From Mountain to Market:
Growing Watsonia lepida for the Cut Flower Industry

May 2020

Source: McMasters, 2012

GRADUATE STUDENT INFORMATION:
Cody Jennings, B.S. in Geography, M.S. in Community and Regional Planning
Currently pursuing an MPS in Horticulture

FACULTY INFORMATION:
Dr. Neil Anderson, B.S in Ornamental Horticulture, M.S. in Horticulture, Ph.D. in Horticulture

Jordyn Lehman, BS in Biology, Chemistry, and Outdoor Conservation. Currently pursuing an MPS in Horticulture

INSTITUTION CONTACT INFORMATION:
University of Minnesota – Twin Cities
Department of Horticulture Science – 305 Alderman Hall
1970 Folwell Ave, St. Paul, MM 55108

WORK LOCATION:
The University of Minnesota Growth Facility Lab – St. Paul Campus

PROJECT CATEGORY INFORMATION:
Floriculture and cut flower

START DATE: January 2021
END DATE: December 2021

TOTAL NCR-SARE REQUEST: $8,685.00

Contents

APPLICATION SIGNOFF SHEET

Northeast SARE Graduate Student Grant Application Signoff Sheet Note: This form must be completed with signatures and attached to the online application at time of submission. The deadline is 5:00 p.m. ET on May 7, 2020. Signatures are required below from the graduate student applicant, the student's faculty advisor, and an authorized official from the institution's grants office.

Applicant (graduate student) name: Cody Jennings
Project title: Watsonia lepida: Down from the Mountain: Incorporating *Watsonia lepida* into the Horticultural MarketFunding request: $8,685.00

APPLICANT'S ASSURANCE: I affirm that I am, or will be, a graduate student at the University of Minnesota, and that I have written this proposal and discussed it with my faculty advisor, listed below. Should I be awarded a grant, I will be the primary contact for managing the project. I will report results each December while the project is in progress and write a final report when the project is complete. I will keep Northeast SARE informed of any contact and e-mail changes for at least two years after the final report is written.
Applicant signature:

FACULTY ADVISOR: I affirm that I have read this proposal and understand that, for the purposes of this proposal, I will be named the principal investigator. I will supervise grant activities and support student compliance with SARE requirements as needed. Faculty advisor signature:
_____ Date_____
Print advisor name:
Address:
Telephone:
Email Address:

INSTITUTIONAL APPROVAL: The grants or sponsored programs office of the University of Minnesota hereby certifies that we have read this proposal, approve this budget, and have the capacity to manage grant funds on behalf of the faculty member named above should the proposal be funded. We further understand that SARE funds cannot be used except as outlined in the proposal and that for organizations with a current federally negotiated indirect cost rate, the USDA/NIFA allowed maximum is 10% of the total request.

Signature of authorized official: _____ Date_____

PROJECT SUMMARY

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Plant enthusiasts in South Africa are provided an opportunity to witness a multitude of floral diversity from the southern Cape provinces to the eastern mountains and grasslands. Endemic to South Africa, the genus *Watsonia* is a corm-bearing perennial consisting of 52 species known for its erect spikes and brilliant showy flowers boasting hues of orange, pink, red, and purple. Moreover, *Watsonia* have been identified as having great potential and interest among growers within the floriculture industry as a cut flower. Given this interest, additional research is needed to successfully gauge the commercial viability and marketability of *Watsonia*. This study will focus on the *Watsonia lepida* – a high grassland loner found in South Africa. The results from this research aims to expand on the dearth of research pertaining to *W. lepida and* gain insight on germination characteristics and requirements. The outcome of this study will provide researchers and professional industry leaders insight on how to grow the species and whether *W. lepida* has potential as a cut flower.

PROGRAM LOGIC MODEL

Situation
This research aims to research and understand germination and growing requirements for *Watsonia lepida* and its potential as a cut flower within the floriculture market. This research would be beneficial to growers, producers, breeders and ultimately consumers who could purchase a new cut flower.

Inputs
Inputs for this research project include the primary researcher, Cody Jennings, partnership/mentors, the physical environment of the Growth Facility Lab at the University of Minnesota and previous research as a guide in the experiment process. In addition, there are the supplies needed to run the experiment – seeds, soil media, labels, markers, etc.

Activities
Activities for this project include the research experiment and the participation involved from others. The research activity includes identifying the preferred growing conditions and germination requirements for *W. lepida* from seed.

Outputs
Research outputs include producing a product information guide on the cultural and preferred growing requirements of W. lepida. Outputs will incorporate the research experiment results in addition to providing opportunities to share the results with students, faculty and industry professionals.

Outcomes		
Knowledge	**Actions**	**Conditions**
Goals are to gain insightful information on the growing characteristics and use of W. lepida in the floriculture industry.	For *W. lepida* to become a new cut flower within the industry and learn new germination requirements from seed.	This research has the potential for a new crop to be introduced into the market, thus expanding new floriculture cut flower market opportunities.

Figure 1. Program logic model illustrating the steps that will be taken for setting up and conducting the experiment design and research activity.

The program logic model (Figure 1) provides a chronological overview for this research experiment. This proposal provides more detail for each section, this model is provided as a general protocol and anticipated outcomes for this study.

PROPOSAL NARRATIVE

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Background

This proposal presents a roadmap to better understand the species *Watsonia lepida* with the ultimate goal of introducing it into the marketplace as a new cut flower. A key aspect is not only understanding the physical environment in which *W. lepida* grows, but also whether it could be positioned in the market as a viable commercial crop. Currently, little information and research is available for *W. lepida* and if / where it can be positioned in the market. Thus, the following includes essential background information for *W. lepida* pertaining to the taxonomy, geography, habitat, and potential identified uses within the horticultural industry. Figure 2 illustrates *W. lepida* growing in a rocky high-altitude outcrop near Drakensburg, South Africa.

Figure 2. Watsonia lepida growing on a high-altitude rocky outcrop near Drakensberg, South Africa (McMasters, 2012).

Taxonomic Classification

Watsonia, known as the Bugle Lily, is in the family Iridaceae which is commonly found in Mediterranean climates consisting of dry hot summers and rainy winters. However, this family is highly adaptable and can be found throughout the World (Eshel, 2002; Raycheva et al., 2011). The Iridaceae family has approximately 65 different genera and over 2000 species of which more than half are located in southern Africa (Davies et al., 2005; Van Kleunen et al., 2007).

The genus *Watsonia*, named after Sir William Watson, are indigenous to southern Africa and found in the western and southern Cape provinces, eastern mountain ranges, and grasslands. However, the majority of the species are found in the western and Southern Cape provinces (Ascough et al., 2009). There are 52 species of Watsonia taxonomically arranged by subgenus, section, and subsection. The species *W. lepida*, meaning attractive or pleasing, is primarily found in the open mountain grasslands near the Drakensberg region of South Africa and the Kingdom of Lesotho (Figure 3). *Watsonia lepida* is taxonomically listed in the following format:

SUBGENUS WATSONIA;

section GLADIOLOIDES;

W. lepida.

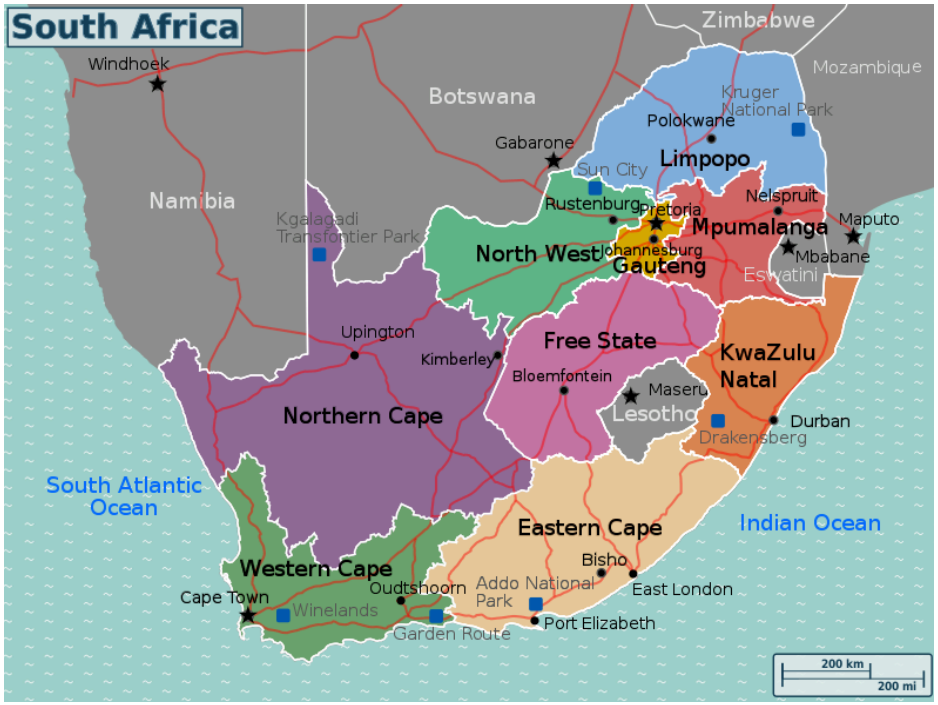

Figure 3. A South Africa regional overview; the Free State Province and Kingdom of Lesotho are where *Watsonia lepida* grows naturally (Bouter, 2009).

Watsonia species are determined by their variation in plant size, corm development, number of leaves, and flower color. *Watsonia lepida* is a corm-bearing perennial, growing approximately 25-65 cm high with 3-4 leaves that form a sheath around the stem base and decrease in size as they extend upwards. The flower spike, which distinguishes the genus, consists of flowering nodes 5-9 mm apart. The funnel shaped flower consists of moderately sized pink to purple hued petals (Figure 3 & 4). (Goldblatt, 1989; Johnson et al., 2009). There are two types of *Watsonia* species: long-tubed and short-tubed. *Watsonia lepida* is a short-tubed species likely pollinated by bees. The pink to purple flowers produces a mild scent (Goldblatt, 1989). They typically flower in the summer months between November and January (Southern Hemisphere) and the seeds germinate between 15°C and 25°C (Ascough et al., 2007).

Figure 3. Purple-pink trumpet shaped flowers of W. lepida in the wild (*McMaster, 2012*).

Figure 4: *Watsonia lepida* botanical illustration showing the above- and below-ground morphology (Goldblatt, 1989).

Geographic Distribution and Native Habitat

Watsonia species are typically categorized as being found within the winter rainfall or summer rainfall regions between 22° S - 35° S latitude. The winter rainfall region, which resembles Mediterranean climates, is located in the southwest Cape provinces and is where the majority of Watsonia species are located. However, W. lepida is a summer rainfall species found in the Kalahari-Highveld Transition Zone and receives an average annual precipitation between 400 mm to more than 1000 mm (Wessels et al., 2011). This ecosystem is dominated by grasslands and includes the Drakensberg region of eastern South Africa and the Kingdom of Lesotho (Van Kleunen et al., 2007) (Figure 5). Watsonia lepida prefer high elevation grasslands, plateaus, and rocky outcrop formations. They are a solitary species typically found in well-drained soils above 2000 m (Goldblatt, 1989). While uncommon, they have been found in clumps of two to three in rocky outcrop formations (Brand et al., 2009; Goldblatt, 1989) (Figure 6). Seeds germinate between 15°C and 25°C (Ascough et al., 2007).

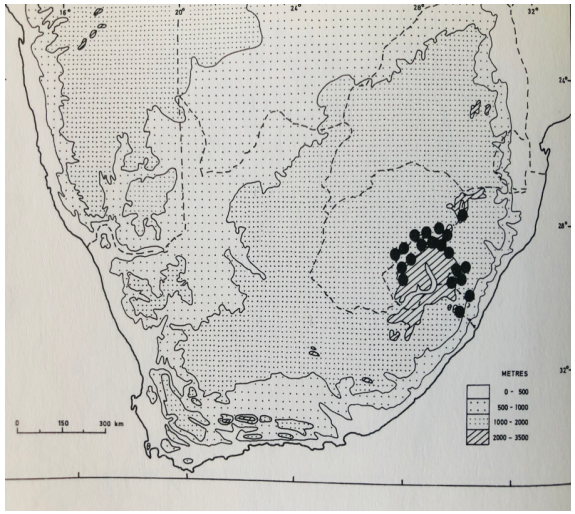

Figure 5: Distribution of *W. lepida (*closed circles) in South Africa near Drakensberg and Kingdom of Lesotho (Goldblatt, 1989).

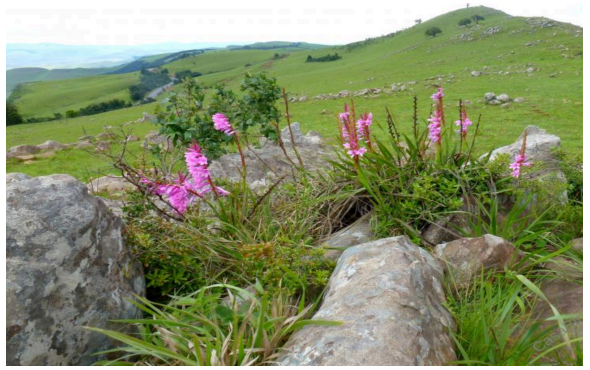

Figure 6. Watsonia lepida in a rock outcrop near the Eastern Cape, South Africa (McMaster, 2012).

Tendency to Naturalize or Become Invasive

A few species of *Watsonia* have been introduced in Australia, New Zealand, and North America as a garden ornamental bedding plant. Some species of *Watsonia* have been introduced in other continents but given the restricted high-altitude growing climate for *W. lepida*, it is unlikely to naturalize outside of its normal habitat range (Kleunen et al., 2007).

Crop Species History and Potential Uses

A few *Watsonia* species from the southern Cape provinces have been bred and utilized for the ornamental bed and cut flower industry (Cooke, 1998; Van Kleunen et al., 2007). Moreover, there is international interest in the South African horticultural market among breeders to identify more species as a cut flower. Watsonia species have been identified as having high potential for cut flowers (Reinten et al., 2011). To date, there is no evidence that *W. lepida* has been domesticated or has had an extensive breeding history. There are no cultivars on the market and only a few vendors sell seeds. While the corms of *Watsonia* are technically edible and could provide a source of carbohydrates, they are considered too tough and sour to be palatable (De Vynck et al., 2016). There is little research as to whether indigenous people specifically used W. lepida as a medicinal or edible crop. In a 2016 South African study, traditional ecological knowledge for Watsonia as an edible or medicinal crop was ranked as low to non-existent (De Vynck et al., 2016).

There has been limited research regarding W. lepida specifically as to whether it has commercial viability within the horticultural industry. The following is a partial list of universities that have been involved in breeding efforts: The Research Center for Plant Growth, School of Biological and Conservation Sciences, University of KwaZulu-Natal, South Africa; Laboratory of Growth Regulators, Palacky University, Institute of Experimental Botany, Czech Republic; and the University of Minnesota Department of Horticultural Science, St. Paul, Minnesota. This research has specifically focused on increasing habitat adaptability, increasing color tones and size, and lengthening flowering period (Cooke, 1989). From that research, limitations have been identified with W. lepida including the amount of time it takes to produce corms that are able to flower (which can range up to two years), plant height and small flower size.

Inputs

Personnel inputs include the primary researcher, Cody Jennings, who is pursuing a Master of Professional Studies in Horticulture at the University of Minnesota. The primary researcher will be mentored by Dr. Neil Anderson and Jordyn Lehman from the University of Minnesota Department of Horticulture. While this may not be a traditional partnership, the mentors will greatly assist in research questions and experiment design. The experiments will take place at the University of Minnesota St. Paul Campus at the Plant Growth Facility Lab on campus (Table 1).

INPUT	Resource	Role
Personnel	Cody Jennings – Pursuing a Master of Professional Studies in Horticulture	Research design, execution of research goals
Partnership/Mentors	Dr. Neil Anderson, B.S in Ornamental Horticulture, M.S. in Horticulture, Ph.D. in Horticulture Jordyn Lehman, BS in Biology, Chemistry, and Outdoor Conservation. Currently pursuing an MPS in Horticulture	Assist student with research design and execution of experiment.
Physical	INSTITUTION: University of Minnesota – Twin Cities Department of Horticulture Science – 305 Alderman Hall 1970 Folwell Ave, St. Paul, MM 55108 WORK LOCATION: The University of Minnesota Growth Facility Lab – St. Paul Campus	To serve as the research location for this study
Educational Resource	Research literature and supporting documents	Educational resources to help with executing research and methodology

Table 1. Research and experiment design inputs, resources and role for study.

Activities

The research activities and experimental design will be described in this section.

Location

This study will be conducted on the University of Minnesota St. Paul campus Plant Growth Facility building (Figure 7). Two greenhouses will be utilized for this study including a mist house and production house. Table 2 highlights the greenhouse growing conditions:

Greenhouse	Conditions
Mist House (#369 B-4) (Used for seed germination)	• Day/night temps: 21°C/21°C (Zero DIF) • Lighting: lights on for 16 hrs. (0600-2200 HR) at 150 umol $m^{-2}s^{-1}$ • Mist frequency: every ten minutes; on for a seven second duration
Production House 1 (#369 B-5) (Used after seeds have germinated)	• Day night temps: 19°C/16°C (+3 DIF) • Lighting: lights on for 16 hrs. (0600-2200HR) at 500 umol $m^{-2}s^{-1}$ • Fertilization: 125 ppm N CLF 15-5-15 Cal-Mag (CLF) • Monthly fungicide drenches will be applied
Production House 2 (369 C-7) Short Day/Long Day Benches	• Early morning temp dip at sunrise to 50F for 2-3 hours • Day/night temps: 21°C/21°C (Zero DIF) • Lighting LD: lights on for 16 hrs. (0600-2200 HR) at 500 umol $m^{-2}s^{-1}$ The two short day benches (8 hours lighting; black cloth opens daily at 0800 HRS and closes daily at 1600 HRS) • Fertilization: 125 ppm CLF 15-5-15 Cal-Mag (CLF) monthly fungicide drenches on flowering crops

Table 2. Greenhouse growing conditions at the University of Minnesota Plant Growth Facility

Figure 7. Plant Growth Facility building at the University of Minnesota, St. Paul campus (Ericksen ROED & Associates, 2007).

Experimental Design

Research methods for this study have been designed to identify the preferred growing conditions for *W. lepida* to germinate from seed. The preferred outcome is to be able to answer questions related to optimal germination preference using different testing metrics of soil media, moisture, and seed sowing depth (Table 3). For this experiment, 288 seeds will be sowed in four different plug trays of different sizes, soil media, and depth of seed in the media (Figure 8). All plug trays will be started in the mist house and moved into greenhouse after germination occurs. Table 3 illustrates the four different scenarios for this study.

Crop	Plug Type	# of Seeds	Media Type	Seed Depth
#1	50	50	Germination mixture	>1 in.
#2	50	50	Germination mixture with vermiculite	>1 in.
#3	72	72	Germination mixture	½ in.
#4	72	72	Germination and soil mixture	½ in.

Table 3. Experimental seed planting design for *W. lepida*

Figure 8. Watsonia lepida seeds to be used for this experiment (photo taken by author).

Germination will be recorded in four stages:

- Stage 1: Germination time (Percent germination will be recorded at this stage).
- Stage 2: Occurs when the radicle has penetrated the soil (Will be looking for hypocotyl expansion during this stage)
- Stage 3: Identified when the true leaves begin to develop
- Stage 4: Begins when seedlings are ready for transplanting. Yield potential will be recorded at this stage. At this stage, 30 plants will be transplanted in 4" pots for the photoperiod greenhouse. Fifteen plants will be placed in short-days and 15 will be placed in long-days for the remainder of the experiment.

All four crops will be evaluated based on when and how long it takes for them to reach each germination stage (Table 4). This will be recorded within the following format:

Crop	Stage 1	Stage 2	Stage 3	Stage 4
Crop # 1 **This will be recorded for each crop experiment**	• Number of days to germinate • Percent germination recorded	• Number of days for hypocotyl to penetrate the soil • Will record hypocotyl elongation tendencies	• Number of days when true leaves begin to develop	• Number of days when seedlings are ready for transplanting • Yield potential will be recorded at this stage

Table 4. Example of germination evaluation and recording

Timeline

The following is a timeline for the work to be completed with this project. Currently broken into one-month intervals for the entire year (Table 5).

Task Description	1-Jan-2021	1-Feb-2021	1-Mar-2021	1-Apr-2021	1-May-2021	1-Jun-2021	1-Jul-2021	1-Aug-2021	1-Sep-2021	1-Oct-2021	1-Nov-2021	1-Dec-2021
Project Begins: Finalize plans, gather supplies, prepare greenhouse space, sow seeds												
Monitor plug trays in mist house for germination												
Continue monitoring - prepare first quarter progress report												
Monitoring continues												
If seedlings are ready - transplant into 4" pots: 15 pots to go into short days/15 pots to long day photoperiod greenhouse												
Prepare second quarter progress report												
Continue monitoring seedlings/transplants												
Start planning for sharing results with faculty and students												
Continue monitoring												
Prepare for final quarter												
Share results with faculty and students at brown bag lunch and learn												
Prepare final report												

Table 5. Timeline and task description for research project

Outputs

Outputs from this research project will include the experiment results, progress made with completing a product information guide, a brown bag luncheon for faculty and staff, and a report where *W. lepida* could fit within the floriculture industry.

Research Experiment Results

After all of the experiments have been conducted and recorded. Results will be compiled in a paper to be shared with the scientific community. One of the outputs will be to compile a product information guide for *W. lepida*. This guide will include standard guide information such as colors, plant size and habitat, characteristics and potential market use. It will also include cultural recommendations such as sow plug tray size, finish container, and plug stage germination and transplant finishing recommendations. In addition, through literature review and research, information on common disease and pests will be included. Information gathered from the research experiments and literature review will help determine where within the floriculture industry *W. lepida* is best suited.

Brown Bag Lunch and Learn

A brown bag lunch and learn seminar will be presented to faculty and students in November at the University of Minnesota St. Paul Campus. This will be an opportunity to share experiment results and answer questions. A PowerPoint presentation will be prepared and presented along with showing transplant progress.

Outcome

There are several expected outcomes from this research project. The first will be to quantitatively measure the germination percent for each experiment in order to identify the best growing conditions of *W. lepida*. This also includes recording information for results from the photoperiod study for short and long days. Specific target outcomes include learning more about germination characteristics and preferred growing conditions. The second outcome would be to be able to populate information in a product information guide. A third outcome is having the opportunity to share research results with faculty and students. This will provide the opportunity to share research results, answer questions, and have a dialogue with colleagues about the results. Finally, the fourth outcome would be able to determine from the research and literature review where *W. lepida* could be positioned in the floriculture market as a cut flower or garden perennial. All of this could lead to a behavior change in the floriculture market as *W. lepida* has been identified as having great potential as a cut flower.

Project Evaluation

Project evaluation is a key aspect of research experiments. The following will address indicators for both project activities and outcomes such as potential changes in awareness, attitudes, knowledge and skills, behavior and practice.

Short-Term Outcomes

Short-term outcomes will address changes in awareness, attitudes, knowledge and skills. Quantifiable short-term outcomes will provide increased knowledge about *W. lepida* from the sowing, germination and transplant stages. This project will also bring awareness to a species that has not had a lot of attention but has potential use in the floriculture market. Other short-term outcomes include the ability to share the information with interested academics and industry personnel. This will allow for a sharing of information about a species that has not been commercially bred and that little information exists.

Intermediate Outcomes

Intermediate outcomes will focus on behavior and practice. The goal of this project is to learn more about growing characteristics of *W. lepida* and where it could be positioned in the floriculture market. Behavior outcomes would include more growers learning about *W. lepida* and possible ways to incorporate in practice into industry. While this may be more of a long-term outcome, the research provided in this study will aid in providing more information to modify behavior and practice in order to incorporate this species into crop scheduling and production.

Key Personnel

- Dr. Neil Anderson, B.S in Ornamental Horticulture, M.S. in Horticulture, Ph.D. in Horticulture
- Jordyn Lehman, BS in Biology, Chemistry, and Outdoor Conservation. Currently pursuing an MPS in Horticulture

A curriculum vitae has been provided for the primary researcher, Cody Jennings.

Education

- Master of Professional Studies in Horticulture
  University of Minnesota – St. Paul, MN (2022 projected)

- Sustainable Farming and Food Systems
  Tompkins County Community College – Ithaca, NY (2017)

- Master of Community and Regional Planning
  Graduate minor in American Indian Studies
  University of Wyoming – Laramie, WY (2013)
  Thesis Titles:
  - Protecting the Casper Aquifer through Septic System Management
  - How Burdened are the Burdened? An Affordable Housing Needs Assessment: Cheyenne, Wyoming

- B.S. Geography with Natural Resources
  University of Wyoming – Laramie, WY (2006)

Professional History

- Senior Planner - 106 Group: St. Paul, Minnesota (2018 – 2020)
- Project Assistant - Tompkins County Planning and Sustainability: Ithaca, NY (2017-2018)
- Planning Consultant - Premium Property Management: Ithaca, NY (2016-2018)
- Lecturer - University of Wyoming, Department of Geography: Laramie, Wyoming (2016)
- Special Project Planner - Albany County Planning Department: Laramie, Wyoming (2015)
- Tribal Planning Director - Muscogee (Creek) Nation: Okmulgee, Oklahoma (2014-2016)

- Creek County Planning Director - Indian Nations Council of Governments: Tulsa, Oklahoma (2013-2014)
- Assistant City Planner - City of Laramie Community Development: Laramie, Wyoming (2012-2013)
- Planning Internship, Albany County Planning Department: Laramie, Wyoming (2011-2012)
- Graduate Assistant/Lecturer - University of Wyoming, Department of Geography: Laramie, Wyoming (2011 -2012)
- Recreation Forestry Technician/Forest Protection Officer - USDA Forest Service Medicine Bow Routt National Forest: Laramie Ranger District, Wyoming (2005-2012)

Teaching Experience

Instructor of Record, University of Wyoming

- GEOG 1010: Physical Geography (4 hrs; one section, Summer 2012; Spring 2016; Summer 2016)

Teaching Assistant**,** University of Wyoming

- GEOG 1010: Physical Geography (4 hrs; two lab sections, Spring 2012)
- GEOG 2150: Introduction to Geographic Information Systems (3 hrs; two lab sections, Fall 2011)

Presentations/Publications

- Managing the Impacts of Cruise Ship Tourism: Published in Proceedings of the Symposium Heritage as a Builder of Peace, Edited by Corinna Del Bianco, Life Beyond Tourism Edizioni, Florence, 2019, ISBN 978-88-943894-3-2.
- Invited Speaker: City of Laramie/Albany County Environmental Advisory Committee
- Topic: Casper Aquifer Protection Area: Groundwater and Septic System Management
- Invited Speaker: University of Wyoming: GEOG/AIST 4340: Resource Management on Western Reservations
- Topic: Tribal Energy Planning, October 2015
- Invited Speaker: Muscogee (Creek) Nation Strategic Planning Conference
- Topic: Tribal Planning, March 2015
- Invited Speaker: Muscogee (Creek) Nation Community Research and Development Conference
- Topic: Introduction to Tribal Planning, June, 2014

Workshop/Conferences

- Planning in the Wild West, August 2015
  Wyoming Planning Association Western Planner Conference: Laramie, Wyoming
- Planning for a More Resilient Oklahoma, October 2014
  Oklahoma Chapter of the American Planning Association: Norman, Oklahoma
- Planning Oklahoma Together, October 2013
- Oklahoma Chapter of the American Planning Association: Tahlequah, Oklahoma

Honors and Rewards

- Golden Key Honor Society, Spring 2012
- Phi Kappa Graduate Honor Society, Spring, 2012
- Gamma Theta Upsilon Geography Honor Society, Fall, 2012
- Chief Washakie Memorial Scholarship, Fall 2012
  Chief Washakie Memorial Endowment, University of Wyoming
- Lester and Lola Roberts Scholarship, Spring 2011
- Department of Geography, University of Wyoming
- Paul Westdt Geography Scholarship, Fall 2010

Memberships

- American Institute of Certified Planners, 2015
- Oklahoma Planning Association, 2013
- Wyoming Planning Association, 2010
- American Planning Association, 2010

BUDGET

BUDGET

The primary researcher will complete the work plan described in this proposal for a firm fixed price of $8,685.00. Table 6 provides a total for each category and a grand total. The following budget narrative breaks down the categories and expense for each line item.

Salaries

The salary for the primary researcher includes hours for all phases of the research and experiment design from start to finish. This includes set up, sowing, taking measurements, notes, and watering. Salary for a 12-month period will be stipend at $600.00 per month totaling $7,200.00.

Materials and Supplies

The list of materials and supplies are itemized below:

- Watsonia lepida seeds
- Plug trays
- Four-inch transplant pots
- Germination mix, soil mix, vermiculite
- Labeling tags
- Sharpie markers
- Fertilizer
- Miscellaneous items needed throughout the year

The total cost for materials and supplies is estimated at $500.00

Travel

The cost to travel to the University for a 12-month period will be based on purchasing a parking pass either or taking public transit to campus.

This will be calculated based on a student public transit pass totaling $300 for the year.

Direct Costs

Direct costs include the price for renting space at the Plant Growth Facility on campus. For this project the following have been calculated for bench space. One 75 square foot bench @ $0.025 ft2 per day = $1.88 per day for 365 days for a total of $684.38 ~ rounded up to $685.00 for the yearlong project.

Category	Cost
Salaries	$7,200.00
Fringe benefits	$0
Non-expendable equipment	$0
Materials and supplies	$500.00
Travel	$300.00
Direct Costs	$685.00
Indirect costs	$0
Total	**$8,685.00**

REFERENCES

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