander Krings
Plant and Microbial Biology, North Carolina State U, Raleigh

Data Redaction for Sensitive Taxa in North Carolina: A Working Group Update

Considering the volume of herbarium specimen data being made available through active digitization in the region and beyond, both (1) a process of comprehensively defining which data should be masked and (2) stakeholder agreement on that process are of paramount importance. Considering the legal, logistical, and stakeholder issues and relationships involved, a state-by-state process is an efficient way to approach achieving these objectives. Here provided is an update of efforts toward this end in North Carolina by a working group comprised by the state-level PIs on the ADBC grant, as well as representatives from the pertinent agencies at the state and federal level. Discussed are the working group formulation, issues addressed, and outcomes achieved. Issues addressed include criteria for data masking, responsibilities for maintaining the list of taxa for automatic masking, and timeframe for revisiting and updating the list. Recommendations are provided to obviate uncertainties in the future regarding data publication through proposed changes in the collection permitting process at the state and federal level.

54 Nelson E. Rios, Henry L. Bart
Biodiversity Research Institute, Tulane U, New Orleans, LA

Engaging the Group in Georeferencing Using GEOLocate

The GEOLocate project began in 2002 as an effort to develop technologies that facilitate georeferencing of the historical collecting events associated with specimens housed in natural history collections and museums. Since its inception, the project has developed a standalone desktop application, a collection of web-based client applications, a collaborative georeferencing portal and web-based API's that collectively: 1) deduce geographic coordinates from textual locality descriptions; 2) compute uncertainty estimates in the form of point-radii and/or polygons; 3) provide a UI to verify and adjust computed coordinates and uncertainties against digital maps; support large scale collaborative georeferencing workflows and enable integration with third party tools such as Symbiota, Specify and Arctos. This presentation will provide an overview of these technologies, demonstrate real-world examples from FishNet2 and SERNEC and provide recommendations for implementation in georeferencing projects.

55 Michael W. Denslow[1], Robert Guralnick[2], Austin R. Mast[3]
[1] Biology, Appalachian State U, Boone, NC; [2] Florida Museum Natural History, U Florida, Gainesville; [3] Biological Science, Florida State U, Tallahassee

Notes from Nature and SERNEC: Leveraging a Citizen Science Tool for Large-Scale Digitization of Herbarium Labels

Notes from Nature (http://www.notesfromnature.org; NFN) is a citizen science tool focused on public engagement and label transcription of natural history specimens. The project was developed collaboratively by biodiversity scientists, curators, and experts in citizen science, within the well-established Zooniverse platform. This project currently brings together digital images of biodiversity records that include ledger books (birds), herbarium sheets (plants), specimen labels (fungi), pinned specimens (insects) and fluid preserved specimens (crabs) from multiple projects and museum collections. Volunteer citizen scientists transcribe textual data contained in the specimen images. Since its launch in 2013, NFN has amassed over 1.2 million transcriptions from over 8,500 registered volunteers worldwide. While successful, it has been difficult to scale up NFN for broadest community use, both for natural history collection providers and citizen scientists. SERNEC is a large collaborative project which is aiming to digitize over 4 millions specimens from 93 museums across the southeast United States. The SERNEC project will make extensive use of the NFN herbarium interface, necessitating an increase in NFN capacity. This talk focuses on the next steps to overcome current NFN limitations in order to meet the SERNEC goal of transcribing over 4 million specimen labels. This will be done by improving the volunteer experience, increasing volunteer motivation and creating meaningful expeditions. BIOSPEX (http://biospex.org/) will deliver an easy to use provider interface for creating, advertising and ingesting output from NFN transcription expeditions. We also discuss SERNEC's engagement and retention efforts, which will be critical to the success of SERNEC's use of NFN. Such improvements and collaboration will help SERNEC and NFN unlock a vast amount of legacy biodiversity data for the public good.

56 Ashley B. Morris[1], James B. Beck[2]
[1] Biology, Middle Tennessee State U, Murfreesboro; [2] Biological Sciences, Wichita State U, KS

Expanding the Role of SERNEC: Opportunities to Address Old Taxonomic Problems With New Collaborative Approaches

Plant phylogeography and population genetics are dependent on high-resolution, high-quality data collected consistently through space and time. The costs and time associated with the collection of such data cause individual investigators to make difficult decisions - cutting sample sizes, sampling frequency, or numbers of genetic markers in order to complete a project. This ultimately limits the accuracy of the inferences that can be made from the resulting data.

Researchers have taken numerous approaches to circumvent this challenge, including contacting other researchers for field collections to be shipped by mail, and sampling herbarium specimens in person at large institutions. While helpful, these approaches remain relatively inefficient, and a multi-institutional collaborative network is needed. The infrastructure of the SERNEC community provides a unique opportunity to further improve the efficiency of our approach. We propose a collaborative network of institutions and herbaria that will work together to generate large-scale, high-resolution genetic data to address outstanding questions in plant taxonomy, biogeography, and evolution. This network will develop community standards for data collection and sharing, insuring that participants collect data consistently and are appropriately acknowledged for their participation. Data collection for a given project could be completed in the context of a class laboratory or through undergraduate or graduate researchers. Such a network would be particularly valuable to researchers with high teaching loads, those who mentor M.S. research exclusively, or to curators of small collections, all of whom have the potential to contribute valuable information but may be limited by time and resource investment. The network concept builds on the successes of previously funded NSF Research Coordination Networks (RCNs) such as EREN (Ecological Research in Education Network) and SERNEC (SouthEast Regional Network of Expertise and Collections), while integrating the expertise provided by iDigBio (integrated Digitization of Biological Collections) and the COS (Center for Open Science).

57 Austin R. Mast
Biological Science, Florida State U, Tallahassee

Crowdsourcing 10 Million Transcriptions—Multiple Strategies for Success with Digitization While Increasing STEM Literacy

The thematic collections network of the Southeastern Regional Network of Expertise and Collections (SERNEC) aims to engage Notes from Nature volunteers in the transcription of perhaps 3.7 million specimens from ca. 100 southeastern U.S. herbaria. Given that Notes from Nature (www.notesfromnature.org) shows each specimen label to three volunteers, this amounts to a goal of more than 10 million individual transcriptions. I will assess recent progress towards integration of digitization into onsite informal education events, formal education events (grades 6–16), and the global Worldwide Engagement for Digitizing Biocollections (WeDigBio) Event, projecting time-to-completion for SERNEC's 10 million transcriptions with partial vs. complete participation among SERNEC's ca. 100 herbaria. New developments at Notes from Nature will permit the packaging of specimen sets into expeditions that are circumscribed based on some compelling theme using Biospex (www.biospex.org). I will also discuss alternative strategies for circumscribing those expeditions (e.g., by herbarium, collection location, or taxonomy). We have good experience with packaging by herbarium—this is what Notes from Nature has done in recent months. I will present a new collaboration with the Florida Native Plant Society's 37 chapters that explores packaging by collection location (regardless of whether or not the specimen is in a Florida herbarium), which enables the development of place-based education materials for both informal and formal education settings. While the Florida Native Plant Society collaboration could result in Florida-collected specimens from across the hundred SERNEC herbaria being completely transcribed, successful transcription of specimens collected in other locations would require buy-in from similar groups in each state.

58 Roland P. Roberts
Biological Sciences / Div Biological Infrastructure, National Science Foundation, Arlington, VA

National Science Foundation Funding Opportunities for Improved Collections Security and Digitization

The goal is to highlight funding opportunities at NSF for improvements in security, and digitization of collections. The Collections in Support of Biological Research (CSBR) Program targets the securing of natural history and living stocks collections, including ownership transfer of orphaned collections while the Advances in Digitization of Biodiversity Collections (ADBC) Program funds

collaborative digitization efforts of specimens to address specific research themes. Requirements and criteria specific to all funding tracks are emphasized. Additionally, opportunities for broadening participation and building of human capital in collections-based activities are discussed.

59 Matthew J. Heard
Biology, Winthrop U, Rock Hill, SC

Examining How Multiple Types of Disturbance Interact to Influence Native and Exotic Plant Coexistence

Changes in resource availability and disturbance can differentially affect native and exotic plants, but how these two factors simultaneously influence native and exotic coexistence remains unknown. In this study, I used an experimental field approach to examine how changes in the deposition and removal of wrack from historically invaded coastal plant communities and the addition of nutrient fertilizers influences native and exotic plant richness, cover, and coexistence. My findings suggest that changing both the level of physical disturbance and the availability of nutrients is different for native and exotic species and that altering these two factors together reduces coexistence. My findings support recent work, which has suggested that exotics may be more likely than natives to increase in dominance in ecological communities that have been impacted by multiple types of disturbances. Additionally, my research also highlights how communities with long-term coexistence between native and exotic plants can still be in flux.

60 Laura Horton, A. Darlene Panvini
Biology, Belmont U, Nashville, TN

Abundance of Earthworms Relative to Leaf Litter Mass and Exotic Plant Coverage

The invasion of European and Asian earthworm species has known detrimental effects on the abundance of native plant species and leaf litter in deciduous forests. The purpose of this study was to investigate the relationship between areas of varying invasive plant coverage, and invasive earthworm and leaf litter presence. Data were collected in a deciduous forested area by establishing three 100 meter transects, each with three 5x5 m^2 quadrats in areas of high, medium, and low invasive exotic plant coverage. Earthworms were collected using a mustard vermifuge from each quadrat. Leaf litter density in each quadrat was determined from dry leaf mass. The greatest earthworm abundance occurred in the quadrats with medium exotic plant coverage; fewer earthworms were found in the quadrats with the highest exotic plant coverage. The difference in dry leaf litter mass per coverage level was not significant, though less leaf litter occurred in the plots with the most exotic plants. The intermediate disturbance hypothesis might explain the greater number of earthworms in the plots with intermediate amounts of exotic plant coverage. This study is valuable as a reference for future sampling on this property to provide a better understanding of the movement patterns of invasive earthworms associated with each level of invasive plant coverage and leaf litter abundance.

61 Ayda Porkar-Rezaeieh, A. Darlene Panvini
Biology, Belmont U, Nashville, TN

Biomass and Diversity of Earthworms is Affected by Presence of Exotic Shrubs

Invasive exotic plants may affect the diversity and biomass of non-native earthworms. Earthworms are mostly known for their positive impact on agricultural systems. However, non-native earthworms can have negative impacts on understory and overstory communities when introduced to a forest ecosystem. The spread of non-native earthworms into unglaciated regions occupied by native earthworms can have significant ecosystem effects. We examined relationships between exotic plant species coverage, leaf litter, earthworm diversity, and earthworm biomass on a forested site in Nashville, TN. We predicted that the presence of exotic plants would affect the diversity and biomass of earthworm species due to differences in leaf litter decomposition rate. All earthworms identified were non-native species. Earthworm species

evenness and overall diversity were greatest in plots with only native plant species coverage. However, earthworm abundance and species number were greater in plots with a mix of native and exotic plant coverage. The intermediate disturbance hypothesis may account for this distribution as different earthworm species may prefer environments with a combination of both native and exotic plants.

62 Katlin Stodard, A. Darlene Panvini
Biology, Belmont U, Nashville, TN

Decomposition of *Acer saccharum* and *Lonicera maackii* Leaf Litter in a First Order Stream

Decomposition of the detritus of a riparian forest influences the nutrients available to a stream and its inhabitants. Invasive plant species have the potential to alter stream dynamics as they spread and form dominant leaf litter decomposing in streams. The objective of this study was to test the decomposition of native *Acer saccharum* and invasive *Lonicera maackii*. The leaves of each species were placed in leaf litter bags, installed in a local stream, and then removed every three weeks to measure decomposition. *L. maackii* was found to decompose more rapidly than *A.saccharum*. These results show that *L. maackii* could impact nutrient cycling within a stream.

63 Sara Haney, A. Darlene Panvini
Biology, Belmont U, Nashville, TN

Effects of Exotic Earthworms and Exotic Plants on Soil Invertebrate Abundance and Diversity

A field study was conducted to examine the effects of exotic earthworms and privet (*Ligustrum sinense*) and honeysuckle (*Lonicera maackii*) on soil invertebrate abundance and diversity. In low, moderate, and high densities of exotic plants, soil samples were excavated using a metal auger and leaf litter was hand collected. Burlese funnels were used to extract invertebrates and identification was made to order and phylum; larvae were left unidentified. Leaf litter biomass and pH were recorded. The greatest abundance of invertebrates was found in plots with the greatest density of exotic plants and the fewest exotic earthworms. The lowest soil invertebrate abundance was found in plots with the highest abundance of exotic earthworms and a moderate amount of exotic plants. The abundance of soil invertebrates and earthworms were negatively correlated. The abundance of soil invertebrates was found to be dependent on exotic plant coverage. Diversity and species' evenness increased as exotic plant coverage decreased and leaf litter mass increased. The results suggest that the presence of exotic plants in high densities had a positive impact on soil invertebrate abundance and a negative impact on soil invertebrate diversity, while high densities of earthworms had a negative impact on invertebrate abundance.

64 G. Neil Douglas, Geri L. Mitchell, Jessica E. Vinson, Sean M. Nilan, Ralph L. Thompson
Biology, Berea College, KY

Prey Remains in Barn Owl (*Tyto alba*) Pellets Collected in 1997 From a Silo Roost in Harrogate, Tennessee

Barn owl (*Tyto alba*) pellets collected in 1997 from the campus of Lincoln Memorial University in Harrogate, Tennessee contained 311 individual prey. Vertebrate prey remains identified, from most to least abundant, included short-tailed shrews (*Blarina brevicauda*; 39.5%), least shrews (*Cryptotis parva*; 14.5%), southern bog lemmings (*Synaptomys cooperi*; 12.9%), hispid cotton rats (*Sigmodon hispidus*; 8.4%), pine voles (*Microtus pinetorum*; 3.9%), deer mice (*Peromyscus* spp.; 3.5%), eastern harvest mice (*Reithrodontomys humulis*; 2.6%), house mice (*Mus musculus*; 2.3%), prairie voles (*Mictrotus ochrogaster*; 1.9%), eastern cottontails (*Sylvilagus floridanus*; 1.9%), avian spp. (1.2%), and *Sorex* spp. (0.3%). Three Norwegian rats (*Rattus norvegicus*; 1.0 %) were identified also. Unlike pellets collected in 1996, black rat (*Rattus rattus*) remains were absent. Compared to Copeland and Caldwell (1991), pellets from the same silo roost analyzed in the current study contained increased ratios of *Blarina brevicauda* to *Cryptotis parva* ($\chi 2 = 10.1$,

d.f. = 1, $P < 0.05$, 3.84) and *Synaptomys cooperi* to *Microtus sp*. ($\chi 2 = 16.7$, d.f. = 1, $P < 0.05$, 3.84). Prey taken by barn owls can be affected by owl hunting preference, habitat, climate, interspecies competition, and population dynamics. However, data from both 1996 and 1997 collections consistently affirm that owl pellet analysis remains a good indicator of the presence of species like *Synaptomys cooperi* and *Cryptotis parva* that are especially difficult to trap within a particular area during a specific timeframe.

65 Chris J. Peterson
Plant Biology, U Georgia, Athens

Intermediate Disturbance Severity Yields Maximal Structural Complexity: An Alternative Mechanism for the Intermediate Disturbance Hypothesis?

One of the most enduring -- and debated -- concepts in contemporary community ecology has been Connell's Intermediate Disturbance Hypothesis, which postulates that disturbances of intermediate frequency or severity produce the highest diversity in tropical forests. This hypothesized relationship may operate at either or both of two scales, namely within or among disturbed patches. At the within-patch scale, intermediate disturbance frequency produces high diversity because the timing allows both pioneer and mature-phase species to coexist via a micro-succession. At the among-patch scale, intermediate disturbance frequency allows the landscape to host patches at a variety of successional stages, thereby fostering beta diversity among patches. I propose here that structural complexity is a possible alternative means by which intermediate disturbances could produce maximal diversity. In fifteen separate forest blowdowns sampled across ten states, I quantified standing and damaged trees. At the plot scale, I calculated structural complexity as a three-component index, comprised of species diversity (Shannon index), size inequality (Gini coefficiant), and diversity of tree damage types (Shannon index). Each of the three components were standardized to a site maximum of unity, thus the composite index varied between zero and three. Disturbance severity was quantified at the plot level as proportion of tree basal area lost from the canopy. Structural complexity shows a unimodal curve with a central peak when plotted against disturbance severity (n=352 plots); Gaussian regression explained a greater proportion of variation than did linear regression. Separate from my work, a variety of other studies have shown greater species diversity is associated with greater structural complexity. Thus any mechanism that maximizes structural complexity potentially also maximizes species diversity. My work demonstrates that structural complexity is maximized at intermediate severity of disturbance and therefore supports the relationship initially proposed by Connell, but by an entirely novel pathway.

66 Joe E. Winstead[1], Michael E. Held[2]
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Exceeding 100 Years in Age an Oak–Hickory Forest in East Central Mississippi Challenges Contemporary Basal Area Concepts

An upland and well drained oak - hickory stand of approximately 6 ha adjacent to a 1200 ha bottom land mixed hardwood forest in Clay County, Mississippi was sampled for species composition and basal area analysis in 2015. We recorded approximately 700 trees (DBH > 10 cm) per hectare in this forest stand. Seventeen tree species were identified in the community. The total basal area of the sample plots indicates an estimate of 52.08 m^2/ha that far exceeds the generally accepted concept that for mesic hardwood forests the total basal area ranges from 30-32 m^2/ha. The eight oak species sampled collectively made up 72% of the total basal area followed by the three hickory taxa equaling 12.4%. The presence of red cedar (*Juniperus virginiana*) contributing almost 8% of the total basal area may be an indication of forest development following agricultural activities prior to the 20th century.

67 Timothy O. Menzel
Natural Sciences, Piedmont College, Demorest, GA

Providing a Complete Picture of Competition between Two Ant Species, *Aphaenogaster carolinensis* and *Nylanderia faisonensis*

Aphaenogaster carolinenesis and *Nylanderia faisonensis* are both common forest ant species in the southeastern United States. This paper summarizes several small scale projects that have investigated their relationship, from their behaviors during physical confrontations between individuals, to colony and population level patterns. These projects have found a high degree of nest site selection overlap, a strong tendency to occur on the same baits, a tendency to avoid simultaneous bait occurrences, and intense physical interactions on baits when they do simultaneously occur.

68 Dwayne Estes

Botanical Research Institute of Texas, Fort Worth, TX; Center for Field Biology, Austin Peay State University, Clarksville, TN

A revolutionary new hypothesis to explain biogeographic disjunctions in the unglaciated eastern United States

Phytogeographers have puzzled over disjunctions of plant populations in the unglaciated eastern U.S., particularly those separated 500-1000 km on either side of the Mississippi Embayment (ME). Many north-south phytogeographic patterns have been attributed to distributional changes that occurred during or shortly after the late Wisconsin Glacial Episode (25000-18000 BP). The Holocene Climate Optimum (9000-5000 BP) has been invoked to explain major west-east disjunctions involving grassland/glade taxa on each side of the ME. However, the west-east disjunctions arent unique to grasslands/glades. In fact, for almost any community type east of the ME there is a nearly equivalent community to the west. These include matrix and large patch communities (e.g. mesic forests, prairies) as well as insular small-patch communities (rockhouses, riverscours). Long-distance dispersal likely explains some examples, but most involve perennials with poor dispersal capabilities and narrow ecological niches, suggesting vicariance. Prior to the Pleistocene (2.5 my-11700 ka BP) these communities were distributed continuously or in stepping-stone corridors across the northern terminus of the ME from TN and KY through IL, MO, and AR. This pre-glacial landscape of the Pliocene Epoch (5.3-2.5 my BP) encompassed a mosaic of different communities that waxed and waned as the landscape eroded and evolved in response to late Neogene uplift in the Appalachians. The once dissected landscape of IL was flattened into till plains by repeated advances of continental glaciers 1.6 my-125 ka BP, obliterating pre-glacial landscapes and severing ecological corridors. Assumptions of this hypothesis are that many woody/perennial species date at least to the Pliocene and that many species remained in-place, enduring colder climates of glacial episodes rather than migrating southward. Evidence in support of this Interior Arc Hypothesis comes from modern biogeographic patterns, community ecology, phylogenetics, phylogeography, and landscape evolution. More phylogeographic studies are needed to test this hypothesis.

69 Margaret A. Small, David B. Vandermast
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Environmental and Soil Characteristics of Elon University Forest

Elon University Forest (EUF) is a 22.5 ha former farmstead that experienced anthropogenic disturbance in the form of plowing, and planting and harvesting of agricultural crops. This activity possibly altered the structure, amount of organic matter, nutrient status, and microbial community of the soil. EUF also contains a forested land that remained relatively untouched, and has been identified as a forest of continuity (FOC). While the agricultural land has since returned to early successional forest communities, the FOC retains an old-growth forest structure and composition. In order to determine how these prolonged disturbances have altered soil quality, this study compared soil composition and structure of the younger plots to that of the FOC. Environmental

variables such as slope, aspect, and McNab indices for landform did not vary significantly between plots. The O and A soil horizons in the FOC were significantly deeper than those in the young forests (p=.035 and p=.011, respectively). In the FOC, soils in both the A and B horizons had CEC and concentrations of soil cations such as Ca, Mg, and Na that were less than 50% of those in the younger forests. Our results provide support for the hypotheses that the FOC is, in fact, different than younger forests on EUF in meaningful ways. Because the FOC was never cutover and plowed, and hence no soil was lost to erosion, it has retained the soil strata depths expected of an old forest. Consistent with our results, older forests in the Piedmont physiographic region also typically exhibit reduced fertility as evidenced by the reduced CEC and cation concentrations in the FOC. Our data provide further evidence that the FOC is a remnant of primary forests that existed in this region before colonization by Europeans.

70 Katelyn Walters, Heather P. Griscom
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Prioritizing Eastern Hemlock Trees for Secondary Imidacloprid Treatment in Shenandoah National Park

Shenandoah National Park (SNP) contains over 20,000 eastern hemlocks (*Tsuga canadensis*); a foundation species in the southern Appalachian Mountains. Hemlock is shade-tolerant and retains a dense needle canopy year-round, creating a unique microclimate providing habitat for many species. The decline in eastern hemlock from hemlock woolly adelgid (*Adelges tsugae*) infestation has negative implications for the overall function of forest ecosystems. We quantified the effect of slope aspect and time since imidacloprid insecticide treatment on crown health change and diameter growth of eastern hemlock in SNP. We compared data from hemlock trees located on southeastern (SE) and northwestern (NW) aspects at sites that were either treated two, five or eight years ago. Trees at control sites received no treatment. Change in crown health was significantly affected by aspect and time since treatment ($p<0.001$) but change in diameter growth rate was not affected by either variable. Crown health decreased in trees treated eight years ago on both aspects and increased in trees treated two years ago with a significantly greater increase on NW aspects. The NW aspect sites have 2919 adult hemlocks whereas, the SE aspects have 1283. This current data along with historical distribution data suggests that hemlocks are more successful on NW aspects in the park. This may explain why hemlocks are recovering more quickly on the NW aspects after treatment. A concerning observational finding was the lack of cones on either aspect, despite evidence of treatment effectiveness. The few trees with cones were located in areas receiving more sunlight, suggesting stress from infestation is reducing reproductive ability. Aspect may have a role in treatment effectiveness initially, but within five years, hemlock trees will exhibit similar health decline. Furthermore, treatment may result in short-term hemlock recovery and survival, but not reduce adelgid stress long enough to allow for reproduction.

71 James A. Vance[1], Gabrielle L. Smith[1], Walter H. Smith[2]
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Use of Google Maps and Street View to Facilitate Analysis in a Wildlife Vehicle Collision Study

Google Maps (GM) and Google Street View (GSV) are widely recognized as free informational and educational tools. They provide millions of people with quick and easy access to a plethora of geographic information. However, these tools have not been commonly recognized as legitimate data collection tools for wildlife vehicle collision studies (WVCS). Collecting data from the field can be costly, time consuming and may be a detriment to the efficiency of a WVCS. We examined the potential of GSV and GM to be considered as an accurate and effective substitute for countless hours of field study. 50 randomly chosen points along a specific route were observed and recorded. The geographical positioning of these collision points were recorded to be observed again through GM and GSV. For these points we measured Road or Median Width,

Median Topography, Median Type, and Fence Presence. We collected the data from the field and from GM/GSV and found the following results for inaccuracy: Fence Presence was 26% inaccurate, Median Topography was 38% inaccurate, Median Type was 4% inaccurate, and the root mean squared error for Road or Median Width was 1.14 meters. Our data analysis indicates that GM/GSV are effective substitutes for field study when it comes to measuring Median Type and Road or Median Width, yet not so much for Fence Presence or Median Topography. Ultimately, these results imply that GM/GSV are not effective tools for all aspects of a WVCS, yet can be used for some moderate scale variables. Thus members of WVCS can save some of the time and money spent on long road surveys by using these free and easy Google programs.

72 Adrienne F. Boucher, Matthew D. Eastin, Sara A. Gagné
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Effects of the Urban Heat Island on Anurans in Remnant and Stormwater Control Ponds in the Charlotte Metropolitan Region

The urban heat island (UHI) has been documented to increase urban air temperatures compared to rural areas, but little is known about the effects of UHI-induced meteorology on anuran breeding and diversity. Our research objective is to understand how the meteorology associated with a UHI affect the breeding activity and diversity of anurans. We selected 66 ponds in the Charlotte Metropolitan Region, in landscapes that varied in impervious surface cover, a correlate of air temperature, and precipitation amount. Twelve evening call surveys at each pond occurred between February-June 2014 and March-June 2015, assessing anuran breeding activity. We quantified meteorological conditions at ponds using data loggers at pond edges, recording air temperature and relative humidity for both breeding seasons and using monthly average rainfall for each landscape. Accounting for variation in local habitat quality and landscape composition, in 2014 and 2015 we measured pond descriptors and vegetation in and around each pond and measured the proportions of landscapes covered by forest, wetlands, agricultural, and impervious surfaces. Landscape variables were quantified for circular areas within 0.5-20 km of ponds. Occupancy analysis and generalized linear modeling will be used to assess the effects of meteorological variables on occupancy and detectability of individual anuran species and on anuran species richness. Preliminary results indicate that anuran species richness is negatively influenced by the minimum temperature range and positively influenced by relative humidity range at ponds. This outcome of this research will inform urban planning to promote the conservation of anuran species in an urban area.

73 Anna J. Markey[1], Sarah B. Sheppard[2], John E. Quinn[1]
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The Effect of Human-Made Ambient Noise on the Pitch of Bird Vocalizations

Avian species communicate through vocalizations that occur at unique frequencies and distinct patterns. However, increasing anthropogenic noise created by roads and cities may interfere and possibly affect inter- and intra- species communication. Given the observed changes in human created noise , we wanted to know if frequencies of bird vocalizations change in the presence of human noise which is also known as the anthrophony. To test this, we set up automated recording units in areas across the city of Greenville, SC identified a priori as quiet or loud. We found that areas of high anthrophony two of the five bird species with sufficient observations sang in higher frequencies than in quiet areas. Therefore, human disturbance is changing frequencies in birds possibly inhibiting communication within and between species. These data suggest that conservation research and urban planning should consider a greater focus on the impacts of increasing noise associated with urban development.

74 Sara A. Gagné[1], Jennifer L. Bates[1], Richard O. Bierregaard[2]
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The Effects of Road and Landscape Characteristics on the Likelihood of a Barred Owl (*Strix varia*)-Vehicle Collision

Collision with vehicles is a major if not the dominant source of mortality for owls.Despite this, there has been no study to date on Barred Owl-vehicle collisions, a species thatbreeds in densely-populated suburban neighborhoods with high road density. We capitalizedon the availability of a large dataset of the locations of Barred Owls hit by vehicles and broughtto a rehabilitation center in Charlotte, North Carolina, USA to investigate the factors underlyingcollision incidence. Using autologistic regressions and multi-model inference, we foundthat the explanatory variables with the largest effects on the likelihood of a Barred Owl-vehiclecollision were speed limit, road width, and habitat suitability within 825 m of roads, in thatorder. Speed limit and habitat suitability had positive effects whereas road width had a negativeeffect. Our results are in agreement with existing studies of birds that have investigated therelative effects of road features and landscape structure in demonstrating the greater importanceof the former. Future research should include systematic Barred Owl roadkill surveysthat account for sampling biases in order to determine the importance of roads as a source ofmortality for the species and to gain a better understanding of the effects of roadway design onthe incidence of Barred Owl-vehicle collisions.

75 Alexandra V. Shoffner[1], Andrew M. Wilson[2], Sara A. Gagné[1], Wenwu Tang[1]
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The Relative Impacts of Habitat Amount, Habitat Configuration, and Urbanization on Forest Breeding Birds

It is clear that urbanization causes changes in landscape structure that adversely affect biodiversity. However, the relative impacts of different components of landscape structure remain unclear. Using the 2006 National Land Cover Database and 2010 U.S. Census data, we quantified forest amount, forest configuration, and urbanization intensity in landscapes spanning the state of Pennsylvania in order to distinguish the independent impacts of these three aspects of landscape structure on avian biodiversity in remnant forest. We estimated abundances of individual forest bird species corrected for detection bias and forest bird species richness from a large and spatially-extensive dataset of point counts collected during the 2nd Pennsylvania Breeding Bird Atlas conducted 2004-2008. Landscape structure variables were quantified in concentric landscapes of 10 different radii (ranging from 0.2km to 16km) centered on point count locations within forest. Forest amount and forest configuration metrics were calculated using ArcGIS v10.3 and FRAGSTATS v3.3, and urbanization intensity was quantified using a principal components analysis of multiple land cover and Census-derived variables. We will present the results of analyses that test for the relative effects of the three landscape variables of interest on avian biodiversity. The outcome of our research will inform urban policy and planning to promote the conservation of avian biodiversity where people live and work.

76 Steven Gardner[1], James R. Rayburn[1], Donna Perygin[2]
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Assessing Differences in Toxicity and Teratogenicity of Three Phthalates, Diethyl phthalate, Di-n-propyl phthalate, and Di-n-butyl phthalate, Using *Xenopus laevis* Embryos

Phthalates, compounds used to add flexibility to plastics, are ubiquitous in the environment. In particular, the diethyl (DEP), di-n-propyl (DnPP), and di-n-butyl (DBP) phthalates were found to exert detrimental effects in both mammalian and non-mammalian studies, with toxic effects varying according to alkyl chain length. Embryos of *Xenopus laevis*, the African clawed frog, have been used to assess toxicity and teratogenicity of several compounds and serves as a model for

assessing adverse and teratogenic effects of ortho-phthalate esters. The purpose of this study was to develop a model for comparison of developmentally toxic effects of orthophthalate esters using *Xenopus* embryos. In this study developing *Xenopus laevis* embryos were exposed to increasing concentrations of DEP, DnPP, and DBP using the 96-h Frog Embryo Teratogenesis Assay–*Xenopus* (FETAX), with 96-h lethal concentrations, effective concentrations to induce malformations, teratogenic indices, and concentrations to inhibit growth determined. DEP, DnPP, and DBP showed enhanced toxicity with increasing ester length. Developing *Xenopus laevis* exposed to DEP, DnPP, and DBP showed similar malformations that also occurred at lower concentrations with increasing alkyl chain length. Teratogenic risk did not change markedly with alkyl chain length, with data showing only DBP to be teratogenic.

77 Annalee M. Tutterow[1], Shannon E. Pittman[1], Gabrielle J. Graeter[2], Michael E. Dorcas[1]
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Landscape-Level Factors Affecting Bog Turtle Populations in North Carolina

The bog turtle (*Glyptemys muhlenbergii*) occupies small bogs, fens, and wet meadows in the eastern United States and is listed as federally threatened in the United States. Previous studies have evaluated habitat and landscape features influencing turtle populations in developed areas, and the effects of habitat loss and degradation on wetland species specifically. However, no study has evaluated landscape features across many populations in the southern extent of the bog turtle's range, where populations may be in decline. The structure and composition of the landscape have important implications for bog turtle populations. For example, the connectivity of wetland patches could facilitate bog turtle movement and maintain spatially-structured population dynamics. In this study, we evaluated the potential impacts of landscape structure and composition on bog turtle densities for eleven intensively-studied bog turtle populations in North Carolina. We considered the effects of several landscape-level factors, including land cover, wetland clumping, bog connectivity, and road proximity. Additionally, we used a closed-population, full-likelihood model in Program MARK to estimate bog turtle abundances. We discuss the role of wetland buffer zones and landscape features in bog turtle conservation. Ultimately, our research provides information that will allow for better management of bog turtle populations in North Carolina.

78 Kathryn M. Greene, Shannon E. Pittman, Michael E. Dorcas
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The Effects of Conspecifics on Burrow Selection in Juvenile Spotted Salamanders (*Ambystoma maculatum)*

Understanding how the presence of conspecifics influences amphibian movement may help predict patterns of juvenile dispersal. Spotted salamanders (*Ambystoma maculatum*) are pond-breeding amphibians that disperse into terrestrial habitat from natal wetlands after undergoing metamorphosis, relying on small-mammal burrows and coarse woody debris for refugia.The effect of conspecifics on burrow use in juvenile salamanders is poorly understood. Determining how the presence of conspecifics influences juvenile salamanders' settlement decisions can increase our understanding of amphibian dispersal and ability to predict population dynamics. We conducted behavioral laboratory trials using 58 recently metamorphosed salamanders to determine how salamanders select burrows in the presence of conspecifics. Salamanders were more likely to settle in a burrow that was occupied by a conspecific versus an unoccupied burrow. Our results indicate that juvenile salamanders may show conspecific attraction and/or trailing behavior during the dispersal phase.

79 Heather L. Maher, David S. McLeod
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Using Geomorphometrics to Understand the *Limnonectes kuhlii* Complex

Recent studies have demonstrated that we have underestimated the biodiversity in South East Asia and elsewhere. As "common" species are more closely examined, especially those with broad geographic distributions, complexes of multiple species that have been hidden because of their morphological similarity are being elucidated. The stream-dwelling fanged frogs referred to as *Limnonectes kuhlii* exemplifies these cryptic species complexes. Long considered to be a single species, this complex has been shown to comprise more than twenty species. This study explores the utility of geomorphometric analyses in species delimitation within the *L. kuhlii* complex. By resolving species boundaries true diversity can be understood and conservation efforts can be advanced.

80 Thomas K. Moore[1], Alexandria A. Gagne[2], John J. Enz[2], Doug M. Hoffman[3], David E. Unger[1]
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From Microscale to Macroscale: Field and GIS analysis of gopher tortoise (*Gopherus polyphemus*) burrows on Cumberland Island National Seashore

Gopher tortoises (*Gopherus polyphemus)* are a threatened, keystone species in the state of Georgia and other parts of the southeastern United States. Cumberland Island National Seashore, near St. Mary's, Georgia is known to have gopher tortoise, but to date, no research has been done on this population. Recognizing burrow locations, distribution, population dynamics, and tortoise density will help develop important management strategies for this National Seashore. Research was conducted during the summer 2015 to obtain baseline data. GPS coordinates of burrows were obtained for analysis of burrows in GIS. Analysis of tortoise burrows was used to identify pods of tortoise, identify distance from edge, road, and trails. Within our study area, a total of 80 individual tortoises were visually documented. Tortoise density in Stafford Field and Stafford Woods was 1.58 tortoise/ha and .23 tortoise/ha, respectively. Analysis of burrow orientation in the Stafford plots showed no statistical difference ($p=0.73$). T-tests on burrow temperature data showed a statistically significant difference ($P<0.001$) in external versus internal burrow temperatures. Analysis of burrows identified 3 pods of tortoise in Stafford Field. This study presents the NPS with new information for the population of gopher tortoises on Cumberland Island with which to develop management strategies. Given the upcoming use of control burning on the island in spring 2016, these data also serve as a baseline with which to measure differences in gopher tortoise population dynamics.

81 Cancelled

82 Carlos D. Camp[1], Jessica A. Wooten[2]
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Genetic Interaction between two Cryptic, Parapatric Species of Two-lined Salamander (*Eurycea bislineata* complex) along their Zone of Contact

Two modes of speciation have been hypothesized to produce a parapatric pattern of distribution in closely related species. Presumably the most common mechanism is allopatric speciation, in which subsets of a parental species become geographically isolated and subsequently diverge into separate evolutionary lineages. Secondary contact may produce a variety of results ranging from a panmictic hybrid zone to reinforcement and reproductive character displacement in a narrow zone of sympatry. A more controversial mode is parapatric speciation, in which selection on either side of a steep environmental gradient results in adaptive divergence without geographic isolation. The predicted pattern of this mechanism is a continuous narrow zone of uninterrupted gene flow across the gradient. We investigated the genetic interaction between two cryptic, parapatric species of two-lined salamander, *Eurycea wilderae* (Blue Ridge Two-lined

Salamander) and *E. cirrigera* (Southern Two-lined Salamander), at their contact zone. The former species is restricted to the Blue Ridge Mountains of the southeastern US, and the latter occurs across the Piedmont and Coastal Plain. We sequenced two genes—one mitochondrial and one nuclear—from four localities of contact along the Appalachian foothills of northeastern Georgia and compared these to allopatric populations in the Blue Ridge and Piedmont, respectively, to determine whether gene exchange is occurring. We found evidence for gene exchange at only a single site, and this exchange does not appear to be panmictic. There was no evidence of gene exchange at any other site, and at at least one there is evidence of character displacement in adult body size. Although these two species meet along a steep environmental gradient, the diverse pattern of genetic interaction suggests secondary contact following divergence in allopatric isolation rather than parapatric speciation.

83 Scott P. Jones, David R. Chalcraft
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Fear, Competition, and Time: The Interaction of Predation, Competition, and Phenology on Treefrog Morphology and Life-History

Many species alter their morphology, behavior, and life-history to enhance their likelihood of surviving and/or leaving more progeny in the presence of predators. Competition for resources may modify the influence of predators on prey, but different species and different age classes of competitors resulting from different breeding phenologies may have different influences. We conducted an experiment to assess how different types (intraspecific versus interspecific [Gray Treefrog]) and age classes (same age versus older) of competitors shaped the response of a focal prey species (Pinewoods Treefrog) to its predator (larval dragonflies). Regardless of age class or type of competitor present, predators induced tadpoles to develop taller tail fins and longer tails and to have a better ability to jump farther when they achieved metamorphosis. Predators also induced tadpoles to develop wider bodies and have longer legs at metamorphosis, except when the number of individuals in the same age cohort as the focal prey was increased. Predators induced tadpoles to have narrower bodies and shorter legs at metamorphosis under these conditions. Tadpoles were generally smaller in the presence of predators except when more prey individuals of the same age cohort as the focal prey were present or when older cohorts of Gray Treefrogs were present. Predators also generally caused tadpoles to have shorter bodies at metamorphosis, except when there were older cohorts of tadpoles (both pinewoods and gray treefrogs) present. Our results highlight that the effect of predators on prey traits can vary among environments depending on the identity of competitors with which they co-occur. This adds to our understanding of how phenology impacts community assembly and phenotypic plasticity. Phenology is widespread in nature but often left out of phenotypic plasticity experiments, so this experiment can help link other experimental results with field studies that incorporate phenology to better approximate natural communities.

84 Walter H. Smith, Skyla L. Slemp, Conner D. Stanley, Melissa N. Blackburn, Jack Wayland
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Are Green Salamanders as Rare as We Assume? Adapting Citizen Science to Address Data Deficiency in *Aneides aeneus* Across the Cumberland Mountains of Virginia

The Green Salamander (*Aneides aeneus*) is an arboreal cliff specialist distributed discontinuously across the Appalachian Mountains from Mississippi to Pennsylvania. This species' cryptic behavior, coupled with its presumed sensitivity to anthropogenic disturbance, has resulted in the Green Salamander being considered a rare species of high conservation concern, with formal protected status in six states. However, many putative Green Salamander populations are located in areas with extremely rugged topography and/or on private lands rarely visited by biologists, presenting the possibility that its presumed rarity in many areas may be an artifact of sampling deficiency. We piloted a citizen science approach to clarify the distribution of Green Salamanders across the Cumberland Mountains of Virginia, specifically targeting outdoor recreation enthusiasts and private landowners that are often active in areas undersampled by

biologists. Regional residents reported 14 new populations of Green Salamanders, in two years uncovering an equal number of populations as almost two centuries of traditional scientific collections across the same region. Further verification surveys near these sites discovered an additional 26 populations, filling significant gaps in this species' regional natural history knowledge and uncovering potential corridors maintaining population connectivity and gene flow. Citizen observers also reported an increased awareness of conservation issues and local biodiversity as a result of their involvement in the project. Our results suggest that targeted citizen science approaches may be valuable yet underutilized tools in addressing data deficiency in presumably rare, difficult-to-study taxa. More broadly, these results also suggest that the assumed rare and disjunct nature of many Green Salamander populations may be due to little more than sampling deficiency, highlighting the need for a broad-scale reassessment of this species' biogeographic distribution across portions of its range.

85 Shem D. Unger[1], Rod Williams[2]
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Filial Cannibalism and Body Condition of the Eastern Hellbender *Cryptobranchus alleganiensis alleganiensis*

In species with parental care, individuals make tradeoffs in terms of expending energy guarding offspring (investment), or to abandon, and in some cases consume their young. Both the state of the environment (availability of resources) and individuals (body condition) determine whether parents are able to maintain energy reserves when guarding young for extended periods. Molecular markers are valuable tools to determine parentage for species with cryptic life histories. We used 12 polymorphic microsatellites to genotype and assign parentage to clutches of the eastern hellbender salamander, *Cryptobranchus alleganiensis alleganiensis*. We document for the first time through molecular methods, filial cannibalism and parentage in this species. We also relate body condition of Indiana's Blue River population to this genetic documentation of filial cannibalism, which may present additional challenges to the conservation of this unique species.

86 Gabrielle A. Hayes[1], Nicole M. Wright[1], Calla Telzrow[1], Patrick A. Vigueira[1], Andrew Wommack[2]
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Methylglyoxal Potentiates the Effect of Linezolid against *Staphylococcus aureus*

Antibiotic resistance has become a major public health crisis, with the rise in cases of methicillin resistant *Staphylococcus aureus* (MRSA) and other resistant bacterial infections. As a possible solution to the increasing rates of antibiotic resistance, approved pharmaceuticals and natural compounds have been investigated in conjunction with current antibiotics in an attempt to identify synergistic activity and reinvigorate bacterial sensitivity to common antibiotics. One natural product with synergistic potential is Manuka honey. Manuka honey has been demonstrated to possess antibacterial properties and is marketed as a treatment for wounds and other infections. A sublethal concentration of Manuka honey increased *S. aureus* sensitivity to the antibiotic Zyvox (linezolid). Compare to control plates, those containing 5% Manuka honey yielded a 37.6% increase in the zone of inhibition in a linezolid disc diffusion assay. One potentially antibacterial component of Manuka honey is methylglyoxal (MGO), and *S. aureus* also exhibited greater sensitivity to linezolid in plates containing the purified compound. In broth microdilution experiments, suboptimal concentrations of MGO increased *S. aureus* sensitivity to linezolid by 32 %. We are currently pursuing experiments to characterize the mechanism of this promising synergistic interaction.

87 Andrew C. Bellemer
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Cellular and Molecular Mechanisms of Sensory Neuron Function in *Drosophila melanogaster*

In *Drosophila melanogaster* and in vertebrates, noxious environmental stimuli are detected by polymodal nociceptor neurons that activate both autonomic and behavioral responses to these stimuli. The overarching goal of our research group is to develop a mechanistic understanding of how nociceptor neurons function at a cellular and molecular level. *Drosophila* larvae detect potentially tissue-damaging stimuli such as elevated temperature, mechanical force, and UV light using the Class IV multidendritic neurons (mdIVs) whose dendrites tile the majority of the larval epidermis. Activation of the mdIV neurons produces a distinctive escape behavior, and studies of mutants defective for this behavior have led to the identification of multiple genes that control mdIV sensitivity and function. These include the gene encoding the TRPA1 ion channel, a central mechanism for insect thermosensation and in pathogenesis of chronic pain in humans. My research group is currently engaged in a set of projects designed to identify additional genes that regulate mdIV neuron function generally or TRPA1 function in the mdIV neurons specifically. These studies make use of genetic tools that allow expression of RNA interference in specific cells of the animal, allowing us to selectively knock down the function of targeted genes in the mdIV neurons. By testing the nociceptive escape responses of larvae manipulated in this fashion, we can identify genes that are required for normal escape behavior and thus for nociceptor neuron function. We have assembled panels of genes associated with cellular processes that are known to have roles in nociception (G protein signaling, RNA processing, and Wnt signaling) and have systematically identified roles for specific genes in each panel in regulating nociception behavior. Candidate genes we have identified using this strategy will be characterized for their roles in neural morphology, electrical activity, and development to characterize the mechanisms of their functions.

88 Chase Mackey, Nick Ragsdale
Biology, Belmont U, Nashville, TN

Circadian Rhythm Dependence of Habituation in *C. elegans*

Circadian rhythms are central to the regulation of a variety of biological processes key to the survival of many animals. Learning may be affected by circadian rhythm fluctuation. The nematode *Caenorhabditis elegans* has recently been demonstrated to have genetically verifiable circadian rhythms, and has long been known to learn under associative and non-associative paradigms. A basic form of learning is habituation, whereby an organism learns a stimulus is inconsequential, and directs attention elsewhere, leading to decreased response. In the present study, the interdependence of learning and circadian rhythms in *C. elegans* was investigated. Using temperature, groups were entrained to have circadian rhythms, which were disrupted, followed by assessment of the group's ability to habituate. It's hypothesized that the disruption of circadian rhythms will cause a deficit in ability to habituate, compared to groups that are allowed to maintain their circadian rhythms.

89 Dora Geving, Nick Ragsdale
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Implications of Parkinson's Disease in Nematodes Treated With the Insecticide Permethrin

Parkinson's disease (PD), a neurodegenerative disorder, is caused by the degeneration of dopaminergic (DA) neurons in the substantia nigra of human patients. In the United States, 50,000-60,000 cases of PD are diagnosed annually. The neurotoxin 6-hydroxydopamine (6-OHDA) may cause this degeneration; in addition, the insecticide permethrin is known to inhibit mitochondrial function, which might play a role in PD. Permethrin is an active ingredient in children's lice shampoo, which presents an immediate concern. 6-OHDA treatment has been

studied in *Caenorhabditis elegans* (*C. elegans*) by the researchers Blakely and Nass, and this model was used in this experiment. The model organism *C. elegans* was chosen because of its simple and thoroughly studied nervous system. A longitudinal study of 6-OHDA was conducted to show that the resting period of *C. elegans* following treatment was significant. In the second part of the experiment, the nematodes were treated with either the control, 6-OHDA, or the treatment, permethrin, and observed through chemotaxis to discover the effects on the worms' motor function. It was already shown in past research that 6-OHDA inhibits the worms' motor abilities. What resulted from this experiment was a decreased ability in the nematode's ability to move towards an attractant when treated with either toxin. Thus, permethrin may cause the death of DA neurons and could be a contributing environmental factor to the development of PD.

90 Miranda West, Nick Ragsdale
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Potential Protective Effects of Nicotine in *C. elegans* Treated with 6-OHDA

Anecdotal evidence and prior research has brought to light poorly understood connections between nicotine use and therapeutic effects for Parkinson's patients, including relief from mobility-related symptoms. This research looks at how nicotine can act as a protective agent for *Caenorhabditis elegans* treated with 6-OHDA, a substance that creates Parkinson's-like symptoms. Results show that *C. elegans* in a nicotine pre-treatment group will yield a higher average speed than *C. elegans* that receive no treatment. Although these results support that nicotine protects against Parkinson's-like symptoms, the negative effects associated with nicotine and human consumption should be taken into consideration.

91 Zara Latif, Nick Ragsdale
Biology, Belmont U, Nashville, TN

Utilization of Obese Worms to Investigate the Link between Parkinson's Disease and Obesity

Parkinson's disease is a neurodegenerative disorder caused by the loss of dopaminergic neurons. Obesity is a possible risk factor for Parkinson's disease, and it is established that obesity causes inflammation. The inflammation caused by obesity could lead to an increase in neurodegeneration levels. It is hypothesized that high fat content could lead to a higher sensitivity to the neurotoxin 6-hydroxydopamine (6-OHDA), which leads to Parkinson's disease. The worm *Caenorhabditis elegans* (*C. elegans*) was used as a model organism for this project; the average speeds of obese and healthy *C. elegans* worms were compared using an application called Image J. The inability to digest fatty acids, which slows the mobility of worms, was the factor tested in this experiment; however, it is not the only factor that affects the motor ability of obese worms. A multi-hit hypothesis with numerous factors acting simultaneously is proposed for this experiment. The lack of fatty acid digestion gives rise to one type of obesity; other types of obesity could include insulin resistance. Future experiments could include testing a mutation in the insulin pathway of worms to get more insight about the effect of a different type of obesity.

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Utilization of Alpha-Lipoic Acid as an Antioxidant in the Presence of 6-OHDA

Caenorhabditis elegans is a model organism used to study the process of oxidizing agents and antioxidants. Research has shown that α-lipoic acid, an antioxidant, increases neural function and chemotaxis in worms, and can protect these worms from the effects of 6-hydroxydopamine. In this study, *C. elegans* were treated with either 6-OHDA, alpha-lipoic acid, or both in order to determine the effects of both oxidative agents and antioxidants on *C. elegans* chemotaxis. It was hypothesized that the alpha-lipoic acid treatment will decrease the effects of 6-OHDA treatment as shown by a higher chemotaxis index. Therefore, the expected results include the groups grown on alpha-lipoic acid and then treated with 6-OHDA will have a similar chemotaxis assay as the control.

93 Elizabeth Quamme, Eric E. Johnson
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Expression Analysis of Centrins during Spermatogenesis in the Model Moss *Physcomitrella patens*

Physcomitrella patens, a member of one of the oldest lineages of plants, uses flagellated sperm cells to complete its life cycle. Its propensity for homologous recombination and its fully sequenced genome make this moss an ideal system for elucidating motile plant sperm cell biology. Centrins are Ca^{2+}-binding proteins often associated with the basal bodies of eukaryotic organisms, including those linked with motile plant sperm cells. This research aimed to identify the expression profile of six putative centrins identified within the *P. patens* genome. We hypothesized that, as vital components of these cells, at least one centrin-encoding gene would show increased expression during spermatogenesis. To test this, RNA was extracted from gametangia-producing and vegetative tissues, converted to cDNA using reverse transcriptase, and expression levels were compared using semi-quantitative PCR. The results indicate that *PpaCENTRIN4* (Pp1s160_86V6.1) was expressed in gametangia-producing tissue, but absent from vegetative tissue, suggesting that this gene evolved functional specificity to aid in sperm cell motility, converse to the other putative centrins tested. Supporting this, a BLAST analysis confirms that this gene, of the six identified, is most similar to a centrin characterized from the spermatogenous tissue of the aquatic fern, *Marsilea vestida*. Altogether, these data raise the possibility that centrins may be functionally specialized in plant cells. We are currently cloning *PpaCENTRIN4* to further characterize its role in spermatogenesis, identify interacting proteins, and assess its expression in tissues not examined in the current study. These data will give a clearer understanding of the molecular interactions necessary for the development and function of the only flagellated cells in the plant kingdom.

94 Sunada Khadka, Holly B Ton
Biology, Wesleyan College, Macon, GA

The Effect of All Trans Retinoic Acid on Collagen Production by Uterine Smooth Muscle Cells

The mammalian uterus responds to steroid hormones and undergoes dramatic changes during the menstrual cycle and pregnancy. In particular, uterine smooth muscle cells undergo dramatic increases in size, due to hypertrophy and number, due to the production of additional smooth muscle cells through hyperplasia. Defects in uterine smooth muscle cells can alter the normal functionality of the uterus; one example of such pathology is the uterine leiomyoma, a disease of smooth muscle cell differentiation leading to increased cell proliferation, a disrupted and disorganized deposition of extracellular matrix (ECM) and altered smooth muscle cell contractility. The ECM supports and facilitates structural and biochemical homeostasis for tissues and cells. Uterine leiomyomas arise, in part, because of an abnormal and excessive deposition of ECM. Collagen is one of the structural proteins of the ECM that plays an integral role in maintaining tissue integrity, cell attachment and differentiation; considerable data in the literature indicates that an increased expression of collagen is also associated with leiomyoma. As both increased proliferation and altered ECM protein production are associated with leiomyoma, these characteristics reflect, in part, disruptions in normal smooth muscle cell homeostasis. Previous studies have established All Trans Retinoic Acid (ATRA), a natural derivative of vitamin A, as having an antiproliferative effect on uterine smooth muscle cells. The aim of this study is to determine if ATRA treatment also alters the levels of collagen produced by normal uterine smooth muscle cells as well as by leiomyoma cells. The data indicate a slight effect of ATRA treatment on collagen production by both normal uterine smooth muscle cells and by those derived from leiomyoma.

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Guide to the Vascular Flora of William B. Umstead State Park (North Carolina)

William B. Umstead State Park (5,439 ac) is located in the Piedmont of North Carolina and is one of the most heavily visited parks in the state. Nearly fifty years have passed since the last floristic inventory of the park and expansions have added ca. 1300 acres to the property. In the original inventory, 746 species and varities in 119 families were recorded from the site. The aim of the current project is to intensively survey the newly acquired acreage, reanalyze specimens from the original inventory, and then develop a user-friendly taxonomic guide to the flora of the entire park. Plant vouchers were collected during 2 growing seasons at least twice a week and during the off season at most biweekly. Vouchers were deposited in the North Carolina State University herbarium, along with tissue samples, preserved in silica gel, for future DNA analysis. Inventory of the newly acquired acreage resulted in 785 specimens, representing roughly 451 species and varities in 113 families. In addition to field collections resulting from this effort, pertinent specimens at the herbaria of Duke University, University of North Carolina at Chapel Hill, North Carolina State University, and University of South Carolina were examined. Utilizing the Wake County GIS data service park, soil and topography data were gathered and generated into maps that will be included in the guide to aid site management. Current analysis has 253 of the 451 species newly collected as previously reported. Of the thirteen species of conservation concern historically reported from the site, only two were relocated.

96 Amanda L. Faucette[1], Alexander Krings[1], William Hoffmann[1], David Lindbo[2]
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Guide to the Vascular Flora of Buxton Woods (Dare County, North Carolina)

Buxton Woods Coastal Reserve (“BWCR”) is a 403 ha (995 ac) Significant Natural Heritage Area (R1 C1) located on Hatteras Island in Dare County, NC (One of ten reserves within the NC Coastal Reserve system). BWCR spans a third of the largest remaining contiguous tract of Maritime Evergreen Forest (Mid Atlantic Subtype) on the Atlantic coast and contains the only occurrence of Maritime Shrub Swamp (Dogwood Subtype) in the world. Buxton Woods is unique along North Carolina’s northern Outer Banks, occurring on a series of east to west running, relict dunes, which indicate the seaward development of Hatteras Island. These relict dunes and intervening swales, in addition to the mix of Labrador and Gulf currents off the coast of Cape Hatteras, allow for a rich diversity of subtropical and temperate plant species. In order to effectively preserve the biodiversity of BWCR, a comprehensive floristic inventory and plant communities map was considered critical to its management plan. Therefore, the objectives of the present study were to: 1) document the vascular flora of the five natural plant communities of BWCR with voucher specimens, as well as leaf tissue samples for DNA banking; 2) create a comprehensive floristic checklist based on collections and reports from the site; and 3) to develop a taxonomic guide with keys to the vascular flora. Ninety-eight families containing over 467 taxa, including twenty Significantly Rare and twelve Watch List taxa have been reported for the site. Keys are provided to all reported families, genera, and species. Taxon accounts include: taxon concept mapping, habitat, phenology, relative abundance, illustrations, and voucher specimen citations (based on field work and study of historical collections at CAHA, DUKE, NCSC, and NCU). Specimens resulting from this work will be digitized and made available through the online SERNEC Symbiota portal (sernecportal.org) and iDigBio (idigbio.org).Guide to the Vascular Flora of Buxton Woods (Dare County, North Carolina).

97 Thomas S. McFadden, Brad R. Ruhfel
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Documenting the Flora of Eastern Kentucky University's Natural Areas Using the SERNEC Symbiota Portal

A survey of vascular plants is being conducted at Eastern Kentucky University's (EKU) natural areas (http://naturalareas.eku.edu/). EKU owns three natural areas: 1) Lilley Cornett Woods Appalachian Ecological Research Station in the Cumberland Plateau; 2) Maywoods Environmental and Educational Laboratory in the Knobs Region of the Interior Low Plateau; and 3) Taylor Fork Ecological Area in the Inner Bluegrass Region of the Interior Low Plateau. These areas represent a variety of habitat types found in central and eastern Kentucky including oak hickory forest, mixed mesophytic forest, and old pasture. Together they comprise 936 hectares of protected land dedicated to research, education, and recreation. The flora of these natural areas is being documented through digitized herbarium specimens linked to online species lists. All data from this project will be made publically available through the SERNEC Symbiota portal (http://www.sernectportal.org). We have created a species list for each natural area that can be accessed independently, and these lists populate a master list of the EKU natural areas. Species lists are generated from ongoing and previous floral surveys, including our own survey of Taylor Fork Ecological Area. Specimen digitization is being conducted as a part of a grant provided by the National Science Foundation to make specimens in Kentucky's herbaria digitally available online. These specimens and lists will provide important botanical knowledge useful for future research and teaching. Online species lists are easily managed as composition changes occur and new species are found. Vascular plant diversity of each site will be summarized and the combined species list of all three sites will compared to the flora of Kentucky as a whole.

98 Raymond O. Flagg[1], Gerald L. Smith
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Clarifying Taxonomic Confusion in Some Mexican*Zephyranthes* (Amaryllidaceae)

Some Mexican *Zephyranthes* species have been difficult to sort out, and as a result, they have been either ignored or erroneously treated as other species. Traub (1941) described *Z. fosteri* without comparison to other species, although it is very close to *Z. grahamiana* Herb. (1837).Both have sessile or shortly pedicellate ovaries and stigmas usually near the bottom of the anthers. In *Z. grahamiana,* the leaves are less than 2.5 mm wide, perianth segments are pink, and the stigmatic lobes are short and thick; in *Z. fosteri*, the leaves are up to 7 mm wide, the perianth segments purplish red, and the stigmatic lobes are short and linear. There has been a strong tendency to identify specimens of *Z. grahamiana* as *Z. fosteri*. *Zephyranthes brevipes* Standl. (1929) is close to *Z. carinata* Herb. (1825) in perianth color and form, and stigma exserted at least 4 mm, but differs from *Z. carinata* by thinner stigmatic lobes, leaves about the same width or narrower than the scape, and usually a much shorter pedicel. We have annotated a close Mexican taxon as *Z.* aff. *brevipes* because the stigma is barely exserted or at the top of the anthers, and the leaves are narrower than Guatemalan specimens of *Z. brevipes*. *Zephyranthes erubescens* S. Watson (1889) has been treated by S. Ogden (1994) and others as a robust form of *Z. lindleyana* Herb. (1837). *Zephyrantheserubescens* differs from *Z. lindleyana* by perianth segments being adaxially white, not pink, and by wider leaves and more robust bulbs. Our studies are primarily based on type specimens and herbarium loans from MEXU, MO, and TEX plus the Blandy Experimental Farm collections made by R. O. Flagg, W. S. Flory, and Morris and Kitty Clint in the 1950's and '60s.

99 Raymond O. Flagg[1], Gerald L. Smith, M. Ariel Spurrier[3]
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Sister Relationships among the US Southeastern *Zephyranthes* species (Amaryllidaceae)

The taxonomy of the US Southeastern *Zephyranthes* species has been problematic. Most of the controversy lies with the taxonomic status of *Z. treatiae* S. Watson. This taxon has been placed into synonymy with *Z. atamasca*; has been considered as a variety of *Z. atamasca* (L.) Herb. and as a species distinct from *Z. atamasca*. R. O. Flagg, G. L. Smith and W. S. Flory recognized *Z. treatiae* as a distinct species *in Flora of North America series* (vol. 26, 2002), and Flagg and Smith provided morphometric evidence of this status in *Castanea* (2008). In an ISSR fingerprinting study (*Novon* 2015), Spurrier et al. showed *Z. treatiae* and *Z.simpsonii* Chapm. as sister taxa and *Z. atamasca* as a a sister clade. Garcia et al. (*Systematic Botany* 2014) showed a different sister relationship with *Z. atamasca* and *Z. simpsonii* as sister taxa and *Z. treatiae* as a sister clade. Morphometrics and biosystematics suggest the sister relationships as shown by ISSR fingerprinting as a more likely scenario.

100 Cancelled

101 Ramhari Thapa, Randall J. Bayer, Jennifer R. Mandel
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Reconstruction of Phylogenetic Relationship in *Antennaria* (Asteraceae) Using Data From Hundreds of Loci

The phylogenetic relationships among amphimictic, sexually reproducing, *Antennaria* (Asteraceae) species are poorly understood. *Antennaria* is a genus of dioecious, perennial herbs with a broad distribution in the Holarctic region except for the three species found in the Andes of South America. Previous morphology-based cladistic approaches and also molecular work utilizing data from nuclear ribosomal DNA internal transcribed spacers (ITS) did not produce a well-supported phylogenetic tree. We employed a novel target enrichment method using a set of custom capture probes designed to work in species across the entire Asteraceae family, coupled with next generation sequencing (NGS) to gather phylogenetic information from hundreds of nuclear loci. We sequenced thirty-four amphimictic *Antennaria* species including newly discovered species *A. sawyeri* and several outgroup taxa, and used bioinformatic and phylogenetic programs to produce a phylogenetic tree to understand the evolutionary history in the group. We also assembled partial chloroplast genomes for these species using the off-target reads to strengthen support for major relationships. Most areas of the tree are well-resolved with this approach, however some relationships are still unknown, and we are continuing to address these areas. The successful reconstruction of phylogeny across the genus would be a valuable tool to provide a framework for future evolutionary studies including species diversification, and the origination of polyploidy in *Antennaria*.

102 Charles N. Horn
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AReview of the Morphological Distinction Between Two Azalea Species: *Rhododendron calendulaceum* and *R. cumberlandense* (Ericaceae)

The distinction between two typically orange-flowered species of *Rhododendron* of the southern Appalachian Mountains, *R. cumberlandense* and *R. calendulaceum*, has long been a challenge. When *Rhododendron cumberlandense* was newly recognized by Braun (1941), she separated the two species on vegetative (twigs, buds, leaves) and reproductive (time of opening, corolla size, filaments, and capsules) features. More recently, publications have commonly used flowering time in taxonomic keys to distinguish these two taxa. During 2014 and 2015 flowers were photographed and specimens collected from a total of 22 populations in northern Georgia (3) western North Carolina (16) and western South Carolina (3) to measure 30 morphological

characters. In addition elevation was included to see if a correlation was present with any morphological features. Data was analyzed using Principal Components Analysis (PCA). With the data analysis the 3-dimensional graph separated the populations in the first dimension (34% of the variation) weighed most by leaf length (positive correlation), lower leaf surface pubescence (positive), and young stem pubescence (negative). The second dimension (33%) was weighed mostly by elevation (positive), peduncle length (positive) and sepal length (negative). The third dimension (32%) weighed mostly by bud scale pubescence (positive), presence of perianth tube hairs (positive), and style pubescence at the base (positive). In conclusion, no strong evidence was seen to separate the populations into distinct morphological taxa based on this limited sampling.

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Diversity and Subspecific Taxonomy of*Phoradendron leucarpum* (Raf.) Reveal & M. C. Johnst. (Leafy Mistletoe)

Phoradendron leucarpum (Raf.) Reveal & M.C. Johnst.(leafy mistletoe) is a hemiparasitic plant belonging to the family Viscaceae. *P.leucarpum* is broadly distributed in N. America, occurring from New Jersey south to Florida, and through the midwest south of Kansas to northern and central Mexico, and westward to Baja and northern California. As a widespread species, *P. leucarpum* harbors considerable morphological diversity. In recent treatments, *P. leucarpum* has been subdivided into four subspecies (*P. leucarpum* ssp. *angustifolium*, *ssp. macrophyllum*, and ssp. *tomentosum*), which have ranges that overlap in large portions of the species range. In regions of overlap, subspecies can be very difficult to distinguish on the basis of morphology. Three subspecies co-occur in eastern Texas, and blend together, giving rise to competing hypotheses that 1) lack of distinguishing characteristics in eastern Texas is due to introgression, and 2) eastern Texas is the center of origin for the species. In this study, morphometric and molecular data were used to test these competing hypotheses. Results support neither. Rather, morphological and molecular diversity is greatest in the west and decreases in eastern populations, indicating that the center of origin might have been in the western United States. Further, neither molecular nor morphological data were sufficient to distinguish the subspecies of *P. leucarpum* as currently circumscribed.

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Reinventing Taxonomy for the Acaulescent Blue Violets (*Viola* subsect. *Boreali-Americanae*), or There are a Lot More Species Out There Than We Thought

The Acaulescent Blue violets (*Viola* subsection *Boreali-Americanae*) are the most taxonomically challenging and diverse group of violets in North America and one of the most complex in the world. Frequent hybrids, bewildering phenotypic variation in many taxa, and different emphases on morphological traits have led to wildly divergent, seemingly irreconcilable taxonomic treatments. Our research group has embarked on a different approach using the Unified Species Concept with diverse lines of evidence to group conspecific populations together and distinguish sets of populations as evolutionary species, and to distinguish species from de novo hybrids. Evidence includes numerous macromorphological traits on structures across the plant body; microscopic features on lateral petal trichomes, seed coats and foliage trichomes; ecological niche variables of soil and light; mature seed output of chasmogamous and cleistogamous capsules; and local and regional geographic distribution. We have coupled Brainerd's invaluable common garden approach and emphases on cleistogamous capsule and seed morphology with Gil-ad's exacting circumscriptions and scanning electron microscopy, augmenting these with ecological observations and statistical analyses. Our investigations on the Acaulescent Blue violets since 2012 began with intensive field surveys and have focused on cut-leaved populations

and taxa in the mid-Appalachians and coastal northeast. Preliminary results unequivocally maintain all species recognized by Brainerd and contemporaries early in the last century, and go much further to detect one to several (mostly undescribed) additional species in each so-called polymorphic species we have examined thus far. An exemplary instance is *Viola subsinuata* (Greene) Greene [*Viola palmata* L., misapplied], for which we have compelling evidence of five distinctive evolutionary species, four deserving of state or federal conservation action. In all instances, lines of evidence are corroborative in promoting recognition of more, and more narrowly delimited species, readily distinguishing these from frequent de novo interspecific hybrids.

105 Tessa Shupe, Lori L McGrew
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The Effects of Bupropion on the Working Memory of Anxious *Danio Rerio*

Bupropion (Wellbutrin) is an atypical antidepressant that has been found to have anxiolytic properties. *Danio rerio* were used as model organisms in this experiment to test their working memory. It was expected that the bupropion would enhance the working memory of anxious *Danio rerio.* The fish were trained in a T-maze using color indication. After training, they were stressed, treated, allowed to rest, and then tested in the T-maze using EthoVision Noldus software. The data recorded included both correct vs. incorrect decision making, the velocity of the fish, and the time it took for the fish to make a decision. A chi-square test was run for the choice accuracy, and a t-test was run for the velocity and latency. It was found that bupropion has no or a slightly negative effect on the working memory of *Danio rerio.* Further testing should be conducted to quantify the negative effect of bupropion since it could have significant implications on the use of the drug.

106 Ted Zerucha
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Characterization of the *Meis2* Locus

The *Meis* genes are a member of the homeobox super-family of genes that code for the production of transcription factors. Homologs of the *Meis* genes have been identified in all animals studied and have been found to be expressed in similar patterns during the embryonic development of those animals. The products of the *Meis* genes are able to directly regulate the expression of target genes but are most well-known for functioning as cofactors, directly interacting with other transcription factors as well as DNA to facilitate transcriptional regulation. Most notably, they appear to act as co-factors of the evolutionarily well-conserved Hox proteins and have also been described as acting with other transcription factors on DNA. Despite being fairly well-characterized in terms of their molecular function and expression during development, little is known concerning how their expression is regulated. By using a comparative genomics approach we have identified several putative regulatory elements that are very well-conserved amongst all species. We have also discovered a novel gene that is linked to *Meis2* in all vertebrate species. We are currently working on the identification, isolation and characterization of these elements and this new gene using zebrafish as a model system.

107 Mary Kinkel
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The Role of Wnt/Beta-Catenin Signaling for Pancreatic Endoderm Development

All types of diabetes are ultimately caused by a failure of the pancreatic beta-cells. Therapies to treat diabetes exist, but there is no cure. Potential cures include encouraging patients' beta-cells to regenerate, or using stem cells in vitro to generate transplantable replacement beta-cells. Both of these strategies benefit from detailed knowledge of how the embryo generates beta-cells. Our previous work showed that, early in development, the mesoderm sends signals directly to the endoderm, via Retinoic Acid, to specify beta-cells. Here we discuss our ongoing work that

suggests that canonical Wnt signaling from the mesoderm is also required to specify beta-cells. This is supported by loss of function approaches, including morpholino knockdown and inhibition with quercetin, a small molecule. Timed inhibition studies suggest that Wnt signaling is required during gastrulation stages. Further, we have found that the embryo must modulate the dosage of Wnt signaling: too much or too little signaling results in reduction or loss of the beta-cells. Our goals for this study include determining the precise time window in which Wnt signaling is required for patterning the pancreatic endoderm, and determining which specific Wnt ligands are involved.

108 Linda M. Niedziela
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Oil Dispersant Alters Atpase Activity and Gene Expression in Gills and Skin of Zebrafish (*Danio rerio*)

Currently approved surfactant-based oil dispersants are deemed safe due to low mortality in aquatic life. However sub-lethal doses can impair key processes and affect long term survivability. ATPase enzymes are essential in maintaining osmoregulatory homeostasis. Dispersants are hypothesized to disrupt ATPase function causing ionic and osmotic imbalances in the cell. Our laboratory found that the oil dispersant, Dispersit™, changed phosphatase activity and the production of ATPase mRNA in the gills and skin of zebrafish. Adult zebrafish (*Danio rerio*) were exposed to six concentrations ranging from 0.05 to 1 ppm for 24 and 48 hr. Gill and skin samples were collected. Total protein was extracted and phosphatase enzyme activity assays were performed. Total RNA was extracted and mRNA was converted into cDNA before being analyzed by comparative quantitative real-time PCR of specific ATPase isoforms *zatp1a.1a.1*, *zatp1a1a.2* and *zatp1a1a.5*. A significant increase in ATPase activity was observed at lower concentrations followed by a rapid decrease. A similarly shaped response was seen in mRNA production for isoform *zatp 1a.1a.1* while *zatp 1a1a.5* exhibited a significant but distinct response and *zatp1a1a.2* showed no change. The shape of the response was similar between gill and skin but the strength of the response differed. We believe the specificity of response between the different isoforms may be attributed to distinct cotransporter coupling in ionocytes containing the different isoforms. While there is still more to learn these results are contributing to our understanding of the mechanism of oil dispersant toxicity at the molecular level.

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Inhibition of Top2 in Zebrafish Results in Axon Guidance Defects by Modifying Expression of Chemotactic Genes

Topoisomerases are well characterized enzymes responsible for DNA repair required for damage free DNA replication and transcription. Recent work in mouse has shown that one isoform of topoisomerase, TOP2β, is required for proper neural development; however the specific role it plays is a matter of debate. Our lab is using zebrafish to better understand the role Top2 plays in neural development and the molecular mechanism by which this DNA repair molecule impacts normal development. We exposed embryos to catalytic inhibitors of Top2, drugs currently used or being studied for use as anticancer agents, during the most active stages of neural development. Observation of neurons revealed aberrant axon guidance in a number of neuronal types. Other tissue types, such as tail muscles, appear unaffected by Top2 inhibition. One set of neurons effected by Top2 inhibition are the mauthner cells, a pair of neurons whose axons cross the midline of the hindbrain. In treated embryos the axons of the mauthner neurons failed to cross the midline, sending projections toward the tail. This lead us to hypothesize that Top2 can regulate the transcription of factors involved axonal guidance. Our data shows that the expression of the netrin receptor, DCC, is reduced in embryos with inactivated Top2. Together our data suggest that Top2 acts to regulate the expression of specific receptors of chemo-attractants, which help guide axons to their appropriate targets. We continue to examine other factors involved in axon guidance to further understand the role of Top2 in neural development.

110 Cortney M Bouldin
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Quiescence is a Critical Feature of the Multipotent Cells That Form the Zebrafish Body

The vertebrate body forms from the head down in a process that is driven by a population of stem-like progenitor cells located at the tail-end of the body. Recent work has shown that these posterior progenitor cells have extensive potency, and at a minimum, can contribute to the muscle, the nervous system or the vasculature of a growing body. As such, the numbers of posterior progenitor cells present in a body should correlate with overall body size. However, because these cells are difficult to label, little about posterior progenitor cell number or their proliferative potential was known. To identify the proliferative potential of the posterior progenitors, fate-mapping of single posterior progenitor cells was performed using time-lapse imaging in zebrafish. I found that while they reside in the posterior as multipotent cells, these cells are quiescent and rarely proliferate. Further, these cells lack an essential component of the cell cycle, *cdc25*. When *cdc25* is broadly expressed, the growth of the zebrafish body is stunted, and I have concluded that quiescence is an essential component of maintaining posterior progenitor cells ability to properly differentiate. In current work, my lab is more extensively modulating the cell cycle by inducing quiescence in different phases of the cell cycle and determining how these changes alter posterior progenitor cell differentiation.

111 Cindy Achat-Mendes
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Examining zebrafish behaviors to investigate the polydrug effects of nicotine and alcohol

There is a high correlation between nicotine and alcohol dependence. For example, smokers are four times more likely to develop alcohol dependence than non-smokers; users of both drugs report a more rewarding effect of the drug combination compared to either drug alone; and typically, the use of either drug is attributed to their purported stress alleviating properties. Despite the high prevalence of nicotine and alcohol polydrug use, the neurobiological mechanisms that underlie the interaction between nicotine and alcohol use remains unclear. Using a behavioral pharmacology approach, we are examining species-typical behaviors of zebrafish to understand the relationship between combined nicotine and ethanol effects compared to that of either drug alone.

112 V. McNeil Coffield
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Exposure to estrogenic compounds alters the rate of calcium incorporation during early bone development in *Danio rerio*.

Estrogen is known to play a significant role in skeletal development and ossification in mammals, however its effects on bone development in *Danio rerio*, zebrafish, remains relatively uncharacterized. This is of particular scientific importance, since the zebrafish is an experimental model system commonly used for assessing the potential health effects of estrogenic endocrine disrupting chemicals (EDCs) in humans and given that exposure to EDCs correlates with skeletal abnormalities in wildlife. Our data demonstrates that zebrafish embryos exposed to 17□estradiol immediately following fertilization begin to show clear signs of enhanced calcium incorporation in their bones by 7 days of exposure and continuing until 12 days. This observation, along with additional experiments testing a variety of estrogenic compounds supports the hypothesis that estrogenic activation influences the rate of bone calcium incorporation and may offer a potential causative agent for the skeletal abnormalities observed in animals living in areas contaminated with high levels of endocrine disruptors.

113 Lauren E. Whitehurst
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Determining the Effects of Herbivory on an Herbaceous Plant, American Bellflower (*Campanulastrum americanum* L.)

Deer are overabundant and are dramatically affecting herbaceous plants through herbivory, possibly leading to selection for tolerance. Plants subjected to herbivory tend to suffer from reductions in fitness, such as delays in reproduction, which can negatively affect life history traits. We used the American Bellflower (Campanulastrum americanum) to investigate whether plants have evolved to tolerate deer herbivory through delays in reproduction and if thistolerance is greater in certain populations. In a common garden experiment, we evaluatedwhether the differences in phenology between populations result from a response to herbivory by using three clipping treatments 1) plants clipped at the same calendar date, 2) plants clipped at a similar phenological stage, and 3) controls (unclipped). Additional plants open to natural deer herbivory were also observed and the fitness components of these plants were compared to those kept from natural herbivory. The reproductive fitness of plants was compared among treatments using one-way ANOVA. Plants clipped at similar phenological stages showed a significant increase in biomass production indicating a strong response to herbivory compared to unclipped. Our data suggests that deer herbivory affects the performance of C. americanum.

114 Danielle Barnes, John Jett
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Bottlenose Dolphin (*Tursiops truncatus*) Survival in Captivity

Bottlenose Dolphins (*Tursiops truncatus*) were first placed in captivity in the U.S. in 1953, and have become familiar to the public due to their wide exposure in marine parks, movies and television shows. Dolphins have shown to have successful breeding in captivity, but despite this breeding success there is growing concern for cetacean welfare in captivity, with claims of poor survival fueling the concern. This claim has brought to question whether whales and dolphins should continue to be kept in captivity. A series of tests including Kaplan-Meier and Cox proportional hazards analyses were employed on 1,569 captive bottlenose dolphins based on data retrieved from the Marine Mammal Inventory Report (MMIR) to determine how sex, facility location (U.S. vs. foreign), captive-born vs. wild-capture and pre-and post-1985 affects survival. Bottlenose dolphins housed in foreign facilities (29.6 years) demonstrated a significantly higher median survival than those in U.S. facilities (18.9 years), as did dolphins that entered captivity post 1/1/1985 (23.4 years) vs. those entering captivity prior to 1/1/1985 (9.6 years). Facility location and pre- vs. post-1985 were good predictors of captive bottlenose dolphin hazard rate.

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Differences in Intra- Versus Inter-Specific Competition May Drive Behavioral Differences in Bluebird Populations

For many animal species, intra- and inter-specific competition for limited resources selects for aggressive territorial defense behaviors. Behavioral ecologists have recently become interested in ‘animal personality’ defined as consistent within-individual repeatability of behavior. Measuring differences in competition and aggressive behavior across spatial and temporal contexts can shed light on how ecological and evolutionary forces shape animal personality. Eastern bluebirds (*Sialia sialis*) are highly aggressive, secondary cavity-nesters that compete for limited nesting sites, defend territories against intra- and inter-specific nest usurpers and aggressively defend their nests against predators. Individual bluebirds display repeatable aggression and those that pair with mates of similar personality type experience higher fitness. We studied eastern bluebirds in the mountains of North Carolina and the coastal plain of Alabama. In Alabama, conspecifics are the predominant nestbox competitor, while, in North Carolina, tree swallows (*Tachycineta bicolor)* often usurped bluebird nests. Indeed, tree swallow breeding range has recently (<40 years) shifted south to North Carolina. Therefore, we hypothesized that bluebird behavior has

been affected by the presence of tree swallows. We quantified male and female bluebird nest defense behavior in response to simulated territorial intrusions of mock predators (crow) at both sites. Alabama bluebirds were much more aggressive towards conspecifics compared to the North Carolina bluebirds. Moreover, the Alabama bluebirds were much less aggressive towards model crows compared to the North Carolina bluebirds. Within both populations, mate pairs displayed similar aggressive behavior. Furthermore, within each population, variation in pair behavior was associated with habitat parameters including the relative densities of competitors. These data suggest that while differences in selection pressures can modify population-level aggression, repeatability of aggression within individuals (personality) and assortative mating for personality may confer benefits to individuals regardless of selection pressures.

116 Ray S. Williams, Megan Avakian
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Terpenes and Genotype Choice by a Specialist Aphid in the Old-Field Plant Species *Solidago altissima*

The potential exist for intraspecific genetic variation within plant species to affect associated arthropod communities. Previous investigations report effects of both genetic diversity (mixtures of genotypes) and genetic identity (individual genotype effects) on insects in the old-field plant species *Solidago altissima*. This widespread foundation species host many herbivores, including the often numerically dominant specialist aphid *Uroleucon nigrotuberculatum*. Though differences between genotypes and aphid abundance have been observed, the reason this herbivore chooses particular genotypes is unknown. To address this, we used a common garden study with plants from different regions of TN-NC representing 16 different genotypes to ask if the secondary metabolite class terpenes varied among regions and genotypes, and if the chemical is related to aphid choice. Plants were grown at the Appalachian State University Gilley Research Station in Ashe County, NC. There were three replicates for each of four genotypes (genetic identity effect) collected at four elevations (environment of origin effect). Abundance of *U. nigrotuberculatum* was visually determined and a non-destructive measure of plot biomass taken. Leaf samples to analyze phytochemistry were obtained. A nested ANOVA examined effects of genotype and environment on aphid abundance and phytochemical measures. Linear and Partial Least Squares Regression (PSLR) examined possible relationships between phytochemicals and abundance. We found no effects of the environment plants were collected from, but significant differences among genotypes for aphid abundance and some terpenes. Leaf nutrients were not different among genotypes. The monoterpene β-pinene was marginally related to aphid abundance, with the number of aphids increasing as the compound concentration increased. Our PLSR model found that terpenes, but not leaf nutrients, significantly explained an increase (49% of variation) in aphid abundance as terpenes increased. This result suggests that terpenes provide at least a partial explanation for differential choice of genotypes by *U. nigrotuberculatum*, though a specific mechanism is yet to be determined.

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Terpene Production in *Solidago altissima* in Response to Aphid Herbivory

The common old-field plant species *Solidago altissima* (tall goldenrod) host many insect species, including the often numerically dominant specialist aphid *Uroleucon nigrotuberculatum*. Because of vegetative reproduction from rhizomes, *S. altissima* often exist in old-fields in discrete patches, with previous investigations demonstrating that genetic variation among patches is widespread within a single field. Our studies have identified the secondary metabolite class terpenes as a possible mechanism for aphid choice of genotypes, with abundance increasing with higher concentrations of some terpene compounds. To better elucidate the relationship between *U. nigrotuberculatum* feeding and terpene production in *S. altissima*, we quantified the chemical in plants with aphids excluded (systemic pesticide) and with aphids allowed to colonize. The experimental design had five genotypes, with four individuals in each group (aphids excluded or

present) for each genotype. Exclusion plants were spatially separated from colonized plants to guard against possible indirect induction. Terpenes were quantified via gas chromatography and aphid abundance visually determined. Of ten compounds identified, we found no significant difference ($P > 0.05$) in terpene concentration between plants with and without aphids, though there was a significantly higher overall diversity of compounds detected on aphid-colonized plants. There were significant ($P < 0.05$) effects of genotype for nine compounds, with only one varying between plants with or without aphids. Interactions between genotype and aphid presence were observed for two compounds. No terpene was significantly related to aphid abundance, but a Partial Least Squares Regression found all terpenes combined significantly predicted abundance, increasing with chemical concentration. This study finds no evidence that this specialist aphid induces terpenes in *S. altissima*. Furthermore, consistent with our previous work, a difference among genotypes in this class of secondary chemicals seems to play a role in insect choice of genotype.

118 Ashley M. Hawk, Laura E. DeWald
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Comparing Maxent and DOMAIN Habitat Suitability Modeling for a Rare Plant Species

There are many species habitat and distribution models available that use field habitat observations to identify environmental predictor variables and quantify species-environment relationships. The relative effectiveness in terms of ease of use and accurately predicting habitat is not known for many of the models. The purpose of our study was to compare Maxent (a machine-learning probability model) to DOMAIN (a simple GIS statistical profile model) in terms of their ease of use and habitat prediction. We used both models to predict habitat for the rare *Trillium simile*, an endemic species of the southern Appalachians found in the very rich cove environments that also provide critical habitat for other similarly rare and sensitive species. Habitat was characterized by measuring biotic and abiotic variables at twenty sites where the species was found scattered throughout National Forests and the Great Smoky Mountains National Park in North Carolina and Tennessee, as well as locations in South Carolina. Digital environmental and climatic data for the known locations were matched to the field abiotic and biotic variables to create habitat models. Highly, moderately, and unsuitable habitat were identified for *T. simile* using both Maxent and DOMAIN. Quantitative and qualitative comparative analyses of the outcomes of the two models were used to determine which model was most useful on a small scale and best represents the desired habitat of interest. These results were used to determine whether Maxent is an efficient model or if a more heavily GIS-based technique is preferred.

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No Evidence for Sexual Selection on Color Dimorphism in *Megalagrion calliphya* Damselflies

Sexual dimorphism is commonly assumed to be caused by sexual selection. The Hawaiian damselfly *Megalagrion calliphya* is an excellent system in which to study the causes of dimorphism because it has a dimorphism in color within females as well as between males and females. Males are always red, while females are either red (andromorphic) or green (gynomorphic). Populations vary in the frequency of these female morphs, from monomorphic green through dimorphic to monomorphic red. We tested the hypothesis that female coloration is under sexual selection due to male sexual harassment, which we expect to be greater in populations with high male frequencies. We also tested two possible forms of sexual selection on female morph. If andromorphs are male mimics, we expect that they will be harassed more than gynomorphs, but if frequency-dependent sexual selection is driving the dimorphism, we expect that the more common morph in a population, whichever it is, will receive more harassment. We measured sex and morph frequencies and performed behavioral trials in five populations on Hawaii Island. We did not find a relationship between male frequency and harassment, and we did not see either predicted pattern of sexual selection. There were no significant differences

between harassment rates of andromorphs, gynomorphs, or males, except for one population in which andromorphs were harassed more than males. These results do not support either the male mimicry or frequency-dependent sexual selection explanations for color dimorphism. However, the morph frequencies do follow an elevational cline, suggesting that this dimorphism may be a result of ecological rather than sexual selection.

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Does Selection for Gamete Dispersal and Capture Lead to Lead to Sex Differences in Clump Water Retention?

Differences in male and female reproductive function can lead to selection for sex-specific traits for gamete dispersal and capture. These traits have been explored from shoot to whole plant levels in wind-pollinated species. While shoot level traits have been explored in water-fertilized species, little is known about how whole plant morphology affects gamete dispersal and capture. We used the dioecious, water-fertilized plant, *Bryum argenteum*, to address how divergent selection affects clump morphology and water holding characteristics. We hypothesized that sex-specific clump morphology would produce relatively low male water holding capacity for gamete dispersal and high female capacity for gamete capture, and that capacity would be an emergent property. We measured individual shoot and clump external water holding capacity and clump morphological characteristics on greenhouse grown plants. Individual shoot characteristics were used to predict clump water holding capacity, which was tested against observed capacity. Our results showed that male shoots held more water per unit length and males had higher shoot density. Thus, extrapolating, male clumps should hold more water. However, female clumps held more water than males and were taller with more robust shoots. Therefore, water holding capacity is an emergent property. In conclusion, sex-specific water holding capacity is associated with clump morphological differences, supporting our hypothesis. The emergent nature of clump water holding capacity suggests selection has acted not only at the shoot but also the clump level. Our results have implications for connecting divergent selection to female-biased sex ratios in *B. argenteum* and other bryophytes.

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Harsh and Unpredictable Ecological Conditions Modulate the Relationship Between Social Structure and Direct Fitness in a Plurally Breeding Small Mammal

Evidence indicates that harsh and unpredictable environmental conditions modulate the direct fitness benefits associated with increased group size (a component of social organization) in cooperatively breeding vertebrates. However, group size is only one component of a social system and is not the best indicator of social complexity. Understanding how ecological variation influences the fitness consequences of group-living also requires an understanding of social structure. A powerful approach is to determine how ecological variation modulates social network structure-direct fitness consequences across multiple years of study. Using 9 years of data, we determined how mean and coefficient of variation (CV) of food abundance, animal density, predation risk, monthly rainfall, ambient temperature, soil hardness, and ectoparasitic flea intensity (EFI) modulated the effect of social network strength and eigenvector centrality on per capita offspring weaned and surviving to reproductive age in the plurally breeding rodent, *Octodon degus*. As predicted, increased social structure was most beneficial when food abundance was more variable, mean monthly rainfall was highest, predator abundance was more variable, soil hardness was more variable, and EFI was low and more variable. In contrast, increased social structure was more costly under high CV of burrow density and mean food abundance, contradicting our predictions. Overall, our results illustrate that the harshness and unpredictability of ecological conditions are not mutually exclusive explanations for social

structure-direct fitness covariation. Moreover, the effects are not the same as those from a previous study evaluating group size, suggesting selection pressures affect components of social systems differently.

122 Cancelled

123 Jamie M. Herold
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Native Landscaping at Oak Ridge National Laboratory

In landscaping, people often expect plants to conform to their image of the "perfect" tree or flowering shrub and to show conformity that is not exhibited in nature. But native landscapes are living entities that are in a constant state of flux – growing, changing with the seasons and responding to even subtle changes in the environment. Oak Ridge National Laboratory's outdoor environment demonstrates how a less controlled native landscape provides equal beauty, and allows employees to notice small changes and variations. At the same time it looks to the biologically divers and beautiful Valley and Ridge of East Tennessee as a model with the objective of increasing ecosystem services provided on-site through landscaping. ORNL research has led to improved landscape-management techniques that have been successfully implemented – rain gardens handle stormwater runoff, wetland plantings provide wildlife habitat in detention basins, vegetation buffers enhance riparian areas, aquatic plants improve local ponds, and newly established native grass communities highlight the local setting. Ecological landscaping at ORNL uses sustainable practices to improve habitat, protect water quality, minimize erosion, and enhance native wildlife. Using local plant species highlights the lab's uniqueness, strengthens its relationship with its natural surroundings, and demonstrates its dedication to conserving and showcasing the environment.

124 Taylor Ledford, Troy Keller, Clifton B. Ruehl

Estimating biomass of island apple snails (*Pomacea maculata*) using shell metrics

Length-mass regressions are important for quickly estimating biomass (g), standing stock (g/m^2) and production ($g/m^2/d$) of species for comparative purposes among ecosystems. Once regressions are established, estimates can be made quickly while still in the field. These measures are important for assessing population size structure, calculating energy flux among trophic levels, estimating ecosystem health, and supporting conservation efforts. For example, estimating standing stock of introduced species facilitates understanding their impact on native flora and fauna. In this study, we established length-mass regressions using multiple shell metrics of size and mass for the apple snail, *Pomacea maculata*, (island apple snail) that has been introduced throughout the southeastern United States. We developed separate regressions for males, females, and juveniles. In most cases, including multiple shell metrics improved estimates of mass better than single measures. We illustrate their use by estimating standing stock of apple snails in a population introduced to a small retention pond. These regressions will provide an important tool for quantifying the effect of apple snails in ecosystems where they have been introduced.

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Herb Abundance and Diversity among Fire Severities in Pine-Oak Forests of Great Smoky Mountains National Park

Prior to the 1934 establishment of Great Smoky Mountains National Park (GRSM), the average wildfire interval in its xeric pine-oak forests was 12.7 years. Fire suppression changed this fire regime and modified woody plant composition, structure and function. Specific effects on the herbaceous plant communities are largely unknown. Our study quantified herbaceous plant abundance and diversity across four burn severities (none, low, moderate, high) in four different

fires occurring within the last seven years in GRSM. Fire severity was determined using Landsat data and strip transects were used to sample vegetation. Herb and subshrub cover combined was low and averaged only 5.86% (ranging 0.025 to 28.25%) across all fire severities. Herb cover and richness were significantly greater in high severity areas where canopy openness was also greater due to increased mortality of the overstory. Presence of forbs, ferns, and graminoids was also associated with higher severity areas. In contrast to these responses to greater light availability, subshrub abundance and non-graminoid monocot presence were not related to fire severity. Historical pre-fire suppression records indicate herb and subshrub cover together generally ranged 5 to 20%. In our study this percentage of cover consistently occurred only in high severity areas (averaged 11.44%) suggesting high severity fires may be required to maintain herbaceous communities in these ecosystems. However, high fire severity may be not be favorable to several species of non-graminoid monocots. Our results also indicate that since subshrub and herb cover responded differently to fire severity, these plant groups should be considered separately in fire effects studies.

126 Erika M. Dietrick, Claudia L. Jolls
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How Does Temperature Affect Germination and the Seed Bank Potential of *Thalictrum cooleyi*?

An understanding of seed biology and seed banks is critical for plant species restoration. Anthropogenic factors have reduced the fire-dependent pine savanna ecosystems of the southeastern U.S., sites for numerous rare plant species. *Thalictrum cooleyi* Ahles (Cooley's meadowrue) is one such rare species, a perennial herb listed as federally endangered since 1989. Virtually nothing is known of its seed biology. We studied the germination requirements of *T. cooleyi* in response to temperature. We divided 300 seeds randomly, as three replicates of 50 seeds each in Petri dishes on moist sand, among four treatments with either the presence or absence of 2.5 min high heat and/or cold stratification. Seeds were then exposed to 3-4 wk of germination conditions (25:15 ºC, light:dark) in the laboratory. We also tested the potential for seed bank formation by comparing germination of 1) bags of seed buried in the pine savanna, 2) seeds in outdoor pots in Greenville, NC, and 3) control seeds germinated in the laboratory. Overall, we had 61% germination across all treatments. Student t-tests showed no significant difference in mean germination of *T. cooleyi* when seeds were exposed to high heat. Cold stratification increased germination three-fold and seeds readily germinated after a winter outdoors. Longer periods of cold (8 wk) yielded higher germination rates than did shorter periods (2 wk). Thus, a period of cold is required to break dormancy in *T. cooleyi*, corroborating previous work. Our work suggests that *T. cooleyi* has the potential to form a transient seed bank of at least one year. We offer new knowledge of seed biology which can aid conservation of *T. cooleyi*, specifically, methods for restoration and possible impacts from global warming.

127 Erin E. Fegley, Claudia L. Jolls
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Modeling Herbivory to Predict Population Viability of a Rare, Monocarpic Perennial (Pitcher's Thistle)

Population modeling of rare plant species can inform management decisions for conservation of biodiversity. *Cirsium pitcheri* is a federally threatened, monocarpic perennial endemic to the shorelines of the upper Great Lakes. *Larinus planus*, a biocontrol weevil, has nontarget impacts on reproductive *C. pitcheri*. Flowering *C. pitcheri* are the resource for *L. planus*: the site of mating, egg-laying, and development of larvae. Nontarget impacts occur through destruction of ovules and seeds by *L. planus* larvae. *Cirsium pitcheri* cannot reproduce vegetatively; successful production of seeds is crucial for population fecundity and persistence. Some models in ecology attempt to explain relationships between plant and herbivore densities: positive (resource concentration) or negative (resource dilution). I sought to evaluate how the time to extinction of a *C. pitcheri* population would change if *L. planus* followed one of three different density patterns:

resource dilution, resource concentration, or no relationship of insect and plant densities. Demographic data have been collected for 20 years on a population of *C. pitcheri* in Wilderness State Park, northern lower Michigan. These data and a stage-based matrix model were used to simulate the population growth rate (λ) for each of three density patterns (resource dilution, resource concentration, no relationship). For each possible pattern, I used a different reduction in fecundity. Population viability analyses were used to compare times to extinction. When there was no relationship of insect and plant densities, time to extinction was within the next 20 yrs. Resource dilution and resource concentration were similar in predicting a longer time to extinction (~40-50 yrs.). Patterns of plant density and their influence on insect impact could be important factors for modeling impacts of herbivory and thus better inform management decisions for rare plant species.

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Bird Diversity in Two Habitats at Georgia Gwinnett College

Human progress tends to leave a wake of urban development that is often unappealing to most bird species. Gwinnett County, Georgia, is quickly becoming more urbanized and birds are being forced to live in smaller, more fragmented communities. In addition to pavement and buildings, urban development brings a new acoustic background and this anthropogenic noise can be detrimental to birds by affecting their behavior and having negative effects on their breeding success. A study of biodiversity among bird species was conducted on the campus of Georgia Gwinnett College during the 2015 fall semester. The purpose of this study was to create a preliminary inventory of bird species on campus in two different habitats: a relatively isolated wooded area with minimal human disturbance, Woods, and an area heavily disturbed by human presence and development, Disturbed. In addition to bird species diversity, noise pollution (airplanes, human voices, car/road noise, other) was also monitored in each habitat. Acoustics were collected using sound meter recordings at each location and then analyzed for both bird species identification and noise disturbance. The Northern Flicker, Pileated Woodpecker, and Red-shouldered Hawk were present in the Woods but not the Disturbed area, while Eastern Towhee and Red-bellied Woodpecker were present in the Disturbed area but not the Woods. Not surprisingly, noise pollution was greater in the Disturbed area than the Woods. Species that were heard more frequently in the Disturbed area than the Woods, Brown-headed Nuthatch, Brown Thrasher, and Northern Cardinal, sang more often as the amount of noise pollution increased. Species that were heard more often in the Woods than the Disturbed area, Tufted Titmouse, Carolina Chickadee, Carolina Wren, and American Robin, sang more often as the amount of noise pollution decreased. Future studies may expand on these habitat comparisons and monitor breeding success of the identified species.

129 Kathleen A. K. Gabler, Brian C. McCarthy
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Restoration of American Chestnut (*Castanea Dentata*): Changing Fuels Will Facilitate Fire

Historically, fire acted as a natural disturbance in forests of eastern North America. The location within the landscape as well as the plant communities in which these fires occurred, would have created a heterogeneous pattern of frequency and intensity. Periodic burning favors pyrophytic species, those species which are tolerant, resistant to damage, or capable of fast response after a fire. Currently, forests in the eastern United States have remained largely unburned since the policy of fire suppression was enforced in the early 1900s. Exclusion of fire allowed moisture-loving species to colonize and dominate the understory of many Appalachian hardwood forests. In these eastern forests, rainfall is often the controlling factor of fire ignition and spread; however, the reintroduction and restoration of certain species has the potential to change the makeup of the litter on the forest floor. To evaluate the potential effects the unique fuels of a single species could have on characteristics of flammability we quantified the absorption and loss of moisture of

leaf litter with varying amounts of American chestnut (*Castanea dentata*) burs, as well as a suite of flammability characteristics, including flame height, flaming time, smoldering time, and total consumption. ANOVA revealed a clear relationship between the addition of these unique fuels with both moisture absorption and drying rate, as well as flammability. Fuelbeds that contained greater amounts of burs absorbed less water, and burned for more time. Restoration efforts will have to be met with appropriate consideration by forest managers for the increase in litter flammability and the effects surface heating may have on the survival of fire-sensitive species.

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Effects of Mountaintop Removal Mining and Valley Filling on the Occupancy and Abundance of Stream Salamanders

Human-induced land-use changes are among the primary causes of ecosystem degradation and biodiversity loss. Across central Appalachia (USA), mountaintop removal mining and valley filling (MTR/VF) is the prevailing form of land-use change and represents a stressor to stream ecosystems. Salamanders are the dominant vertebrate in Appalachian headwater streams. Thus, we addressed the question: is salamander occupancy and conditional abundance reduced in streams impacted by MTR/VF? We conducted repeated counts of adult and larval salamanders within 10-m reaches in 11 valley-filled streams and 12 reference streams in south-eastern Kentucky. Relationships between occupancy, conditional abundance, and site type (MTR/VF vs. reference) were modelled using the hurdle model (Dorazio, Martin & Edwards 2013), where occupancy is modelled separately from abundance while accounting for differences in per-individual detection probabilities among groups. We found mean occupancy probabilities were >0.85 for all groups in reference reaches, whereas mean occupancy probabilities were relatively lower in MTR/VF reaches (ranging from 0.23 to 0.66). Posterior means of the difference in occupancy between site types was negative across all groups, although MTR/VF stream reaches were at least 95% less likely to be occupied by spring salamander *Gyrinophilus porphyriticus*, adult southern two-lined salamander *Eurycea cirrigera* and larval dusky salamanders *Desmognathus* compared to reference reaches.Posterior means of the difference in conditional abundance between MTR/VF and reference stream reaches were negative across all groups; 95% credible interval for difference in conditional abundance covered zero for only one species (red salamander *Pseudotriton ruber*). After adjusting for goodness-of-fit, point estimates of differences in occupancy and conditional abundance still remained below zero for most species. Additionally, MTR/VF reaches had higher ion concentrations, total organic carbon, and specific conductance compared to reference reaches. Our study concludes that MTR/VF reduces salamander occupancy and conditional abundance. Although the potential mechanisms responsible for reduction are numerous, our findings suggest a change in the current regulatory framework is needed to offset the impacts of MTR/VF on stream ecosystems and biota. Reclamation techniques that enhance conditions for vegetative succession within catchments may improve habitat on reclaimed surface mines.

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The Endangered Species Act in the Southeast

The US Endangered Species Act (ESA) is considered one of the strongest laws in the world for protecting imperiled species. Determining whether the ESA's implementation is fulfilling its promise requires critical analysis of data. To facilitate such analysis and enable the dissemination of the data to conservation practitioners, lawmakers, and the public, we have created several dynamic web applications that allow users to see, for the first time, how various components of the ESA have been implemented. Focusing on the Southeast, we will discuss details of section 7

consultations, state and federal expenditures on listed species, the Working Lands for Wildlife program, and data on candidates for listing. We will then highlight outstanding data needs, with a particular focus on some of the biological information that is needed to improve ESA implementation. Our results illustrate one way to communicate essential information to the audiences who need to understand how critical laws such as the ESA are performing and how performance can (or cannot) be improved.

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Analyzing the rewards and risks of biological control

Invasive species are well-documented threats to biodiversity world-wide, second only to habitat loss. Biological control is the use of a predator or pathogen from the invader's native range to control invasive plants in their introduced range. The rewards (efficacy of weed control) and risks (non-target impacts, NTIs) of such approaches have been the subject of several recent reviews; some meta-analyses have suggested that biocontrol is both effective and safe. We argue that true biocontrol success needs to include both ecological and economic components, e.g., the target weed needs to be significantly controlled or eliminated on a population level and non-target effects must be very minor or non-existent. We evaluated ten randomly-selected case studies of biocontrol: five from a list of widely cited biocontrol successes and five from the "heavy impact" cases in the catalog of biocontrol introductions. We reviewed the literature for information on agent success and asked if the experimental design was appropriate to show a decline in weed density or fitness. We found overwhelmingly that the literature describing biocontrol successes, at least for our case studies, was based on personal communications, before and after photos, and visual estimations of changes in cover. With very few exceptions, quantitative experiments demonstrating population-level effects have not been done. Similarly, most information used to classify NTIs as less than minor is from more casual surveys which lack systematic, long-term monitoring for these impacts. To date, NTIs have been discovered at places and times removed from release points, almost providentially, some 14-35 yr post-release. Detailed monitoring for efficacy and NTIs is critical, particularly for rare native plant species. Given limited efficacy and potential risks of biocontrol, its use should be less frequent, more carefully tested, better regulated, and better monitored.

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Combined Effects of a Flame Retardant and Ammonium on Plankton Community Structure in Blackwater Pond Mesocosms

Flame retardant chemical inputs to freshwater ecosystems can trigger sublethal and lethal effects on microscopic aquatic organisms. For example, tetrakis hydroxymethyl phosphonium chloride (THPC), is produced worldwide at a rate of ~3,000 tons per year and used in the textile industry. The THPC that reaches freshwater systems in wastewater becomes mixed with other chemicals, including excess nutrients from fertilizers in agricultural runoff. While the effects of excess nutrients on planktonic communities are well studied, recent findings suggest the presence of nutrients alters the effects of other contaminants on aquatic organisms. Our goal was to measure the influence of environmentally relevant concentrations of THPC and nutrients (ammonium) alone and in combination on freshwater plankton abundance and species composition under field conditions. Individual floating mesocosms containing ambient plankton communities were established in a blackwater pond in southeast GA, USA. Replicate mesocosms were exposed to treatments: no-addition control; low THPC (0.08 mg L^{-1}); high THPC (0.8 mg L^{-1}); ammonium (0.3 mg L^{-1}); or THPC and ammonium in a fully crossed design for one month. While no significant changes in the plankton communities occurred due to treatment, several consistent patterns emerged over the course of the experiment. Notably, low THPC+ammonium and high THPC appeared to increase rotifer and decrease copepod abundance over the first three weeks. Both

THPC-only treatments also appeared to have the lowest copepod nauplii abundances of all treatments after three weeks of exposure, averaging ~50% fewer individuals than the control. Copepods and nauplii provide essential food resources for fish, thus decreased availability could affect higher trophic levels. Our results suggest that any interactive effects of THPC and ammonium are likely complex, but have the potential to adversely affect aquatic communities, warranting additional testing.

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Biology, William Peace U, Raleigh, NC

PCB Contamination in *Ictalurus punctatus* in the Crabtree Creek Drainage System (Wake County, NC)

Crabtree Creek in Wake County, North Carolina is a major tributary to the Neuse River. The urban stream, which drains about 21 miles, is historically prone to periodic high flow and frequent flooding. In the 1970's an electrical equipment factory, Ward Transformer Co., contaminated the headwaters of the stream with discarded PCBs (Polychlorinated Biphenyl). High levels of PCBs have been detected in all trophic levels of the stream. State governmental agencies have warned the public that game fish should not be ingested in the upper part of Crabtree Creek. These agencies presume that the contamination dissipates further down the stream and therefore have suggested only reducing consumption of fish on the lower half of the drainage. To test that assumption, this study examined the amount of PCBs in channel catfish (*Ictalurus punctatus*) muscle tissue from sites along the entire stretch of the stream. In all sites surveyed, the PCB levels in the catfish were well above the dangerous level (0.5 ppm) for human consumption. The PCB levels in the fish ranged from 1.8 to 7.5 ppm with all sites averaging around 3.4 ppm. There was no significant difference in mean PCB levels between the fish in the headwaters and the mouth of Crabtree Creek. Furthermore, catfish mark-recapture data and analysis of age/PCB concentration relationships suggest that the catfish are consistently moving or being pushed downstream from the highly contaminated headwaters. The data suggest that local governmental agencies need to extend their no consumption warnings to the entire creek and possibly extend it several miles down the Neuse River from the mouth of Crabtree Creek.

135 Aaron Q. Hite, Tom A. Blanchard
Biological Sciences, U of Tennessee at Martin

The Initial Response of a Benthic Macroinvertebrate Assemblage to a Stream Re-Channelization Project in Northwest Tennessee

Stream channelization is the process of removing natural meanders of a stream to improve navigation and to increase drainage. The process of stream straightening is known to cause head-cutting, valley plug formation, and a reduction in the variability of microhabitat types available to aquatic organisms. In West Tennessee, the majority of rivers and streams has been extensively channelized. Because of the known adverse effects of channelization, stream restructuring projects have been implemented to restore the natural sinuosity characteristic of unaltered streams. Though the first restoration project in West Tennessee was completed in 2001, relatively little is known about how aquatic communities respond to stream channel reconstruction. The purpose of this project was to investigate the initial effects of a restoration project on benthic invertebrates in a small stream in northwest Tennessee. We sampled aquatic macoinvertebrates from two areas of Town Creek in Henry Co., TN. We used kick-net sampling to collect benthic invertebrates from three, 50-meter reaches within a restored section of the stream and three, 50-meters reaches within a channelized section. Upon collection, all specimens were preserved in 70 % ethyl alcohol and returned to the laboratory at UTM for identification and enumeration. Specimens were identified to the lowest taxonomic category possible (Genus for most). Mean overall abundance was substantially higher in the restored section of Town Creek as compared to the channelized section. The restored section also showed a much higher mean abundance of sensitive taxa such as Ephemeroptera and Trichoptera. This project demonstrated that stream restoration had an initial effect on aquatic communities and, based on the community

structure of benthic invertebrates, it appears water quality has been improved as a result of the restoration.

136 Ted F. West III, Matthew N. Waters
Biology, Valdosta State U, GA

Spatial and Temporal Phytoplankton Dynamics in Response to Environmental and Anthropogenic Stressors in Lake Seminole, GA

Past research has convincingly demonstrated that alterations by humans to landscapes can seriously impact the trophic status, health, and benefits of aquatic environments. Examples of anthropogenic land-use changes include urbanization and agriculture in which the effluent and materials are either directly or indirectly deposited into rivers. In large rivers, reservoirs alter natural flows creating lentic ecosystems susceptible to allochthonous inputs from up-river. Here, we report photoplankton community change over a multi-year period in Lake Seminole, GA linking primary producer change to environmental and anthropogenic stressors. Lake Seminole is a shallow reservoir in southeastern Georgia formed from the confluence of three rivers, the Chattahoochee and Flint Rivers and Spring Creek. The Chattahoochee contains urban/industrial effluent, the Flint and Spring Creek carry mainly agricultural runoff creating a natural experiment of differing landuse between the inputs. Phytoplankton community structure was measured as photosynthetic pigments and stressors included precipitation, temperature, flow and the presence of the invasive macrophyte Hydrilla verticillata which is seasonally known to cover up to 50% of the lake at times. Results show that average phytoplankton abundance is increased in the presence of Hydrilla verticillata along with total phytoplankton degradation. The community structure and abundance of algae varies and increases respectively from up-reservoir to down-reservoir. Nutrient data correlate with algal blooms observed in multiple sampling stations in the reservoir. The phytoplankton community of Lake Seminole demonstrates the complexity and multivariate integration of anthropogenic stressors in large reservoirs showing the difficulty of management efforts targeting one stressor.

137 Devin N. Kinney, Amber A. Burgett
Biology, Wittenberg U, Springfield, OH

Effectsof Roundup and Reduced Hydroperiod on the Behavioral Response of *Hyla versicolor* Tadpoles to Predator

Sub-lethal levels of many environmental contaminants can alter development, growth, and behavior of amphibian larvae when combined with an additional stressor. Delayed growth, increased mortality, and changes in behavioral response to predators are exacerbated when amphibian larvae are exposed to multiple stressors including Roundup. For example, chemical cues from predators can elicit a reduction in the activity level of tadpoles. Roundup exposure reduces this response in tadpoles, potentially as a result of interference with the olfactory system. An additional stressor, which may interfere with the activity level and development of tadpoles, is a reduction in hydroperiod as a result of drought. We examined the interactive effects of drought and sublethal concentrations of Roundup on *Hyla versicolor* tadpole growth and behavioral response to caged predators over time. When exposed to Roundup, tadpoles decreased their overall activity level and their behavioral response to predators, an effect that strengthened with time since exposure. Drought or its interaction with Roundup had no impact on overall activity or behavioral response. Previous studies showed a reduced response of tadpoles to predator chemical cues. However, we demonstrate that the reduction in response is to both visual and chemical cues. In addition, Roundup decreased the length of the tadpoles at metamorphosis but did not influence the weight of the tadpoles. As our results suggest, Roundup's impact on amphibian behavior is particularly concerning as it can alter the structure and function of the aquatic community.

138 Thomas A. Hess, Lori Tolley-Jordan
Biology, Jacksonville State U, AL

Do Fish Elicit Behavioral Responses of Macroinvertebrates in Small Streams of the Bankhead National Forest, Alabama?

Although laboratory studies have shown strong behavioral responses of benthic macroinvertebrates to fish presence, the timing and magnitude of these responses in natural stream settings is poorly understood. We investigated differences in behavioral responses of benthic macroinvertebrates to fishes in situ by measuring changes in the densities, diversities, and timing of the downstream transport of benthic invertebrates in the water column (aka drift). In July 2015, we conducted diel drift studies in two, small headwater streams which both had reaches with and without fish. In each stream, drifting invertebrates were collected from the water column over a 24 hour period using standard drift nets placed in reaches with and without fish. All invertebrates collected in the drift samples were enumerated and identified to the lowest taxonomic level in the lab. Differences in diversity between fish and fishless reaches were measured according to taxa richness, evenness (Shannon-Wiener and Simpsons Reciprocal Indices), and community similarity indices. Drift rates (number of individuals per cubic meter of water per second) were calculated to determine differences in timing and magnitude of invertebrates in fish and fishless stream reaches. In the fishless stream reaches, 1188 individuals/m^3 from 41 families were collected, and in reaches with fish, 1028 individuals/m^3 from 47 families were collected. No significant differences in diversity and community structure in any time interval were observed. Also, overall drift periodicities were similar between reaches with and without fish with the greatest drifting rates occurring around midnight. However, drift periodicity for dominant insect within the Chironomidae, Perlidae, and Baetidae varied between fish and fishless reaches and between streams. Further analyses of invertebrate densities, diversities, and drifting periodicity from four additional streams included in the Summer 2015 sampling period will help clarify the effects, if any, on the behavior of drifting macroinvertebrates.

139 Anna S. Sarkisova, Michael Erwin, Peter C. Sakaris
Biology, Georgia Gwinnett College, Lawrenceville

The Effect of Urban Fragmentation on Genetic Structure of Redbreast Sunfish (*Lepomis auritus*) and Green Sunfish (*L. cyanellus*) Populations

The increase of anthropogenic activities in urban watersheds have resulted in profound fragmentation of local stream habitats. Fragmentation of stream habitats has occurred through the construction of dams and roads, extreme bank erosion leading to sedimentation and fallen trees, habitat degradation, and zones of poor water quality. The aim of this study was to examine the effects of habitat fragmentation on the connectivity of fish populations in an urban stream. To study potential genetic isolation of fish subpopulations throughout the system, mitochondrial cytochrome c oxidase I gene (CO1) was sequenced from pectoral fin tissue of redbreast sunfish (*Lepomis auritus*) and green sunfish (*Lepomis cyanellus*) from a tributary of the Yellow River, Lawrenceville Georgia. In addition to genetic analysis, mark-recapture was conducted in the field to estimate the sizes and monitor fish migration patterns throughout the highly fragmented system.

140 A. Ashlea McCann, Jennifer L. Greenwood
Biological Sciences, U of Tennessee at Martin

Effects of Turtle Size and Microhabitat Preference on Patterns of Carapace Algal Growth and Community Structure at Reelfoot Lake

There is potentially a unique community of algae that grows on the carapace of freshwater turtles, however, there have been very few studies examining the relationship between freshwater turtles and their algae. Previous studies primarily report the occurrence of *Basicladia* or simply identify turtles with algal growth. The objectives of this study were to examine the relationship between freshwater turtle species and their algal communities, as well as to assess whether there is a

relationship between carapace size and percent cover of algae. We hypothesized that 1) predatory turtles who generally stay submerged accrue more algae on the carapace than basking turtles which spend more time above water, 2) larger (older) turtles will have more algal growth than smaller (younger) turtles, and 3) algal communities will differ depending on turtle size and microhabitat preference. Turtles were collected from Reelfoot Lake in June 2015. From their shells, percent algal cover was estimated and algal samples were collected. There was a weak but significant positive relationship between percent algal cover and carapace size (r^2=0.08, $p<0.05$).

141 Michael A. Schoonover[1], Sarah T. Asemota[1], Zechariah Avello[1], Derek Anderson[1], Steven J. Symes[2], David K. Giles[1]
[1] Biology, Geology & Environmental Sciences, Chattanooga, TN; [2] Chemistry, Chattanooga, TN

A Survey of Bacterial Biodiversity and Lipid Content within Raccoon Mountain Caverns

Research concerning microbes in the subterranean oligotrophic environment is sparse and must be conducted in order to obtain a better understanding of their effect on the health of the cave and those who venture into it. Identifying microorganisms in different locations inside Raccoon Mountain Caverns has the potential to define and expand our taxonomic knowledge of organisms in these environmental niches. Furthermore, our approach involved identification of cultivable bacteria and analysis of lipid profiles from four collection types of cave samples: mud, dirt, water, and areas that experience high human traffic. Utilizing traditional microbiological techniques, each sample was streaked for isolation of individual colony types. Pure cultures were prepared for genomic extraction, amplification of the 16s rRNA gene using universal primers, and Sanger sequencing for identification. Several Gram negative and Gram positive bacteria were identified, including *Bacillus*, *Acinetobacter*, and *Pseudomonas* species. Concurrently, each sample was analyzed for lipid content using quadrupole mass spectrometry following direct injection electrospray ionization in both positive and negative modes. Lipid profiles of fatty acids, lysophospholipids, and glycerophospholipids among sample sites were similar, providing a lipid signature that may hold potential for characterizing biomarkers that are indicative of cave health and floral composition. More detailed analysis of cave sediment lipids using reversed-phase ultra performance liquid chromatography-mass spectrometry (UPLC-MS) revealed several species of PE and PG whose preliminary structures reveal a variety of fatty acyl chains. Through DNA and lipidomic analyses, we hope to gain a better understanding of the microbial diversity found among and between the different ecological niches of the subterranean environment and the effects humans may have on that diversity.

142 Kacey M. Talbot
Biology and Marine Science, Jacksonville University, Jacksonville, FL

Evaluation of CHROMagar™ Staph aureus for Isolation of *Staphylococcus aureus* from Local Impaired Water Samples

Staphylococcus aureus, often referred to as staph, is a common cause of bacterial infection in humans. On CHROMagar™, *S. aureus* colonies should appear pink to mauve. In this project, waterways impaired with fecal bacteria were filtered onto CHROMagar™ for *S. aureus* isolation. Initial MALDI-TOF mass spectrometry results revealed that colonies of other bacterial species, such as *Bacillus cereus*, are also pink to mauve. Real-time PCR, biochemical tests, and Biolog Gen III identification plates were used to further characterize species appearing as *S. aureus* on CHROMagar™. The number of false positives acquired demonstrates the limitations of CHROMagar™ for isolating *S. aureus* from environmental samples. All identified false positive species were evaluated for human health risks in an effort to characterize the potentially unknown risks associated with impaired waterways.

143 Abigail V. Nails, Jennifer D. Hayden
Biology, William Peace U, Raleigh, NC

Cellular Processes in *Mycobacterium smegmatis* Are Regulated by Lysine Acetylation

Tuberculosis disease is caused by *Mycobacterium tuberculosis* and is a complex global health threat. While many metabolic processes important to *M. tuberculosis* pathogenesis are understood, regulation of these various processes remains unclear. We have been focusing on lysine acetylation as a possible metabolic regulator. Our studies show that lysine acetylation does impact mycobacterial metabolism, and we identify the mediators of lysine acetylation in *Mycobacterium smegmatis,* a soil bacterium often used as a model for *M. tuberculosis*. Lysine acetylation is a post-translational modification in which an acetyl group is covalently attached to lysine side chains. While not as well-studied as phosphorylation, lysine acetylation is likely to regulate a similarly large and functionally varied number of proteins. Lysine acetylation is mediated by acetyltransferases, which add acetyl groups to lysine residues, and deacetylases, which remove the acetyl groups. One of the few well-studied acetylated bacterial proteins is acetyl-CoA synthetase (Acs). In *Mycobacterium smegmatis* Acs is required for acetate and propionate metabolism. By measuring acetate metabolism in various mutants, we identified that the lysine acetylation/deacetylation system in *M. smegmatis* cells is comprised of one acetyltransferase, PatA, and one deacetylase, SrtN. Using mutants that lack either PatA or SrtN, we examined the need for lysine acetylation in other cellular processes such as biofilm formation and DNA repair.

144 Phoebe Parrish[1], Suma Chakravarthy[2], Kevin G. Smith[1], Alan Collmer[2]
[1] Biology, Davidson College, NC; [2] Plant Pathology and Plant-Microbe Biology, Cornell U, Ithaca, NY

The Multifactorial Role of the Phytotoxin Coronatine in Plant Disease in *Nicotiana benthamiana*

Pseudomonas syringae pv. *tomato* (*Pst*) is a hemibiotrophic bacterial pathogen that is the causative agent of bacterial speck of tomato, a devastating disease that causes periodic crop losses worldwide. *Pst* is also an important model pathogen that has been used to advance our understanding of the pathogenesis of bacterial plant pathogens and the molecular interactions between these pathogens and the plant immune system. My work focuses specifically on the phytotoxin coronatine, which is produced by many strains of *Pst* in the field. Coronatine has a well-known role as a plant defense hormone mimic. However, recent work has suggested possible additional pathogenic functions for this toxin. I therefore used a minimalist system of effectorless coronatine mutant *Pst* strains in *Nicotiana benthamiana* plants with knockdown expression of key immune components such as pathogen-associated molecular pattern receptors and vesicle trafficking. I used bacterial growth assays and disease symptom scoring to reveal that coronatine does not greatly aid in bacterial growth. Instead, this toxin appears to play a key, multifactorial role in *Pst* pathogenicity aside from its well-known function as a hormone mimic. The results of my research can be applied to understand the role of bacterial phytotoxins in plant disease, as well as to prevent the spread of bacterial speck in crop plants.

145 Cancelled

146 Tyler Wilson, Patrick A. Vigueira
Biology, High Point U, NC

Synergistic Effect of Amoxapine and β-Lactam Antibiotics Against MRSA

Bacterial resistance to antibiotics is a growing concern in the field of healthcare today. The antibiotics that we currently use are becoming less effective due to the ability of bacteria to quickly develop resistance. Meanwhile, large pharmaceutical companies are hesitant to invest in the development of new antibiotics due to their low economic return. Our goal is to restore

bacterial sensitivity to existing antibiotics by identifying and characterizing synergistic interactions with other pharmaceutical compounds. Amoxapine is a tetracyclic antidepressant used in the treatment of major depressive disorder. We determined that amoxapine acts synergistically with β-lactam antibiotics against methicillin-resistant Staphylococcus *aureus* (MRSA). In broth culture, suboptimal concentrations of amoxapine reduced the MIC of oxacillin against MRSA from 100µg/mL to 2µg/mL. Future studies will explore the mechanism by which amoxapine potentiates the effect of oxacillin.

147 Stephanie S. Momeni[1], Jennifer Whiddon[2], Stephen A. Moser[2], Noel K. Childers[3]
[1] Biology/Pediatric Dentistry, U of Alabama at Birmingham; [2] Pathology, U of Alabama at Birmingham; [3] Pediatric Dentistry, U of Alabama at Birmingham

Tracking Transmission of *Streptococcus mutans* using rep-PCR and MLST

The high cost of downstream applications such multilocus sequence typing (MLST) or whole genome sequencing (WGS) is a concern for researchers. Preliminary data has suggested that repetitive extragenic palindromic PCR (rep-PCR), a more cost-effective option, correlates well with MLST sequence types (ST) when evaluating *Streptococcus mutans*, a bacteria associated with dental caries. In this study, rep-PCR dendrograms were analyzed to determine prediction accuracy for MLST ST. Clinical application was assessed for analysis of rep-PCR strain G12 to track transmission. Rep-PCR dendrograms were generated for the 10 most common rep-PCR genotypes using isolates of *S. mutans* from 20 unrelated schoolchildren and infants (N=200). Isolates were selected for MLST analysis including 2 isolates from the extreme branches and 7-9 from internal branches. MLST was performed using the Nakano scheme (2007). For clinical assessment, rep-PCR dendrograms were generated for each family for all children with rep-PCR strain G12 (isolates N=701) including 7 mother-child pairs, 1 father-child pair and 11 children only. Ninety-seven *S. mutans* isolates were evaluated with MLST for the top 10 genotypes. Predication accuracy for ST were 62%. Allowing for single and double locus variants (recently diverged strains) improved predication accuracy to 73%. Sixty-nine isolates were evaluated by MLST for clinical analysis. ST matched mothers for infants, while 50% of schoolchildren had non-matching ST. Two ST (ST157 and ST202) were commonly shared among children. Two mothers were identified as potential infection sources for these two strains. This study support that affordable rep-PCR screening can be used to reasonably predict potential isolates for more expensive downstream applications such as MLST or WGS. Clinical application of rep-PCR to predict MLST ST in this study offers evidence consistent with horizontal transmission of some *S. mutans* strains. These findings indicate the need for further larger-scale analysis with MLST to track transmission routes of *S. mutans*.

148 Andre L. Lorenz, Blake W. Nelson, Jay A. Yoder
Biology, Wittenberg U, Springfield, OH

Linkage Between the Honey Bee Colony and Growth Characteristics of a Bee Fungal Pathogen

A fungus, *Ascosphaera apis,* causes chalkbrood disease. This fungus infects a bee larva (*Apis mellifera*) from the inside out, killing the bee and turning the larva into a chalk-like mummy. The disease transmission is by way of spores (conidia). To determine conditions under which fungal infection occurs, radial growth rates were measured at varying water activities and temperatures. Results indicate that *A. apis* has a typical growth curve, characterized by a high water and high temperature requirement for growth and producing spores. Strains were similar from different geographic regions, and none could be made dry-adapted by rearing on low water activity media. Growth curves were analyzed as a three-dimensional graph and superimposed over the colony. High points on the 3-D graph (denoting optimal growth) coincide with environmental conditions at the edge of the frame and where mummies are found. Visualizing growth curves by this new approach demonstrates the connection between growth requirements of *A. apis* and the ecology of the bee. As a note to beekeepers, 1. this fungus requires a damp surface for producing spores; 2. mummies at the edge of the colony lead to additional infection as secondary spore producers

providing early prediction of disease outbreaks; and 3. warm and dry conditions in the colony prevent chalkbrood, which places an emphasis on keeping bees healthy or use of hygienic bees.

149 Christopher E. Barton
Biology, Belmont U, Nashville, TN

A Model for Interprofessional Collaboration That Promotes Student Learning and Faculty Development in Undergraduate Anatomy and Physiology Courses

Undergraduate anatomy courses are the foundation for future graduate and professional programs. While there are many approaches to teaching anatomy, scientific and pedagogical literature are clear that cadaver-based instruction is perhaps the most efficient method of increasing student learning. However, due to many factors, gross anatomy labs are becoming much less common at the undergraduate level. We have developed an interdepartmental collaboration to increase student exposure to cadaver-based instruction. Our collaborative system increases learning, while providing additional benefits to graduate students in professional programs. These experiences also serve as professional development opportunities for instructional faculty. Our approach, we believe, can serve as a learning model to be applied at multiple institutions where there is a desire to increase undergraduate exposure to the gross anatomy laboratory

150 Jennifer T. Thomas
Biology, Belmont U, Nashville, TN

A Strategic and Multi-level Approach for Teaching Undergraduates How to Read Scientific Articles

Reading scientific articles can be a daunting exercise for even the most gifted students. Beyond the difficulty of understanding the question, rationale, methodology, and findings of a research paper, the style and format of these articles is unfamiliar territory. By introducing students to the structure of articles and the use of figures and tables, students can slowly gain confidence in *how* to read a paper, regardless of the research being presented. I will present the strategies, exercises, and worksheets that I have developed in my courses to help students gain the skills needed to effectively read scientific articles. I will then offer suggestions for how to introduce this material in introductory courses and build upon it in subsequent courses, resulting in student-led journal clubs in upper-level courses. Given the correct tools, students can learn to successfully read scientific articles and, consequently, practice their analytical and reading comprehension skills, experience the rewards of conquering difficult material, and participate in the excitement of scientific discovery.

151 Christopher E. Barton, A. Darlene Panvini
Biology, Belmont U, Nashville, TN

Promoting Student Well-Being in STEM Through Community and Civic Engagement

Promoting student engagement through internships and community service can be a challenging task, especially in STEM fields. As a result, we sought to identify ways in which we could increase student and faculty awareness of opportunities for student involvement within the local community. To begin a dialogue among STEM faculty and students, community STEM leaders, and campus partners, a series of seminars in the College of Sciences and Mathematics were held to promote student well-being through community and civic engagement. These events are providing an opportunity for students to interact and create connections with an panel of local community-based STEM leaders, while also allowing faculty the chance to have candid conversations with the panel about how we can best prepare our students for community engagement and entry into the STEM workforce following graduation. Our hope is that these seminars will increase student engagement in the community, as well as equip faculty with tools that will allow us to best prepare our students for entry into STEM careers.

152 John H. Niedzwiecki
Biology, Belmont U, Nashville, TN

Teaching the Value of Sustained Observation: A Multiweek Research Experience in Animal Behavior at the Zoo

When designing laboratory experiences in our classes we face several tradeoffs. Two of the main trade offs are between structured labs and open inquiry style labs, and between many lab exercises focused on particular topics, or fewer longer integrated experiences. Courses in animal behavior can be especially challenging because the most important aspects of a project include understanding how the animal behaves and finding a means of quantifying and recording that behavior in the most appropriate way for a particular circumstance rather than learning a particular technique or instrument. This can only be accomplished with time and observation. In my animal behavior course at Belmont, I have chosen to devote about half of my scarce lab time to a single research experience that focuses on inquiry and integration, rather than tight structure and focus. Two students are paired with a zookeeper at the Nashville Zoo at Grassemere, and after a basic orientation to their animals, are tasked with testing meaningful statistically supportable hypotheses about their focal animals. Projects range from zoo-suggested projects to examine effectiveness of enrichment activities, to dominance hierarchies, to behavioral tendencies of individuals. After initial sessions to see animals and learn the basic methods of observation and design, students spend weeks of lab time, observing animals, developing hypotheses, taking data and finally presenting their results to zoo staff and the general public at the zoo. Students are challenged with many important aspects of completing an experiment including: applying theory learned in class to real problems, developing and modifying hypotheses using statistics, preparing graphs, and presenting their findings to a diverse audience. Feedback from students suggests that the project is meeting its learning goals. The project has the added benefit of connecting the university and its students with a great biological resource in the Nashville area.

153 Nicole T. Welch
Sciences & Mathematics, Mississippi U for Women, Columbus

Pulling Out All of the Stops to Teach the Basics of General Ecology to a Changing Student Population

General Ecology is an upper-division, synthesis course required for Biology Majors at most colleges and universities. The course teaches ecological concepts, most of which require students to scale information supposedly mastered in lower-division science courses to larger levels of biological organization (e.g., scaling photosynthesis to ecosystem primary productivity). While students have struggled to scale information for years, the problem may be becoming worse as more and more students fail to see connections between details of major concepts, and default to informal reasoning, rather than scientific reasoning. The purpose of this presentation is to examine trends in student performance in General Ecology over the last eight years, and relate those trends to the varied pedagogies applied, as well as student metrics. In the time frame of 2008-2011, approximately 30% of students completing General Ecology earned an A in the course and received information via passive lectures and traditional lab activities. In contrast, approximately 15% of students completing General Ecology earned an A in the period of 2012-2015. Surprisingly, students in the 2012-2015 cohorts received the information with a mix of lectures, study guides, active learning exercises (many of which mimicked exam questions), longer-term, research-based lab activities. The overall GPA of students enrolled in General Ecology declined from 2008 to 2015, but not significantly so. It is perplexing to explain the decline in student mastery of ecological concepts, which, on the surface, appears to be due to lower student quality, increased student apathy, and shallow understanding of information gained in lower-division science courses.

154 Oluwaseun O. Agboola, Anna C. Hiatt
Biological Sciences, East Tennessee State U, Johnson City

Improving Student Success in Introductory Biology: The Use of Summative Assessment as an Inclusive Practice

Increased course structure improves student learning in introductory STEM courses by offering students opportunities to frequently assess their progress. Much has been studied on the value of frequent formative assessment; however, few studies have evaluated the frequency and modes of effective summative assessment delivery. With summative assessment, teachers can review data from assessment results of previous years or other courses to identify students who are struggling academically in certain subject areas or concepts. This strategy may be useful for bridging the gaps in college readiness among at-risk students. The following project has examined the use summative assessment as an inclusive teaching practice to improve first generation college student success in Introductory Biology at a regional university with more than 50% of students identifying as first-generation college students. The study analyzed exam data and end of semester surveys for three semesters of an introductory biology course for science majors and observed trends in student performance along three different modes of course delivery for post-lecture work in which each semester varied: in-class, online, and hybridized (some online, some in-class) summative assessment delivery. Final exams were evaluated and categorized by Bloom's Taxonomy of Learning and questions categorized as testing either higher order cognitive skills or lower order cognitive skills. In each semester, more than half of the examination questions in each semester were at the higher-order cognitive levels. Student performance and preference for mode of delivery of summative assessments are fairly consistent with the hybridized mode of course delivery being the least preferred and least successful in achieving higher order cognitive skill development. However, student viewpoints and performance on online and in-class summative assessments offer many interesting insights into how instructors may best use this approach as an inclusive practice to improve student learning

155 Anna C. Hiatt
Biological Sciences, East Tennessee State U, Johnson City

NABT Presents... A Framework for Improving Science Practice Skills in Undergraduate Introductory Biology

Across the nation, students may be enrolled in undergraduate introductory biology courses in a variety of settings: in AP Biology, as part of a high school dual enrollment course, at a Community College, or at a 4-year University. Regardless of intention to pursue a STEM career (majors vs. non-majors), these courses provide an introduction and foundation to science for many undergraduates. Instructional practices among these courses are also highly varied and may, or may not, be tailored to specific guiding polices like the AP Biology Curriculum Framework or Vision & Change. While content coverage may be contested between these guiding policies, there are clear and consistent commonalities in the recommended science practice skills across K-16 life sciences education. This presentation will provide a framework for faculty to learn how to "unpack" and integrate core competencies and science practice skills into their courses. We propose to reconceptualize how instructors think about conceptual learning in an information-rich age where information literacy is paramount for concept acquisition in all areas. This process is also helpful in establishing a continuum of skills development across departmental or institutional learning goals. In setting out to align national policies on life science education, we hope that college faculty will no longer think of concepts and skills individually, but rather consider the intersection between them.

156 Jane P. Ellis
Biology, College of Charleston, Charleston, SC

NABT Presents… Does the Use of Active Learning Strategies in STEM Courses Actually Improve Student Retention and Learning? If So, What Are the Best Practices?

Active learning strategies have been touted as improving student engagement, retention and learning in STEM courses but do they really? Recent research covering metaanalysis data over 225 studies has proven that in undergraduate science, technology, engineering and math courses there is a significant increase in student retention and learning when comparing active learning to the traditional lecture. This research also indicates that the use of active learning strategies could have an impact on underprepared and underrepresented students in STEM courses. In this interactive session we address the best practices, major concerns, and "second generation research" on active learning. Some topics covered include the latest research on the use of mobile devices, clickers, minute papers, online discussion forums, small group assignments, and case studies.

157 Cancelled

158 Thomas M. Dodson
Sciences & Mathematics, Mississippi U for Women, Columbus

Critical Thinking and Art in the Big Picture of Biology

Many times students leave a general education course such as Biology without understanding the relevance of the subject to themselves or how the various topics covered in the course relate to one another. An instructor can illustrate these connections, but this creates a situation where the student is a consumer in the learning process without the use of critical thinking to find the connections on their own. General Biology courses are starting to incorporate active learning more commonly into the classrooms. These activities are designed to increase critical thinking, but they sometimes lack the opportunity for the student to produce a thought-out larger idea of the main concepts that are covered in the course. Another concept that has been proposed in science education is the idea of incorporating Art into the more traditional STEM (Science, Technology, Engineering, and Math) disciplines. These two ideas can be combined in various ways to help students learn the relevance of biology for themselves and also bring about understanding that comes from higher thought about the subject covered in their General Biology course. A combination of assignments are used in which the student produces their own critical thinking questions with answers throughout the semester and also an artistic production of their choice at the end of the semester showing the main connections (or Big Picture) between the following topics: Photosynthesis, Cellular Respiration, Digestive System, Circulatory System, and Food Chains/Food webs. This presentation will discuss the utility of the critical thinking questions as students progress in their ability to produce thought-provoking questions from the beginning of the semester until the end. Lastly, this presentation will show how for some students the "Big Picture" assignment made real personal connections to the science topics and helped them grasp main connections by the time of the final exam.

159 Lytton J. Musselman, Jay Bolin
Greeting and Welcome

160 W. Carl Taylor
Botany, National Museum of Natural History, Washington, DC

Species Evolution and Phylogeny of *Isoetes*

Isoetes (Isoetaceae) is a cosmopolitan genus of heterosporous lycophytes containing at least 250 species. These species have arisen from an ancient lineage with a simple form so preserved that members of the genus are recognized in the Triassic. Extant species are widely distributed from

the tropics to the sub-arctic. In habit, they range from evergreen aquatics to ephemeral terrestrials. In spite of their long history, widespread distribution, and diverse habit, species have a remarkably conserved morphology that provides few diagnostic features to delineate species and determine their evolutionary history. DNA sequences provide information needed to define species and reveal phylogeny. Sequence data shows that species have evolved through ecological isolation and genetic divergence. For example, the Hawaiian endemic *I. hawaiiensis* is closely related to pan-boreal *I. echinospora*. Spores of *I. echinospora* were likely carried to Hawaii by waterfowl where the isolated plants diverged. Species have also evolved by interspecific hybridization and chromosome doubling. *Isoetes* chromosome numbers range from 2n=2x=22 to 2n=12x=132. LEAFY sequences reveal *I. echinospora* and *I. engelmannii* as the basic diploid parents of the primary interspecific hybrid *I.* X *eatonii* and the allotetraploid *I. riparia*. ITS sequences reveal biogeographical clades that show long-range dispersal, habitat convergence, and morphological convergence. For example, west coast species *I. nuttallii* and *I. orcuttii* are more closely related to Mediterranean species than to other species in North America. *Isoetes australis*, part of a southern gondwana group, and *I. brevicula*, a member of a more northern Austral-Asian clade, are very different plants that have converged in rock pool habitats of western Australia. *Isoetes tegetiformans* from Georgia, USA and *I. australis* from Western Australia are remotely related, but they share a unique, rhizomatous habit that represents morphological convergence. DNA sequencing is a powerful tool to resolve *Isoetes* species and their phylogeny.

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Rhizomorphs, Scales, and Sporelings of Isoetes

The ill-defined stem structure of *Isoetes* is unique among Lycophyta with a form of cambial activity, deciduous annual growth structures (abscission caps), and root production restricted to distinct regions. Polarity of the axis varies from discoid (most Southeastern species), to elongate (*I. tegetiformans*, *I. australis*), to elongate-upright (*I. andicola,* some *I. butleri* populations). Axis branching has been reported only from *I. andicola* (=*Stylites andicola*) but is present in taxa from the Levant, Southern Africa, and the Southeastern United States. Branched axes often have a form of budding that could play a role in asexual reproduction, a phenomenon previously unreported in the genus. Scales are tiny brown or black structures in alternating rows with sporophylls. They are usually overlooked and easily removed when rinsing specimens. Our research indicates that scales are widespread in most terrestrial/amphibious species and absent from submersed plants. Scales are ontogenetically distinct from phyllopodia: scales develop from distinct primordia while phyllopodia are indurate bases of sporophylls. The role of scales is unknown, some have taxonomic value. Lastly, sporelings may be an important form of diaspore in some species where the young sporelings float to the surface of the water and are carried by the current. Ideally, some of the rhizomorph and scale features could be of value to field biologists who presently have few non-laboratory resources for determining taxa. Research on *Isoetes* phylogeny could help determine which of the rhizomorph and scale characters might be plesiomorphic.

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Using fLow Cytometry to Aid Species Delimitation in *Isoetes*

The genus *Isoetes* is known for morphological convergence and a relative paucity of characters for identification. Thus the chromosome complement of *Isoetes* spp. (base chromosome number *2n*=22) is a key attribute for species delimitation. Like many other lycophyte plant lineages, polyploidy and reticulate evolution are an important drivers of speciation in the *Isoetes.* In the southeastern *Isoetes* flora, diploids, sterile triploids, tetraploids, hexaploids, octoploids, and decaploids are present. We discuss the application of flow cytometry for the estimation of ploidy level, including the preparation of suspensions of intact nuclei and staining with propidium iodide for analysis. Using reference material with known chromosome complements we were able to predict the ploidy level of unknown material supported by traditional microscopic chromosome

counts. Moreover we will share our experiences using contract flow cytometry facilities for analysis of fresh and herbarium material. Flow cytometry may prove a useful tool for routine species identification, systematic work, and for population level analyses of *Isoetes* in situations of mixed ploidy levels.

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DNA Sequences Identify Cryptic Species of Quillworts (*Isoetes* L.)

The tetraploid Louisiana quillwort, *Isoetes louisianensis*, a rare plant found in St. Tammany and Washington Parishes, was placed on the Endangered Species List in 1992. Subsequently, several populations found in Mississippi also have been identified as *Isoetes louisianensis*. In order to test whether the Mississippi populations indeed are *Isoetes louisianensis*, DNA from the type locality and three of the Mississippi sites was extracted, amplified, cloned and sequenced for the nuclear intron 2 of the LEAFY gene that previously has been proven useful in resolving relationships across *Isoetes*. Sequences of basic diploids that were suspected of contributing a parental genome to the allotetraploids were obtained by direct Sanger sequencing. Together the sequences produced an evolutionary tree indicating that a single Mississippi population, from a "Gator Branch" site, possessed the same diploid parental genomes as the type species *Isoetes louisianensis*. In the case of the other two populations from "Okey Branch" and "Moody Branch", different combinations of diploids were observed. Next Generation DNA Sequencing performed on the Illumina MiSeq® instrument then produced complete chloroplast genomes for the four tetraploids and the three relevant diploid progenitor species previously obtained by LEAFY gene sequencing. Phylogenetic analyses of the sequences for the seven *Isoetes* plastomes identified the chloroplast donor (presumed maternal) genome of the tetraploids. Again, the "Gator Branch" population was most similar to the *Isoetes louisianensis* type species.

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The Molecular Evolution of the Organellar Genomes of *Isoetes*: A Phylogenetic Perspective

Plant mitochondrial genomes show much more evolutionary plasticity than their organelle counterparts in chloroplasts. This plasticity is exemplified by more genomic rearrangements, greater variation in genome size, and more organelle specific RNA editing and (*trans*-)splicing of introns in the maturation of mitochondrial transcripts. We analyzed the mitochondrial genome and transcriptome of a lycophyte, the quillwort *Isoetes engelmannii*, which is extraordinary rich in recombination events and RNA editing sites. High recombination activity in the mitochondrial genome leads to complex repetitive structures with diverse gene arrangements. Since the mitochondrial genome is very gene dense with only small intergenic regions, recombination breakpoints often affect gene or intron sequences. Thus, novel molecular structures evolved to compensate for this evolutionary trend and maintain gene function, (like a very rare *trans*-spliced group I intron). Contrary to the complex mitochondrial genome, the more conserved chloroplast genome provides a critical resource to identify informative loci for phylogenetic analyses. We selected two established chloroplast markers (*rbcL* and *atpB-rbcL*) and the nuclear marker *ITS* to expand existing phylogenies of *Isoetes*. Our taxonomic sampling had a special focus on two South American species (*I. andicola* and *I. gemmifera*), which initially comprised the genus *Stylites*, and utilized historic herbarium collections housed at the Field Museum, Chicago. We were able to isolate the DNA of 17 *Isoetes* specimens (including 4 *I. andicola*, but none *I. gemmifera*) in sufficient quality to sequence small overlapping regions that connect to full length marker regions. Furthermore, we used 9 taxa with high-quality DNA to test the chloroplast *rpl16* gene for its potential as a new marker sequence. In all resulting phylogenies, *I. andicola* clustered within other *Isoetes* taxa, verifying its genera as Isoetes through the utilization of molecular data.

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A New *Isoetes* Species From Granitic Flat Rocks in Alabama

Populations of tetraploid (2*n*=44) *Isoetes* from ephemeral pools on granite outcrops in Randolph and Lee Counties of east-central Alabama represent a previously undescribed species. It appears to be closely related to and can be difficult to separate from the widespread outcrop diploid(2*n*=22) *I. piedmontana* (*s. str.*). Three populations of the tetraploid species have been cytologically confirmed. As many as five populations are suspected to occur, including one in adjacent western Georgia. The Flat Rock quillwort represents a globally rare endemic of the western Piedmont. It presents considerable potential for further ecological, biogeographic and taxonomic research.

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A Contribution to the Phylogeny and Biogeography of the Genus*Isoetes* (Isoetaceae) in the Mediterranean Region

To better understand the phylogeny of *Isoetes* species in the Mediterranean region, sequences of the second intron of a LEAFY homolog were determined for 11 Mediterranean *Isoetes* specimens and together with other sequences available at GenBank were analyzed using MEGA 5.1. In addition, ITS sequences of Euro-Mediterranean species also from GenBank were analyzed. Nomenclature of the species was updated according to recent literature. Examination of voucher specimens from previously sequenced taxa revealed that the specimen of *I. histrix* from Crete, Greece used in several previous molecular studies of the genus is actually *I. phrygia*. Analysis of ITS DNA sequence data confirms the division of Mediterranean species into three groups as suggested by earlier studies made on the genus as a whole: First, an older group, including *I. longissima, I. histrix, I. durieui, I. libanotica* and similar species in addition to other probably "Laurasian" species; second, an intermediate endemic relic group, including only *I. malinverniana* and *I. anatolica*; and third a younger group, including the Mediterranean *I. delilei, I. phrygia* and *I. todaroana*, along with the widely-distributed *I. echinospora* and other species occurring in several continents. Analysis of LEAFY sequence data confirms the division into three groups, too; in addition, it suggests that the *histrix/gymnocarpa* group from which the allopolyploid *I. durieui* arose contains one or more cryptic species. Correlations between the three groups (as defined by DNA sequence data) and morphological characters (including megaspore ornamentation, velum cover, presence or absence of phyllopodia), habitat preferences and distribution areas are unclear. Further investigations are needed to improve our understanding of *Isoetes* in the Mediterranean region.

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Towards a Phylogeny of *Isoetes* in the Southeastern United States

The systematic treatment of *Isoetes* in eastern North America afflicts taxonomists, especially with the discovery of several new taxa in the 1990s and 2000s. These elusive lycophytes have few variable morphological features to provide insight into the evolutionary history of the group. DNA sequences from multiple nuclear markers and whole chloroplast genomes provide a set of data to infer a phylogeny of the thirteen basic diploid taxa of *Isoetes* that occur in the southeastern US. Within the region several large clades are resolved, though relationships between some species are still unclear. Pacific Biosciences SMRT sequencing of the LEAFY marker reveals that within allopolyploid taxa, many individuals are descendants of hybridization events between different diploid parents. Since these plants are often morphologically indistinguishable, how to treat them taxonomically is matter that needs further investigation. Several unique parental combinations are

known from just a single collection, emphasizing the need for additional fieldwork and conservation of these individuals.

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Variation in Carotenoid Concentrations of House Sparrow (*Passer domesticus*) Eggs Across the Laying Sequence

Female birds allocate high concentrations of carotenoids (i.e., biologically-active yellow, orange, and red pigments) to their egg yolks, where the pigments protect sensitive embryonic tissues against damage from metabolic free radicals. Chicks that hatch from eggs with higher concentrations of yolk carotenoids tend to be larger and to grow faster than chicks that hatch from eggs with lower concentrations. Laying-sequence variation in carotenoid allocation has been documented in several bird species, with most females allocating higher concentrations of carotenoids to earlier-laid eggs than to later-laid eggs. However, most work has been done on European bird species, with very little work done here in North America. Therefore, we collected full clutches of eggs from House Sparrow (*Passer domesticus*) nests to identify the yolk carotenoids of the species and to determine if sparrows exhibit laying-sequence variation in carotenoid allocation. Forty five nest boxes were checked regularly on the main campus of Columbus State University in Columbus, Georgia. Eggs were marked on the day they were laid and then were collected 24 hours later for each egg until the full clutch was collected. Each collected egg was weighed, measured for length and width, and then frozen until carotenoid extraction. In the lab, the yolk of each egg was separated and weighed and a subsample was removed for carotenoid extraction. Carotenoids were identified and quantified using high performance liquid chromatography. The results of this research will provide much-needed data on the allocation of yolk carotenoids for birds in North America.

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Assessment of Reproductive Health in Marginal Populations of Buffalonut (*Pyrularia pubera*), a Dioecious Parasitic Shrub

The Buffalonut (*Pyrularia pubera*) of the family Cervantesiaceae is a hemi-parasitic shrub that inhabits the understory of forests of the Appalachian Mountains from northern Alabama through southwestern Pennsylvania, where it is listed as rare. Pennsylvania populations have come under special threat due to deer-browsing. *P. pubera* is dioecious and is also capable of asexual reproduction by rhizomatous growth. In this study we assess the reproductive health of SW Pennsylvania populations of *P. pubera* experiencing a spectrum of herbivory. A census was taken at each of four sites at anthesis of female flowers to estimate 1) the number of male and female plants belonging to the population, 2) the number of male and female flowers present, and 3) pollen to ovule ratio. Populations vary considerably in potential for sexual reproduction, likely due to extremely small census size. Future molecular studies will examine the degree to which limited sexual reproduction has shaped genetic diversity in *P. pubera*.

170 Justin Hendy
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Changes in Biogeography of Rare Plant Species Endemic to the Southeastern United States from 2001 to 2015

A comparison of county distributions of rare vascular plant species endemic to the southeastern United States from 2001 to 2015 was done to analyze changes in distributions. Out of the 482 species identified in 2001 as rare southeastern endemics only 419 species can currently be classified as such. Similar trends are found in 2015 when compared to 2001 showing a histogram of total county occurrences being skewed to the right. This right skew indicates that species endemic to the southeast are most likely to be regionally rare. About 20% of the species have

exhibited a range contraction whereas only 11.5% have shown a possible range expansion. The biogeographic trends are clear in showing that the status of these rare southeastern endemics are largely not improving and remain on the brink of extinction.

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The Paris Climate Talks and the 800 lb (363 Kg) Gorilla in the Room: Population Growth as the Root Cause of Global Climate Change

This past December, 196 parties convened in Paris to negotiate a comprehensive climate treaty, which would become legally binding if 55 countries, constituting 55% of global greenhouse emissions (GHGE), ratify the agreement. Despite negotiations and concern regarding the consequences of emissions, there was little discussion about population growth as one of the root causes of excessive GHGE. Using three independent sets of data obtained from publically available databases, I show strong, linear relationships between global population and atmospheric CO_2 concentration ($r^2 = 0.98$), between population and global average temperature ($r^2 = 0.86$), and between CO_2 and global average temperatures ($r^2 = 0.90$), over the past 140 years. Restricting the analyses from 1950 to the present improves the relationships slightly but does not significantly change their slopes. Every billion person increase in the world population is associated with a rise in CO_2 of 21 ppm and global temperatures of 0.17^oC, while every 10 ppm increase in CO_2 raises world temperatures by 0.10^oC. Since only four countries produce 67% of all GHGE, and per capita emissions are not always correlated with affluence, it is surprising that these relationships are linear, for which the underlying causes remain to be discovered. They demonstrate that population by itself quite accurately models global warming, despite the diverse activities of multiple civilizations around the globe. If they hold up for the foreseeable future, then the only way to minimize catastrophic climate change will be to reduce the world's population. Accomplishing that with a minimum of misery will require lowering birth rates rather than raising death rates, something that will be socially and politically difficult to achieve. Such changes will require decades or more due to reproductive inertia and force us to re-evaluate our current socio-economic systems and how a global civilization operates on a crowded planet.

172 Christopher Adams, Olamide Adejumo, Moondil Jahan, Kevin Montgomery
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Variation in Dormancy States for Seeds of *Calycanthus floridus* L.: Does Indefitine Retention in the Fruit Affect Germination Patterns of Seeds?

Calycanthus floridus is a shrub of the Calycanthaceae native to eastern U.S. forests from New York to Florida. Many fruits are not dispersed following maturation and may remain on the plant until the next year's flowering commences. Prior research has determined that seeds possess physical dormancy, and the seed coats must be made permeable to water before germination can occur. Seeds in fruits that are retained on the mother plant can be exposed to various dormancy-breaking mechanisms. Furthermore, it has been determined, in the last decade, that some species with physical dormancy can exhibit a dormancy cycling process if their seeds break physical dormancy but are prevented from germinating. The purpose of this study was to determine if seeds retained on the mother plant have their dormancy broken while in the fruit and, thus, exhibit different germination patterns from those seeds in fruits dispersed soon after maturity. Seeds were subjected to various scarification methods to break physical dormancy and then incubated at 25°C as were freshly matured seeds dispersed soon after maturation. Seeds with delayed dispersal germinated to significantly higher percentages in the following treatments: wet heat with vibration and buried seeds under burned soil. In all other treatments, however, seeds germinated to significantly lower percentages or at approximately the same percentages as dispersed seeds. Thus, at least some seeds may have physical dormancy broken while still within the fruits. It is not clear, however, as to whether other seeds are undergoing dormancy cycling or simply have not broken physical dormancy.

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Introduced Island Apple Snails (*Pomacea maculata*) in Western Georgia

Island apple snails (*Pomacea maculata*) are large caenogastropods that have become established in the southeastern United States. They pose ecological and human health threats where they occur outside their native range. Previous work proposed that island apple snails could expand their range across the coastal plain to the Piedmont, but little work has been conducted to establish their current distribution. We conducted surveys throughout the lower Apalachicola, Chattahoochee, and Flint (ACF) basin to map their distribution in this region of Georgia. Island apple snails have spread across Lake Seminole to the northern shore at the Spring Creek Resort. They have also spread east and west along the southern shore. We found no evidence that island apple snails have reached the Chattahoochee arm of Lake Seminole. Interestingly, we discovered a population of Florida apple snails (*Pomacea paludosa*) in the western portion of Lake Seminole. The isolated population in Albany, GA is well established and appears to expand into adjacent canals during rainy periods. We propose that the Albany population might be a candidate to attempt eradication. We found no evidence of apple snails in the main stem of the Flint or Chattahoochee Rivers, Walter F. George Lake, or Lake Blackshear.

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Selective Predation of Native Reef Fish by Lionfish (*Pterois volitans*/*miles*) Along the North Carolina Coast

Populations of the invasive Indo-Pacific lionfish (*Pterois volitans* and *P. miles*) have been present off the coast of North Carolina for over 10 years, yet relatively little is known about the effects that this predatory fish may be having on local native fish populations and community structure. The effects of invasive predators are likely to depend on their diet selectivity. In the case of selective predation, the identification of targeted taxa can help predict the potential negative effects of invasive predators such as lionfish. The goal of this study was to specifically test whether lionfish are nonselective generalist predators that feed on native fish in proportion to their abundances, or if they selectively target specific native fish taxa. To this end we developed a simple simulation null model, which we applied to published data on lionfish stomach contents and native reef fish abundance along the North Carolina coast. Using this method, 12 out of 28 native fish families appeared in lionfish stomachs as frequently as would be expected under the simulated conditions that lionfish are indiscriminant generalist predators. However, six native fish families were significantly under-represented in lionfish stomachs, suggesting that these taxa are avoided by lionfish or occur in different habitat types. Importantly, we identified ten fish families that were found in lionfish stomachs significantly more frequently than would be expected. Of these taxa, Scaridae (parrotfish), Monacanthidae (filefish), and Synodontidae (lizardfish) had the highest effect sizes, appearing in lionfish stomachs at a rate up to 52 standard deviations more frequently than expected based on our abundance-based simulation model. Our results suggest that these 10 preferred fish families, which include commercially and recreationally important fish species, may suffer disproportionate effects of lionfish establishment and predation.

175 Patricia D. Parr
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Promoting Pollinator Friendly Management on Federal Lands: The Oak Ridge Reservation Example

In response to the continued loss of pollinators in the U.S., a June 2014 Presidential Memorandum directed federal agencies to create a federal strategy promoting health of pollinators. Pollinator Best Management Practices were published and specific protection plans for agencies were developed. Key criteria for management include quality foraging habitat, reproduction sites, nesting and overwintering sites, pollinator presence for sensitive/rare plants,

invasive plant removal, native seed use in plantings, adaptive management, and public education and engagement. Specific examples include identifying presence of pollinators (beetles, butterflies, bumblebees, honeybees, other bees, monarch butterflies, moths, hummingbirds); diversity of plants including at least three species in bloom at any one time during spring, summer, and fall; butterfly host plants, especially *Aesclepias*; hummingbird habitat; ground-nesting areas for bees; habitat for cavity and wood nesting pollinators; accessible clean water; stable soil; invasive plant treatments; and providing good wildlife habitat. Although not a major land management agency, the Department of Energy is responsible for thousands of acres associated with its national laboratories and other operations. An assessment of the 33,400 acre Oak Ridge Reservation in Tennessee was performed during 2015 and confirmed that most current land management actions nicely complement pollinator habitat. Additionally, recommendations were made for actions that could be expanded or initiated to improve pollinator habitat with little or no cost and while still meeting other DOE mission objectives.

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Species Composition and Temporal Patterns of Road-kills Along Physiographically Distinct Routes in Southwest Virginia

Roads have negative impacts upon wildlife species through direct mortality, but little is known about the species composition and temporal patterns of road-kills, especially in Southwest Virginia. We conducted biweekly surveys on two physiographically distinct routes from January 1, 2015 to December 31, 2015. The aims of the study were to determine the species composition of vertebrate road-kills in Southwest Virginia, compare patterns of road mortality between seasons and along routes, and determine the detection probabilities of vertebrate species that potentially occur within the study area. We detected 1,837 road-kills from 65 species, 38 families and 19 orders. Mammals were most commonly killed (77%), followed by birds (10%), domestics (7%) and reptiles (6%). For species with average weight over 100 grams, detection was 20 of 24 (83%) species of mammals, 4 of 22 (18%) species of snakes and turtles, and 18 of 68 (26%) species of birds. We observed 20 of 134 (15%) species of birds with average weight less than 100 grams but in small numbers. Number of road-kills differed over seasons and routes, with Virginia opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), woodchuck (*Marmota monax*) and eastern cottontail (*Sylvilagus floridanus*) the most frequent species. Within the 38 species of birds detected, the eastern screech owl (*Megascops asio*) and American robin (*Turdus migratorius*) were the most frequent. The eastern box turtle (*Terrapene Carolina*) listed as a species of High Conservation Need in the VA Wildlife Action Plan was the most frequent reptile detected. Our findings show how two distinct routes can have different effects in terms of vertebrate mortality. We recommend a series of relatively low cost mitigation measures for the existing routes with further research to determine their effectiveness.

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Informing the Restoration of Piedmont Savanna Using High Quality Rights-of-Way as Reference

The presettlement Piedmont landscape supported an apparent abundance of fire-maintained landscapes, including Piedmont savannas. A loss of fire on the natural landscape led to a decline of fire-tolerant, sun-loving native herbaceous plants that had persisted for thousands of years. These plants are now restricted to few natural areas and a suite of rights-of-way, where frequent mowing has favored them. There is great interest within the conservation community in restoring these management-intensive savanna landscapes.Thirty-one rural rights-of-way (ROWs) displaying savanna-like herbaceous vegetation in the North Carolina Piedmont were surveyed in order to build a reference for managers wishing to restore savannas. Four distinct vegetative groups and their environmental preferences were identified. Edaphic variables were then

identified at the Mason farm Biological Reserve, a target restoration site. The edaphic variables at the target site were then compared to those of the ROW sites to infer which ROW vegetative groups to prescribe at the target restoration site.

178 Michael Kunz[1], Wade A. Wall[2], John L. Randall[1], Matthew G. Hohmann[2], Janet B. Gray[3]
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Germination Ecology of the Rare Southeastern Endemic, *Amorpha georgiana* (Georgia indigobush, Wilber [Fabaceae])

Understanding the germination ecology of a species leads to a greater understanding of the environmental factors necessary for germination and reveals what type of dormancy, if any, is present in the seeds of a species. Seeds that exhibit physical dormancy are impermeable to water and must undergo treatment such as mechanical scarification, exposure to heat or cold, or exposure to fire. Once physical dormancy is broken the seed can imbibe water and germinate. *Amorpha georgiana* (Georgia indigobush) is a rare subshrub found in fire maintained longleaf pine ecosystems and endemic to the coastal plain and sandhills of NC, SC and GA. Approximately two-thirds of the known occurrences are on Fort Bragg, an Army installation in NC where there is ongoing work on the species' demography and reintroduction. However little is known about its germination ecology. We describe the seeds of *A. georgiana* as possessing physical dormancy. To determine how physical dormancy may be broken, we tested mechanical scarification, heat shock and cold stratification, as well as the role the pods, by measuring germination percentages and mean time to germination. Intact fruits create a mechanical barrier to germination, regardless of treatment. Mechanical scarification and heat shock produce the highest germination rates and the shortest mean days to germination (89%, 2.85d and 80%, 5.88d, respectively), while cold stratification had a significantly lower germination rate of 26% and a mean germination time of 7.0d. Cold stratification was not significantly different from the control (17.5%, 10.86d). Since heat shock is less time intensive than mechanical scarification, we recommend this method for propagation. Fire likely plays a role in the germination of seeds and therefore in the long term viability of *A. georgiana* populations.

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Propagation and Reintroduction of the Sandhills Lily, *Lilium pyrophilum* (Liliaceae)

The Sandhills lily, *Lilium pyrophilum*, is a narrow endemic known from the Sandhills region of NC, SC, and the Outer Coastal Plain of VA. Most populations contain fewer than 10 individuals. NatureServe classifies it as globally imperiled (G2) and it is state-listed as Endangered in NC. We collected approximately 1,500 seeds for *ex situ* seed bank storage, seed plot establishment, and seedling propagation. We planted and marked for demographic monitoring 700 seeds, 105 bulb scales, and 695 seedlings across several years in order to increase population numbers on Fort Bragg Military Reservation, the NC Plant Conservation Program Eastwood Preserve, and Weymouth Woods State Park, NC. Of the 700 seeds planted *in situ* in 2008, 51 seeds (~ 7%) germinated by 2010. We continued to find new individuals, as well as individuals marked in previous years through 2015. Of the 105 bulb scales planted in Eastwood Preserve, 17 produced single leaves the following summer but none survived past the first year (as far as we know). One year post planting, five bulbs were excavated and four of the five had put on substantial growth, approximately doubling the bulb size and producing new scales. We are still evaluating the survivorship of the seedlings planted at Fort Bragg (2012-2015). To date there is a greater success with bulb plantings than with seeds, but because of year to year vegetative dormancy, overall reintroduction success is inconclusive at this time. Reintroduction does appear, however, to be a viable conservation tool for the recovery of Sandhills lily.

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The Use of Species Distribution Models (SDMs) to Guide Surveys for and to Evaluate the Distribution of the Streamside Salamander (*Ambystoma barbouri*) in the Central Basin of Tennessee

The Streamside Salamander (*Ambystoma barbouri*) is a medium-sized, fossorial member of the family Ambystomatidae. This species occurs throughout the bluegrass region of Kentucky, Ohio and Indiana, with disjunct populations in southwestern West Virginia and in the central basin of Tennessee. Breeding occurs in winter months and tends to occur primarily in low-order streams. This species is listed as Near Threatened by the International Union for the Conservation of Nature and is petitioned for listing under the Endangered Species Act. We developed a preliminary species distribution model (SDM) using current and historical occurrence data to be used as a guide for more efficient evaluation of the distribution of this species in Tennessee. We evaluated a variety of spatial data layers, including land-use, geology, soils, slope, elevation, vegetation cover, type and height. Preliminary results suggest high model support (mean AUC=0.940) with geology and soils being the most supported variables. These data will inform the listing review process, as well as serve as a guide to target areas of conservation concern and inform land management and habitat delineation processes.

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Biology, U of Louisiana at Monroe

American Alligator Nest Depredation by Feral Hogs

The American alligator (*Alligator mississippiensis*) is managed as a commercial, renewable natural resource in Louisiana. Conservative estimates have valued this resource at 80 to 90 million dollars annually, providing significant, direct economic benefit to Louisiana (Louisiana's Alligator Management Program, 2014-2015 Annual Report). American alligator nests in Cameron Parish, Louisiana were monitored during the summers of 2014 and 2015 for evidence of depredation by feral hogs (*Sus scrofa*). Remote game cameras were deployed during the month of July on 17 nests in 2014, and again on 10 nests in July of 2015. All cameras were retrieved in the month of September after hatching had occurred. Additionally, in 2015, two sham nests embedded with a player broadcasting recorded sounds of alligator hatchlings were monitored by the same technique. During the 2014 nesting season, 14 of the 17 nests were successfully monitored for the duration of the project. Of these 14 nests, eleven (78%) had hog visits documented on camera. Three of those eleven nests visited by hogs had evidence of successful hatching. The average number of hog visits was 1.64 visits/nest, and ranged from 1 to 3. During the 2015 nesting season, two corrupt SD cards resulted in 8 of the 10 cameras producing photographic data on nests for the duration of the project. Five of these eight nests (63%) were visited by hogs, and two of those five nests had evidence of successful hatching. The average number of hog visits was 5.2 visits/nest, with a range of 2 to 14.One of the two sham nests with the player broadcasting hatchling calls was visited 30 times by hogs.

182 Alvaro Pèrez[1], Antonio Vázquez-García[2], Frank Arroyo[3], David Neil[4], Daniela Cevallos-Garzín[1]
[1] Herbario QCA, Escuela de Ciencias Biológicas, Pontificia U Católica del Ecuador, Quito; [2] Botánica y Zoología, U de Guadalajara, Instituto de Botánica (Herbario IBUG), Guadalajara, México; [3] Herbario MOL, U Agraria La Molina, Lima, Peru; [4] Herbario ECUAMZ, U Estatal Amazónica, Puyo, Ecuador

Diversity and Conservation Assessment for Ecuadorian species of *Magnolia* L. (Magnoliaceae)

Magnoliaceae has a long evolutionary history of over 100 million years. It belongs to Magnoliid Clade and Magnoliales Order. Actually, only the genus *Liriodendron* L. and *Magnolia* L. are recognized; the former comprises about 350 species worldwide. The aims of this study were to understand Magnoliaceae diversity in Ecuador and assess their species conservation status. As

a result, a notable increase on diversity was generated; thus, a total of 23 species of *Magnolia* are recognized (18 endemic species; 7% of the world´s diversity; and 15% of the Neotropical diversity). All Ecuadorian *Magnolia* species belong to section *Talauma*, 15 of them belong to subsection *Talauma* and 8 species belong to subsection *Dugandiodendron*. Moreover, the species conservation assessments for Ecuadorian Magnolia´s revealed that 17 species (73%) are under a threat category: as Critically Endangered (CR) 7 species were recorded (*M. bankardiorum*, *M. canandeana*, *M. crassifolia*, *M. dixonii*, *M. napoensis*, *M. neillii* and *M. yantzazana*); 4 species were recorded as Endangered (EN) (*M. jaenensis*, *M. kichuana*, *M. shuariorum* and *M. striatifolia*); and 6 species were recorded as Vulnerable (V) (*M. chiguila*, *M. mercedesiarum*, *M. palandana*, *M. pastazaensis*, *M. zamorana* and *M. vargasiana*). The other species were evaluated as Near Threatened (NT) (*M. llanganatensis* and *M. mindoensis*); as Least Concern (LC) (*M. equatorialis*, *M. mashpi* and *M. rimachii*), and one species as Data Deficient (*M. lozanoi*). The main threats that these species face are deforestation, land use change, the over exploitation of individuals destined for timber, mining operations and low recruitment rate. To date there has been no *in situ* or *ex situ* conservation efforts for the Ecuadorian *Magnolia* species. It is urgent to implement conservation plans due to increased threats on their restricted populations.

183 Alexandria Jeffers, A. Darlene Panvini
Biology, Belmont U, Nashville, TN

Water Quality and Macroinvertebrate Diversity in Closed-Canopied and Open-Canopied Sections of an Urban Stream in Nashville, TN

Riparian corridors act as barriers along fragile stream ecosystems and help regulate the input and internal processes of streams. Widely susceptible to disturbance, especially in urban settings, changes in the riparian corridor can result in reduced water quality and biodiversity. A water quality assessment examining nine variables and a macroinvertebrate survey were conducted along two stretches of urban Richland Creek, in Nashville, TN. One stretch consisted of open canopy and riparian disturbance while the other was fully covered with a natural riparian canopy. The hypothesis was that water quality and macroinvertebrate diversity would be lower in the disturbed, open-canopied area. The water quality assessment (WQI) was in the “good” range for both sections, though slightly higher in the closed-canopied section. 1896 macroinvertebrates were identified to order. 64.5% of the macroinvertebrates were found in the closed section with the orders Gastropoda and Coleoptera dominating the closed section and the orders Gastropoda and Trichoptera most prevalent in the open-canopied section. Diversity, as measured by the Simpson’s and Shannon Indices indicated no differences, however, among the closed and open sections. This study establishes base-line data that can be used to determine the future success of small tree replanting along the banks of the degraded areas of the stream and will support the monitoring efforts of Richland Creek Watershed Alliance and future citizen science projects.

184 Walter Burn, A. Darlene Panvini
Environmental Science, Belmont U, Nashville, TN

Biodiversity of Macroinvertebrates in a First Order Spring-Fed Stream on the Belle Forest Cave Property, Bellevue Tennessee

Headwater streams are ecologically important, but often overlooked, and thus polluted, in urban areas. An urban first order stream was sampled for macroinvertebrates to discover how position in a stream affects water quality and macroinvertebrate abundance. Macroinvertebrates, used as indicator species, are an established means of determining stream health. The stream was divided into sections: upper, middle, lower; and further divided into pools, rifles and leaf packs. Two sites were sampled from each location for a total of 18 samples. The data were used to compare macroinvertebrate abundance and to create a water quality index. The results showed no statistical difference in macroinvertebrate diversity among the locations or habitat types. Future studies examining macroinvertebrates throughout the year are needed to further understand macroinvertebrate abundance and stream health of this first order stream.

185 Sandra L. Cooke
Biology, High Point U, NC

A Comparison of Zooplankton Diel Vertical Distribution During Transparent and Turbid Conditions in a Natural Southern Appalachian Montane Lake

According to the transparency-regulator hypothesis (TRH), water transparency is the main driver of zooplankton diel vertical migration (DVM) because it influences ultraviolet radiation (UV) exposure and visual predation, which vary greatly over a diel period. I examined zooplankton DVM in Mountain Lake, Virginia, which experiences fluctuations in transparency and water level, including complete emptying in recent seasons from subterranean seeps. Day and night distributions were measured May-July 2012 and June-August 2013. During the intervening winter, natural seeps in the lake were filled with sediments, which resulted in reduced transparency in 2013 compared to 2012. *Daphnia pulicaria* migration amplitude and Secchi depth were positively correlated, but this was not the case for *Diaphanosoma brachyurum* and diaptomids. On most dates zooplankton, including rotifers, exhibited diurnal deficits (DDs; higher night densities compared to day), indicating that DVM does not account for all diel movement. DDs are sometimes attributed to light-mediated sampler avoidance or diel horizontal migration (DHM), but DDs did not increase with Secchi depth and DDs in littoral zones do not suggest DHM. UV transparency, however, was low even in 2012 (the "clear" year). The TRH posits that in low-UV systems, factors such as visual predation, rather than transparency, more strongly influence DVM.

186 Logan Perkins[1], Mary Zaradich[1], Jeffrey Fore[2], Tom A. Blanchard[1]
[1] Biology, U of Tennessee at Martin; [2] The Nature Conservancy, Nashville, TN

The Effect of Stream Restoration on Fish Species Richness and Diversity in the Coastal Plains of West Tennessee

Most coastal plain streams in Tennessee have been channelized causing physical stream habitat and fish community degradation. Stream restoration has been implemented to restore stream habitats and fish communities. Little is known about fish community and physical habitat response to these efforts. The goal of this project was to determine the effects of stream restoration on physical habitats and species diversity and richness of fishes in three coastal plain streams in west Tennessee. Physical instream habitat data and fish were collected from three treatments (reference, channelized, and restored) annually during the summers of 2013-2015. Reference treatments (n=3) were those considered least-disturbed and channelized treatments (n=3) were located upstream of restored treatments (n=3). We used ANOVA to assess differences in species richness and Shannon-Weiner diversity among treatments. Species richness did not differ among treatments ($F=0.459$, $P=0.638$). Species diversity differed among all treatments ($F=16.71$, $P<0.001$). Post-hoc tests revealed species diversity significantly differed among all treatments ($P\leq0.0224$) and was highest in reference streams and lowest in channelized streams. Linear regression indicated a moderately positive relationship between standard deviation of depth and species diversity ($P=0.052$, $r^2=0.161$). No other habitat features were significantly related to species diversity. Stream restoration in coastal plains can increase species diversity relative to more disturbed, channelized systems and this is likely due to greater heterogeneity of depth habitats in restored streams. However, species diversity at reference sites was significantly higher than restored reaches which indicates channel restoration may not result in full recovery in the short-term (<5 years).

187 James T. Ragan, Matthew N. Waters
Biology, Valdosta State U, GA

The Environmental and Ecological Change of Cherry Lake, FL, USA, From the Mid-Holocene to Modern Day: Placing Human Impacts in the Context of Natural History

Humans often play a direct role in the influx of nutrients into a lake ecosystem. High concentrations of phosphorus (P) and nitrogen (N) cause trophic state shifts from desired algal communities and

natural ecosystem states to potentially harmful cyanobacteria dominance. Changing climate conditions and increased human alteration to landscapes stress natural ecosystems. Lakes can serve as sentinels of the environment because lakes are sensitive to climate, respond rapidly to change, and integrate information about changes in the catchment. Likewise, lake sediments are able to store information about climate change, internal lake changes, and changes to the catchment area by deposition of allochthonous and autochthonous materials. Here, we utilize paleolimnological tools to reconstruct ecosystem changes in Cherry Lake, FL from the mid-Holocene to present day. Cherry Lake is located in Madison, Florida and has an average depth of 2.8 meters and a surface area of 1.19 km^2. The shores of Cherry Lake are heavily developed with residential houses, and monitoring of Cherry Lake did not begin until the 1970s by the Suwannee River Water Management District. Sediment cores were retrieved in order to reconstruct nutrient inputs and primary producer responses over time prior to human settlement to understand baseline conditions and establish management targets for the future. Sediment cores show very low primary productivity and oligotrophic conditions throughout the Holocene with recent rapid increases in primary production corresponding to human impacts. The recent anthropogenic inputs have also triggered the only period of cyanobacterial existence in the lake which have led to intense blooms and fish kills. Cherry Lake serves as an example of the rapidity of eutrophication and the establishment of novel ecosystems from human-mediated eutrophication.

188 Neil Billington, P. Taylor Ezell
Biological and Environmental Sciences, Troy U, AL

A Comparison of Two Indices of Nitrogen Deficiency in Ponds in Pike County, Southeastern Alabama

Cyanobacterial blooms can be an unwelcome product of waterbody phosphorus eutrophication. Their dominance in eutrophic waterbodies is often associated with low (<10) N/P (Redfield) ratios, with values of <2 indicating indicating extreme phosphorus eutrophication, while at N/P=16 phytoplankton are phosphorus limited. In a 1979 paper, Watson and Osborne suggested using a 480/664 nanometer spectrophotometer pigment ratio for a 90% acetone extract of phytoplankton as an indicator of nitrogen deficiency in waterbodies, with values of <1.4 indication no limitation, 1.4 to 2.4 moderate limitation, and >2.4 indicating extreme nitrogen limitation. By using nitrate+nitrite and orthophosphate values, and 480/664 nm pigment ratios we compared these two methods for seven ponds in and around Troy, AL. Of these ponds, three were studied from spring 2003 until spring 2015 as part of a Troy University limnology course. A total of 51 comparisons were made. Only twice were Redfield ratio values recorded where phosphorus was limiting; on all other occasions values were <10, with a vast majority of values being <2 showing severe nitrogen limitation. Pigment ratio values showed severe nitrogen limitation on three occasions, 37 occasions when nitrogen was moderately limiting, and 11 occasions when nitrogen was not limiting. The Redfield ratio appeared to be more sensitive to nitrogen limitation than the pigment ratio. Low nitrogen and high phosphorus values can lead to blooms of cyanobacteria, because of their ability to fix atmospheric nitrogen. This could create problems if landowners have animals such as cattle near ponds, because some cyanobacteria are toxic to cattle.

189 Gary D. Grossman
Warnell School of Forestry and Natural Resources, U of Georgia, Athens

Long-Term Persistance, Density-Dependence and Effects of Climate Change on Rosyside Dace (Cyprinidae)

We used long-term population data for rosyside dace (*Clinostomus funduloides*) a numerically dominant member of a stochastically organized fish assemblage to evaluate the relative importance of density-dependent and density-independent processes to population persistence. We also evaluated the potential impacts of global climate change (GCC) on this species and predicted how directional environmental changes will affect dace. We sampled two 30 m permanent sites in spring and autumn in the Coweeta catchment for rosyside dace density using three-pass electrofishing between 1984 and 1995, and a single 100 m site from 1991 to 2003.

Habitat availability and flow variation data for this 20-year period demonstrated that two droughts (1985-1988 and 1999-2002) produced smaller wetted areas, lower mean, maximum and minimum flows, fewer high flow events and greater amounts of depositional substrata in the sites. Droughts produced significant increases in abundance, and significant decreases in standard length and mass of rosyside dace. Increases in abundance were due mainly to increased survival/immigration of young-of-the-year (YOY). Model selection analysis using multiple single and multivariable models indicated that density-dependence in various forms possessed substantial explanatory power with respect to long-term variation in the per-capita rate of increase (r) in all sites and seasons. Density-dependent effects on r were stronger in autumn than spring, whereas, negative density-independent models (flow variation) had the greatest explanatory power in spring. Results for growth data were similar to those for rosyside dace density and confirm density-dependence likely through intraspecific competition for food or foraging sites leading to reduced growth at higher densities. These data support the hypothesis that species may persist in stochastic animal assemblages via strong intraspecific density-dependence. Greater flow variability or increased high flows produced by GCC may destabilize this population leading to reduced compensation and possibly eventual extinction.

190 Karl H Joplin
Biological Sciences, East Tennessee State U, Johnson City

Description of the Microbiome of a Model Appalachian Stream

Sinking Creek (Waterbody ID TN06010103046) is a EPA 303(d) impacted stream of the Watauga watershed tributary with both relatively natural to highly impacted sites along a 14km transect. Environmental Health has surveyed the stream since 2003, but I have recently examined the microbiome along the stream bed in different microniches using 16S rDNA primers with Next Generation Sequencing. Out of 1,023,181 reads from 9 samples, 1607 identified Operational Taxonomic Units (average 78%) in 23 Phyla show differential community composition along the steam transect. The highest microbiome diversity was found in stream sediments with subsets in the water column, periphyta and invertebrate gut showing lower biodiversity results. The headwater samples cluster with other natural trout streams, with the downstream samples clustering as an outgroup. These results show the potential of using microbiome analysis to examine the biohealth of impacted and natural aquatic sites.

191 Jennifer R. Mandel[1], Rebecca B. Dikow[2], Vicki A. Funk[3]
[1] Biological Sciences, U of Memphis, TN; [2] Smithsonian Institute for Biodiversity Genomics, Smithsonian Institution, Washington, DC; [3] Botany, Smithsonian Institution, Washington, DC

Using Phylogenomics to Resolve Mega-Families: An Example From Compositae

Next-generation sequencing and phylogenomics hold great promise for elucidating complex relationships among large plant families. Here we performed targeted capture of low copy sequences followed by next-generation sequencing on the Illumina platform in the large and diverse angiosperm family Compositae (Asteraceae). The family is monophyletic based on morphology and molecular data, yet many areas of the phylogeny have unresolved polytomies and interpreting phylogenetic patterns has been historically difficult. In order to outline a method and provide a framework and for future phylogenetic studies in the Compositae, we sequenced 23 taxa from across the family in which the relationships were well established as well as a member of the sister family Calyceraceae. We generated nuclear data from 795 loci and assembled chloroplast genomes from off-target capture reads enabling the comparison of nuclear and chloroplast genomes for phylogenetic analyses. We also analyzed multi-copy nuclear genes in our data set using a clustering method during orthology detection, and we applied a network approach to these clusters—analyzing all related locus copies. Using these data we produced hypotheses of phylogenetic relationships employing both a conservative (restricted to only loci with one copy per targeted locus) and a multigene approach (including all copies per targeted locus). The methods and bioinformatics workflow presented here provide a

solid foundation for future work aimed at understanding gene family evolution in the Compositae as well as providing a model for phylogenomic analyses in other plant mega-families.

192 Katherine G. Mathews, Danielle Richardson
Biology, Western Carolina U, Cullowhee, NC

Cross-Species Microsatellite Amplification in the *Trillium erectum* Complex

Trilliums exemplify the plant diversity of the Southern Appalachians, and the *Trillium erectum* complex, a monophyletic group comprising ca. seven species, contributes greatly to this. However, botanists struggle with defining species boundaries in this group. Each species possesses sets of characteristics distinguishing them from the others, yet intermediates occur, many of which may be hybrids, particularly in sympatric populations. How extensive is gene flow between species in sympatric versus allopatric populations? How do species in the complex maintain their identities while hybridizing with others? What are the phylogenetic relationships among these species? Previous studies of the *T. erectum* complex have failed to answer these questions due to the lack of adequate variation at standard genetic markers. To address this issue, we tested the amplification of six microsatellite markers developed for *T. camschatcense*, the Japanese sister species to the *erectum* complex. All six markers amplified in some of our test samples. We sequenced the three marker regions with best amplification and confirmed the presence of a microsatellite in each case. For one marker, TC36, we performed fragment analysis of PCR products in 17 individuals of two species (*T. vaseyi* and *T. erectum*, both color morphs) from pure and mixed populations. The locus was polymorphic in each species. Thirteen alleles were identified, including potentially species-specific loci. We intend to increase our sample sizes for TC36 and to optimize amplification for the other five markers to study gene flow and relatedness among all seven species.

193 Alexander Krings[1], Piyush Agarwal[2], Bruce K. Kirchoff[3]
Plant and Microbial Biology, North Carolina State U, Raleigh; [3] Biology, UNC Greensboro

Image Sort Creator: A New Web Service for Developing Visual Learning Exercises for Field Courses

Field courses are critical for developing in students the necessary framework and beginnings for expertise in taxon recognition required for success in field-based careers in environmental agencies, consultancies, and non-profits. Field courses are effective learning tools to teach organismal identification because they help expose students to the variation in character states requisite for training their minds to recognize features and patterns like domain experts. However, not all subject matter is easily taught in a comprehensive field-based approach within the constraints of a university semester (e.g., rare plants) or locality (e.g., limited growing season). Thus, classroom or homework activities that mimic exposure to variation in the wild can also play an important role in developing expertise. Furthermore, even when subject matter can easily be covered and demonstrated in the field, availability of pre- or post-field exposure pattern recognition exercises based on the organisms learned in the field can help increase student retention of the material. We here present a new web service that with input of only digital images and a csv file allows anyone to create their own visual learning exercises to serve on their own web space. In addition, we discuss the use of the web service and incorporation of resulting image sorts in the learning framework of a field based botany course at North Carolina State University.

194 Abagail C. Burrus, Dane Kuppinger
Biology, Salem College, Winston-Salem, NC

Exploring the Historical and Modern Collections of the Salem College Herbarium

Salem College, founded by the early Protestant denomination of Moravians in 1772, curates hundreds of years' worth of herbarium specimens. Until very recently, the contents of the historical (1815~1900) and modern collections (~1900-2015) have remained unexplored. Now, a geographical study of the historical collection challenges the prevailing assumption that these

specimens are mostly local flora of Forsyth County, N.C. Additionally, the modern collection has been databased as part of the SERNEC herbarium digitization effort. Going forwards, the exploration of these two floral collections brings many opportunities for future studies involving their specimens. The database constructed for the historical study and the SERNEC catalogue of the modern collection allow much easier access to the herbarium's records. Both of these efforts are bringing what was once dark data to much broader awareness of the herbarium and its flora, which are relevant to the biological community as well as Salem's historical community. Curatorial suggestions following the construction of the modern collection's database propose future activities that will help the herbarium recover from beetle damage as well as foster greater student involvement.

195 John M. Herr, Jr.
Biological Sciences, U of South Carolina, Columbia

A Comparison of Anatomical Features in Fresh Sections of *Coleus blumei* Benth. With Sections Fixed in Carnoy's Fixative and Stored in 70% Ethanol and Sections Dehydrated, Paraffin Infiltrated and Embedded with Application of the Tertiary Butyl Alcohol Technique or with the Xylene Technique

Stem sections, 22 µm thick, of *Coleus blumei*i Benth. prepared with a hydro-microtome were stained with 0.05% aqueous toluidine blue 0 and their anatomical structural features examined and photographed with a Wild M-20 microscope equipped with an AmScope digital camera. These sections were then fixed in Carnoy's fixative (ethanol : acetic acid, 3:1) for 1 hr, stored in 70% ethanol, and after several days returned to water and stained with 0.05% aqueous toluidine blue O. The anatomical features were again examined and imaged. The same sections were returned to storage ethanol for several days then processed either with the tertiary butyl alcohol or xylene dehydration, paraffin infiltration and embedding technique. Xylene was applied to the sections to remove the paraffin. The sections were then returned to 70% ethanol, then to water, again stained with 0.05% aqueous toluidine blue O, and examined and imaged as previously described. There was no appreciable difference in the anatomy of fresh stem sections and sections fixed and stored. However, the anatomy was markedly distorted in sections embedded in paraffin by both techniques mentioned. The primary walls of angular collenchyma were severely shrunken, thin parenchymatous walls in cells of the cambial zone and other layers were wrinkled, and the protoplast structure in most parenchyma either destroyed or severely distorted. Paraffin embedding requiring a long period of exposure of the sections to a temperature of 55 C to 60 C evidently provides the major factor in the distortion of the natural anatomical structure in *Coleus* stems and suggests that anatomy of stems generally should be investigated in fresh sections or fixed and stored sections.

196 Catherine E. Garner, John M. Herr, Jr., John B. Nelson
Biological Sciences, U of South Carolina, Columbia

A Comparison of Stem Anatomy in *Stachys caroliniana* and *Stachys floridana* Shutlw. and Stem and Leaf Anatomy in *S. caroliniana* and Four Previously Investigated *Stachys* species

The objective in this investigation was to determine whether any anatomical features in *Stachys caroliniana* uniquely define the species. Stem and leaf cross sections sectioned with a hydro-microtome, 22 µm thick, were fixed in Carnoy's fixative (ethanol:acetic acid, 3:1) for 1 hr, stored in 70% ethanol, returned to water, and stained with 0.05% aqueous toluidine blue O . In cross section *Stachys* stems are rectangular, with large corner bundles and angular collenchyma, and four faces with a thin cortex of lamellar collenchyma and parenchyma above small vascular bundles. *Stachys* leaves have a large midvein bundle with abaxial, compact parenchyma. *S. caroliniana* and *S. floridana* differ anatomically in trichome structure and abundance and the amount of cortical angular collenchyma and parenchyma. The epidermis and lamellar collenchyma characteristically and naturally separate from the remaining cortex between the corners forming elongated air spaces in *S. floridana.* An infrequent, tearing separation occurs in

S. caroliniana. In *Stachys rupestris* the pith is solid unlike that of *S. caroliniana*. Corner bundles are more narrow and broader beneath less angular collenchyma. Few layers of abaxial, compact parenchyma occur in the midvein than found in *S. caroliniana.* The pith is solid in *S. scardica*,and the corner angular collenchyma is thinner than in *S. caroliniana*. Also, trichomes are branched on both stems and leaves, and the palisade mesophyll is two-layered. *S. balansae* stems have a larger band of corner angular collenchyma, more phloem fibers, smaller corner bundles, only 2 layers of peripheral pith cells, and a more rounded midrib bundle. In *S. carduchorum* angular collenchyma cells are smaller, the amount of phloem fiber smaller, and the corner bundles broader and thicker than found in *S. caroliniana*.Clearly, anatomical features define *S. caroliniana* and distinguish it from other *Sachys* species.

197 Charlie Williams
Michaux Society, Charlotte, NC

Retracing André Michaux's Botanical Explorations in the Carolinas and East Tennessee With a Michaux Family Member

Assisted by several active and retired botanists, Charlie Williams guided French journalist Régis Pluchet, Michaux's great-great-great grandnephew, an authority on Michaux's Persian travels, on a week-long tour of sites in the Carolinas and east Tennessee botanized by his ancestral uncle in the 1780s and 1790s.

198 Zach Irick, Joey Shaw
Biology, Geology & Environmental Sciences, U of Tennessee at Chattanooga

Preliminary Vascular Plant Flora of the Big Soddy Creek Gorge

The premise of this study is to document the vascular flora of the Big Soddy Creek Gorge (BSCG), located in Hamilton and Sequatchie Counties, Tennessee. BSCG is a dissected river gorge on the eastern edge of the Cumberland Plateau and it drains into the Ridge and Valley. From May 2014 until April 2016 I made approximately 30 collecting trips to upland plateau, gorge slope, and lowland Ridge and Valley habitats. Voucher specimens were collected and are being prepared for entry to UCHT. Preliminary results of the survey include 97 families, 277 genera and 450 species. Eight species of conservation concern have been documented, including *Castanea dentata, Diamorpha smallii, Diervilla lonicera, Diervilla rivularis*, *Gelsemium sempervirens, Phemeranthus teretifolius, Ribes curvatum,* and *Scutellaria montana*. Forty-five non-native species (10% of the flora) have been documented. Future directions include collecting through the 2016 growing season, delineating the plant communities of the gorge, and a phytogeographic analysis to determine the nature of the BSCG vascular flora.

199 Alan S. Weakley
UNC Herbarium, NC Botanical Garden, UNC Chapel Hill

An Example of What We Still Don’t Know About the Southeastern Flora: What Would Sherlock Think About the Confusticated and Combinatorial Case of the Alder on the Mountain?

The Roan Mountain population of “green alder” has been known for two centuries and is known in the region as a celebrated example of long distance disjunction and considered a conservation priority. Why do we still have so little certainty how to classify it, what name to apply to it, and its evolutionary history? It is instructive to review the history of taxonomic treatments that apply to the Roan Mountain “green alder” and their scientific and philosophical bases. Varying taxonomic philosophies, unstated but varying definitions and applications of taxonomic ranks, and purely nomenclatural issues have interacted to keep the name, rank, circumscription, and evolutionary history of the Roan Mountain green alder uncertain, with negative implications for botanists, ecologists, conservationists, and naturalists in the region. We can do better! Note that no Latin binomials were even used (let alone harmed) in the creation of this title and abstract.

200 Alan S. Weakley
UNC Herbarium, NC Botanical Garden, UNC Chapel Hill

John and Amos's Excellent Adventure: What Can We Learn 125 Years Later From Their Account About Taxonomic Exploration and Changes in the North Carolina Landscape?

In the summer of 1891, John K. Small and Amos A. Heller (then aged 22 and 24, respectively) made a three month "botanical campaign in the South", mainly in the Piedmont and northwestern mountains of North Carolina. Their narrative account is recorded in the Memoirs of the Torrey Botanical Club and the scientific results were reported in a series of papers published in ensuing years. Even at this time, successional pine forests (though of shortleaf, not loblolly) of the Piedmont were deplored ("a great part of this region is covered with a growth of *Pinus echinata*; these woods do not contain much of special interest, for some years ago they were cultivated fields", but other passages show the presence of fire-maintained woodlands with diverse and distinctive flora ("eight miles to the east are the pine-barrens, which are natural gardens") and the apparent ease with which now rare plants such as *Solidago ptarmicoides* and *Acmispon helleri* were found. In the mountains, *Sedum roseum* was described as "plentiful" at Lyon's Bluff (where now considered "historical") and *Lilium grayi* was already being protected from collection by exclosures and signage! The "swamp about halfway between Cranberry and Linville … which ought to have more attention paid to it" has had more attention paid it, yielding important rarities missed by Small and Heller. Such historical accounts provide perspective on the vast changes visited on the landscape and the challenges before us in conserving our remnant flora.

201 Henry G. Spratt, Jr.[1], David Levine[2], A. Grace Collier[1], Robert Kropp[1]
[1] Biology, Geology & Environmental Sciences, U of Tennessee at Chattanooga; [2] Physical Therapy, U of Tennessee at Chattanooga

Incidence of Bacterial Contamination in a Hospital's Neonatal Intensive Care Unit

The Clinical Infectious Disease Control (CIDC) group at UTC was asked by officials at a local hospital to investigate possible causes of high rates of infections in babies in their neonatal intensive care unit (NICU). The CIDC was asked to determine areas of the NICU that might be contaminated. After assessing the NICU, the CIDC proposed sampling 46 sites, replicated in three NICU pods (containing 8-10 babies each). Sample collection sites were of four types: individual baby stations, communal equipment, the physical plant, and non-specific. A total of 142 individual sites were sampled using sterile transport swabs. Swabs were placed on ice and returned to a microbiology lab at UTC, where within three hours they were use to inoculate Mannitol Salt Agar (for Staphylococci), CHROMagar MRSA (for methicillin resistant *S. aureus*), Pseudomonas Isolation Agar (for *Pseudomonas sp.*), Eosin Methylene Blue (for enteric bacteria), and Tryptic Soy Agar (for non-specific bacteria). Of the swabs collected 69/142 (48.6%) supported some type of growth, with 15/142 (10.6%) growing *S. aureus*, 7/142 (4.9%) growing MRSA, and 20/142 (14.1%) growing some sort of enteric. Based on sampling areas in the NICU, 36 out of the 46 areas sampled (78%) had bacterial contamination. The most contaminated sites were the return air ducts (3 out of 3 swabs growing *S. aureus* and enterics) and the floor near pod sinks (3 out of 3 swabs growing *S. aureus*, with 2 of the swabs growing MRSA, as well as enterics). Multiple items directly linked to baby stations (e.g., stethoscopes, nurse cell phones, baby charts, physician computer carts) were contaminated with *S. aureus*, with one stethoscope contaminated by MRSA. Recommendations for improved cleaning in the NICU were made and discussed with personnel, and the CIDC will sample all areas again to determine how effective these changes have been.

202 A. Grace Collier[1], Henry G. Spratt, Jr.[1], David Levine[2], Julie Bage[2]
[1] Biology, Geology & Environmental Sciences, U of Tennessee at Chattanooga; [2] Physical Therapy, U of Tennessee at Chattanooga

Potential Bacterial Contamination From Lotions and Creams Used for Soft Tissue Mobilization and Massage in Outpatient Rehabilitation Clinics

Soft tissue mobilization and massage play an important role in rehabilitation settings and are commonly performed by physical and occupational therapists at outpatient clinics. The purpose of this study was to determine the incidence of bacterial contamination in lotions/creams utilized in these therapies. In August 2015 our group sampled 22 different outpatient rehabilitation clinics in southeastern Tennessee and northwestern Georgia. Five types of lotion were found (Deep Prep, Palmers Cocoa Butter, Free Up, Prelim Balm, and Prelim 27 Cream), with 81 jars sampled. Three sites on each jar were sampled via sterile swabs: threads, the inner lip of the jar, and lotion obtained from the center of the jar. Swabs were placed on ice and transported to a microbiology lab at UTC, where within six hours they were used to inoculate Tryptic Soy Agar (for non-specific bacterial contamination), Mannitol Salt Agar (for *Staphylococcus* species), Pseudomonas Isolation Agar (for *Pseudomonas* species), and Eosin Methylene Blue Agar (for enteric bacteria). Of the 81 containers sampled, 27 (33.3%) tested positive for some type of bacterial growth. Bacterial contamination was found in all brands sampled, and in all sampling locations. The majority of contamination (22 out of 27, 81.5 %) was found on the jar threads, with only two, and three jars having contamination on the inner lip, or in the lotion itself. Eight of the jars (threads) were contaminated with *Staphylococcus* species, with four identified as *S. aureus* (one culture was determined to be methicillin resistant *S. aureus* – MRSA). Three jars had some form of enteric contamination, and no *Pseudomonas* sp. contamination was observed. This study supports the need to develop standardized cleaning procedures for lotions/creams used in outpatient rehabilitation clinics. Such action may help reduce nosocomial infections, particularly those associated with patients who are immunocompromised, or those with open skin lesions.

203 Bryan R. Eoff, Nick Ragsdale
Biology, Belmont U, Nashville, TN

Caenorhabditis elegans Response to Hyperglycemic and Hypoxic Conditions Post Infection with _Staphylococcus aureus_

Diabetes and strokes account for more than 200,000 deaths within the United States every year. Diabetes occurs when the body cannot regulate glucose properly, while strokes occur when the blood flow of oxygen to the brain is disrupted; causing a hypoxic environment. *Staphylococcus aureus (S. aureus)* kills *Caenorhabditis elegans (C. elegans)* by creating pore-forming toxins (PFTs), but *C. elegans* survival response is to activate hypoxia inducible factor 1 (HIF-1) in response to hypoxia and decrease the formation of PFTs, increasing survivability. In a previous study, excess glucose caused inactivation of HIF-1 due to decreased of transcription activation of *HIF-1α*. In this experiment, *C. elegans* were infected with *S. aureus* and/or excess amounts of glucose, replicating type II diabetes, and placed into a hypoxic chamber with 1% oxygen. *C. elegans* showed a higher rate of death when exposed to excess glucose and *S. aureus* indicating that HIF-1 was not activated and decreased survivability in a hypoxic environment.

204 Austin T. Leavell, Katelyn E. Mcgee, Christopher E. Muegge, Henry G. Spratt, Jr.
Biology, Geology & Environmental Sciences, U of Tennessee at Chattanooga

Microbial Community Dynamics Related to the Function of an Artificial Wetland

In 2006 the City of Chattanooga completed work on Renaissance Park near the Tennessee River in downtown Chattanooga, TN. The area's industrial past resulted in varying degrees of pollution infiltrating into groundwater and the adjacent Tennessee River. An artificial wetland was included in the park's design to help filter groundwater/stormwater-runoff before it reached the river. This study focused on determining whether microbial communities necessary to clean water flowing through the area are present in the water-column and sediments of this wetland. To determine if sulfur-transforming bacteria that help sequester many metals in wetland sediments were present, sediment samples were collected and placed in Winogradsky Columns, which were allowed to mature for two months. Assessment of microbial community activity necessary to break down the high load of organic matter found in the wetland was done for sediments and the water column in microcosms to which ^{14}C-glucose was added. Mineralization rates were calculated after short incubations in the microcosms. Numbers of heterotrophic bacteria present in the water column

and surface sediments were quantified using serial dilution and viable plate counts on tryptic soy agar. Abundant growth in the Winogradsky columns suggested that there are high numbers of sulfate-reducing bacteria present in wetland sediments, which could help sequester metals in the anoxic sediments. Rates of glucose mineralization obtained in this experiment were not significantly difference (ANOVA; $p > 0.05$) for microbial communities in the water column (2.1 ± 0.6; pg/cfu/day ± SD) or in surface sediments (1.2 ± 0.2; pg/cfu/day ± SD). This suggests that organic matter coming into the wetland has equal chance of being mineralized in either the water column or the sediments. Overall, the Renaissance Park artificial wetland possesses microbial communities that should help the wetland accomplish its intended function to reduce pollution flowing into the Tennessee River.

205 Dane M. Kuppinger, Laura Aleman, Jessica Askey, Alanna Natanson, Juyong Shin, Laura DeFord-Watts
Biology, Salem College, Winston-Salem, NC

Assessing the Impact of Coal Ash Exposure on Soil Microbes in the Dan River

Coal ash often contains significant concentrations of heavy metals and in spite of impoundment efforts, numerous spills have taken place. One such spill occurred in February 2014 along the Dan River. This study assessed the impact upon soil microbes as these may show evidence of teratogenic effects more rapidly than vertebrate and macro-invertebrate populations. Soil and water samples were taken from the channel and banks of the river at 8 locations; three locations upstream from the plant, one at the spill site, and four downstream of the spill site. On the banks, there was a significant difference between chromium content upstream, at the spill, and below the spill ($p<0.05$ for all) with the concentration at one location above EPA safety limits. In the channel, there was a significant difference in chromium levels upstream vs. downstream and at the spill vs. downstream of it ($p<0.05$ for both). Except for Nitrate and Phosphorous, when grouped by location relative to the spill, there were also significant differences in all other measured abiotic soil properties. Microbial density declined significantly upstream vs. downstream in bank and channel samples ($p\leq0.05$ and $p\leq0.01$, respectively) and at the spill vs. downstream in bank samples ($p\leq0.05$). At the spill site, dehydrogenase activity on the bank and the number of CFU/g soil in the bank and channel significantly declined from upstream values but both were greater downstream in bank and channel samples than they were at the upstream and spill sites ($p<0.05$ for all). A Log-linear analysis found that phyla level microbial diversity varied significantly between locations ($p\leq0.001$). The changes in abiotic variables upstream vs. downstream of the spill strongly suggest a significant impact upon the microbial environment. Although overall soil microbe density appears to have been reduced by ash exposure, certain soil bacteria appear to have flourished.

206 Chasity Lawless[1], Debbie Curtis[1], Mishal Jamil, Michelle Zedonek[1], Amelia Abdullah[1], Robert Haining[1], Lee Kurtz[1], Rebekah Ward[1]
Science & Technology, Georgia Gwinnett College, Lawrenceville

Nitrogen Fixation Dynamics in *Pueraria montana*

Pueraria montana, better known as Kudzu, is an invasive species rapidly spreading throughout the Southeastern United States. This plant can form root nodules which house nitrogen-fixing bacteria, allowing atmospheric N_2 to be converted into biologically available forms nitrogen for use by the plant host. Kudzu is able to grow at an accelerated rate due to a symbiotic relationship held between the plant and nitrogen-fixing bacteria in the nodules. This capability of Kudzu makes dramatic changes to the local nitrogen cycle however, doubling NO emissions and increasing ozone. Previous research has suggested that there are some nodule bacteria that can give little or no benefit to the host. These bacteria are referred to as cheaters. If cheaters were added to soil surrounding Kudzu, there is a possibility that these bacteria would slow the growth of the host, reducing air pollution. In an attempt to identify and better characterize Kudzu nodule-associated cheaters, nodule samples were taken from seven locations around the metro Atlanta area. Bacteria from inside the nodules were isolated and grown in four different nitrogen-free

media under both aerobic and anaerobic conditions. Four possible cheaters were identified using data evaluating relative growth, possibly reflecting reduced nitrogen fixation and corresponding benefit to the host. DNA was extracted from the isolates in order to amplify two genes, *nifD* and 16S rRNA. *nifD* genes are part of the nitrogen-fixing enzyme nitrogenase while 16S rRNA genes are routinely used for species identification. 16S rRNA gene reveals minor evolutionary diversity amongst isolates. Analysis of *nifD* reveals variations between isolates and some correspondence with an ability to fix nitrogen. With these data, further characterization of the putative cheaters may reveal the mechanism of reduced fixation rates and provide insight into possible bioremediation of Kudzu.

207 Marlan E. Hare, Philip Rock
Biology, Virginia Wesleyan College, Norfolk

A Comparison of the Cultivatable Bacteria From *Wolbachia*-Free and *Wolbachia*-Infected Strains of *Drosophila melanogaster*

Wolbachia is an obligate intracellular symbiont of many arthropod species and has various effects upon hosts. Understanding the impacts *Wolbachia* has on the microbiome of hosts could reveal valuable insights into the role this endosymbiont could have in controlling human pathogens spread by arthropods. Yet there is little published work on the influence of *Wolbachia* on its host's microbiome. If *Wolbachia* has an effect on the microbiome of the host, then there should be a quantifiable difference in bacteria populations between infected and uninfected organisms. Surface-sterilized strains of infected and uninfected *Drosophila melanogaster* were homogenized and dilutions were spread on nonselective growth media to observe total bacteria cell count and the variety of bacterial species. Bacterial isolates were identified using standard growth-dependent methods. In contrast to previous work at VWC, *Wolbachia* does not seem to significantly influence the microbiome of *Drosophila melanogaster,* either in total numbers of bacteria or the species recovered. However, significant fly to fly variation in bacterial gut population totals may have obscured any observable effect *Wolbachia* may have had on gut microbiome composition. Additionally, the bacteria identified were only species that could be grown under our stringent conditions and are not representative of the microbiome as a whole.

208 Jay A. Yoder, Andrew J. Jajack
Biology, Wittenberg U, Springfield, OH

Preventive Steps for Minimizing Effects of Fungicides (and Pesticides) on Honey Bee Colonies

Our work indicates that fungicides weaken honey bee (*Apis mellifera*) colonies by decreasing beneficial probiotic fungi in the colony, causing an inability to fight disease. Bees are exposed to fungicides in agricultural areas that have been sprayed to prevent plant diseases. The fungicides show up in the colony (including colonies in certified organic fields), as the pollen, nectar, and bees themselves become contaminated with these compounds. This occurs at concentrations of fungicides that are considered safe for bees by the manufacturers. The probiotic colony fungi are a mixture of *Aspergillus*, *Penicillium*, *Cladosporium,* and *Rhizopus*. This set of fungi protects the colony by secretion of antifungals and exploitation competition: fungicides reduce all of these beneficial fungi, and no single fungus component is more important than the overall quantity and diversity. Moving colonies can magnify the problem by exposing bees to additional fungicide residues. Communication with growers, marking colonies for aerial detection, and closing or reducing colony entrances are important ways to lower the amount of fungicides that enter the colony. We report that activating pollen traps, and feeding colonies syrup, clean pollen or pollen substitute reverse the fungicide effect and maintain probiotic fungi levels in the colony.

209 Jennell M. Talley, Rebekah Ward
Science & Technology, Georgia Gwinnett College, Lawrenceville

Use of Creative Writing to Encourage Students to Address Their Misconceptions in Genetics

Genetics is one of the more difficult courses taken in biology. Often time students confuse ideas due to misconceptions that pervade in their homes or in popular media. Other misconceptions arise due to the extensive jargon that is present in the field and the fact that some words or concepts sound similar (example mitosis vs. meiosis or homologue and homozygous). Some alternative conceptions may arise due to the abstract nature of genetics. For example, because an allele of a gene on a chromosome cannot be seen in a compound microscope, students might not fully understand the difference between a chromosome, a gene and an allele. It has been suggested that because the misconceptions in genetics can often be tightly held, students require more time with the material and repeated exposure to the same concepts over time may help them relinquish some of these misconceptions. To allow students more time with challenging concepts, a creative writing assignment was developed as a semester long project. Students were asked to create their own alien creature that they discovered on a voyage to a distant planet. They were required to explain in detail the following topics in relationship to characteristics they developed for their creatures: (1) Basic Mendelian characteristics (2) Sex determination and Sex-linkage (3) Extensions of Mendelian characteristics (4) Pedigrees (5) Epigenetics (6) Mutations and Repair. They were required to show multiple Punnett squares and apply chi-square tests to their “observed” data and predictions they made based on the different patterns of inheritance. Differences between a section that completed the assignment and one that did not will be discussed. Student opinions of their learning and student assessment of the assignment will also be presented.

210 Victoria A. Burgess, Janyne Musso, Elizabeth Javazon, Jennifer Hurst-Kennedy, Allison R. D'Costa, Latanya Hammonds-Odie, Cindy Achat-Mendes
Biology, Georgia Gwinnett College, Lawrenceville

Using Peer Supplemental Instruction in an Introductory Biology Course to Cultivate STEM Competencies

Peer Supplemental Instruction (PSI) involves a different approach to learning course content as opposed to the conventional method of tutoring. This PSI program was designed to support an introductory biology course, Principles of Biology I with Laboratory (BIOL 1107K) for STEM majors. Our PSI model is focused on: 1) equipping students with active learning competencies specific to STEM education and 2) developing in students' biology laboratory skills through lab-embedded PSI leaders. In PSI sessions, leaders were trained to incorporate study skills techniques with collaborative learning strategies to facilitate an active learning environment. The effect of PSI participation on understanding BIOL 1107K course concepts were evaluated using pre- and post- concept inventories and by analyzing student exam grades as a function of PSI participation. In labs, leaders helped to identify common sources of errors in micropipetting and graphing and developed an assessment rubric which was used to evaluate students at mid-term and end of term. In a sample of BIOL 1107K PSI students (n=40), PSI participants either maintained or improved exam scores by approximately half of a letter grade compared to their non-participating classmates (n=65). Attending more than four PSI sessions also seemed to improve exam scores by approximately 11% or a whole letter grade whereas attending less than four sessions improved scores by only 2%. Further, students who attended PSI performed better in specific course goals that are perceived to be more challenging including biochemistry and central dogma of biology. Analysis of student performance in lab research skills indicate a significant improvement in micropipetting but not graphing between end of semester and mid-semester assessments. Collectively, these data reveal a correlation between improvement in student performance and participation in PSI and provide evidence for the effectiveness of peer supplemental instruction in developing STEM competencies in freshmen students taking introductory biology courses.

211 Candace Timpte, Peter C. Sakaris, Alexandra Kurtz, LaTanya Hammonds-Odie, James M. Nolan, Mark A. Schlueter, Jill Penn
Biology School of Science and Technology, Georgia Gwinnett College, Lawrenceville

Analysis of Reading Speed and Comprehension in Biology Majors

Successful students must be able to comprehend and summarize their college level reading assignments and critical thinking can begin only after readers have information and knowledge. Faculty members frequently note that students either do not read or have difficulty reading. Moreover, students frequently report that college level texts are difficult to read. In this study, students read a passage with a time limit, summarized the passage and answered comprehension questions. Student reading scores are analyzed with respect to number of college hours completed, GPA, ethnicity, English as a second language skills and other metrics. Since successful science students must understand and interpret literature that uses technical language appropriate to the field, we hope to document correlations between reading comprehension and student success in order to better understand difficulties STEM students encounter.

212 Mark A. Schlueter, Boyko Gyurov
Science & Technology, Georgia Gwinnett College, Lawrenceville

Teaching Biology and Mathematics During Field Experiences in a Month-Long Study Abroad Program in Vietnam

Student engagement and hands-on learning experiences can be valuable tools when teaching new concepts to students. Study-abroad experiences have traditionally been used to enhance student learning and application in history and language classes. In the following presentation, the effectiveness of integrating a biology and math field experience in a month-long study abroad program in Vietnam will be explored. Ten students performed a three-week long experiment, while also taking both a Tropical Biology class and a Calculus I class in Vietnam. During the field study, they measured bee and fly diversity at and between two different flower plots located approximately 50 meters apart. The first plot contained numerous small yellow flowers, while the second plot contained numerous medium-size blue-purple flowers. The students collected flies, bees, ants, and several other types of insects using blue, yellow, and white pan traps and malaise traps placed at five-meter intervals between the two flower patches. Students gained valuable skills in experimental design and techniques, performed field experiments, sorted insects, tabulated data, and performed statistical and mathematical analysis learned in the Calculus class they were taking. The field study allowed for a practical application of the theoretical knowledge they acquired in both biology and math classes. Overall, students reported favorable reactions to the field experience and stated that their knowledge of insects, research design, and data analysis increased. It is also important to note the cultural enrichment the program offered due to the constant interactions of the American students with their international counterparts, since the field study and the program's courses took place at Thai Nguyen University of Technology (Vietnam).

213 Valarie A. Burnett
Science & Mathematics – Biology, Newberry College, SC

Incorporating Student-Centered Learning Strategies, Including Flipped Classroom Activities and Course-Embedded Research, Into the Classroom Environment

Recent innovations in teaching call for an increase in student-centered instructional methods, which engage students in inquiry and empower them to take responsibility for their own educational process and sustain lifelong learning. Therefore, students enrolled in my Anatomy and Physiology courses were given a variety of flipped-classroom-style assignments, in which they surveyed and researched course-related concepts and presented them to their classmates. At the end of the term, they were asked to evaluate the usefulness of these assignments on the following criteria: learning & retaining course material, providing an engaging & enjoyable

experience, promoting inquiry, developing critical reading & thinking skills, and enhancing written and oral communication. At least 90% of the students reported these assignments were very useful to extremely useful in the afore-mentioned categories. To further explore student-centered learning, these students, along with students in a non-major general biology course, were given a research question with limited background information and asked to design and conduct experiments to answer the question. They analyzed the results and wrote a formal lab report. Most students were able to design appropriate experiments and successfully interpret the results; however, many were deficient in writing an acceptable lab report. Improvement in this area will be addressed in the future. Most students reported that the process of scientific inquiry and investigation was an engaging and enjoyable experience. Data collected from the student evaluations is used to improve the design and learning applications of previous assignments and to develop new learning strategies. Further exploration in course-embedded research and additional active-learning methods is planned for the future.

214 Roger A Sauterer
Biology, Jacksonville State U, AL

Using Ecosystem Jars to Support Inquiry-Based Student Experiments

Sample or Mason jars filled with water, sediment and photosynthetic organisms such as algae from local ponds or streams and then sealed can form self-sustaining miniature ecosystems powered only by sunlight. These ecosystem microcosms can sustain themselves for a decade or more, requiring only exposure to sunlight. These ecosystems evolve, with the proportions of various organisms in them increasing or declining over time. Using simple identification keys for common organisms such as nematodes, mites, tardigrades, protists and rotifers, students can determine the proportion of each group of organisms in the jars by microscopic observation. Students can also measure environmental parameters such as pH, dissolved oxygen, hardness and nitrates or phosphates by instruments and/or chemical tests using commercially available water test kits. Students can then correlate ratios of specific categories of organisms with measured environmental parameters, exploring such questions as “are certain organismal groups more tolerant to high or low pH or low levels of dissolved oxygen than others?” Students can also alter ecosystem jars collected at the same time and place by reducing or increasing light exposure, adding nitrates or phosphates as fertilizer, adding environmentally relevant levels of common pollutants or other alterations and observe changes in organism ratios over a period of weeks. Students then present their data and conclusions in a poster or paper type format or in oral presentations. Ecosystem jars can support a wide variety of inquiry-based and student-initiated projects and experiments and can be performed in both college and secondary school labs.

215 Michael K. Moore, Virginia A. Young
Biology, Mercer U, Macon, GA

A Redesign of Introductory Biology for Majors: Experimental Implementation of the Supplemental Model of Instruction

BIO 211, Introduction to Biology I, is a semester-long, five-credit-hour, freshman-level gateway course for students majoring in biology at Mercer University. Historically (i.e., since 1997), this course has been offered on a traditional schedule of 3 hours of lecture, 3 hours of lab, and one hour of recitation (e.g., with some kind of group active-learning activity) per week. In 2014, we redesigned this course generally following the principles defined by National Center for Academic Transformation (NCAT) for a Supplemental Model of instruction. The most significant changes in instruction include the use of lecture periods for individual and small group problem-based learning, the addition of online homework modules, and the use of recitation periods to develop skills related to data analysis and writing in the scientific style. Using a parallel design, we are gathering a variety of data from 6 sections to evaluate the efficacy of this new approach. In the spring of 2015, two sections (N=48 students) of the revised course and one section (N=24) of the traditional design were offered. In the current semester, the numbers are reversed (i.e., N=48

traditional and 24 revised). We have additional baseline data from 2 sections offered by the same instructor (MKM) in the spring 2014 semester. Data collected include performance on shared exams (including specific learning objective and taxonomic-level analyses), student-reported analyses of study approaches, student perceptions surveys of the course and its various components, and student performance in the second semester introductory course.

216 Cancelled

217 Melissa M. Fox, Erika S. Niland
Biology, Wingate U, NC

Biology Intensive Orientation Seminar (BIOS) Enhances Student Performance in Introductory Biology Courses

Derivations of the Biology Intensive Orientation Seminar (BIOS) program have been implemented at schools around the country in an effort to increase student success and retention within the biological sciences. These models have largely been developed around the context of providing the students with early exposure to course content during one or two-week summer sessions. At Wingate University, the premise of the BIOS program has been tailored to provide incoming first-year students with a six-day experience that introduces students to academic skill sets, as opposed to course content, that are required for success in the biological sciences. To accomplish this goal, exercises were developed that addressed note-taking skills, study habits, and test taking strategies that were centered on a biological theme. Programming also emphasized exposure to innovative laboratory exercises, introduction to campus resources, awareness of biological and health-related career opportunities, and development of peer and faculty relationships. BIOS participants were placed in linked cohorts for fall semester that included the same faculty member serving as their BIOS facilitator, BIO150 professor, Gateway101 professor, and academic advisor. BIOS participants were also housed together in a living-learning community. Student performance in BIO150 (introductory-level cell and molecular biology), retention information, and survey data were used to evaluate the efficacy of the program. At the completion of fall semester, the BIOS cohort (n=43) scored 10.12 points higher (+/- 11.60, p=00004) overall in BIO150 compared to the Non-BIOS control group (n=41). Significant differences were also found in course withdraw rates, retention in the major, and student perceptions on the type of programming that contributed towards their performance. Notably, BIOS participants reported significant advantages to the peer and faculty relationships that were established during the summer BIOS program. Overall, the BIOS program can be a powerful tool to establish engaged and successful students in the biological sciences.

218 Gary D. Grossman
Warnell School of Forestry and Natural Resources, U of Georgia, Athens

Innovative Approaches to Fisheries Education

Biological pedagogy frequently uses outdated instructional models, even though newer approaches such as multimodal and active instruction may result in better educational outcomes. We discuss a variety of innovative instructional approaches for biology classes including multimodal educational approaches using original music videos, student karaoke videos, and active learning approaches using videos of naturally behaving animals. Questionnaire responses from both undergraduate and graduate classes indicated that the various multimodal and active learning approaches generally improved student's attitudes towards class and studying. I discuss varied student responses and the evolution of these multimodal and active learning exercises.

219 Jennifer Thompson
Science, Could Middle School, Charlotte, NC

From the Merman to the Weatherman: The Evolution of Weather Prediction

This curriculum unit investigates how weather forecasting has changed over the years. Students will begin by investigating weather myths and folk sayings in order to analyze whether these myths were rooted in science. Students will participate in cooperative learning groups while completing I-charts and reflective journaling activities to master the content presented. An important piece of this unit is the use of primary sources in the science classroom. Science instruction is often centered on text book like information text, but primary sources can be just as valuable as tools of learning and instruction. Students will analyze primary sources from two historical storms in order to understand the cultural, social, and economic impacts of these storms. Students should be able to make the connection that modern forecasting techniques were born not only for the curiosity of predicting the future, but out of necessity for keeping us safe and our cities secure. To that end, we'll explore the myriad of ways that early cultures ventured into meteorological prediction, ranging from observing merman as harbingers of bad weather to observing changes in animal behavior. Learning about modern forecasting technologies will come next in this unit with students making the connection that science has come a long way in the past several hundred years. The unit wraps up with a project where students will demonstrate that they understand how scientists have developed the field of meteorological forecasting over the years.

220 Connie Wood
Biology, East Mecklenburg High School, Charlotte, NC

Metamorphosis—Triggers of Transformation

In this unit you will find a summary of some of the latest research on the evolution and the mechanisms of metamorphosis. This information provided me with multiple ways to include metamorphosis in my IB Biology class. This unit incorporates a review of gene regulation, cell differentiation, and development—which are taught during the first year of the course—in order to prepare the students for their IB exams. I use examples of the causes of metamorphosis to review these concepts during new lessons on evolution, hormones, ecology, and animal behavior. Students don't always make the connection between the effects of hormones and environmental factors and the actions of genes, or how changes in DNA can affect the evolution of a species. With this background knowledge, students will design experiments testing the effects of some environmental factor on the transition from larva to pupa: crowding, temperature, food, moisture, or chemicals in the environment such as BPA. Students will also do an activity involving modeling of hormones and cell communication.

221 Cindy Woolery

Science, Elizabeth Traditional School, Charlotte, NC

Life Cycles of Animals—Constant Change!

This curriculum unit (CU) is targeted for second grade students. The unit will address two of the Essential Standards for second grade. The first Essential Standard is Structures and Functions of Living Organisms; Understanding animal life cycles. The clarifying objectives for this strand are: Summarize the life cycle of animals including: birth, developing into an adult, reproducing, and aging and death. The second objection is to compare life cycles of different animals. The second is Evolution and Genetics; Understanding that organisms differ from or are similar to their parents based on the characteristics of the organism. The goal of this unit is to first help my second grade students come to an understanding of animals' life cycles which begins with birth, then a period of time in which the animal develops into an adult. At adulthood, animals reproduce in order to sustain their species. All animals are programmed to age and eventually die. This CU will guide students' knowledge that animals might look the same, similar, or completely different at specific

stages of development. The second goal of this unit is to provide background information and ideas that other second grade teachers can use to teach these concepts.

222 Janet Raybon
Science, Myers Park High School, Charlotte, NC

The Rest of the Story: A Study of Death, Decomposition and Metamorphosis

The use of insects to determine post mortem intervals dates back to the 13th century. It was not until the 1990's that forensic entomology began being used in death and criminal investigation as a way to determine estimated time of death or connect a suspect to a crime scene. By knowing and understanding the metamorphic cycle of the common blowfly (blue or green bottle fly), a forensic entomologist can use weather data and life cycle stages to determine an approximate post mortem interval. This unit introduces the learner to the processes of death and decomposition and connects them with the metamorphic cycle of the blowfly. Through research and field studies, students will engage in the work of a forensic entomologist as well as a crime scene investigator.

223 Rima Solh
Mathematics, Southwest Middle School, Charlotte, NC

Metamorphosis in Mathematical Models

This unit integrates science and math for best practices. It can be used for teaching statistics with algebraic models of metamorphosis for all middle-grades mathematics. In Grade 6, students will be able to develop a deeper understanding of variability and more precise descriptions of data distributions; in Grade 7, students should be able to transition to production of data and creating a good plan to produce a relevant data base. In Grade 8 proper and successful interpretation of the data is the major skill. Math teachers will be able to adjust the activities according to the grade level without difficulty. Metamorphosis is the theme of this unit, and I have a feeling at the end, my mind will metamorphose to an extensive and sophisticated stage of knowledge. Joining Charlotte Teachers Institute has been the most outstanding professional development I have had in my 11 years of teaching. My goal is to present this unit as impeccably as possible. However, my challenge is to interpret and picture all the knowledge and experiences I have had with these seminars meticulously.

224 Amy H. Ringwood
Biological Sciences, UNC Charlotte

CTI Education Symposium Welcome

BBB ORAL PRESENTATIONS (Abstracts follow on page 462)

225 Maria Marlin, Swarup Roy Choudhury, Sona Pandey
Nu Upsilon, Bridgewater College

The Role of Heterotrimeric G-protein signaling in *Camelina sativa* Growth and Development

226 Kristy Williams, Costance Rogers-Lowery
Tau Eta, Catawba College

Effects of Ocean Acidification on Motility of Coral Larvae

227 Kyle Macke
Sigma Psi, Florida Institute of Technology

Efficacy of alternative contrast agent in anemonefish culture

228 Louis Penrod
Sigma Psi, Florida Institute of Technology

Thermally induced shift in biomechanical performance of the invasive lionfish, *Pterois volitans*

229 Sebastian Martinez
Sigma Psi, Florida Institute of Technology

Impacts of urbanization on Anuran species richness

230 Lindsay Millward, A. Darline Parvini
Mu Theta, Belmont U

Differences in leaf decomposition rates between invasive exotic *Lonicera maackii* and native *Acer saccharum* in a temperate deciduous forest

231 Rachel Pearson, lauren King
Mu Omicron, Columbus State U

Characterization of neutrophil cell death in response to nontypeable *Haemophilus influenza*

232 Jacob Dirkman, Renee Yuh, Kathleen Hughes
Mu Omicron, Columbus State U

Estrogens Effects on the Viability of Astrocyte Cells Exposed to Oxidative Stress

233 Tara Burke, Lori Tolley-Jordan
Mu Phi, Jacksonville State

Does a large trematode parasite, *Proterometra epholkus*, induce mortality on its freshwater snail host, *Elimia modesta*?

234 ASB oral Presentation-Addition
Jessica L. Allen & James C. Lendemer

The impacts of sea-level rise on coastal biodiversity: A case study in the Mid-Atlantic Coast Plain

Large-scale assessments of global sea-level rise (SLR) have predicted significant impacts to coastal and island biodiversity. The Mid-Atlantic Coast of eastern North America is particularly threatened because the sea-level is rising four times faster than the global average. Specific estimates of how SLR will impact biodiversity in this region are needed to take effective conservation action. Here we use a dataset of >13,500 occurrence records for lichens, obligate symbiotic fungi, in the Mid-Atlantic Coastal Plain of eastern North America to model distributions of 193 species and estimate how they will be impacted by SLR. We found that species have likely already lost an average of 32% of their distributional area to development and agriculture, and are predicted to lose an average of 12.4 and 33.7% of their distributional area with one foot and six feet of SLR, respectively. Furthermore, species reproducing with symbiotic propagules have significantly larger distributions than species that reproduce sexually with fungal spores alone, and that the sexually reproducing species are predicted to lose greater distributional area to SLR. Comparisons of the differences in SLR impacts on taxonomic groups recovered two genera with contrasting distribution patterns and SLR impacts. We further examined patterns of total species diversity and found that the areas with the highest diversity are peninsulas in the Albemarle-Pamlico Sound, which are also predicted to lose the most land area to SLR. The workflow established here is flexible and applicable to estimating SLR impacts worldwide and can provide essential insights for local conservation planning.

235 Emily K. Deas, Robert T. Grammer
Biology, Belmont U, Nashville, TN

The Effects of Glucose, Saccharine, Aspartame, and Sucralose on Longevity in *Caenorhabditis elegans*

Cell Metabolism published a study by Dr. Seung-Jae Lee showing glucose was found to shorten the lifespan of *Caenorhabditis elegans*. Aspartame, saccharine, and sucralose are all common artificial sweeteners known as Equal, Sweet'N Low, and Splenda respectively. Artificial sweeteners were designed as a low calorie substitute for glucose. Research was conducted following the procedure established from the study on glucose to determine how the artificial sweeteners would impact longevity. Each sample of *Caenorhabditis elegans* lived on a medium of 2% of either glucose, aspartame, saccharine, or sucralose throughout their lifetime. All of the *Caenorhabditis elegans* that consumed artificial sweeteners experienced a 14.3 to 23.1% decrease in longevity. The *Caenorhabditis elegans* that consumed glucose experienced a 14.3 to 30.8% decrease in longevity. This suggests that artificial sweeteners and glucose are processed in the same manner by the body and thus produce the same effects.

ASB Poster Abstracts

P1 Elizabeth A. Villa, Ted Zerucha, Ece Karatan
Biology, Appalachian State U, Boone, NC

Identification of Genes Involved in *Vibrio cholera* Colonization of the Zebrafish (*Danio rerio*)

Vibrio cholerae, the causative agent of the clinical disease cholera, is an extremely successful colonizer of aquatic environments and may remain endemic in regions following outbreak for indefinite periods. As such, most humans contract this disease following consumption of contaminated food or water. While extensive investigation on pathogenicity and virulence in *V. cholerae* has been conducted, relatively little is currently known about this bacterium's ability to survive and proliferate so successfully in the environment. Recently, fish have been implicated as an environmental reservoir for *V. cholerae*, providing a means for dispersal over vast distances as well as a means for transmission to other hosts, but a thorough investigation of this relationship has not been conducted. Biofilms are matrix-bound aggregations of bacterial cells, and are thought to aid in *V. cholerae* environmental survival by providing structural protection from many environmental stressors. A variety of signals have been shown to impact biofilm formation in *V. cholerae*, including small hydrocarbons known as polyamines. Previous investigation has shown that the polyamines spermidine and norspermidine have distinct and inverse effects on biofilm formation despite very similar molecular structures. Through comparison of the colonization ability of known mutants with demonstrated altered biofilm phenotypes to wild-type colonization levels, this study aims to better characterize the role of biofilm formation in the natural association of *V. cholerae* and fish. Ultimately, we aim to determine the role of polyamines and biofilm in the environmental survival of *V. cholerae* in order to better understand the life cycle of this pathogenic microbe.

P2 Autumn Bass, David Guzman, Karen Guzman
Biology, Campbell U, Buies Creek, NC

A Simplified Method to Create Transgenic Zebrafish and Drosophila Using Electroporation

Zebrafish and Drosophila are used extensively to study embryonic development and gene function. Transgenics are often made using these model organisms. The frequently used method of microinjection can be technically challenging. Electroporation can be less technically challenging, but often requires expensive equipment. The purpose of this project is to develop a more cost effective electroporation method to transfer genes into zebrafish and Drosophila embryos. The design uses low-cost materials and simpler mechanisms for generating a pulse that is capable of creating pores in embryonic membranes. The pulse generator prototype is capable of producing 200 volts-DC with an adjustable pulse width of 1 - 100 msec. In addition to the simplified pulse generator model, more cost effective options for biocompatible electrodes were developed. The pulse generator prototype can be programmed to produce various pulse durations and voltages, which were verified using an oscilloscope. The ability to manipulate the pulse strength, length, and number of pulses allows for several experimental trials to be conducted on both zebrafish and Drosophila embryos to identify the optimal set of parameters. Initial experiments with trypan blue will assess if pores have formed in either models and the viability of the embryos.

P3 Megan M. Sibree, Linda M. Niedziela
Biology, Elon U, NC

The Role of N-Nitroso-N-ethylurea (ENU) in the Induction of Chromosomal Abnormalities in Zebrafish (*Danio rerio*)

Cancer is caused by changes in the genome that result in the rapid production of compromised cells. Carcinogens including ENU have been shown to cause these changes through a variety of mechanisms. Although these mechanisms are studied intensively in the cancer research

field, the role of chromosome instability in cancer induction is not well understood. Because chromosome instability is frequently observed in cancer patients, it is essential to determine how it occurs to further understand cancer disease progression and discover more effective prevention and treatment plans. In this study, adult zebrafish were used experimental models to investigate mechanisms of cancer induction utilized by ENU. DNA was isolated from muscle tissue and analyzed using primers 2 and 6 of the GE Healthcare Ready-To-GoTM RAPD Analysis Kit. This kit was used to conduct random amplified polymorphic DNA (RAPD) analysis, which uses DNA primers to amplify DNA at random sequences that should be consistent in fish that have not been exposed to carcinogens. When chromosome instability is induced, alterations in the amplified DNA can be visualized using gel electrophoresis. A greater number of changes in banding pattern compared to control DNA suggests greater genomic instability. Using primer 2 resulted in highly variable bands in control and experimental samples, making it difficult to discern what bands were created due to exposure to ENU. Primer 6 resulted in bands that were stable and consistent in experimental and control samples, and no significant changes in banding pattern were observed in experimental samples. The results found using RAPD analysis were inclusive, suggesting that RAPD may not be the best tool for investigating the mechanism of cancer initiation utilized by ENU. Direct observations of chromosomes from mitotic chromosome spreads will be used next to assess chromosome instability. It is expected that aneuploidy and chromosome breaks will be observed.

P4 Jimmy Rager, Cailyn Scanlan, Matt Slitzky, Angela Bauer, V. McNeil Coffield
Biology, High Point U, NC

17β-Estradiol Increases the Rate of Calcium Incorporation During Early Development in *Danio Rerio*

Estrogen is known to play a significant role in bone development and ossification in mammals. To date, however, little is known about the sex hormone's role in bone ossification in the zebrafish model, *Danio rerio*. In this study, zebrafish embryos were raised in various concentrations of 17β-estradiol (10^{-11} M - 10^{-9} M) for 14 days. Two staining methods, Alcian Blue/Alizarin Red and calcein were used to determine bone ossification and development. First, embryos treated with 17β-estradiol were stained with Alcian Blue and Alizarin Red, which stain for cartilage and bone, respectively. The specimens were scored for the extent to which their embryonic skeleton had ossified and the length of various endochondral bones and total body length were measured. The second method of staining used calcein dye, which adheres to calcium minerals and fluoresces under GFP-similar-wavelengths, indicating the onset of bone ossification. Lateral/dorsal images of the embryos were obtained from day six through day ten and each of the first fifteen vertebrae were then blindly scored based on the amount of stain present (0= none, 1= x<30%, 2= 30%<x<70%, 3= x>70%). Preliminary data from the first staining method suggests a significant dose-dependent increase in total body length and also an increase in the length of specific endochondral bones compared to untreated controls ($p<0.05$ and <0.005, respectively). Calcein staining data supports the notion that 17β-estradiol increases the rate of vertebral bones ossification, most drastically at day 7. Our data supports the hypothesis that 17β-estradiol influences the rate of calcium incorporation during early development and offers a potential causative agent for the skeletal abnormalities observed in animals living in areas contaminated with high levels of endocrine disruptors.

P5 Matt Slitzky, Cailyn Scanlan, Jimmy Rager, Angela Bauer, V. McNeil Coffield
Biology, High Point U, NC

Resveratrol Alters the Rate of Calcium Incorporation During Early Bone Development in *Danio rerio*

Resveratrol, a naturally occurring phytochemical found in grapes and red wine has been shown to have many health benefits as well as increase bone growth in some mammalian species. Resveratrol is thought to exert many of these health effects (including those on bone growth) through its ability to weakly bind and activate the estrogen receptor. Little is known, however, about the effects of resveratrol on bone ossification in *Danio rerio* (zebrafish). This study

investigated the effects of resveratrol on vertebrae ossification in *D. rerio*. Embryos were exposed to increasing concentrations of resveratrol (10^{-8} M -10^{-4} M) for 12 days. To determine the effects of resveratrol on ossification, embryos were then stained with calcein dye from day 6 to day 12. Calcein is a fluorescent dye that adheres to calcium ions, thereby serving as a marker for ossified bone. Specimens were imaged using confocal microscopy and vertebrae were scored according to their degree of ossification. Results indicate that resveratrol accelerates ossification of vertebrae at all concentrations beginning at day 6 compared to untreated controls supporting the hypothesis that resvertatrol alters early bone development in *D. rerio.*

P6 Riley Parr, Tray Neilson, Zach Williams, Caroline Cochrane, Brandon Carpenter, Brantley Graham, Ted Zerucha
Biology, Appalachian State U, Boone, NC

Characterization of a *Meis2* Linked Gene in Zebrafish

We have identified a novel gene linked to the *Meis2* gene (*meis2a* in zebrafish) in vertebrates with publicly available genome date. This gene is located immediately adjacent to *Meis2* (*meis2a* in zebrafish) and is organized in an inverted convergently transcribed manner. Quantitative real time PCR has revealed that transcripts of this gene in zebrafish are expressed maternally with highest levels early in development which then decrease quickly until 8hpf. Transcripts of this gene are observed again around 12hpf and low levels of expression are then maintained through development. Using in situ hybridization we observe transcripts are expressed ubiquitously early and are later localized to the developing neural tube with further restriction to the retina of the developing zebrafish at 48hpf. Using an antibody raised against a peptide portion of the predicted zebrafish protein product we have shown that the gene is translated into protein within the developing embryo and that it is expressed at various stages throughout development. Western blots show that the protein is present as early as 2hpf and is found in significant amounts until 24hpf, when it significantly decreases. Immunohistochemistry shows that the protein is present, is highly localized to the retinal area and the optic nerve, and in general matches its RNA expression.

P7 Mackenzie Trapp, Hannah Freundlich, Kyle Nelson, Ted Zerucha
Biology, Appalachian State U, Boone, NC

Characterization of a Highly Conserved Tetrapod Regulatory Element Associated With the *Meis2* Gene in Zebrafish

The *Meis* genes are highly conserved across vertebrate species where they play roles in embryonic development. There are four known members of the *Meis* gene family in vertebrates, *Meis1*-*Meis4*. Because of the genome duplication event that occurred in teleosts following the divergence from the lineage that would give rise tetrapods, zebrafish have 2 copies of the *Meis2* gene, *meis2a* and *meis2b*. We have identified four highly conserved non coding elements (CNEs) in tetrapods that we hypothesize direct *Meis2* expression named m2de1-4 (for *Meis2* downstream element). To date only one of these, m2de1, has been identified in zebrafish. The purpose of this study is to characterize m2de2 using zebrafish as a model. Using the Tol2 system, expression constructs containing mouse m2de2 driving expression of EGFP through the cfos minimal promoter have been constructed and microinjected into zebrafish embryos at the single cell stage. Confocal microscopy was used to determine EGFP expression at different time points post-fertilization. To date we have observed in muscle fibers in the trunk of developing zebrafish embryos.

P8 Laiton Steele, Alicia Ramsaran, Kyle Nelson, Ted Zerucha
Biology, Appalachian State U, Boone, NC

Characterization of the *Meis2* Associated Highly Conserved M2de3 Noncoding Element

Meis genes are well known for their important roles in gene regulation and development. The *Meis* family encodes homeodomain proteins that are known to work in combination with other transcription factors such as the Hox and Pbx families to regulate development. This purpose of this study is to gain a better understanding of the genetic mechanisms that control the expression of *Meis* genes in development. The Zerucha lab has identified four highly conserved non-coding elements (NCE's) associated with the *Meis2* gene, named m2de1-m2de4 (for *Meis2* downstream element). All four elements have been identified in all tetrapods examined, however in teleosts only m2de1 has been identified. My research project is characterizing m2de3 in an attempt to determine if this element is able to direct spatial and temporal gene expression that is consistent with that of *Meis2* using zebrafish as a model organism. I have generated transgenic zebrafish through the microinjection of a Tol2 expression cassette carrying the murine m2de3 element, a *cfos* minimal promoter and the EGFP (enhanced green fluorescent protein) gene. These zebrafish exhibit a punctate expression pattern in the trunk along the spine and neural tube, which I have found to be expressed in embryos examined from 32hpf to 60hpf. These results are consistent with where *Meis2* is expressed during mouse development, providing evidence that the expression seen is directed by the m2de3 element.

P9 Megan Tennant, Tyler Ferrara, Cody Barrett, Kyle Nelson, Ted Zerucha
Biology, Appalachian State U, Boone, NC

Characterization of the *Meis2* Associated Highly Conserved Vertebrate Noncoding Element m2de1

The *Meis2* gene encodes a protein that is a member of the TALE (three amino acid loop extension) superclass of homeodomain containing proteins. The Meis proteins are transcription factors that also act as Hox cofactors that regulate development in vertebrate embryos. While the function and expression patterns of these genes is fairly well known, how their expression is regulated is not. We have identified four highly conserved noncoding elements associated with the vertebrate *Meis2* gene and named them m2de1-4 (for *Meis2* downstream element). While m2de2-4 have to date only been found in land vertebrates, m2de1 is also found in teleosts like zebrafish. The m2de1 sequence is approximately 450bp in length and its sequence and relative position to *Meis2* (*meis2a* in zebrafish) is highly conserved amongst all vertebrates. Using the Tol2 system we have generated transgenic zebrafish in which either the zebrafish element (dr-m2de1) or mouse element (mm-m2de1) have been able to direct reporter transgene expression the mid and hindbrain of developing embryos.

P10 Rachel Krizek, Mary Kinkel
Biology, Appalachian State U, Boone, NC

Human Gut Motility Disorders: Can Larval Zebrafish Provide a Live Animal Model?

1 in 5000 children are born with Hirschprung's Disease (HD), a motility disorder of the large intestine. HD is a genetic defect and is characterized by failure of enteric neurons to fully populate the intestinal wall. Neuronal deficiency causes abnormal and slow peristaltic contractions of the intestine. Food passes through the gut abnormally slowly, and often the gut is blocked. Although there are animal models to study aspects of specific HD genetic mutations, studying peristalsis and food passage along the gut poses challenges. Normal gut function requires an intact animal, but the gut is difficult to observe in an intact animal. The goal of this project is to develop the larval zebrafish as a model for studying gut motility disorders. Larvae have transparent body walls, which allows us to image the gut contents in the live fish. Our strategy is to feed wildtype larvae a defined volume of a fluorescent meal, then track food transit to determine the average transit time. Previous work in our lab and others has shown

that larval fish must be fed an attractive, palatable, and digestible food in order for normal feeding to occur. To meet these requirements, we will fluorescently label a component of the normal larval diet. The daily diet consists of a dry formulated feed and live *Artemia salinas* (brine shrimp). In preliminary work, we ruled out using the dry feed, as its fluorescence is quenched in water. Our approach is to label *Artemia* using transgenesis. Here we show preliminary work generating transgenic shrimp that express Enhanced Green Fluorescent Protein or tdTomato. In ongoing studies, we will determine whether this approach is feasible. Namely, we will ask whether visible fluorescence is maintained during passage through the gut, or whether digestion quenches the fluorescence in proximal gut regions.

P11 Kitt Franse, Mary Kinkel
Biology, Appalachian State U, Boone, NC

Onset of Metamorphosis Depends on Body Length, Not Age, for Larval Zebrafish

Larval zebrafish go through a period of metamorphosis in which nearly every major system undergoes dramatic developmental and morphological change. Zebrafish emerge from metamorphosis virtually unrecognizable. Adult characteristics replace the larval with respect to anatomy, physiology, and behavior. How such change unfolds is poorly understood. We do not know when metamorphosis typically begins or how long it lasts. Here, we begin to define the metamorphic period. We show that onset of metamorphosis depends on body length rather than age. To test that, we raised larvae on a daily regimen that consisted of a dry formulated feed. A second group received a higher quality diet by supplementing the dry feed with live *Artemia* (brine shrimp). Live *Artemia* are thought to provide nutrients, including fatty acids, that are not available from formulated feed. Additionally, there are suggestions that live prey may provide digestive enzymes that are not yet produced by the larvae themselves, thus making more nutrients available. We found that supplementing with live shrimp encouraged rapid growth in length, and faster entry into metamorphosis. Therefore, we will study metamorphosis using zebrafish that are maintained on a strictly defined feeding regimen that includes live shrimp. Our short-term goals include determining 1) the minimum body length necessary for metamorphosis to begin, and 2) the duration of metamorphosis with respect to fin development. We chose to study the fins because they are easily observable and because, by the end of metamorphosis, four new fins are added to the larval skeleton, giving us a relatively simple readout. We will observe metamorphosis of the skeleton by collecting specimens at intervals and labeling cartilage versus bone using two-color histological staining. Our longer-term goal is to define metamorphosis with respect to the progressive maturation of the fin skeleton.

P12 Mary E. Skrabut, Amanda D. Williams, Bonny B. Millimaki
Biology, Lipscomb U, Nashville, TN

The effect of topoisomerase II inhibition on expression of axon pathfinding genes in zebrafish

Topoisomerase is an enzyme with a well-documented role in DNA repair. The enzyme is responsible for causing breaks in the DNA double-helix to relive the tension caused by the unwinding of DNA during replication and transcription. Recent studies have indicated that TOP2, an isoform of TOPO, also plays a role in neuronal development. Our lab is interested in the specific role TOP2 plays in neural development. We have previously seen that the inactivation of TOP2 with a chemical inhibitor, HU-331, results in axonal pathfinding defects, specifically mauthner neurons fail to cross the midline. I hypothesize that TOP2 functions as a transcription factor for the genes involved in axonal pathfinding. We used semi-quantitative RT-PCR and real-time PCR to look at expression levels of axonal pathfinding genes at 24 hours post fertilization (hpf) in control embryos and embryos that had been treated with HU-331 from 12-24 hpf. We are using real-time PCR to analyze the expression level of dcc and robo3, the receptors of chemotactic ligands which guide commissural axons to cross the midline, at 24 hpf. We hypothesize that if TOP2 is acting as a transcription factor for these genes, the expression of the receptor for the chemo-attractant will decrease or the expression of the

receptor for the chemo-repellant will increase.

P13 Sara M. Stevers, Bonny B. Millimaki
Biology, Lipscomb U, Nashville, TN

Topoisomerase2 Inhibition Specifically Effects Axonal Guidance in Zebrafish

Topoisomerase is widely known for its function in DNA repair; however, in 2000 one isoform of Topoisomerase (TOPIIβ) was shown to be required for proper neural development in mice. The specific role of TOPIIβ in neural development remains unclear. Our lab has shown that inhibition of Top2 (the zebrafish homologue of TOPII) using the chemical inhibitor HU-331 results in abnormal reflex responses and aberrant axonal guidance of a subset of hindbrain neurons. To further characterize the effects of Top2 inhibition I have evaluated additional neuronal markers (antibodies) and found that axonal pathfinding is affected throughout the brain and peripheral nervous system. Additionally, through observation of muscle markers, I have provided evidence that inactivation of Top2 does not affect muscle development. This lends further evidence to the hypothesis that Top2 is necessary for proper neural development but is not required for other tissues to form properly.

P14 Michelle L. Hall, Cindy Achat-Mendes
Science & Technology, Georgia Gwinnett College, Lawrenceville

Comparison of the Anxiolytic Effects of Nicotine and Ethanol on Novelty-Elicited Responses in Zebrafish (*Danio rerio*)

Nicotine and ethanol have been identified as being one of the most abused licit drugs in the United States. One of the reported uses of nicotine is that it helps alleviate stress. However, nicotine's mechanism of action involves dopamine release which stimulates arousal and activity. On the other hand, ethanol is a depressant which involves GABA release which inhibits stimulation. Based on the neurotransmitters released by nicotine and ethanol it is postulated that nicotine would increase anxiety where ethanol would decrease anxiety. Typically, zebrafish dive to the bottom of the tank when the environment is novel suggesting that this behavior might be an escape mechanism from predators. Therefore, to measure nicotine and ethanol's ability to affect anxiety, we examined zebrafish novelty-elicited response and subsequent habituation following acute and chronic exposure to varying concentrations of nicotine, ethanol, and the combination of both drugs. Behaviors included immobility, areas of exploration, speed, and distance moved. Our preliminary findings revealed that zebrafish exposed to some acute doses of nicotine spent more time in the upper third of the tank only on the first day and then spent more time in the bottom third of the tank in subsequent days compared to controls. On the other hand, ethanol-exposed zebrafish showed the opposite effects of nicotine-exposed zebrafish. Nicotine-treated zebrafish also swam longer distances on all three days compared to controls and ethanol-treated zebrafish. These findings suggest that the doses of nicotine tested might be anxiolytic at first, but appear to produce anxiety-like behaviors over time. These findings also suggest that doses of ethanol tested were anxiolytic.

P15 Maria C. Granada, Cindy Achat-Mendes
Science & Technology, Georgia Gwinnett College, Lawrenceville

Measuring the Rewarding Effects of Nicotine and Ethanol Polydrug Use in Zebrafish (*Dani rerio*)

Zebrafish are small experimental models with high genetic homology to humans. To investigate the combined effects of ethanol and nicotine on the brain and on behaviors, neurobiological features of zebrafish will be utilized in this research. It is already known that both ethanol and nicotine are rewarding drugs of abuse. Anecdotal reports indicate that combining ethanol and nicotine can produce rewarding effects that are greater than that produced by each drug alone. Therefore, the aim of this experiment was to determine if low doses of ethanol and nicotine produced the same reinforcing response as a high dose of the individual drug. Zebrafish were conditioned to associate nicotine, ethanol and nicotine + ethanol combinations with distinct

visual cues through a procedure involving classical Pavlovian conditioning. In the conditioned place preference paradigm, dose response curves were established for nicotine and ethanol. The low doses of each drug that did not produce rewarding effects were combined to measure the combined effects of both drugs. Subjects' initial preference between two compartments with different visual cues was first tested. Zebrafish were exposed to drug in the less-preferred chamber of the test apparatus and then exposed to untreated aquarium water in the originally preferred side of the apparatus. These steps were repeated for 2 more days and on the test day zebrafish were placed into the apparatus with only aquarium water; no drug present. This enabled comparison of the preference for the drug-paired compartment before and after conditioning. Behaviors were recorded and analyzed using EthoVision software. Data showed that zebrafish seemed to have an adverse effect to drug combinations similar to the effects seen with a high dose of an individual drug. These data suggests that combining low doses of ethanol and nicotine produces effects similar to those produced by high doses of one drug alone.

P16 Lenka N. Malec, Linda M. Niedziela
Biology, Elon U, NC

The Effect of Aspartame and Sugar on the Behavior of Adult and Juvenile Zebrafish

Aspartame is a common artificial sweetener that can be found in products such as diet soda or Crystal Light™. As a result of the increasing emphasis on maintenance of a healthy weight in the United States, many adults and children are using sugar free products. Previous neurotoxicology studies have looked at the effects of aspartame on adult zebrafish, but the results of these studies were inconclusive. The purpose of the study is to determine the effect of aspartame and sugar on adults and juvenile zebrafish, specifically looking at anxiety related behavior and behaviors related to attention deficit/hyperactivity disorder (ADHD). Adult and juvenile zebrafish were placed in five different concentrations, the higher of each being what is found in soft drinks: 0.79 g/L and 0.079 g/L aspartame, 65.5 g/L and 6.55 g/L sucrose, and a control of treated tank water. The adults were exposed for five days then filmed, and the juveniles were filmed seven days post fertilization (dpf). The Novel Tank Diving Test was performed on the adults and the quantitative variables collected were time in top half of tank, time in bottom half of tank, number of freezing times, and number of erratic movements. Results showed a significant difference between the anxiety indicators of the control compared to both the sugar and aspartame exposed fish. The amount of time spent in the bottom half increased as the dose of aspartame and sugar increased, and was significant with a p-value of 0.0009. However, even though there was a significant difference in erratic movements ($P=<0.0001$), this variable was not dose dependent. Based on the results it seems that it does not matter what type of sweetener is ingested, both aspartame and sugar caused an increased anxiety; therefore, aspartame may not actually be the healthier option for adults in today's society.

P17 Abigail Poff, Donnie Pickel, Bonny B. Millimaki
Biology, Lipscomb U, Nashville, TN

The Effect of Top2 Inhibition, With Dexrazoxane, on Zebrafish Neural Development

Topoisomerases are well known for their role in relieving torsional stress during DNA replication and transcription. Recent work indicates that certain topoisomerases may play a less understood role in neural development. Previous experiments indicate that topoisomerase II (Top2) is necessary for survival and complete innervation of neurons in developing zebrafish embryos, potentially serving as a transcription factor for genes involved in axon guidance. To demonstrate this, embryos were treated with HU-331, a catalytic inhibitor of Top2. As a result, Mauthner neurons do not properly approach and cross the midline resulting in decreased sensitivity to external stimuli in behavioral startle response assays. Other commissural neurons have also been observed to lack proper innervation. Preliminary data suggests that axon guidance defects are the result of misregulated expression of chemotactic genes as a result of Hu-331 treatment. Although HU-331 has been shown to inhibit the ATPase domain of Top2, it

exhibits some level of promiscuity. Our efforts have been to repeat these HU-331 experiments with another catalytic inhibitor of Top2, Dexrazoxane (DEX), to demonstrate that the errors in axon guidance found with HU-331 treatment were specifically due to inactivation of Top2. We hypothesize that embryos treated with DEX will display Mauthner neurons that do not properly cross the midline in the hindbrain, misregulation of genes involved in axon guidance, and delayed startle response. This would further support the suggestion that Top2 plays a, yet undiscovered, role in regulating the expression of chemotactic genes in order to help in axon guidance.

P18 Mackenzie P. Payne, Edward B. Mondor
Biology, Georgia Southern U, Statesboro

Temporal, Spatial, and Age Distributions Of White-Tailed Deer, Odocoileus Virginianus, Killed on Bulloch County Roadways

White-tailed deer (*Odocoileus virginianus*) are native to the state of Georgia. As there are over 1.2 million individual animals in the state, they are implicated in a large number of motor vehicle accidents (ca. 1 million) each year. It is currently unknown, however, if deer are more likely to be killed 1) at certain times of year, 2) in particular areas, and 3) of particular age classes? We addressed these questions by collecting the remains of white-tailed deer killed in motor vehicle accidents in Bulloch County, GA. When a deer was located, the head was removed and road characteristics recorded. In the lab, the lower jaw was excised so the deer could be aged by 1) tooth eruption sequence and 2) cementum annuli aging of incisors. From the obtained results, we hope to better understand the factors influencing white-tailed deer mortality rates. Recommendations will be made to the Department of Natural Resources (DNR) and the Department of Transportation (DOT) where additional “deer crossing” signs should be posted in Bulloch County, GA.

P19 Jaylin Grant, Michelle Thomas, Jamie Garner
Biology, Campbell U, Buies Creek, NC

The Identification of Environmental Microorganisms that Utilize Bifenthrin

Insecticides and herbicides are widely used for lawn maintenance in golf courses throughout the Piedmont area of North Carolina. Bifenthrin is a common pyrethroid insecticide used among residential, agricultural, and commercial settings including golf courses. Environmental microorganisms that degrade pyrethroids may play a key role in bioremediation and discovering species with this property is significant. The aim of this project is to test previously isolated bacteria for Bifenthrin utilization and to identify and characterize these bacterial isolates. Soil samples from Keith Hills golf course in Buies Creek, NC yielded four bacterial isolates that grew on media with Bifenthrin as the sole carbon source. Presently, four isolates were screened for Bifenthrin utilization by testing them on media where Bifenthrin is the only carbon source. The identification process took two strategies, the first being ribosomal DNA analysis and the second being phenotyping using various carbon sources. For ribosomal DNA analysis, chromosomal DNA extractions were performed to isolate the bacterial DNA, and with the isolated product, PCR was used to amplify the rDNA. The PCR product was purified, sequenced, and compared to sequences from known microorganisms. For phenotyping, ninety-six well microplates containing different carbon sources and antimicrobials were inoculated with bacteria and allowed to grow using the Biolog Microstation System. Growth in wells gave a phenotypic fingerprint; the results were then compared using Biolog’s GEN III database. Future studies will focus on these isolates’ ability to degrade pyrethroids so experimental testing for bioremediation can be confirmed.

P20 Cathy Huynh, Mark A. Schlueter
Science & Technology, Georgia Gwinnett College, Lawrenceville

An Examination of Bacteria and Fungi Diversity and Abundance in Different Size Bowling Balls and Shoes

Bowling alleys have many areas that are prone to microorganism contamination. The majority of people believe that bowling shoes are the dirtiest item in the bowling center due to the large number of people who rent shoes. However, this may be incorrect. Bowling balls may be an even greater source of bacteria and fungi (microorganisms) contamination. In the following experiment, we hypothesize that the finger holes in the bowling balls are the most contaminated area in the bowling center. The purpose of this experiment is to examine the microbiology organism diversity and abundance located in different size bowling balls (Child (6 lbs) to Adult (15 lbs) and different shoes sizes. Three different types of Agar mediums used: Nutrient Agar (All bacteria), Sabouraud(All Fungi), and MacConkey agar (gram negative bacteria). Several of the gram-negative bacteria (typically found in the human digestive system) were identified further. Preliminary results have indicated that the holes in the bowling balls do have more bacterial growth than the rental shoes. This may be due to the daily use of the disinfectant on the shoes, while no daily disinfectant is used in the finger holes of the bowling balls. In this experiment we will also be testing different types of cleaning agents to reduce the bacterial growth and contamination in the finger holes of the bowling balls. The microbiological assessment of this project will be able to contribute to the public health knowledge and to better inform citizens of the potential dangers that could be spreading around bowling centers. This may be particular important since it is common practice of many people to eat snack (finger) foods while bowling.

P21 Neely M. Wood, Min-Ken Liao
Biology, Furman U, Greenville, SC

Bacterial Diversity from Soil of Varying Land Management at Furman University

There are at least three different soil management practices on the Furman University campus: chemical management (lawn on the Furman Mall), organic management (Furman Farm), and no management (untreated forested area). Based on the assumption that different land managements create different ecosystems, we hypothesized that there would be different bacterial communities in these soils. In 2014, we isolated soil bacteria from the sites of varying management and selected morphologically distinct, site-representative culturable bacterial isolates. We amplified, sequenced, and analyzed their 16S rRNA genes. We taxonomically identified them only to the genus level and categorized them at the family level. Concurrently, we performed double restriction enzyme digests (HinP1I and MspI) on the 16S rRNA genes for an abbreviated comparison of the overall bacterial community diversity of the different soils. Based on sequence analysis and the Simpson's Diversity Index, the soil bacterial community in the forested area was the most diverse, followed by the organically managed soil and, lastly, the chemically managed soil. In 2015, we continued our studies but took the cultivation-independent approach to study the bacteria present in the these soils. We isolated and amplified the 16S rRNA genes of the bacterial communities at each site and cloned the 16S rRNA genes using the pGEM-T vector system. Transformants were selected and screened, and the 16S rRNA gene inserts were amplified individually. Amplicons were sequenced, the sequences were BLAST-ed against the NCBI database for crude taxonomic identification to the genus level, and categorized at the order and family levels. The Simpson's Diversity Indices revealed that the organically managed soil was most bacterially diverse, followed by the chemically managed soil, and then the forested area soil. More specifically, at the family level, the organically managed soil was also the most bacterially diverse, followed by the forested area soil, and, lastly, the chemically managed soil.

P22 Jingtian Wang[1], Thomas Hart[1], Leigh Robertson[2], Jessie Barnett[2], John E. Quinn[1], Min-Ken Liao[1]
[1] Biology, Furman U, Greenville, SC; [2] Earth & Environmental Science, Furman, Greenville, SC

Application of a Multi-Disciplinary One Health Approach to Understanding Environmental Drivers of the Spatial Distribution of Rocky Mountain Spotted Fever

While much has been done to understand the micro-scale biological factors of infectious

diseases, less has been done to understand the macro-scale environmental drivers of disease emergence and spread. Therefore, this research program takes the multi-disciplinary One Health approach to identify environmental factors, both biotic and abiotic ones, that contribute to the pathogen distribution and prevalence. More specifically, we studied the distribution of ticks and the presence of *Rickettsia* sp., the pathogens of Rocky Mountain Spotted Fever (RMSF), in the Southeastern United States. To signify the public health importance of this approach, instead of collecting ticks from the wild, we studied ticks from dogs by soliciting tick submissions from veterinarians and pet owners via social media. Ticks (5782) received were separated based on origin, species, life stage, degree of engorgement, and sex, with *Dermacentor variabilis* and *Ixodes scapularis* being the most abundant. To detect the presence of bacterial pathogens in ticks, a hybrid DNA extraction protocol was developed to accommodate the various conditions in which the ticks were preserved. The 16S rDNA of all bacteria was PCR-amplified and *Rickettsia*-specific primers were used for nested-PCR. The amplicons were sequenced and the sequences were BLASTed against the NCBI database. Based on the crude taxonomic indication, we found spotted fever group *Rickettsia* species such as *R. rickettsii*, *R. amblyommii*, *R. monacensis*, *R. montanensis* and *R. parkeri*, as well as other tick-borne intracellular pathogens such as *Coxiella burnetii* and *Diplorickettsia massiliensis*. *Rickettsia* sp. were detected in 50.0% of the 165 samples sequenced. Correlating these with the environmental data, we are in the process of identifying the environmental drivers of the distribution of ticks and RMSF. Based on the success of this proof-of-concept study, we will continue to take this integrative approach to study other vector-borne diseases in other regions of the US.

P23 Sydney Dishman[1], Suzanne Henderson[1], Jennifer Easterwood[1], Kent Rhodes[1], Michael Wolyniak[2], Joanna Katsanos[1]
[1] Queens U of Charlotte, NC; [2] Hampden—Sydney College, VA

Isolation and Genomic Annotation of the Novel *Bacillus thuringiensis* Bacteriophage Rex16

Bacteriophages, viruses that specifically infect and replicate within prokaryotic organisms, are exceptionally abundant, ancient, mosaic, and diverse. The novel Bacillus thuringiensis bacteriophage, Rex16, was isolated from a soil sample taken from Queens University of Charlotte and characterized. Electron micrographs indicated a myoviridae morphotype and genetic sequencing revealed a 160 thousand base pair genome falling under the C1 subcluster. The genome was divided into approximately 300 open reading frames and annotated with possible gene products and functions. This project further provided the university's biology department with a model to allow the SEA-PHAGES protocol to be incorporated in fundamental biology courses.

P24 Rowan E. Pitts
Biology, College of Letters and Sciences, Columbus State U, GA

Synergistic Effects of Antibiotics, Antimicrobial Peptides, and Neutrophil Phagocytosis Upon *Acinetobacter Baumannii*

The emergent pathogen *Acinetobacter baumannii* is responsible for a significant proportion of nosocomial infections and infections among military personnel. Due to multidrug-resistance (MDR), standard antibiotic treatment of *A. baumannii* is often ineffective. The mortality rate associated with *A. baumannii* infections is often high. Current research is focused on alternative treatments including antimicrobial peptides produced by the innate immune system and the effect of human neutrophils on *A. baumannii*. Our studies have shown that some strains of *A. baumannii* appear to be sensitive to antimicrobial peptides and show inhibited growth in a dose-dependent manner. Our current study seeks to further elucidate the effects of antimicrobial peptides on clinical isolates of *A. baumannii*. We will also examine the effects of commonly used antibiotics upon clinical isolates of *A. baumannii* and if that treatment can be enhanced by combining with antimicrobial peptide treatment. Finally, we will characterize *A.*

baumannii's interaction with the innate immune system by examining intracellular survival of *A. baumannii* within human neutrophils and whether or not this could be impacted by treatment with antimicrobial peptides. *A. baumannii* poses a significant risk within the healthcare setting and by finding novel treatments, we could possibly combat growing drug resistance.

P25 Nicole M. Wright, Gabrielle A. Hayes, Patrick A. Vigueira
Biology, High Point U, NC

Combinatorial Effects of Manuka Honey and Fosfomycin on *Escherichia coli*, *Staphylococcus aureus* and Methicillin-Resistant *Staphylococcus aureus*

Bacteria are becoming more resistant to antibacterial drugs, and developing new drugs to combat antibiotic resistance is a time consuming process that yields low economic return. As a possible strategy to overcome antibiotic resistance we combined existing antibiotics with Manuka honey, which possesses antimicrobial properties, to find synergistic effects. We hypothesized that the combination of approved antibiotics with the honey will produce an increase in bacterial sensitivity to the antibiotics. We used disc diffusion to combine medications that can be used topically or orally, with Manuka honey to determine if the combination had significant effects on the growth of *Escherichia coli*, *Staphylococcus aureus* and *methicillin-resistant Staphylococcus aureus* (MRSA). Fosfomycin is a broad spectrum antibiotic that is used to treat urinary tract infections. When this antibiotic is tested with Manuka honey an antagonistic response is induced. Fosfomycin was then tested with methylglyoxal (MGO), an active ingredient in Manuka Honey, and a synergistic response was produced.

P26 Sarah L. Edmark, Patrick A. Vigueira
Biology, High Point U, NC

Methylglyoxal Sensitizes *Bacillus oleronius* to Topical Antibiotics

Rosacea is an inflammatory disease of the skin that affects nearly 16 million people in the United States. Recent evidence suggests that this inflammation may be a response to *Bacillus oleronius*, a bacterial endosymbiont of Demodex mites that live in or near the hair follicles of humans. Several studies have demonstrated a positive correlation between the occurrence of rosacea and the presence of *B. oleronius*. In light of this association, topical treatments that limit *B. oleronius* colonization could represent a novel rosacea therapy for some patients. Manuka honey, a monofloral honey from the manuka bush of New Zealand, has natural antibacterial properties and is becoming increasingly popular as a natural skin care product. We assessed the effect of methylglyoxal (MGO), an active compound in manuka honey, on the growth of *B. oleronius* in broth culture. The minimum inhibitory concentration was 100 µg/mL. We then added a suboptimal concentration of MGO (25 µg/mL) to Müller-Hinton agar plates in order to explore the potential for MGO to alter *B. oleronius*'s sensitivity to a variety of antibiotics. MGO increased the sensitivity of *B. oleronius* to a number of commonly prescribed antibiotics in a disc diffusion assay. In particular we found statistically significant increases in the zones of inhibition produced by 4 topical antibiotics: bacitracin, polymyxin B, neomycin, and clindamycin.

P27 Norbeth E. Dzotefe
Biology, High Point U, NC

The Interaction of Antimicrobial Therapeutics with Amoxapine, a Commonly Prescribed Medication

Through the misuse and over-prescription of antibiotics, bacteria are becoming more resistant to antimicrobial therapeutics. Since developing newer, more powerful drugs is a time-consuming and expensive process, we have decided to take commonly prescribed medications and couple them with antibiotics in hopes of identifying novel synergistic interactions. Amoxapine, a drug that is used in the treatment of major depressive disorder, affects several chemicals in the brain, including serotonin and norepinephrine. We hypothesized that the grouping of various antibiotics with amoxapine will yield a change in bacterial sensitivity.

Through the method of disc diffusion, we have exposed *Staphylococcus aureus* and *Methicillin-Resistant Staphylococcus aureus* to amoxapine and antibiotics simultaneously. We found that rifampin, imipenem, and meropenem in the presence of amoxapine, generates synergistic effects.

P28 Allison Shelton, Lisa Ann Blankinship
Biology, U North Alabama, Florence

Resistance to Beta Lactam Antibiotics: Development of a Rapid, Paper-based Detection Test

Rapid assays for the detection of specific illness and health conditions such as Strep throat and pregnancy are routinely used within the clinical environment. What if this technology could be used to develop rapid, low-cost testing for antimicrobial resistance? The potential outcome of a rapid detection test for antibiotic resistance based on anitmicrobiall drug class would allow healthcare providers to more accurately prescribe antibiotics that would effectively treat illnesses such as respiratory and urinary tract infections. The goal of this project is to develop a rapid, low-cost detection method based on ELISA methodology to detect beta lactamase production. Antibodies targeting a specific beta lactamase protein will be selected and an ELISA test will be developed using a cellulose paper support. The ELISA will be tested against bacteria with known antibiotic resistance patterns before collecting and testing clinical patient samples from a local healthcare facility.

P29 Hannah Mordy, James L. Smart
Biology, U of Tennessee at Martin

Investigating the Function of *pufQ* in *Rhodobacter capsulatus*

In *Rhodobacter capsulatus* the *pufQ* gene encodes a regulatory protein thought to be responsible for the biosynthesis of bacteriochlorophyll. Previous attempts to elucidate the function of the *pufQ* gene by transposon insertion, markless deletion, or start codon mutation resulted in photosynthetically deficient strains. We show that this deficiency is caused by a polar effect on the rest of the *puf* operon, which encodes structural polypeptides for the reaction center and light harvesting apparatus. We report the identification of suppressors to this phenotype that map to the *fdhB* gene encoding formate dehydrogenase. We hypothesize that the PufQ protein interacts with the NADH dehydrogenase complex to prevent back-flow of electrons from the photosynthetically reduced quinone pool to the NADH pool in the cytoplasm. Additionally, we report the construction of a strain JS1260 in which the *pufQ* gene contains a pair of compensating frame-shift mutations, so that the *pufQ* reading frame produces an alternative protein, but the polar effect on the remainder of the *puf* operon is no longer present. This strain is photosynthetically competent, but grows at reduced rate relative to wild-type strain SB1003. In the present study, we investigated the effect of *fdhB* disruption on the photosynthetic growth rate of *pufQ* mutant strain JS1260, and report a partial suppression to this phenotype.

P30 Janay F. Franklin, Sharon Taft- Benz, Shaun Steele, Lauren Radlinski, Tom Kawula
Microbiology and Immunology, UNC Chapel Hill

Manipulating the Cellular Genome of a *Francisella tularensis*-Infected Cell

Francisella tularensis is a pathogenic, Gram-negative bacterium that infects over 250 mammalian species, including humans and is the causative agent of tularemia. *F. tularensis* is an intracellular bacteria that is taken up by the cell via phagocytosis. Once in the cell, the bacteria escapes from the phagosome into the cytosol where it replicates to high numbers within the infected host cell. Our goal is to understand the cell processes affected during a *F. tularensis* infection and the effects these processes may have on *F. tularensis* growth. To this end, we designed a tool to manipulate the genome of *Francisella tularensis*-infected cells. To do this, we generated a secreted *F. tularensis* protein with a cellular nuclear localization signal (NLS) fused to CRE recombinase. This construct was cloned into pEDL17, a *F. tularensis*

vector containing an inducible promoter upstream of the cloning site. During infection, addition of inducing agent, Anhydrotetracycline, will result in expression of the *F. tularensis* gene NLS-Cre fusion and ultimately produce a *F. tularensis* protein-NLS-Cre fusion protein. The secretion of the fusion protein from *F. tularensis* in the *Francisella*- infected cell, will result in the fusion protein localizing to the nucleus where the CRE recombinase will excise any desired gene flanked by LoxP sites. Therefore, we can knockout specific genes in the infected cells. Using the *FT*-NLS-CRE expression tool, we can obtain a better understanding of the host cell responses to the *F. tularensis* infection and the role that these cell specific proteins may play during a *F. tularensis* infection. In addition, the deletion of a specific gene that codes for a particular function allows us to control that specific function in the host cell, enabling us to change the response of the host cell to *F. tularensis* and thereby assess the effect of various host cell processes on *F. tularensis*. Furthermore, we are in the process of obtaining and screening the pEDL17 *FT*-NLS-Cre clones, which may result in new ways to control the *F. tularensis* bacteria or the host.

P31 Yancey T. McCoury, Elizabeth A. Brady, Weston R. Walker, Jessica S. Jones, Lauren M. Warzecho, Kevin B. Kiser
Biology and Marine Biology, UNC Wilmington

Cape Fear River Sediment Reveals Antibiotic-Producing Bacteria

Antibiotic resistance is a major clinical obstacle in modern medicine. In order to combat this problem, students from across the globe are searching their local environments for novel antibiotic-producing soil derived microbes. The Cape Fear River in Wilmington, NC is an easily accessible source for sediment collection and offers a unique environment key to the discovery of antibiotic-producing soil-dwelling bacteria. Sediment samples collected at River Road Park along the Cape Fear River were combined with water, serially diluted, and cultured on actinomycete isolation agar. After incubation, cultures were overlayed with a tryptic soy soft agar containing *Staphylococcus epidermidis*. Two colonies producing zones of inhibition were then isolated and plated on tryptic soy agar. To confirm the antibiotic activity of the Cape Fear River Sediment (CFRS) isolates, a cross-streak test was performed against a variety of bacteria including ESKAPE pathogens. The cross-streak test revealed that both isolates showed antibiotic activity against a variety of bacteria. Gram staining, BIOLOG, and 16S rRNA sequencing techniques were then used to identify the species of each unknown isolate. Both CFRS isolates appeared as Gram-negative bacilli through gram staining and were identified as the same species, *Bordatella trematum*, with the BIOLOG assay. Sequencing of the 16S rRNA gene, however, revealed the species of each CFRS isolate to be *Alcaligenes aquatilis,* a species similar to *B. trematum*. No previous reports suggest that *A. aquatilis* exhibits antibiotic activity, indicating that this may be a novel finding. Growth curve assays were conducted to determine the optimal culture conditions and time when the most antibiotic compound is produced.

P32 Hannah M. White, Lea A. Cenname, C. Brian Odom
Biology, Wingate U, NC

Bacterial Contamination of Commercially Dispensed Iced Tea: A Preliminary Study

Sweetened and unsweetened samples of iced teas were obtained from 20 different outlets of a fast food franchise. These samples were plated to determine their degree of bacterial contamination. Isolated representative contaminant colonies were screened for resistance to several common antibiotics.

P33 Zachary P. Johannesson, Ashton L. Honeycutt, Matthew C. Mason, Caroline L. Jones, Aaron T. Kesinger, Nicholas C. Loekman, Kevin B. Kiser
Biology, UNC Wilmington, Wilmington, NC

Antibiotic Resistance Profiles of *S. aureus* Isolates Collected From the Noses and Throats of Nursing Students

Staphylococcus aureus (*S. aureus*) is an opportunistic bacterial pathogen that can cause a

range of skin, soft tissue and invasive infections in humans. It is also carried harmlessly in the nose of 30% of the population as well as throat in unknown amounts. *S. aureus* is of concern in healthcare settings, where compromised hosts and invasive procedures allow the bacteria to bypass host defenses, causing infection. These infections are made worse by antibiotic resistant strains, particularly methicillin-resistant *S. aureus* which are difficult to treat with antibiotics. Studies have shown that MRSA is carried by 6.25% of healthcare workers, possibly contributing to the spread in hospitals. To test whether the rates of MRSA carriage will increase from the 1-2% with an increase in clinical exposure, the noses and throats of UNCW nursing students were tested for the presence of MRSA. The nose and throat swabs were incubated in a selective culture then transferred to CHROMagar Staph aureus plates. *S. aureus* colonies were identified, isolated, and then subjected to antibiotic susceptibility testing. Over six semesters the *S. aureus* carriage rates have been 52% (36% nose/31% throat), 43% (23% nose/29% throat), 41% (24% nose/31% throat), 62% (46% nose/34% throat), 50% (22% nose/36% throat), and 47.8% (29% nose/39% throat). Only six students (1%) tested positive for MRSA, indicating the increased clinical exposure in nursing school does not lead to increased carriage rates. However, this study highlights the importance of testing the throat in addition to the nose, as several semesters saw more throat than nasal carriers.

P34 Stephanie M. Unkles[1], Kingsley D. Dunkley[1], Karen Harris-Shultz[2]
[1] Biology, Abraham Baldwin Agricultural College, Tifton, GA; [2] USDA, ARS-USDA, Tifton, GA

Evaluating Growth Phases and Virulence Factors Associated with *Shigella flexneri 2a* Propagation *in vitro*

The genera S*higella* is a group of gram-negative, non-motile, opportunistic bacteria comprised of four species, which are highly contagious causing 500,000 cases of shigellosis infections in the United States each year. *Shigella flexneri* infections are a major public health problem in developing countries, spreading by means of fecal-oral transmission or ingestion of contaminated food or water. It causes the infectious disease shigellosis, inducing symptoms of severe abdominal cramping, high-grade fever, diarrhea or death. Some individuals infected with *S. flexneri* have developed post-infectious arthritis that can last from months to years after the infection which can lead to chronic arthritis.
The objectives of this study are to evaluate the optimal pH for growth of *S. flexneri strain* 2a as well as to determine various virulence genes that make this microorganism flourish in a simulated *in vitro* environment. *S. flexneri* strain 2a, ATCC 29903 was grown in LB broth *in vitro* in pH 4.0, 5.0, 7.0, 8.0 and 8.5. Our preliminary results reveal that *S. flexneri* doubled its generation steadily in pH 7.0 and 8.0. However, *S. flexneri* failed to maintain satisfactory growth rates in pH 4.0, 5.0 and 8.5. In Trial Two, exponential phases started at 2hrs while stationary phase started between 4 and 6 hrs. Although each treatment started at a different pH, data indicated a consistent pH (4.7) in all treatment groups after 6 hrs. We assume that *S. flexneri* could not metabolize substrates and express genes effectively in LB broth to attain satisfactory generation doubling time in pH 4.0, 5.0 and 8.5 compared to pH 7.0 and 8.0. As we proceed with our research we will try to evaluate the expression of virulence genes (*rpoS and virB*) and selected metabolites that are associated with the pathogenesis of *S. flexneri* in the human GI tract. Hopefully, our investigation will provide additional information on variables that are associated with *S. flexneri* infections in human and other animal models, which may help to effectively reduce the incidence of its infection worldwide.

P35 Patrick Thomase, Kelsey Rodgers, Christiane Ingram, Benedict Okeke
Biology, Auburn U at Montgomery, AL

Evaluation of Sulfate Reducing Bacteria for Salt Tolerance

Activities of modern societies including mining, electroplating, leather tanning, power generation, manufacturing of electronics and crude oil spill can cause metal pollution of water. Under anaerobic conditions, sulfate reducing bacteria (SRB) produce hydrogen sulfide from

oxidation of organic materials using sulfate as the final electron acceptor. Hydrogen sulfide can precipitate soluble metal species as insoluble metal sulfides which can be removed. In this study, SRB were isolated from MPN tubes positive for SRB. The MPN tubes were inoculated with sediment cores from sites polluted by crude oil. Using 16s rRNA gene sequence analysis, two strong sulfate reducing bacteria were identified to be *Citrobacter* species. The isolates were evaluated for growth in media amended with 1-6% sodium chloride. Results suggest potential application of salt tolerant SRB in biotreatment of saline wastewater contaminated with metals.

P36 Emily A. Linton, Michelle L. Suhan-Thomas
Biological Sciences, Campbell U, Buies Creek, NC

DNA Hybridization Studies and Phenotypic Characterizations of Carbon Source Usage of the*Kistimonas* Species

A proposed *Kistimonas* species of bacteria, *Kistimonas allitiae*, has been isolated from the marine polychaete *Alitta succinea* and shows potential for bioremediation efforts as a surfactant degrader. The genus *Kistimonas* is comprised of two species, *Kistimonas asteriae* and *Kistimonas scapharcae*, which have been isolated from marine invertebrates in the Korean coastal waters. Current research is focused on providing evidence that the proposed isolate is a separate, distinct *Kistimonas s*pecies that is capable of metabolizing surfactants. Genomic DNA hybridizations studies comparing the proposed isolate to both established *Kistimonas* species, *Kistimonas scapharcae* and *Kistimonas asteriae*, will help to elucidate the species designation. Genomic DNA of proposed *Kistimonas allitiae* was digested for synthesis of a chemiluminescent probe and hybridized to extracted genomic DNA from the established *Kistimonas* species and itself. Genomic DNA was linked to a zeta probe membrane prior to hybridization. Percent hybridization was determined using densitometry. In addition to genomic comparisons, phenotypic studies using Biolog PM1 MicroPlates were done to compare carbon source usage among the species. The proposed *Kistimonas allitiae* produced a similar, but not identical, phenotypic profile to the two established species. Surfactant utilization will be studied using Biolog PM19 MicroPlates, containing surfactant and surfactant-like compounds.

P37 Shelby R. Curren, Rosyln Crowder
Biology, Stetson U, DeLand, FL

Comparison of Genistein-Induced Apoptosis in T-Cell Leukemia Jurkat and Nonmalignant Lung Fibroblast MRC-5 Cells

Genistein is a potential chemotherapy represented by its notable reduction of cell viability. Continuing previous research that showed a time and dose dependent decrease in cell viability when treated with Genistein, this research seeks to compare Genistein's effects on malignant T-cell leukemia Jurkat cells and nonmalignant lung fibroblast MRC-5 cells. Genistein caused cell death in both cell lines over 24 and 48 hour treatment periods. In the 48 hour trial, Genistein treatment resulted in more loss of cell viability in the malignant cells than in the nonmalignant cells. This is significant as it proves that Genistein is effective in causing cell death at a higher rate in cancer cells than nonmalignant cells, and therefore may be of use as a chemotherapy.

P38 María A. Trujillo, Veronica A. Segarra
Biology, High Point U, NC

Mapping theSorting Signals of the Cytoplasmic Domain of Atg27

Proteins perform different cellular functions such as structural support and transport of solutes. It is essential that these proteins be delivered to where they are needed. Membrane trafficking is an important process that allows for the distribution of specific macromolecules, such as proteins, throughout the cell. Protein transport is carried out with the help of sorting signals, which are short stretches of amino acids that mediate the transport of proteins to their designated compartment or organelle. Autophagy is a specialized type of membrane trafficking

during which unneeded or damaged cytoplasmic components are taken to the degradative organelle of the cell for recycling. Irregularities in autophagy can lead to human diseases like cancer and neurodegenerative disease. In addition, certain pathogenic bacteria are known to escape targeting by harnessing autophagy. Because autophagy is highly conserved in eukaryotes, the eukaryotic microbe *Saccharomyces cerevisiae* (baker's yeast) has been a great model system to better understand autophagy and its connection to human diseases. One of the key trafficked proteins in autophagy is Atg27, a membrane protein with a single cytoplasmic domain. In order to map the sorting signals of this protein, we have generated multiple fluorescent Atg27 cytoplasmic domain deletion mutants. Our current work is focused on dissecting the effects of these mutations on Atg27 localization and function during autophagy.

P39 Natalie Telfeja, Arlety Mendez, Alfredo Leon, Steven Ritter
Biology, Miami Dade College, FL

Mitochondrial Identification and Barcoding of *Sabal* Palms

DNA Barcoding is a used to identify genetic similarity between species. Targeting the mitochondrial cytochrome c oxidase subunit I (COI) for DNA barcoding in Sabal palms can provide knowledge on the distinctiveness amongst the genus, which is native to the Caribbean. By generating a homogenate and later conducting a PCR we aim to locate the mitochondrial Once we have identified this gene, we will be able to determine if the mitochondria is present in an optimized chloroplast enrichment technique previously developed. We obtain the palm extract by blending pieces from palm leaves in a 0.2 M sucrose solution. The solution is then filtered through cheesecloth to obtain a plant homogenate. DNA from the plant homogenate is then isolated using the DNeasy Plant Mini Kit. Presence and quality of DNA is determined by quantifying the extracted material from the Qiagen kit, and after successfully extracting DNA, a PCR will be conducted to determine the presence of the mitochondrial cytochrome.

P40 Russell P. Webb[1], Moges W. Woldemariam[2]
[1] Biology, Abraham Baldwin Agricultural College, Tifton, GA; [2] Veterinary Pathology, U of Georgia, Tifton

Ki-67 Expression in Canine and Feline Squamous Cell Carcinomas

The objective of the study was to observe if there is a positive correlation between the mitotic index and the expression of the KI-67 protein in canine and feline squamous cell carcinomas. Squamous cell carcinoma (SCC) is a neoplasm (uncontrolled growth of cells) that arises from squamous epithelium in the skin and other tissues. In this study, tissue samples from cats (feline) and dogs (canines) with squamous cell carcinoma were analyzed. The first part of this study analyzes the mitotic index as an indicator of malignancy in squamous cell carcinoma. KI-67 is a well-defined proliferative marker, only found during cell proliferation. The KI-67 protein is expressed in all parts of the cell cycle with the exception of the G0 (resting phase) making this protein an excellent indicator of the growth fraction in a given cell population. The fraction of KI-67-positive tumor cells is generally used as an indicator of the level of 'aggressiveness' in some tumors in animals and humans. The second part of this study uses the same tissues to analyze the mitotic index and stains them with an antigen binding complex that is specific to KI-67.

P41 Hannah M. Tardif, Mackenzie Jarvis, Michael Gladhill, Angela Bauer, Kristen Bowey
Biology, High Point U, NC

An Investigation into the Effects of Genestein on Hman Breast Cancer Cells

Various chemicals in the environment have an effect on hormone signaling in the body. Endocrine disruptors such as phthalates are extremely prevalent in the environment and block the binding site where estrogen attaches. This may contribute many serious heath problems including breast cancer. Genestein is a phytoestrogen that is found most commonly in soy plants. It has been shown to both inhibit and promote cell proliferation. We will be working with the MCF-7 BOS cell line treated first with a phthalate and second with different concentrations

of Genestein to asses its effect on cell proliferation.

P42 Ashley D Fox, Scott Weir, Patricia Koplas
Biology, Queens U of Charlotte, NC

The Cytotoxic Effect of *Annona muricata* (Soursop) Fruit Pulp Extract on Hep-G2 Cells

Cell culture is a valuable tool for investigating potential drugs and the degree of their cytotoxicity to tumorigenic cells for the treatment of cancer. In addition to potential chemotherapeutic drugs, recent studies have also used cell culture models to characterize the antiproliferative and apoptotic effects of alternative compounds on cancer cells. Research on such compounds has been prompted by the increasing popularity of herbal teas, botanically derived products such as leaf extracts, and other nutritional products such as vitamin supplements among cancer patients. One such extract is the *Annona muricata (*soursop) leaf extract. It has been reported to have cytotoxic effects against several cancer cell lines including lines derived from lung, breast, and colon carcinomas. This study analyzed the cytotoxicity of soursop fruit pulp extract on the Hep-G2 cell line derived from a liver hepatocellular carcinoma. Hep-G2 cells were exposed to varying concentrations of the extract for 24 hours and lactate dehydrogenase (LDH) assays were performed to assess cytotoxicity. Results suggest that the cells exposed to the soursop extract demonstrated increased cell death compared to the cells exposed to the DMSO vehicle. This supports the hypothesis that soursop fruit extracts have a cytotoxic effect against hepatocellular carcinoma cells. The results of this study also support the findings of previous studies performed in tumorigenic cell lines derived from other tissues and suggest that additional research is needed on the chemotherapeutic potential of soursop extracts.

P43 T. Jeffrey Cole[1], Patrick A. Buszka[1], James A. Mobley[2], Robert A. Hataway[1]

[1] Biological & Environmental Science, Samford U, Birmingham, AL; [2] Surgery, U of Alabama at Birmingham

Characterization of the Venom Proteome for the Wandering Spider, *Ctenus hibernalis* (Aranea: Ctenidae)

Spider venom is a rich multicomponent mixture of neurotoxic polypeptides. The venom of a small percentage of the currently classified spiders has been categorized. We constructed proteomic data from crude venom of the wandering spider *Ctenus hibernalis* using HPLC paired with LTQ XL ion MS, to determine what venom proteins are expressed in this species. We found 1,238 proteins that closely matched the sequences of other venom proteins of several species of spiders. Our results suggest that the venom proteins of *C. hibernalis* contain several proteins with conserved structures similar to other species. Future work will further characterize the sequences of the proteins that did not have any matches within the database in order to further understand the proteomic makeup of the venom of this species.

P44 Gabrielle J. Valles, Elliott T. Draughn, Melissa M. Fox
Biology, Wingate U, NC

The Metabolic Regulator AMPK Alpha-2 Promotes Breast Cancer Cell Adhesion Properties

AMP-activated protein kinase alpha-2 (AMPK alpha-2) is a metabolic regulator that traditionally responds to low cellular energy levels to protect the cell from damages incurred by excess energy consumption while simultaneously attempting to restore energy homeostasis. These processes are viewed as a checkpoint to maintain a normal phenotype. Interestingly, AMPK alpha-2 has also been found to regulate cytoskeletal components during cell migration, mitosis, and membrane dynamics. Studies suggest that this activity results from phosphorylation of proteins related to actin polymerization and stabilization. Due to these findings, it was proposed that AMPK alpha-2 signaling may also influence cancer cell adhesion properties since cell surface adhesion proteins tether to the cytoskeleton inside of the cell. In this study, it was hypothesized that the presence of AMPK alpha-2 would inhibit the loss of cancer cell adhesion

properties thereby preventing a critical step in the Epithelial to Mesenchymal Transition (EMT), a process that promotes tumor metastasis. To evaluate whether the presence and activation of AMPK alpha-2 modulates breast cancer cell adhesion interactions from both cell-cell and cell-extracellular matrix (ECM) standpoints, MCF-7 breast cancer cells transfected with GFP or AMPK alpha-2 overexpression constructs were employed. Proliferation assays were performed using cells grown in monolayer (to evaluate cell-cell and cell-ECM properties) or mammosphere (to evaluate cell-cell properties) cultures using metformin as an AMPK activator. Adhesion assays to various ECM substrates were also performed to determine binding preference. Overall, it was found that AMPK alpha-2 expression enhanced cell adhesion properties under most conditions. These results suggest that cells expressing AMPK alpha-2 may prevent early stages of metastasis by enhancing cell-cell and cell-ECM adhesions to the primary tumor site but support late stages of metastasis by increasing survival during anchorage independent migration and formation of new cell-ECM adhesions to the secondary site.

P45 Michael Mutchler
Biology, Appalachian State U, Boone, NC

Genetic Screen for G Protein Signaling Components Involved in Nociception in *Drosophila melanogaster* Identifies Genes in the GAQ Pathway as Important for Nociception

Chronic pain is a widespread issue in the United States, with over 100 million people claiming to suffer every year. This leads to billions of dollars lost in productivity and spent on treatment and care. There is a need for a more extensive understanding of how pain is perceived and also how it is transduced by sensory neurons. Elucidating the cellular and molecular mechanisms involved in transduction of noxious stimuli could lead to more effective and cost efficient treatment methods. Previous studies have indicated that G proteins play crucial roles in nociception and long-term sensitization to pain; however, the mechanisms are not completely understood. *Drosophila melanogaster* is a powerful model organism to manipulate genes involved in nociception in an attempt to expose different genes' impacts on the transduction of noxious stimuli. *Drosophila* larvae respond to noxious stimuli with well-documented response behavior referred to as nocifensive escape locomotion (NEL), which is marked by rolling along the longitudinal body axis. Using RNA interference to knock down functional transcripts of mRNAs specifically in the nociceptor neurons, we have performed a screen of G protein signaling genes potentially involved in nociception by identifying G protein signaling genes that produce an NEL defect when knocked down. The candidates identified in this initial screen are genes involved in the Gαq signaling pathway in *Drosophila melanogaster* class IV multidendritic neurons. Future directions of study will have a focus on the cellular and molecular mechanisms of how these candidates function. This will include analyses of neural morphology and electrical activity.

P46 Regan Chewning, Alison Woods, Mary A. Sahawneh
Biological & Environmental Science, Samford U, Birmingham, AL

Effects of Potential Neuroprotective Compounds on PC12 Cells

Oxidative stress is a feature of neurological disorders including Alzheimer's disease, Parkinson's disease and cerebral ischemia. This study investigates the potential neuroprotective effect of curcumin and hesperidin, separately, in the presence of hydrogen peroxide-induced oxidative stress in a PC12 cell line. Curcumin, a polyphenol compound derived from *Curcuma longa*, has antioxidant and anti-inflammatory properties and has been studied regarding its role in promoting neurogenesis. Hesperidin is a flavonoid glycoside found in citrus fruits that is capable of crossing the blood-brain barrier and attenuating oxidative stress-induced neurotoxicity. Our preliminary results indicate that both hesperidin and curcumin are capable of increasing cell viability in undifferentiated PC12 cells in the presence of hydrogen peroxide as measured by MTT assay. We are beginning to investigate the regulation

of MAPK signaling and neuronal outgrowth that occurs as a result of curcumin or hesperidin treatment of differentiated PC12 cells.

P47 Paul R. Freeman, Andrew C. Bellemer
Biology, Appalachian State U, Boone, NC

A Genetic Screen for Wnt Signaling Factors in *Drosophila melanogaster* nociception

Nociception is the process by which sensory neurons in the periphery detect noxious stimuli and cause behavioral responses. The mechanisms behind the transduction of noxious sensory stimuli and the resulting behavior are still not fully known. Recently, Wnt–related signaling has been found to play a role in the hypersensitization of these nociceptor neurons. In order to determine Wnt-signaling molecules' roles in the regulation of nociceptor neuron function, we have compiled a list of candidate Wnt signaling genes based on literature and gene ontology. We have obtained UAS-RNAi transgenic fly lines for each gene from this list, which will produce RNA hairpins that target the mRNAs of genes of interest for degradation. To ensure that RNAi knockdown is limited to nociceptor neurons, we will cross the RNAi transgenic fly lines with fly lines that carry the ppk-GAL4 transgene, a driver line that causes expression of UAS transgenes specifically in nociceptor neurons. We will test the larval progeny of these crosses with a well-established thermal nociception assay. We will measure response rate relative to wild type and expect to find knocking down specific genes of interest will produce 1) hypersensitivity to noxious stimuli; 2) reduced sensitivity to noxious stimuli; or 3) no difference in responses to noxious stimuli. Once we have used behavioral data to identify candidate genes that suggest the regulation of nociceptive function, we can complete further analysis to identify the cellular and molecular mechanisms in regulation of nociceptor function.

P48 Nickolaus Willis, Kala Downey, Carol Baskauf
Biology, Austin Peay State U, Clarksville, TN

Population Genetics of Seep Endemic *Xyris tennesseensis*

This study examined the population genetics of the federally endangered seep endemic *Xyris tennesseensis*. Leaves of individual plants were collected from five seeps in Tennessee, four in Alabama, and five in Georgia. An isozyme survey was performed on nine populations and revealed that genetic diversity for this species is unusually low, even for an endemic species. At the species level, *X. tennesseensis* was polymorphic at 25% of the eight loci assayed, with an average of 1.25 alleles per locus. However, no single population showed any variability at any locus, and there was no clear regional pattern regarding alleles shared by populations. One Alabama population was fixed for a unique allele at the 6PGDH isozyme, and another Alabama and one Georgia population were fixed for an alternate shared allele at the MDH isozyme. Thus with isozyme markers detecting only "among-population" variability, it will be particularly important to protect as many populations as possible in order to conserve the genetic diversity of this species. The fact that isozymes were not able to detect very much genetic variability in *X. tennesseensis* indicates that it would be beneficial to use a higher resolution genetic marker in evaluating the species' population genetic structure and variability. Consequently, a microsatellite library has been developed for *X. tennesseensis*, and survey work using individuals from 12 populations has resulted in some promising microsatellite markers for use in a future population genetics study of this endangered species.

P49 Lolita L. Muñoz[2], Karen Harris-Shultz[2], Hongliang Wang[3], Richard Davis[2], Joseph Knoll[1], Jason Peake
[1] College of Agriculture and Environmental Sciences, U of Georgia, Tifton; [2] Crop Genetics and Breeding Research Unit, USDA-ARS, Tifton, Georgia; [3] Crop Protection and Management Research, USDA-ARS, Tifton, GA

Introgression of a Root-Knot Nematode Resistance Gene from 'Honey Drip' into Susceptible Sorghum Lines

Southern root-knot nematodes (*Meloidogyne incognita*) are soil-dwelling microscopic worms that feed on the roots of many crop plants. This feeding can cause damage to the root systems of many crops such as tomatoes and cotton, and prevent the plants from properly absorbing water and nutrients. Management of root knot-nematodes relies on nematicides, plant resistance, and cultural practices such as crop rotation. Sorghum can be an effective rotation crop for keeping root-knot nematode populations low but cultivar choice is parmamount. The sorghum cultivar 'Honey Drip' was found to be resistant to root-knot nematodes. A previous genetic study identified that a single dominant gene on Chromosome 3 from' Honey Drip' restricts nematode reproduction. We sought to determine if the root-knot resistance gene from 'Honey Drip' can be introgressed into susceptible sorghum lines and confer resistance. Thus, a marker-assisted backcross introgression scheme will be utilized in the development of BC_2F_3 lines which will contain DNA primarily from the recurrent susceptible parent, but also contain 'Honey Drip' DNA in the root-knot nematode resistance gene area. Progress in the development of these backcrossed lines will be presented.

P50 Christine A. Bowen, Matt C. Estep
Biology, Appalachian State U, Boone, NC

Developing Microsatellite Markers to Distinguish Between Varieties of Vetiver (*Chrysopogon zizanioides*)

Vetiver (*Chrysopogon zizanioides*) is a tropical grass (Poaceae) within the tribe Andropogoneae. Typically, this grass is grown as a cash crop in developing counties for medicinal purposes and the perfume industry. Vetiver's deep root system has allowed a second use to develop in erosion control. A sterile variety known as "Sunshine" has recently been allowed into the U.S. for this purpose. Several grasses from the same tribe have become invasive species after being introduced to the U.S. (*Imperata*, *Miscanthus*, *Microstegium*). Currently, there are no tools that identify the "Sunshine" variety from other varieties of Vetiver that can sexually reproduce. To avoid the risk of allowing a potentially invasive species into the U.S., a genetic marker needs to be determined to separate the Sunshine variety from others. The purpose of this study is to develop a microsatellite marker that distinguishes between the Sunshine varieties and others. Illumina sequencing generated ~ 4 million sequence reads for Vetiver. MSAT commander was then used to identify over 20,000 sequences containing microsatellite repeats from 10 to 20 nucleotides long. 46 Primer pairs were then developed to amplify microsatellites regions. Each pair has been tested across a panel containing various types of Vetiver. Results from this initial screen will be presented.

P51 David Klein, Marian Baker, Renee J. Chosed
Biology, Furman U, Greenville, SC

Modeling the Mixed-Lineage Leukemia (*MLL1*) Multi-Protein Complex in *Saccharomyces cerevisiae*

The goal of this project is to define the regulatory mechanisms of the human mixed-lineage leukemia (MLL1) multi-protein complex by modeling the complex in the budding yeast, *Saccharomyces cerevisiae*. H3K4 methylation in mammals is catalyzed by the MLL family of methyltransferases. Chromosomal translocations and other mutations in the *MLL1* gene lead to misregulation of *Hox* genes and can lead to various types of leukemia. MLL1 is associated with a large complex of proteins, several of which are *required* for the methyltransferase activity of the enzyme. The role of the accessory proteins within the complex associated with MLL1 is likely to regulate the function of MLL1 since some of the proteins are requisite for enzymatic activity of MLL1. Complicating the research of MLL1 is the fact that there are several MLL-like proteins with the same function that are active in mammalian cells. This system is simplified by modeling the MLL1 protein complex in budding yeast. Budding yeast contain a single protein complex referred to as COMPASS (Complex Proteins Associated with Set1), that is homologous to the MLL1 multi-protein complex in mammalian cells. We hypothesize that the accessory proteins associated with the human MLL1 complex regulate the enzymatic activity of MLL1 and that yeast can provide an ideal system to recreate this human multi-protein complex

to probe the intricacies of the regulation. The proposed research seeks to examine the protein-protein regulatory mechanisms within the human MLL1 complex using yeast as a model system. We propose the following specific aims:

- Construct the human MLL1 multi-protein complex in yeast.
- Investigate the interactions between yeast COMPASS and human MLL1 complex members in hybrid protein complexes.

P52 Harley Williams, Jeffrey Thomas, Jennifer Easterwood
Biology, Queens U of Charlotte, NC

A Genetic-Sexing Study of Raptor Species Native to the South-Eastern United States

Accurate non-invasive identification of sex in raptors is important for their management and conservation purposes, such as sex-biased injury rates. Molecular methods offer a less invasive way to sex monomorphic species. Raptors native to the south-east have not been studied in this manner. Polymerase chain reaction (PCR)-based methods have been used frequently in the sexing of monomorphic species, using a diversity of sex-linked markers. The aim of this research was to determine an accurate protocol using CHD linked gene primers for sexing of southeastern raptors. The CHD genes are found on the sex chromosomes and are highly conserved. It was discovered that different raptor species required different primer sets to distinguish males from females. All samples used were from deceased birds gathered from the Carolina Raptor Center and the VHS Wildlife Rehabilitation Center. All birds were necropsied to be able to confirm the sex both morphologically and genetically. This study was able to determine a protocol for accurately sexing raptors of several different species.

P53 Jordin Ellingson, Emily Bewick, Robert H. Wainberg
Biology, Piedmont College, Demorest, GA

The Effects of Caffeine and Alcohol on Development in *Drosophila melanogaster*

The consumption of drugs, such as caffeine and alcohol during pregnancy is associated with spontaneous abortions, pre-mature births, and restricted development. Using *Drosophila melanogaster* as a model, we tested whether the independent or synergistic effects of each drug were more or less restrictive on key markers of development (body length, total development time, sex ratio, and wing, body, and eye defects). Larvae were reared on media containing either 15% alcohol, 500 $\mu g ml^{-1}$ caffeine concentration, a combined alcohol and caffeine solution, or water only (control) in four independent trials. Days to adult emergence were counted, and the developmental markers listed above were measured for each adult fly. As determined by an ANOVA, body length was significantly shorter in all three treatments compared to the control: caffeine (P=0.009), alcohol (P=0.001), and combined (P=0.005). Development of wings (P<0.000) and body (P=0.002) were also significantly different, but eye development and sex ratio were not. While the effect of any treatment was significantly different than the control in most tests, we could not distinguish any significant effect among non-control treatments. This suggests that while the presence of either drug alters development, the interaction of the drugs does not have an enhanced effect. The results parallel the effects of alcohol and caffeine in human development, suggesting that these drugs affect biochemical processes that are conserved in both humans and flies. However, our hypothesis that the synergism of the drugs would alter development to a greater extent was not supported.

P54 Halley G. Watson, Chuck Smith, Patrick A. Vigueira, Cindy C. Vigueira
Biology, High Point U, NC

Comparison of *Ambystoma maculatum* and *Ambystoma opacum* population genetics in the Uwharrie Mountains of North Carolina

Vernal pools provide critical breeding habitats for a variety of amphibians including the Spotted Salamander (*Ambystoma maculatum*) and its relative, the Marbled Salamander (*Ambystoma opacum)*. The isolated nature of vernal pools in the landscape has potential to greatly influence

gene flow and thus genetic variation within and between salamander demes. In this study, we used Nested PCR and population genetics programs to assess the genetic variations between and within three populations of each of these species found in the Uwharrie National Forest. We screened twenty genetic markers, which were developed for phylogenetic comparisons within the clade Caudata. We found that seven markers amplified consistently and were genetically variable within our samples. These markers are being used to estimate population size, structure, and migration in both Spotted and Marbled Salamanders to establish the impacts of their life history differences.

P55 Joshua Baulch, Patrick A. Vigueira, Cindy C. Vigueira
Biology, High Point U, NC

Genetic Identification and Phylogeny of Parasitoid Wasps (Family *Ichneumonidae*) from North Carolina

Insects are some of the most diverse organisms in the animal kingdom, with species numbers that have been described to be in the millions. However, described species account for an estimated 20% of total species diversity. In the family Ichneumonidae, there have been around 24,000 species identified and estimates of at least 60,000 species in existence. Most ichneumonid species have been described based on morphological traits and host specificity. Genetic marker development is lacking within this important group; current phylogenies are based on 1-3 genes and only represent a small portion of identified species. The purpose of this research is to add to current phylogenies of previously identified ichneumonids with samples collected from North Carolina. We are sequencing a portion of the mitochondrial Cytochrome C Oxidase gene that has previously been used in other ichneumonid phylogenies. In addition, we are utilizing next generation sequencing techniques to develop new genetic markers that can be applied to both phylogenetic and population genetic analyses. These new markers will allow us to measure genetic diversity across the genome rather than at a single locus. Our goals are to unravel how life history differences in ichneumonid species can impact diversity and divergence of populations.

P56 Carl A. Chmielewski, James R. Kerfoot, Jr.
Biology, Union U, Jackson, TN

The Influence of Seasonal Fluctuations in Temperature on Feeding Kinematics of Juvenile *Alligator mississippiensis*

The effect of temperature on gender determination, thermoregulation, and digestion in American alligator (*Alligator mississippiensis*) have been well documented, however, very few studies have investigated its influence on feeding behavior. For poikilotherms increasing temperature should have an increasing effect on physiological rates, including their feeding kinematics. The objective of this study was to investigate the influence of temperature on the feeding kinematics of American alligator juveniles feeding at various temperatures. It was hypothesized that there would be no difference in feeding kinematic variables in juvenile individuals feeding on immobile prey at 20 and 30 ºC. Also, Q_{10} temperature coefficients were calculated to explore the influence of a 10 ºC change on maximum gape and attack velocities. Individual juveniles (standard length range: 45 – 60 cm) were placed in 75.7 L filming tanks, filled with 19.0 L of water. A Casio high speed camera filming at 300 frames s^{-1} (fps) was used to film individuals feeding on immobile golden shiners (*Notemigonus crysoleucas*) suspended above the water. Individuals were assigned a random temperature treatment order (20 and 30 ºC) and filmed feeding, three times for each treatment. Feeding events were analyzed using Tracker 4.92 video analysis software and a series of paired t-tests were run in R statistics on the data, with the α-level set to 0.05. Preliminary results indicated that maximum gape distance (mm), maximum gape velocity (mm s^{-1}), attack velocity (mm s^{-1}), and length of feeding bout (s) were not significantly different for individuals feeding in the two temperature treatments (all P-values > 0.05). The preliminary Q_{10} measurements averaged 0.80 ± 0.23, however, they were not different from 1.0, showing thermal independence of those rates at this temperature range.

Individuals fed equally well, perhaps indicating that temperature has little influence on juvenile feeding kinematics at this temperature range.

P57 Emily E. Easter, James R. Kerfoot, Jr.
Biology, Union U, Jackson, TN

How Doth the Little Crocodile: Analyzing the Effects of Environmental Viscosity on Feeding Performance of *Alligator mississippiensis* Juveniles

Successful growth to maturity is limited by successful resource acquisition by American alligator (*Alligator mississippiensis*) juveniles. Because wetland habitats are used as nursery sites for hatchlings and juveniles, alligators must be able to exploit prey in both aquatic and terrestrial settings. However, little is known about how viscosity of the medium affects feeding behavior. The objective of this study was to determine whether there were differences in feeding performance of alligator juveniles feeding on prey placed above (terrestrial setting) or below the water line (aquatic setting). Feeding events were recorded using a Casio Exilim-FX high speed video camera at a rate of 300 frames per second. Feeding performance was summarized by analyzing three feeding kinematic variables that included maximum gape distance (mm), maximum gape velocity (mm s^{-1}), and duration of feeding bout (s). Successes of alligator strikes were also measured for each video. The three kinematic variables were analyzed using a series of paired t-tests, and success was analyzed using a Wilcoxon Signed Ranks test. No significant differences were found in feeding kinematic variables or in alligator success between treatments. One explanation for these results is that as the medium viscosity increases (i.e. aquatic treatment) the relevant feeding musculature increases its output to balance the attack. Also it was observed that alligators would approach underwater prey with mouths partially open. This behavior could be an indication of methods used to overcome water viscosity. Another explanation could be that alligators are known to rely on different senses when feeding in different mediums. Further research examining specific feeding behaviors and sensory mechanisms utilized in different mediums and the potential use of electromyography assessing the outputs of the jaw musculature would benefit in elucidating the contribution of various alligator senses and musculature outputs associated with successful feeding in various medium scenarios.

P58 Justen Dick[1], Emily Belanger[2], Gerald Bresowar[2]
[1] Kelly Ridge Farms, Meadowview, VA; [2] Biology, Emory and Henry College, Emory, VA

The Effects of Pruning Manipulation and Early-Spring Hoop House Use on Hop Production in Southwest Virginia

The bulk of America's production of Hops (*Humulus lupulus* L.) has historically been limited to the Pacific Northwest of North America. Several recent economic and cultural factors have spurred an interest by farmers in the southeast toward hops production. A major hurdle to production in the southeastern United States is lower overall production per acre compared to that of traditional production areas. Virginia growers have estimated current average production per acre at about 25% of larger Western producers. The ability to achieve an adequate amount of vegetative growth prior to flowering is hypothesized to be a significant variable in this production gap. In order to investigate methods for increasing southeastern US hop yields, we developed a study of growth and production in southwestern Virginia. Using a combination of pruning manipulation to alter plant growth response and floral initiation, and hoop house utilization in early spring to shorten dormancy and thus increase number of post-dormancy growing days, we assessed growth response, and floral-chemical (alpha and beta acid content) data from 324 plants. We report on the findings for the first year of this project.

P59 Donald Shaw[1], Laina L. Roberson[2]
[1] Biology, U of Tennessee at Martin; [2] Psychology, U of Tennessee at Martin

Impact of Serious Games on Learning and Teaching in Undergraduate Anatomy and Physiology Classes

Serious games are designed for the purposes of education and training. As claimed by publishers, interactive art quizzes and jeopardy games are two serious games that are beneficial to learning in health science disciplines. However, there is little evidence to support the publishers' claims. Our research was aimed to test the impact of these two serious games on a teacher's evaluation and students' learning in anatomy and physiology classes. In our research, students in two classes in fall 2015 (n=25) and spring 2016 (n= 26) (Classes A and B, respectively) at UTM were selected to test the impact of serious games on their learning. There were four exams administered for both classes, respectively. The same exam was used for both classes; however, the order of questions in each exam was reshuffled. In period 1 (of both semesters), Class A only played jeopardy games, and Class B played neither. Students then took Exam#1. In period 2, Class A only played jeopardy games, and Class B played both jeopardy games and art quizzes. Both classes took Exam#2 thereafter. In period 3, Class A only played art quizzes, and Class B did not play either serious games. Both classes then took Exam#3. In period 4, Class A played neither games, while Class B played both jeopardy games and art quizzes. Exam#4 was administered for both classes afterwards. We have found the scores of all four exams for Class A. Obtaining exam scores for Class B is on-going. Our results will help clarify if serious games impact students' performance on exams. This will be the first direct evidence of serious games gathered on academic performance in college level science classes. The teacher's evaluation will also be analyzed to see the impact of serious games on teacher's performance.

P60 Eric M. Benfield, Barrett W. Bradham, Ivan P.M. Dingle, Zachary S. Ford, Charles P. Fyfe II, Fernando U. Gonzalez, Danny J. Gustafson, Kristy Y. Johnson
Biology, The Citadel, Charleston, SC

A Long-Term Study of Cortisol as a Biomarker for Chronic and Acute Stressors

Stress has often been referred to as the 'silent killer' of humans. Over long periods of time, stress can increase the chance of heart disease, high blood pressure, and irregular heartbeat. In part, these negative health effects can be attributed to the physiological effect of prolonged exposure to high levels of cortisol, a steroidal hormone that increases rapidly in the bloodstream in response to both acute and chronic stress. While transient elevations of cortisol in the blood have been studied extensively, it has only recently been shown that cortisol deposited in growing hair is an accurate reflection of a systemic concentration over a long period of time. We conducted our study at The Citadel, a military college known for its rigorous regimented lifestyle and stressful fourth-class system for freshman cadets. We collected hair samples from junior cadets who were participating in a rigorous selection process for the Summerall Guards, an elite drill unit made up of senior cadets, which exemplify the standards and values of The Citadel. So far, data has been collected from phases one and two of training, on a weekly basis. Our results suggest that cortisol deposits in hair can be an accurate biomarker for chronic stress and, with further investigation, have implications to be used as a biomarker for acute stress.

P61 Joshua T. Clontz, Erika S. Niland, J. Alison Brown
Biology, Wingate U, NC

Effect of CrossFit on Academic Performance and Examination Stress in Preprofessional Undergraduate Students—A Preliminary Analysis

Stress that many pre-health professional undergraduate students face may lead to decreased academic performance. The benefits of exercise on stress have been reported for many years, but how exercise effects academic performance is a relatively unknown, especially in college students. Intense rigorous exercise consisting of a combination of aerobic and skill acquisition was associated with higher academic performance in elementary school students, especially in science and math. This type of exercise is thought to increase concentrations of Brain Derived Nerve Factor (BDNF) leading to an increased rate of learning, long term memory, and cognitive thinking, thus attributing to increased academic performance in students. CrossFit is a popular fitness regime that is performed at a high intensity and combines both the acquisition of skills, such as Olympic weightlifting and gymnastics, and aerobic exercise. Pre-health professional

undergraduate students may benefit academically from exercise regimes such as CrossFit. The objective of the study was to determine the effects of CrossFit on academic performance and examination stress in pre-health professional undergraduate students. Pre-health professional students enrolled in Human Anatomy and Physiology (Bio 312) or Microbiology (Bio 320) volunteered to serve in an exercise group that attended a local CrossFit gym three times per week or in a control group. All study participants completed a survey of perceived stress and submitted a saliva sample for Cortisol measurement directly before each major examination in either course. Examination grades, final course grade, and GPA were collected at the end of the semester from each group. Preliminary analysis will be conducted to determine if students that participated in CrossFit had higher academic performance and lower perceived stress than students in the control group.

P62 Nikolai M. Hay[1], Chris Ulrey[2], Gary Kauffman[3], Zack E. Murrell[1], Matt C. Estep[1]
[1] Biology, Appalachian State U, Boone, NC; [2] Blue Ridge Parkway, NPS, Asheville, NC; [3] National Forest Service, Asheville, NC

Preliminary Analysis of Genetic Diversity in *Geum radiatum* Suggests Inter-Population Diversity

Geum radiatum Michx.(Rosaceae) is a high-elevation, federally endangered herb that is widely recognized as a hexaploid and a relic species. Little is known about *G. radiatum*'s genetic diversity or population interactions. The southern part of the range has been sampled and analyzed using nine microsatellite markers. The data suggests inter-population level diversity as well as intra-population diversity. This data will provide a greater understanding of the genetic sustainability of *G. radiatum* and what kind of conservation efforts will most help this imperiled species survive.

P63 Paige L. Stover, Jennifer A. Hamel
Biology, Elon U, NC

Assessing Viability and Development of Hybrid Offspring From Two Closely Related Insect Species

In nature, copulations between individuals of different species rarely produce viable offspring. In Florida, individuals from two closely-related species of insects (*Anasa tristis* and *A. andresii*) are commonly observed mating together in an area where they are secondarily sympatric. These copulations have recently been shown to produce hybrid offspring, however the viability of these hybrids is unknown. We predicted that survival of hybrids to adulthood would be reduced relative to survival of offspring from a single parental species. In the laboratory, we compared the survival and developmental rates of hybrid offspring to offspring from conspecific pairs (both parents A. tristis). We found that many more offspring from conspecific pairs survived to adulthood than did offspring of heterospecific pairs ($c^2 = 16.95$, $p < 0.001$). However, there was no significant difference in developmental rate between hybrid and A. tristis offspring. Our data suggest that females can incur high fitness costs when they mate with heterospecifics. Future research should evaluate the frequency of mating between these species in the field, and whether females who mate once with a heterospecific male pay high lifetime fitness costs.

P64 Dawson W. Nance, Jennifer A. Hamel
Biology, Elon U, NC

Examining the Effects of Parasitism on Female Mate Choice and Copulation Duration

In many species, individuals are choosy about prospective mates, expressing preferences for traits that can increase the number or quality of offspring they will produce. Predators and parasitoids may act as a source of selection on mate preferences, for example by reducing an individual's reproductive opportunity. Although interactions with parasites are ubiquitous in animal populations, how parasitoids affect mate preferences is largely unknown. In North

Carolina, the squash bug (*Anasa tristis)* is parasitized by a fly (*Trichopoda pennipes*): larval *T. pennipes* develop in the host's abdomen and cause death within ~14 days. In the field, parasitized female squash bugs are more frequently found *in copula* than not. To explain this pattern, we hypothesized that parasitized females are less choosy than unparasitized females, because their lifespan and reproductive opportunity are reduced. Alternately, copulations by parasitized female squash bugs may have longer durations than those of non-parasitized females. To determine how parasitism affects the likelihood and duration of copulation, we manipulated parasitism of female *A. tristis* and paired parasitized and non-parasitized females with male *A. tristis.* We scored male mating attempts, copulations, and copulation durations. We found that non-parasitized and parasitized females are equally receptive to male mating attempts, and that whether a female is parasitized does not affect male mating effort. However, our data suggest that parasitized females copulate for longer than non-parasitized females. We suggest additional comparisons of copulation duration between parasitized and non-parasitized females and evaluation of whether extended copulations benefit the parasite or host.

P65 Tyler K. Lehmann[1], Jennifer A. Hamel[2]
[1] Environmental Studies, Elon U, NC; [2] Biology, Elon U, NC

Costs of Between-Species Mating for Secondarily Sympatric and Allopatric Populations

Hybridization between congeners is common in areas of secondary sympatry. *Anasa tristis* and *A. andresii* are closely-related insect species that have been sympatric in North Florida for 80-100 generations, and male *A. andresii* and female *A. tristis* have been observed mating in the field at this location. Throughout the rest of the southeastern U.S., the two species are allopatric: *A. tristis* is present, but *A. andresii* (which is native to the southwestern US) does not occur. Because mating between species commonly results in reduced reproductive success, we predicted that heterospecific pairs would produce fewer offspring than conspecific pairs. Because selection has had >80 generations to act in north Florida, we also predicted that female *A. tristis* from this population would release fewer eggs after mating with male *A. andresii* than would allopatric female *A. tristis* (from North Carolina). We tested these predictions by comparing the numbers of eggs and offspring produced by conspecific *A. tristis* pairs with those produced by heterospecific pairs (F – *A. tristis*, M – *A. andresii*), and by comparing eggs and offspring produced by the heterospecific pair females from sympatric and allopatric populations. We recorded female fecundity and reproductive success for 28 days. Females in conspecific pairs produced significantly more eggs and offspring than did females in both types of heterospecific pairs. We found no difference in the numbers of eggs produced by heterospecific pairs containing female *A. tristis* from sympatric versus allopatric populations. Our findings suggest that there are barriers during or after copulation that prevent *A. tristis* eggs from being fertilized by male *A. andresii*, and that these barriers existed prior to secondary contact. Future research should examine possible mechanisms preventing fertilization, including cryptic female choice and mechanical incompatibility.

P66 Lauren Woods[1], Casey Murakami[1], Paul Zwiers[1], Philip Fulmer[2]
[1] Biology, Francis Marion U, Florence, SC; [2] Physics & Astronomy, Francis Marion U, Florence, SC

Quantification of Male White-Crowned Manakin (*Dixiphia pipra*) Displays Using Object-Recognition Software

White-crowned manakins (*Dixiphia pipra*) have a range distribution across much of northern South America. Found in forested habitats, males in this species form exploded leks where individuals are located within auditory distance but not necessarily visual distance of male neighbors. Males produce loud calls to advertise their location, and perform acrobatic displays on narrow horizontal branches to visiting females. Documentation of considerable variation in male advertisement calls, and some genetic evidence, suggests that a reassessment of the taxonomic status of the currently 11 described subspecies is necessary. It may also be important to include data on differences in male display in this reassessment. To do so, we

present a methodology for quantifying male displays in this species using motion-tracking software. We recorded the displays of male white-crowned manakins at the Wildsumaco Biological Station in Napo Province, Ecuador. Motion-detecting passive infrared sensors triggered GoPro cameras to record high-resolution videos of displaying males via an arduino controller. These videos were imported into ImageJ (National Institutes of Health) and analyzed in parallel on Francis Marion University's PandA cluster computer. Results show successful conversion of male position into x, y coordinates to measure both direction and speed of movement. In addition to helping define male displays among described white-crowned manakin taxa, this methodology will also be used to detect differences among displaying males within the population at Wildsumaco to test for differences in female preference.

P67 Edward D. Mills
Biology, Wingate U, NC

Whispered Communication: The Structure of a Low-Amplitude Signal Produced by Hatchling Chinese Blue-breasted Quail (*Coturnix chinensis*)

Chinese Blue-breasted Quail (*Coturnix chinensis*) are known to produce high volume, vocally-rich A-shaped calls immediately after hatching. It is believed that this contact call helps maintain the cohesiveness of the foraging precocial family group. The newly-discovered, low amplitude S-shaped signal seems to also serve as a contact call. Low amplitude signals are often defined in comparison with high amplitude signals (e.g. A-call), or defined by the active space from signaler to potential receivers. Vocalizations were digitally recorded immediately after the hatchlings were removed from the incubator and placed in a brooder. Six spectral properties of the low-amplitude S-call were measured and compared to the high volume A-call: call length (sec), three signal frequency components (Hz), and amplitude (average and maximum power, dB). The results of statistical analyses indicate that the S-call meets the criteria for a special class of low-amplitude signals: it is acoustically distinct; it is produced only at low amplitudes so that it attenuates rapidly, and it has a broader frequency bandwidth than broadcast calls.

P68 Andrew Murray, James Wise, Lindsay Shields, Alyssa Phillips, William Fenner, Matt C. Estep
Biology, Appalachian State U, Boone, NC

Identifying Transposable Elements Using a Comparative Approach to Understand Grass Genome Evolution

The repetitive fraction of plant genomes has historically been viewed as "junk DNA". A growing body of evidence suggests that repetitive sequences play a large role in the evolution of species. Transposable elements (TEs) are ubiquitous structures across eukaryotic organisms, and make up a large portion of their genomes. In order to investigate the role of repetitive sequences on genome evolution we have constructed several databases composed of the individual elements found within typical TEs using an existing database from the maize genome. We also sample sequenced four grass taxa closely related to *Zea Mays*. This allowed us to identify novel and shared TEs within our sample sequence data sets. Preliminary results of these comparisons will be presented.

P69 Sarah Rawlins[1], Ashley Watford[2], Autumn Lupotsky[2], Mya Praileau[2], Timothy Tedder[2], Paul Zwiers[2], Jeff Camper[2]
[1] , Clemson Pee Dee Research and Education Center, Florence, SC; [2] Biology, Francis Marion U, Florence, SC

Amplification and Sequence Verification of Gene Regions to Be Used in a Phylogeographic Study of the Pine Barrens Treefrog (*Hyla andersonii*)

The current range of the Pine Barrens treefrog (*Hyla andersonii*) is restricted to three isolated regions within a wide geographic range, New Jersey, North and South Carolina, and Alabama and the Florida panhandle. This taxon is found in acidic habitats and is particularly susceptible to changes in pH. It is therefore considered near threatened by the IUCN, and is a species of

special concern in Florida and threatened in New Jersey. A comprehensive phylogeographic study would estimate the evolutionary relatedness, times of divergence, species status, and potential methods of isolation among these groups. Here we present results of our assessment of primer pairs aimed at amplifying phylogenetically informative gene regions in this species. To date, we have collected and tested over 22 pairs of primers aimed at amplifying gene regions in both the nuclear and mitochondrial genomes. Results show successful amplification from all but one primer pair, and sequencing results verify target gene amplification from the sequenced amplicons. These results will later be used in the phylogeographic reconstruction of this threatened species and inform future conservation efforts.

P70 Ashley Sibley, Deirdre Gonsalves-Jackson
Biology, Virginia Wesleyan College, Norfolk

Dentition and radula morphology in an undescribed *Ercolania* species (Mollusca: Opisthobranchia: Ascoglossa)

Ascoglossans are opisthobranchs that exhibit specialized feeding behavior on various green algae species. They use their radula to drill a hole in the algal cell to consume the contents. The ascoglossan radula exhibits morphological adaptations that reflect its specific diet. Radula morphology is also significant evolutionarily and can be used to determine phylogenetic relationships. In this study the radula of an undescribed *Ercolania* species is documented. The, size, structure and dentition is examined using the scanning electron microscopy (SEM). The morphology and variation in structure of the radula are presented and compared with all *Ercolania* species, confirming a new species within the genus.

P71 Ashley Byers, Deirdre Gonsalves-Jackson
Biology, Virginia Wesleyan College, Norfolk

Spiculation in *Doriopsilla pharpa* (Mollusca: Gastropoda: Opisthobranchia: Nudibranchia) and Its Sponge Prey

Opisthobranch mollusks are an ecologically important group of gastropods with a reduced or absent shell. As a result of their shell loss, many opisthobranchs exhibit unique adaptations for defense. The focus of this study is to determine if the sea slug *Doriopsilla pharpa* seqesters spicules from its prey sponge for its own defense. We examined spicule morphology of *D. pharpa* and four closely associated sponge species that coexist with *D. pharpa* from the Eastern Shore of Virginia. Spicules from the slug and sponge species were dissected and examined using the scanning electron microscope. Five morphological spicule types observed in the four sponge species were absent in *D. pharpa*. Two additional spicule types were present in both sponge and slug species. These may be extrinsic and originate from the sponges because they were present in both sponge and slug. The other spicule types observed in *D. pharpa* are likely intrinsic to the nudibranch because they were lacking in all of the four sponge species.

P72 Cancelled

P73 Heather J. Vidal, Michael H. Schiebout
Biology, Union U, Jackson, TN

Comparison and Phylogenetic Classification of *Quercus margaretta* Populations by DNA Barcode Analysis

In 2004, based on morphology, a population of *Quercus margaretta* (sand post oak) was identified for the first time in the state of Tennessee. The population is located in Fayette County and represents an extension of the previously known range of this coastal species. The aim of this research is to determine if molecular barcode data confirms the morphological identification of this species. Specifically, two DNA barcoding regions, *rbcL* and *ITS2* were isolated and amplified by polymerase chain reaction (PCR) from both the Tennessee population and a Florida population of sand post oaks. Upon successful sequencing of these regions, a sequence alignment will be conducted to assess similarity between the two

populations. In addition, a phylogenetic analysis will be done with other *Quercus* species utilizing sequence data from the Barcode of Life Data Systems database to investigate relationships of these populations with other *Quercus* species.

P74 Phillip D. Lowe, Richard Carter
Biology, Valdosta State U, GA

A Morphometric Study of the *Cyperus granitophilous–Cyperus squarrosus* Complex in Georgia

Cyperus granitophilous McVaugh, a narrow endemic of granitic outcrops in the southeastern United States, is closely related to wide-ranging *Cyperus squarrosus*. The two taxa are similar with diagnostic features overlapping to some degree. In the original description of *C. granitophilous*, McVaugh cited quantitative differences showing no intergradation when both species are sympatric, which he presented as evidence supporting the treatment of *C. granitophilous* as a distinct species. Although most features are generally larger in *C. granitophilous*, intermediate specimens can sometimes be difficult to identify as one or the other species. In order to define precisely the limits of these two taxa and to seek other characters that might be useful in identifying these plants, we did a morphometric analysis on 128 specimens from holdings in the herbaria at Valdosta State University (VSC) and University of Georgia (GA). Including key differences cited by McVaugh, we selected and measured 23 characters related to habit, vegetative structures, inflorescence form, florets and fruits. Data were entered into a spreadsheet and analyzed using principle component analysis. With few intermediate plants and outliers, our results show two fairly distinct groups, and they support McVaugh's taxonomy and his contention that both scale and spikelet dimensions are useful in identifying these two species. Our analysis also showed anther length and achene dimensions are important, characters used in the *Flora of North America* treatment and in Weakley's *Plants of the Southeastern and Mid-Atlantic States* to distinguish between the two taxa.

P75 Viridiana Mandujano, Karina Noyola-Alonso, Morgan E. Elder, Jay F. Bolin
Biology, Catawba College, Salisbury, NC

Identification of Mycorrhizae Associated With the Aquatic Plant*Isoetes* (Isoeteaceae)

Aquatic plants form a variety of associations with arbuscular mycorrhizae (AM) but are understudied relative to terrestrial plants. The Lycophyte genus *Isoetes* represents an ancient lineage and may provide insight into the evolution of AM associations. Fossil data from Carboniferous era ancestors of lycophytes demonstrate that the co-evolution of lycophytes and AM dates to at least 300 million years before present. Only a handful of *Isoetes* spp. have been evaluated for the presence of AM and no studies have been conducted in the New World. We collected *Isoetes melanopoda* subsp. *sylvatica* and *Isoetes engelmanii* from the central piedmont of North Carolina to determine the presence of AM, and if present to identify the AM species. We used *Glomus* specific AML1 and AML2 PCR primers to amplify AM fungi from whole root DNA extracts. Preliminary data indicate the presence of *Glomus* AM associates in 100% of root samples analyzed (n=6). The next steps of our research include microscopic evaluation of the roots and cloning and sequencing of the purified PCR products.

P76 Morgan E. Elder, Joel D. Schlaudt, Douglas B. Taylor, Jay F. Bolin
Biology, Catawba College, Salisbury, NC

Molecular Identification of Quillworts (*Isoetes*) in the Aquarium Trade

The planted aquarium is a popular trend among aquarium hobbyists with the advent of high efficiency lighting and CO_2 enrichment systems. The genus *Isoetes* is available as an aquarium plant from biological supply houses and retailers on the internet under several ambiguous names including "Octopus Plant" and "*Isoetes vetata varsiculata*" (not a recognized name). Some retail *Isoetes* were sold as *Isoetes lacustris*, a taxon of cool, northern, and oligotrophic lakes. We purchased and studied living *Isoetes* plants from four retailers and collected

molecular (ITS, atpB-rbcL, LFY), cytological, and morphological data to make species determinations. The accession sold as "*Isoetes vetata varsiculata*"was not an *Isoetes* sp. but rather *Lilaeopsis mauritana* (Apiaceae). Based on preliminary results two other accessions are tentatively identified as *Isoetes flaccida*, a taxon without conservation concerns, native to aquatic habitats in Alabama, Georgia, and Florida.

P77 Elizabeth Castiglione, Bryan Gonzalez, Steven Ritter, Alfredo Leon
North Campus, Miami Dade College, FL

Genetic Sequencing and Barcoding of *Sabal* Palms

DNA barcoding genetic sequence is a common practice used in the agronomy industry for identification and classification of plants. Standard practices specifically use the DNA found in the chloroplasts since it is a shorter sequence that can provide the identifiable variability within a genus. At Miami Dade College's North Campus, a Palmetum houses a variety of palms from the *Sabal* genus. These palms are native to the Caribbean and the America's and are an integral part of the Floridian landscape. By isolating their chloroplasts and barcoding their DNA, more knowledge about this genus and how the plants are genetically and evolutionarily related can be obtained. Isolation is done by using an optimized enrichment technique. It is then followed by chloroplast DNA extraction using Qiagen's DNeasy® Plant Mini Kit; from there, presence of DNA is quantified from the extracted material. Successful extraction of DNA allows for whole chloroplast genome sequencing, which can become readily available as the specific palm species' barcoded sequence. Sequences from the various *Sabal* palms will then be used to determine the phylogenetic and evolutionary relationships between the species.

P78 Heather J. Vidal, Michael H. Schiebout
Biology, Union U, Jackson, TN

Comparison and Phylogenetic Classification of *Quercus margaretta* Populations by DNA Barcode Analysis

In 2004, based on morphology, a population of *Quercus margaretta* (sand post oak) was identified for the first time in the state of Tennessee. The population is located in Fayette County and represents an extension of the previously known range of this coastal species. The aim of this research is to determine if molecular barcode data confirms the morphological identification of this species. Specifically, two DNA barcoding regions, *rbcL* and *ITS2* were isolated and amplified by polymerase chain reaction (PCR) from both the Tennessee population and a Florida population of sand post oaks. Upon successful sequencing of these regions, a sequence alignment will be conducted to assess similarity between the two populations. In addition, a phylogenetic analysis will be done with other *Quercus* species utilizing sequence data from the Barcode of Life Data Systems database to investigate relationships of these populations with other *Quercus* species.

P79 Jonathan P. Evans[1], Callie A. Oldfield[1], Mary P. Priestley[1], Yolande M. Gottfried[1], L. Dwayne Estes[2], Alfire Sidik[3], George S. Ramseur[1]
[1] Biology, Sewanee: The U of the South, TN; [2] Biology, Austin Peay State U, Clarksville, TN; [3] Cellular and Molecular Biology, U of Texas at Austin

The Vascular Flora of the University of the South, Sewanee, Tennessee

Sewanee: The University of the South, located in Franklin County, Tennessee, is a 5,263 hectare site that encompasses a variety of plateau and cove habitats on the southern Cumberland Plateau in southeastern Tennessee. The vascular flora of the University of the South was documented from 1948-2015 and comprises 1,118 species and lesser taxa which make up 551 genera and 150 families. We documented 229 exotic taxa, which represents 20.5% of the flora. This flora contains six state records, 74 Franklin County records, and two potential new species. Eighteen taxa are listed as protected either at the state or federal level, including the federally listed endangered *Clematis morefieldii* and state listed endangered *Diamorpha smallii, Silphium brachiatum,* and *Symphyotrichum pratense.* When compared to

the five other published floras for the southern Cumberland Plateau in Tennessee, the University of the South flora is the most diverse, capturing 69% of the total taxa at the species level for the region. The high diversity of plant species in the University of the South flora reflects the broad range of habitats that can be found within the campus and contiguous natural areas. This flora demonstrates that herbaria at small liberal arts colleges can play an important role in the documentation and promotion of plant biodiversity within their region.

P80 Cristina Pena, Linda Braun, Kimberly A. Hays
Natural Science, Dalton State College, GA

The Gift of Natural History: The Annie M. Smith Collection at Dalton State College

Marine shells consist of one of the most diverse groups of animals on the planet. They are largely assorted in their morphology, size, as well as ecological habitats. Seashells are the outer protecting layer of several marine species, and are usually found along coastlines and beaches washed up from the tides. Historically, shells have been collected all over the world and have also been used to make jewelry and other decorative items. In spring 2015, Dalton State College received a generous donation of over 1,000 shells and other marine specimens collected from throughout the world by the late Annie M. Smith. The collection also included Ms. Smith's notes, catalogs, and poetry. Her passion as a naturalist, poet, and collector stems throughout the decades and is now proudly on display on the 2nd and 3rd level of Peeples Hall at Dalton State College. The objective of the ongoing project is to update the taxonomy and identification of the donated specimens, create an electronic database with photos, and display Ms. Smith's publications, presentations, and poetry shared throughout the years. Students and faculty hope to continue sharing her passion by expanding an interest to others within the community on the diversity, beauty, and science behind the intricacies of seashells and the species that inhabit them. The specimens currently on display are only a small portion of a variety of shell families that were donated. These include but are not limited to conchs (Strombidae), whelks (Buccinidae), nautilus (Nautilidae), murex (Muricidae), tritons (Bursidae), and helmets (Cassidae). The collection also includes a few rare specimens such as the *Conus sozoni, Voluta zebra lineolatus, Tibia fusus, Latiaxis mawae,* and *Thatcheria mirabilis.* In addition to shells, Ms. Smith also collected several species of sponge like the glass Venus Flower Basket (E. *aspergillum*).

P81 Nickolaus A. Gonder, Ashley B. Morris
Biology, Middle Tennessee State U, Murfreesboro

Modernizing the MTSU Herbarium to Reflect 21st Century Approaches to Collections Curation

In the fall of 2014, Middle Tennessee State University (MTSU) opened the doors to a new state-of-the-art Science building, which ushered in a new beginning for the MTSU Herbarium. With the new space, we acquired a climate-controlled room dedicated to the storage and curation of herbarium specimens. The collection was haphazardly organized as a result of years of inadequate storage and the chaos of transferring to the new building. A new organization system was needed to more effectively curate the collection. The task was facilitated by the curator and delegated to two undergraduate workers to organize the collection by the linear angiosperm phylogeny group III sequence. Once the initial organization was complete, an infection of pests set into motion a need for sanitation protocols to help prevent deterioration of the collection. The protocols consisted of freezing each and every specimen for seven days. With a collection of approximately 23,000 specimens, the undertaking took nearly ten months to complete. The infection did afford the opportunity to fine-tune the organization of the specimens. Now that the collection has seen its final iteration of organization, a push is in place to image and digitally catalog the collection and upload data to the SERNEC online portal hosted by Symbiota, which is accessible to the public. Our digitization efforts are funded by the SERNEC NSF ADBC grant and by the MTSU Foundation. I and two undergraduate research assistants will proceed with the digitization this term, with the intent of completing the entire collection by the end

of April 2016. Once the digitization project has been completed, our collection will serve both educational and research communities here and online.

P82 Richard Carter, Ashlee D. Robinson, Phillip D. Lowe
Biology, Valdosta State U, GA

Advances in Wiregrass Georgia: Infrastructural Improvements to Sustain another Half-Century of Herbarium-Based Research and Teaching at Valdosta State University

In April 2015, the Valdosta State University Herbarium [VSC] began a three-year project to initiate infrastructural improvements funded by the National Science Foundation Collections in Support of Biological Research (CSBR) Program. A compactor system has been installed, including 41 new herbarium cabinets, increasing specimen holding capacity by 35% and providing secure and safe storage for this valuable biodiversity resource. Through this support, 5,000 backlog specimens will be mounted and digitized and nearly 15,000 specimen records will be georeferenced, making these vouchers and derived digital images and data readily available to the community of biodiversity researchers and others through the Internet and through direct access to specimens. This project will also secure and revitalize the extensive and currently dormant Vanderbilt University teaching collections by bringing them to Valdosta State University where they will be used to train future generations of students and biodiversity researchers, and it will promote learning through direct involvement of students in a variety of herbarium activities bringing them new perspectives about possibilities for careers in science. Promoting participation of under-represented groups by providing opportunities to work in biological collections and biodiversity research, outreach programs will place issues of biological collections and biodiversity before a large and diverse audience through herbarium tours and informal presentations, targeting young people at an impressionable age and their teachers.

P83 Jennifer M. McKenzie[1], Steven J. Price[1], Leo J. Fleckenstein[1], Andrea N. Drayer[1], Jeffrey M. Lorch[2]
[1] Forestry, U of Kentucky, Lexington; [2] US Geological Survey, National Wildlife Health Center, Madison, WI

Assessment of the Distribution of Snake Fungal Disease in Kentucky

Snake fungal disease is an emerging infectious disease caused by the fungal pathogen, *Ophidiomyces ophiodiicola*. Clinical signs of SFD include skin ulcers, hyperkeratosis, subcutaneous nodules, abnormal molting, localized thickening of the skin, facial swelling, and cloudiness of the eyes.In some cases, altered behaviors and substantial population declines have been documented. Snake fungal disease appears to be widespread in the eastern U.S. and has recently been documented in Kentucky. Our objective was to determine the ubiquity of SFD across Kentucky by sampling multiple species in several physiographic regions. From March to September 2015, we collected swab samples from a total of 231 snakes across 15 different species. Snakes were captured opportunistically and the presence of *O. ophiodiicola* was tested through quantitative PCR. Our results suggest that SFD is widespread in Kentucky and infects several snake species. Further research is required to determine the population-level consequences of SFD, however, the exceptionally secretive behavior of snakes presently complicates these efforts in Kentucky and elsewhere.

P84 Alanna R. Horton, Meagan A. Thomas, Michael E. Dorcas
Biology, Davidson College, NC

Developing Length Estimates for Incomplete Rattlesnake Skeletons Through Vertebral Measurements and X-Ray Technology

The Eastern diamondback rattlesnake (*Crotalus adamanteus*) is the largest species of rattlesnake in the world, with adults typically reaching lengths of 1.2-1.5 m (4-5 ft). Although there are reports of individuals up to 2.4 m (7.8 ft), physical evidence (e.g. museum specimens,

skins, scalable photographs) is limited for individuals over 2.1 m (7 ft). In this study we used museum specimens (skeletal and preserved) to develop a model that would allow determination of body length from skeletal remains of *C. adamanteus*. We X-rayed 10 preserved known-length specimens of varying size and measured the pre- and post-zygapophyseal articular facets of the largest vertebra for each specimen. We used these data to develop body length estimates for three partially complete *C. adamanteus* skeletons with highly variable vertebral size (largest vertebra of each specimen measured 14.16, 16.60, 27.04 mm long). We discuss our findings and how they relate to what is currently known about *C. adamanteus* body size and natural history. Studies such as this are important for developing new techniques which can further our understanding of the natural history of extinct, rare, or understudied organisms that are difficult to acquire in nature, but are available through museums or other similar collections.

P85 Brielle L. Bowerman[1], Emma R. Johnson[1], Meagan A. Thomas[1], Kristine L. Grayson[2], Michael E. Dorcas[1]
[1] Biology, Davidson College, NC; [2] Biology, U Richmond, VA

Factors Affecting Aquatic Activity in Red-Spotted Newts (*Notophthalmus viridescens*)

Numerous environmental factors can affect animal behavior, including how and when they are active. Ectotherms are particularly sensitive to changes in climate because the environment directly impacts their body temperatures and activity levels. To investigate the impact of abiotic factors on behavior and activity, we examined capture patterns in the aquatic habitat of red-spotted newts (*Notophthalmus viridescens*). These migratory amphibians are commonly found in wetlands and small ponds throughout the eastern United States, however, little is known about the effect of various environmental factors on their activity and movements within breeding ponds. In this study, we used unbaited surface minnow traps at Cowan's Ford Wetland (Mecklenburg County) in the Piedmont of North Carolina to capture adult red-spotted newts during the breeding season in January and February. We determined sex, mass, and snout-vent length from individual newt captures, and used the same toe clip on all newts to identify whether individuals had been previously captured. We used data loggers to continuously collect environmental data, including air and water temperature, rainfall, relative humidity, and solar radiation. Using these data, we examined associations between newt activity and sex, size, and environmental data. To examine potential larger-scale patterns between abiotic variables and newt behavior, we also compared data from Cowan's Ford to data from a newt population in the Virginia mountains (Mountain Lake Biological Station, Giles County). Knowledge of the effects of environmental factors on newt activity will provide insight regarding optimal conditions for newt sampling and knowledge about red-spotted newt behavior. The information can be applied to predict how amphibian behavior will alter based on changing environmental conditions and has implications for conservation.

P86 YangYu Zhou, Meagan A. Thomas, Michael E. Dorcas
Biology, Davidson College, NC

Evaluating the Potential for Unmanned Aerial Vehicles (UAVs) to be Used as a Tool to Study Freshwater Turtle Populations

Sampling freshwater turtle populations has traditionally relied on several standard sampling methods (e.g., trapping and land based surveys), most of which are limited by habitat accessibility. Aerial surveys using unmanned aerial vehicles (UAVs) may overcome this difficulty and facilitate surveying remote or difficult to access study sites. In this study, we evaluated the use of UAV technology to study freshwater turtle populations. Using a small UAV, we conducted 192 aerial surveys at three locations at four heights and four speeds to determine the optimal piloting strategy for accurate detection and identification of turtles. We recorded environmental conditions of each survey to determine effects of weather on turtle detectability. We also conducted baited hoop-net trapping to compare aerial surveys to trapping. Our results indicated that direct sunshine, percentage of cloud cover and wind speed

negatively affected turtle detectability by increasing the difficulty of the reviewing process. Our results also showed aerial surveys at low flight heights yielded better turtle detectability and more accurate species identification, whereas flight speed did not appear to affect any aspects of the aerial surveys. Furthermore, the relative abundances of turtle species estimated by aerial surveys were similar to those estimated by baited hoop-net trapping. We recommend conducting aerial surveys under direct sunshine and clear skies, and at lower heights for long-term monitoring projects, while higher heights are likely suitable for preliminary surveys. We demonstrated that UAV surveying is a viable and accurate alternative to trapping and has potential to be used as a tool for studying freshwater turtle populations, particularly in remote or difficult to access areas.

P87 Aren J. Carpenter[1], Paige A. Farrar[1], Jason Ortega[2], John D. Willson[2], Michael E. Dorcas[1]
[1] Biology, Davidson College, NC; [2] Biological Sciences, U Arkansas, Fayetteville

Feeding Frequency Affects Growth Rates and Assimilation Efficiency in Juvenile Burmese Pythons

Invasive Burmese pythons (*Python molurus bivittatus*) have been linked to severe mammal declines in Everglades National Park. Recent modeling research suggests that these cryptic, generalist predators may be able expand their range beyond southern Florida. Studying Burmese python energetics at multiple life stages is necessary to further our understanding of their impacts on Florida ecosystems, and to make predictions about the effects they may have on the prey communities in areas of potential range expansion. Burmese pythons have an exceptional capacity for rapid growth, sometimes reaching maturity in two years. In this study, we examined the effects of feeding frequency on the ability of juvenile Burmese pythons to assimilate food. We divided 24 juvenile pythons of similar age, mass, and length into three feeding regiments of twice a week, once a week, and once every two weeks for four months. Each individual's mass and length was recorded weekly during the trial period. Our initial results indicate clear patterns of increased growth with increasing feeding frequency, the average total percent growth in the most frequently fed group being 324% compared to only 90% in the least. Bomb calorimetry will be used to assess the energy density of food, feces, and urates. These data will allow feeding frequency to be linked to metabolizable energy and assimilation efficiency. Our results provide a critical component to understanding Burmese python energetics and insight to the apparent, severe impact of this invasive species in Florida.

P88 Anna Marie Scoccimaro, Michael E. Dorcas
Biology, Davidson College, NC

The Relationship Between Population Structure and Density in Pond Turtles

Age and size structures of populations represent life history characteristics that are often indicative of population condition. Most turtle species are characterized by their long life spans and thus exhibit age structures and life history characteristics that are typical of long-lived organisms. Painted turtles are good candidates for studies of age and size structure because they are found in discrete populations (e.g., ponds) and can be easily captured and measured over long time periods. Previous studies have suggested that pond turtle population structures may shift according to habitat quality and site specific land use. In this 11-year study, we trapped, processed, and re-released painted turtles from four different ponds in the vicinity of Davidson, North Carolina: River Run, Glen Grove, Mallard Head, and Davis. Female carapace lengths were larger in River Run than in Glen Grove and Mallard Head, but not Davis. River Run contained a larger proportion of juveniles than Glen Grove, and Glen Grove contained a higher proportion of juveniles than Davis, but Mallard Head had neither a significantly larger or smaller proportion of juveniles relative to all other ponds. Because River Run had the highest density and proportion of juveniles, we conclude that River Run pond may have habitat features that make it particularly favorable for reproduction and survivorship in painted turtles. Because turtles are especially susceptible to environmental change including anthropogenic development, it is important to monitor populations effectively so as to detect possible factors of detrimental declines in the incipient stages.

P89 Alanna R. Horton[1], Kathryn M. Greene[1], Meagan A. Thomas[1], Aaron N. Rice[2], Michael E. Dorcas[1]
[1] Biology, Davidson College, NC; [2] Bioacoustics, Cornell U, Ithaca, NY

Impacts of Airplane Noise on Winter-Breeding Anuran Populations

Global declines of anuran (frog and toad) populations have been documented, partly as a result of increasing urbanization. Noise associated with urban environments (e.g. traffic noise) disrupts the ability of species to establish territories and attract mates because it can interfere or mask their acoustic signals. Although numerous studies have examined the impacts of traffic noise on bird populations, the effects on anuran populations have not been fully determined. Even fewer studies have investigated the effects of airplane noise on anuran reproductive behavior. By conducting MCS (manual calling surveys) and analyzing digital recordings, we established the degree to which airplane noise affects the calling activity of winter-breeding populations of anurans. Following a BACI (Before-After-Control-Impact) experimental design, we conducted three MCS at impacted wetlands located within8 km of a large, international airport and control wetlands located within 32 km of the airport. We used a generalized linear model to examine the effect of multiple factors on characteristics of calling activity, such as call presence/absence, rate, and pitch. Our results contribute to our overall knowledge of amphibian conservation and management by providing much needed insight on the extent to which anthropogenic noise can affect anuran reproductive behavior and ultimately the persistence of populations.

P90 Sara B. Freytag[1], Steven J. Price[1], Simon J. Bonner[2], Breneé L. Muncy[1], Andrea N. Drayer[1], Christopher D. Barton[1]
[1] Forestry, U Kentucky, Lexington; [2] Statistical and Actuarial Sciences, U of Western Ontario, London

Occupancy Dynamics of Stream Salamanders in Degraded and Reference Headwater Streams

Mountaintop removal mining (MTR) is a notorious stressor of stream ecosystems in the central Appalachians. Valley fills (VF), generated by the relocation of excess land mass (i.e. overburden), modify biotic and abiotic conditions of headwater streams with significant repercussions to salamander populations. We used repeated surveys of stream salamanders from 2013-2015 to ask the question: do population dynamics of stream salamanders differ between references and streams impacted by MTR/VF? Specifically, we estimated changes in occupancy and probabilities of colonization and extinction of 5 stream salamander species in 11 streams impacted by valley filling and 12 reference streams in southeastern Kentucky. As expected, occupancy estimates in reference streams consistently exceeded 0.70 for all species and remained relatively stable over the three years. Conversely, we found that occupancy in MTR/VF streams was greatly reduced for all species and exceptionally dynamic for others. Potential mechanisms responsible for the dynamics and reduced occupancy in this system may be related to the abiotic and biotic attributes of streams impacted by MTR/VF.

P91 Cody L. Townsend, John L. Carr
Biology and Museum of Natural History, U of Louisiana at Monroe

Movement of Hatchery-reared Alligator Snapping Turtles at Two Lentic Sites in Northern Louisiana

We introduced 80 head-started Alligator Snapping Turtles (*Macrochelys temminckii*) into two lentic bodies of water located on Boeuf Wildlife Management Area in Caldwell Parish, Louisiana. The first release of 40 turtles occurred in August 2014, and the second release occurred in June 2015. Of the 80 turtles, forty were 2 year olds, twenty were 3 year olds, and twenty were 4 year olds. All turtles were raised at the Tishomingo National Fish Hatchery in Oklahoma until they were released. Turtles were fitted with VHF radio transmitters, and all turtles initially weighing over 200 grams were also fitted with iButton temperature loggers. Radio telemetry was used to track the location of each turtle, where GPS coordinates were

recorded. Tracking began in August 2014 and continued through December 2015. A total of 769 turtle locations were used in the data analysis. Data were analyzed in RStudio to determine the mean daily movement for each turtle using the northing and easting coordinates from relocations. A linear regression was used to determine there was no significant difference in mean daily movement among age groups, study sites, or different sizes of the turtles.

P92 Jennifer N. Archis, Amanda J. Chunco
Environmental Studies, Elon U, NC

Predicted Impact of Climate Change on the Geographic Range of the Eastern Coral Snake (*Micrurus fulvius*)

Climate change is considered to be a significant global driver of biodiversity loss and species distribution change. Although it is postulated that species may experience a range expansion at their upper limits, data on range shifts is still limited and studies on many taxonomic groups are lacking. One method of predicting distributional responses to climate change is through species distribution modeling. Herpetofaunal species are an excellent organism to model in this context because of their ectothermic nature, which promotes a strong dependence on climate. This study examines the influence of climate change on one snake species, the eastern coral snake (*Micrurus fulvius*). We had two primary objectives: (1) identification of current range and suitable environment of *M. fulvius* in the Southeastern United States, and (2) investigation of potential impacts of climate change on *M. fulvius* distribution, especially at the species' northern range limits–the Sandhills of North Carolina. We applied the species distribution modeling program Maxent using 20 environmental variables and 105 occurrence records. Two different future climate change scenarios were compared against current environmental conditions for the near (2050) and distant (2070) future. Both future models showed an increase in habitat suitability across a significant portion of the range; however, results also suggest that much of the Southeast will be well outside the range of typical climate conditions today, suggesting no-analog environments in the future. Given these findings, and the fact that *M. fulvius* is rare throughout its range and especially at the northern range limit, population monitoring is recommended.

P93 Alexis Moorhouse, Joni M. Criswell
Biology, Anderson U, Anderson, SC

Nocturnal Tracking of Genus *Hyla* with Fluorescent Pigments on Anderson University Wetlands (Anderson, SC).

Nocturnal tracking of the anuran species in the genus *Hyla* using fluorescent pigment powder was conducted from August 2014 until March 2015 on the wetlands at Anderson University in Anderson, South Carolina. Two species, *Hyla chrysocelis* and *Hyla cinerea*, were located, observed and tracked. To better understand the behavior of these species during night activity, calling locations and overnight resting non-calling locations were observed. Individuals were collected, measured and marked with fluorescent powder between the hours of 1900-2100 which corresponded with the end of the normal calling time period. Individuals were tracked after sunset until calling had ceased, using an ultraviolet flashlight to illuminate tracks of each individual. Distance travelled was recorded for all movements made by each individual. The average distance traveled by the adult *H. chrysocelis* was 190.29 ± 167.16 cm whereas adult *H. cinerea* distance traveled was 327.28 ± 236.30 cm. No significant difference was observed when comparing the adult movements of the two species (t-test; $p=0.23$ and F-test; $p=0.46$). This could have been to a low amount of frogs collected or the frogs caught were from the same genus, which would indicate that they would behave similarly. However this experiment proved successful in using a novel approach to observing and collecting both diurnal and nocturnal positions of individual species within the genus *Hyla*.

P94 William C. Best, David M. Donnell
Biology, The Citadel, Charleston, SC

The Impact of Diet on Pupation Site Choice in the Caterpillar *Trichoplusia ni*

Trichoplusia ni caterpillars spend most of their time feeding on cruciferous plants in preparation for the rigors of pupation and metamorphosis. The duration of the larval stages is a function of diet quality and the critical weight required of the animal before it commits to pupation. Pupation occurs on the undersides of leaf surfaces or in the soil possibly as a function of host plant phenology and/or perceived predation risks. While investigating the utility of spent grains as a dietary ingredient for caterpillars, we observed a substantial drop in pupal weight and silk production relative to caterpillars reared on the standard diet. To determine if an alteration in diet quality could influence the location of pupation, caterpillars were reared in cups containing both soil and simulated leaf structures. The animals were provided either a standard or a spent grain diet and their pupal weights, extent of silk production and location of pupation noted. We present our findings and discuss the role of diet quality on the life history traits of this organism.

P95 Stephanie Brandys, Leah Orange, Diana Porras, Evan Lampert
Biology, U of North Georgia, Oakwood

Non-Preference of the Catalpa Sphinx, *Ceratomia catalpae* (Lepidoptera: Sphingidae) to Invertebrate Predators

Aposematic traits such as bright contrasting coloration and gregarious feeding are often signals to predators that a potential prey is unpalatable. Larvae of *Ceratomia catalpae*, the catalpa sphinx, show aposematic traits and sequester catalpol, a secondary compound from their host plant *Catalpa* spp. Catalpol sequestration by other caterpillar species has been shown to deter both invertebrate and vertebrate predators, but the palatability of *C. catalpae* has not been explicitly tested. Choice tests with both spiders (*Hogna carolinensis*) and predatory hemipterans (*Podisus maculiventris*) showed that predators naïve to both *C. catalpae* and the alternate prey *Trichoplusia ni* and *Manduca sexta* preferred the alternate species, and that *P. maculiventris* that were exposed previously to *T. ni* also preferred *T. ni*. In non-choice tests, *P. maculiventris* grew significantly slower upon *C. catalpae* compared to *M. sexta*. These results suggest that *C. catalpae*, like other caterpillars that sequester catalpol, is unpalatable and that the catalpol is an effective chemical defense against invertebrate predators.

P96 Jenna I. Hojnacki, Rachel C. Fenner, Sarah B. Spiro, Tin B. Tran, Matthew M. Howell, John F. Moeller
Biology, Wofford College, Spartanburg, SC

***Callosobruchus maculatus* Oviposition Preference Influenced by Chemical Cues on Bean Surfaces**

In past behavior experiments, female bean beetles (*Callosobruchus maculatus)* consistently preferred adzuki beans (*Vigna angularis)* over mung beans *(Vigna radiata)* during oviposition. Preference shifted to mung beans when a new variety of adzuki beans were used in choice experiments (Matched pairs, $p < 0.009$). Studies suggest chemicals on the surface of the beans strongly influence oviposition preference. Gas chromatography mass spectrometry (GC-MS) has confirmed a chemical difference in the two varieties of adzuki beans. When adzuki and mung beans were washed in acetone to remove polar compounds from the surface of the beans, *C. maculatus'* preference switched back to adzuki beans. These results suggest the seed coat on the new adzuki beans contain a repellant compound. To understand the effects of the unique compounds on the coat of each bean, we first washed the beans in acetone. We then recoated the acetone-washed mung beans with the extracted compounds from the adzuki bean, and vice-versa. A choice experiment was used to assess preference. Control groups included untreated beans, acetone-washed beans, and acetone-washed beans recoated with the acetone extract. Although untreated mung beans were preferred over adzuki beans, when both beans were washed in acetone there was a strong preference for adzuki, consistent with previous observations. There was an even stronger preference for the adzuki bean when

compounds extracted from the adzuki beans were coated onto mung beans. These results lend further support of the chemical repellant hypothesis. GC-MS experiments suggest the repellant chemical could be squalene.

P97 Manuela Gallego Builes, Gina V. Amariles, Alicia M. Flood, Juan P. Aristizabal, Ivan Magana, Kerami D. Moss, Stefano R. Rosillo, Catherine G. Schlueter, Mark A. Schlueter
Science & Technology, Georgia Gwinnett College, Lawrenceville

A Survey of Pollinating Flies and Bees around Yellow and Blue Flower Resources in Vietnam using Multiple Trap Methods

Pollination is critical in agriculture and in nature. Insects are the most important pollinator in the environment. For example, bees pollinate over 30% of the human food supply. A bee pollinates every vegetable, fruit, and nut that you eat. Bees and flies pollinate most plants including wildflowers and trees. Honeybees are commonly used by farmers to pollinate crops and boost agricultural yields. Without these "domesticated honeybees", crop production would dramatically decline. In the United States alone, bees contribute $15 Billion in pollination services. However, honeybee populations are in crisis and are suffering critical declines. In the United States, some beekeepers have lost over 50% of their bees each year due to colony collapse disorder (CCD). It is critical that scientists discover alternatives to the honeybee if we are to safeguard human agriculture for the future. The best alternative to honeybees is the thousands of quite abundant native bee species that exist in the world. Besides bees, flies and butterflies are also useful pollinators. However, butterflies occur in low numbers, making them a poor candidate to become commercial level pollinators. On the other hand, flies, particularly hoverflies, are beneficial and very effective pollinators. The first step in identifying possible alternatives to the honeybee is to survey native bee and fly species in order to determine their species diversity and abundance. The following project was performed by GGC students in Vietnam (June 2015) and assessed bee and fly diversity at and between a patch of yellow flowers and a patch of blue/purple flowers over a 3-week period.

P98 R. Benjamin Snipes[1], David M. Malakauskas[2], Ann M. Thompson[3], Donald W. Schloesser[4]
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Molecular Evidence of Undescribed *Ceratonova* sp. (Cnidaria: Myxosporea) Infecting Freshwater Polychaete, *Manayunkia speciosa*, in Western Lake Erie

We used PCR to screen pooled individuals of the freshwater polychaete, *Manayunkia speciosa*, from western Lake Erie, Michigan, USA for myxosporean parasites. Sequenced amplicons showed the presence of a *Ceratonova* sp. that infects an estimated 1.2% (95% CI = 0.53%, 1.9%) of *M. speciosa* individuals. We sequenced 18S, ITS1, 5.8S, ITS2 and most of the 28S rDNA regions of this parasite and part of the protein-coding EF2 gene. Phylogenetic analyses of ribosomal and EF2 sequences showed Lake Erie parasites were most similar to, but genetically distinct from, *Ceratonova shasta*. Marked polymorphism in all genes examined, and particularly in the ITS barcoding genes, along with geographic location suggests this is an undescribed *Ceratonova* species. This finding represents the fourth known myxozoan hosted by *M. speciosa*, and the third known parasite in the genus *Ceratonova*.

P99 Bryant Brumbill, J. Scott Harrison
Biology, Georgia Southern U, Statesboro

Characterization of *Wolbachia* Endosymbionts From Two Species of Widow Spiders and a Widow Spider Egg Parasitoid

Wolbachia pipientis is an endosymbiotic bacteria found in many arthropods. This endosymbiont is known to have a wide variety of effects on its hosts ranging from reproductive incompatibility between infected and uninfected individuals to causing genetic males to develop as reproductive females. *Wolbachia* is transmitted from mother to offspring through the egg. The

mechanisms of initial infection are not well understood in nature, but horizontal transfer is thought to be involved. In the southeastern US, we have found *Wolbachia* in the introduced brown widow spider (*Latrodectus geometricus*), the native black widow spider (Latrodectus mactans), and a parasitoid wasp (*Philolema lactrodecti*) that parasitizes egg sacs of both species of spider. The objective our study is to characterize the *Wolbachia* strains from the two species of widow spiders and their parasitoid using multi-locus sequence typing (MLST). We also used phylogenetic relationships to explore the possibility of horizontal transfer between the parasitoid and host. *Wolbachia* from *L. mactans* and the parasitoid wasp (*P. latrodecti*) both group within *Wolbachia* supergroup A. However, the two strains were not each other's closest relative indicating recent horizontal transfer was unlikely between these species. *Wolbachia* inhabiting *L. geometricus* falls in the uncommon super group F strain of *Wolbachia*. F-group and A-group *Wolbachia* are highly divergent from each other.

P100 Jennifer Zettler, Bil Leidersdorf, Abigail Johnson
Biology, Armstrong State U, Savannah, GA

Color Change in Larval Antlions in Response to Background

Larval antlions (Neuroptera: Myrmeleontidae) construct pits in sandy soils to trap invertebrate prey. These ambush predators sit at the bottom of their pits with their mandibles open and ready for prey to tumble in. Those most successful in prey capture will take less time to develop into the adult stage. Antlions can be found in many soil types that vary in texture and color. In our study, we investigated if an antlion has the ability to alter its color to match its background. Some insects are capable of this change by selective breakdown and synthesis of cuticular and epidermal pigments. We placed 40 first instar larval antlions each in a condiment cup filled with either black or white soil. Biweekly, antlion head capsules were photographed using a microscope-mounted digital camera set at the same focal distance and exposure. All images are placed into Photoshop, where their head capsule is assigned an average RGB value in a 101 x 101 pixelated area and each result is recorded. Each RGB value is a series of 9 numbers that ranged in shades of increasing hue. Using an objective approach, we can appropriately identify if background color influences larval pigmentation.

P101 Daniel De La Hoz, Riccardo Fiorillo
Science & Technology, Georgia Gwinnett College, Lawrenceville

Life History of a Facultative Precocious Trematode, *Alloglossidium progeneticum*, in the White Tubercle Crayfish, *Procambarus spiculifer*, in the Yellow River, GA

Most trematodes are simultaneous hermaphrodites that utilize a 3 host life cycle. In a molluscan intermediate host, the parasite reproduces asexually and larval stages leave this host and infect a secondary intermediate host. There, the parasite remains encysted until the host is eaten by a definitive host, typically a vertebrate, where the worm excyst, matures and reproduces sexually. Across the southeastern US an into Texas and Oklahoma, populations of *Alloglossidium progeneticum* show an obligate 3 host lifecycle with adult worms found only in ictalurid fishes. In Georgia, however, populations with a facultative precocious 2 host life cycle have been reported in the Flint and Oconee river systems. These worms become sexually mature and begin egg production while encysted within the antennary glands of the white tubercle crayfish *Procambarus spiculifer,* typically considered an intermediate host, but have also been found in Ictalurids in the same river systems. Here we extend the range of these facultative precocious populations to include the Oconee River system and examine the seasonal and population dynamics of *Alloglossidium progeneticum* in the crayfish *Procambarus spiculifer* and how host sex and size affect the prevalence, abundance and developmental stage of this parasite.

P102 William H. Dees[1], Caleb M. Ardizzone[1], Jill Hightower[2], Omar E. Christian[3], Janet R. Woolman[4]
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Effect of Botanical Components and Essential Oils of 21 Plant Species on the Yellow Fever Mosquito, *Aedes aegypti*

We are investigating the effect of plant components and plant derivatives on the behavior and development of medically important arthropods (e.g., mosquitoes, fire ants and nuisance flies). Information obtained from these investigations may lead to innovative area-wide pest management methodologies as well as novel personal protective measures against biting/stinging arthropods. Current studies focus on the effects of botanical components on mosquito mortality. We evaluated the effects of freshly-cut plant parts, including essential oils, from eight plant families on female *Aedes aegypti* mosquitoes. Plant families included: Apiaceae, Apocynaceae, Asteraceae, Euphorbiaceae, Lamiaceae, Lythraceae, Malvaceae, and Verbenaceae. We used standard plastic Petri dishes to hold mosquitoes and cut plant parts. We obtained essential oils from plant parts by hydrodistillation using a Clevenger-type apparatus. Glass Petri dishes were used to test essential oils in contact assays. We recorded percent mortality at 24 and 48 h. Mosquitoes exposed to fresh-cut flowers/petals, buds, leaves, stems, and seeds from Apiaceae, Asteraceae and Lamiaceae exhibited over 50% mortality when compared with the controls. Genera of interest include: *Chrysanthemum*, *Eryngium*, *Eupatorium*, *Rudbeckia*, *Monarda*, *Solidago*, and *Pycnanthemum*. Mosquitoes exposed to different parts of a chrysanthemum plant (flowers, buds, leaves, stems and seeds) exhibited 100% mortality in 24 h. Mosquitoes exposed to cut buds of *Pycnanthemum muticum*, *P. tenuifolium*, and *Monarda fistulosa* as well as crushed seeds of *M. fistulosa* exhibited 100% mortality in 24 h. Mosquitoes exposed to essential oils of *M. fistulosa* and *Eryngium yuccifolium* buds and *Solidago gigantea* seeds exhibited 100% mortality in 24 h.

P103 Caleb M. Ardizzone[1], Nick DeVito[1], Jill Hightower[2], William H. Dees[1], Omar E. Christian[3], Janet R. Woolman[4]
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Investigations of Potential Insecticidal Compounds From *Monarda fistulosa* and *Solidago gigantea*

Mosquito-borne diseases like chikungunya, dengue fever, and Zika virus remain a significant threat to public health. New and more efficacious strategies to combat these mosquitoes at various stages in their life cycle are critical to controlling the spread of these disease pathogens. Studies are underway in our laboratory that may lead to innovative personal protective measures against these mosquito pests. We examined the mosquitocidal activity of the essential oils of two plant species native to southwest Louisiana - *Monarda fistulosa* and *Solidago gigantea*. *Monarda fistulosa* is a member of the Lamiaceae (mint) family which is known for producing a wide range of volatile insecticidal compounds. In preliminary Petri dish assays, female *Aedes aegypti* mosquitoes exposed to crushed seeds and buds of *M. fistulosa* exhibited 100% mortality in 24 h. We obtained essential oils from seeds and deseeded buds of *M. fistulosa* by hydrodistillation using a Clevenger-type apparatus. The GC-MS analysis of the buds identified carvacrol, durene, thymol, terpinene-4-ol, and caryophyllene oxide as the major components of the buds. The oil derived from the buds displayed moderate mosquitocidal activity. Interestingly, in preliminary mosquitocidal investigations using freshly ground plant parts of *S. gigantea*, we detected no mortality in Petri dish assays using female mosquitoes. Usually, tests that show no evidence of mosquito mortality preclude us from conducting further studies due to the many plant species under investigation. However, due to the abundance of plant material, we decided to investigate the essential oil from *S. gigantea*. Investigations of the essential oil of *S. gigantea* displayed concentration-dependent toxicity toward *Aedes aegypti*

mosquitoes in Petri dish contact assays. The essential oil from *S. gigantea* seeds yielded 17 compounds. Currently, we are in the process of determining which compounds are responsible for toxicity.

P104 Caleb M. Ardizzone[1], Dakota L. Johnson[1], William H. Dees[1], Jill Hightower[2]
[1] Biology and Health Sciences, McNeese State U, Lake Charles, LA; [2] Calcasieu Parish Mosquito and Rodent Control, Lake Charles, LA

Seasonal Survey of Adult Mosquitoes in an Urban Park

We are conducting a seasonal longitudinal survey at an urban 24-acre woodland park. The park is separated into two distinct areas: one is an open area with playground equipment, picnic tables, open shelters, a small conference center, exhibits, wetland ponds, and concrete walking paths with benches; the other is a preserved forest with nature trails. The mosquito survey was initiated in the summer of 2011. We use Centers for Disease Control and Prevention (CDC) light traps baited with CO_2 to collect mosquitoes. Mosquitoes are collected in the open area near the preserved forest in each of the four seasons. Temperature and humidity data are recorded during each trap night. To date, the predominant species collected (i.e. >50 in one trap night) are *Aedes atlanticus*, *Ae. taeniorhynchus*, *Ae. vexans*, *Coquillettidia perturbans*, *Culex erraticus*, *Cx. nigripalpus*, *Cx. salinarius*, and *Psorophora columbiae*. The number of *Cx. erraticus* was greater in the 2015 summer collection than in the past (n=57, previous high was n=8). The number of *Cx. salinarius* was greater than the number of *Culiseta inornata* in the 2015 winter collection compared with previous winter collections. Populations of *Cs. inornata* only have been collected in the winter, and are collected in much greater numbers when the temperatures are low. The increase in numbers of *Cx. salinarius* may be attributed to the higher average temperatures during the weeks leading up to the 2015 winter trap night.

P105 Maynard H. Schaus, Victor R. Townsend, Jr.
Biology, Virginia Wesleyan College, Norfolk

Harvestman Size Impacts the Realized Trophic Level in a Rain Forest Food Web

Harvestmen (Arachnida, Opiliones) are diverse members of many Central American rain forest food webs. They are frequently thought to be omnivorous, potentially ingesting small arthropods and other invertebrates, plant tissues, detritus, fungi, and other materials. However, for most harvestmen species, quantitative diet data are lacking, and the presumed diet is based on a handful of field or lab observations, or is merely inferred. We sought to quantify the diets of several harvestman species in the rain forest found at La Selva Biological Station, Costa Rica, using multiple stable isotope analysis. Harvestmen and potential food items were collected, dried, ground, and sent off for analysis of $\delta^{13}C$ and $\delta^{15}N$ using a continuous flow isotope ratio mass spectrometer. This technique quantifies the source of carbon ($\delta^{13}C$) and the realized trophic level ($\delta^{15}N$) over the time scale of tissue turnover. For the cosmetid harvestmen, there was a significant increase in $\delta^{15}N$ with increased body size ($P=0.035$). The diet of a cosmetid harvestman nymph was approximately 1 trophic level lower than that observed in adult harvestmen. The trophic level of the largest species (*Eupoecilaema magnum*) was approximately 1/3 trophic level higher than that of the other cosmetid (*Cynorta marginalis*, *Cynortellana oculata*, *Eucynorta tenuipes*) and sclerosomatid (*Prionostemma* sp.) harvestmen sampled. This indicates that the diet of harvestmen can vary ontogentically, and that larger species can subdue larger prey items, which are more likely to be at a higher trophic level. Our results also indicate that this technique may provide valuable insight into the diet of harvestmen and can complement other analyses of diet.

P106 Maynard H. Schaus, Victor R. Townsend, Jr., Ashley N. Shrives, Cynthia L. Richardson
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Responses of the Harvestman *Cynorta marginalis* to Olfactory Cues and Conspecifics

Harvestmen (Arachnida, Opiliones) interact with their environment using a variety of sensory cues. It is thought that vision is typically poor, suggesting that other senses, such as olfactory and tactile cues may be more important. We investigated the impact of olfactory cues and the presence of conspecifics on the behavior of the harvestman *Cynorta marginalis*, in a laboratory setting. For the olfactory experiments, harvestmen were placed in a Plexiglas chamber with a filter paper containing an olfactory cue (scents of 2 potential food items, potential predator, millipede, or control); activity time, time spent on the half of the chamber with the cue, and times touching the filter paper for each scent type were recorded. Harvestman behavior was highly variable, and there was a significant reduction in activity in the presence of fruit cues, resulting in a significant avoidance of that side of the chamber. In the presence of conspecific odors (same or opposite sex), harvestmen also displayed variable behavior, but no significant differences were observed. In interactions with individuals of the same and opposite sex, a higher rate of physical contact (≥2.5x) was observed between opposite sexes and between two males, as opposed to between two females. Fighting behaviors were only observed between males and mating attempts were observed in 15% of the Male-Female trials. It is unclear why *C. marginalis* displayed a slight but significant avoidance of the fruit olfactory cue. Our results indicate that although olfactory cues may play a role in the behavior of *C. marginalis*, other factors, such as visual or tactile cues, may be more important.

P107 Daniel J. Smith[1], Nicole H. Levi-Polyachenko[2], Amy H. Ringwood[1]
[1] Biological Sciences, UNC Charlotte; [2] Plastic and Reconstructive Surgery, Wake Forest School of Medicine, Winston-Salem, NC

Cellular Responses of the Eastern Oyster, *Crassostrea virginica,* to PolyDOTs

Engineered nanoparticles are increasingly being used in a wide variety of applications in medicine and biology. As with any new and novel technology, nanoparticles have the ability to cause unintended environmental consequences including impacts on non-target organisms. Polymer dynamic organic theranostic spheres (PolyDOTs) are engineered nanoparticles (ENPs) that are being studied as a potential cancer treatment. In vivo, the PolyDOTs used in this study attach to specific cell surface receptors and are then activated by 808nm of near-infrared light to thermally ablate cancer cells. The specific PolyDOTs used in this study are a hybrid ENP that combines the P3HT and BSe PolyDOTs. Like other ENPs, their properties and potential to act as an environmental pollutant are not well understood. To study the potential toxicity of these ENPs, oysters, *Crassostrea virginica,* were exposed to PolyDOTs for either 48hrs or 96hrs. After the exposure periods, the animals were sacrificed and hepatopancreas and gill tissues were collected from each individual. Sublethal toxicity endpoints were assayed using the Neutral Red Lysosomal Destabilization assay and no significant differences were found between treatments within the 48hr and 96hr exposure periods. However, the percentage of destabilized lysosomes was higher in the 96hr exposure compared to the 48hr exposure with a range of concentrations (10 ppb to 1 ppm). Lethal toxicity endpoints were assayed using the MTT assay. For the 48hr *in vivo* exposuresno statistically significant differences in cell viability between treatments were found for either gill or hepatopancreas tissues. For the 96hr *in vivo* exposures, no statistically significant differences in cell viability were found for hepatopancreas tissue. However, for gill tissues cell viability was lower at the highest concentration. Lipid peroxidation analyses indicated evidence of sublethal effects and tissue specific differences in oxidative damage.

P108 Adrianna L. Parson, Joseph M. Dirnberger
Ecology, Evolution & Organismal Biology, Kennesaw State U, GA

Spatial Patterns in Herbivory Within Belizean Seagrass Beds as Estimated by Blade Injury, Length and Width

Barren patches in seagrass beds around hard coral heads, “halos”, are thought to be created by reef dwelling herbivores as a result of a trade-off between protection provided by the reef from predation and the benefits of receiving nutrition in adjacent seagrass beds. We examined seagrass beds of *Thalassia testudinum* near Tobacco Caye, Belize that were adjacent to hard coral, soft coral, and rubble zone ecotones to compare herbivory patterns along transects (64 m) laid into the beds. Patterns in blade length, width, and tissue damage suggest greater herbivory closest to the edge of the bed. Blades adjacent to hard corals had the most damage and those adjacent to soft corals had the least, providing evidence that more structurally complex habitats provide greater protection to seagrass herbivores.

P109 Genevieve Patrick, Kirsten Work

Biology, Stetson U, DeLand, FL

Resolving a Florida Spring Food Web Through Diet Analysis of Fish

Florida Springs have experienced many different types of disturbances including changes in flow rates, changes in nutrient loading, and introductions of exotic species. Stable Isotope Analysis (SIA) has allowed for the construction of an ecosystem’s food web based on the analysis of carbon and nitrogen ratios of the different species present. We sought to determine the effects of the previously mentioned disturbances on the Volusia Blue Spring food web. Using SIA we determined nutrient sources and the trophic levels of present species and constructed a provisional food web. We collected samples of leaves, algae, amphipods, sailfin mollies (*Poecilia latipinna*), and mosquitofish (*Gambusia holbrooki*) seasonally. We also collected fecal samples of the Florida manatee (*Trichecus manatus*) and fecal and/or muscle samples of sailfin suckermouth catfish (*Pterygoplichthys*). These samples were collected at three different sites: the spring boil, midrun, and the St. Johns River just outside the run. Preliminary results revealed that for algae, there were seasonal and spatial differences in nitrogen signatures, possibly due to fertilizer inputs to the spring, and spatial differences in carbon signatures, possibly due to the use of bicarbonate from limestone as a carbon source in spring as opposed to organic sources in the river. For many organisms, the isotopic signatures differed spatially, with different signatures in the spring run and in the river and spatially. The isotopic signatures of sailfin mollies and mosquitofish were similar, so we used gut content analysis to determine how much diet overlap there was. Analysis suggests that the isotopic overlap in the sailfin mollies, mosquitofish, and sailfin suckermouth catfish were due to similarities in diets.

P110 Annalise M. Reagan, Courtney T. Dobash, Elizabeth B. Sudduth
Science & Technology, Georgia Gwinnett College, Lawrenceville

Ammonium Retention Analysis at Mill Creek Restoration Site

Mill Creek in Atlanta was disrupted by construction, forming a new channel. Beavers have since entered the site providing an opportunity to observe the effectiveness of their dams in restoring streams and wetlands by retaining and removing nutrients. Ammonium is a form of nitrogen that is vital to life in streams, but it also can indicate the presence of human waste and synthetic fertilizers. As more dams are built along the new stream channel, ammonium concentrations should decrease downstream of the dams due to nutrient retention. Ammonium concentrations were analyzed at points upstream and downstream of the beaver dams and varied greatly across monthly samples in 2015. March had the highest concentrations, mostly greater than 0.20 mg/L NH4-N and climbing to 0.3 mg/L NH4-N. Contrary to initial predictions, the months of April-July showed a steady increase in ammonium moving downstream through the study site, with the greatest concentrations from 0.075 mg/L NH4-N to 0.10 mg/L NH4-N in

April and concentrations of 0.045 mg/L NH4-4 to 0.090 mg/L NH4-N for the other three months. In August, a general decrease occurred from 0.04 mg/L NH4-N to 0.02 mg/L NH4-N. September also saw an increase in ammonium, from 0.02 mg/L NH4-N to 0.03 mg/L NH4-N downstream. October had the lowest ammonium concentrations of approximately 0.01 mg/L NH4-N. Although there is an annual decreasing trend, ammonium concentrations at the site have not decreased significantly as predicted. However, as the beaver dams become more established, the ammonium concentrations are expected to decrease accordingly downstream.

P111 Courtney T. Dobash, Annalise M. Reagan, Elizabeth B. Sudduth
Science & Technology, Georgia Gwinnett College, Lawrenceville

Sediment Transport at Mill Creek Restoration Site

Construction on Mill Creek in Atlanta drained a wetland and created a new channel. Mill Creek flows into Nancy Creek, which is monitored by the EPA due to high amounts of sediment. The presence of beaver dams along this stream provides the opportunity for the restoration of the stream and wetlands, which could be observed through the monitoring of sediment transport as total suspended solids (TSS; g/L), the concentration of sediment transported per volume of water. The concentration of TSS will be expected to decrease with the construction of beaver dams along the new channel as the dams retain sediment. A rising stage sampler collects water at three different heights in storm flow to measure sediment transport during different stages of the storm. The samplers were placed upstream and downstream of the site, on the old and new channels, and upstream and downstream of the beaver dams for comparison. A lower TSS and a higher percent of organic material were observed downstream of the old channel than in the new channel. Many beaver dams have been constructed along the new channel; however, most of them have been destroyed by high storm flows, limiting their ability to retain sediment. In the old channel, we are already seeing an effect of the beaver dams in the lower suspended solids and lower percent of inorganic material compared with the new channel. In the future, similar effects could be seen on the new channel as well.

P112 Mary Clare A. McGinn
Biology, High Point U, NC

Investigation of the UV Sensitivity and Photoenzymatic Repair Capabilities of *Daphnia magna* and *Daphnia lumholtzi*

Ultraviolet (UV) radiation can be an important stressor in aquatic systems. Organisms vary in both their UV sensitivity and their UV response strategies. This study was conducted in order to compare the effects of UV radiation on the water fleas *Daphnia lumholtzi* and *Daphnia magna*. Though there is previous research on the effects of UV on *Daphnia magna*, there is little known about the effects of UV on *Daphnia lumholtzi*, which is an exotic species found throughout the central and southern United States. Specifically, we aim to determine whether either species uses photoenzymatic repair (PER) to repair their DNA damage. UV exposure experiments were conducted in a temperature and light-controlled environmental chamber. *Daphnia* were exposed to damaging 312 nm UV-B radiation and were then separated into two groups, one receiving photorepair radiation (+PRR) in the form of UV-A and visible light and one not receiving photorepair radiation (-PRR). The survival of *Daphnia* in the +PRR, -PRR and dark control groups was followed over several days. These results will further our understanding of UV response strategies within the *Daphnia* genus.

P113 Haley K. Lloyd, Kimberly J. Bolyard
Biology, Bridgewater College, Bridgewater, VA

Habitat Contamination and Antipredator Behaviors in Longnose Dace (*Rhinichthys cataractae*)

Longnose dace (*Rhinichthys cataractae*) are common inhabitants in the Shenandoah Valley, including South River, part of which has high levels of mercury contamination. Pollutants and contaminants in aquatic ecosystems may alter fish behavior such as predator avoidance,

feeding, and social interactions. Yet, few studies have shown the effects of habitat contaminants generally, and mercury specifically, on individual fish behavior. To evaluate the effects of mercury, we examined the antipredator behavior of longnose dace from two different river systems. We collected fish in July, 2015 from South River where mercury levels are higher than normal, and from Dry River where mercury contamination has not been reported. In the laboratory, we tested the antipredator responses of fish by exposing them individually to three different stimuli: a model of a largemouth bass (*Micropterus salmoides*), a similarly sized piece of wood, or no object as a negative control. Trials were videotaped from behind a fish blind. Fish from South River (mercury contaminated) made fewer approaches and fewer retreats from the stimulus tank than did fish from Dry River (not contaminated). Mercury exposed fish spent more time resting and less time swimming during each stimulus presentation than did the non-exposed fish. There was no significant effect of the type of stimulus presented. The significance of hypoactivity of fish from mercury contaminated South River has implications for reduced antipredator and feeding behaviors of longnose dace. Fish from South River, however, were significantly longer and heavier than fish from the uncontaminated river. Our study suggests that sublethal levels of mercury in the environment can significantly affect the behavior of individual fish. If these behavioral changes affect predator-prey relationships in the field, then they have the potential to impact aquatic ecosystems including population sizes of key fisheries species such as largemouth bass.

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[1] Biology, Middle Tennessee State U, Murfreesboro; [2] Basic and Applied Sciences, Middle Tennessee State U, Murfreesboro

Identifying *Daphnia* Species by Morphological Traits and DNA Barcoding

The zooplankton *Daphnia lumholtzi* is a non-indigenous species (NIS) of tropical and subtropical origin that has spread rapidly throughout US waterways. Due to their rapid expansion, recent research has not only monitored *D. lumholtzi* range expansion, but also distribution in comparison to native *Daphnia* populations. While most studies have focused on reservoir populations, our lab has been investigating an established *Daphnia lumholtzi* population from a coastal Alabama estuary. We have found that *D. lumholtzi* and native *Daphnia* species occur together throughout the year in low densities. To better understand these relationships between *D. lumholtzi* and native populations, we need to unambiguously identify each species in our field samples. Species identifications are typically made using dichotomous keys based upon diagnostic morphological traits. Although *D. lumholtzi* can be reliably identified by its distinct morphology, native species identification can be complicated by high phenotypic plasticity. For this reason, DNA barcoding is increasingly used for molecular conformation of identities made using morphological keys. Recently, zooplankton-specific DNA barcoding primers have become available. In this study, we sought to 1) identify *Daphnia* species present in our study site, and 2) test the validity of zooplankton-specific DNA barcoding primers for conforming morphological identification. Three researchers separately used two different sets of morphological keys to identify five individual *Daphnia* samples that appeared to be morphologically distinct upon initial inspection. Based upon dichotomous keys, all three inspectors agreed on the identification of *D. lumholtzi, D. ambigua* and *D. pulex*, but did not initially agree on the identification of two native species. DNA barcoding is ongoing to confirm species identity. We will continue to use DNA barcoding to investigate changes that have occurred in the *Daphnia* egg bank structure.

P115 Anna Lee Whitaker, Alex Dye, J. Scott Harrison
Biology, Georgia Southern U, Statesboro

The Effect of Female Egg Production on Male Mating Behavior in the Copepod *Tigriopus californicus*

Males of the intertidal copepod, *Tigriopus californicus*, clasp to and mate-guard immature virginfemales until their terminal molt when they mate and release them. Females mate once in their life, store sperm, and produce multiple clutches of eggs from this single mating. After a

female has mated, no other males will attempt to clasp and mate with her. The mechanism by which males recognize mated females and avoid them is unknown. We have observed that *T. californicus* virgin females will produce unfertilized egg sacs. In this study we test we test whether the production of an egg sac by a virgin female will reduce mating attempts by males. The goal of this study is to quantify the clasp rate of immature virgin females against the mature females who have already produced an egg sac. We predict that the clasping and mating rate of immature virgin females will be more common than virgin mature females already producing egg sacs.

P116 Whitney B. Leach, Adam M. Reitzel
Biological Sciences, UNC Charlotte

Effects of Light Cycling and Wavelength on the Molecular Components and Circadian Clock of *Nematostella vectensis*

In aquatic habitats, the intensity and wavelengths of visible light that penetrate to particular depths vary, thus species occurring over this depth range experience different optical environments and it is unclear how marine organisms respond to them. The starlet sea anemone, *Nematostella vectensis* inhabits estuarine environments that often differ optically, and while our current understanding is that *N. vectensis* responds cyclically to diel lighting patterns with an endogenous circadian clock, we have not characterized how differences in the light environment impact expression of the genome broadly (i.e., how many genes exhibit rhythmic expression) or how behavior may be affected. For the first question, we used oligo microarrays to measure transcriptome-wide oscillations in gene expression to determine which genes cycle in light:dark (LD) conditions and which of these continue cycling after removal of the light cue (dark:dark, DD). Comparisons of LD and DD exposed animals revealed approximately 220 genes with significant differences in expression in light:dark culturing, with more than 85% of these losing differential expression within 4-days after removal of light cue. These results further support evidence for a substantial impact of light cycling on various molecular pathways in this cnidarian, some of which are regulated by a circadian clock. Second, we are using video analysis of anemone locomotion to determine if isolated portions of the visible spectrum result in different behavioral responses. Ongoing experiments suggest that individuals are active in all lighting conditions, suggesting that activity is maintained throughout all portions of the visible light spectrum.

P117 Mark Frederick, Carolyn Day, Dennis C. Haney
History and Biology, Furman U, Greenville, SC

An Historical Analysis of Legacy Agricultural Land Use and its Effects on Present Day Fish Abundance and Diversity in Streams of the South Carolina Piedmont

In South Carolina, rural Piedmont streams often possess lower diversity and greater homogeneity of fish populations than would be expected for streams with minimal urban impacts. Indeed, compared to similar areas elsewhere in the southeastern U.S., these streams are generally depauperate in fish fauna, even in rural, forested locations where we would expect diversity to be high. Thus, anthropogenic influences on streams are apparent even in current rural areas of the SC Piedmont. One explanation for these observations relates to current land use. However, studies we have conducted do not support this association between present day land covers and fish abundance and diversity. Another explanation for the observations we have made in rural areas relates to historical land cover and use, or land use legacies. Specifically, many of the current physical and biological characteristics of Piedmont streams may be remnants from the widespread land degradation and deforestation associated with intensive farming across the region during the first half of the 20th century. To investigate this hypothesis we undertook an intensive examination of farming data found in historical archives which we compared with our present day biological and environmental data. Using 35 sample sites of forested, pastured, and agricultural land covers throughout the SC Piedmont as a starting point, we located historic maps for Greenville (1882) and Anderson (1897) counties

to use as historic land reference points. Tracing the family names and farm owners in the archives and federal census data produced a wealth of agricultural information including amount of improved/unimproved land, types and amount of acreage of crops, value of farm productions, fertilizer use, and types and amount of livestock. This data was converted into usable forms for analysis and geotagged to both the historic and current maps for comparison with data from present day sampling sites.

P118 Elaine Rossignol, Debra Dooley

Natural Sciences, Piedmont College, Demorest, GA

Survivability of *Daphnia magna* in Aqueous Hexavalent Chromium

Daphnia magna, a cladoceran crustacean, is commonly used in toxicity studies due to ease of culturing and because of the niche they occupy in aquatic ecosystems. Coal ash byproducts including solid ash and fly ash containing hexavalent chromium can leach into water systems resulting in contamination. While hexavalent chromium is reduced within most animals to trivalent chromium, this process takes a toll, including DNA mutations, DNA lesions, cytotoxicity, and the production of free radicals. *D. magna* has served as a test subject in previous studies of aqueous chromium toxicity due to the organism's high sensitivity to aqueous chromium. Negative effects of aqueous chromium on *D. magna* populations could result in severe ecological imbalances due to trophic disruption within the aquatic system. This study simulated coal ash leachate concentrations of hexavalent chromium (Cr(VI)) to clinically study the survivability of *D. magna* in the presence of this toxin. Based on previous studies of coal ash leachate concentrations, the concentrations of chromium used were 0.05 and 0.10 ppm Cr(VI). A randomized clinical trial of individual *D. magna* was conducted: four replicates for the control and both treatment concentrations were conducted by placing fifteen *D. magna* in 200mL of the appropriate solution with food media. The beakers were monitored and the number of alive and dead individuals were recorded at predetermined time intervals of 4 hours (up until 12 hours reached) and 12 hours (up until 72 hours). Dead individuals were also removed at each interval. Using Kaplan-Meier survivor analyses and a logrank test, a significant difference in the survivability of *D. magna* between the treatments and control as well as between the treatments themselves was demonstrated ($p<0.0001$). Increased aqueous Cr(VI) leads to decreased survivability. Therefore, when coal ash spills occur and leachates appear in surface water systems, there could be huge impacts on aquatic ecology both on the micro- and macroscale levels.

P119 Benjamin C. Webster, Matthew N. Waters
Biology, Valdosta State U, GA

Organic Carbon Burial in Subtropical, Shallow Lakes in Florida, USA: Investigating the Impacts of Warming and Humans

Organic carbon burial in aquatic environments has shown to be much higher than previous estimates. Most recent work on carbon burial has focused on areas in high latitudes in North America and Europe resulting in a paucity of information on carbon burial in southern temperate and subtropical areas. Here, we present carbon loading rates of lakes located in the subtropical area of Florida, United States, to global averages and studies from northern temperate regions. Carbon burial rates were calculated using organic carbon measurements and mass sedimentation rates acquired from ^{210}Pb dating models. Results show that warmer climates allow for extended seasons of algal growth and in turn a greater amount of carbon buried in sediment. Likewise, we compare the carbon burial rates before and after intense human impacts to these systems (~1950) to show the influences of human impacts on carbon storage. Given these rates, it is possible that lakes closer to the equator could be underrepresented as sinks for carbon.

P120 Lacy J. Clark, Timothy A Kreps
Biology, Bridgewater College, Bridgewater, VA

An Analysis of the Effectiveness of Underwater Video Analysis as a Survey Technique for Fish Communities in Mountain Streams

Electrofishing has become a standard method for analyzing freshwater fish communities. Even though this method is effective and generally nondestructive, there can be negative effects on fish that are captured and released and those that evade capture. This can create challenges when surveying areas with rare or sensitive species, such as brook trout. It can also limit how frequently streams can be surveyed without affecting the fish community. In order to avoid these problems, a few researchers have experimented with underwater video analysis (UWVA) using video cameras. With the rapidly decreasing cost of waterproof video cameras, this technique could be increasingly useful if found to be effective. We tested the effectiveness of UWVA in two sections of headwater mountain stream in western Virginia. We estimated fish species composition and relative abundance with UWVA and compared the results to estimates from three-pass electrofishing surveys.

P121 Cecilia L. Hernandez[1], Seth Oster[2], Jennifer L. Newbrey[1]
[1] Biology, Columbus State U, GA; [2] Southeastern Raptor Center, Auburn Univeristy, AL

Retrospective Study of Birds of Prey Treated at the Southeastern Raptor Center in Auburn, Alabama

Raptor rehabilitation programs treat and release thousands of birds of prey each year that otherwise would have likely perished. Although research results vary greatly across species and age groups, researchers agree that raptor rehabilitation is an important part of raptor conservation. North American studies show that physical trauma tends to be the primary cause of admittance to raptor rehabilitation centers. However, birds are also admitted for a variety of other reasons including emaciation, orphaning, gunshot wounds, and electrocution. We are investigating morbidity and mortality rates, release rates, and survivability across species and age groups in raptors admitted to the Southeastern Raptor Center in Auburn, Alabama in order to identify age-related and species-specific trends. Medical records from 2010 to 2014 (n = 1,225) are being compiled and analyzed in order to identify species-specific, age-related, and trauma-related trends in injuries and release rates. Data for each species are being analyzed separately, as well as within groups for nocturnal and diurnal raptors. To determine the effects of raptor age on injuries and release rates, birds are being categorized as adults, immatures, fledglings, or nestlings. The conclusions generated from this research will be very helpful for informing and improving current raptor conservation efforts in the region.

P122 Carmen Kuan[1], Bob Curry[2], Gloria DeGrandi-Hoffman[3], Kris Garber[4], Andrew Kanarek[4], Tom Purucker[5]
[1] Oak Ridge Institute of Science and Engineering, Athens, GA; [2] Crystal River Consulting, Tucson, AZ; [3] USDA Agricultural Research Service, Tucson, AZ; [4] US Environmental Protection Agency, Arlington, VA; [5] US Environmental Protection Agency, Athens, GA

Parameter Sensitivity Analysis for Pesticide Impacts on Honeybee Colonies

Simulation models are used to compute and predict dynamic environmental fate, transport, exposure and effect processes. These models often include multiple inputs and highly dimensional calculations to represent the domain as accurately as possible. One risk of such simulation models is over-parameterization, potentially resulting in overfit models that are difficult to calibrate under a range of conditions. Sensitivity analysis is often used in these situations to identify critical parameters, reduce the risk of overfitting and provide information to reduce prediction bias and uncertainty. In this study, we implement two sensitivity analysis techniques, regression coefficients and Sobol' method, to identify sensitive parameters, establish their relative importance and describe the model dynamics of a honeybee colony exposed to pesticides over time. Monte Carlo simulations confirm queen strength and forager lifespan as important, sensitive parameters for estimating colony dynamics in the core colony

dynamics model (VarroaPop) and relates their sensitivity to newly added parameters for estimating pesticide risk. Sobol' analyses also reveals that the relative importance and ranking of these parameters fluctuate throughout the simulation period. Particularly important are seasonal conditions related to pollen quality as well as timing of discrete events (e.g., pesticide application timing). By using sensitivity analysis to assess model output, applications of simulation models can yield more robust predictions of complex ecological processes and better support environmental decision-making.

P123 Rebecca L. Sale, Chloe E. Wilson, Mary K. Sledge, John S. Lewis
Biology, Lipscomb U, Nashville, TN

Genetic Structure of Feral Pig Populations in Tennessee

Feral pigs (*Sus scrofa*) are an invasive species in the United States, including Tennessee. Habits of feral pigs cause extensive damage to cropland in Tennessee and cost farmers millions of dollars every year. They also cause general undesirable effects on the natural ecosystems in Tennessee, especially affecting small animals and insects that live in the soil. Additionally, feral pigs harbor diseases that are a health risk to humans and livestock. To date there have been ineffective means of controlling the species in Tennessee. Determining the genetic structure of the feral pig populations inhabiting 80 of Tennessee's 95 counties will aid in controlling the species at the source. We have isolated DNA from blood samples of 96 individuals and have PCR amplified 11 microsatellite loci. These loci were genotyped with Geneious 9.0.5. Genetic structure was analyzed with STRUCTURE 2.3.4. Our current analysis using the program STRUCTURE suggests that there are two genetically distinct populations within the counties sampled.

P124 Harley B. Kitching, Edward B. Mondor
Biology, Georgia Southern U, Statesboro

Tomorrowland: Elevated CO_2 Alters Broad Bean, Vicia Faba L., Growth/Defense Tradeoffs

Atmospheric changes, associated with global climate change, are increasing at an unprecedented rate. Plants generally display higher rates of growth in response to elevated CO_2 levels, but this response varies among species. In addition, very little is known about how plant growth/defense tradeoffs will be altered by increasing CO_2 levels. By raising Broad bean, *Vicia faba* L., plants under ambient (400 ppm) and elevated (900 ppm) levels of CO_2, we show that atmospheric composition directly alters plant growth/defense tradeoffs. Plants grown under ambient atmospheric conditions had heavier stem and root weights. Conversely, plants grown under elevated CO_2 produced greater numbers of extrafloral nectaries and had higher rates of extrafloral nectar secretion. Thus, plants grown under elevated CO_2 invested more in defense (EFNs and nectar production) than growth (biomass). These results indicate that CO_2 may act as a stressor for Broad bean plants. Future research will examine how this tradeoff influences higher trophic levels (i.e., herbivores and their natural enemies).

P125 William G. Mitchell[1], John A. Barone[1], JoVonn G. Hill[2]
[1] Biology, Columbus State U, GA; [2] Mississippi Entomological Museum, Mississippi State U, Starkville

Dendrochronology of *Juniperus virginiana* on Mississippi Black Belt Prairie

Black Belt prairies once occupied a roughly 500 by 40 km arc of land that extends from northern Mississippi into eastern Alabama. A threat to existing prairies is cedar trees (*Juniperus virginiana*). These trees shade out areas of open prairie, often leading to a decline of prairie species. This appears to be a relatively recent phenomenon. It has been hypothesized that fire suppression over the last century has allowed the spread of cedar trees into these prairies. To test this hypothesis, we took cross sections of cedar trees from Osborn Prairie in Oktibbeha County, Mississippi. We collected 21 cross sections from trees in an open prairie. We then used these to determine both the age and fire history of cedar trees at the site through tree ring analysis and stem measurements. The oldest tree studied was 160 years old with an average

age of 95 years. Eight trees were found to be between 80 and 90 years old, suggesting that conditions were favorable for the spread of cedar trees onto the prairie at that time. We also found a significant positive correlation between stem size and age; however stem sized only explained about 40 percent of the variability in age. This indicates that other factors greatly influence stem sizes besides age. We were unable to find fire scars in any of our cross sections, suggesting that fires have not occurred on this prairie in the last century. The apparent lack of fires may have allowed for the spread of cedar trees on this prairie. Future research will expand this project to other sites.

P126 Tyler K. Lehmann[1], Jennifer A. Hamel[2]
[1] Environmental & Ecological Science, Elon U, NC; [2] Biology, Elon U, NC

Comparing Reproductive Success in Allopatric and Sympatric Species of *Anasa trists* and *andresii*

Individuals of different species mate together, and this is particularly common in areas of secondary sympatry. *Anasa tristis* and *A. andresii* are closely related insect species that have been secondarily sympatric in North Florida for 80-100 generations, and male *A. andresii* and female *A. tristis* copulate in the field at this location. Throughout the rest of the southeastern U.S., the two species are allopatric: *A. tristis* is present, but A. andresii does not occur. Because interspecific mating commonly results in reproductive costs such as wasted gametes, we predicted that heterospecific pairs would produce fewer offspring than conspecific pairs. Because selection has had >80 generations to act in north Florida, we also predicted that female *A. tristis* from this population would waste fewer gametes mating with male *A. andresii* than would allopatric female *A. tristis* (from North Carolina). We tested these predictions by comparing the numbers of eggs and offspring produced by conspecific *A. tristis* pairs with those produced by heterospecific pairs, and by comparing eggs and offspring produced by heterospecific pairs with female *A. tristisfrom* sympatric and allopatric populations. We recorded female fecundity and reproductive success for 28 days. Females in conspecific pairs produced many more eggs and offspring than did females in both types of heterospecific pairs. We found no difference in the numbers of eggs produced by heterospecific pairs containing female A. tristisfrom sympatric versus allopatric populations. Our findings suggest that there are barriers during or after copulation that prevent *A. tristis* eggs from being fertilized by male *A. andresii*. Future research should examine possible mechanisms preventing fertilization, including cryptic female choice and mechanical incompatibility.

P127 Brian K. Bonville, Ray S. Williams
Biology, Appalachian State U, Boone, NC

Effects of Genotype, Environment and Their Interaction on Leaf Terpenes and the Abundance of a Specialist Aphid in *Solidago altissima*

The population dynamics of plant-dependent arthropods may be influenced by the genetic diversity of dominant plant species. Dominant plant's phytochemical composition has been demonstrated to vary by genotype and impact the colonization of herbivorous insects. Terpenes are one of the largest classes of phytochemicals and can vary based on plant genotype. They also may play a role in deterring or attracting herbivorous insects such as aphids. Our study examined plant terpene concentration in tall goldenrod (*Solidago altissima*) as a phenotypic attribute that might influence colonization by a specialist aphid (*Uroleucon nigrotuberculatum*). We sought to understand how genotype and environmental conditions in the form of soil nitrogen and phosphorous might influence terpenes and aphid abundance. We separated the effects of genotype (G) from environment (E) and examined any potential interaction (GXE). Six genotypes of tall goldenrod were grown in a common garden design under different nutrient regimes; nitrogen addition, phosphorous addition and control (no nutrients). After allowing aphids to naturally colonize our plants we quantified aphid abundance throughout a growing season. During the two main peaks in aphid population we took estimates of plant biomass and leaf samples for phytochemical analyses. Aphid abundance was significantly influenced by nutrient treatment and there was a GXE interaction. The extent

of these effects varied between the two aphid population peaks. Terpenes were statistically different between genotype and nutrient treatment, while the proportion of terpene compounds allocated in each plant was affected by genotype but not nutrient treatments. Regression analyses demonstrated that aphid populations were positively correlated with the terpenes caryophyllene and ledene under nitrogen and phosphorous fertilization, but not under the control treatments. This investigation shows that genotypic variation in *S. altissima* can influence aphid populations through GXE effects, where different genotypes of tall goldenrod have varied responses toward nutrient regimes.

P128 Julie A. Ragsdale, Ray S. Williams
Biology, Appalachian State U, Boone, NC

Effects of Genotype and Site on Flower Terpenes and the Pollinator Community of the Old-Field Plant *Solidago altissima*

The field of community genetics explores the interplay of ecology and evolution, attempting to understand how the genetic variation and diversity of a focal species affects associated communities. Numerous effects of plant genetic variation on arthropod communities in the old-field plant species *Solidago altissima* are identified, with terpenes acting as a potential mechanism for insect choice of genotypes. However, flowers and pollinators have received little attention. We used *S. altissima* to examine how insect pollinators were affected by genotypic variation (genetic identity effect) and spatial scale (site effect) and investigated the possible role of the plant secondary metabolite class terpenes. Pollinator surveys were conducted three times in four patches at four sites throughout the blooming period and pollinators identified to the lowest possible taxa. Inflorescences were collected for biomass and terpene analysis using gas chromatography. We used a general linear model (Proc GLM) to partition effects of site from genotype and found that site explained only a small amount of the variation for pollinator abundance and terpene concentrations, indicating differences among genotypes and not sites. We hypothesized there would be a relationship between pollinator abundance and floral terpenes, such that if terpenes varied by genotype this would influence pollinator choice of host plant. Overall we found a few significant relationships between total pollinators and some individual terpenes. Even so, it is possible that examining individual terpenes rather than suites of compounds proves problematic in identifying relationships. Nonetheless, our data does support the conclusion that genetic variation is more important in this widespread old-field plant than spatial separation and that some terpenes could play a role in pollinator choice of genotypes.

P129 Marie J. Singletary, Jennifer L. Newbrey, Michael G. Newbrey
Biology, Columbus State U, GA

Effects of Human Disturbance on Hatching Failure Rates of Eastern Bluebirds (*Sialia sialis*) in West-Central Georgia

Hatching failure of eggs, which is surprisingly common for many bird species, can be caused by numerous factors, including improper incubation habits of parents, genetic factors, environmental conditions, and human disturbance. High levels of human disturbance can keep parents away from nests for long periods, causing eggs to cool, and thus reducing the hatching rates of eggs. Therefore, birds breeding in sites with higher levels of human disturbance likely experience higher rates of hatching failure than birds breeding in sites with lower levels of disturbance. We are assessing the effects of anthropogenic disturbance on the rates of hatching failure of Eastern Bluebirds (*Sialia sialis*) breeding in west-central Georgia. Unhatched eggs were collected from study nests at a high disturbance site, the main campus of Columbus State University, and a low disturbance site, Callaway Gardens, a private resort 50 km north of the university. Occupied nests were monitored daily during the breeding seasons of 2014 and 2015. Unhatched eggs were collected from nests when a nest failed, during the nestling stage when possible, or after all chicks had fledged from a nest. Unhatched eggs were frozen at -20°C until analysis. In the lab, salvaged eggs were thawed, opened, and classified as fertile or infertile based on the presence or absence of a notochord, respectively. The rate of hatching failure is being compared between the two study sites to determine if bluebirds breeding at the site with a higher level of

disturbance hatched fewer eggs. Since factors affecting the hatching success of passerines likely also affect non-passerine species, this research may have widespread implications for the effects of human disturbance on many other species.

P130 Cancelled

P131 Brittany R. DiRienzo[1], David B. Vandermast[2]
[1] Environmental & Ecological Science, Elon U, NC; [2] Biology, Elon U, NC

Visualizing Forest Characteristics of Elon University Forest in ArcMap

Successional stage during forest development has a large impact on the species composition in forest stands. The 22.5 ha of Elon University Forest (EUF) contains former farmland which was abandoned and re-vegetated between roughly 40-70 years ago. In addition, there is an area of approximately six ha which has always been forested, and is considered to be a "forest of continuity" (FOC). The purpose of this study was to use ArcMap to show the spatial relationships of forest measurements such as forest age, basal area, woody plant diversity, similarity between sapling and tree strata, and ice-storm mortality. Carolina Vegetation Survey (CVS) protocol was used to collect data from eight 20 x 50m plots in forests of varying age and composition. Vegetation data from trees (woody stems > 10cm DBH) and saplings (woody stems between 1 and 9.9 cm DBH) were collected in each plot. Overlays of the forest composition and ice storm damage were created in ArcMap, a Geographic Information Systems program. Our results indicate that tree abundance, basal area, and diversity (Shannon's index) map onto forests based on their age and were consistent between the FOC plots while the variation in these measures was far greater in the younger forests. Furthermore, the forest sapling strata (which is the strata containing trees that would replace dead canopy trees) composition is more similar to the canopy in the FOC than it is in the younger forests (Sorensen's index range: 92.1-93.9%) between sapling and canopy composition for the FOC versus (58.5-80.7%) for the younger, transitional forest. ArcMap also indicates that the majority of ice-storm damage occurred in younger forest dominated by Virginia pine (Pinus virginiana). Our results are consistent with those of other studies in successional forests in this region. EUF is unique in having an FOC to compare to younger forests.

P132 Sarah A. Gilley, David B. Vandermast
Environmental & Ecological Science, Elon U, NC

Carbon Sequestration and Changes in Aboveground Tree Biomass on Elon University Forest

The southeastern United States has been identified as an area with especially high potential growth rates, and thus is significant in the understanding of forests' role in the carbon cycle. As trees grow they fix atmospheric carbon dioxide and convert it to biomass in the form of leaves, branches, roots, and trunks. Carbon in woody biomass is sequestered there for the life of the tree. The rate at which trees sequester carbon is dependent on several factors, including the species, forest age, climate, and land-use history. This study aims to understand the rate of aboveground biomass (AGB) accumulation and carbon sequestration in Elon University Forest (EUF), a microcosm of Piedmont forest types. EUF contains a "forest of continuity"—a forest type with a high level of continuity in vegetation, structure, and disturbances—as well as a younger, more dynamic, pine-dominated forest. We used tree diameter (DBH) data gathered in 2011 and 2015 from eight permanent vegetation plots on EUF to calculate changes in AGB and carbon sequestered over the four-year period. Algorithms gathered from peer-reviewed sources were used to convert DBH measurements to estimates of AGB. Our results depict a forest with significant ($p<0.01$) declines in AGB (an average loss of 9.7% from 1625.3 to 1467.2 Mg/ha) and carbon sequestered (from 731.4 to 660.2 Mg/ha) in living trees. However, the older plots showed a higher level of stability (loss of AGB of 5.7%) in biomass and carbon sequestered, and the younger plots showed more variability (loss of 10.7%). We believe the decrease in biomass across the entire forest can be attributed to a transitional phase in many

of the plots, as well as a number of recent ice storms that have increased the mortality rate of the pine trees in the EUF.

P133 Garrett L. Wilkerson[1], Kim M. Tolson[1], J. Dale James[2]
[1] Biology, U of Louisiana at Monroe; [2] Conservation Planning, Ducks Unlimited, Ridgeland, MS

Quantifying Private Lands Contributions to Waterfowl Habitat Management Objectives in the Lower Mississippi Alluvial Valley

Waterfowl habitat objectives in the Lower Mississippi Alluvial Valley (LMAV) are quantified and expressed using units known as Duck-Energy-Days (DEDs). These units are used to express carrying capacity of the landscape for a 110-day wintering period. One DED is the amount of energy needed to sustain one average-sized duck for one day, 294.35 kilocalories. Increased efficiency of modern agricultural harvesting equipment, escalating fuel costs, and the decreasing acreage of agriculture on public lands have caused reduced DED values on much of the landscape within the LMAV. Currently, the DED value provided by private lands is uncertain. Waterfowl habitat management surveys were mailed to private land proprietors in the Lower Mississippi Alluvial Valley (LMAV) portions of Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana. Responding land managers were then contacted to schedule site visits to their properties so that DED values on their properties could be computed. From April 2015 to February 2016, 65 surveys were returned, and 22 site visits were conducted, representing 46,941 total acres. Using a table of average DEDs for each cover type on private lands (Reinecke and Kaminski, 2006) and the appropriate daily DED availability correction factor (Public Lands Disturbance Database, 2009), it was calculated that 44,394,157 DEDs were provided by those properties that were site-visited. Once all calculations have been completed, extrapolation will be used to estimate the number of DEDs provided by private lands in the LMAV.

P134 Danielle K. M. Merritt, Sara A. Gagné
Geography & Earth Sciences, UNC Charlotte

Invertebrate Diversity on Urban Green Roofs in Charlotte, NC

As of 2015, more than 50% of the Earth's population lives in urban areas, and by 2050, the United Nations projects this proportion to increase to 67%. Urbanization causes land cover change in cities, resulting in degradation of ecosystems and habitats. In consequence, there is a general loss of biodiversity in urban areas, as many species are not able to thrive under the characteristically high-stress environments of cities. A trend toward green roofing is taking hold in many cities worldwide, but little attention has been given to their potential as habitat. The factors that affect the habitat potential of green roofs and their relative importance are not well understood, but may include vegetation amount and diversity, substrate type and depth, roof area, and irrigation and maintenance regimes. Our research objectives are to evaluate the effect of local environmental variables on invertebrate diversity and abundance on urban green roofs. We will focus on five green roofs in Charlotte, NC, using a grid pattern of sampling stations on each roof. We will record the quality of habitat by measuring temperature, humidity, vegetation density, and vegetation structure at each sampling location. We will sample invertebrates along the grid patterns on each roof using pan trapping, vacuum collection of ground dwelling specimens, and butterfly transects. We will identify individual specimens to the smallest identifiable taxonomic class. Our results will shed light on the effect of green roof design on the invertebrate community in a highly urban environment.

P135 Abel Ayon, Sara A. Gagné
UNC Charlotte

The Effect of Bird Diversity on Human Psychological Wellbeing on the Neighborhoods of Charlotte Metropolitan Area

The purpose of this research project is understand the interactive relationship between biodiversityand human well-being in low-income and high-income neighborhoods of Charlotte, North Carolina on its metropolitan area. This project is developed through a empirical research of social and ecological dimensions to comprehend the influence of biodiversity on human well-being in nine neighborhoods of Mecklenburgh county, NC with low income and high income characteristics.To complete part of our research objectives, we will use avian diversity and psychological wellbeingas indicators of biodiversity and human well-being. The interaction between nature the people of neighborhoods it will measure using demographic variables and two different humansubject survey Attentional Function Index and Visual stress Analogue. For the avian diversity wewill quantify bird community structure using around 252 raster points and conducted through abird survey at each site during the spring of 2015 the methods will conform to the North AmericanBreeding Bird Survey. This study expected a potential social and environmental outcome, where its main goal is understand and analyze the dimensions of human well-being and bird diversity inthe Mecklenburg County.

P136 Lori M. Sherling, Carrie R. Crabtree
Science, Abraham Baldwin Agricultural College, Tifton, GA

Monitoring the Effectiveness of Storm Water Bioretention Areas on the Abraham Baldwin Agricultural College Campus

The purpose of this study is to fully evaluate the environmental effectiveness of the storm water bioretention areas that are currently on the Abraham Baldwin Agricultural College (ABAC) campus in Tifton, Georgia. It is of interst to establish their filtering ability against potential pollutants. Storm water retention areas have been documented to provide water purification properties through the action of the plant and microbial life existing within them. Filtering and/or purification of the water that flows through these areas can inlcude the removal of contaminants that result from the human activity in the surronding area like waste oil from vehicles in the surronding parking lots or excess nutrients from grounds maintenance. Data collections of these areas include a survey of the biotic communities, collection of the water influent, and collection of the water effluent. This portion of the study focused mainly on the nutrient content of the water samples and seasonal changes of the nutrients. Nutrients tested for include nitrogen, phosphorus, dissovled oxygen, pH, and temperature. Results of the tests have indicated a deacreasing trend in the amount of nitrogen and phosphorus contained within the water as it travles from the inlet to the outlet point, as well as from one bioretention area to the other.

P137 Kara V. DeGroote, Grace L. McCartha, A. Joseph Pollard
Biology, Furman U, Greenville, SC

Interactions of the Manganese Hyperaccumulator *Phytolacca americana* with Soil pH and Phosphate

Hyperaccumulators are plants that sequester exceptionally high concentrations of heavy metals and/or metalloids in their leaf mass. Such plants are attracting interest due to applications in phytoremediation and phytomining. *Phytolacca americana L.* (Phytolaccaceae) is one of only a few species known to hyperaccumulate manganese (Mn). Neither the mechanism by which *P. americana* hyperaccumulates Mn nor the ecological significance of this trait are fully understood. It has recently been suggested that *P. americana* secretes acids into the rhizosphere as a means of acquiring phosphate, and that rhizosphere acidification may coincidentally cause heavy metal uptake. An experiment was designed to reveal if and how much *P. americana* acidifies the surrounding soil. Plants were grown in rhizoboxes to allow access to growing roots. A thin layer of agar containing bromocresol green pH indicator dye

was placed over the roots to observe color changes indicative of acidification. This experiment has shown that *P. americana* acidifies the rhizosphere and does so substantially more than the non-hyperaccumulating plant Acalypha rhomboidea collected from the same community. A second experiment studied how cultivation in soil with modified pH and phosphate affected foliar Mn concentrations of *P. americana* seedlings. Foliar Mn was measured using atomic absorption spectrophotometry. This experiment revealed that *P. americana* hyperaccumulates Mn in the greatest quantities when grown in soils of low pH and/ or low phosphate concentration. These results suggest that Mn hyperaccumulation may be a side effect of phosphorus-acquisition mechanisms rather than an adaptation in its own right. The findings may be relevant to current attempts to utilize *P. americana* for phytoremediation.

P138 Margaret Essepian, Allyson Kane, Nicole Hughes
Biology, High Point U, NC

Morphological and Ecological Study of the Crane-Fly Orchid (*Tipularia discolor*)

The crane-fly orchid (*Tipularia discolor*) is a perennial, terrestrial orchid native to woodlands of the southeastern United States. It features several unique morphological and life history features which make it an interesting species to study, including production of single, evergreen leaf with bright purple undersides in the fall, small purple spots on the dorsal (adaxial) surface, and variable numbers of corms. In this study, we asked the following questions: 1) does leaf size correlate with corm mass? 2) does number of purple spots correlate with leaf nitrogen, corm mass, and/or presence of micro-organisms within the leaf? 3) does a prone (prostrate) leaf orientation affect leaf temperature, humidity beneath the leaf, and/or leaf water potential? Experiments are currently underway to answer these questions.

P139 Jessica L. B. Hunnicutt, Kunsiri C. Grubbs
Biology, Winthrop U, Rock Hill, SC

Testing Potential Allelopathic Mechanisms of Chinese Privet (*Ligustrum sinense*) for Herbicidal Purposes

Chinese privet (*Ligustrum sinense*, Oleaceae) is native to eastern Asia. It was introduced to the U.S. as an ornamental plant and a plant for animal grazing. Later, the plant became naturalized and is now considered one of the most invasive species found in the Southeastern U.S. The objective of this study was to investigate the impact of allelopathic compounds from the Chinese privet on the development of potential biological herbicides. The investigators examined the inhibitory effects of various concentrations of plant extracts (called “leachate”) from the leaves and mature fruits. The experiments were to test the leachate’s effects on the emergence, growth and development of some important crops and weed-like species. Here we used a total of seven plants (wheat, rye, tomato, radish, red clover, alfalfa and sunflower). The leaves and mature fruits of Chinese privet were collected from Winthrop Recreation & Research Complex multiple times during the experiment. We prepared the leachates by using water as a solvent at concentration levels of 1, 5, 10, and 15% (weight by volume) respectively. To test the allelopathic mechanism of leachates on seed germination and development, 10 seeds of each kind were placed in separate Petri-dishes containing 2 layers of filter paper, which were moistened with 5 ml of leachates from leaf and mature fruit respectively. Each experiment was replicated 10 times. Seed germination percentage, root & shoot weight measurement, and the image recording of each treatment were observed and record after two weeks. The results showed that the leachates from both leaf and fruit extracts showed strong inhibition in plant growth. The effect was significantly stronger in the fruit extract than the leaf extract. Though, the leaf extracts did not significantly inhibit the seed germination of the tested plants. However, the growth (shoot and root weights) of the tested plants decreased when the leachate concentrations increased (highest at 15%). The dicot types of tested plants (tomato, radish, red clover, alfalfa and sunflower) were more susceptible to the effects of the leachates than the monocot plants (wheat and rye). We found that both wheat and rye produced a large number of roots that tried to “escape” from the plant extract that was submerged by the seeds. Both primary and adventitious roots produced copious amounts of root hairs. It was a unique

occurrence to see that the roots grew against gravity to avoid the absorption from the leachates. We believe that the fruit extracts of the Chinese privet has a strong potential to be developed into an effective herbicide in the future.

P140 Morgan E. Kennedy, John T. Emery, Abidemi T. Adamson, Jingjing Sun, Jessica L. Ertel, Adedolapo A. Odutola, Heather D. Sutton
Ecology, Evolution & Organismal Biology, Kennesaw State U, GA

Effects of 1-Alkyl-3-Methylimidazolium Chloride Ionic Liquids on the Growth of Agricultural and Native Wetland Plants

The negative impact of volatile organic compounds (VOCs) on the environment has led to research into alternative, more environmentally friendly compounds for industry use. Ionic liquids (ILs), which are being promoted as green chemicals with negligible vapor pressure, are one of the compounds of interest for replacing VOCs. However, ILs may disrupt cell membranes and are readily miscible in water, so toxicity testing must be performed on plant and animal systems to determine potential environmental risks. Four 1-alkyl-3-methyimidazolium chloride ILs that differed only in length of the alkyl side chain were tested. Plant species tested include radish (*Raphanus sativus*), carrot (*Daucus carota*), lettuce (*Lactuca sativa*), swamp milkweed (*Asclepias incarnata*), proso millet (*Panicum miliaceum*) and wingstem (*Verbesina alternifolia*). Seeds were planted in potting soil and grown for a set number of days depending on the species. Seedlings were removed from the soil, the length of root and shoot were measured, and then the seedlings were inserted into a parafilm covered beaker containing an IL and Hoagland's plant growth medium. Each concentration was replicated 10 times. At the end of the exposure period, root and shoot length were measured and the wet weight was taken. Plants were placed in an oven set at 65°C for 5 days, after which the dry weight was taken. Lowest observable adverse effect concentrations and EC50 concentrations were calculated. Longer alkyl side chains appeared to result in increased toxicity, and of the plants tested to date radish and lettuce appear to be the most sensitive.

P141 McCoy, Ciera, Craig Lind, Terence Farrell
Biology, Stetson U, DeLand, FL

Seasonal Variation in Immune Function, Energetic Status, and Infection with Snake Fungal Disease in Free-Ranging Pigmy Rattlesnakes (*Sistrurus miliarius*) in Central Florida

The documentation of the snake fungal pathogen, *Ophidiomyces ophiodiicola (SFD),* has exhibited a dramatic increase over the last decade. Researchers are unsure as to whether the spread and negative impacts of SFD are caused by the pathogen invading new populations, or if snakes have become more susceptible as the result of weakened immune responses. Pigmy rattlesnake (*Sistrurus miliarius*) populations in Central Florida have exhibited fungal infections for over two decades; however, local population sizes have remained relatively stable. Vulnerability to infection may vary seasonally as a result of thermal conditions and energetic tradeoffs. To determine if season, sex, and energetic status influence an individual's susceptibility to infection, we examined fungal infection severity, body condition, and serum complement activity (plasma bactericidal ability) in free-ranging pigmy rattlesnakes over the course of one year. Fungal infections are more commonly seen during late Fall, Winter, and early Spring. Individuals with severe infections were in lower body condition compared to the general population; however, infected snakes exhibited the highest mean bactericidal ability. Of the nine severely infected individuals captured in the winter of 2015, six were recaptured later in the year. All recaptured individuals exhibited minimal or no evidence of infection, indicating that free-ranging pigmy rattlesnakes are capable of surviving the infection. Infection vulnerability varies with season and body condition indicating that both intrinsic and extrinsic factors may explain annual variation in vulnerability to fungal infections in snakes.

P142 Sarah Parker, Gregory Raymond, Jennifer Boyd
Biology, Geology, and Environmental Science, U of Tennessee at Chattanooga

The Influence of Light and Soil Moisture Availability on the Rare Terrestrial Orchid *Platanthera integrilabia*

Platanthera integrilabia is a rare terrestrial orchid species typically associated with semi-open, forested seeps in the southeastern U.S. It has been suggested that *P. integrilabia* has restrictive abiotic resource requirements; however, these requirements have not been implicitly studied. To inform its management and conservation, we investigated the influence of light and soil moisture availability on *P. integrilabia* at landscape and local scales and population and organismal levels across and within four occurrences with different canopy openness. We also evaluated the potential for adaptation and plasticity of leaf-level physiological responses of this species to light and soil moisture to influence its optimal habitat and rarity. At landscape scales, light and soil moisture availability were not associated with *P. integrilabia* density or the size of individuals. When compared across sites, photosynthetic light-response and water-use efficiency measurements indicated that *P. integrilabia* is generally adapted to shady, moist environments, but also capable of utilizing greater light availability and tolerating drier conditions. At the organismal-level, minimal associations of these measures with local-scale variations in light and soil moisture within sites suggested that plasticity of photosynthetic traits may be limited. The preservation of seep habitats generally associated with *P. integrilabia* is obviously warranted. But its adaptive leaf-level physiology suggests that it could tolerate well-managed tolerate timber harvesting and subsequent succession and that the creation of additional suitable habitat need not necessarily be restricted to moist forested sites. However, we recommend that habitat modification, whether from planned disturbance or active management, be considered only in occurrences with relatively large populations more likely to provide adequate genetic variability to facilitate adaptation to new conditions.

P143 Arleeya S. Alexander, Kathlyn Alexis, Steven Ritter, Alfredo Léon
Biology, Health & Wellness, Miami Dade College, FL

Optimization of Chloroplast Isolation from the Sabal Genus

The Palmentum at Miami Dade College′s North Campus houses several different Sabal plant species that are native to the Caribbean and Central America. Due to the constant change in environmental and evolutionary conditions, it is crucial to fully understand how the chlorophyll-protein complexes are affected by these continuous changes. The purpose of this project is to determine and characterize the components of the photosynthetic apparatus of several different Sabal plants. The Chloroplast organelle contains numerous amounts of molecules that aid in the capturing of light energy during the photosynthesis process, as well as converting it into chemical energy. In order to determine a standard procedure for chloroplast isolation in Sabal palms, chloroplasts were isolated using 2 grams of plant material from six different Sabal plant species using volumes of 40mL and 60mL of 0.2 M sucrose. After the isolation, chloroplasts were quantified indirectly by determining the absorbance of chlorophyll molecules in the isolated extract. The results revealed that different plant species belonging to the same Sabal family produce different amounts of chloroplast due to each palm's divergent environmental conditions. This experiment provides more awareness and knowledge amongst the different Sabal species. So, when doing genome barcoding to identify each species, there is more understanding of the approximate amount of chloroplast that will be present during quantification.

P144 Catherine Cooke, David B. Vandermast
Biology, Elon U, NC

Winter Photosynthesis of Chinese Privet (*Ligustrum sinense*)

Chinese privet (*Ligustrum sinense*) is invasive woody shrub that is widespread in the forests of the eastern United States. In the North Carolina piedmont, privetis a semi-evergreen plant that may be photosynthesizing in the winter enhancing its success as an invasive plant in this

region. Leaves are metabolically expensive to grow and maintain, especially when conditions are not optimal, so the benefits of privet keeping leaves in the winter should outweigh the costs. However, the degree to which privet photosynthesizes during winter months is not known. To determine whether privet is photosynthetically active during the winter, for one year we collected weekly measurements of quantum yield (QY) from privet growing in seven locations in Elon University Forest (EUF). In four of the locations the privet was shaded (shade) by canopy trees and in three of them the privet was growing in an open area where it was in direct sunlight (open) for at least part of the day. In addition, we calculated chlorophyll concentration from leaves collected from privet each season. Our results indicate that QY is strongly influenced by temperature (R^2=0.79). Furthermore, we found that QY varies significantly (p=0.05) between seasons but that wintertime values for privet are similar to those of agricultural plants that grow during the winter months. Annual measurements of QY from shaded privet were not significantly different than that of open privet. However, shaded privet had significantly lower QY than open privet on 15 of the 44 weeks data were collected. Finally, we found that there was no significant annual difference in chlorophyll concentration between shade vs. open privet. Our findings indicate that privet is photosynthesizing during the winter months and that this additional carbon capture may help its invasive potential.

P145 Joseph B. Lovenshimer, Michael D. Madritch
Biology, Appalachian State U, Boone, NC

Community Effects and Genetic Diversity of Post-Fire *Paulownia tomentosa* Invasions in the Linville Gorge Wilderness Area, Burke County, NC

Many naturalized populations of the exotic-invasive tree *Paulownia tomentosa* exist in North America, yet little research has quantified its effect on native communities. A series of recent wildfires in the Linville Gorge Wilderness Area, LGWA promoted a large-scale *P. tomentosa* invasion in this ecologically important area. To measure community shift casued by these *P. tomentosa* invasions across fire regimes, we sampled vegetation in paired invaded and non-invaded plots in mature and immature invasions within two burn areas of the LGWA. Community composition significantly shifted in all invaded plots across all invasion stages and burn areas. Species richness and Shannon values decreased in invaded plots in the 2000/2007 and 2000/2013 burn areas. *Paulownia tomentosa* age classes in both burn areas indicate that fire strongly promotes invasion but is not necessary for subsequent recruitment. Chemical and manual treatment for *P. tomentosa* did not differ in post-treatment community assemblage. Additionally, genetic analyses among distinct *P. tomentosa* populations revealed very low genetic diversity suggesting high dispersal within the LGWA. This information regarding community shift and strong post-fire recruitment by *P. tomentosa* may inform management decisions related to fire and invasive plant control.

P146 Victoria P. Van de Vuurst[1], David M. Frings[2]
[1] Biological & Environmental Science, Samford U, Birmingham, AL; [2] Oak Mountain Interpretive Center, Samford U, Birmingham, AL

Exploring Trapping Methodology in Species Richness Estimation of Rodents and Insectivores at Oak Mountain State Park

Accurate estimations of rodent and insectivore species richness are important for the sustainability of many food chains, and can aid in various ecological studies. It is difficult, however, to ascertain these estimates due to many innate difficulties that are faced when studying these elusive creatures. Comparisons of how rodent and insectivore species segregate across both large geo-region and smaller habitats or microhabitats can aid in addressing these difficulties. Also, comparing the effectiveness of both new and accepted methods of conducting live capture rodent and insectivore surveys could aid in future study. We conducted a study consisting of these two comparisons across a three month time period in Oak Mountain State Park. Our results supported previous studies which indicated that rodents and insectivores segregate in activity based on microhabitat, and could congregate in

microhabitats that have an association with water. We also found that different bait types showed significant differences in both efficacy and practicality in their field applications.

P147 Malia D. Berg[1], Tamara L. Johnstone-Yellin[1], Kate Guenther[2], David McRuer[2]
[1] Biology, Bridgewater College, Bridgewater, VA; [2] Wildlife Center of Virginia, Waynesboro

Effects of drying and storage method on nutritional content of acorn masts for wildlife rehabilitation patients: a pilot study

Wildlife rehabilitation facilities face challenges when creating diets for patients that closely mimic nature. We are attempting to determine long term storage methods of acorn masts for use in poor mast years. Fat extractions were preformed to determine how much fat is lost during three types of storage (room temperature, refrigeration, freezing) after using three different types of drying methods (oven, sun, room temperature). The results from this pilot phase will inform a long-term study on the best method to preserve nutritional content of masts collected by community members interested in helping rehabilitation centers collect food.

P148 Christopher P. Coggin, Matthew Morrissey, Guy Stewart, Heather P. Griscom
Biology, James Madison U, Harrisonburg, VA

A Long-Term Experimental Study With American Chestnut Hybrids in a 100-Year-Old Forest Within the Ridge and Valley province of Virginia

This experimental field study investigated the effects of slope position and gap size on the survival and growth of pure American chestnuts (*Castanea dentata*), chestnut hybrids,and tulip poplar (*Liriodendron tulipifera)* in the Ridge and Valley province of Virginia. Twelve gaps were created on upper ridge positions with xeric soil and lower slope positions with mesic soil. In 2008, one year old seedlings were planted within large (60-75% light) and small gaps (30-45% light). A two meter tall nylon mesh fence (100 x 100 meters) surrounded all gaps to protect seedlings from deer browse. Survival, height and diameter at root collar were quantified at the end of every growing season. Seven year-old chestnut saplings had significantly greater diameters ($p = 0.042$) and survival ($p < 0.0001$) in small gaps. Interestingly, chestnut survival was also higher within the plots located on upper slopes. This trend is due to higher predation by rodent girdling in the first several years on the lower slopes. Surprisingly, tulip poplar is outcompeting chestnut under all experimental conditions, suggesting that competition with this light-demanding, fast-growing species is a major barrier for chestnut reintroduction in these forests.

P149 Christopher P. Coggin, Brittany O. Culp, Abigail R. Goszka, Bruce A. Wiggins, Heather P. Griscom
Biology, James Madison U, Harrisonburg, VA

Searching for the Ghost of the Appalachians: The American Chestnut

An essential part of any species recovery plan is understanding how environmental factors affect survival and reproduction. Our species of interest, the American chestnut (*Castanea dentata*), was first infected with the chestnut blight (*Cryphonectria parasitica*) in 1904 and the entire species was pushed to the brink of extinction by 1940. This species' ability to re-sprout from existing root systems, enabled it to persist as an understory shrub. Our study aims to determine if the distribution of chestnut sprouts in Shenandoah National Park (SNP) is correlated with the environmental factors: soil texture, elevation, slope, aspect, pH. The American Chestnut Foundation (TACF) provided the coordinates and tree health data used in the study from their 2013 Appalachian Trail MEGA-transect Project. This is the first study to examine sprouting patterns within SNP using a large dataset. ArcGIS (Desktop10.3) and SPSS were used to analyze the significance of the impact certain environmental factors have on sprout distribution, blight presence, and reproductive indicators (presence of burs and/or flowers). Based upon the historic record and past studies we hypothesized each factor would have a significant effect on sprouting distribution and reproduction. Sprouts were predicted to be most abundant in environments with sandy soil, on mid to low slopes, at elevations of

approximately 875m, on southern to southwestern aspects, and a pH of 4 to 5. All quantified environmental factors had a significant effect on sprouting distribution, and preliminary analysis showed them most abundant on: 20-30% sand, slopes of 10-20%, and 500-700m elevation, southeastern to southern aspect The results of this study could help direct future searches for American chestnut sprouts within SNP.

P150 Abigail R. Goszka, Ashley M. Warrington, Emily C. Thyroff, Heather P. Griscom
Biology, James Madison U, Harrisonburg, VA

Where does the elusive American Ginseng grow best? Experimental Field Trials

American ginseng (*Panax quinquefolium*) is a shade tolerant herbaceous perennial that has been a valuable, non-timber forest product for the last 300 years. Ginseng is becoming increasingly rare in the wild mostly due to overharvesting. The increasing market demand for ginseng root and declining population numbers has caused a surge in ginseng cultivation. In this study, we examined slope aspect and soil type to address inconsistencies in the literature regarding optimal locations for ginseng growth. We implemented a three by two factorial design (soil*slope aspect) at a field site in an Appalachian Cove forest system in West Virginia. Soil was transplanted from three forest sites: calvin series (fertile loam that was limed), macove series (fertile loam), and dekalb series (cobbly, sandy loam). Seeds were planted in raised beds at six sites in the fall of 2014. All beds were placed in gaps with approximately 30% light. We predicted that leaf area, height, berries and survival of two-year-old plants would be significantly greater in limed loam soil on north-facing slopes. We found that soil had a significant effect on height and leaf area ($p<0.05$), while aspect had no effect on these measured variables. On average, plants in calvin loam soil that was limed were 32% taller and had 57% more leaf area than plants in the macove loam soil, and were 38% taller and had 54% more leaf area than plants in dekalb cobbly, sandy loam soil. Survival, which ranged from 0% to 59% at each of the six sites, was not affected by aspect or soil type. Although aspect is not significant at two years of age it may become important at a later stage, given variability in precipitation between years. An understanding of how environmental variables affect ginseng's growth and performance will help with the development of successful reintroduction plans.

P151 Thomas C. Byrd, Rebecca A. Cook
Biological Sciences, U of Memphis Lambuth Campus, TN

A Preliminary Investigation of the Ages of *Juniperus virginiana* L. in the Cedar Glades and Barrens of Tennessee

Cedar glades and barrens are open areas dominated by *Juniperus virginiana* L. (eastern red cedar) and grasses. They are typically found over calcareous bedrock where the thin to nonexistent soils limit the growth of woody vegetation. In Tennessee these unique ecosystems are primarily found in the Central Basin region although some are found in the west Tennessee in the Tennessee River valley and in eastern Tennessee in the Valley and Ridge region. The shallow soils, summer drought and full sunlight make the growing conditions in the glades and barrens harsh. In other habitats with harsh growing conditions, such as cliff faces, *J. virginiana* has been found to be a slow growing, long-lived species with some reaching ages of over 700 years. Unlike cliff-face forests, the barrens and glades are easily accessible and have been heavily impacted by human activity. A study was begun in the fall of 2015 to see if there are old trees in the Tennessee glades and barrens or if most of the trees are relatively young. To estimate age, cores were taken with increment borers from selected trees growing in what appeared to be harsher conditions (shallower soils, sloped areas and in the open) and annual rings were counted. At each site a tree in an area with deeper soils was also cored. The soil depth was measured and the diameter at breast height (DBH) as well as the diameter at the height of the core were taken. To date 40 trees have been sampled in five cedar barrens. The average age is 80 and the oldest tree was 127 years old. The average diameter increase is 2.2 mm per year excluding the reference trees which have an average increase of 11.8 mm per year.

P152 Sarah G. MacDonald, Mark A. Schlueter
Science & Technology, Georgia Gwinnett College, Lawrenceville

A Multi-Year Study Examining the Effect of Human Settlements on Carnivore Abundance and Diversity

The following study surveys mammalian carnivore diversity in Georgia's piedmont forests. Human settlements and man-made structures have impacted wildlife abundance and diversity. The purpose of this study is to assess mammalian carnivore species diversity and abundances in forests located in urban, suburban, and rural sites to determine how successful each environment is at providing habitats for carnivores. The project used DLC Covert II digital infra-red and Moultrie W-900itx trail cameras. Four to eight cameras were placed at each site near known game trails. A scent lure was placed approximately 1 meter from the camera, in the center of the field of view. Lures were created by dipping wooden stakes in bobcat urine and Milligan's Steppenwolf II Animal Lure and placing them upright in the ground. Cameras were left out for two weeks at each study site. A variety of species were seen on the cameras. In 2012: whitetail deer, opossum, squirrel, rabbit, armadillo, fox, raccoon, coyote, and bobcat were photographed. In 2016: whitetail deer, squirrel, rabbit, fox, raccoon, and coyote were photographed. The suburban sites had the greatest concentration of mammalian carnivores. In 2012, coyotes appear on film twice in urban forest sites, 32 times in suburban forest sites, and not at all in rural forest sites. Foxes, opossums and raccoons were most abundant in suburban forest sites. Bobcats, however, were only filmed in rural forest sites. We hypothesize that greater abundances of the smaller carnivores typical of Georgia in suburban sites is related to the greater frequencies of road kills, which provide additional food resources. These results suggest that large protected areas of forest, for instance state parks, in suburban areas are best for protecting carnivore populations and increasing carnivore diversity.

P153 Susan Monteleone[1], Jesse Purser[2], Hannah Turner[3], Shea Spicher[4], Boyd Butler[1], Chris Elsey[1], Jonathan Paul[1]
[1] Natural Science, Shorter U, Rome, GA; [2] Georgia Power, Rome, GA; [3] Medicine, U of Alabama; [4] Occupational Therapy, U of Alabama, Birmingham

The Distribution, Reproductive Viability and Nutrient Status of an Endemic Population of Large-Flowered Skullcap Mint [Scutellaria Montana L.] in Marshall Forest, Rome, GA

As part of an ongoing multiyear study of an endangered and endemic population of *Scutellaria* in Marshall Forest, factors limiting population growth and maintenance are under investigation. Marshall Forest Nature Preserve is a rare old growth forest located in Rome, GA. Little is known about *Scutellaria's* pollinators or other limiters of reproductive success. The size and patchy distributions of plants, or the variability of anthesis out of sequence with the emergence of potential pollinators may profoundly affect successful generation of this small population. Manual cross-pollination of a small group of plants yielded seed nutlets collected for determining seed production and viability.
This Marshall Forest population has been under investigation for two years. The distribution of patches of plants in the understory have been flagged and counted. Topographical descriptors like aspect and slope have been correlated to population locations. Observations of understory ground conditions prompted an investigation into the limitations of nutrient availability through N-nitrate assays, leaf litter decomposition rates, and examination of soil microbial communities. Microbial communities are being investigated for the presence of nitrogen cycling microbes. Future studies of this population of *Scutellaria* will inquire into pollination rates, seed germination rates, and the establishment and survival of seedlings in the understory conditions of Marshall Forest and related to comparable studies of nearby populations of *Scutellaria* located in Black's Bluff Nature Reserve, Rome, GA.

P154 Tabitha A. Petri, Cynthia C Bennington
Biology, Stetson U, DeLand, FL

Restoration of Sandhill Ecosystems: The Importance of Soil Fungi on the Growth of a Native Perennial, *Liatris tenuifolia* Nutt

Possessing a highly diverse understory, sandhill ecosystems are found on dry ridges of the southeastern United States. These systems are highly fragmented due to lumbering, agriculture, and urban development; such practices have significantly impacted soil traits including nutrient levels, pH and microbial communities. The Volusia Sandhill Ecosystem (VS) was established as a small-scale restoration project in a degraded 2 hectare site on the perimeter of Stetson University's campus. There we tested how the introduction of soil microbes from an established sandhill ecosystem affected the growth of shortleaf gayfeather (*Liatris tenuifolia)*. We collected soil from the rhizosphere of individual plants in Heart Island Conservation Area (HI), DeLeon Springs, FL, an established sandhill. Half of the soil from Heart Island was treated with fungicide (Daconil®). Two hundred seedlings were divided evenly into four treatment groups: a) untreated HI soil, b) HI soil treated with fungicide, c) VS soil inoculated with untreated HI soil, and d) VS soil inoculated with HI soil treated with fungicide. We measured the length of the longest leaf and the total number of leaves over thirteen weeks. The addition of native (HI) soil to VS soil had no significant effect on number or size of leaves ($p>0.15$). However, plants grown in native soil treated with fungicide had fewer and small leaves than those grown in untreated native soil ($p<0.0001$). Our results suggest that the presence of mycorrhizal fungi is important to the growth of *Liatris tenuifolia* in healthy sandhill soils. Yet, the inoculation of degraded soil with this native soil is ineffective at improving seedling growth, as other soil characteristics (e.g. pH and nutrient levels) may have a greater effect.

P155 Joseph T. McKenna, Zack E. Murrell, Matt C. Estep, Nikolai M. Hay
Biology, Appalachian State U, Boone, NC

Hybridization in the *Hexastylis heterophylla* Species Complex, With a Focus on the Conservation of *Hexastylis naniflora*

Hexastylis naniflora (Dwarf-flowered heartleaf) is a federally threatened species in the Aristolochiaceae endemic to North and South Carolina. Recent surveys performed by NCDOT identified populations in North Carolina with morphologies intermediate between *H. naniflora* and its closely related, co-occurring congeners, *H. minor* and *H. heterophylla*. Using 16 microsatellite markers, we performed a genetic assignment test to identify these populations and quantify the degree of hybridization occurring among the three species in the contact zone. We further examined ecological and geographic factors that may be driving the observed patterns. Results indicate there has been significant hybridization within the complex, and field identifications based on morphology accurately identify admixture among species. These finding complicate state and federal agency decisions regarding the best strategy to conserve the federally threatened *Hexastylis naniflora*.

P156 Ashlee S. Taylor, Walter H. Smith
Natural Science, The U of Virginia's College at Wise

Hellbender Citizen Science: A Survey Focusing on the Distribution of the Eastern Hellbender (*Cryptobranchus alleganiensis alleganiensis*) in Southwest Virginia

The eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*) is a large, fully-aquatic salamander that can reach lengths of two feet in size. Due to concerns about ongoing declines, hellbenders are classified as a Tier II species in Virginia (Very High Conservation Need). However, no known localities for hellbenders exist north of the Clinch River in far southwest Virginia, preventing the design and implementation of conservation and management plans. In this project, we adapted a citizen science survey distributed at local bait shops, along with environmental DNA (eDNA) and water quality analyses, as an approach to investigating the status of hellbender populations north of the Clinch River in Virginia and these populations' association with high-quality regional waterways. 108 regional anglers completed surveys and

agreed that hellbenders are important to local ecosystems. Additionally, most individuals agreed that removing hooks was a better conservation intervention than cutting their line or killing hellbenders if catching animals while fishing. These respondents also reported 59 incidental observations of hellbenders from the study area, forming a rough screening method for designing field surveys. We collected water samples from 13 sites, located in areas with multiple, independent citizen reports, for eDNA analysis in partnership with the Smithsonian Conservation Biology Institute. One positive eDNA signal resulted from these analyses and, when combined with two photographic vouchers submitted by local anglers, uncovered three new hellbender localities. Streams containing these and historic hellbender records had higher dissolved oxygen levels, cooler temperatures, and lower conductivities than randomly selected streams across the southwest Virginia region. These results suggest that fostering improvements in water quality and positive human-hellbender interactions can lead to both improved conservation measures and novel techniques for surveying broad, previously understudied portions of this species' range.

P157 Andrew M. Dawdy[1], Kate C. Donlon[1], John B. Jensen[2], Thomas C. McElroy[1]
[1] Ecology, Evolution & Organismal Biology, Kennesaw State U, GA; [2] Wildlife Resources Division, Georgia Natural Resources, Forsyth

An Evaluation of Visible Implant Elastomer Tags in The Northern Slimy Salamander, *Plethodon glutinosus*

Mark-recapture studies are used to monitor individuals within a species of interest and estimate population trends such as abundance and dispersal. The ability to effectively mark individuals is a necessary component of mark-recapture studies. The marking methods used within such studies are best utilized if they are easily readable, have no negative impact on the health and survivability of the species being sampled, and are durable enough to persist through the duration of the study. Visible Implant Elastomer (VIE) tags have become a useful means of marking small vertebrates such as fish, reptiles, crustaceans, and amphibians due to their cost, versatility, and readability. The focus of this study is to assess the effectiveness of VIE tagging within terrestrial woodland salamanders. To accomplish this, 19 adult and 15 juvenile *Plethodon glutinosus* were collected, tagged, and kept in captivity for eight months in order to monitor tag readability and retention rate. Six different locations on the ventral side of individuals were used in conjunction with three different colors of elastomer, yellow, pink and orange tags. Tag retention and visibility were compared between juveniles and adults, tagging locations and colors. It was concluded that VIE tags are an effective methods of marking both juvenile and adult slimy salamanders. The VIE tags in this study maintained their visibility and overall location well enough to be effective in reliably identifying salamanders.

P158 Sarah Marshburn, Zack E. Murrell
Biology, Appalachian State U, Boone, NC

The Appalachian Arkcode: A Vision & Change Inspired Model for an Authentic Research Lab Series Aimed at Freshman

An effective way to engage students and foster expert-like thinking is to teach biology through *doing* biology. Inspired by the Vision & Change report, we set out to design a two-semester, freshman-level authentic research lab series to replace our traditional "confirmation of biological principles" labs. Our design goals were to: (1) create a learning environment where the outcomes of the students' projects are unknown and students have varying degrees of independence while engaging in the cognitive tasks associated with the process of science, (2) equip students with a basic and utilitarian research skill set, (3) blur the lines between biological sub-disciplines, (4) bring together the three mentors—the field, the bench, and the *in silico* environment, (5) utilize University resources and research expertise, (6) tie into key University initiatives, (7) allow for collaborations between courses and departments, (8) capitalize on assets that are unique to Boone, NC, and (9) create a model that is sustainable and logistically feasible. From these goals we created a model, dubbed the "Appalachian Arkcode," whose

purpose is to archive the microbial diversity of our campus's 67-acre nature preserve through metagenomic barcoding.

P159 Joseph Bidwell, Cerrone Foster, Anna C. Hiatt, Cecilia McIntosh, Rebecca Pyles
Biological Sciences, East Tennessee State U, Johnson City

SERP Update: Departmental Transformation at East Tennessee State University

Over the last two years the Faculty of Biological Sciences at East Tennessee State University have been evaluating core coursework for biology majors and working towards transforming teaching approaches to enhance the undergraduate learning experience and improve overall learning outcomes among our graduates. Our institution serves a large population of low-income and first generation college students living and working in Southern Appalachian region. The most important motivation behind transformation is to provide highly-qualified graduates who can contribute to the economic development and growth of the area. In focusing on traineeship and skills development of graduates, we adopted an action plan focused on students, faculty, and curriculum development. Under the leadership of the department chair, productive and positive discourse on curricular goals among faculty has shaped well-defined core concepts and competencies we envision for our graduates. The department has begun to map out departmental learning outcomes across all undergraduate courses so we can better evaluate coverage across different degree tracks. We also recently redesigned our senior capstone course to evaluate the effectiveness of our major program and to better understand the needs of our graduates. Our hopes are that investing in transformative changes in the classrooms and providing high-quality educational opportunities will increase the time our students devote to STEM career development and ultimately result in large-scale economic development on the Southern Appalachian community.

P160 Ellen S. Goldey[1], Judy Awong-Taylor[2], Mary P. Smith[3]
[1] Wofford College, Spartanburg, SC; ; [2] Georgia Gwinnett College, Lawrenceville, GA; [3] NC A&T, Greensboro, NC

Moving Mountains: The Impact of the Southeastern Regional PULSE Initiative on Twenty Diverse Institutions Engaged in Department-Wide Undergraduate Biology Reform

The Partnership for Undergraduate Life Sciences Education (PULSE) is working to catalyze, at the department-level, reforms called for in *Vision and Change in Undergraduate Biology Education: A Call to Action*. With support from the National Science Foundation (EAGER 1435389) and the Howard Hughes Medical Institute, the PULSE Leadership Fellows in the Southeast engaged teams from twenty diverse institutions (including eight Minority Serving) in a yearlong project, which included participation in a three-day Southeast Regional PULSE (SERP) Institute in June 2014. The Institute's workshops and plenary sessions addressed ten factors (based on the STEM Department Evaluation Rubric) that research has shown improve student outcomes and instructor efficacy: 1) embedding authentic research into coursework 2) building students' higher-order cognitive skills, 3) improving students' metacognitive awareness and resilience, 4) developing students' core competencies, 5) expanding extracurricular research opportunities, 6) employing engaging pedagogies, 7) providing ongoing faculty development opportunities, 8) using high-quality assessment, 9) building a supportive and collaborative ethos among the faculty and administration, and 10) integrating the learning goals of the department with broader institutional learning goals. Teams used the Rubric to develop a departmental action plan for improvement. Follow-up surveys, phone interviews, and poster presentations by all 20 teams at the Association for Southeastern Biologists conference in April 2015 show that developing a shared vision and becoming part of a supportive regional network can lead to substantial, departmental improvements in a fairly short period of time. This poster will summarize key findings and provide updates of the year-long project.

P161 Kyle Seifert, Tim Bloss, Joanna Moat
James Madison U, Harrisonburg, VA

Evolution of the Biology Major Curriculum at James Madison University: It Starts with the Freshman

The James Madison University Biology Department continues to develop and implement the foundations for a comprehensive restructuring of the Biology Major experience, with the goals of enhancing student learning and increasing retention. Significant progress has been made in the past two years towards the goals initially developed at SERP in 2014. Funded by a 4VA grant, a summer working group developed a first year curriculum, to be implemented this fall, based on values closely aligned with the best practices of Vision and Change. The classroom experience follows a small to big biology format that fosters instructor ownership by allowing them to choose the subject matter of the class, but also subjects first year biology Majors to a common set of assessments designed to ensure consistent outcomes from class to class and year to year. The laboratory experience focuses on authentic research in which students collect samples and evaluate sequence data from an individually assigned organism, and develop projects based on this organism. Both the classroom and laboratory experiences are designed to reinforce core concepts and competencies assessed by Vision and Change as essential for the modern day biologist. Already in place is a freshman advising seminar with a strong metacognition component that incoming biology majors experienced in the fall of 2015. In addition, we maintain a long term vision to increase diversity of students in our major through the establishment of an REU proposal strongly associated with the community college system throughout Virginia. Ultimately, the vision and strategy we established at PULSE in the summer of 2014 remains the same today: the development of a student-centered, engaged faculty implementing a relevant, research-embedded curriculum based on core competencies and metacognition.

P162 Lisa McDonald, Mark J. Pilgrim, Emily Prince, TD Maze
Biology, Lander U, Greenwood, SC

Transforming a Department using Strategic Planning, Assessment data, and Department Inclusion: A Progress Report at Lander University

Several members of the Lander University Biology department along with the Dean of the College of Science and Mathematics attending the Southeast Regional PULSE (SERP) Institute held June 2014. At the conclusion of the SERP institute each university was charged with completing an Action Plan that would guide them over the course of the next year and beyond to make meaningful reforms to their departments. In the year following the SERP institute Lander University made significant progress completing the tasks in their action plan making notable changes: 1. Using the recommendations in the 2011 *Vision and Change in Undergraduate Life Science Education,* a thorough department survey was completed in order to map out key concepts and competencies in our existing courses and curriculum, 2. We increased the use of novel research in our upper-level courses and the amount of presentations by our undergraduate students, and 3. Our introductory biology lecture and lab for non-majors was redesigned to include more relevant topics to non-majors and to shift to more student-centered learning practices. Two years after the SERP institute we have continued transforming our department by focusing on several projects: 1. Lander University submitted a HHMI: Inclusive excellence grant in a collaboration with four other 4-year schools from the SERP Institute (Barton College, Clayton State University, Hampden-Sydney College, and Shaw University) and one 2-year school from the SERP Institute (Durham Technical Community College), 2. We have aligned our department's goals with the university strategic plan, 3. We are using feedback from the introductory biology program for non-majors from the previous year to build a first year introductory sequence for the majors, 4. We brought in a nationally recognized speaker, Saundra McGuire, to make three presentations to the general faculty about metacognition, 5. We made connections across campus by joining in an intra-professional education (IPE) program focusing on health care with the College of Nursing, the

Physical Science Department, and the Healthcare Management Department. The biggest challenge for bringing about positive change remains Time. As a teaching institution our full-time load is 12 contact hours per semester, our department is very involved in committee work, and there are research expectations. Despite the challenges, we have stayed the course and attribute our success to annually updating an action plan and getting department-wide participation in directions and decisions.

P163 Katharine V. Northcutt, Virginia A. Young, Linda L. Hensel, Kevin M. Drace
Biology, Mercer U, Macon, GA

Save the Bears: An Update on the Action Plan of Mercer University's Biology Department

At the SERP 2014 conference, we developed an action plan for our department that focuses on enhancing student engagement in the classroom, incorporating authentic research in departmental courses, improving mechanisms for undergraduate research, and developing student metacognition. We have made significant progress towards these goals over the last two academic years. For example, we have developed two integrated learning programs that incorporate active learning techniques and authentic research projects. One of these is a year-long program for freshmen that includes biology, physics, psychology, pre-calculus and statistics; students in this program have developed research projects related to squirrel behavior and ecology. The second program integrates the second semester of biology with organic chemistry and mathematical modeling, and includes a research project synthesizing antibiotics that inhibit biofilms. Both of these programs have allowed students to see the connections between disciplines and to better transfer skills and concepts. In order to carry out their research projects, they have also engaged with primary literature much more than what we typically require in introductory biology courses. In addition, our department designated an Undergraduate Research Advisor who is responsible for marketing internal and external research opportunities to students, and who acts as an advisor for students interested in research. Finally, all of the Biology faculty now spend class time helping students think through their cognitive strategies. To help us with this endeavor, one member of our department compiled research on student metacognition and has presented this information to groups of students and biology faculty. As a result of these changes, we have already observed an increase in student success and engagement both in and out of the classroom. The majority of our department is contributing to these initiatives, and we are excited to continue improving our teaching and mentoring of students.

P164 Valarie A. Burnett, Charles N. Horn
Science & Mathematics – Biology, Newberry College, SC

A student-centered learning focus: strategies to strengthen the P.U.L.S.E. of the Newberry College Biology Program

In June 2014, a group of Newberry College biology professors and one administrator attended the Partners for Undergraduate Life Science Education (P.U.L.S.E.) Institute in Richmond, VA and developed an action plan for our Biology Program. We presented this action plan to the Science and Mathematics Department and encouraged participation. The ideas presented at the P.U.L.S.E. Institute were based on initiatives described in a recent report entitled *Vision and Change in Undergraduate Education: A call to Action,* released by the American Association for the Advancement of Science. This document and the P.U.L.S.E. Institute advocated a student-centered approach to undergraduate life science education. Our Biology Program has a well-developed system of assessment, so we use our assessment data and classroom observations to identify strengths and weakness of our students and course content and to improve instructional methods. Many students are unprepared for college level work. Therefore, the main focus over the past two academic years has been incorporating activities that promote inquiry, student-engagement, hands-on experience, and the application of scientific method. Some new teaching strategies and activities were introduced, and some existing assignments were modified to align them better with the goals of the P.U.L.S.E.

Institute and our action plan. In the current year, we expanded on strategies begun in the previous year. We continued to develop activities that build critical thinking and high order cognitive skills. We included more course-embedded research and flipped-classroom-style assignments, in which, students presented course-related concepts. We discovered that statistical analysis, generating graphs, and interpretation of data are weaknesses among our students, so improving these skills and developing additional opportunities for course-embedded and independent research are a priorities for the future. While we have engaged in some faculty development and gained some new equipment and technologies for the program, additional resources are needed in these areas.

P165 Mary A. Smith
Biology, North Carolina A & T State U, Greensboro, NC

Integrating Discovery-Based Research Into the Undergraduate Curriculum: A Report of a National Academies of Sciences, Engineering, and Medicine Convocation

The impact of undergraduate research experiences on student development and persistence in the sciences is well documented in the science literature. Thus, leading science educators and policy makers strongly advocate providing early undergraduate research experience for all students who major in STEM. In her introductory remarks at the recent Academies Convocation on Integrating Discovery-Based Research Into the Undergraduate Curriculum, Jo Handelsman, associate director for science at the White House Office of Science and Technology Policy proposed an aspirational goal that every student, at all institutions ----- from community colleges to universities ------ would have a course-based research experience sometime during his or her first year in college. In concert with the 2012 Presidents Council of Advisors on Science and Technology reports recommendation #2, multiple institutions have developed course-based research models to broaden the participation of undergraduate students in research. The May 2015 Academies Convocation examined the efficacy of several evidenced-based models for course-based research and the feasibility of the strategy for all STEM disciplines, class levels, and types of institutions, including minority serving institutions. I will present a summary of the findings of the Convocation report on Integrating Discovery-Based Research in the Undergraduate Curriculum, highlighting successful national models and their impact, the benefits of the course-based approach, and some of the challenges in developing and/or implementing course-based research training initiatives. I also will provide printed copies and an electronic link to the full convocation report to conference attendees who visit the poster.

P166 Alfredo Leon
Miami Dade College, North Campus, Miami, FL

Active Learning Strategies Program Implementation Through Project-Based Learning as Part of a Biotechnology Curriculum

Laboratory experiences serve as a cornerstone in natural science courses. The learning environment created by the laboratory provides students with awareness into experiences related to the natural sciences and job-related skills, including collaboration and hands-on experiences. Changes in pedagogical approaches focus on student-centered education, the impact on student learning and long-term achievement. Following the recommendations within the Vision and Change in Undergraduate Biology Education: A Call to Change and the experiences with the South Regional PULSE, changes were made to the Biotechnology curriculum at Miami Dade College that have focused on the integration of active learning strategies though project-base learning experiences for the students. The Biotechnology courses at Miami Dade College focus on providing the students the necessary skills to join the work force. As such, the technical aspects of the laboratories are enhanced by individualized experiences through the development of projects using techniques learned in the lecture and introductory laboratory courses. Furthermore, students that continue in our Institutions bachelor in Biological Sciences program return for an advance course in Biotechnology where they are

assigned the isolation and cloning of a gene. Students develop problem solving and collaboration skills, as well as peer-led discussions in order to address the data they are collecting. While initially disoriented by the unstructured nature of the course, students report deeper learning and ownership of their results as compared to other experiences.

P167 Mabel O. Royal, Wendy H. Grillo, Amal M. Abu-Shakra, Gail P. Hallowell
Dept of Biological and Biomedical Sciences, North Carolina Central U, Durham, NC

Course-based Undergraduate Research Experience in an Introductory Biology Course: Assessing the PULSE of our Majors

North Carolina Central University, with the support of a Howard Hughes Medical Institute grant, has developed course revisions for success of students in STEM majors by integrating Course-based Undergraduate Research Experiences (CURE) into the Biology curriculum. CURE labs for our 3 core introductory biology courses were developed with a scaffold design using Saccharomyces cerevisiae (yeast) as a model organism. Additionally, the CURE labs adapted a modular concept for the core courses, with Module 1 (8 weeks) focusing on scientific techniques to familiarize students with scientific equipment; followed by Module 2 (7 weeks) which incorporates discovery based research experiences. The overall project goals of the CURE labs were to give our science majors an early exposure to basic scentific research concepts and techniques, ultimately improving retention rates within the core introductory biology course. We compared student performance in Biology I CURE labs vs Biology I traditional labs. Traditional Biology I labs are designed to reinforce concepts covered in lecture. These labs utilize worksheets, web- based research and have minimal wet lab activities; while the research module of CURE Biology I labs explores morphological, biochemical and genetic characteristics of yeasts to identify pathogenic features. Data show that since Fall 2012, 686 students have enrolled in Biology I, with 178 (29%) being taught using research-infused strategies. When comparing students in traditionally taught sections to their peers in research-infused sections, the two groups were statistically the same across course performance measures, i.e., grades, incomplete and withdrawal rates, as well as scores on an instructor-administered content assessment. However, students who completed research infused sections of Biology I were statistically more likely than their peers to indicate high learning gains resulting from three different course design features: 1) collecting data, 2) learning laboratory techniques, and 3) understanding of how scientists work on real problems. Additionally, students in CURE labs acknowledge the value of CURE course experiences when applying for summer internships.

P168 Judy Awong-Taylor, Clay Runck, David Pursell, Tirza Leader, Allison R. D'Costa, Patrick Smallwood, Thomas Mundie
Science & Technology, Georgia Gwinnett College, Lawrenceville

Using Course-Embedded Undergraduate Research Experiences (CUREs) to Build and Sustain High Student Engagement in STEM Fields at Georgia Gwinnett College

Undergraduate Research, Service Learning, and Internships are three of the ten High-Impact Educational Practices for student engagement and learning listed by the American Association of Colleges and Universities. Course-Embedded Research and Service Learning Internships are components of GGC's STEM Initiative for enhancing student engagement and learning in STEM disciplines. In this poster we will describe GGC's *Four-year Undergraduate Research and Creative Experience (4YrURCE)* program based upon a novel discipline-specific *course-embedded research* model which scaffolds multiple research and creative experiences for ***all*** STEM majors during all four years of matriculation. Each Course-embedded Undergraduate Research Experience (CURE) provides a scaffolding of research skills, creative abilities, and core content knowledge (STEM competencies). As students progress through multiple CUREs, they gain the ability, confidence, and skills to conduct independent research and to enter the STEM workforce. The 4YrURCE identifies key courses in each year of the curriculum during which students are exposed to research skills and experiences. Over the past four and a half years, faculty have been engaged in a) developing and/or redesigning courses to include

course-embedded research, b) designing individual faculty–student research projects, and c) developing SoTL projects. These activities and projects are supported through competitively funded mini-grants. We will describe key components of this program and report on our progress to date. GGC's STEM Initiative is supported by a USG-STEM initiative II grant.

P169 Clay Runck[1], Allison R. D'Costa[1], Bernadette Peiffer[2], Judy Awong-Taylor[1], Melissa Kinard, Thomas Mundie[1]
[1] Science & Technology, Georgia Gwinnett College, Lawrenceville; [2] Education, Georgia Gwinnett College, Lawrenceville

Using Service Learning Internships to Build and Sustain High Student Engagement in STEM Fields at Georgia Gwinnett College

Undergraduate Research, Service Learning, and Internships are three of the ten High-Impact Educational Practices for student engagement and learning listed by the American Association of Colleges and Universities. Course-Embedded Research and Service Learning Internships are components of GGC's STEM Initiative for enhancing student engagement and learning in STEM disciplines. The goals of GGC's Service Learning Internship course are (1) to provide a problem-based learning STEM enrichment program for 5th graders and (2) reinforce concepts and content knowledge for GGC STEM majors by teaching the nature of science to 5th graders. For the past 4 years GGC's Service Learning Internship course has partnered with a local elementary school to teach a series of 6 lab sessions at the elementary school during the school day as part of the semester's science instruction program. The Service Learning Interns spend 45 hours over the semester working directly with the 5th Grade teachers and their students, and develop and plan Georgia Performance Standards (GPS)-based inquiry lesson plans, hand-on activities, and research-based science projects with 5th Grade teachers. Our STEM majors teach a semester-long problem-based learning STEM enrichment program which places 5th graders in the role of science sleuths. The Service Learning Interns guide their 5th grade students to generate hypotheses, perform experiments to test these hypotheses, interpret lab results, and propose a solution to a science mystery based on their results. The Service Learning Interns also plan, implement, and assess the Family Science Night at the elementary school in conjunction with GGC Science and Technology Faculty to share the science experience they gain during the internship with parents, siblings, and community members. We will describe key components of the Service Learning Internship and report on our progress to date. GGC's STEM Initiative is supported by a USG-STEM initiative II grant.

P170 Mary E. Lehman
Biological and Environmental Sciences, Longwood U, Farmville, VA

Using Learning Styles to Predict Instructional Preferences

It is widely assumed that students with different learning styles should have distinct preferences for different educational activities. However, few studies have provided data for instructional preferences in contemporary college students. My previous study, utilizing Gregorc learning styles, found that self-reported instructional preferences were poorly matched to purported preferences for the learning style categories. The present study investigated relationships of instructional preferences with the VARK learning style system that is specifically focused on preferences for input and output during learning. Introductory biology students were classified into five learning style categories (Visual, Aural, Read/Write, Kinesthetic, and Multimodal) that were compared to self-reported instructional preferences on a 19-question survey. Statistically significant differences between some of the VARK learning style categories were seen for 11 of the 19 questions, indicating a better predictive ability than the Gregorc learning style categories used in the previous study. As predicted, kinesthetic learning styles reported a significantly stronger preference for hands-on activities compared to those with a read/write style. Students with a read/write style reported the expected preference for reading assignments and also had a significantly greater preference for independent study projects, as compared to those with a visual learning style. Aural learners indicated a stronger preference than read/write learners for group discussions, but did not differ significantly for any questions related to lectures. Additional

differences were found among learning styles and also between the two populations of students in the study (biology majors vs. pre-service education majors). Overall, regardless of learning style, major, or gender, students indicated the strongest preferences for clearly organized and structured lectures, hands-on activities, and field trips. The most strongly disliked instructional activity reported on the survey was reading assignments.

P171 William H. Dees[1], Christopher G. Struchtemeyer[1], Caroline E. Hennigan[1], Caleb M. Ardizzone[1], Janet R. Woolman[2]
[1] Biology and Health Sciences, McNeese State U, Lake Charles, LA; [2] Economic Development, McNeese State U, Lake Charles, LA

Engaging Undergraduate Science Students at Risk of Leaving Science

Faculty members from the Department of Biology and Health Sciences (BIHS) and Innovation Engineering at McNeese State University in Lake Charles, Louisiana, are conducting a project that focuses on science students, especially those with marginal grades and adequate but not impressive ACT/SAT scores who, wanting to do well academically, still experience a lack of direction and understanding from just being in the classroom. Students who lack direction may not make the adjustments needed for success in college, and are therefore "at-risk" of becoming a student who attended college but did not graduate. In August 2015, we established activities to provide students, especially those "struggling" from an academic perspective, with information on science careers while, at the same time, immersing them in science exploration and professional engagement. Our project is a three-pronged student-led interdisciplinary, multi-institutional approach to student immersion into the agricultural, biological, chemical, environmental, and mathematical sciences, including the principles of innovation. Through this project, we recruit freshman and sophomore level science majors and provide them opportunities to serve as field/laboratory research assistants and to participate in a variety of professional scientific engagements (e.g., seminars by BIHS faculty members, presentations by science professionals outside academe, off-campus tours, and attendance at scientific meetings). Presentations by all BIHS faculty members have increased the interest of many students, some who are at-risk, to continue in their chosen field. To date, average student attendance at our monthly seminars is 66 students. Of these students, 33% show an interest in participating in undergraduate research. Continual monthly engagement in an extracurricular program seems to be one factor that encourages students to further participate in their chosen scientific disciplines. This project provides freshmen and first-semester sophomores with opportunities to personally engage with, learn about, experience, and access the world of science beyond the classroom.

P172 William H. Dees[1], Jonathan R. Davis[2]
[1] Biology and Health Sciences, McNeese State U, Lake Charles, LA; [2] Infectious Disease Consultant, Alexandria, VA

Practical Guidelines for Health Education and Training for Emerging Diseases in Overseas Communities

With the emergence and re-emergence of disease pathogens around the world, such as the Zika virus, the only way to mitigate their effect on local communities is with knowledge. Scientists are continually called on to provide health education and training to overseas communities that lack both knowledge and expertise in addressing and combating these pathogens. Coordinating and presenting educational programs overseas can be exceedingly worthwhile, but extremely complicated, especially when working with foreign institutions as well as nongovernmental organizations and universities. Workshops are excellent avenues to relay current information on healthcare issues. A variety of methods exist for conducting workshops. This presentation provides considerations and recommendations for individuals responsible for developing and conducting international scientific workshops at the grassroots level. Information in this presentation was obtained from first-hand experiences by the authors conducting international workshops at remote sites in tropical countries. Cultural sensitivities and understanding of cultural diversities are paramount for a successful health education and training program. Presenting scientists must understand the local situation concerning the emerging

disease(s), including challenges faced by those responsible for disease surveillance and response and managing public expectations. Often, multidisciplinary teams are necessary to provide information required by different community sectors (e.g., public works, schools, and local civic officials). Information can be shared through designing audience-specific programs (e.g., lectures, hands-on activities and/or group projects). Using the standard concept of "who, what, when, where, why, and how" guides the on-site educational mission. Providing tangible products before, during and after the educational event also aids in future cooperation and community acceptance. Effective and correct communication of health education vital to preventing or mitigating disease threats has benefitted thousands worldwide. Scientists planning to coordinate/present educational programs overseas must continually re-assess their target goals to provide the best possible support to local communities combating disease outbreaks and threats.

P173 Elizabeth S. Bradshaw[1], Justin M. Bradshaw[2]
[1] USDA-NIFA Food Virology Collaborative (NoroCORE), North Carolina State U, Raleigh; [2] Math, Social, & Natural Sciences, Johnston Community College, Smithfield, NC

The Nightmare Buffet: An Introduction to Epidemiological Practices for General Biology Students

Despite the impact of public health and epidemiology on the everyday lives of students in any career path, introductory biology programs rarely cover the science of these practices in lecture or laboratory settings. To this end we have developed "The Nightmare Buffet," a laboratory activity designed for high school/early college students that introduces students to epidemiological statistics in an easy, interactive way and underscores the importance of proper food handling techniques to limit the spread of foodborne diseases. In this laboratory, students first take the role of attendees at a buffet, are determined to be well or sick with norovirus based on foods they selected, then use that information to hypothesize as to which foods were the source of the norovirus. Once the likely source of the outbreak is identified, the students continue as investigators in a traceback investigation, deciding their own specific questions to ask the instructor on the origin and handling of the food item's ingredients to discover the specific point at which contamination occurred. The use of multi-colored sticky notes as different food items makes the lab inexpensive and makes setup less than an hour. Responses to an anonymous student survey conducted across multiple sections and semesters indicates that students found the Nightmare Buffet a valuable activity and that it increased their knowledge of disease transmission and public health practices. Many students also said that this lab increased their interest in the field of public health and even changed their day-to-day approach to food safety. Implementation of this lab module in biology courses not only provides a low-cost, hypothesis-driven lab option for programs with limited funding, but drives interest in public health fields and instills knowledge of practices and procedures valuable to majors and non-majors alike.

P174 Michelle N. Tremblay, Edward B. Mondor
Biology, Georgia Southern U, Statesboro

Maggots 101: A Lesson in Entomology for Law Enforcement

After 72 hours, entomological evidence from a death scene is the most accurate method for determining the minimum post-mortem interval, or time since death. For this evidence to be of value, however, it must be properly collected, reared, preserved, and identified. From working with Georgia law enforcement officers on several cases, it became clear that they do not have sufficient training in how to collect, rear, and preserve insects from death scenes. Here we describe the results of a 3-hour workshop designed to provide practical, hands-on experience, in collecting entomological evidence, for law enforcement personnel. The workshop had four key objectives: 1) Assessing a death scene from an entomological perspective, 2) Recognizing and collecting entomological evidence, 3) Rearing and preserving entomological evidence, and 4) Identifying insects of forensic importance. To assess knowledge acquisition, a 21-question, multiple-choice questionnaire was given to each participant before and after the workshop. We found that participants more than doubled their knowledge (Pre-test = 38%, Post-test = 93%) of

collecting, rearing, preserving, and identifying insects from death scenes, after completing this workshop. In addition, participants' confidence in working with entomological evidence significantly increased (Pre-test = 1.7/5, Post-test = 3.9/5). We believe that this workshop provided participants with a better understanding of the field of forensic entomology, the knowledge and confidence to properly assess and collect entomological evidence, and insight into the services an entomologist can provide in forensic investigations.

P175 Erin Schrenker, Margaret Dempsey, Alexandra Korshun, Ashton Mitchell, Richard Schwartz, Bradley Reynolds, Thomas P. Wilson
Innovation in Honors Program c/o Biology, Geology, and Environmental Science, U of Tennessee at Chattanooga

The Development and Implementation of a Natural Science Living and Learning Community Utilizing the Biological Field Station at the University of Tennessee at Chattanooga

The University of Tennessee at Chattanooga (UTC) is a regional metropolitan university that is exploring new and exciting ways to better engage and prepare students for careers. Pedagogically speaking, the traditional approach of paring lectures and laboratories is not always effective when compared to research approaches utilizing problem-based learning with design process thinking. The latter has received some traction at UTC and is a dynamic way to prepare students for productive careers in science. Our Natural Science Living and Learning Community (NSLLC) will be a residentially based research opportunity that focuses on a particular aspect of natural science. In 2004, UTC officials began drafting a plan to acquire properties to be used as biological field stations (BFS) so that faculty could better engage students in education, research, outreach and conservation. UTC's BFS are pivotal for this NSLLC because they provide the frame work for students to better understand wildlife-habitat relationships in urban systems. By using existing elements of the curricula and university infrastructure, we have devised a plan to integrate the BFS into a four semester curriculum so that students can gain hands-on experience in scientific research. The NSLLC will be tied to the current research being performed at the BFS because it provides an excellent jump-off platform that dovetails flawlessly within a realistic problem based learning environment. In closing, the NSLLC will build capacity for undergraduate research, facilitate partnerships among community stakeholders, and foster active yet collaborative learning by studying the urban ecology of the Chattanooga area.

P176 Elizabeth Harrison[1], Joel K Abraham[2], Virginia M Card[3]
[1] Science & Technology, Georgia Gwinnett College, Lawrenceville; [2] Biological Science, California State U, Fullerton; [3] Biology, Metropolitan State U, Saint Paul, MN

Evidence for Cognitive Bias in Undergraduate Biology Students

The human brain is susceptible to many different kinds of cognitive biases. Anchoring is a form of cognitive bias where one's brain will "anchor" on to a given number and then adjust away from that number instead of formulating a numerical response on its own. Based on research conducted at Metropolitan State University, we documented evidence of anchoring in 294 undergraduate students in a Biology class for non-majors using test questions that contained numerical values. We also studied whether teaching students about anchoring and encouraging them to explain how they developed their test answers affected their anchoring bias. Understanding cognitive heuristics and biases will allow students to develop more effective higher-level reasoning skills and will encourage educators to be aware of the kinds of questions that they give to students.

P177 Heather P. Griscom, Patrice M Ludwig, Kyle N Seifert
Biology, James Madison U, Harrisonburg, VA

Nuts and Bolts of a Curriculum Revision

In the summer of 2015, faculty were invited to participate in the revision of the first year experience (FYE) of the Biology major curriculum, with the goal of aligning more with major Biology Education initiatives such as Vision and Change: A Call to Action, a document sponsored by the American Association for the Advancement of Science and National Science Foundation, and to provide first-year students an engaging classroom experience. The structure of the FYE was finalized by the end of the summer, and an plan to assess student learning was constructed with assessment tools developed from six existing instruments: 1) Diagnostic Question Cluster (http://biodqc.org), 2) Natural Selection Concept Inventory, 3) Undergraduate Scientists: Measuring the Outcomes of Research Experiences from Multiple Perspectives, 4) The Self-Motivation and Self Efficacy Survey, 5) The Metacognitive Awareness Inventory; and 6) The Test of Scientific Literacy Skills. The assessment protocols were approved by IRB. The Engaged Teacher-Scholar (ETS) program within the Center for Faculty Innovation (CFI) at JMU provided support for a faculty member to organize interested faculty with the objective of aligning curriculum revision research questions with assessment tools to increase faculty engagement in the scholarship of teaching and learning (SOTL). The resulting group ranged from faculty who have published articles on pedagogical research to faculty who were new to SOTL. Over the course of several meetings, research questions were defined and assessment tools were revised using multiple tools for facilitation. Three research questions were developed: 1) how has the new curriculum impacted students' *understanding, retention, reasoning* of core biological concepts and competencies laid out in "Vision and Change: A Call to Action" document sponsored by the American Association for the Advancement of Science and National Science Foundation, 2) how has the new curriculum impacted students' *self-efficacy, persistence, engagement* in the classroom; and 3) how has the new curriculum affected *faculty attitudes* and *engagement* in the classroom? Faculty also worked on the design of the overall assessment protocol including the timing of the assessments in order to satisfy the research questions. In the spring 2016 semester, initial pre/post gains data from the fall 2015 semester will be analyzed to provide a baseline of student learning in the original core curriculum, developed 15 years ago.

P178 David Goode[1], Christina Bure[2], Shawn Canavan[2], Linda L. Hensel[2]
[1] Chemistry, Mercer U, Macon, GA; [2] Biology, Mercer U, Macon, GA

Synthesis and Efficacy Testing of Novel Anti-biofilm Lead Compounds—Authentic Research in an Undergraduate Classroom

As part of an integrated laboratory experience for Biology and Organic Chemistry, 24 students tested over 50 novel lead compounds as potential inhibitors of biofilm formation and used their results to determine which derivatives of candidate drugs they should synthesize. Students then tested their novel drugs' efficacy in three bacterial species: *Bacillus subtilus, Pseudomonas aeruginosa*, *Staphylococcus aureus.* Drugs were synthesized as an extension of the D3 project (IUPUI) and biofilm inhibition with a modified crystal violet 96-well assay. Bacteriostatic and bactericidal activity was measured with disk-diffusion and chemical dilution assays, respectively. Students discovered both broad and narrow spectrum biofilm inhibitors (and in some cases enhancers) using ANOVA and Tukey analyses to verify statistical significance. More than 75 % of the active drugs had neither bacteriostatic or bactericidal activity indicating that they may be true competitive inhibitors of the biosignals required for biofilm formation. We have analyzed the class data and reconfirmed results to present over a dozen novel anti-biofilm lead compounds.

P179 Priyanka Naik, Kaitlyn Mcbride, Linda L. Hensel
Biology, Mercer U, Macon, GA

UV-induced DNA Topology Affects Transformation Frequency in E. coli recA$^-$ and recA$^+$ strains: Authentic Research in a Junior-level Genetics Course

Studies have shown that the transformation frequency of chromosomal DNA depends on the topological state--supercoiled or relaxed. Other researchers have determined that ultraviolet light treatment of plasmid DNA results in topological changes with increased exposure times: supercoiled to relaxed circular to linear forms. The purpose of this study is two fold: first, determine if- UV-induced topological changes in plasmid DNA affect the transformation frequency, and second, determine if the recA protein is involved in the mechanism. Over 30 groups of 2-3 students processed the primary literature, learned the basic techniques, and performed sets of experiments to address these two questions. We fine-tuned the procedure, participated in the class one of the semesters, and have now analyzed four sets of class data. In *E. coli recA*$^-$ there is a clear drop in transformation frequency with DNA treated with UV for 5-10 seconds followed by a rise in transformation frequency with 10-20 seconds of additional UV exposure. This could mean that both supercoiled and linear plasmid DNA have a greater transformation frequency than relaxed circular DNA. Additional enzymatic studies will confirm the initial interpretation of our results. To our surprise, *E. coli recA*$^+$ strains do not demonstrate the initial steep decline in transformation frequency with minimal UV treatment of plasmid DNA.

P180 cancelled

P181 Nadine Brockmann, Virginia Merida, Carmony L. Hartwig
Biology, Catawba College, Salisbury, NC

Microbial Diversity in Student Athletes: Implications for Human Health

Microbial community dynamics may have a profound effect on human metabolism, immune system function, allergic response, and infant growth and development. Recent research suggests that the overall health of our skin and wound-healing capabilities are associated with an increase in bacterial diversity and abundance. As a society we often consider one major aspect of human health and wellness to be not only exercise, but time spent in the natural environment. We therefore sought to investigate differences in skin bacterial diversity and abundance from human populations that have distinct levels of regular exercise in varied environments. The most protected environment on the human skin is the belly button and prior research has demonstrated the abundance and variety of bacterial species that thrive there (Hulcr *et al*., 2012). We hypothesized that student athletes, particularly those that exercise regularly outdoors, will have more skin-associated bacterial species diversity and abundance in navel swabs than individuals who do not exercise on a regular basis. Here we present our collective findings and discuss the implications of exercise on skin microbiome composition as it relates to human health.

P182 Rodrigo Catalan-Hurtado, Dinene L. Crater
Biology, High Point U, NC

Analysis of the DNA Binding Characteristics of GerE From *Geobacillus Stearothermophilus*

Geobacillus stearothermophilus is a thermophilic, anaerobic bacteria found in habitats such as thermal vents. Its high resistance to heat makes it a very interesting subject because it would have to adapt to this harsh environment. *G. stearothermophilus* is a gram-positive, rod shaped bacterium that is able to undergo sporulation to produce small, tough, protective and metabolically dormant endospores in order to endure heat, desiccation, radiation and chemical threat. The genes responsible for encoding proteins that form the spore coat are *cot* genes. The appearance of the regulatory protein GerE is essential at the late stage of spore development because it directly activates the transcription of sigma K-dependent genes, including *cotB* and *cotC*. Therefore, our hypothesis is that *G. stearothermophilus* uses methods similar to *B. subtilis*

for the regulation of sporulation. We have overexpressed *G. stearothermophilus* GerE in *Escherichia coli* and purified the protein using standard techniques. We plan to develop a non-radioactive *in vitro* DNA binding assay that will be used to determine if GerE from *G. stearothermophilus* has the ability to bind to the *cot* promoters at high temperatures. Preliminary experiments indicate successful *in vitro* binding of control reactions using our non-radioactive assay. Further studies will investigate the ability of GerE to function as a transcription regulator *in vitro*, as well as its binding characteristics in *G. stearothermophilus in vivo*.

P183 Devanshi D. Patel, Robert M. Roach, Michael K. Moore, Virginia A. Young
Biology, Mercer U, Macon, GA

The Impact Of Viral Load on Mite Parasitism In Harvestmen (Opiliones)

Harvestman, belonging to the arachnid order Opiliones, are found worldwide. Little is known about their susceptibility to infectious diseases. For this study, harvestmen were collected from the Ocmulgee National Monument located in Macon, Georgia. Cells were isolated from harvestman and cultured using methods similar to culturing tick tissues (Martin and Vidler, 1901). Once cell cultures had been established, we began to isolate any viral pathogens present in the local harvestmen species. To increase our chances of isolating viruses, we collected harvestmen that were carrying mites on their exoskeletons. The interaction between mites and harvestmen is thought to be a parasitic one. Therefore, we reasoned that individuals that were in a parasitic relationship would be more likely to harbor additional parasites, such as viruses, relative to other non-parasitized individuals in the population. The results of our harvestmen cell culture and virus isolation efforts will be discussed, along with an analysis of the impact these viruses could have on the ecology of local harvestmen species.

P184 Lyssa Y. Baker, David K. Giles
Biological and Environmental Sciences, U of Tennessee at Chattanooga

Polyunsaturated Fatty Acids (PUFAs) Impact Antimicrobial Peptide Resistance in *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* and Cause Reduced Motility in *P. aeruginosa*

Pseudomonas aeruginosa and *Klebsiella pneumoniae* are world-renowned for being 'superbugs'. There is an urgent need for the development of new methods for treating these multidrug resistant bacteria. Previous studies in our laboratory have observed Gram negative bacterial assimilation of exogenous polyunsaturated fatty acids (PUFAs) into membrane phospholipids, a phenomenon that alters membrane permeability and susceptibility to environmental stresses. The purpose of the present study was to examine the effect of polyunsaturated fatty acids on i) antimicrobial peptide resistance and ii) swimming motility. *P. aeruginosa* exhibited a two-fold increase in minimum inhibitory concentration (MIC) to polymyxin B (PMB) when grown in the presence of linoleic acid (18:2) and eicosapentaenoic acid (20:5). Strikingly, arachidonic acid (20:4) elicited an 8-fold increase in MIC, indicating a significant protective effect conferred by a fatty acid associated with eukaryotic membranes and inflammatory processes. Exposure of *K. pneumoniae* to PMB resulted in 4-fold increases in MIC in the presence of 18:2, 20:5, alpha-linolenic acid (18:3α), and gamma-linolenic acid (18:3γ). Conversely, the MIC of another AMP, colistin, was decreased 4-fold by 6 of the 7 fatty acids tested, suggesting potential for PUFAs as synergistic compounds for antimicrobial treatment. The current study also observed varied effects of fatty acids on the swimming motility of *P. aeruginosa*. Each fatty acid caused a decrease in motility, with 20:4 suppressing motility by 50%. Since motility is an important measure of virulence, PUFAs may serve as key signaling molecules that can impact survival and pathogenesis.

P185 Mikaela M. Hardy, Kevin M. Pitz
Biological Sciences, U of Tennessee at Martin

Isolation and Characterization of Wild Yeasts from Fruit Samples

The aim of this study is to isolate, identify, and test the utility of wild yeast strains in brewing applications. Members of genera *Saccharomyces* and *Brettanomyces* are used in commercial brewing, and are often found in association with fruits. We have isolated candidate yeast strains from fruit samples collected in northwest Tennessee and southwest Kentucky. This work has yielded 16 candidate yeast strains for identification and characterization. We used the ITS (Internal Transcribed Spacer) region (rRNA) for generic, species, and strain identification for these 16 candidate samples. Herein, we present the results of molecular and microbiological analyses characterizing and testing the utility of these strains.

P186 Kaitlyn G. Jackson, Kevin B. Kiser
Biology and Marine Biology, UNC Wilmington

Development of a Test to Measure Possible Correlation between Stress and Increased *Streptococcus mutans* in College Students

Dental caries, also called cavities, are a common problem for both adults and children. In ordinary circumstances, good oral hygiene can help to prevent dental caries by decreasing the bacterial load present in the oral cavity. However, some studies have shown that psychological stress can have a negative impact on oral health by causing an increase in oral acidity, a subsequent decrease in ecological competition, and the increased growth of cariogenic bacteria. Recently, dental health professionals have placed significant resources into the study of *Streptococcus mutans*, a bacterial species which has shown to have great importance in the development of dental caries. Because college is a stressful time for most students, a test was developed to determine the quantitative prevalence of *Streptococcus mutans.* Comparative methods of testing were performed including culture methods and molecular techniques. Bacterial culture methods were applied to MSFA and TYCSB agars which are complex selective media use to obtain pure culture of *S. mutans*. In addition, PCR was performed as a comparative study using primer variations of *S. mutans*, spaP and dexA. Of the three techniques, PCR with the dexA primer was found to be the most promising method in gaining a quantitative measurement of S. *mutans* since the results of the MSFA and TYCSB culture methods were inconclusive. Although further testing for PCR sensitivity will be required, PCR will be effective for future administration in testing administered to college students for the possible correlation between high psychological stress and increased quantitative prevalence of the cariogenic bacteria, *Streptococcus mutans*.

P187 Danielle M. D'Angelo, Camry L. Wagner, Kristen T. Jernigan, Kevin B. Kiser
Biology and Marine Biology, UNC Wilmington

Isolation, Characterization and Antibiotic Susceptibility of *Staphylococcus* Species on Surfaces in a University Weightlifting Facility

Staph infections can be easily spread in public places where people are constantly interacting and there can be extensive skin-to-fomite contact, such as in workout facilities. Benches and weights are potential vehicles for the spread of pathogenic species of *Staphylococcus* between the hundreds of student athletes sharing a weightlifting training facility. Normal flora *Staphylococci* may also be a threat by carrying antibiotic-resistant genes that can be transmitted to pathogenic species. Rubber and metal surfaces in the UNCW Hanover Hall weightlifting facility, further subdivided into smooth and rough textures, were sampled on three different occasions throughout the Fall 2013 semester to identify various *Staphylococcus* species present. Salt-enriched cultures were spot-transferred to ChromAgar™ plates to differentiate between *S. aureus* and other species. Different methods were utilized and evaluated for efficiency on identifying *Staphylococcus* species, consisting of the 16S-23S rDNA intergenic-spacer PCR analysis, RapID™ Staph Plus system and genus-specific DNA sequencing of 16S rRNA. Isolates of each *Staphylococcus* species were tested for antibiotic

susceptibility by disk diffusion. Effectiveness of an assortment of antibiotics against the isolates, such as penicillin, tetracycline, and cefoxitin, were tested. Part of the disk diffusion test included the D test using clindamycin and erythromycin that examined inducible-clindamycin resistance, but only a few isolates revealed it. Of the many *Staphylococcus* species obtained and identified from the training facility, they appeared on all types of surfaces swabbed with little variation and accumulated during the month the gym was utilized most. *S. saprophyticus* was amongst the most prominent species. Results of the antibiotic susceptibility tests showed resistance to the antibiotics, with most resistance toward azithromycin, erythromycin and clindamyciin. Proper and frequent sanitation of all surfaces throughout the facility and maintained personal hygiene can assist in preventing accumulation of *Staphylococcus* bacteria, resistance and infections spread between athletes.

P188 Zahna Bigham, Monica Mohanty, Wanda T. Schroeder
Biology, Wesleyan College, Macon, GA

The Effect of 17 α-Ethinyl Estradiol on the Growth of Uropathogenic *Escherichia coli*

In recent years there has been an increase in the use of estrogen supplements by women experiencing the effects of menopause. These estrogenic compounds have been highly controversial because of some of the unknown physiological consequences of their extended use. Menopausal women are disproportionally more susceptible to contracting chronic and recurrent urinary tract infections, which are primarily caused by the uropathogenic bacteria, *Escherichia coli*. This supports the hypothesis that estrogen deficiency is a significant risk factor in developing UTIs. In this experiment, 17α-ethinyl estradiol, which is an epimer of the naturally produced 17β-estradiol, was used. Seventeen α-ethinyl estradiol is one of the primary estrogen supplements given to menopausal women, as well as women looking to prevent conception. In this study, the effects of 17α-ethinyl estradiol on the growth of bacteria *Escherichia coli* was tested. *E. coli* cultures grown in concentrations of 21.5 µg/ml, 10.75 µg/ml, and 5.38 µg/ml of 17α-ethinyl estradiol were plated and observed for growth. The results indicated that there was a significant difference between the concentration of 17α-ethinyl estradiol and the amount of *E. coli* growth. It was found that higher concentrations of 17α-ethinyl estradiol inhibited the growth of uropathogenic *E. coli*. These findings have profound implications that estrogen deficiency contributes to the occurence of chronic and recurrent UTIs in menopausal women, and estrogen supplements could possibly prevent these UTIs.

P189 Thomas H. Hogan, Carrie Koenigstein
Biology, Anderson U, Anderson, SC

Rainfall Influence on *Escherichia coli* for the Anderson University Cox Creek Monitoring Site

Anderson University has been working in tandem with Georgia-Adopt-A-Stream to collect water quality data for the Cox Creek and Rocky River sites near the university. Monitoring efforts have focused on temperature, dissolved oxygen, pH, electrical conductivity, and *Escherichia coli* levels from February 2014 to the present. During the first nineteen months of monitoring, *E. coli* levels for the site on Cox Creek measured at or above 400 colony forming units per 100 ml (cfu/100 ml) on five seperate monitoring events including two events measuring over 1000 cfu/100 ml. During the same time interval the Rocky River site, upstream of where the two bodies of water meet, never exceeded 367 cfu/100 ml. Given the known relationship between rainfall and *E. coli* concentrations, this project was to determine the extent and scope of the influence of rainfall on bacterial levelsfor this local creek. In addition to collecting the normal monthly water quality data, Cox Creek was also tested for the presence of *E. coli* directly after rainstorm events, defined by any storm that produced 0.25 inches of rainfall in a 24 hour period. All such rain events had a noticable effect on bacterial levels in the creek and a t-test indicated a very high probability that there is a connection between excess rainfall and the rapid rises in levels of *E. coli*. Generally speaking, the more rain that fell, the larger the spike that

occurred in the bacterial count. Based on current data, bacterial levels returned to a lower level within three days following the rain event.

P190 Jamal H. Hunter, Carrie R. Crabtree
Science, Abraham Baldwin Agricultural College, Tifton, GA

Development of Continuous Cultures for the Purification and Repurposing of Chitin

Chitin is a polysaccharide that is readily found in nature, second only to cellulose. Extraction and purification of chitin sources such as insect and crustacean exoskeletons has been established as a viable method for the development of renewable products such as plastic. Two methods of extraction have been identified. A chemical process that produces large amounts of waste that is not environmnetally friendly and a biological method that is both envrionmetnally and economically friendly. The biological method produces less harmful waste, but also allows for the purification of a larger chitin molecule for repurposing. This procedure uses the action of protease and lactic acid producing microbes to extract the chitin. The majority of chitin extraction processes in place today use a batch culture. The purpose of this study was to determine if a continuous culture could be desinged and utilized for the extraction of chitin. Several cultures of *Bacillus subtillis* were established to determine the appropriate feeding and waste removal rates. The *Bacillus subtillis* culture waste effluent is being used to determine the amount of possible protease that can be produced in this culture setting and the nessecary amounts needed for chitin extraction. The pH of the cultures has been maintained at an average of 6.42 and no endospores have been detected.

P191 Joshua Doughty, Jeffrey Thomas
Biology, Queens U of Charlotte, NC

Isolating Fungal and Bacterial Growth on Agar Mediums

In order to assist in the treatment and rehabilitation of birds of prey, the detection and identification of bacterial or fungal infections is a priority. Swab samples were taken from the lungs and posterior air sacs of various taxonomic groups of raptors. Inoculated plates were for three days at 30 degrees Celsius. These samples were used to inoculate two kinds of agar medias: 10% NaCl nutrient agar, and Brain/Heart infused agar. The 10% NaCl nutrient agar was designed to inhibit growth of most bacteria to allow growth of preferably only resistant bacteria and fungi. The Brain/Heart infused agar is not meant to inhibit growth but simply have a more suitable environment for fungal growth. Samples do have growth of both bacterial and fungi. Later studies could lead to more precise ways to isolate only fungi or bacteria in agar mediums, which will aid in identification and treatment of infections of raptors.

P192 Olivia R. Brown, April Sipprell
Biology, Queens U of Charlotte, NC

Specificity of bacteriophage when infected into Bacillus thuringiensis kurstaki and Bacillus thuringienses israelinsis

The use of antibiotics to treat diseases is creating antibiotic-resistant bacteria. A new method for treating antibiotic-resistant bacterial diseases is needed. A possible method of treatment is bacteriophage therapy. Bacteriophages are viruses that infect bacteria and can either lyse a cell or incorporate its genome within the cell. Phages are specific in the choice of bacteria they adsorb to. This study looks at the specificity of phages HS and Rex 16 adsorbing to similar bacterial subspecies *Bacillus thuringiensis kurstaki* and *Bacillus thuringiensis israelinsis*. Both phages were purified using *Bacillus thuringiensis kurstaki*. In an initial trial HS showed complete lysis of *Bacillus thuringiensis kurstaki* but not *Bacillus thuringiensis israelinsis*. In the second trial, HS showed a complete lysis of *Bacillus thuringiensis kurstaki* and partial lysis of *Bacillus thuringiensis israelinsis*. Rex 16 showed complete lysis in *Bacillus thuringiensis kurstaki* and *Bacillus thuringiensis israelinsis* during the first trial, but not during the second trial. Conflicting results could be explained by purification issues, resistance, differences in protein receptors, mistakes made, and the possibility of temperate phages. The two phage samples were purified

again and re-infected into the two subspecies in order to perform further replications to obtain more reliable results.

P193 Chasity Lawless, Debbie Curtis, Mishal Jamil, Michelle Zedonek, Amelia Abdullah, Robert Haining, Lee Kurtz, Rebekah Ward
Science & Technology, Georgia Gwinnett College, Lawrenceville

Isolation and Characterization of Kudzu Nodule Bacterial Growth in Nitrogen-Free Media

The invasive species *Pueraria montana*, or Kudzu, is a legume; it contains nitrogen fixing bacteria inside its root in nodules. These bacteria allow for a competitive advantage over non-leguminous native plants. Given the centrality of these bacteria to the spread of Kudzu, isolates from nodules were characterized after collection from seven different locations across the metro Atlanta area. Twenty five isolates were grown on two different variants of nitrogen free media. Four different carbon sources were evaluated as well. Finally growth under both aerobic and anaerobic conditions was investigated. Almost all isolates grew better under anaerobic conditions. Additionally, the carbon source and other components of the composition of the media affected growth. These data suggest significant metabolic diversity inside a relatively small geographic area posing questions about the relative contribution of nitrogen fixing bacteria to Kudzu's invasive expansion in this region.

P194 Chasity Lawless, Debbie Curtis, Mishal Jamil, Michelle Zedonek, Amelia Abdullah, Robert Haining, Lee Kurtz, Rebekah Ward
Science & Technology, Georgia Gwinnett College, Lawrenceville

Investigations into putative Kudzu nodule "cheaters"

Nitrogen fixing bacteria can provide a leguminous plant host with advantageous nutrients. The bacteria, in turn, receive the carbon products of photosynthesis. One key protein that contributes to this symbiosis is nitrogenase. This enzyme is capable of converting di-nitrogen gas into ammonia. This is then converted to organic forms of nitrogen containing compounds for transport throughout the plant. Therefore relative efficiency of the nitrogenase enzyme can affect the health of the plant. However, some bacteria receive the photosynthate with reduced or no nitrogen transfer to the host, so-called cheaters. One potential mechanism for cheating would be alterations in the sequence of the nitrogenase gene, decreasing efficiency. In this study, isolates from nodules were investigated at a molecular level using sequencing of the phylogenetic molecular clock, the 16S gene, and comparing that to the *nifD* (a subunit of nitrogenase) gene. The 16S gene identified the close relatives of the isolates. The *nifD* gene of these relatives was then compared to the isolates' *nifD* sequences under the assumption that they should match the relative's sequence. Several possible mutations were observed in these isolates which could, in turn, affect function. If these mutations cause reduced function, this would serve to identify cheaters within these nodules.

P195 Cancelled

P196 Amber D. Dyson, Morgan R. Gaglianese-Woody, Carolyn K. Kawada, Rebeccah K. Stewart, Andrew C. Bellemer
Biology, Appalachian State U, Boone, NC

RNA-Processing Genes Control Sensory Neuron Function in *Drosophila melanogaster*

Chronic pain affects approximately 100 million Americans and generates costs of up to $600 billion per year, according to the Institute of Medicine. Characterization of molecular signaling pathways in sensory neurons is an important step toward development of more effective clinical interventions. The goal of this study is to identify genes involved in regulating the function of neurons integral to sensing pain (nociceptors). We are using *Drosophila melanogaster* larvae as a model organism, which exhibit a distinct and quantifiable response to noxious stimuli

termed nocifensive escape locomotion (NEL). Recent research has found that the transcripts of key genes necessary for nociceptor function are alternatively spliced. Using the GAL4/UAS system, we are able to manipulate nociceptor-specific expression of interfering RNA (RNAi) to reduce or eliminate function of targeted genes. In this screen, we systematically knocked down putative RNA-processing genes with a previously identified role in dendrite development and/or alternative splicing. We then tested for changes in nocifensive response latency relative to wild-type larvae. In a number of identified candidate genes, knockdown resulted in either a significant increase or decrease in response latency, indicating a potential defect. Additionally, our results have confirmed that behavioral defects do not correlate with defects in dendrite morphology and have revealed there is considerable variation in the effects observed when knocking down different initiation factors.

P197 Samantha Saylor[1], Malia D. Berg[1], Chris S. Lantz[2], Tracy L. Deem[1]
[1] Biology, Bridgewater College, Bridgewater, VA; [2] Biology, James Madison U, Harrisonburg, VA

Role of IL-3 inImmune Responses to *Plasmodium berghei* in a Murine Model of Malaria

Malaria is one of the most severe public health problems worldwide and is a leading cause of death, especially in children and pregnant women in developing countries (CDC, 2012). Murine models of malaria infection have been used to understand malaria pathogenesis. In our laboratory, we previously showed knocking out the cytokine, interleukin-3 (IL-3) during malarial infection with *Plasmodium berghei* NK65 extended the time of death of male mice, suggesting IL-3 exacerbates disease (Auclair *et al*.,2014). Therefore, we hypothesized the reason WT mice die faster may be due to an overwhelming recruitment of inflammatory cells that results in tissue damage. We examined recruitment of early inflammatory cells and the expression of inflammatory cytokines and found there was a significant increase in the number of inflammatory macrophages and neutrophils, as well as inflammatory cytokines in WT mice compared to KO mice. To extend these findings, our current research investigates whether or not differences inflammation may be due to MHC class II expression and/or differences in androgen levels in WT and KO mice.

P198 Shelby Howard, Aditi Talkad, Eesha Oza, Jennifer Bradford
Biological Sciences, Augusta U, GA

$p65^{fl/fl}$/LysMCre Transgenic Mouse Model Shows Altered NF-κB Signaling in Macrophages

We have produced and begun characterizing a transgenic mouse model, $p65^{fl/fl}$/LysMCre, that lacks canonical nuclear factor-kappaB (NF-κB) signaling (p65) in cells of the myeloid lineage, which includes macrophages. NF-κB pathway activity is very important in normal immune function, synaptic plasticity, and memory, and aberrant NF-κB activity is associated with autoimmune disease, and importantly, cancer. Macrophages can be present in very large numbers in a variety of cancers, and can lead to tumor progression through promotion of tumor inflammation, angiogenesis, invasion, and metastasis. This animal model will allow our group to pursue experiments involved in better understanding how stromal macrophages communicate with cancer cells through the NF-κB pathway, and how loss of canonical NF-κB signaling in cells of the myeloid lineage might weaken the tumor and make it more susceptible to standard treatments. Characterization of the model thus far reveals that p65 protein is indeed absent in macrophages derived from bone marrow monocytes, and that NF-κB signaling is altered when stimulated with lipopolysaccharide. We have just begun co-culture experiments with p65 deleted macrophages and glioma cells, and anticipate altered communication when compared to glioma cells cultured with control macrophages.

P199 Emery Longan, Melissa Knutsen, Renee J. Chosed
Biology, Furman U, Greenville, SC

Measuring UV Sensitivity in New Zealand Vineyard Yeast Species

The goal of this project is to assess the UV sensitivity of yeast strains found in vineyards in New Zealand. A variety of yeast species were identified in these vineyards by Goddard and colleagues[1]. We have grown several of these species in the lab (along with a lab strain of *Saccharomyces cerevisiae*) then treated the yeast with different doses of UV light and assessed growth on agar plates. Several UV tolerant yeast isolates were also found in these experiments. Yeast treated with UV light were also used for analysis of global histone H3 acetylation levels often associated with UV-induced DNA damage in lab yeast strains. Data will be presented that compares UV sensitivity and H3 acetylation levels in the wild New Zealand yeast strains and a *Saccharomyces cerevisiae* lab strain.

1. Gayevskiy, Velimir, and Matthew R. Goddard. Geographic delineations of yeast communities and populations associated with vines and wines in New Zealand. *The ISME journal* 6.7 (2012): 1281-1290.

P200 Thomas S. Moss, Veronica A. Segarra
Biology, High Point U, NC

Identification of a Mammalian Equivalent for the Autophagy-Related Yeast Protein Atg27

Autophagy is the biological process in which cytoplasmic material is targeted, sequestered, and transported to lysosomes for degradation. Similar to taking out the trash, autophagy functions to destroy cellular waste in aims of maintaining a healthy intracellular environment. When autophagy fails to function correctly, cellular waste will collect within the cell, a condition that can result in various autoimmune and autoinflammatory diseases such as Lupus and Crohn's disease. As a result of its importance for cellular health, many aspects of autophagy have been conserved in eukaryotes throughout evolutionary time. During autophagy cellular debris is transported in specialized transport vesicles to lysosomes. In the eukaryote *Saccharomyces cerevisiae* (baker's yeast) the transmembrane protein Atg27 is important to the formation of autophagic transport vesicles and therefore is vital for efficient autophagic processes. As of now, a mammalian equivalent for Atg27 has not been identified. Analysis of the unique structure and function of Atg27 has allowed for the identification of several mammalian proteins that could be functional orthologs of Atg27. Candidates include the Lysosomal-associated Membrane Proteins (LAMPs). In order to test whether yeast Atg27 and mammalian LAMPs are functional orthologs, we determine whether strains of yeast expressing human LAMP proteins and lacking Atg27 are able to carry out autophagy efficiently.

P201 Maxwell Marlowe[1], Gretchen E Potts[2], Margaret Kovach[1], Ethan Carver[1]
[1] Department of Biological and Environmental Sciences, U of Tennessee at Chattanooga;
[2] Chemistry, U of Tennessee at Chattanooga

Cell Viability and Gene Regulation Following Exposure to Contents of E-Cigarette Refill Solutions

E-cigarettes have become increasingly popular in the past decade and are marketed as smoking cessation aids. However, these products are not well regulated or researched with respect to health concerns and safety issues. A number of toxic compounds have been discovered in refill solutions. However, the long-term effects of e-cigarette use are still largely unknown. Nicotine is one of the primary alkaloids within e-cigarette refill solutions. Nevertheless, other tobacco alkaloids are present including; cotinine, myosmine and anabasine. These compounds are not disclosed on the packaging. This study uses known amounts of tobacco alkaloids, in an *in vitro* culture system, to test of the effects of these chemicals on the growth of human lung cells. Cell viability was measured as a function of metabolic ATP activity, using the Cell-Titer Glo Luminescent assay. Preliminary results from single alkaloid trials indicate decreased cell growth in culture, in comparison to a control.

Changes in gene expression may be linked to the development of tobacco-related diseases in humans. To address this issue, we used qRT-PCR to analyze gene expression for multiple markers, to search for variations between control and exposed cultures. Overall, this project illustrates the need for more research on the contents and physiological effects of refill solutions, and the requirement for better labeling and regulation of refill solutions.

P202 Changed to Oral Presentation 235.

P203 Maria Valverde, Dinene L. Crater
Biology, High Point U, NC

In Vitro* Analysis of Transcription Repression by GerE during Sporulation in *Bacillus subtilis

*Bacillus subtilis*is a gram positive, rod shaped, aerobic soil bacteria. In times of environmental stress, the bacteria carry out sporulation. The bacterial cell undergoes asymmetric division involving a mother cell engulfing a forespore and creates protective layers, called coats, to eventually form a spore coat. Desiccation, UV radiation, and extreme temperatures are a few among other environmental stresses of which the spore becomes resistant to. It will remain in this state until the environment has reestablished conditions appropriate for germination. Many proteins play a role in sporulation, most interestingly, GerE. The appearance of the regulatory protein GerE is essential at the late stage of spore development in the mother cell. It not only activates the essential genes for spore formation, but also represses the transcription of several sigma K-dependent genes, includingsigK,cotA, cotE and cotH. We have identified GerE binding sites on the promoter region of these genes, and hypothesize that GerE binds to these promoter regions to repress transcription from the sigma K associated RNA polymerase. Through the use of a non-radioactive DNA binding assay, the binding characteristics of purified GerE to these promoter regions will be analyzed. We have performed preliminary experiments to determine the control reaction conditions, and future work will analyze the ability of GerE to bind to the sigK promoter region. The completion of this project will enhance our understanding of the role of GerE in the down regulation of genes required for efficient sporulation.

P204 Bridget Smith, Kathleen Hughes, Glenn Stokes, Kevin Burgess
Biology, Columbus State U, Columbus, GA

Effects of stress on hormonal protection in neuronal-like cells

This study will test the effects of hormones as neuronal protectors when neuron-like cells are stressed with various toxins including epinephrine, norepinephrine, and low oxygen concentration. Hormone Replacement Therapy (HRT) is used by many women to alleviate menopausal symptoms; there is often a combination of hormones in HRT such as endogenous estrogens, progesterone, and conjugated equine estrogens (CEE) which are taken from the urine of pregnant mares. Previous studies have found positive correlations between estrogens such as 17□estradiol and improved cognitive function. Others illustrated estradiol and progesterone provided a significant protective mechanism for post-ischemic stroke victims. Little is known about CEEs compared to endogenous estrogens in possible neuroprotective effects, but recent research has concluded CEE provide less protective mechanisms as compared to endogenous hormones. This study will seek to determine which hormone treatment alone and hormone treatment combination will provide the best protection when neurons are induced with stress (epinephrine, norepinephrine, and low oxygen concentration). Cultured human progenitor neurons will be treated with the following single hormones: 17a-estradiol, 17□estradiol, estrone, equilin, and progesterone. Neurons will be exposed to stressors following hormone treatment, and flow cytometry will be used to measure cell viability, proliferation, and oxidative stress. I hypothesize 17□estradiol will provide the most neuronal protection as a single hormone treatment, and the most significant neuron protection will be the hormone combinations 17□estradiol with estrone and 17□estradiol with progesterone. I also hypothesize low oxygen concentration will have the greatest detrimental

effects on the neuron-like cells as compared to epinephrine and norepinephrine. The analysis of this research will help elucidate the relative neuroprotective effects of various estrogens.

P205 Kenyon D. Jones, Robert H. Newman
Biology, North Carolina A & T State U, Greensboro, NC

Total Synthesis of the Far-red Fluorescent Protein mNeptune2

Recently, several far-red FPs have been made suitable for protein fusion and live cell imaging in tissue sections and translucent animals. Nonetheless, the spectral properties of far-red FPs (whose emission maxima range from ~610 to ~650 nm) are still not ideal for imaging in deep tissue and most animal models. Indeed, due to marked reductions in both cellular autofluorescence and light scattering between 650900 nm, the development of FPs that exhibit emission maxima > 650 nm has become an intense area of research in the imaging field. The far-red FP, mNeptune2 (Ex: 600 nm; Em: 650 nm), is one of the farthest, and brightest far-red FPs reported to date. To further improve the spectral and photophysical properties of mNeptune2 for deep-tissue imaging, we are using a directed evolution protocolwherein libraries of mutagenized FPs are created and screened for functionto optimize the mNeptune2 variants for parameters such as brightness, photostability, and spectral shifts. To help inform these experiments, we are using structure prediction programs to identify a specific subset of amino acid positions that, when mutated, are most likely to impact the photophysical properties of the mNeptune2 fluorophore. Here, we describe a templateless PCR scheme to incorporate rapidly and efficiently either one or several mutated residues, based on computational predictions. We have successfully synthesized both wild-type and mutant versions of the mNeptune2 gene. Importantly, not only are the gene synthesis techniques used to generate the mNeptune2 libraries useful in synthesizing individual genes, but they can also be generalized to synthesize any genomic region-of-interest. In the future, we will additionally apply these synthetic biology techniques to contribute to the whole genome synthesis of the worlds first synthetic eukaryotic cell (the synthetic yeast, Sc2.0) through the Build-A-Genome Network.

P206 Paul V. Cupp, Jr.
Biological Sciences, Eastern Kentucky U, Richmond

Substrate Avoidance Behavior in Green Salamanders, *Aneides aeneus*

Green salamanders, *Aneides aeneus,* sometimes assume postures that reduce body contact with the substrate such as the floor of a rock crevice or paper towel. Due to the body configuration of this salamander with the limbs splayed out to the side, the body is almost always in direct contact with the substrate. Various factors or properties of the substrate may affect the salamander, such as: temperature, pH, water content, etc. Physiological and behavioral responses of the animal may occur as a result to changes in the substrate in regard to these factors. While, typically, *A. aeneus* occur in humid but not wet crevices, they may be exposed to wet crevices temporarily, especially after heavy rains. Also, water may be standing in the bottom of some crevices for a few hours or days. Here, I report field and laboratory observations of green salamanders responding to prolonged direct contact with wet substrates. In eight instances (equally divided in lab and field), Individual adult *A. aeneus* were observed in a posture in which the limbs were raised high and the head and tail were raised off the substrate thereby significantly reducing exposure of the skin to direct contact with the substrate. One of these salamanders shifted to an alternate posture in which all four feet were in contact with the substrate with limbs extended, and the mid-body arched above the substrate. These postures may allow terrestrial salamanders, such as, *A. aeneus*, to remain in home crevices thereby reducing exposure to predation without becoming overhydrated.

P207 Miranda Gulsby, Riccardo Fiorillo
Science & Technology, Georgia Gwinnett College, Lawrenceville

Effect of Predation Risk on the Substrate Choice of Two-Line Salamander, *Eurycea cirrigera*, Larvae

In streams and other aquatic systems, salamander larvae are often subject to predation by adult salamanders as well as crayfish, fish, snakes, raccoons, birds and other predators. These larval salamanders are themselves predators on small aquatic invertebrates and thus move through various substrates (gravel, sand, leaf litter etc.) in search of prey. Larvae foraging behavior is risky and exposes these salamanders to predation. Theory predicts that larval salamanders should change their substrate choice in the presence of predators to minimize the risk of predation while maximizing their chance to find prey. We are conducting a laboratory experiment to investigate if/how the substrate preference of two line salamander larvae is affected by the presence of a potential predator (Crayfish). We want to examine whether larval salamanders prefer specific substrate (gravel, woody debris, sand, leaf litter) and how the presence of Crayfish predators may affect that choice.

P208 Kristina Coggins, Stephen Owensby, Carlos D. Camp
Biology, Piedmont College, Demorest, GA

A Test of Ecological Character Displacement between the Larvae of Two Species of Cryptic, Sympatric Species of Two-lined Salamander (*Eurycea wilderae* and *E. cirrigera*)

Competition has been hypothesized to represent a powerful force in determining the interactions between similar species. One possible result of interspecific competition is resource partitioning, which in turn may result in ecological character displacement. Character displacement is a pattern in which two species with overlapping ecological requirements differ more when they co-occur than when they do not. This pattern has been demonstrated in terrestrial, lungless salamander species that compete for food resources. Because the aquatic larval stages of biphasic species often occur in high densities, competition between sympatric species may be more likely between larvae than between adults. However, the ecology of larval lungless salamanders has not received the research attention as post-metamorphic salamanders. We studied two cryptic species of salamanders, *Eurycea wilderae* (Blue Ridge Two-lined Salamander) and *E. cirrigera* (Southern Two-lined Salamander), which occur in two different types of environment – the Blue Ridge versus the Piedmont physiographic provinces – in the southeastern US. These two species occur in a narrow zone of sympatry in the foothills of the Blue Ridge Mountains of northeastern Georgia. We tested for food partitioning in the larvae by determining prey items (to order) from specimens collected from allopatric and sympatric localities and comparing them with the available invertebrate fauna within each stream. We similarly tested for character displacement in head measurements known to be associated with feeding dynamics. Larvae at the sympatric sites were identified genetically. Chi-square analyses indicated no significant difference between species in prey items taken in sympatry. Moreover, MANCOVA indicated no consistent interspecific differences in head measurements. Therefore, we concluded that there is evidence for neither food partitioning nor ecological character displacement between the larvae of these two species.

P209 Scott M. Weir[1], Shuangying Yu[2], David E. Scott[3], Stacey L. Lance[3]
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Acute Toxicity of Copper to the Larval Stage of Three Species of Ambystomatid Salamanders

Copper (Cu) appears to be consistently toxic to amphibian species relative to other taxa. There has been limited Cu toxicity data for salamanders, and much of the data available used embryos. We performed acute toxicity experiments with three species of ambystomatid salamanders using the larval stage. We found very high toxicity for these three species compared to previously published research on the embryo stage. Specifically, the 4 d LC50s for *Ambystoma tigrinum* and *Ambystoma opacum* were 35.3 µg/L and 18.73 µg/L, respectively. The same test concentrations of Cu caused similar toxicity to *Ambystoma talpoideum* (LC50 = 47.88 µg/L), but exposures required up to 48 days to elicit the same toxicity. Our results

suggest that Cu is much more toxic to larval salamander stages than for embryos, which has been found for fish as well.

P210 Rob Hopkins, Jacob Manning
Wildlife Conservation Program, U of Rio Grande, OH

Geospatial Analysis of Introduced Python in Florida

Burmese Python (*Python molurus bivittatus*) is one of the largest snake species in the world and is native to Asia. However, the species has been accidentally and intentionally released in southern Florida and is now considered an established invasive species. In this study we conducted a geospatial analysis of python distribution in Florida over an 11 year period (2003-2013) using 700+ verified records from the Florida Museum of Natural History. A visual assessment of python distributional change using minimum bounding geometry analysis indicated a notable bi-directional expansional trend. Subsequent regression analysis (GPS coordinates vs. year) revealed a significant north and westward trend at 0.573 degrees/year and 0.371 degrees/year, respectively. Kernel density analysis suggest established core populations in the Everglades National Park with putative local dispersal. However, over the last decade there have been confirmed sightings of python across the entire state. To visualize the relative rate of expansion at the state-scale, records were fitted to a second order global polynomial interpolation model. The sporadic record of occurrences coupled with the very rapid rate of geographical expansion suggests that the broad scale pattern of spread is not natural. Rather, the pattern is an artifact of higher detection rates of isolated pet releases due to increased public awareness and more systematic state-wide monitoring efforts. Nonetheless, given the ecological success of the species in south Florida any record of the species should be duly investigated to circumvent the establishment of additional populations.

P211 Eran S. Kilpatrick[1], Nancy Jordan[2], Gregory T. Joye[3], Will Dillman[4]
[1] Mathematics and Science, U of South Carolina Salkehatchie, Walterboro; [2] Carolina Sandhills National Wildlife Refuge, McBee , SC; [3] Civil and Environmental Engineering, U of South Carolina, Columbia; [4] South Carolina Department of Natural Resources, Columbia

The Importance of Gas Line Right-of-Ways as Breeding Habitat for the Pine Barrens Treefrog (*Hyla andersonii*) at Carolina Sandhills National Wildlife Refuge

Hyla andersonii (Pine Barrens Treefrog), a state-listed species with significant conservation status, was first surveyed at Carolina Sandhills National Wildlife Refuge from 1975 to 1982. A span of thirty years passed before the next comprehensive survey, which detected fewer *H. andersonii* in actively managed habitats compared to habitats within a gas line right-of-way. Monitoring continued in 2014 to further explore *H. andersonii* occurrence at right-of-way sites and to document the associated anuran community. From May 30 - August 13, 2014 two gas line right-of-way sites, two non right-of-way sites, and two sites where *H. andersonii* occurred historically were surveyed using SongMeter digital recorders. *H. andersonii* was detected 499 times with 70% of detections occurring within right-of-ways and 27% of detections occurring at non right-of-way sites. The mean calling index, a measure of vocal intensity, was highest for *H. andersonii* in right-of-ways. *Acris gryllus* (Southern Cricket Frog), *Hyla femoralis* (Pinewoods Treefrog), *Lithobates catesbeianus* (Bullfrog), *Lithobates clamitans* (Green Frog), and *Lithobates virgatipes* (Carpenter Frog) were detected most often with *H. andersonii*. The trend for *H. andersonii* to be detected more frequently, and produce more active choruses in right-of-ways, could be attributed to vegetative structure, larval competition, and watershed properties. A distinct ecotone between forest and herbaceous habitat occurs on the right-of-ways. Right-of-way forest edges have more hardwood canopy trees, saplings, and more diverse herbaceous zones than sites not within right-of-ways. *L. catesbeianus* and *L. virgatipes*, which were detected more frequently in non right-of-ways, could be influencing *H. andersonii* larval success. The right-of-ways are riparian in structure and associated with higher volume streams than the non right-of-way sites. It is apparent that the gas line right-of-way sites, which are not

actively managed for *H. andersonii*, are serving as productive breeding habitats and possible source populations for this species on the refuge.

P212 Mark J. Dillard, Jeremy Hooper, Team Salamander, Thomas P. Wilson
Biology, Geology & Environmental Sciences, U of Tennessee at Chattanooga

The Spatial Ecology of the Eastern Box Turtle in an Urban and Fragmented Landscape of Southeast Tennessee

The landscape throughout the range of the box turtle (*Terrapene carolina carolina*) has changed drastically over the last few centuries. Consequently, populations appear to be in an overall state of decline. Habitats are fragmented and the microclimates are altered when roads, telephone and power lines transect them or when they are clear-cut. In this study, the spatial ecology and seasonal movement patterns of the box turtle in contrasting habitat and management types are investigated. Home range size, daily movement patterns, and habitat use areas were investigated to determine how box turtles use fragmented or anthropogenic disturbed habitats. We monitored a total of 15 radio-tagged turtles (3 males and 3 females) from August 2013 to November 2016 and (8 males and 1 female) from May 2014 to January 2015. Turtles were located at least two times per week throughout the active seasons and bi-weekly during the winter months. Turtles emerged from hibernation in late April each season and exhibited extensive movement through hardwood forests and early successional habitat in a power-line right-of-way. Home range sizes averaged 4.05 ± 3.18 ha using minimum convex polygon analysis. The average distance moved per relocation in a straight line distance was 59.43 ± 15.78 m. The average net distance moved throughout the season by all turtles in both study years was 2,163.60 ± 1,369.70 m. During both monitoring seasons, turtles were located at sites with moderate to heavy canopy cover and woody debris often present at the microhabitat level, suggesting that canopy cover may be an important attribute for box turtles when selecting suitable habitat and thermoregulation or other life history needs. We expect to complete more data on habitat preferences as data analysis continues on this project.

P213 Cambre L. Goodlett, Barry P. Stephenson
Biology, Mercer U, Macon, GA

Ultraviolet Predicts Body Size in Adult Eastern Fence Lizards (*Sceloporus undulatus*)

Many lizards use colorful badges in displays with conspecifics during courtship and aggressive interactions. In the eastern fence lizard *Sceloporus undulatus*, males and females reveal sexually dimorphic abdominal coloration during social interactions, and use these features to signal sex. However, the significance of ventral badge color or other color features for signaling quality remains largely unknown in this species. We examined the relationship between spectral variables of ventral and dorsal skin color and morphometric traits linked to fitness in adult male and female *S. undulatus* under standardized temperature conditions. For males, ventral patch hue tended to decrease (i.e., was blue-shifted) as body size increased, whereas dorsal hue was unrelated to male size. In contrast, there was no relationship between ventral hue and body size in females, whereas dorsal hue increased (i.e., was red-shifted) with body size. For both males and females, lower ultraviolet (UV) chroma of ventral abdominal color was correlated with increasing body size. In addition, females in better body condition also exhibited lower UV chroma of the venter. Brightness was not a predictor of any morphometric trait in males or females. These results suggest that UV reflectance of skin is an indicator of size and thus age, and so could serve as an index of signaler quality in this species.

P214 Bethany L. Williams, Amanda S. Williard
Biology and Marine Biology

The Effect of Acclimation Temperature on Anaerobic Metabolism in Exercising Yellowbellied Sliders (*Trachemys scripta scripta*)

The effects of temperature on anoxia tolerance and overwintering behavior in the yellowbellied slider (*Trachemys scripta scripta*) have been well-studied, but the degree to which temperature affects anaerobic metabolism during activity has received less attention. We assessed lactate accumulation as a metric of anaerobic metabolism for cold- and warm-acclimated yellowbellied sliders exposed to an exercise protocol. Ten yellowbellied sliders were collected by hoopnet trapping from ponds in Wilmington, North Carolina and randomly assigned to either a cold or warm temperature treatment (18ºC and 28ºC respectively). After 4-5 weeks of acclimation, turtles were individually exercised in a swim flume for 5 minutes at 1.5 body lengths per second at their respective acclimation temperatures. Blood samples were taken immediately before and after the swim flume trials and stored at -80°C until analysis. Blood lactate was assessed using a spectrophotometric assay (Pointe Scientific Inc., Canton, MI, USA). Initial results indicate that exercise resulted in an increase in blood lactate for turtles in both temperature treatment groups. Our research provides insight into temperature effects on metabolism of yellowbellied sliders that may have implications for locomotory performance and survival during the active season.

P215 Alexandria A. Gagne[1], Thomas K. Moore[2], John J. Enz[1], David E. Unger[2]
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The Population Dynamics of the Gopher Tortoises on Cumberland Island, Georgia

Due to habitat loss, urban sprawl, and ever exploration, the land-dwelling gopher tortoise (*Gopherus polyphemus*) is now listed as a threatened species in much of the southeastern United States. In order to effectively manage gopher tortoise populations, many of which are isolated, and/or subject to stresses from the surrounding environment, an accurate population count must be known. Therefore, any information regarding the current status, distribution, density, and impacts that may affect this species is critically important to the long term viability of remnant populations such as the unstudied population of gopher tortoises on Cumberland Island, Georgia. The purpose of this study was to use burrow cameras and remote game cameras to measure the gopher tortoise population size, activity patterns, and other animals burrow use on the 40 square mile island. Additionally, data on burrow depth, dimensions, temperature, and GPS locations were documented. Tortoise morphometric data and activity patterns were also recorded along with predation. Throughout Cumberland Island, approximately 400 burrows were found with half or these classified as active. Tortoises were concentrated in one area of the Island known as Stafford Field which contained 252 burrows and 30% occupancy. Tortoises of all age classes were found, along with evidence of reproduction and egg laying. The population on Cumberland Island should be considered a healthy, viable, and reproducing one.

P216 Gavin R. Lawson[1], Eran S. Kilpatrick[2]
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Phylogeographic Patterns Among Eastern Newts (*Notophthalmus viridescens*) in the Southeastern United States

Recent molecular phylogenetic analyses of eastern newt populations in South Carolina found evidence of introgressive hybridization among the three subspecies occurring in the state (*Notophthalmus v. viridescens* – red-spotted newt, *N. v. louisianensis* – central newt, *N. v. dorsalis* – broken-striped newt). Observed patterns of genetic variation indicate that population groups likely represent refugial populations established during the last glacial maximum (Lawson and Kilpatrick 2014). To evaluate the regional extent of these groups, we sequenced 530 bp of the NADH dehydrogenase (ND2) and the flanking $tRNA^{Met}$ genes in 384 specimens

from a total of 46 populations in South Carolina, North Carolina and Virginia. Statistical parsimony analysis recovered two population groups whose contact zone coincides roughly with the Yadkin-Lumber-Pee Dee River drainages in North and South Carolina. Even with the extended sampling, haplotypes still did not group by taxonomic designation in phylogenetic analyses suggesting introgressive hybridization has occurred. Additionally, there is evidence of genetic exchange between the groups at their shared boundary, particularly in the Coastal Plain. These results support our earlier conclusion of the presence of at least two refugial groups for eastern newts in the southeastern United States.

P217 Zeshan S. Velani[1], Nikolett Ihász[2], Barry P. Stephenson[1]
[1] Biology, Mercer U, Macon, GA; [2] Psychology, Mercer U, Macon, GA

Testing the Effect of Albinism on Avian Attack Rates in Eastern Garter Snakes (*Thamnophis s. sirtalis).*

Albinism is an unusual and conspicuous color phenotype of animals arising from the absence of melanin in the skin. Albinos are rare in most wild populations, and are generally assumed to have low fitness as compared to wild-type phenotypes; however, demonstrations of such an effect in field-based studies are lacking. We tested the hypothesis that albino eastern garter snakes (*Thamnophis s. sirtalis*) suffer higher rates of attack by visually-oriented predators (birds) through the use of plasticine models in a field experiment. We constructed 200 models of juvenile garter snakes corresponding to each of four treatments (wild-type, albino, and two intermediate forms with a mixture of wild-type and albino features), and placed them along transects in Bond Swamp National Wildlife Refuge in central Georgia in June 2015. After collection, we examined models for evidence of attack as indicated by impressions in the clay, and classified observed damage to each of several major predator groups. We found evidence of bird attack on all model treatments, indicating that models elicited relevant responses by predators. Ongoing statistical analysis, coupled with additional fieldwork in 2016, should clarify the extent to which albinism elicits differential rates of bird attack in our study population as compared to wild-type forms.

P218 William L. Kuenzinger, Jonathan M. Travis, Jordan Weesner, Joaquín Goyret
Biological Sciences, U of Tennessee at Martin

The Effect of Background and Illimuniation on the Visual Cues Used by Foraging *Manduca sexta* Hawkmoths

Manduca sexta is a nocturnal nectarous hawkmoth that feeds with its long proboscis while hovering in front of a flower. Like most pollinators, it relies heavily upon vison and olfaction to discover its feeding source. Most animals may detect visual stimuli through either chromatic (color) or achromatic (brightness) contrast. Physiological constraints of the visual system hinder the detection of color under dim illumination. Thus, *M. sexta* is expected to have difficulties to detect potential nectar sources through color vision. On the other hand, *Deilephila elpenor*, a close relative, has been shown to use color vision under very dim illumination. A previous study found that, in dual choice experiments, *M. sexta* had an innate bias toward an artificial dark-blue feeder over a white-one, when a white background was used under twilight levels of illumination. Another study found that moths had a bias toward the white feeder when the background was dark. Interestingly, in the latter study this bias was found under starlight illumination, but under brighter, moonlight conditions the bias disappeared. Did moths choose feeders based on their chromatic properties (preference for blue) under brighter illuminations, but used achromatic contrast under dimmer conditions? To explore this question we have performed an experiment in which we tested moths with blue and white feeders against either a dark or a white background under both starlight and half-moon illumination levels. Our preliminary results indicate that, under starlight, moths' biases are based on the brightness of the target regardless of the background, Under brighter, moonlight illumination no bias is observed, possibly indicating individual differences in the use of color vision at this intermediate illumination level. We are in the process of testing moths under even brighter, twilight conditions.

P219 Amanda L. Perez, Shihui Liang, Barry K. Rhoades
Biology, Wesleyan College, Macon, GA

The Effects of the Neonicotinoid Imidacloprid on the Electroretinogram (ERG) of the parasitoid wasp *Nasonia vitripennis*

Neonicotinoid insecticides, such as imidacloprid, are widely used to control agricultural pests. A growing concern is that this use has unintended deleterious effects on pollinators. There is increasing evidence that strongly implicates the ubiquitous environmental presence of neonicotinoids in honeybee colony collapse disorder (CCD), especially in the failure of worker bees to return to the hive from foraging. The effects of environmental neonicotinoids on parasitoid insects are also of concern because of their importance in controlling pest populations. In the fruit fly *Drosophila melanogaster,* topically applied imidacloprid has been shown to interfere with retinal reset by slowing the rate at which the photoreceptors return to the resting state after a light flash stimulus. We recently developed a method for recording electroretinograms (ERGs) in *Nasonia vitripennis*, a tiny parasitoid wasp commonly referred to as the jewel wasp. The current study investigates the effects of imidacloprid on ERGs in *N. vitripennis*. Our results confirm that acute application of imidacloprid within a typical environmental range of exposure extends the recovery to baseline of the slow retinal component of the ERG following a light flash. The current study is the first to look at physiological effects of imidacloprid on parasitoid wasps, which may be subject to indirect environmental exposure via contaminated hosts. We believe that this study is also the first to demonstrate that the effects of imidacloprid on the visual systems of hymenopterans are similar to the reported effects on dipterans. This suggests that one factor contributing to disappearing honeybee populations in CCD may involve compromised forager visual systems due to neonicotinoid exposure.

P220 Julia de Amorim, Athena Downes, Kelsea Young, John David Riechert, Forrest Collins, Jennifer Zettler, Bil Leidersdorf
Biology, Armstrong State U, Savannah, GA

Foraging Behaviors of the Fungus-growing Ant, *Cyphomyrmex rimosus*

Cyphomyrmex rimosus is a species of fungal farming ants native to the Neotropics that has become established throughout the southeastern United States. Unlike its relative, the tropical leaf-cutting ants, which cultivate their fungal crops on leaves, *C. rimosus* uses insect excrement as a fungal substrate. *C. rimosus* is active year-round, so we hope to determine any seasonal changes in foraging behavior. We are monitoring and comparing the temporal foraging behaviors and movements of *C. rimosus* colonies in ten nests found in both lawn and forested habitats on the Armstrong State University campus in Savannah, Georgia. Preliminary observations show that *C. rimosus* primarily collect insect excrement, invertebrate parts, wood pieces, and fresh plant material. Forage is identified and catalogued by macro photography. Further, we collect and examine discard piles located outside nest entrances to search for materials that are collected for fungal substrate within the nest. We hope our study will provide an understanding of how *C. rimosus* foraging can differ across an urban landscape where substrates might be limited.

P221 Sean M. Zweygardt, E. Natasha Vanderhoff
Biology & Marine Science, Jacksonville U, FL

Does Color Matter? Function of Color Polymorphism in *Gasteracantha cancriformis* in Northeast Florida

Recent investigations of the function of body coloration in spiders have led to several hypotheses including prey attraction, crypsis, and aposematism. The spiny crab spider *Gasteracantha cancriformis* is polymorphic with as many as eight different color patterns, including white with black spines, white with red spines, and yellow with black spines. The significance of these color variations has yet to be determined. We gathered data on a population of *G. cancriformis* in northeast Florida to determine the degree of polymorphism and

what if any affect coloration has on prey capture. In addition to gathering data on spiders and their webs, we compared prey capture between natural spiders and a group of spiders painted black to test the prey attraction hypothesis. 93% of the spiders we encountered were white with red spines and 62% of those individuals had yellow spots on the underside of the body. Orb area averaged 533 $cm^2$and average web height was 200 cm. Contrary to the prey attraction hypothesis spiders painted black had higher prey capture rates than untreated spiders. Although this difference was insignificant, our data combined with other studies support the idea that coloration in *Gasteracantha* plays a role in warning predators. In future studies we will investigate the aposematic function of color to deter predators, including birds and parasitoid wasps.

P222 Peter M. Schlueter[1], Mark A. Schlueter[2]
[1] U of North Georgia, Oakwood; [2] Georgia Gwinnett College, Lawrenceville

A Six-Year Survey of Flower Fly (Family *Syrphidae*) Diversity and Abundance Found in Georgia Apple Orchards (2010-2015) Over Significantly Different Growing Seasons

Flower flies (Family Syrphidae), also known as hoverflies, are pollinating insects that mimic bees in external anatomy (black and yellow color patterns). A survey of Family Syrphidae was performed from 2010-2015 in five large apple orchards in North Georgia (8-10 collections per site per year). Collection methods included: pan traps, malaise traps, and one-hour timed sweep netting. There were approximately 150-300 flower flies collected each year. The most abundant species were: *Toxomerus geminatus* and *Toxomerus marginatus*. The species collected indicate a diverse assembly of flower flies in Georgia. Flower flies significantly (p= .0001) preferred yellow trap color to other colors (blue and white). Pan traps collected the largest raw number of flower flies and the most different species. During the study, flower flies were observed in orchards 2 to 4 weeks prior to the emergence of native bees and other pollinators. This survey is one of the first steps in discovering and documenting the diversity and abundance of flower flies in the southeastern United States. Based on other regional studies in the past, it is likely Georgia has 40-80 species. Additional surveys are needed to fill in the complete picture of the biodiversity of these important pollinators and pest-mangers.

P223 Samia Ladner, Gabrielle A. Hayes, Kristen Korankyi, Josh Campbell, Cindy C. Vigueira, Patrick A. Vigueira
Biology, High Point U, NC

Excess Power Index: A Sexually Dimorphic Trait in Bees

Sexually dimorphic traits vary between the sexes of many hymenopteran species. These differences can reflect selection for specialized biological roles, many of which have not been documented for the majority of bee and wasp species. A multitude of studies have identified insects that exhibit sexual dimorphism for a single variable trait, such as color or antennae length. The excess power index (EPI) is an estimate of insect flight performance that is inferred by the combination of a number of morphological characteristics. The EPI can be used to infer basic ecological knowledge (e.g. foraging behaviors, foraging distances flown, etc.) about bee and wasp species. We calculated the EPI of three species of bees, *Agapostemon virescens*, *Melissodes bimaculata* and *Xylocopa virginica*, and one species of wasp, *Pachodynerus erynnis*. Female bees were larger in every trait we measured in isolation. However, when these variables were combined into a single allometric variable, males had a significantly larger EPI. Male fitness may be dependent on EPI; males that have greater flight capacity can travel further in search of mates. This trend was not present in the wasp, *P. erynnis.* We will continue to explore EPI in additional bee and wasp species in order to determine if our data are reflective of a larger trend in bees and wasps.

P224 Matthew Jordan-Steele, Joshua York, Elizabeth Brown, Ashley Wagoner, Bruce Harrison, Carmony L. Hartwig
Biology, Catawba College, Salisbury, NC

Delimiting Cryptic Species of the *Anopheles crucians* Complex in the Fred Stanback Jr. Ecological Preserve at Catawba College, Salisbury, North Carolina

The Fred Stanback Jr. Ecological Preserve (FSJEP), located in Rowan County, central piedmont, is a 68 Ha natural area bracketed by the Catawba College campus, a riparian greenway, and residential areas. The FSJEP is a seasonally inundated wetland forest, with a high flora and fauna diversity that varies dramatically from the open-field ecology that was present when it was established as a wildlife refuge in 1999. Thirty seven species of mosquitoes are now known to occur in the FSJEP, which surprisingly represents 55 % of the 67 species that are currently recognized in North Carolina. Cryptic species within the *Anopheles crucians* complex occur in high relative abundance in the preserve (~ 34.1 % in 1993-6; ~ 16.6 % in 2013 collections), and are of environmental importance as potential vectors for pathogens such as West Nile virus (WNv) and Eastern Equine Encephalomyelitis (EEEv). Of the 6 species presently known to exist within this complex, species A and E were reported in the FSJEP 1993-6 collections. We therefore employed the ITS2-based PCR assay developed by Wilkerson *et al.* (2004) to investigate possible dynamic shifts in recent collections of the *An. crucians* species complex. Thus far we have determined that populations of *An. crucians* species E and a species not previously found in North Carolina, species C, are currently established in the FSJEP. Similar to earlier findings regarding species of this complex, these two members were often found in sympatry, occurring across a majority of locations tested throughout the sampling season (April-September). Ongoing efforts to investigate the presence of additional cryptic members of the *An. crucians* complex within the preserve and confirm the new species C record using DNA sequence information will enhance our understanding of mosquito diversity in the FSJEP.

P225 Richard W. Zealy, David M. Donnell
Biology, The Citadel, Charleston, SC

Investigation of Cysteine-Rich Peptides in the Parasitoid Wasp *Copidosoma floridanum*

The polyembryonic wasp *Copidosoma floridanum* produces two larval castes, soldiers and reproductives, during development within its caterpillar host. Soldier larvae defend the brood against competitors while reproductive larvae develop into adult wasps. Recent research has added to the number of cysteine-rich peptides (CRPs) identified in *Copidosoma*. Although the function of these peptides in *Copidosoma* is not yet known, the spacing of encoded cysteine residues in the CRPs resembles that of certain scorpion toxins and anti-microbial proteins identified in other organisms. We analyzed the gene structure of CRPs using bioinformatics tools and sought insight into the potential function of these molecules by analyzing differential expression patterns of the CRPs in wasp embryos, larval stages and adults using reverse transcription-PCR. We found evidence for differential expression of CRPs in larval castes and adults and discuss the significance of these findings.

P226 Rebecca Holmes, Brandon Miner
Molecular Biology/Biochemistry, Wittenberg U, Springfield, OH

A Sequence Comparison of Cytochrome Oxidase I in *Hadenoecus cumberlandicus* Populations Found in the Sloans Valley Cave System, Pulaski County, Kentucky

Sloan’s Valley Cave, located in Pulaski County, KY, is one of the largest cave systems in the Cumberland Plateau, with at least 39 km of documented passage and 16 entrances. The distribution entrances throughout the system, allow for a greater diversity of organisms to enter and exit the system, contributing to the balance of the cave's ecosystem. Hadenoecus cumberlandicus is one of several troglophiles that inhabit the Sloan’s Valley Cave. These crickets migrate within the cave throughout the year, staying deeper in the system during cold

months and closer to an entrance during warm months. At each point of their migration these crickets may have contact with outside populations; other entrance populations at interior cave locations in the cold months, and exterior populations from neighboring caves during warm months. These outside contacts allow for interbreeding of the populations, increasing the genetic diversity of a given entrance population. After collecting samples of *H. cumberlandicus* from five entrances, DNA was purified from a single hind femur from all collected samples. Regions of the COXI gene were amplified by PCR. Four of the ten UEA primers within the 1500bp segment were selected to produce two overlapping fragments to be used later to sequence about one-fourth of the gene. Amplification with primers UEA7 and UEA10 selected a 550 bp fragment and primers UEA5 and UEA8 selected a 220 bp fragment. The PCR products were purified, with a yield of 2.71∗10 -2 ng/µl determined by Abs 260 . Sequencing of these purified amplification products permits identification and analysis of single nucleotide polymorphisms (SNPs) to assess the genetic variability within and among the populations and determine the level of genetic mixing.

P227 Sara J. Farthing, Darwin D. Jorgensen
Biology, Roanoke College, Salem, VA

Using Fluorescence Microscopy to View Real Time Hemocyte Aggregation in Response to Acute Bacterial Exposure in the American Lobster

When foreign materials, such as bacteria, enter the open circulatory system of the American lobster, *Homarus americanus*, a rapid immune response is initiated. Previous studies suggest that, in the presence of bacterial cells, hemocytes produce adhesion proteins that allow them to bind to foreign material, as well as to other hemocytes, forming tight clusters referred to as nodules. Fluorescence microscopy was used to observe *in vitro* nodule formation in lobster hemolymph in response to acute bacterial challenge. We used *Vibrio campbellii* bioengineered to express green fluorescent protein (GFP), which allowed us to better-visualize the interaction between hemocytes and bacterial cells. Hemocyte responses were viewed in real-time with a fluorescence microscope using time-lapse videography. Images were taken at five second intervals over ten minutes and showed that nodule formation began to occur within one minute following the mixing of hemolymph and a suspension of *V.campbellii*. Our experiments suggest an apparent relationship between hemocyte response to bacteria and the hemolymph clotting mechanism.

P228 Elaina K. Furr, Angela M. Montalvo, Darwin D. Jorgensen
Biology, Roanoke College, Salem, VA

The Role of Tissues and Organs in the Immune Response to Acute Bacterial Infection in the American Lobster: Characterization by Confocal Microscopy

American lobsters mount an immune response to bacterial infection by releasing hemocytes (which engulf bacterial cells) into their hemolymph. In the open circulatory system of lobsters, hemolymph issues from the arterial network and bathes tissue cells directly. It is then collected into the venous system, which terminates in the infrabranchial sinus located just upstream from the gill circulation. Previous research suggests that hemocytes that have engulfed bacteria embolize, usually as aggregates, in different tissues. In our research, we acutely-challenged lobsters with *Vibrio campbellii* bioengineered to 1) be resistant to the antibiotics kanamycin and chloramphenicol (allowing us to isolate the effect of *V. campbellii* alone), and 2) express green fluorescent protein (allowing us to visualize distribution of emboli in the tissues). We used confocal microscopy to visualize hemocytes (that had engulfed bacteria) in both whole organs and thin sections of organs and tissues. The gills have been suggested as principle hemocyte sequestration sites but our results show that other organs, notably the heart and antennal glands, may be more important on a per mass basis. Other tissues also appear to play a significant role in this immune response.

P229 Areli Ibarra, Renee M. Wiggs, Victor R. Townsend, Jr.
Biology, Virginia Wesleyan College, Norfolk

Survey of Microorganisms Associated With Male and Female Genitalia of Harvestmen

Among arachnids, the reproductive biology of many species of harvestmen is considered rather unusual because males directly transfer sperm to the female via a penis. In social interactions, there is the potential for individuals to transfer microorganisms during courtship or copulation. Unfortunately, little is known about the microflora of harvestmen genitalia and no commensals or pathogens have been identified. In this study, we used scanning electron microscopy (SEM) to survey the diversity of microorganisms occurring on male (penis) and female (ovipositor) genitalia of two species of harvestman including *Cynorta marginalis* (Laniatores, Cosmetidae) and *Leiobunum formosum* (Eupnoi, Sclerosomatidae). For each species, we examined the genitalia of more than 60 adults. Copulatory organs were carefully excised with the aid of forceps and a scalpel. Prior to dehydration, specimens were not ultrasonicated or cleaned with detergents. Ovipositors and penises were chemically dried, mounted on aluminum stubs with carbon adhesive tabs, and sputter-coated with gold for 2 minutes. Specimens were examined with a Hitachi S3400N SEM at accelerating voltages of 5-10 kV. For males, we noted the occurrence of microorganisms on the stylus, glands and lateral margins of the penis. For females, we surveyed the external surfaces of the peripheral setae and the distal surface of the ovipositors. The genitalia of most individuals did not appear to be infected. However, we found several types of microorganisms on multiple individuals of both sexes including bacteria (bacillus and coccus) and fungi.

P230 Juan Morales, Erika S. Niland
Biology, Wingate U, NC

Lethal Concentration Rates of Eight Potential Entomopathogens

Beauveria bassiana is an entomopathogen that causes natural epizootics, and the GHA strain has been sold commercially for insect control. One such insect pest that this fungus could control is the kudzu bug, *Megacopta cribraria*. Current reports indicate a natural epizootic of *B. bassiana* affecting kudzu bugs in soy beans fields in GA and SC. This suggests a natural epizootic could be occurring in kudzu patches in North Carolina. This study aims to quantify the lethal concentrations of eight strains of *B. bassiana* isolated from soil samples. Preliminary mortality bioassays indicate three of the eight strains demonstrate higher mortality than compared to the positive control, *B. bassiana* GHA strain.

P231 J. Aaron Burnette, Mary Ann McBrayer, G. John Lugthart
Natural Sciences, Dalton State College, GA

Pre-Restoration Survey of Fish Diversity in a NW Georgia Lake and Wetland

A survey of the fishes in a small urban wetland and lake was conducted during May and July, 2015. The study site is within a public park in Dalton, Georgia. The lake is spring-fed and sub-divided into three basins. The entirety of the lake is bordered by mowed grass and steep, slumping banks. Within a year, a habitat restoration project will begin in which the lake banks will be stabilized and riparian shrubs and trees planted. The objective of the present study was to determine the fish species composition and relative abundances in these habitats. Following restoration, this baseline information can be compared with the results of a follow-up survey to determine if the improvements in riparian habitat had an effect on fish population structure. Sampling was conducted at multiple locations around the margins of the wetland, the lake basins, and a channel which drains the wetland. Fish were captured using hoop traps, minnow traps, gill nets, seines, cast nets, and rod and reel. Upon capture, fish were identified and measurements of length and weight were made. Water quality parameters were measured on six dates during the study. A total of 15 fish species and 378 individual fish were captured. The most common and widespread of the species was bluegill, *Lepomis macrochirus*. Eight of the other species were found in only one or two of the five sampling areas, possibly indicating

habitat selection based on water quality parameters. Species diversity was highest in the lake basin directly fed by the adjacent spring. This basin had the lowest average temperature and turbidity and highest level of dissolved oxygen.

P232 Danielle Williams[1], Elizabeth G. Dobbins[2]
[1] Chemistry, NC Agricultural & Technical State U, Greensboro; [2] Biological & Environmental Sciences, Samford U, Birmingham, AL

Sedimentation in Headwater Streams in a State Park

Headwater streams provide a tremendous source of biotic diversity.Sediment has negative impacts on stream integrity and impairs the survival of macroinvertebrate communities, which forms the base of the aquatic food chain. The deposition of sediment from dirt roads into adjacent water systems is well established, but little is known of the effects of bike trails on streams. We compared three paired headwater stream sites within one watershed at Oak Mountain State Park, in Birmingham, Al. Each contained an upstream (control) site and a downstream site, adjacent to a bike trail segment of at least 75 meters. We hypothesized that control stream sites would have less fine sediment and greater biotic richness (total taxa, sensitive taxa) and composition (percent sensitive taxa) when compared to sites downstream from bike trails. There was, however, no difference in sediment distribution between sites. All of the sites had greater than 1% of the bottom sediment composed of the finest sediments that most impact macroinvertebrates. All the macroinvertebrate metrics reflected impaired water quality and altered community structure. There was, therefore, no correlation between sediment loads and biotic richness. The surprisingly low macroinvertebrate diversity and high levels of sediment in all the sites indicate pervasive watershed problems that did not allow us to discriminate between the control and test sites. The impairment of these critical headwater streams suggests a challenge for balancing protection of stream integrity with access and recreation.

P233 Cancelled

P234 Elizabeth B Sudduth
Science & Technology, Georgia Gwinnett College, Lawrenceville

Do Stream Restoration Projects Get Better With Age?

A frequent criticism of ecological evaluations of the effectiveness of stream restoration projects is that sufficient time has not been allowed to pass for ecosystem recovery to occur. I revisited 4 bioengineered stream bank stabilization sites in the Peachtree Creek watershed in Atlanta, GA, USA that had previously been evaluated in 2002-2003 (Sudduth and Meyer, 2006) to see how physical and biological metrics had changed as the restoration sites aged. The oldest restoration site was completed 21 years prior to this follow-up study. As in the previous study, I compared the sites to other sites in the watershed: a similar still unrestored site and a reference site within a nature preserve. Most of the sites had maintained the stabilized, vegetated banks of the restoration, although the oldest restoration site had suffered erosion of previously stabilized banks. The bank macroinvertebrate communities were generally similar across all 6 sites and similar to the communities observed 12 years prior, although several new taxa, including one family of Trichoptera, were found in 2014 that were not seen in 2002-2003. As previously observed at these sites, the macroinvertebrates showed a preference for organic habitat such as wood and roots that could be created by these restoration projects. All restoration sites showed evidence of increased abundance of these habitats in 2014. As in the previous study, the limited change in the macroinvertebrate community following restoration, despite the increased availability of favorable habitat, suggests that the watershed conditions rather than the local conditions determine the bank macroinvertebrate communities in these urban streams.

P235 Tao Li, Elizabeth G. Dobbins
Biological & Environmental Science, Samford U, Birmingham, AL

Cumulative Impacts of Coal Mining on the Chemistry of the Black Warrior River

Although there is strong evidence of individual coal mining and processing operations having effects on aquatic systems, there is little known about the cumulative effects of coal mining and processing on major rivers. The Black Warrior River runs through a major coal basin. There are over 100 active, expired, or closed mining permits in the watershed. To investigate the impacts of these activities, we collected water samples in the Mulberry and Locust Forks of the Black Warrior River and performed elemental analysis with an Inductively Coupled Plasma Emission Spectrometer (Shimadzu ICPE-9000). Initial results found increases in Aluminum, Calcium, Cobalt, Iron, Lead, Magnesium, Potassium, Silicon, Sodium, Strontium, Sulfur, Thorium, and Thallium downstream of mine sites and accumulating in the river. A large coal refuse pile on the Locust Fork is also leaching Arsenic, Cadmium, Chromium, Lithium, Manganese, Molybdenum, and Nickel into the river. Our results indicate water quality degradation at a watershed scale and suggest that permitting of new mines and facilities should be addressed in the watershed context.

P236 Julia Marcellus[1], Jen Andrews[1], Kenneth Fortino[1], Matthew N. Waters[2]
[1] Biological and Environmental Sciences, Longwood U, Farmville, VA; [2] Biology, Valdosta State U, GA

Sediments Alter the Decomposition of Leaf Litter in Small Man-Made Ponds in Central Virginia

Terrestrial leaf litter can be an important resource subsidy to aquatic ecosystems. In streams, terrestrial leaf litter is well documented to increase secondary production and ecosystem metabolism, rendering many streams net heterotrophic. However, despite its established role in streams, the impact of leaf litter inputs on carbon cycling in ponds and lakes has remained largely unexplored. Small man-made lakes are very abundant in the northern hemisphere, and in regions that lack natural lakes, they represent a significant proportion of total aquatic habitat. Understanding the impact of terrestrial organic matter inputs on small man-made lakes is critical to understanding their role in carbon cycling and global change. We have found that the sediments of small man-made ponds in central Virginia contain a median density of 40 g AFDM m^{-2} of terrestrial leaf litter with 12% of the samples exceeding 400 g AFDM m^{-2}. A 44 day laboratory incubation study found that leaves decomposing on pond sediments significantly decreased their percent carbon content and increased their percent nitrogen content. Leaves not associated with pond sediments showed a similar increase in percent nitrogen content but no change in percent carbon content. Furthermore, leaves associated with the sediments lost 47% of their initial mass, while those incubated in just pond water lost only 30% of their initial mass. These results suggest that the sediment environment of small man-made ponds may accelerate leaf decomposition.

P237 Paul T. Stankus, Angela H. Lindell, John C. Seaman, J Vaun McArthur, Dean E. Fletcher
Savannah River Ecology Laboratory, U Georgia, Athens

Effects of an Industrial Basin Overflow on Trace Element Accumulation in Sediment and Biota of a Coastal Plain Stream

An industrial sedimentation basin holding contaminated sediments overflowed for the first time following record rainfalls in 2013, potentially contaminating an adjacent Coastal Plain stream. We evaluated 16 trace element concentrations in sediment and biota collected downstream of the basin before and one year after the overflow event. Additionally, sediments from an upstream beaver pond were analyzed to assess possible effects of upstream contaminant sources. Analysis of dragonfly nymphs (7 genera), crane fly larvae (1 genus) and crayfish (3 species) verified whether contaminants detected in sediments were bioavailable and entered the stream food web. Dragonfly community composition, size frequencies, and head width-weight relationships were compared between years. In coarser sediments of swift runs, few

element concentrations increased between years and rarely exceeded Ecological Screening Values (ESV). Slower pools represented depositional zones where finer sediments with more organic matter and clay settled out, as did higher trace element concentrations. Organic matter, clay content and correspondingly most trace element concentrations increased between years in depositional zones resulting in more samples exceeding ESVs. The organic matter rich sediments of the upstream beaver pond contained substantially higher contaminant concentrations with more samples exceeding ESVs. Contaminant sources upstream of the basin are evident, but remain to be identified. Modest shifts in dragonfly community composition were noted with a decrease of a more sensitive genus. Body mass relative to head width also decreased between years in this genus. Genus and element specific patterns of accumulation occurred among all study organisms. Overall, increased concentrations between years were evident. Biotic-Sediment Accumulation Factors for most elements decreased between years across all taxa consequent to biota concentrations increasing at lower rates than in sediment. This work illustrates the dynamic nature of stream systems and the need of watershed level evaluations.

P238 Josephine B Anthony, Lauren E Turbyfill, Richard L Mahon, Ashley Gaynor, John Hains
Biological Sciences, Clemson U, Clemson, SC

Observations on the Fecundity of *Bellamya japonica*, a New Invasive Species in the Savannah River Basin

Bellamya japonica, the Japanese mystery snail, is an invasive species in Lake Hartwell, and this is the only reported occurrence in the Savannah River Basin although it is widespread in other parts of the United States. Our project focused on the continued study of fecundity rates through weekly observations to determine seasonal effects on fecundity. Fecundity is the fertility of a species and its ability to produce successful offspring. Fecundity is an important parameter of population growth because it contributes to the increase of a population and must be known in order to calculate population dynamics. For invasive species fecundity is important to the ability of a species to spread through a new environment. The more efficient a species is at reproducing increases its ability to populate an area and to compete with native species. For *B. japonica* there has been little previous research on its fecundity rate. To collect data on the fecundity rate of *B. japonica* over time previous groups designed a collection of 25 in situ chambers to house individual female snails. Each female had its mass, volume, and diameter recorded before being placed in its own chamber. Each female also received a unique tag. The chambers are checked weekly throughout the school year to observe how many baby snails are produced. All of the data is recorded and shows that the snails are most productive during the warmer months and production declines during the colder months. This leads us to conclude that the snails would have the most offspring during the summer when water temperatures are the warmest. The data from multiple Creative Inquiry teams has been combined and this project will continue until there is data for a full year.

P239 Andrea Sanchez, Abbie Tomba
Biology, U of Mary Washington, Fredericksburg, VA

Determining the Molecular Weight of the Alarm Cue in the Crayfish *Cambarus acuminatus* Using a Behavioral Assay

Chemical signals play an important role in aquatic ecosystems. Crayfish in particular use chemical signals to find food, mates and sense danger. Alarm cues are chemical signals used by a wide variety of organism to detect predation. In crayfish the alarm cue is a conspecific damage released signal. Response to alarm cues in crayfish is well documented and includes a decrease in locomotion, feeding and increase in time spent in defensive positions. However, there is limited research on the identity of the alarm cue. Previously we determined that the alarm cue is present in the hemolymph of the crayfish *Cambarus acuminatus* as demonstrated by decreased locomotion. In this experiment we used a paired design to determine the molecular weight of the alarm cue in *C. acuminatus* by using a behavioral assay and hemolymph fractioning. Crayfish were collected from Horsepen Run (Stafford Co. VA) and

divided into donors and trial subjects. The hemolymph was first separated into fractions of >30kda and <30kda through centrifugation creating two size treatments. Treatments were prepared by combining food odor with fractioned hemolymph to be injected into the tanks. Food odor was used to stimulate crayfish's locomotion. Crayfish locomotion was observed for four minutes, including two minutes after injection of the control (water), followed by two minute after addition of the selected treatment. Locomotion was determined by the amount of time the walking legs were moving. Mean change in locomotion (treatment-control) was compared between the two size treatments. The same methods were used to conduct another paired experiment using >10 kda and <10 kda fractions. We hypothesize that the alarm cue is found in the hemolymph and is between 30 kda and 10 kda. Preliminary results show a trend that the alarm cue is less than 30kda.

P240 Sarah Fishburne, Jacob Bartell, John Hains
Biological Sciences, Clemson U, Clemson, SC

Observations on the Metabolism of *Bellamya japonica*, a New Invasive Species in the Savannah River Basin

In spite of its expanding range and ecological importance as an invasive species in North America, little is known about the Japanese Mystery Snail, *Bellamya japonica*, as an invasive species. While our research includes ecological investigations of distribution, behavior, and fecundity, we also are studying their basic biology related to growth and metabolism. At this time we have begun to estimate respiration rates. Once cleaned, each specimen is placed in a sealed chamber with an optical dissolved oxygen probe and filled with water from Lake Hartwell. A separate chamber without a specimen is employed as a control for any oxygen consumption by organisms in the water. Our study employs water at room temperature (21°C). The water is allowed to equilibrate to room temperature to prevent it from being supersaturated with oxygen as it warms. Oxygen consumption rates are then measured over a period of 24 hours. Results are calculated on a volumetric basis and related to organismal mass. We hypothesized that there is a linear relationship of organismal mass to the respiration rate. We also hypothesized that respiration would predictably increase with temperature and that there would be both upper and lower limits to this trend. Our results thus far indicate that the mass relationship is linear but we have not yet completed enough observations to identify the thermal relationship or the metabolic-thermal limits. Our plans are to extend this research to identification of these and other metabolic niche characteristics for this invasive species.

P241 John Hutson, Kyle Kilpatrick, Nike Pappas, Jake Laird, John Hains
Biological Sciences, Clemson U, Clemson, SC

Population Dynamics of *Bellamya japonica*: An Experimental Investigation of Sources of Mortality

Although native to southeast Asia, the *Bellamya japonica*, the Japanese mystery snail, was first introduced to North America in the late 1890s. *B. japonica* was first discovered in the state of South Carolina in 1995 and can now be found in the Savannah River Basin as well as other areas throughout the United States. This live-bearing snail is prospering in many locations, including Lake Hartwell. Over the course of the last 2 years we have analyzed the shell dimensions of snails found in Lake Hartwell in order to determine if there are allometric relationships between mass, length, and volume. We have also begun estimating their fecundity. Our current experiment investigates mortality of the snails. The mortality rate, along with fecundity, influence or control the dispersal and life cycle of the species. Lower mortality rates may allow greater population growth and may allow the species to disperse at a greater rate. These details give us clues to the future of the snail and the possible problems it could cause. Calcium may be a limiting element in the environment and the snails in Lake Hartwell may have calcium limited loss of shell integrity. Our hypothesis is that their inability to maintain their shells results in an increase in the mortality of the snails. In our experiment we sealed the erosions of a captive population and compared this with a separate untreated captive population. Initial results have shown that there are no benefits to the snails with the polymer, in

fact the snails with the polymer have died off at a greater rate than the snails without polymer. However, the number of observations is still low and we will continue this line of inquiry.

P242 Melissa Pompilius, Robert U. Fischer
Biology, Middle Tennessee State U, Murfreesboro

The Effects of Temperature on the Exotic Zooplankton *Daphnia lumholtzi*

Daphnia lumholtzi is an exotic crustacean zooplankton that was inadvertently introduced to the US during the stocking of African sport fish into Texas reservoirs. Unlike most introduced species, *D. lumholtzi* quickly became established in US waterways, and continues to spread with exceptional speed throughout diverse aquatic habitats that include coastal estuaries, major river systems, the Great Salt Lake and the Great Lakes. Although *D. lumholtzi's* range expansion has been well-documented, it is not clear what characteristics contribute to this high colonization potential across such a wide geographic range. In this study, we compared life history traits at 23°C versus 30°C in clones of *D. lumholtzi* collected from the Mobile-Tensaw estuary in Alabama and Pickwick reservoir in Tennessee. At 23°C, median lifespans were similar (range 24-27 days), while generation time (range 16-21 days) and lifetime reproductive potential (range 28–49 offspring/ female/ generation) varied among all three clones. Preliminary results indicate that at 30°C, age of first reproduction decreases, coupled with a lower median lifespan (19-22 days in estuarine clones). High variability in life history traits within *D. lumholtzi* populations may be an important factor facilitating their range expansion.

P243 Donna K. McCullough, Ellen C. Tomlin, Kimberly T. Wright, Jill G. Schulze, Nancy E. Dalman
Biology, U North Georgia, Dahlonega

Variation in Parrotfish Species Abundance and Sex Ratios among Multiple Reefs of Calabash Caye, Belize

We investigated the sex ratios of six species of parrotfish (Family Scaridae) at multiple reef sites off the coast of Calabash Caye, Belize. All species are protogynic hermaphrodites, meaning they begin their lives as "initial phase" females and change to "terminal phase" males. Parrotfish graze directly on coral to consume tiny symbiotic algae living inside the coral. Parrotfish also feed on large algae growing on the reef. The tiny coralline algae compete with the large algae for sunlight. By feeding on the competitors of coralline algae, Parrotfish play a key ecological role in the health of coral reefs. Males must consume more food than females in order to maintain their larger body sizes and meet the energy demands of competitive behavior associated with the harem social system of Parrotfish. We hypothesized that greater ratios of terminal males would occur at deeper reefs, which generally have greater biomass and food supplies, than at shallow reefs. We elected four reef sites which varied in depth from 5' to 30': one shallow, two intermediate, and one deep. We surveyed the species along randomly chosen 20m linear transects for the same total amount of time at each site. We identified initial and terminal phase individuals on the basis of established coloration differences. The percentage of terminal phase males ranged from 23-39% at the intermediate and deep sites, but was only 3% at the shallow site, supporting our hypothesis. We observed 71-100% male Queen Parrotfish at the intermediate and deep sites. Two species, Stoplight and Princess, were twice as abundant as the other species at all sites. The lack of males at the shallow reef may reflect an environment lacking sex change cues, insufficient food, or a recent dispersal event. The absence of female Queen Parrotfish may be a concern for population sustainability.

P244 Mark S. Schorr[1], Dan Huser[2], Josuha B. Smith[2]
[1] Biology, Geology & Environmental Sciences, U of Tennessee at Chattanooga; [2] Limestone Valley Resource Conservation and Development Council, Fort Oglethorpe, GA

Influence of Perched Road Culverts on the Abundance of Blacknose Dace (*Rhinichthys atratulus*) in Blue Ridge Streams in Cherokee National Forest, Tennessee

We studied culvert-related effects on habitat features and *Rhinichthys atratulus* (Blacknose Dace) abundance in eight headwater streams (Tennessee and Conasauga river drainages) in Cherokee National Forest (Blue Ridge ecoregion), Tennessee, May-August 2008. Four stream sites had perched culverts with artificial bottom substrates (concrete or metal) and four sites had non-perched culverts with natural bottom substrates (mainly gravel/cobble). At each site, paired sampling reaches (spaced >100 m apart) were established upstream (50 m above) and downstream (50 m below) of the culvert. Each sampling reach was approximately 35 times the mean stream width and at least 100 m in length. Culvert-related effects on environmental and fish abundance data were analyzed using a nested randomized-block analysis of variance (ANOVA). Reaches downstream of perched culverts exhibited increased water depths, reduced gravel/sediment depths, reduced cobble substrates, and reduced Blacknose Dace abundances (compared to upstream reaches; $P < 0.05$, ANOVA). In contrast, reaches upstream and downstream of non-perched culverts had similar habitat features and fish abundances ($P < 0.05$, ANOVA). These data suggest that perched culverts altered the local habitat features and abundance of Blacknose Dace, whereas non-perched culverts had no measureable effect on the habitat or fish abundance in the study reaches. Our findings suggest that reduced upstream abundance of Blacknose Dace is probably related in part to physical barriers associated with perched culverts during base-flow conditions (vertical distance from stream to lower end of culvert; faster current velocity in culvert; reduced depth in culvert).

P245 Teresa Nguyen, Abbie Tomba
Biology, U of Mary Washington, Fredericksburg, VA

Digenetic Trematodes of Eastern Virginia: an Ode to DNA Barcoding

Digenetic trematodes parasitize organisms from a variety of taxa, primarily using snails as intermediate hosts and vertebrates as definitive hosts. Within Eastern Virgina, common intermediate hosts include, *Elimia virginica* and *Leptoxis carinata* (Gastropoda: Pleuroceridae).There is evidence that these parasites have behavioral and physiological effects on their intermediate hosts, such as increasing food consumption and castration. These effects imply that trematodes could have larger ecological effects, with potential variation between each species. The identity of individual trematode species that parasitize snails within the Rappahannock and Little Rivers (Fredericksburg, and Hanover Co., VA) remains unknown due to the morphologically cryptic larval stages present inside the snail hosts. However, DNA barcoding using the cytochrome c oxidase (COI) gene makes species identification possible. In previous work, we isolated DNA from 3 potentially different trematode taxa, 1 of which belongs to the order Echinostomatidae with the other 2 belonging to the family Collyriclidae. For this study, additional larval COI gene sequences will be isolated and COI sequences from adult trematodes will be compared to those of the larval stages. Snails and fish were collected from the Rappahannock River. From the snails, we isolated 12 larval trematode samples. Three of the samples were germ balls, 3 were sporocysts, and the other 6 were sporocytes that had shed cercariae. Based on the morphology of those 6 cercarial samples, we determined that there are at least 2 taxa. Five of these 6 had cup tail cercariae and the sixth cercaria sample had a monofurcated tail. Previously, we had dissected 159 fish from the Rappahannock River site. Three of these fish, all *Notropis procne*, yielded adult trematodes. DNA analysis of these 12 larval samples and the adult samples is still ongoing.

P246 Cancelled

P247 Joseph Oyugi
Natural Sciences, Gardner–Webb U, Boiling Springs, NC; Zoology – Ornithology Section, National Museums of Kenya, Nairobi

A Comparative Study of Disturbed and Undisturbed Forest Patches: Variation in Bird Communities Within a *Brachsytegia* Woodland

The Arabuko-Sokoke Forest in the eastern Kenya is one of the few remaining indigenous forests in Kenya, and one of the largest extant fragments of a coastal forest that once covered much of the East African coast. The forest is ranked by Birdlife International as the second most important forest for bird conservation in mainland Africa and forms part of the Eastern Arc Forest Ecosystems – one of the globally recognized biodiversity hotspots in eastern Africa. I used mist netting to assess bird species composition in disturbed and relatively undisturbed forest patches within the *Brachystegia* woodland of the Arabuko-Sokoke Forest. A total of 16 bird species were recorded from 8 mist netting session (4 sessions in disturbed and undisturbed forest patches respectively). Both disturbed and undisturbed patches exhibited similarities in species richness (12 vs. 12 bird species). However, 4 forest specialists, 4 forest generalists and 4 forest visitors were recorded in undisturbed patches. 2 specialist species, 6 forest generalists and 3 forest visitors were netted in disturbed areas. The overall bird species composition and diversity did not differ significantly between these forest patches, but differences in species composition of different strengths were evident between the sites.

P248 Johanna P. Cotter, E. Natasha Vanderhoff
Biology and Marine Science, Jacksonville U, FL

Anthropogenic Sound Pollution and Northern Cardinal Calls

The effect of anthropogenic sound pollution on animals has been well documented, particularly as it relates to bird song. Many birds will shift the frequency of their songs to compensate for low-frequency sound pollution. Less attention has been paid to bird calls. We examined whether or not Northern Cardinal *chip* calls are affected by noise pollution. We recorded cardinal calls and at the same time collected ambient noise data to determine if there was a correlation between calls and anthropogenic sound. We did not find a strong relationship between call frequency and noise levels. Cardinals may do better in urban areas than other birds with lower frequency calls.

P249 Kelly M Livernoche, Heather P. Griscom
Biology, James Madison U, Harrisonburg, VA

Does Sustainable Pasture Management Increase Soil Carbon? Implications for Climate Change

Cattle pastures have the potential to be substantial carbon sinks, sequestering atmospheric carbon dioxide and storing it long-term in soil. While industrial agricultural practices tend to consistently release carbon dioxide though continued soil disturbance, more sustainable methods can be implemented to increase carbon sequestration. Rotational cattle pastures, ones in which cattle are moved periodically between enclosed sections of the pasture, are suspected to improve soil carbon content compared to conventional, free-range cattle pastures. This increased carbon sequestration pathway is two-fold: 1) increased distribution of manure increases plant biomass and 2) increased cattle movement decreases soil compaction, thereby erosion. More carbon is predicted to be contained within the soil and plant biomass that otherwise would have been released as carbon dioxide. The purpose of this study is to compare soil carbon content with respect to slope position and slope aspect between three pasture management types: 1) a high frequency rotational cattle pasture; 2) a low frequency rotational cattle pasture; 3) a conventional cattle pasture with no rotation, each with a forested control site. Soil samples will be collected from top, middle, and bottom slope positions at depths of 0-10, 10-20, 20-30, and 30-40 cm. The prediction is that overall soil carbon will be greatest in the forest control sites followed by the high frequency rotational pasture. Soil carbon in the conventional pasture is expected to be the lowest, particularly at the bottom slope position

where cattle tend to congregate when not actively rotated. Rotating cattle is believed to greatly improve overall soil health by increasing plant biomass and reducing erosion. This study will determine whether rotational pasture systems increase carbon sequestration thereby mitigating climate change.

P250 Anna E. Nordseth
Biology, James Madison U, Leesburg, VA

Effects of Leguminous and Timber Shade Trees on Coffee (*Coffea arabica*: Exploring Plantation Diversification

Coffee (*Coffea arabica*) is the second most traded commodity crop worldwide with cultivation covering 11 million ha in the tropics. Although coffee originated as an understory plant, its production has shifted to intensive, full sun plantations. In recent years, shade has been 'reintroduced' into coffee plantations through the implementation of agroforestry systems. Effects of shade on coffee vary greatly with local climate and also with the specific shade tree characteristics. Leguminous trees are the most widely used shade trees but timber species are being increasingly utilized because they can add to plantation profitability. This study seeks to compare the effects of leguminous and timber trees on coffee—specifically with regards to competition for soil nutrients. A single coffee seedling will be planted in a 2 gallon pot with a seedling of either a leguminous species, *Inga densiflora*, a timber tree, *Eucalyptus deglupta* or *Cordia alliodora*, or alone. Soil analysis determined that a Lodi silt loam would most closely resemble soils commonly found on suboptimal coffee sites, with similar levels of macro and micronutrients. Greenhouse conditions will mimic suboptimal coffee growing conditions with mean temperature of 25°C, 3500 mm annual precipitation and a dry season from January to March. Height, leaf area, and diameter of coffee and shade tree seedlings will be monitored throughout the first year of growth in a greenhouse environment. Soil nitrogen will also be measured. We anticipate that coffee seedlings will grow equally well with timber trees as with leguminous trees or alone. If timber species have no deleterious effects on coffee growth, they could be incorporated into coffee agroforestry systems in replacement of full sun systems. Additionally, utilization of timber shade trees would diversify farmers' incomes, protecting them against fluctuations that often accompany the coffee market.

P251 Megan Budnik, Andrew Sharp, Heather P. Griscom
Biology, James Madison U, Harrisonburg, VA

Experimental Trials with American Chestnut Hybrid Seedlings in an Appalachian Cove Forest

The American chestnut, *Castanea dentata,* was a foundation species in the eastern United States prior to a devastating fungal blight. After many years of functional extinction, The American Chestnut Foundation (TACF) has produced potentially blight-resistant hybrids ("Restoration Chestnuts 1.0"). We conducted an experimental study in an Appalachian cove system of West Virginia in which we created four small (40% light) and four large (60% light) gaps by cutting canopy trees and clearing all vegetation. In March 2014, we planted seeds, protected by aluminum flashing tubes, within the 8 fenced plots but seed predation was greater than 85% in 7 of the 8 plots. One year later, we planted 50 hybrid chestnut container seedlings within the same plots. Large gaps, due to their higher light levels, were predicted to have more intense competition with herbaceous species. In each plot, half the seedlings were planted within landscape fabric to quantify the effect of herbaceous competition. We randomly placed 12'' tree shelters around half of the seedlings to quantify the effect of rodent girdling on growth and survival. After one growing season, chestnut survival across all plots was 91%. Seedlings in large gaps were significantly taller (mean = 48.99 cm) than those grown in small gaps (mean = 46.29 cm) ($p=0.035$). Landscape fabric and canisters had no effect on measured growth variables. We predict that in subsequent growing seasons, the overall height of chestnuts in large gaps will suffer due to more intense competition or physical crushing by *Rhubus spp.* Continued monitoring is critical to understand how these trees will respond to different management treatments as they grow beyond the seedling stage.

P252 Jonathan P. Evans[1], Callie A. Oldfield[1], Kristen K. Cecala[1], J. Kevin Hiers[2], Christopher Van De Ven[3], Meg M. Armistead[1]
[1] Biology, Sewanee: The U of the South, TN; [2] Environmental Stewardship and Sustainability, Sewanee: The U of the South, TN; [3] Earth and Environmental Systems, Sewanee: The U of the South, TN

Effect of Topography on White-Tailed Deer (*Odocoileus virginianus*) Herbivory Across a Plateau Landscape

Across the eastern United States, increasing white-tailed deer (*Odocoileus virginianus*) populations can have significant effects on long-term forest regeneration. Deer herbivory patterns are variable across a landscape due to patterns of deer distribution and movement as related to habitat patchiness and topographic features. The relative importance of landscape features associated with topography in controlling the heterogeneity of deer browse is poorly understood. At a landscape scale, when deer population densities are high, deer herbivory can cause saplings to be generally underrepresented in plant communities, allowing sapling density to be used as a measure of deer impacts on forest regeneration within natural areas. In this study, we examined the heterogeneity of deer herbivory as it affects sapling densities across a landscape characterized by a single forest type on the Cumberland Plateau. The study site is surrounded on three sides by steep bluff punctuated by stream drainages; the fourth side quickly transitions from forest to developed land. The objective of this study is to contrast the relative importance of topographic features that restrict deer movement to that of habitat edge as landscape-level drivers determining the heterogeneity of deer herbivory on tree saplings. We used a stratified random design to sample points across the landscape for sapling density in 2012 and 2015. We modeled sapling density relative to topography, edge, and deer culling related to adaptive management strategies. We found that the intensity of deer herbivory varies widely over the landscape, with the fewest saplings in forested areas surrounded by suburban development and associated edge habitat. Our model predicted that plateau accessibility measures were the most important in determining sapling densities, followed by distance from edge and deer culling. For managers of contiguous uniform habitat, our results suggest that it cannot be assumed that herbivory impacts will be homogeneous if the habitat is constrained by topographic barriers.

P253 Lauren Childress, Jennifer Koslow, David Brown
Biological Sciences, Eastern Kentucky U, Richmond, KY

Comparison of the Application of Two Herbicides as a Management Strategy for Running Buffalo Clover (*Trifolium stoloniferum*)

Running Buffalo Clover (*Trifolium stoloniferum* Muhl. ex Eaton) is a federally endangered species native to the midwestern and southeastern United States. It is thought that historically *T. stoloniferum* was common, but after European settlement, populations decreased until near extinction. Conservation efforts for *T. stoloniferum* have been hampered due to lack of evidence-based management strategies. It is thought that *T. stoloniferum* is a poor competitor, therefore, to design an effective management strategy, we applied herbicides that target competitor species to restoration plots of *T. stoloniferum*. We hypothesized that herbicide application would reduce the competition *T. stoloniferum* experiences and allow populations to increase in size. Two post-emergent herbicides (Fusilade II and Butyrac 200) were applied to a *T. stoloniferum* population established in 2012 at Taylor Fork Ecological Area in Central Kentucky. The study included thirty $1m^2$ plots, each planted with four propagated *T. stoloniferum* plants. Treatments included application of Butyrac, Fusilade, and control (no herbicide). Treatment application occurred once a year for three years. Effects of herbicides were determined by comparing total stolon length, number of inflorescences, and number of rooted crowns recorded over three years. Results suggest *T. stoloniferum* treated with Fusilade were more successful (more rooted crowns) than those treated with Butyrac and those not treated with herbicide. Furthermore, *T. stoloniferum* treated with either herbicide had more inflorescences than control plants. Results suggest herbicide application increases population size and is an effective and efficient way to manage *T. stoloniferum*.

P254 Melissa E. Encinias, Gregory M. Mansour, Matthew W. Riordan, Walker S. Webster, Dean Cocking
Biology, James Madison U, Harrisonburg, VA

Ambient Detectable Mercury Within the Habitat of "uncontaminated" Terrestrial Forest Ecosystems in Rockingham Co., VA

Industrial mercury contaminates the South River within Waynesboro VA. Elevated terrestrial total mercury (THg) concentrations are documented in South River Science Team studies. Floodplain soils downstream from the point source in Waynesboro range from 6–14 μgTHg•g^{-1} at several sites and garden crop soils 20 km downstream contain as much as 40 μgTHg•g^{-1}. Significant mercury contamination was not expected 50 km away in Rockingham County, and this was assumed to be a suitable control for a survey of airborne mercury deposition. In several studies, the JMU Mercury Research Laboratory used an inexpensive passive multi-site sampling method involving inverted plastic petri dishes containing Tangletrap® adhesive substrate to collect particulates, vapor and other airborne THg. It turned out that Hg in detectable amounts occurred both in Harrisonburg, making it a low level (rather than zero) control and Waynesboro. Ultimately 85 locations in Harrisonburg and Rockingham Co. have been sampled for airborne deposition. Three sites with detectable THg were selected for more detailed analysis of airborne, soil and duff concentrations. Detectable mercury presence in invertebrate biomass is quantified in the companion poster. Preliminary analysis in Summer 2014 found airborne THg deposition on the order of 0.4- 0.7 μg•$m^{-2}$$mo^{-1}$, with 0.04 μgTHg•$g^{-1}$ in soil, and 0.02 μgTHg•g^{-1} in the duff. This is consistent with multiple control sites along the South River near Waynesboro. Concentrations around 0.1 μgTHg•g^{-1} occurred in a low mercury control plot on the floodplain at the Augusta Forestry Center in a 2006 study of garden crops. In our 1999 study of woody floodplain plants in Waynesboro, the control location upstream from the point source also contained 0.1 μgTHg•g^{-1}, while in an 1986 study, the upstream control was 0.2 μgTHg•g^{-1}. Therefore detectable THg is present in soils of Rockingham Co. habitats, but these background concentrations are significantly lower than contaminated floodplain soils.

P255 Gregory M. Mansour, Melissa E. Encinias, Matthew W. Riordan, Walker S. Webster, Dean Cocking
Biology, James Madison U, Harrisonburg, VA

Ambient Detectable Mercury Within the Invertebrate Biota of "Uncontaminated" Terrestrial Forest Ecosystems in Rockingham Co., VA

Forest ecosystems in the Shenandoah Valley of Virginia are not directly exposed to major sources of mercury (Hg) contamination. Therefore, Harrisonburg, located in Rockingham County in the Shenandoah Valley of Virginia, was thought to be a suitable control habitat for comparison of Hg concentrations with sites studied in Waynesboro, VA. As detailed in the companion presentation, these were not "zero concentrations;" low detectable Hg does occur under these background conditions. Three locations in Rockingham Co. were examined in 2014 with the focus being to characterize differences in Hg concentrations of multiple components of the invertebrate community. All samples were air dried, digested with nitric/sulfuric acid at 95 - 98°C, and then analyzed with a Perkin-Elmer FIMS spectrophotometer. Preliminary surveys during the summer of 2014 identified greater than 0.05 μgHg•gdw^{-1} concentrations associated with a variety of beetles, hornets, small samples of centipedes and millipedes, thunder and peacock flies, and also pill and stink bugs. Japanese beetles, ants, spiders, wasps, bees and daddy-longlegs exceeded this baseline with some having 0.20 μgHg•gdw^{-1} or greater content. However, common house flies, moths, butterflies and yellow jackets did not contain Hg at these concentrations. Summer 2015 collections are presently being analyzed to produce larger sample sizes in order to expand and refine this data base. It is anticipated that the tendency toward greater Hg content within higher trophic levels will continue to be demonstrated in the final analysis. It is thought that none of the concentrations attained at these Rockingham Co. sites are great enough to be considered a health hazard and no adverse effects on the biota were observed. Mercury is identified as

merely associated with these organisms; this study does not confirm whether the association is superficial or internal.

P256 Logan Clark[1], Marietta Shattelroe[2], Kristin Barton[2], Zack E. Murrell[1], Jennifer Rhode Ward[2], Matt C. Estep[1]
[1] Biology, Appalachian State U, Boone, NC; [2] Biology, UNC at Asheville

Assessing Genetic Diversity in *Spiraea virginiana*

Spiraea virginiana Brit. (Rosaceae) is a rare clonal shrub found along Cumberland, Tennessee and Ohio River drainages in isolated populations. Reproduction is mostly asexually by ramet formation with occasional dispersal downstream, and neither artificial nor pollinator-mediated crosses typically produce viable seeds. Morphological studies indicated some fidelity to river drainages, but this hypothesis was not supported by RAPD and ISSR based genetic studies. Those studies indicated that there was greater genetic variation in the southern portion of the range. Small-scale seed germination studies indicate that the species does produce some fertile seeds, but seedlings are not seen in the wild or planted genets, suggesting that the major means of dispersal is by dislodged rhizomes. The species does appear to be able to outcompete other shrub species by vigorous rhizome production that can withstand scouring floods. This study aims to assess the genetic diversity between populations across the range of the species using microsatellite markers and small numbers of individuals per population to better understand the genetic diversity of this threatened species.

P257 Erin R. Smarr, Edward B. Mondor
Biology, Georgia Southern U, Statesboro

Flower Power: Does Methyl Jasmonate Induce Extrafloral Nectar?

Plants have evolved multiple mechanisms to defend themselves against herbivorous insects. Methyl jasmonate is a plant compound that plays an important role in plant defense, as it upregulates defensive pathways that reduce herbivory (by activating proteinase inhibitor genes than interfere with insect digestion). This plant compound, however, has multiple systemic effects in a plant, such as influencing flowering, seed, and fruit maturation. Many plants, like Broad bean, *Vicia faba* L., have a defensive mutualism in which extrafloral nectaries (EFNs) attract and retain predatory insects, such as ants, for defense. It is not clear the degree to which methyl jasmonate alters this mutualistic defensive pathway; i.e., EFN secretion rates. Here we show that EFN secretion rates significantly increase in Broad bean plants in response to exogenous applications of methyl jasmonate. This result did not appear to be dose dependent, as even the lowest levels of methyl jasmonate increased EFN secretion rates. Thus, methyl jasmonate has the potential to alter defensive mutualisms between plant and predatory arthropods through mutualistic defensive pathways.

P258 Susan H. Tinch, David W. DesRochers
Natural Sciences, Dalton State College, GA

Evaluating Bird and Plant Communities of a Degraded, Urban Wetland

The United States has lost over 50% of its wetlands. These ecosystems play key roles in climate, hydrology, and provide habitat for many forms of wildlife. To help better understand their role in the environment and bolster conservation efforts, I surveyed the breeding bird and vegetation communities at a degraded, urban wetland in Northwest Georgia in 2015 as part of an ongoing restoration effort to establish baseline information for these groups. I conducted point count surveys for the breeding birds to determine species richness, abundance, and I calculated a Simpson's Diversity Index with these data. For the vegetation survey I recorded species observed along transects and collected species not observed along transects. I observed 24 bird species during the point count surveys, four were obligate wetland bird species and seven were facultative, the average maximum abundance per species was 4.33 (±10.11), and the Simpson's Diversity Index was 2.55. The vegetation survey yielded 13 sedge and two rush species. Bird data suggest a decrease in diversity from a previous study specifically in use by

obligate and facultative species. Alternatively, the plant community has diversified. Further research is underway to evaluate the wetland's use by birds outside of the breeding season.

P259 Esther Medrano, Savannah Chiarello, Heather Joesting
Biology, Armstrong State U, Savannah, GA

Investigating Spatial and Diurnal Patterns for the Sand Dune Shrub *Croton punctatus* in Georgia

The coastal sand dune habitat is characterized by a unique combination of abiotic factors that vary both spatially and temporally, which can create a harsh environment for plant growth and reproduction. Thus, native sand dune plants should possess morphological and physiological adaptations to cope with the abiotic environment. *Croton punctatus* is a woody shrub commonly found in the sand dune habitat of Georgia barrier islands and likely plays an important role in dune creation and maintenance. However, little research has been done on how this species adapts to the sand dune environment. The purpose of this study was to determine if there were spatial and/or diurnal patterns in leaf and plant morphology and physiology for *C. punctatus* on Sapelo Island, Georgia in June and July 2015. Specifically, leaf and plant morphology were compared between plants occupying the windward and leeward side of sand dunes to investigate potential spatial patterns, and leaf photosystem efficiency (proxy for photoinhibition) was measured every two hours to investigate potential diurnal patterns in leaf physiology. Results showed significantly larger, thicker leaves with more trichomes on top and bottom leaf surfaces in June and significantly greater plant area in July for plants on the windward side of dunes, as well as significantly greater leaf chlorophyll content in June for plants on the leeward side, suggesting that there are spatial patterns in plant and leaf morphology. Furthermore, there was a significant diurnal pattern in leaf photosystem efficiency, with decreases at midday in both June and July, indicating that midday photoinhibition occurred in both months. However, midday photosystem efficiency values were near the lower limit for healthy leaves (i.e., no photoinhibition), suggesting that *C. punctatus* leaves did not experience substantial midday photoinhibition in the sand dune habitat.

P260 Austin M. Thomas, Michael D. Madritch, Ray S. Williams
Biology, Appalachian State U, Boone, NC

Goldenrod Stem Gall Fly Induction of Terpenes and the Colonization Preference of *Solidago* Specialist Aphids in the Genus *Uroleucon*

Host specific insect colonization and feeding stimulants are key aspects of plant-insect interactions. Volatile compounds such as terpenes are often used by plants as insect herbivory deterrents, though terpenes can also act as semiochemicals, both priming nearby plants and acting as colonization triggers for insects. Often insects that use terpene signals are host specialists. Furthermore, specialist phytophagous insects may have the ability to avoid inducing host defenses. In this study we focused on the interactions of tall goldenrod, *Solidago altissima*, the goldenrod stem gall fly, *Eurosta solidaginis*, and specialist aphids in genus *Uroleucon*. Prior research demonstrated that *E. solidaginis* induces a terpene response in *Solidago* and *Solidago* specialist aphids preferentially colonize ramets with high terpene production. In this system the ramet's chemical response to the gall fly may function as an allomone deterring the inducing species, while simultaneously also functioning as a kairomone, signaling aphid colonization. Using spatial mapping techniques we constructed a biologically-based model of interspecific induction in a patch of *S. altissima* driven by *E. solidaginis* gall formation to predict areas of aphid colonization. Measurements made via gas chromatography analysis of plants sampled at varying distances from *E. solidaginis* galls were used to develop a spatial model of terpene induction within the patch. To map estimated aphid abundance within the patch, ramets were sampled on a grid transect and aphid counts were made and adjusted for ramet biomass at each sample point. The model demonstrates the kairomone function of the terpene response. The model-based map was compared with the map of field observed aphid abundance via fuzzy kappa comparison to reveal concordance (Fuzzy Kappa: 0.344, Average Similarity: 0.570). This

indicates the induction model accounts for a substantial portion of biological factors driving aphid colonization preference and lends support to a co-evolutionary relationship.

P261 Brian L. McPherson, Clinton S. Major, Joel Borden, Kelly Major
Biology, U of South Alabama, Mobile

Influence of Disturbance on Plant Community Structure and Biological Invasion in the Riparian Zone of the Mobile-Tensaw Delta

Although the East Gulf Coastal Plain is recognized for its high degree of endemism, relatively little is known about the environmental circumstances and ecological processes that promote long-term maintenance of diversity and ecosystem integrity in this region. With this in mind, we designed this project to investigate patterns in plant diversity in the Mobile-Tensaw Delta (i.e., a region of Alabama characterized by varied and unique habitat types, a high number of endemic species, as well as high biodiversity). We've taken a multi-scaled approach that consists of an intensive monitoring plan with sampling plots along geographic gradients in the transition zone between aquatic and terrestrial habitats. Two major questions have guided our work: 1. How do floristic diversity, community structure, and environmental characteristics vary with time (season and year) and space (E-W, N-S) in the disturbance-prone floodzone of the MTD? and 2. How do plant community structure and long-term successional patterns change through time relative to the dynamic river's edge? Descriptive and multivariate statistical analyses are being used to show variation among sampling plots with location and to demonstrate shifts in vegetation due to natural disturbance (specifically, rainfall and flooding). To our knowledge, this will be the first study of its kind to be conducted in the Mobile-Tensaw Delta and will provide baseline data for future assessments of impacts of disturbance and invasion on Alabama's unique plant communities. To date, we have recorded presence and abundance data for 218 plant species belonging to 81 families, of which 12 species have achieved invasive status. Plant and environmental data are clustered around geographical gradients. Resultant data on floral diversity, environmental variation, and the effects of disturbance (both natural and human-influenced) on plant assemblages will be used for the development of future long-term studies aimed toward the preservation of unique coastal freshwater habitats.

P262 Russell Milam[1], Adrianne Smith[1], Nancy Buschhaus[1], Cy Mott[2], Robin Baker[3], Howard Whiteman[3]
[1] Biological Sciences, U of Tennessee at Martin; [2] Biology, Valdosta State U, GA; [3] Biological Science, Murray State U, KY

The Relationship of Salamander Size Structure and Bat Activity in the Land Between the Lakes Watershed in Western Kentucky

Size variation in top predators can be used to explain fluctuations in lower trophic levels. In addition, a trophic cascade in an aquatic system can also influence species in terrestrial communities. For example, in aquatic systems, size variation in aquatic predators can potentially influence the availability of emergent insects that are then consumed by terrestrial bats. As a result, in ponds with both large and small salamanders, the smallest salamanders themselves may become prey of the larger salamanders, decreasing predation pressure on aquatic insect larvae that, in turn, emerge in greater quantities and are available for bat predators. We hypothesized that salamander size structure in ponds in the Land Between the Lakes National Recreation Area in western Kentucky would be related to bat activity. To quantify bat activity and bat species richness, we recorded bats with a Wildlife Acoustics SM2BAT+ detector and used SonoBat 3.1 with visual verification to assign species identification. Using SonoBat, bat call passes were first filtered to remove all non-bat calls. The remaining calls were visually reviewed to confirm or reject SonoBat species identification. If bat call quality was too low to assign confident species identification, bats were assigned as high (above 40 kHz) or low (below 40 kHz) frequency bats and included in the overall bat activity analysis. We identified the presence of 9 species of bats that foraged in the study area for at least one night during July 2015. We captured mole salamanders, *Ambystoma talpoideum*, with dip nets and analyzed their size variation by using ImageJ. The three sampled ponds were

identified as high, medium, and low in regard to the amount of variation in salamander size. We collected emerging aquatic invertebrates by placing emergence traps on each sampled pond. We found a significant relationship between bat activity and size variation among salamanders.

P263 Alissa J. Brown, Robert K. Peet, Peter S. White
Biology, UNC Chapel Hill

Does the Spatial Pattern of Tree Recruitment in Temperate Forests Reflect a Species' Successional Status?

Susceptibility of tree seedlings to herbivores and pathogens is a mechanism of the Janzen-Connell (J-C) effect, which predicts spatial over-dispersion of seedlings around established conspecifics. It has also been proposed that trees exhibit a life-history trade-off such that high growth rate is correlated with low investment in tissue defense against plant enemies. Thus, early successional species should be more vulnerable to herbivores and pathogens than late successional species. Because there exists both 1) spatial heterogeneity of plant enemies and 2) differing tissue defense strategies among tree species, I expect there to be species-specific differences in spatial patterns of tree recruitment. I hypothesize that early successional species will exhibit over-dispersion of seedlings around conspecific adults, whereas late successional species will reveal random or aggregated patterns of recruitment. I use spatial point pattern analysis (PPA) of mapped forest plots from the Duke Forest (Orange County, North Carolina), and generalized joint attribute modeling (GJAM) in plots across the southeastern U.S. to test these hypotheses. PPA reveals species-specific differences in spatial patterns of tree recruitment indicative of the successional status of the trees, where early successional trees show spatial over-dispersion, and mid- to late-successional trees show random recruitment patterns. Preliminary results from GJAM indicate that after accounting for environmental differences between plots, residual error could be explained by biotic neighborhood effects (such as the J-C effect). This poster discusses the statistical approaches and existing theory supporting these findings, as well as implications such as the maintenance of tree species diversity in temperate forests.

P264 Cancelled

P265 Minh Chau N. Ho[1,2], Claudia L. Jolls[2,3]
[1] Ecology and Evolutionary Biology Frontiers, U of Michigan, Ann Arbor; [2] U of Michigan Biological Station, Pellston, MI; [3] Biology, East Carolina U, Greenville, NC

Seed predation changes reproductive investment in *Cirsium pitcheri*

Reproductive investment represents a complex and dynamic problem that has direct influence on species persistence. Plants, in particular, are capable of a remarkable range of phenotypic plasticity in reproductive mechanisms, such as shifting flowering time in favor of more favorable conditions. In this study, I investigated changes in the reproductive investment of *Cirsium pitcheri* (Pitchers thistle), a federally listed species endemic to the Great Lakes dune habitats, in response to seed predation by an adventive biocontrol agent, *Larinus planus* (seed head weevil). Seed predation correlated with larger capitulum diameters, even after controlling for the number of capitula per plant. Significant differences in the size class distribution of capitulum suggest that plants experiencing seed predation invested more resources to develop small capitula into medium ones after the abortion of large capitula, which are preferentially targeted by the weevil. Further research into the magnitude of such reproductive plasticity and its impact on population dynamics of this rare species can contribute to their conservation and management.

P266 Christy T. Carter[1], Harvey E. Ballard, Jr.[2], Irwin A. Ungar[2]
[1] Biology, Wingate U, NC; [2] Environmental & Plant Biology, Ohio U, Athens

Genetic Variability of Three Annual Halophyte Species in an Inland Salt Marsh Through Time

Soil seed banks have been proposed to be a repository of genetic information and reported to be more genetically diverse than a single population at any given point in time. Genetic diversity of three annual autogamous halophytic species (*Atriplex prostrata*, *Salicornia depressa*, and *Spergularia salina*) from an inland salt marsh community was compared within and among three cohorts representing populations from 1981, 1998, and the persistent seed bank of 2000 using Inter-Simple Sequence Repeat (ISSR) analysis. Genetic variation was assayed using three primers on thirty samples (individuals) for each cohort of each species. Analysis of Molecular Variance (AMOVA) showed that cohorts were significantly different for each species. Principal Coordinates Analysis (PCoA) indicated a high degree of separation for the three cohorts of each species, indicating a turnover in genetic composition over the 17-y period and between above- and belowground cohorts. Percent polymorphic loci indicated the 2000 seed bank of *S. salina* and *S. depressa* were less diverse than either cohort representing 1981 or 1998 (the seed bank of *S. salina* was monomorphic), but the persistent seed bank from 2000 of *A. prostrata* was more diverse than either the 1981 or 1998 aboveground cohorts. Overall diversity increased from 1981 to 1998 for *S. salina* and *A. prostrata*, but decreased for *S. depressa*. Our findings show that seed banks are not always a long-term repository of genetic information and can be less genetically diverse than any one population. Genetic diversity may increase or decrease for a given population over time. More multi-year or cross-decade investigations on seed banks and aboveground vegetation in wetland species, especially those found in extreme habitats such as inland salt marshes, are needed. (Published in 2016 in *Sabkha Ecosystems Vol. V, The Americas.* (Khan, Boër, Ozturk, Clüsener-Godt, Gul, and Breckle, eds.) Springer, Dordrecht, The Netherlands.)

P267 Yianni P. Laskaris, Christopher E. Hill
Coastal & Marine Systems Science, and Biology, Coastal Carolina U, Conway, SC

MacGillivray's Seaside Sparrow Demographics and Incubation Behavior at the Tom Yawkey Wildlife Center

MacGillivray's Seaside Sparrow (*Ammodramus maritimus macgillivraii*) is a coastal marsh species sensitive to habitat alteration and threatened by coastal wetland loss. Data on seaside sparrow distribution, breeding success, and critical habitats are lacking in South Carolina. To better understand the demographics and incubation behavior of the species, we monitored breeding success, densities, song output, and presence of predators at three 7-hectare plots at the densest known population in the state. We also placed temperature data-loggers in a subset of nests to discern any links between incubation behavior and nest fate. Densities varied from a low of 5 birds/ha in a *Juncus*-dominated site to an estimated 68 birds/ha in *Spartina alterniflora*/*Distichlis spicata*-dominated impoundment. Sparrows built nests at a mean height of 31.1 cm, lower than nests found in Georgia and Florida. Daily nest mortality was low, at 6.9%. Nest height, mean nest temperature, and duration of off-bouts best predicted nest fate. Marsh rice rats (*Oryzomus palustris*) caused 90% of known nest failures. Females that incubated successful nests had significantly shorter off-bout durations, lower off-bout frequencies, and higher mean nest temperatures than females from unsuccessful nests. Results from our demographic study suggest that the breeding seaside sparrow community at Tom Yawkey nested in dense, semi-colonial clusters when nesting habitat was ideal, and had fairly high productivity compared to breeding populations in nearby states.

P268 Aaron S. Robinson, Ebony Brown, Jeff Steinmetz, Travis Knowles
Biology, Francis Marion U, Florence, SC

Acoustic Monitoring of Bat Populations in Florence, SC

In this study a bioacoustics monitoring system was used to collect data on the bat populations of Florence County. Wildlife Acoustics Echo Meter Touch provides spectrograms of bat calls and auto identification. Bat populations were monitored between the months of May 2014 to March 2016. A route was selected that sampled a variety of areas including ponds, open fields, neighborhoods, and city streets. The route was driven every two weeks to record bat populations. For the Pee Dee region, the Echo Meter Touch auto identifies nine species of

bats. Based on the bat calls recorded, eight of the nine species were collected. The most commonly detected species were *Lasiurus borealis* (Eastern red) and *Nycticeius humeralis* (Evening bat). The numbers of recordings collected in the study were higher in the summer and fall compared to the winter. This data will provide a baseline for a long term bat monitoring project.

P269 Brandy R. Riekert, Guissela Arita-Fajardo, Joel R. McNeal
Ecology, Evolution & Organismal Biology, Kennesaw State U, GA

Development of Population Genetics Markers for the Rare Parasitic Plant *Cuscuta harperi*

Harper's Dodder (*Cuscuta harperi*) is a rare stem parasitic annual vine that is endemic to a low number of scattered populations in Georgia and Alabama. It is a habitat specialist, occurring only on exposed sandstone and, more rarely, granite outcrops and barrens within its range. Populations of *C. harperi* are widely disjunct, and most populations are comprised of only a few individuals. Current methods in ecological genetics allow detection of genetic variation within and among populations, and variation can be used as an indicator of organismal fitness. Population genetics data can also be used to determine conservation priorities for populations that may be at increased risk for inbreeding depression as compared to populations with higher levels of variation. We will develop genetic markers to detect levels of variation within and among populations of *C. harperi* to elucidate population structure and identify populations that are in greatest need of conservation efforts.

P270 Caitlin M. Gallagher, Jennifer L. Newbrey
Biology, Columbus State U, GA

Effects of Female Condition and Human Disturbance on the Allocation of Biliverdin to Eggshells of Eastern Bluebirds (*Sialia sialis*) Breeding in West-Central Georgia

Variation in avian eggshell coloration has been a topic of scientific interest for many years. Several hypotheses have been proposed to explain the significance of eggshell diversity, but many researchers continue to be baffled by the evolution of the highly conspicuous blue-green background coloration seen in many bird species, including the Eastern Bluebird (*Sialia sialis*). This blue-green coloration is due to the pigment biliverdin, which is synthesized by female birds and allocated to the outermost layer of the eggshell through the shell gland of the oviduct. In addition to being incorporated into eggshells, biliverdin also has antioxidant properties for female birds and it helps to reduce free radical damage. Therefore, female birds in better condition may be able to allocate higher concentrations of biliverdin into their eggshells, making biliverdin-eggshell coloration a post-mating signal of female quality and overall health. In addition to female condition, stressful environmental conditions can also reduce a female bird's ability to allocate biliverdin to her eggshells due to the increased need for biliverdin in dealing with oxidative stress. We are comparing biliverdin concentrations in the eggshells of female Eastern Bluebirds breeding in high and low disturbance areas in west-central Georgia to determine if there is an effect of stress on biliverdin allocation in the species. We are also determining if biliverdin concentrations are correlated with egg mass, measurements of female quality, or reproductive success. In order to determine this, we collected third-laid eggs from bluebirds breeding on the main campus of Columbus State University (high disturbance) and at Callaway Gardens (low disturbance), a private resort near Pine Mountain, GA. In the lab, we are quantifying biliverdin concentrations using reversed-phase high-performance liquid chromatography. Surprisingly little is known about the biliverdin content of the eggshells of North American songbirds, making our research very novel and important.

P271 Fhallon C. Ware-Gilmore[1], Robert A. Hataway[2]
[1] College of Natural Sciences and Mathematics, U of West Alabama, Livingston; [2] Biological and Environmental Sciences, Samford U, Birmingham, AL

Hypoxic Coma as a Strategy to Survive Inundation Across Ground Hunting Arachnid Taxa

One ramification of climate change is the selective pressure placed on organisms to acquire physiological adaptations that ameliorate the effects of increased environmental fluctuation. Ground hunting spiders constitute a major arthropod group that inhabit habitats inundated by water during heavy rainfall events. Thus inundation is expected to become more frequent with climate change. Taxa which have the ability to enter into a hypoxic coma during inundation, thus avoiding drowning, should be better prepared for increases in extreme weather events. We compared the survivorship of ground hunting arachnids utilizing a hypoxic coma when exposed to inundation, to investigate the conservation of the trait across these taxa. The highest survivorship through hypoxic coma was found in *Dolomedes scriptus;* however, all of the species, with the exception of *Rabidosa punctulata*, had individuals' exhibit hypoxic coma as a survival strategy. Baseline respiration and respiration during hypoxic coma were determined to quantify the suppression of aerobic respiration.

P272 Peter A. Van Zandt[1], Grant Gentry[2], Brittany Harry[3], Will Hemminger[4], Benjamin Hunt[1], Sarah Martin[5], Caroline Rowan[1]
[1] Biology, Birmingham–Southern College, AL; [2] Biology, Samford U, Birmingham, AL; [3] Entomology, Auburn U, AL; [4] Biology, Elon U, NC; [5] UNC Chapel Hill

Urban Heat Islands Have an Effect on Moth Phenology, But Not Always the Way You'd Expect

Urban zones retain more heat than rural areas, especially at night. This effect, known as the urban heat island (UHI), increases the metabolic rates of ectotherms and can influence their phenology, or timing of life cycle events. Several studies have shown that plants typically flower earlier in warmer urban zones than in in nearby rural areas, but few have investigated the effects of UHIs on insects. We tracked moth phenologies and temperatures for three years to determine whether Birmingham's UHI caused moths to fly earlier in an urban area than in rural area. We assessed the impact of temperature on moth phenology using biweekly samples of moths at three different Birmingham locations that had different levels of urbanicity. Temperature loggers at each site showed that Birmingham had a UHI that was 1-2 ºC warmer on average than the intermediate and rural areas. We analyzed the flight times of 19 focal species, and while a few species emerged latest at the inner city location, most emerged earliest at locations with greater urbanicity – sometimes as much as 30 days earlier than at the rural site. These results, along with the consistency among species analyzed across years, suggest that Birmingham's UHI has the ability to exert a strong influence on moth phenologies, but that species responses may be idiosyncratic. Our study mimics the effects global warming could potentially have on moth emergence and behavior, and demonstrates a method for assessing the effects of anthropogenic temperature increases on insect activity.

P273 Adam M. Reitzel[1], Vanna Sombatsaphay[1], Yehu Moran[2]
[1] Biological Sciences, UNC Charlotte; [2] Ecology, Evolution & Behavior, Hebrew U of Jerusalem, Israel

Genetic and Transcriptional Variation in Venom Genes Expressed by an Estuarine Cnidarian

Toxin peptides produced by venomous animals strongly modulate the interspecific interactions of animals as they are utilized to both capture prey and deter predators. Knowledge of the environmental, genetic, and molecular factors involved in modulating expression of toxin proteins is essential to understand and predict how venomous species will respond to changes in the composition of biological communities. The starlet sea anemone, *Nematostella vectensis*, is an important estuarine predator and, like other cnidarians, produces an arsenal of

potent peptide toxins. Here, we will describe genetic variation in a suite of genes that compose the venom cocktail in anemones collected along the Atlantic coast of North America. These data suggest that natural selection may have resulted in specific mutations affecting the coding sequence for these toxin peptides. Quantitative measurements of gene expression revealed that a subset of these genes are differentially expressed when anemones are cultured under shifting environments, including circadian cycles in light and other abiotic factors. Together, this research provides a window to identify mechanisms that determine shifts in the quantity and composition of the venom essential for the feeding ecology of this model cnidarian specializing in heterogeneous habitats.

P274 Amanda Long[1], Taylor Faas[1], Nancy Morvillo[1], Malcolm Manners[2], Brittany J. Gasper[1]
[1] Biology, Florida Southern College, Lakeland; [2] Citrus Science, Florida Southern College, Lakeland

Examining the Genetic Relatedness of *Rosa setigera* Varieties by DNA Barcoding

Rosa setigera is a prairie rose native to a large area of the eastern half of North America, from New England to North Florida and as far west as Texas, Nebraska, and Central Canada. It is unusual among native American roses in that it is a member of the genus section Synstylae, a group that is mostly Asian in origin. In the 1840's, Samuel Feast of Baltimore made a number of *R. setigera* hybrids from seeds he acquired from south-central Ohio. In addition to these hybrids, there are other hybrids of unknown origin which some have suggested may be more of Feast's *R. setigera* hybrids. Two of these roses of unknown origin are Caldwell Pink and Pink Pet. As the original clones used by Feast are no longer in existence, DNA barcoding was used to determine the genetic relatedness of eighteen different known *R. setigera* species and whether there are characteristic DNA sequences that are always present in *R. setigera*. The sequences of Caldwell Pink and Pink Pet were also compared to determine if they are the same rose and whether they are likely to also be hybrids of R. setigera. The *rbcL* gene that codes for ribulose bisphosphate carboxylase (RuBisCo) was used for the barcoding. PCR amplified *rbcL* gene sequences from the *R. setigera* hybrids as well as Caldwell Pink and Pink Pet were sequenced twice and bioinformatically compared. A phylogenetic comparison showing the relationships between the organisms based on the *rbcL* gene sequence was generated and produced unexpected results that will be discussed.

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Tau Delta Kappa, Abraham Baldwin Agricultural College

Suwannee bass (*Micropterus notius*) population decline in the Ochlockonee River in Georgia

P276 Cassidy Callaway , Wendy Marchant , Rajagopalbabu Srinivasan
Tau Delta Kappa, Abraham Baldwin Agricultural College

Testing the Propagative Quality of *Tomato yellow leaf curl virus* in Its Whitefly Vector

P277 Amy Klass , Christopher Beals
Tau Delta Kappa, Abraham Baldwin Agricultural College

An Investigation into the Allelopathic Effects of the Invasive Alligator Weed, *Alternanthera philoxeroides*

P278 Maegan Thomas , Ariel Battle , Carrie Thurber, Heather Cathcart
Tau Delta Kappa, Abraham Baldwin Agricultural College

Neurons and Nematodes: the Use of *Ginkgo biloba* Extract to Rescue Neurologically Derived Defects in *Caenorhabditis elegans*

P279 Ariel Battle , Maegan Thomas , Heather Cathcart, Carrie Thurber
Tau Delta Kappa, Abraham Baldwin Agricultural College

A Needle in the Transcriptomic Haystack: Using RNA-Seq to Identify Differential Expression in GBE Treated *C elegans*

P280 Dementris Williams, Melissa Davis
Tau Delta Kappa, Abraham Baldwin Agricultural College

Mammographic Breast Density Disparities Among African-American and European-American Women

P281 CJ Booth, Stephen Baron
Nu Upsilon, Bridgewater College

Expression of the Polyhydroxybutyrate Depolymerase Gene of *Streptomyces* sp. 5A in *Streptomyces lividans* TK24

P282 Ashley Crossman, Stephen Baron
Nu Upsilon, Bridgewater College

Purification and Genomic Sequencing of Bacteriophages from *Streptomyces* sp. 5A

P283 Alys Harshbarger, Kimberly Bolyard
Nu Upsilon, Bridgewater College

Evaluation of Habitat Use by Longnose Dace (*Rhinichthys cataractae*) in Mercury-Contaminated and Non-Contaminated Rivers

P284 Amelia Johnston, Tamara Johnstone-Yellin
Nu Upsilon, Bridgewater College

Changes in Tannin Content Found in Vegetation Inside vs. Outside Deer Exclosures of the Allegheny National Forest

P285 Maria Marlin, Ed Lickey
Nu Upsilon, Bridgewater College

An Alluring Ascomycete: A Taxonomic Study of *Chlorosplenium chlora*

P286 Christopher Resch, Brian Schwartz
Mu Omicron, Columbus State U

Genetic and Biochemical Characterization of Mutants of Yeast That Grow Brown in the Presence of Copper

P287 Tabitha Clevenger
Mu Omicron, Columbus State U

Genetic analysis of North American red mulberry populations using SS-PCR and DNA barcoding

P288 John D. Gary, Jeffrey Zuiderveen
Mu Omicron, Columbus State U

Effects of acute copper and lead toxicity on the behavior of *Pimephales promelas* (fathead minnow)

P289 Micah Staples, Lauren King
Mu Omicron, Columbus State U

Screening for pathogenic *Escherichia coli* in the Chattahoochee River, Columbus, GA

P290 Pryianka Moody
Mu Omicron, Columbus State U

Diversity of Lichens in Temperate Forest and Sandhills Scrub in West-Central Georgia

P291 Erin Kirk, George Angyros
Eta Jota, Emory & Henry College

Epithelial Body Swabbing as a Non-Invasive Method for DNA Sampling of Salamanders

P292 Anna Green, George Angyros
Eta Jota, Emory & Henry College

Prevalence of Antibiotic Resistance in the Gut Flora (Enterobacteriaceae) in a Community of Stabled Horses (*Equus caballus*): Implications for Community Acquired Drug Resistance

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Eta Jota, Emory & Henry College

Determining Different Alternative Male Phenotypes and Reproductive Structure in *Lythrypnus dalli*

P294 James Wilmouth
Eta Jota, Emory & Henry College

Effects of Vitamin D Receptor Downregulation via Lentivirus Silencing on Human Glioblastoma Cells

P295 Kenneth Sterne, Melissa Taverner
Eta Jota, Emory & Henry College

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P296 Maria Byrd, Gerald Bresowar, Laura Hainsworth, Melissa Taverner
Eta Jota, Emory & Henry College

Examination of the Possible Correlation Between Microbial Communities and the Diversity of Nitrogen Species

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Sigma Gamma, Erskine College

Computational Modeling of Missense Mutations in the Human Smoothened (SMO) Receptor Implicated in Basal Cell Carcinoma

P298 Kristina Treat
Sigma Psi, Florida Institute of Technology

Phase-Sensitive Thermal Response of Feeding Kinematics in the invasive Lionfish, *Pterois volitans*

P299 Molly Wightman, Taylor Jones
Sigma Psi, Florida Institute of Technology

Thermally induced phenotypic variation in the invasive fish, *Cichlasoma uropthalmus*

P300 Nathaniel Zbasnik
Sigma Psi, Florida Institute of Technology

Ontogeny of ecomorphological divergence in sympatric North American fishes

P301 Wendy A. Harmon, Joseph Oyugi
Tau Sigma, Gardner-Webb U, NC

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P302 Sarah Bailey
Beta Upsilon, Georgetown College

An unbiased approach to discovering peptide inhibitors of Sialic acid binding CD33 receptor

P303 Casey H Wilson, Casey Garr, Christina Budzinski, Tawannah Allen, Theresa Hegedus, Veronica A. Segarra
Phi Zeta, High Point University

Exploring Methods in Art-Driven Science Outreach

P304 Taylor B. Cunningham, Veronica A. Segarra
Phi Zeta, High Point University

Mutagenic characterization of a newly-recognized mannose-6-phosphate receptor domain in Atg27 and its role in autophagy

P305 Kayla DeOca
Sigma Alpha, Jacksonville U

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P306 Vesta Nwankwo, Katharine V. Northcutt
Beta Omega, Mercer University

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P307 Elena Brown, Joong-Wook Park
Mu Epsilon, Troy U

Bacterial Response to the Elk River Chemical Spill in West Virginia

P308 Madison A. Cooper, Katrina Bokenfohr, Callie Bennett, Joong-Wook Park
Mu Epsilon, Troy U

Analysis of Bacterial Community along a Depth Gradient in Marine Tar Balls

P309 Mona Patel, Abena Adaboh, Cathy Huang, Glenn Cohen
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Microarchitecture of the Hair Shaft

P310 Kathryn Citrin
Tau Iota, U of NC Chapel Hill

Regulation of BMP-dependent angiogenesis via the SMAD7 and PMEPA1 inhibitors

P311 Tesha Vickery, Alexis Melton, Lisa Ann Blankinship
Beta Zeta, U of North Alabama

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P312 Breanna A. Littrell, Lisa Ann Blankinship
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Antibiotic Resistance Profiles of Bacteria Found on Cell Phones and the Hands of their Owners

P313 Sunada Khadka, Yuting Bai, Holly Boettger-Tong
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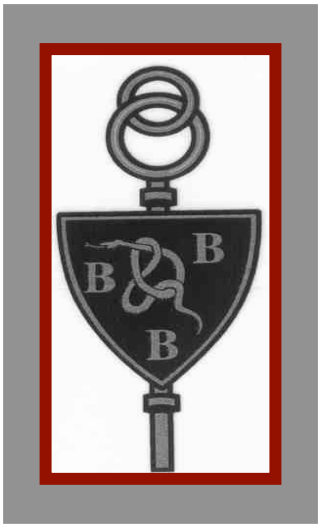
FIFTY-NINTH ANNUAL MEETING
BETA BETA BETA
SOUTHEASTERN REGION

DISTRICTS 1 and 2

MEETING JOINTLY WITH THE SEVENTY-SEVENTH ANNUAL MEETING OF THE ASSOCIATION OF SOUTHEASTERN BIOLOGISTS

hosted by

Davidson College, Davidson, North Carolina
Queens University of Charlotte, North Carolina
Charlotte Teachers Institute, North Carolina
University of North Carolina at Charlotte



Host Chapter: Mu Epsilon, Troy University, Troy, Alabama

March 31 – April 3, 2016
Concord, North Carolina

2016 Beta Beta Beta Abstracts
Southeast District I and Southeast District II

District I Platform Session (Brooks Award Session)

D1-1T

Macke, Kyle. Sigma Psi. Florida Institute of Technology. Efficacy of alternative contrast agent in anemonefish culture.

Captive-rearing of anemonefish (*Amphiprion spp.)* has become a major industry in ornamental aquaculture in the recent decades. As such, investigating the best culture methods has been the focus of ornamental-aquaculture research. One critical concern is the determination of the best culture environment that is optimal for growth and survivorship in the larvae- to juvenile-stage of anemonefish culture. In an attempt to advance culture techniques for anemonefish, this study addresses the question, does environmental contrast affect the growth and survivorship of anemonefish? Newly hatched anemonefish were reared in 12 five-liter tanks, grouped into three treatments: Clay, Control (Just Seawater), and Live Algae. The treatments were kept uniform by measuring turbidity for each tank. Each experiment trial lasted until all individuals were sampled or until metamorphosis. The individuals sampled were measured in length and survivorship for each treatment. Comparative analysis revealed that Anemonefish grown in green water were larger than those grown in either clay or seawater; fish grown in clay were smaller than those grown in seawater or green water. Survivorship analysis also showed the same pattern. These results suggest that rearing anemonefish in green water is the most efficient method in anemonefish aquaculture.

D1-2T

Penrod, Louis. Sigma Psi. Florida Institute of Technology. Thermally induced shift in biomechanical performance of the invasive lionfish, *Pterois volitans*.

Invasive species impose increasing detrimental ecological and economic strife from their expanding distributions due to oceanic warming. At the core is the first successful invasive-marine carnivorous fish, the lionfish, *Pterois volitans*. Ecologically, lionfish outcompete native piscivores; economically, lionfish consume commercially and recreationally important species, influencing the economies of many communities that rely on fishing and ecotourism. This study investigates the effects of temperature on lionfish's feeding behavior to forecast the future effects of global warming on lionfish. With the use of high-speed videography and kinematic analysis to calculate Ram-Suction Index (RSI), the feeding mode of the lionfish was determined at different environmental temperatures. Comparative analysis shows the temperature at which the lionfish are subjected to causes an alteration the lionfish's feeding mode. At higher temperatures (30°C), lionfish utilize ram-feeding which shifts to suction-feeding as water is cooled to 20°C. This temperature dependent switch in feeding mode has not been previously recorded and the mechanism is currently being investigated. The ability of lionfish to modulate their feeding mode in response to temperature contributes to their successful spread over a wide latitudinal (temperature) range. This phenomenon ought to be considered in efforts to eradicate this voracious predator as climate change progresses.

D1-3T

Martinez Palomera Baez, Sebastian. Sigma Psi, Florida Institute of Technology. Impacts of urbanization on anuran species richness.

Anuran species (frogs and toads) are excellent indicators of wetland quality; high abundance and diversity of anurans are usually indicative of high quality habitats. Anurans are relatively simple to study during their breeding season by monitoring their calls. Choruses of >3 overlapping callers may reflect a robust local population and indicate a suitable habitat for breeding. Around 20 anuran species can be found in Central Florida. Amphibian populations are declining and the leading cause of amphibian population collapses not related to chytridiomycosis is habitat destruction. This study consisted on determining the relationship between anurans and urbanization. Over the past year and a half, I have analyzed recordings made between 2012 and 2014 of 35 wetland sites in Brevard County, Florida. I have found 13 anuran species and all have been heard chorusing. Using Google Earth Pro and ArcGIS (Geographical Information System), I mapped wetlands and urbanized areas inside 100 m, 200 m, and 1000 m buffers surrounding each site. Preliminary results using the poisson regression tool in R have shown that native and total species richness have a statistically significant negative relationship with urbanization.

D1-4T

Marlin, Maria, Roy Choudhury, Swarup, & Pandey, Sona. Nu Upsilon, Bridgewater College. The Role of Heterotrimeric G-Protein Signaling in *Camelina sativa* Growth and Development.

The three subunits (α, β, and γ) composing heterotrimeric G-proteins in plants are critical in regulating many pathways, including growth, stress, and hormone-regulated responses. Overexpression of the Arabidopsis γ-subunit *AGG3* gene in *Camelina sativa*, a crop plant of high environmental and economic importance, has resulted in increased plant height, seed size and weight, and ability to grow in presence of heavy metals. To evaluate whether *AGG3* acts alone or if it does interact with the Gβ subunit to regulate the signal, Arabidopsis *AGB1* was overexpressed in Camelina, and the resulting phenotypes were compared with those resulting from overexpression of *AGG3.* Additionally, in order to characterize Camelina's Gβ subunit, the genes coding for the three isoforms of this subunit were knocked down using RNA-mediated interference. Weekly phenotypic analysis revealed overexpression of *AGB1* did not result in any change in height, seed characteristics or tolerance of heavy metals. These data suggest that in many pathways, *AGG3* is acting individually, not in tandem with Gβ, to regulate the signaling event. Interestingly, the Gβ RNAi knockdown lines exhibited a dwarf phenotype and had significantly less biomass throughout development. Experimental results provide supportive evidence which can be used to maximize yield efficiently and in an environmentally-friendly manner.

District II Platform Session (Brooks Award Session)

D2-1T

Pearson, Rachel & Lauren King. Mu Omicron, Columbus State University. Characterization of Neutrophil Cell Death in Response to Nontypeable *Haemophilus influenzae.*

Nontypeable *Haemophilus influenzae* (NTHi) is a commensal gram-negative bacterium that inhabits the human nasopharynx in up to 80% of people. In a healthy individual, NTHi is usually asymptomatic, but with improper mucosal clearance can cause infections like

rhinosinusitis, bronchitis, pharyngitis, and otitis media despite significant white blood cell infiltration to the site of infection. Our project focuses on characterizing this ineffective clearance within the host. Neutrophils combat bacterial infections primarily through phagocytosis and the formation of neutrophil extracellular traps (NETs) with varying degrees of efficacy, both ultimately leading to neutrophil cell death and death of the pathogen. This study aims to elucidate the process of cell death in response to NTHi infection by examining viability of neutrophils exposed to the bacteria. Human peripheral neutrophils were isolated from healthy volunteers, infected with NTHi, and tested for viability using a trypan blue assay and determining DNA fragmentation. Upon exposure to NTHi in vitro, neutrophils rapidly lost membrane integrity, suggesting that *H. influenzae* may damage these immune cells in vivo as well, offering a possible explanation for ineffective clearance.

D2-2T

Dirkman, Jacob, Renee Yuh, and Kathleen Hughes. Mu Omicron, Columbus State University. Estrogen's Effects on the Viability of Astrocyte Cells Exposed to Oxidative Stress.

A decrease in astrocyte function and viability has been linked to many neurodegenerative diseases, including schizophrenia, major depressive disorders, Alzheimer's disease, and Amyotrophic Lateral Sclerosis (ALS). Previous research indicates that some estrogens may have a positive effect on neuron and astrocyte viability. Estrogens' effects on the brain are of interest as estrogens are commonly prescribed as hormone replacement therapy to reduce the symptoms of menopause in women. Unfortunately, these effects are not completely understood. The goal of the project was to discover if estrogen has any protective effect on astrocytes exposed to oxidative stress. We measured the oxidative stress level of N1 1321 glial cells that were exposed to 600 μM hydrogen peroxide. The cells were pre-treated for one hour with one of four types of estrogen (10 nM – 10μM). Two endogenous human estrogens, 17-alpha estradiol and 17-beta estradiol, and two equine estrogens, equilin and equilenin, were utilized. Relative to untreated controls there was not a significant difference in oxidative stress levels across estrogen pretreatments. These results indicate that estrogen does not protect against oxidative stress in human glial cells.

D2-3T

Special, Samantha. Mu Omicron, Columbus State University. Comparison of Adequan and Cosequin treatment on growth, viability, and cartilage production of chondrocytes treated with a free radical.

Osteoarthritis is becoming a prominent ailment among older dogs. Currently, there are two medications used to repair affected cartilage: Adequan and Cosequin. Extensive research has been done to determine the effectiveness of both of these drugs, although they have yet to be compared. The purpose of this experiment was to determine which drug was more effective at repairing cartilage damaged with hydrogen peroxide. Chondrocyte cultures were treated with either Adequan or Cosequin as well as damaging hydrogen peroxide daily for 28 days. After this period the cultures' cell count, viability, and transmittance were recorded and compared via one-way ANOVA. It was found that Adequan and Cosequin do have a positive effect on chondrocytes, but not enough to overcome the damage caused by hydrogen peroxide. Thus, both treatments work more as a preventative measure than a true treatment.

D2-4T

Burke, Tara and Lori Tolley-Jordan. Mu Phi, Jacksonville State University. Does a large Trematode parasite, *Proterometra epholkus*, induce mortality on its freshwater snail host, *Elimia modesta*?

Digenean parasites are flatworms that require at least two hosts to complete the life cycle. *Proterometra epholkus* (Digenea: Azygiidae) requires the freshwater snail *Elimia modesta* for asexual reproduction and larval development and the spotted bass, *Micropterus punctulatus*, for sexual reproduction and adult worm development. As the free-swimming parasite larval forms that emerge from the snail host are very large (2-3 mm length) when compared to the overall length of the snail host (maximum length 15 mm) we predicted that infection would kill the snail host. In October 2015, 250 live *E. modesta* were collected from a nearby stream and transported to the lab where each snail was isolated. Infection was determined by observing free swimming cercariae in the water column and snail mortality was determined by touching the snail with a probe and observing movement. Only two snails were infected and both snails shed, on average, one cercaria per day for 32 days. One-week after the last emergence of cercariae, snails were dissected and the tissues were no longer infected. Thus, further studies are required to determine if other trematode parasites of *E. modesta* induce mortality or if survival of snails infected by trematode parasites is a general pattern.

D2-5T

Millward, Lindsay. Mu Theta, Belmont University. Differences in leaf decomposition rates between invasive exotic *Lonicera maackii* and native *Acer saccharum* in a temperate deciduous forest.

Invasive exotic plant species may have various impacts in terrestrial forest ecosystems depending on their interaction with the native plants. This study compared the decomposition rates of the exotic invasive shrub *Lonicera maackii* and native *Acer saccharum* in a terrestrial forest ecosystem at the Belle Forest Cave Property in Nashville, TN. Additionally the influence of dominant canopy cover type, native or exotic, on decomposition was examined. Litter decomposition rates were measured over a five-month period using single-species litterbags of *L. maackii* and *A. saccharum*, with replicates placed either directly under *L. maackii* or not (open canopy). Litter from L. maackii decomposed more rapidly than A. saccharum. The evidence of faster decomposition of exotic plants than native plants suggests a need for better understanding of the ecological consequences of exotic species invasion in native forests.

D2-6T

Howard, Sarah M. Mu Iota, Northern Kentucky University. Implications of Fluoridated water: How your oral health is being compromised.

Fluoridated water has been central to debate among health care professionals for nearly 70 years. Fluoride is credited for a decrease in dental carries, but opponents suggest it is linked with various cancers. Fluoride appears to reduce the growth of common cavity causing bacteria, but this has not been tested on true oral biofilms. Biofilms that form on teeth are a complex of many species and are different in different people. Bacteria from biofilms isolated from children's teeth were grown in blood agar containing Fluoride (0.0 mg/L, 0.5 mg/L, 1.0 mg/L and 2.0 mg/ L). Water normally contains 0.7 mg/L. *Streptococcus mutans* the usual cause of cavities, was also tested.

D2-7T

Corsby, Julie, Sarah Tingle, Steven Stracener, & Lisa Ann Blankinship. Beta Zeta, University of North Alabama. Biological Sample Detection Using a UV Crime Light Camera.

Crime scenes frequently contain biological specimens to help identify criminals. One tool is a UV light equipped with a camera that will detect the presence of proteins in surfaces that have come in contact with biological samples such as blood, saliva, semen, and urine. In this project, blood, saliva, semen, and urine were spotted onto cloths of different colors and composition. The cloths were then either exposed to a light treatment or a wash treatment. Light treatment exposed the samples to office light, sunlight, or no light by burying in dirt. Wash treatment subjected the samples to different types of detergents or bleach; mechanical and hand washing were also tested. For each treatment, samples were checked over the period of one month to determine if proteins in blood, saliva, semen, and urine could still be detected by the UV light.

D2-8T

Navaja, Lauren, Shelby Caudill, Kelsey Klinefelter, Katherine Ollier, and Christine Curran. Mu Iota, Northern Kentucky. Thyroid hormone disruption, immunosuppression and gene expression changes in three genotypes of PCB-treated mice.

Polychlorinated biphenyls (PCBs) are neurotoxic pollutants found mainly in our food supply that cause motor impairments, learning and memory deficits, and are known to disrupt thyroid hormone levels. Previously, we reported that both high-affinity AhrbCyp1a2(-/-) and poor-affinity AhrdCyp1a2(-/-) are more susceptible to developmental PCB exposure compared with wild type AhrbCyp1a2(+/+) mice. Our current studies are aimed at looking at the underlying biochemical and gene expression changes responsible for the observed learning, memory, and motor deficits. We treat pregnant dams using corn oil-soaked food or food dosed with an environmentally relevant mixture of coplanar and noncoplanar PCBs. Treatments begin on gestational day 0 and continue until weaning at postnatal day 25 (P25). We used enzyme-linked immunoassays to measure thyroid hormone levels in plasma of mice at P14, based on previous studies showing that is a critical time for thyroid hormone disruption in early brain development. We found a significant main effect of treatment ($P < 0.05$) with PCB-treated mice having lower T4 levels than controls as well as reduced spleen ($P < 0.01$) and thymus ($P < 0.001$) wet weights. There was also a significant gene x treatment interaction with the most susceptible AhrbCyp1a2(-/-) having significantly reduced spleen ($P < 0.001$) and thymus ($P < 0.001$) wet weights. Our gene expression studies focused on two developmental time points: P14 and P30 when PCB exposure is highest in pups. We confirmed CYP1A1 induction only in livers of the high-affinity Ahrb mice. In the cerebellum, we found differential expression of CYP1A1 and BDNF at P14 and down-regulation of neurotrophin3 in PCB-treated high-affinity Ahrb mice at P30. Together, these results confirm our previous results that both the AHR and CYP1A2 affect susceptibility to developmental PCB exposure and that thyroid hormone disruption is highest in AhrbCyp1a2(-/-) mice. Supported by ES020053 and GM103436.

D2-9T

Patel, Mona, Cathy Huang, and Abena Prempeh Adaboh. Mu Epsilon, Troy University. The microarchitecture of human scalp hair.

The hair shaft consists of three regions that are readily visible by routine microscopic methods: 1) the outer cuticle, 2) the cortex, and 3) the centrally located medulla. Although extensive microscopic, biochemical, and molecular research have demonstrated the major

details of hair structure and composition, the microarchitecture of the longitudinal keratin fibers that extend along the length of the hair shaft remains unsettled. In order to visualize the microarchitecture of the keratin fibers in the cortex, we bleached human scalp hairs to remove the pigments. We then divided the bleached hairs into two experimental groups: 1) stained (phloxine B) intact and longitudinally split hairs and 2) unstained intact and longitudinally split hairs. Staining times were empirically determined. We viewed hairs using bright field, differential interference, epi-illumination, and polarization microscopies. We demonstrated a previously unreported finding that keratin fibers in the cortex form repeating barrel-shaped bands of similar sizes that dovetail into each other along the length of the hair shaft. We confirmed the presence of these barrel-shaped bands in both stained hairs and unstained hairs (visualized best with polarization microscopy). In short, bands form the basic units of keratin fibers that extend along the length of the hair shaft.

District I Poster Session (Johnson Award Session)

D1-1

Nwankwo, Vesta. Beta Omega, Mercer University. Variations in Juvenile Rat Play Behavior Among Three Rat Strains.

Juvenile rats are a commonly used as a model for animal play behavior. Many studies involving this species have shown that play is critical for development of the prefrontal cortex as well as normal adult social behavior (Bell et al., 2010; Gordon et al., 2003; Van den Berg et al., 1999 a, b, c). Some studies have indicated that dramatic sex differences may exist, while others using different strains show no influence of sex on juvenile play (reviewed in Northcutt and Nguyen, 2014). The goal of this study was to analyze strain and sex differences in juvenile rat play behavior using a consistent behavioral paradigm. We found that there may be important differences between strains, with some showing female-biased sex differences (Long-Evans strain), others showing male-biased sex differences (Wistar strain), and yet others showing no sex differences (Sprague-Dawley strain). However, the play behaviors observed during play bouts are similar, with pins being the most common behavior regardless of sex or strain. These potential strain differences are important because they suggest variations in the underlying neurobiology of different strains, and understanding these will allow future experiments to investigate these variations.

D1-2

Dykes, Kaitlin and Gary Burtle, Tau Delta Kappa, Abraham Baldwin Agricultural College
Suwannee Bass (*Micropterus notius*) Population Decline in the Ochlockonee River in Georgia.

The Suwannee Bass, *Micropterus notius*, is a member of the black bass family, native to the Ochlockonee and Suwannee river drainages in Georgia and Florida. This bass population is of special concern due to the limited range of the rivers in which it lives, especially in Ochlockonee river of Georgia. The objective of this study was to increase the population and monitor the health of the species in the Ochlockonee River through electrofishing, tagging and release. The condition of the species as well as the catch per unit effort (CPUE) were monitored. CPEU went from 2.0 to 4.49 Suwanee bass per hour in 1997 to 0.5 to 0.0 per hour in 2015. Since 1998 electrofishing samples show fewer and larger older Suwanee bass with no young Suwannee bass present. It is believed that these fish are concentrated in areas of the river that are too thick with brush to allow access and data collection by electrofishing. In January 2016, 130 tagged Suwanee bass fish were released into the

Ochlockonee River where electrofishing is possible. We hope to see a gain in CPUE and a rise in health and population size for this fish species in the Ochlocknee river of Georgia.

D1-3

Callaway, Cassidy; Wendy Marchant; & Rajagopalbabu Srinivasan. Tau Delta Kappa, Abraham Baldwin Agricultural College. Testing the Propagative Quality of *Tomato yellow leaf curl virus* in the Whitefly Vector.

The *Tomato yellow leaf curl virus* (TYLCV) can cause significant yield loss in tomato crops and is a major problem for Southeastern growers. TYLCV is transmitted by its silverleaf whitefly vector, *Bemisia tabaci*, and is characterized by stunted growth, reduced fruit production, and leaf curling and yellowing. It has been accepted that TYLCV is non-propagative within its vector, but one study produced results that suggested the virus is, in fact, propagative. The purpose of this experiment was to test for propagative qualities of this geminivirus. Non-infected whiteflies were placed on a TYLCV-infected tomato plant to be inoculated by the virus before being moved to non-host cotton. Samples of the whitefly population were taken over the course of three weeks. The whiteflies were surface sterilized to remove external sources of the virus before DNA extraction. Real-time PCR was performed for relative quantification of the C2 gene for TYLCV in relation to the β-actin gene of the whitefly to determine the ratio of viral DNA to whitefly mass. Our results seemed to support the commonly accepted model that the virus is non-propagative in its whitefly vector because there was no conclusive spike in DNA concentration throughout the samples.

D1-4

Klass, Amy & Christopher Beals. Tau Delta Kappa, Abraham Baldwin Agricultural College. An Investigation into the Allelopathic Effects of the Invasive Alligator Weed, *Alternanthera philoxeroides*.

Alligator Weed (*Alternanthera philoxeroides*) is a perennial invasive plant from South America that has spread throughout many other countries including the United States. Alligator Weed has a high capacity for asexual reproduction through vegetative propagation and phenotypic plasticity possessing both terrestrial and aquatic forms. Alligator Weed is known to produce allelopathic chemicals that alter the community of algae in the water column. We studied the effects of Alligator Weed on two species of amphibians including the Southern Toad (*Bufos terrestris*) and the Southern Cricket Frog (*Acris gryllus*) tadpoles. Due to the limited mobility of obligate gill breathers, we hypothesized that these tadpoles would be especially susceptible to plant allelopathy. We also explored the allelopathic effects on microbial populations using a handheld luminometer, which measures ATP production by aquatic microbes. Our results show that when exposed to Alligator Weed, Southern Toad tadpole development is adversely impacted and Southern Cricket Frog tadpoles experience increased mortality. Luminometer measurements of microbial activity also show decreased population density with Alligator Weed exposure.

D1-5

Thomas, Maegan, Ariel Battle, Carrie Thurber, and Heather Cathcart. Tau Delta Kappa, Abraham Baldwin Agricultural College. Neurons and Nematodes: The Use of *Ginkgo biloba* Extract to Rescue Neurologically Derived Defects in *Caenorhabditis elegans*.

Ginkgo biloba extract (GBE) is used as an alternative treatment to delay the development of Alzheimer's disease (AD); however, little is known regarding its protective mechanisms. The rate at which AD progresses varies between individuals; but, early-onset familial AD

(EOFAD) shows more rapid development of symptoms. EOFAD is associated with mutations in several genes, including amyloid precursor protein (APP). This protein is involved in the increased toxicity associated with amyloid beta peptides, as well as an accumulation of iron in the insulin signaling pathway. *Caenorhabditis elegans* is a beneficial tool for studying AD because it expresses an APP ortholog, apl-1, which also plays a role in insulin signaling in the nematode. We studied the touch withdrawal response in apl-1overexpressers, as well as in a strain with a neuronal signaling defect to nose touch. Using touch habituation techniques, we set out to determine whether feeding the mutants GBE would enhance their ability to remember and respond to touch. Theoretically, the strains overexpressing apl-1 and fed a GBE diet would habituate to touch more quickly than those fed the typical *E. coli* OP50. Preliminary data shows *C. elegans* strains habituate faster when fed a GBE diet.

D1-6

Battle, Ariel, Maegan Thomas, Heather Cathcart, Carrie Thurber. Tau Delta Kappa, Abraham Baldwin Agricultural College. A Needle in the Transcriptomic Haystack: Using RNA-Seq to Identify Differential Expression in GBE Treated *C. elegans*.

Similar to a grand production of a play, genetic information contained within our DNA puts on a great performance. The ribosomes are the directors, processing scripts of messenger RNA (mRNA) to produce great actors of enzymes and signaling molecules. RNA sequencing (RNA-Seq) can be used to determine which mRNAs are being transcribed and in what quantity, as well as their specific sequences. These sequences can be used to identify genes responsible for traits of interest and their effects on interacting genes. We performed RNA-Seq on *C. elegans* with a mutated *apl*-1 gene, with and without treatment with *Gingko biloba* Extract (GBE), a natural, experimental treatment for Alzheimer's disease. In *C. elegans*, the *apl-1* gene is found to be similar to a human gene *APP*, a causative factor in Alzheimer's disease. Mutations that occur within the gene inhibit the ability of *C. elegans* to molt, proving fatal in early development. Total RNA was extracted using the Purelink© RNA Mini Kit and quantified using both a Nanodrop and a 1.0% agarose bleach gel. Our goal is to model differential expression of genes involved in the response to GBE in both wild-type and mutant *C. elegans* and examine the molting deficiency genetic pathway.

D1-7

Williams, Dementris and Dr. Melissa Davis, Tau Delta Kappa, Abraham Baldwin Agricultural College. Mammographic Breast Density Disparities Among/Between African-American and European-American Women.

Breast Density is highly correlated with breast cancer in most cases. High levels of chemokines in the circulation of the body may be the cause of such high density. African Americans tend to have more dense breasts, compared to European Americans, as well as higher levels of chemokines, due to the absence of the Duffy receptor on red blood cells. We sought to use medical informatics to determine breast density within healthy individuals. Density is currently not actually quantified, but subject to individual clinician interpretation. We attempted to develop an algorithm that would accurately measure breast density from mammograms, using data from the Virtual Komen Tissue database. Breast density intensity values were significantly different between races, menopausal status, age, and other factors. Specifically, breast density is higher in women who are: premenopausal, age 40-49, and obese. The most interesting result was that African American Women had more breast density than European American Women. Completion of an algorithm that quantifies mammographic breast density will improve risk models for breast cancer.

D1-8

Treat, Kristin. Sigma Psi. Florida Institute of Technology. Phase-sensitive thermal response of feeding kinematics in the invasive lionfish, *Pterois volitans*.

Concerns about the ability of invasive species to expand their invasive range have been critical in the light of climate change. To advance our understanding of the adaptive mechanisms that underlie successful invasions as a consequence of global warming, we investigated the thermal response of the two key components of feeding performance in the invasive lionfish, *Pterois volitans*. The rate at which jaws move from expansive to compressive modes as fish captures its prey is determined by the speed of muscular contraction. It is hypothesized that the rate of muscular contraction decreases at low temperature and increases at high temperature. Is this temperature-induced change in muscle performance reflected in the feeding performance of lionfish? We compared the velocity of jaw kinematics during the expansive and compressive phases of prey-capture at different water temperatures using high-speed video. Different sizes of lionfish were collected from Florida waters and filmed while eating mosquitofish, *Gambusia* sp. Statistical tests revealed that (1) at each fish-size category (small, medium, large) there was no significant difference in the thermal response of the speed of jaw movement between expansive and compressive phases; and (2) small fish were more sensitive to temperature change than large and medium fish.

D1-9

Wightman, Molly & Jones, Taylor. Sigma Psi. Florida Institute of Technology. Thermally induced phenotypic variation in the invasive fish, *Cichlasoma uropthalmus.*

Global water-temperature-change has been expected as a consequence of climate change. Thus, it is critical to know the direct effects of temperature on the performance of aquatic organisms, including invasive fishes. It is imperative to determine how invasive fishes adapt to new environmental conditions driven by global warming (and cooling) of water temperature. This study investigates the effects of temperature on the morphological features that underlie feeding performance in the Florida invasive fish *Cichlasoma uropthalmus*. The hypotheses that were tested include: (1) As temperature increases, the morphological features used for feeding in *Cichlasoma urophthalmus* will increase in size; and (2) The size of morphological features of *Cichlasoma urophthalmus* will vary across temperatures. These hypotheses were tested by raising these invasive generalist fish in five different temperatures (20°C, 24°C, 28°C, 32°C, 36°C) and then measuring a variety of morphological features that enhance the ability of fish to eat. Kruskal-Wallis tests showed that there was no significant difference among the different temperatures in the median size of each of the five morphological measurements. It is conceivable that invasive fishes are very resilient to environmental change, which gives them an advantage over native species, outcompeting them for limited resources.

D1-10

Zbasnik, Nathaniel. Sigma Psi. Florida Institute of Technology. Ontogeny of ecomorphological divergence in sympatric North American fishes.

The ecomorphological principle is rooted from the premise that morphological adaptations (e.g., feeding apparatus) reflect the ability of an organism to perform fitness-relevant tasks (e.g., feeding). We test the hypothesis that shifts in food habits of two sympatric species are consistent with shifts in the feeding biomechanics of both conspecifics through ontogeny.

Two species of North American fishes, *Lepomis macrochirus* and *Lepomis microlophus* that coexist in Florida lakes were collected at the same time, and then we compared the trajectory of their food habits and feeding biomechanics through ontogeny. Larvae and early juveniles of both species are planktivorous and suction feeders, but, after metamorphosis, *Lepomis macrochirus* continues to suction-feed on soft, elusive, and planktonic prey whereas *Lepomis microlophus* becomes durophagous and eats hard-shelled invertebrates such as snails. Scaling equations indicated a shift in the growth trajectories of feeding-biomechanical traits including Suction Index (SI) and physiological cross-sectional area of feeding muscles that is coincident with the shift in food habits of these sympatric fishes. Results support the hypothesis that shifts in food habits of two sympatric species is consistent with shifts in the feeding biomechanics of both conspecifics through ontogeny.

D1-11

Kathryn Citrin, Lyndsay Wylie, Kevin Mouillesseaux, Victoria Bautch, Department of Biology, The University of North Carolina at Chapel Hill, Chapel Hill NC 27599. Regulation of BMP dependent angiogenesis via the SMAD7 and PMEPA1 Inhibitors.

Angiogenesis, the development of blood vessels from existing vasculature via sprouting of endothelial cells, is regulated by growth factor signaling. One such signal is BMP, a TGFβ superfamily member. BMP ligand binding to its receptor phosphorylates SMAD1/5/8 intracellular proteins for nuclear translocation and transcription regulation.[1] Another signal called Notch downregulates endothelial cell responsiveness to BMP signaling by mechanisms that are not fully understood. A screen to identify Notch-regulated BMP/TGFb pathway members identified two proteins upregulated by Notch that negatively regulate BMP signaling, PMEPA1 and SMAD7.[1,2] Understanding the function of these Notch-regulated BMP/TGFb pathway inhibitors is critical, as they hold therapeutic potential for diseases of aberrant BMP signaling.[3] Knockdown of PMEPA1 expression significantly increased nuclear fluorescence of phosphorylated SMAD1/5, which is a readout of upregulated BMP signaling. However, SMAD7 knockdown did not affect BMP responsiveness. These data indicate that PMEPA1 inhibits BMP signaling in endothelial cells, a novel finding that warrants further investigation. Experiments designed to test the effect of reduced levels of PMEPA1 or SMAD7 in a 3D blood vessel formation sprouting assay are currently underway. We hypothesize that PMEPA1 is an important protein that allows endothelial cells to set their responsiveness to BMP by virtue of their Notch status.

D1-12

McDonald, Sarah & Stanley, Neal. Sigma Gamma. Erskine College. Computational Modeling of Missense Mutations in the Human Smoothened (SMO) Receptor Implicated in Basal Cell Carcinoma.

This research uses bioinformatics and molecular modeling to examine mutations in the human smoothened receptor, a receptor of the GPCR class frizzled family. Variations (nsSNPs) resulting in single amino acid substitutions in the smoothened receptor protein can confer resistance to novel drugs such as Vismodegib, used in the treatment of basal cell carcinoma, as well as cause sporadic BCCs. Through different imaging and diagnostic methods we examined four missense mutations: Asp473Tyr, Asp473His, Gly497Trp, and Trp535Leu. In order to understand the effect of these nsSNPs on the smoothened receptor's structure and function, computational modeling of the wild type SMO receptor and four of its mutant forms was performed. In addition to sequence and structural analysis, the Gibbs free energy of folding was also calculated. Our results show that Trp535Leu (located in TM7) and Gly497Trp (located in EC3) destabilized the receptor, while Asp473Tyr (located in TM6)

over stabilized the structure slightly. The mutated receptors lead to inappropriate signaling in the Hedgehog pathway, which can be associated with sporadic BCCs or resistance to Vismodegib.

D1-13

Booth, CJ E. Nu Upsilon Bridgewater College. Expression of the Polyhydroxybutyrate Depolymerase Gene of *Streptomyces sp. 5A* in *Streptomyces lividans TK24*.

Polyhydroxybutyrate (PHB) is a biodegradable, plastic-like polymer produced by bacteria. The actinomycete, *Streptomyces sp. 5A,* degrades PHB, using an extracellular PHB depolymerase. This enzyme is synthesized during growth on PHB but not glucose, suggesting transcriptional regulation of its gene, *phaZ*. PHB depolymerase-specific antibodies would be useful for immunoblotting to monitor expression of the enzyme. Production of high titer antibodies requires milligram quantities of purified protein, but only microgram amounts can be purified from cultures of *Streptomyces sp. 5A.* Therefore, *phaZ* will be overexpressed in an efficient cloning host, *Streptomyces lividans TK24*, using the vector, pIJ86. This vector has genes for interspecific conjugation with an engineered strain of *Escherichia coli, 12567/puz8002,* and a strong promoter for expression of foreign genes. First, *phaZ* was amplified by the polymerase chain reaction, ligated with a TOPO®-TA vector, and cloned in *E. coli TOP10* cells. Recombinant plasmid from transformants was restriction digested, releasing the *phaZ* insert, which was then ligated together with pIJ86. The *phaZ*-pIJ86 construct will be introduced sequentially into *E. coli TOP10*, *E. coli 12567/puz8002*, and finally *S. lividans TK24* by interspecific conjugation. Exconjugants will be screened for PHB depolymerase synthesis by appearance of clearing zones on agar plates containing PHB.

D1-14

Crossman, Ashley & Baron, Stephen. Nu Upsilon, Bridgewater College. Purification and Genomic Sequencing of Bacteriophages from *Streptomyces sp 5A*.

The rise in antibiotic resistant bacteria has become a prominent concern within the medical community and much research is currently devoted to developing alternative forms of fighting bacterial infections. One potentially promising solution is the use of endolysins, phage-encoded hydrolases which are used by bacteriophages to degrade the peptidoglycan cell wall of their host bacteria. Endolysins are structurally similar to bacterial exolysins, enzymes released by bacteria to kill the cells of a different species or strain. Like exolysins, endolysins target specific bonds found only in bacterial cell walls and are also type- or species-specific, suggesting that they could be used to target harmful bacteria without affecting the body's own cells or natural microflora. Our research involves the Gram positive soil bacterium *Streptomyces sp. 5A,* whose bacteriophages likely produce potent endolysins to degrade its thick cell wall. As a first step to acquire these enzymes, we isolated and purified a bacteriophage isolated from *Streptomyces sp. 5A* from compost and extracted the phage DNA which will be sequenced in its entirety. After the genome of the phage has been sequenced, the gene or genes responsible for the production of endolysins will be identified.

D1-15

Harshbarger, Alys and Dr. Kimberly J. Bolyard. Nu Upsilon, Bridgewater College. Evaluation of Habitat Use by Longnose Dace (*Rhinichthys cataractae*) in Mercury-Contaminated and Non-Contaminated Rivers.

Mercury contamination may have sublethal effects on aquatic organisms who bioaccumulate mercury. We observed the movement of longnose dace fish (Family Cyprinidae) in a habitat selection container in mercury-contaminated South River and uncontaminated, but ecologically similar, Dry River. Fish from South River spent more time in the open than did fish from Dry River. Fish from Dry River spent more time in the large rocks than did fish from South River. Our results suggest that habitat use by longnose dace depends on mercury exposure, indicating that mercury may influence fish behavior and impact the ecology of the river.

D1-16

Johnston, Amelia & Tamara Johnstone-Yellin. Nu Upsilon, Bridgewater College. Changes in Tannin Content Found in Vegetation Inside vs. Outside Deer Exclosures of the Allegheny National Forest.

Tannins are polyphenolic secondary metabolites found in the majority of vegetation biodiversity as a defense mechanism against herbivory. Along with other nutritional qualities, tannin content impacts the digestibility of a plant. Ungulates evolved to bypass the toxicity of tannins which effects the nutritional quality of browse species in an ecosystem. For this research, we are testing the plant diversity and digestibility for the white-tailed deer (*Odocoileus virginianus*). To understand the relationship between deer density and their effect on vegetation, plant samples from inside and outside exclosures were collected from the Allegheny National Forest. They were analyzed for fiber digestibility previously and here we present the preliminary results of protein digestibility by utilizing the BSA tannin-binding assay technique (Robbins et al. 1978). This last step of analyzing tannin content contributes to the overall digestibility of a plant and gives the information necessary for full assessment of the nutritional status of deer browsing. Furthermore, the proposed experiment could serve as a useful forest management tool for implementing successful ecosystem services.

D1-17

Marlin, Maria, & Lickey, Edgar. Nu Upsilon, Bridgewater College. An Alluring Ascomycete: A Taxonomic Study of *Chlorosplenium chlora.*

Chlorosplenium chlora is a saprobic ascomycete that occurs on the underside of fallen hardwood branches. This fungus, while discovered in 1822, has received very little attention; sequences of its DNA have not been reported, and its mating behavior and ecology have not been researched. Members of *Chlorosplenium* were once considered to belong to *Chlorociboria,* a genus of fungus possessing very similar morphological characteristics. However, they are now recognized as two different genera. Macroscopic characters of *C. chlora*, including ascocarp size, color, and texture were analyzed as well as the number and density of fruit bodies and potential substrate preference. Microscopic characters, including ascospore size and shape and asci size are also reported. Additionally, genetic differences between geographically isolated populations were investigated using nuclear ribosomal ITS 1 – 5.8S – ITS 2, and its phylogenetic relationships with its more well-known relative *Chlorociboria aeruginosum* were analyzed using nuclear ribosomal Large Subunit DNA sequences.

D1-18

Kirk, Erin M. Eta Iota, Emory & Henry College. Epithelial body swabbing as a non-invasive method for DNA sampling of salamanders.

Amphibians include some of the highest proportion of species threatened with extinction. When sampling threatened or endangered species, the least destructive and minimally invasive methods should be used. Genetic sampling utilizing epithelial mucosal swabs has been demonstrated to yield sufficient quantities of skin cells for DNA analysis, comparable to conventional, but more invasive and potentially harmful, toe or tail clipping methods. The goal of this study is to demonstrate the effectiveness of this non-invasive DNA sampling technique and its utility in conservation genetic studies. Additional benefits of this method are its utility for use with previously collected museum specimens, and testing for the presence of Amphibian Chytrid Fungus. In our study, DNA samples were taken from museum specimens preserved in 10% Formalin, and 70% Ethanol, as well as hand-captured salamanders utilizing non-invasive body swabbing of skin epithelial cells. Genomic DNA extractions were quantified utilizing a Nanodrop™ 2000 Spectrophotometer, followed by PCR amplification of mitochondrial genes: cytB and COIII. These techniques provide data on both quantity and quality of DNA extracted by epithelial swabbing, compared to conventional tail/toe clipping based extractions. Ratios of DNA yields in nanograms ranged from 1.3:1 to 29:1 (swabbing : tail tissue).

D1-19

Green, Anna M. Eta Iota, Emory & Henry College. Prevalence of antibiotic resistance in the gut flora (Enterobacteriaceae) in a community of stabled horses (*Equus caballus*): Implications for Community Acquired Drug Resistance.

The diversity of microbial communities in the gastrointestinal tract of horses plays roles in both maintaining health and causing disease. Through bacterial identification, we determined the most prevalent gut flora (Enterobacteriaceae) in the horses, and tested antibiotic resistance in those microbial communities. From these results, we determined that 31.7% of horses were resistant to 6 or more of the antibiotics tested, suggesting that antibiotic resistance is indeed prevalent in the representatives of this community of horses. Further conclusions will be drawn concerning the health of the stabled horses and whether proximity of the stalls aids or negates the antibiotic resistance in the gastrointestinal tract. The statistical results of this final phase of the project will complete the study.

D1-20

Hess, Jacob. Eta Iota, Emory & Henry College. Determining different male phenotypes and reproductive structure in *Lythrypnus dalli*.

Lythrypnus dalli, a hierarchal, sex changing teleost fish in the Gobiidae family that live off of the coast of Catalina Island, California. The hierarchy primarily consists of a dominant male, an alpha female and two or more females. The alpha female in *L. dalli* has the ability to change sexes when the dominant male is removed from the group. Our group wanted to study a form of alternative reproduction in a secondary male phenotype, mini males. It was noted that mini males have a different mechanism of fertilizing eggs. This led to the question in the two major internal components of reproduction in male gobies. The testes and the accessory gonadal system (AGS). We hypothesized that the mini male tested would have a higher concentration in sperm than the dominant male but a lower concentration of mucous in the AGS.

D1-21

Sterne, Kenneth E. Eta Iota, Emory and Henry College. The effects of increased creatine levels on developmental processes in chicken embryos.

Creatine is an essential factor in transporting energy to highly metabolically active cells located throughout the body. In conjunction with creatine kinase and phosphocreatine, an energy shuttle is created to maintain a certain amount of ATP readily available to provide energy for the cell. By increasing the amount of creatine in the cell via injections into the yolk sac during embryogenesis increases the concentration of ATP at it's target tissues, mainly muscles and neurons. Subsequently, by increasing the available ATP concentration during a high-energy demanding process like embryogenesis can increase the rate at which the embryo grows, specifically from day three to day seven, while neurulation and somites are forming.

D1-22

Byrd, Maria C. Eta Iota, Emory & Henry College. Examination of the possible correlation between soil microbial communities and the diversity of nitrogen species.

Organic nitrogen compounds found in soil are converted to accessible, inorganic forms of nitrate and ammonia, which are then available for uptake by the surrounding plants. We hypothesized that the microbial communities of three different locations and environmental factors, will differ spatially and temporally, and will be associated with varying levels of nitrate, ammonium, and nitrite in the soil of the rhizosphere. Hypothesis testing involved sampling three designated areas on Emory & Henry's Bartlett-Crowe field station over a six-month period. We collected soil samples from marsh, ridge, and hillside localities. Chemical analyses were conducted to examine the presence of nitrate, ammonia, and nitrite. Pure cultures of collected common and unique microbes were identified using the BIOLOG GEN III Identification Database. In our findings, the marsh location showed the highest concentration of nitrate, with the ridge location showing the highest concentration of both nitrite and ammonia throughout the sampling period. There was a general decreasing trend for the nitrate in all three sample sites correlated with the average seasonal temperature decreases. Further bacterial identification is being conducted to support or reject our hypothesis of correlation between the presence of these nitrogen species and varying microbes within each sampling location.

D1-23

Harmon, Wendy A., and Joseph Oyugi, Tau Sigma, Gardner-Webb University. The Effects of Severe Drought on Dispersion Patterns of Local Salamander Populations in Streams near Boiling Springs, North Carolina.

Severe drought conditions are believed to affect salamander population dispersion, as well as salamander body size. In this investigation, we hypothesized that the local salamanders will be dispersed closely to the stream, and that there would be differential dispersal distance with age (juvenile or adult). Two streams in Boiling Springs, North Carolina were utilized for this research from August 17 to September 17, 2015. Within each stream, fourteen - 7 meter alternating transects were established perpendicular to the stream; along each transect, three - 1.5 m x 1.5 m plots were established at 1m intervals. All salamanders were identified to species level, their size estimated, classified by age (adult or juvenile) and number tallied. A Shapiro-Wilks normality test was used to analyze the average distance where salamanders were found. Four species were found during this study: the Mountain Dusky Salamander (Desmognathus ochropaeus) (Cope, 1859), the Red-backed Salamander (Plethodon cinereus) (Green, 1818), the Southern Two-lined Salamander (Eurycea bislineata cirrigera) (Green, 1818), and the Black-bellied Salamander (Desmognathus quadramaculatus) (Holbrook, 1840). All individuals (all species combined) occurred at an average distance of 1.760 ± 0.060 meters from streambed and exhibited

non-normal distribution. The Desmognathus species (two species combined) were much closer to streambed 1.652 ± 0.079 meters, with non-normal distribution. Juveniles were found at greater distances from the streambed (1.865 ± 0.141 m) than adults (1.509 ± 0.089 m). The conclusion of this investigation indicated that local salamander populations were affected by severe drought conditions. The four species of salamanders encountered during this study all preferred to be within less than 2 meters of the stream bed. Furthermore, age did impact the dispersal distance of Desmognathus species.

D1-24

Holbrooks, Christina. Sigma Gamma, Erskine College. The degree to which de novo mutations in *DDX3X* contribute to the South Carolina population of the intellectually disabled.

Intellectual disability (ID), defined as a significant limitation in both intellectual functioning and adaptive behavior, includes disorders such as Down Syndrome, Fetal Alcohol Syndrome, and Fragile X Syndrome, as well as other intellectual and behavioral limitations that are not syndromic. The main cause of non-syndromic ID is random genetic mutations. Recently published research by Snijders Blok et al. (2015) found that de novo mutations in *DDX3X* gene affect up to 3% of unexplained intellectual disability in females. *DDX3X* was proposed as a candidate gene causing intellectual disability. Through my research performed at Greenwood Genetic Center, I screened a cohort of 380 females with intellectual disability to determine the degree of contribution of mutation in *DDX3X* to intellectual disability in the South Carolina population. Results of the study are presented.

D1-25

Valverde-Ceciliano, Mara, and Dinene L. Crater. Phi Zeta, High Point University. In Vitro Analysis of Transcription Repression by GerE during Sporulation in Bacillus subtilis.

Bacillus subtilis is a gram positive, rod shaped, aerobic soil bacteria. In times of environmental stress, the bacteria carry out sporulation. The bacterial cell undergoes asymmetric division involving a mother cell engulfing a forespore and creates protective layers, called coats, to eventually form a spore coat. Desiccation, UV radiation, and extreme temperatures are a few among other environmental stresses of which the spore becomes resistant to. It will remain in this state until the environment has reestablished conditions appropriate for germination. Many proteins play a role in sporulation, most interestingly, GerE. The appearance of the regulatory protein GerE is essential at the late stage of spore development in the mother cell. It not only activates the essential genes for spore formation, but also represses the transcription of several sigma K-dependent genes, including sigK, cotA, cotE and cotH. We have identified GerE binding sites on the promoter region of these genes, and hypothesize that GerE binds to these promoter regions to repress transcription from the sigma K associated RNA polymerase. Through the use of a non-radioactive DNA binding assay, the binding characteristics of purified GerE to these promoter regions will be analyzed. We have performed preliminary experiments to determine the control reaction conditions, and future work will analyze the ability of GerE to bind to the sigK promoter region. The completion of this project will enhance our understanding of the role of GerE in the down regulation of genes required for efficient sporulation.

D1-26

Catalan-Hurtado, Rodrigo, and Dinene L. Crater. Phi Zeta, High Point University. Analysis of the DNA Binding Characteristics of GerE From Geobacillus stearothermophilus.

Geobacillus stearothermophilus is a thermophilic, anaerobic bacteria found in habitats such as thermal vents. Its high resistance to heat makes it a very interesting subject because it would have to adapt to this harsh environment. G. stearothermophilus is a gram-positive, rod shaped bacterium that is able to undergo sporulation to produce small, tough, protective and metabolically dormant endospores in order to endure heat, desiccation, radiation and chemical threat. The genes responsible for encoding proteins that form the spore coat are cot genes. The appearance of the regulatory protein GerE is essential at the late stage of spore development because it directly activates the transcription of sigma K-dependent genes, including cotB and cotC. Therefore, our hypothesis is that G. stearothermophilus uses methods similar to B. subtilis for the regulation of sporulation. We have overexpressed G. stearothermophilus GerE in Escherichia coli and purified the protein using standard techniques. We plan to develop a non-radioactive in vitro DNA binding assay that will be used to determine if GerE from G. stearothermophilus has the ability to bind to the cot promoters at high temperatures. Preliminary experiments indicate successful in vitro binding of control reactions using our non-radioactive assay. Further studies will investigate the ability of GerE to function as a transcription regulator in vitro, as well as its binding characteristics in G. stearothermophilus in vivo.

District II Poster Session (Johnson Award Session)

D2-1

Vickery, Tesha, Alexis Melton, and Lisa Ann Blankinship. Beta Zeta, University of North Alabama. Detection of Tetracycline and Penicillin Resistance by PCR.

Antibiotic resistance is a wide spread medical concern that directly impacts patient care and healthcare cost. The problem of antibiotic resistance is not a new one, but it is one that challenges medicine more every year as new and more bacteria become resistant to antibiotics. While little can be done to feasibly monitor patients taking their entire course of prescribed medication, the development of specific and rapid methodologies for the detection of antibiotic resistance will help to offset the rapid spread of antibiotic resistance genes between and among various bacteria. The purpose of the experiment was to develop successful PCR reactions for detecting tetracycline and penicillin resistance that could later be used to develop a rapid PCR detection test for resistant bacteria to tetracycline class and penicillin class antibiotics. *Pseudomonas aeruginosa* was used to perform a PCR amplification of the 16S rDNA gene. Due to unknown laboratory errors, the gel electrophoresis yielded no results. Further experimentation should be completed to yield gels and continue in finding a rapid detection test.

D2-2

Littrell, A. Breanna and Lisa Ann Blankinship. Beta Zeta, University of North Alabama. Antibiotic Resistance Profiles of Bacteria Found on Cell Phones and the Hands of Their Owners.

Bacteria found naturally on human skin are easily transferred onto inanimate objects. These bacteria are typically harmless in healthy individuals. However, in immunocompromised individuals, infections occur easily. If the bacteria causing such infections are resistant to antibiotics, it can result in death for some individuals. The purpose of this project is to determine the antibiotic resistance profiles of bacteria found on cell phones and the hands of their owners. In this study, random samples will be obtained from cell phones and the hands of the cell phones' owners. The samples will be cultured and the organisms present will be tested for antibiotic sensitivity using the Kirby Bauer method.

D2-3

DeOca, Kayla. Sigma Alpha, Jacksonville University. DNA Sequence is the Key to Understanding Meiosis.

Meiosis is a special type of cell division that falls under the NSF “Vision and Change” core concept of “Information Flow”. The flow of information in the form of DNA and chromosomes through meiosis is considered an essential concept in biology that is difficult for students to understand. Typically, undergraduates have only a superficial knowledge of the process and fail to comprehend the molecular interactions underlying the process or the importance of how it works. We hypothesize that fundamental understanding of how DNA sequence relates to homology is a key concept that is often neglected in classroom instruction. In the study, interviews were conducted with biology experts in order to identify gaps between expert and novice mental models. We confirmed our hypothesis that experts anchor the concepts of homology, ploidy, and chromosome structure to DNA sequence. These findings will be used to create a new framework for teaching meiosis.

D2-4

Brown, Elena, and Joong-Wook Park. Mu Epsilon, Troy University, Bacterial Response to the Elk River Chemical Spill in West Virginia.

In January 2014, up to 7,500 gallons of 4-methylcyclohexanmethanol (MCHM), a chemical used for coal purification, leaked into Elk River in West Virginia. However, there is scant research on the chemical properties and its toxicity to human and the environments. One of the main concerns involves the MCHM's potential as an inducer for microbial growth, either pathogenic or biodegrading species. This research proposes to identify microbial species in the MCHM-treated sediments. We hypothesize that there are bacteria that thrive in sediments containing MCHM. In order to test our hypothesis, bacterial DNAs were extracted and analyzed using molecular-based techniques, including PCR-DGGE and DNA sequencing. The results of this research can help develop biodegradation strategies for future MCHM-spills and establish safety regulations in handling this chemical.

D2-5

Cooper, Madison, Katrina Bokenfohr, Callie Bennett, and Joong-Wook Park. Mu Epsilon, Troy University. Analysis of Bacterial Community along a Depth Gradient in Marine Tar Balls.

Tar balls are the remainder traces of petroleum located along the shoreline following oil spills or oil seeps. Multiple features of tar balls favor the qualities of a biofilm-forming environment, characterizing them as a feasible and attainable microcosm for bacteria. A considerable amount of research has given prominence to oil-biodegrading microbial communities in marine tar balls, as a study by Tao et al. in 2011 revealed that tar ball samples collected on the Gulf coast contain an unusual accumulation of non-hydrocarbonoclastic bacteria Vibrio vulnificus, a human pathogen. To gain a better understanding of other factors influencing the microbial presence in tar balls, this study proposes to investigate the internal and external environment of marine tar balls collected along the Gulf coast. After the collection of tar balls along the Gulf Coast of Alabama is complete, DNA will be extracted from the outside and inside of sampled tar balls to analyze bacterial community structures using PCR-DGGE and DNA sequencing.

D2-6

Resch, Christopher L. & Brian W. Schwartz. Mu Omicron, Columbus State University. Genetic and biochemical characterization of mutants of yeast that grow brown in the presence of copper.

Certain mutants of yeast produce brown pigments when grown in the presence of copper. Two strains that have the brown phenotype, *brn1* and *brn2*, are likely deficient in sulfur amino acid synthesis. *BRN1* and *BRN2* gene products are thought to act in the pathway downstream of the production of hydrogen sulfide by the product of the *MET5* gene. One idea is that because of these metabolic deficiencies, hydrogen sulfide accumulates in mutant cells and combines with copper to produce a brown pigment. Our research addresses the roles of copper and hydrogen sulfide in the production of the brown pigment. The brown phenotype was present when the mutants were grown on either $CuSO_4$ or $CuCl_2$ but not $MgSO_4$, indicating that the mutant phenotype depends on copper rather than sulfate. Preliminary results suggest that deletion of *MET5* suppresses the brown phenotype in *brn1*. This result supports the idea that the brown phenotype depends on accumulation of excess hydrogen sulfide due to disruption of the sulfur amino acid synthesis pathway downstream of sulfide production by *MET5*. We are currently testing to see if deletion of *MET5* also suppresses the brown phenotype in *brn2*.

D2-7

Clevenger, Tabitha & Lauren Whitehurst. Mu Omicron, Columbus State University. Genetic analysis of North American red mulberry populations using SS-PCR and DNA barcoding.

Red mulberry (*Morus rubus* L.) populations in Ontario, Canada have been impacted by habitat disturbance and increased fragmentation. Ten key populations remain in Ontario containing five or more red mulberry trees. The decline of these remnant populations is due to; reduced gene flow; increased genetic drift; and competition with the introduced white mulberry (*Morus alba* L.). This study will provide insight into negative impacts of hybridization on remaining populations of red mulberry in Point Pelee National Park in Canada, where 150 unknown samples have been collected. These samples belong to Red, White, and hybrid Mulberry trees. Identification of these trees based purely on morphology is extremely difficult. DNA was isolated according to protocols established by the Canadian Center for DNA Barcoding. Amplification of DNA for the *rbcL* and *ITS* gene regions was carried out by PCR. In the case of *ITS*, species-specific PCR was performed, where primers specific to red and white mulberry were used which, upon gel electrophoresis, result in a specific banding pattern which reliably confirms the red/white/hybrid status of the tree. All *rbcL* PCR products were sequenced, allowing for the identification of the maternal tree, providing information on the directionality of the hybridization.

D2-8

Gary, John, Jeffrey Zuiderveen and Clifton Ruehl. Mu Omicron, Columbus State University. Effects of acute copper and lead toxicity on the behavior of *Pimephales promelas* (Fathead Minnow).

Heavy metals are a contamination problem found in many freshwater environments. However, few studies have focused on the behavioral effects of multiple heavy metals on aquatic organisms. This study examines behavioral responses in adult *Pimephales promelas* (fathead minnow) to nonlethal concentrations of lead, copper, and some combinations of the two metals. Reaction time, reaction distance, and interest in feeding, as well as responses to light and sound stimuli, were measured. When compared to each

metal's own LC_{50}, lead concentrations altered all behaviors more than copper. In mixtures, copper seemed to ameliorate the negative effects of lead on behavior. These results suggest that metals can affect the behavior of fish, which may impact their ability to survive. Also, the mixture results indicate that assumptions based on single metal toxicity may not reflect the true situation in an aquatic environment where there are a mixture of metals.

D2-9

Staples, Micah & Lauren King. Mu Omicron, Columbus State University. Screening for pathogenic *Escherichia coli* in the Chattahoochee River, Columbus, GA.

Escherichia coli testing is used frequently in water quality testing globally because *E. coli* is a reliable indicator of fecal contamination. While normally used to indicate the presence of other pathogens, *E. coli* itself can be pathogenic. Serotype O157:H7, enterohemorrhagic *E. coli,* is likely the most medically important pathogenic strain of *E. coli* in the United States and, in this study, we surveyed for O157:H7 and three strains of another pathogenic subtype: enterotoxigenic *E. coli*. We isolated *E. coli* colonies from samples taken from the Chattahoochee River in Columbus, Georgia at two different locations, above and below wastewater outputs. Water temperature and pH were measured for each sample, and rainfall data was provided by Columbus Water Works. We used PCR to test for the individual subtypes and then used a nested PCR protocol for the three types of enterotoxigenic *E. coli*, which come from humans, cows, or birds. Preliminary results show that most isolated *E. coli* strains are not O157:H7 or enterotoxigenic *E. coli*. However, nested PCR specific for human enterotoxigenic *E. coli* amplified target sequences in the majority of tested colonies, indicating that humans are most likely the primary source of *E. coli* at our sample sites.

D2-10

Moody, Priya N. Mu Omnicron, Columbus State University. Diversity of Lichen at Lynnhaven Wildlife Sanctuary and the Black Creek Natural Area in West Central Georgia.

Previous studies have shown that the local environment affects lichen diversity. Here I describe the preliminary results of a study that is comparing lichen diversity from two sites in west-central Georgia a dry, sand hills site and a moist temperate forest. I predicted that lichen diversity would be lower at the sand hills site because it is drier and on sandy soil. To test this hypothesis, I sampled lichens from tree bark. In the temperate forest, a total of 25 trees were sampled. Lichen colonies occurred on every tree species. I collected an average of four different lichen species on each of the sampled trees.

D2-12

Bailey, Sarah. Beta Upsilon, Georgetown College. An unbiased approach to discovering peptide inhibitors of Sialic acid binding CD33 receptor.

D2-13

Fhallon C. Ware-Gilmore, Malia Fincher, Drew A. Hataway. University of West Alabama, Samford Universty. Hypoxic coma as a strategy to survive inundation across ground hunting arachnid taxa.

One ramification of climate change is the selective pressure placed on organisms to acquire physiological adaptations that ameliorate the effects of increased environmental fluctuation.

Ground hunting spiders constitute a major arthropod group that inhabit habitats inundated by water during heavy rainfall events. Thus, inundation is expected to become more frequent with climate change. Taxa which have the ability to enter into a hypoxic coma during inundation, avoiding drowning, should be better prepared for increases in extreme weather events. We compared the survivorship of ground hunting arachnids utilizing a hypoxic coma when exposed to inundation, to investigate the conservation of the trait across these taxa. The highest survivorship through hypoxic coma was found in Dolomedes scriptus; however, all of the species, with the exception of Rabidosa punctulata, had individuals exhibit hypoxic coma as a survival strategy. Baseline respiration and respiration during hypoxic coma were determined to quantify the suppression of aerobic respiration.

D2-14

Dongo, Maria. Mu Iota, Northern Kentucky University. A Summer with the Ohio River STEM Institute.

The Ohio River STEM Institute (ORSI) is a partnership between the Foundation for Ohio River Education (FORE) and the NKU Ecological Stewardship Institute (ESI). It promotes the monitoring and understanding of water quality in the Ohio River by citizen scientists and students. ORSI teaches water quality monitoring to K-12 students in the Science, Technology, Engineering and Math (STEM) disciplines through science camps and individual undergraduate research projects. The summer of 2015 I worked as an ORSI undergraduate research assistant. The work involved collecting water quality parameters for the Ohio River, as well as serving as a teaching assistant for three STEM camps. The purpose of my research assistantship was two-fold: to collect water quality data from the Ohio River for ORSI's official website River on the Web (ROW) and to assist K-12 students in learning the STEM disciplines.

D2-15

Zavala, Jeanette. Eta Lambda, Loyola University. Impact of vitamin B12 and nitrate availability on the concentration of particulate dimethylsulfoniopropionate in phytoplankton.

DMSPp concentrations in mixed phytoplankton communities from the Atlantic Ocean were measured after the addition of vitamin B12 and nitrate. Under nitrate-limited conditions, with or without B12, DMSPp concentration increased but this change appeared to be a result of increase phytoplankton biomass rather than increased biosynthesis. DMSPp concentrations of these mixed phytoplankton communities did not appear to be limited by the availability of B12. In a laboratory experiment, DMSPp concentrations in the diatom Phaeodactylum tricornutum (P. tric) were measured after the removal of vitamin B12 and nitrate from the culture media. DMSPp concentrations increased under nitrate-limited conditions with or without B12, and is argued to be the result of increased synthesis. DMSPp concentration in P. tric were unaffected by B12 limitation. It is hypothesized that P. tric is using the B12-independent methionine synthase MetE to synthesize DMSPp rather than the methionine synthase MetH, which requires the use of vitamin B12 as a co-factor.

Treasurer's Report, Edgar B. Lickey

EXPENDITURES for 2015

	DEBITS	**RECEIPTS**
ANNUAL MEETING		
CHATTANOOGA		
Hotel and conference space	$74,151	
Appalachian State Conference and Camps Services	20,109	
Exhibit hall display	7,325	
Thursday night - Aquarium, Ducks, two bands	22,690	
Awards	8,173	
Registration reimbursement for volunteers	1,775	
Field trip - ASB and BBB	1,082	
T-shirts, hats, pint glasses	2,712	
Printing	3,435	
Liability insurance	1,355	
CONCORD		
Community Café - Friday Social deposit	15,010	
Discovery Place - Friday Social deposit	2,500	
Embassy Suites Hotels - September EC meeting	5,110	
TOTAL MEETING DEBITS	**$165,428**	
Total meeting receipts (before paying App State CCS)		$190,461
Direct support - UTC		4,000
Exhibitor and vendor fees and support		11,490
Raffle		1,001
Auction		4,160
T-shirt, hats, glasses sales		3,126
TOTAL MEETING RECEIPTS		**$214,238**
TOTAL MEETING REVENUE = $61,250.37		
MEMBERSHIP DUES - 2015 (including some 2016)		$**30,832**
GENERAL OPERATING EXPENSES		
Office supplies	178	
Shipping and postage	250	
Google.com, MacHighway, andMyFax line	408	
IRS - 1023 application (plus cashier's check fee)	868	
Cvent membership management	8,300	
Bank fees (including new card readers)	650	
PROFESSIONAL SERVICES		
Accountant - Bryce Holder	121	
C-Vent manager - Chris Flemming	4,760	
Meeting planner - Shannon Gordon	3,682	
Attorney - Di Santi, Watson, Capua & Wilson	1,636	
Secretarial Services - Eunice Turner at UTK	200	
Meeting program layout - abi Graphics	720	
Sub-totals	**$87,201**	**$245,070**
TOTAL REVENUE for 2015		**$57,870**

Treasurer's Report
Edgar B. Lickey

2016 Annual Meeting
Concord, NC

ASB remains in excellent financial shape with total assets of $237,759 divided between two accounts. As of now, $100 is held in our PayPal account as a buffer until the account is finally closed. This is including having paid all bills and invoices to date.

Taxes
Soon after the Chattanooga meeting last year, we were informed that our 501(c)(3) status was retroactively reinstated after losing that status in 2010. We also successfully filed and are recognized as tax exempt for the State of North Carolina. Donations to ASB, past, present and future, are entirely tax deductible.

Merchant Accounts
Since regaining our tax exempt status, we successfully obtained a merchant account through Wells Fargo which has interfaced with Cvent and allows us to directly accept credit card payments instead of having to go through PayPal interface. The PayPal account was opened in a private name, and this person risked financial liability when we could not obtain the merchant account due to our non-exempt status.

Enrichment Fund
It is the judgment of the Finance Committee that the amount of Enrichment Fund monies should be set at $100,000. Past records are missing and incomplete and this number is by far the highest amount ever designated as Enrichment Fund. Based on a review of ASB's financial status, this is entirely feasible and we feel is a level that the Enrichment Fund could have achieved had we not experienced our recent crisis. Because of this crisis, we had not been actively solicited donations. However, ASB should reinvigorate our Enrichment Fund drives.

Calendar year	**2014**	**2015**
Beginning 1 January	$79,484	$163,280
Ending 31 December	$163,280	$221,150
Change	**+$83,796**	**+$57,870**

CURRENT BALANCE (as of 28 March 2016)	
Wells Fargo Checking	$44,471.09
PayPal (Closed)	$100.00
Wells Fargo Savings	$193,287.55
Total	**$237,858.64**

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Return Form to Ashley B. Morris, Department of Biology, Middle Tennessee State University, 1301 East Main Street, Murfreesboro, TN 37132, amorris.mtsu@gmail.com. ☙

BEQUESTS TO THE
ASSOCIATION OF SOUTHEASTERN BIOLOGISTS

If you would like to help assure ASB's future through a provision in your will, this general form of bequest is suggested:

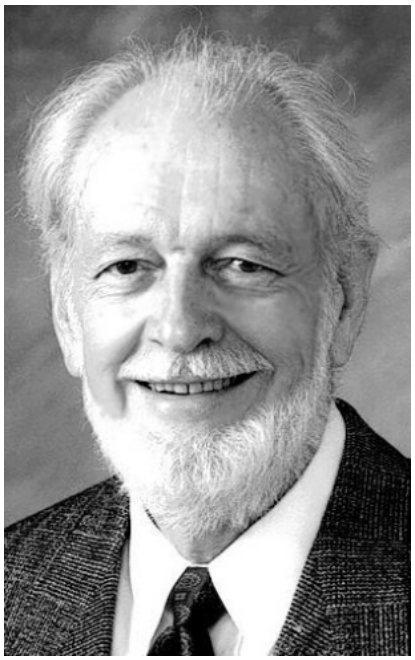
I give, devise and bequeath to the Association of Southeastern Biologists, business office located in Bridgewater, VA, the sum of $_____ and/or (specifically described property).

If property, please describe.

We welcome any inquiries you may have. In cases in which you have specific wishes about the disposition of your bequest, we suggest you discuss such provisions with your attorney.

OBITUARY

Dr. John Mervin Herr, Jr.
1931-2016



Dr. John M. Herr, Jr., 85, of Columbia, SC, passed away Sunday, June 19, 2016 in Belford, VA. After a hike in the beautiful sunshine at The Peaks of Otter off the Blue Ridge Parkway, he sat resting with his wife, Lucrecia. He reached out, touched her hand, and breathed his last breath. He did not suffer, but died in peace after hiking in his beloved mountains. He was often referred to as a "true Southern gentleman."

Dr. Herr was Distinguished Professor Emeritus in the Department of Biological Sciences at the University of South Carolina. He graduated from the University of Virginia with BA and MA degrees, from the University of North Carolina with a Ph.D. in botany, and served a post-doctoral appointment at the University of Delhi, India on a Fulbright Fellowship (1957-58). He was also a Fellow of the Linnean Society of London (1988). During his 34 years of service at USC, before retiring in 1993, Dr. Herr taught courses in botany and performed notable research in flowering plant embryology, culminating in theoretical papers on the evolutionary origin of seeds and leaves. His inventions included tissue processing and microscopy techniques now utilized worldwide. For the 23 years following retirement, he contributed his wisdom to the university and multiple students and researchers. His office and lab were never silent. He served on many committees, authored guidelines for organizing the USC Faculty Senate, chaired the faculty senate, and served as President of the Thomas Cooper Society.

He held memberships in several scientific associations such as the Southern Appalachian Botanical Society, which awarded him the Elizabeth Ann Bartholomew Award in 1996. He led workshops and seminars all over the world and supervised numerous dissertations. Dr. Herr's major professional affiliation was with the Association of Southeastern Biologists (ASB) where he was the Archivist for many years and served on the Executive Committee (1973), was Vice President (1974) and President (1976). He was the author of the constitution and bylaws of the Association and was instrumental in designing the ASB logo that we use today. ASB presented him the Meritorious Teaching Award (1989) and the Senior Research Award (1998). Only six ASB members have received the Meritorious Teaching Award, the Senior Research Award and have served as President. He was awarded the inaugural "John Herr Lifetime Achievement Award" (2007). In presenting the Herr Award, the Association noted: "He is perspicacious, sagacious, and mighty fine!" Dr. Herr helped the Association to weather some very difficult times.

In 2005, Dr. Herr decided to give a unique gift to the university. He set about composing a specific tune for Carolina's alma mater, "We Hail Thee, Carolina", which has traditionally been sung to the tune of "Flow Gently, Sweet Afton." The new tune was performed by the USC Concert Choir in 2009, but has not (at least, yet) been accepted as the official tune for the alma mater. The experience of having his tune brought to life helped build a deeper relationship between Dr. Herr and the School of Music. With funds contributed by Dr. Herr and his wife, the School of Music established the annual John and Lucrecia Herr Composition Award, open to all music students.

Dr. Herr, a native of Charlottesville, VA, is survived by his wife, Lucrecia Linder Herr, for whom the Lucrecia Herr Outstanding Biology Teacher Award is named; his sister, Dr. Nancy Herr Fallen; his daughters and their husbands: Susan Rebecca (John) Fallen; Rachel Lynn (Michael) Leach; his stepson and his wife, Frederick Brent (Mary Grace) Wahl; his niece, Margaret Fallen; and six grandchildren. A private family service will be followed by a celebration of his life at a future date.

Those wishing to make a contribution in memory of Dr. Herr are asked to consider The John and Lucrecia Herr Composition Award, University of South Carolina School of Music, 813 Assembly Street, Columbia, SC 29208 and/or the Association of Southeastern Biologists; C/O Dr. Edgar B. Lickey, Treasurer; Department of Biology; Bridgewater College; 402 East College Street, Box 125; Bridgewater, VA 22812.

Please sign the online guestbook at www.dunbarfunerals.com in memory of Dr. Herr.

The obituary was prepared by Lucrecia Herr, Columbia, SC; Dr. J. Kenneth Shull, Appalachian State University, Boone, NC; and Dr. James D. Caponetti, University of Tennessee, Knioxville, TN. ☙

Southeastern Naturalist

Volume 15 2016 Number 1

RESEARCH ARTICLES

Continued on inside back cover

Publication Date: March 31, 2016

ALL TAXA BIODIVERSITY INVENTORY (ATBI)

GATLINBURG, TENNESSEE

ATBI is an organization devoted to surveying all life in the Great Smoky Mountains National Park.

More information about the ATBI and Discovery Life in America (DLIA) may be obtained from the Executive Director, Todd Witcher, by e-mail todd@dlia.org. The website is http://www.discoverlifeinamerica.org or at http://www.dlia.org. The mailing address is Discover Life in America, 1314 Cherokee Orchard Road, Gatlinburg, TN 37738-3627. The telephone number is (865) 430-4752.

SOUTHERN APPALACHIAN FOREST COALITION (SAFC)

ASHEVILLE, NORTH CAROLINA

As stated in their newsletter *Across Our Mountains*, SAFC is an organization dedicated to "working together to protect and restore southern Appalachian forests."

More information about SAFC may be obtained from their web site at http://www.safc.org, and by e-mail at safc@safc.org. The mailing address is Southern Appalachian Forest Coalition, 46 Haywood Street, Suite 323, Asheville, North Carolina 28801-2838. The telephone number is (828) 252-9223.

Patron Member:
Dwayne A. Wise
Professor of Biology
Department of Biological Sciences
Mississippi State University
Mississippi State, MS

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ASB membership includes discounts on annual meeting registration and on subscriptions to Southeastern Naturalist (SENA), the official journal of ASB.

To join or renew and pay by cash, check, or money order, complete contact information below, enclose cash or check/money order payable to Association of Southeastern Biologists, and send by mail. **To pay by credit card**, please log on to our membership management page (http://www.sebiologists.org/membership/) and use our secure online payment system. If you would like further information or have questions, contact **Edgar B. Lickey, ASB Treasurer, Department of Biology, Bridgewater College, Bridgewater, VA 22812; (540) 828-5426; elickey@bridgewater.edu.**

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SOUTHEASTERN BIOLOGY

VOLUME 63, NUMBER 3, July, 2016

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