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# **Status of the Egyptian Biodiversity: A Bibliography (2000-2018)**

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**Contribution to the Sixth National Report on  
Biological Diversity in Egypt (2018)**

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## **Introduction**

Egypt has attracted the attention of the explorers of natural history due to its unique position midway between Africa and Asia, with its long coasts of the Mediterranean Sea in the north (c. 970 km) and the Red Sea in the east (c. 1100 km). It is connected to the Mediterranean and sub-Saharan Africa by way of the Nile Valley, and to the tropical Indian Ocean through the Red Sea. It has diverse habitats with micro-climates that host many plant species and communities. Terrestrial and aquatic habitats include desert areas, mountains, plains, slopes, sand formations, salt marshes, wetlands including sea coasts, fresh and marine waters, as well as urban habitats particularly in the Nile region are the major habitat types in Egypt.

Egyptian biota face threats by a combination of factors such as: over-collection, unsustainable agriculture practices, urbanization, pollution, land use changes, the spread of invasive species and climate change which often leads to decline and extinction in its biodiversity. This is due to other factors such as increasing population growth, high rates of habitat destruction, modification and deforestation, overexploitation, spread of invasive species, pollution and threats of climate change (Shaltout and Eid 2016). Because of the barren nature of so much of Egypt, plants and animals tend to be high in localized area, while remaining low for the region or country as a whole.

This report is one of the requirements for producing the Sixth National Report which will be presented to the 14<sup>th</sup> Conference of Parties (Convention on Biological Diversity - Cop-14), which will be held in Sharm El-Sheikh (November 2018). It deals the available publications (e.g. theses, books and papers) about the biodiversity elements in Egypt including: Essential References, Flora and Vegetation, Alien Flora, Bryophyta, Agrobiodiversity, Phytoplankton, Bacteria and Viruses, Fungi and Lichens, Zooplankton, Insects, Arachnida, Fishes, Reptiles Amphibians and Mammals, Alien Fauna, Birds, Marine Biology (botanical, zoological and plankton studies), Paleobiology, Goods and Services (carbon sequestration, bioremediation, biofuel and others), Chemistry and Pharmacology (botanical, zoological and microbiological studies) and Protected Areas.

The publications reported in this bibliography were collected from various sources including: site of the Egyptian Universities Libraries Consortium Portal, accounts of the biodiversity specialists on Researchgate, direct contact with the national experts of the Egyptian biodiversity, libraries of some universities and research centers, EEA publications on biodiversity and national protectorates, in addition to my own library. The collected publications cover the period from 2000 till 2018, with focusing on those of direct reflection to the biodiversity topics. The publications are classified taxonomically and chronologically provided with concise abstracts. Conclusion and recommendations are added at the end of this report.

# 1- Essential References

## 1.1-Botanical Studies

**2018. El-Khalafy, M. The redlist of endemic and near-endemic species in Egypt. M.Sc. Thesis, Faculty of Science, Tanta University.**

The present study aims to answer the following questions: 1- what are the recent numbers of endemic and near-endemic species in the Egyptian flora ?, 2-what are the reasons and justifications for addition or exclusion of plants to or from the final list of endemic and near-endemic species?, 3- what are the conservation categories of these species according to IUCN categories?, 4- How we can make their red list?, 5-what is the services and goods of endemic and offered by them, 6- what are the most threats that impacted these species?. These aims are achieved through prepare a recent and verified checklist for the endemic and near-endemic plant species and their habitats in the Egyptian flora. The list was analyzed in terms of taxonomic diversity, life and sex forms, size structure, flowering activity, dispersal types, economic potentiality, threats and national floristic distribution, and make a red list of these plants according to IUCN categories. The total number of endemic species in the present study was 44, belonging to 36 genera and 20 families. On the other hand, the total number of near-endemic species was 73, belonging to 58 genera and 28 families. For endemic species, 10 main habitats were identified: banks of water bodies, desert plains, depressions and wadis, sandy formations, alluvial and loamy soils, cultivated fields, mountains and hills, rocky surfaces, well surroundings and road sides. The most represented life form was the therophytes, while the most represented stem height was between 25 and 50 cm, and the most represented dispersal types were the ballochores and pogonochores. There was a gradual increase in the frequency of the flowered endemic species from December till May, and then decreased again reaching a minimum from September to December. Thirty-seven species had a distribution in only one phytogeographical region, while the remaining species had a wide distribution in two or more regions. All endemic plants have at least one aspect of economic goods and exposed to at least one type of threats. The most represented good offered by these plants was the medicinal uses, while over-collecting and over-cutting were the most represented threats. For near-endemic plants, 11 main habitats were identified: banks of water bodies, desert plains, depressions and wadis, sandy formations, alluvial and loamy soils, cultivated fields, mountains and hills, rocky surfaces, road sides, calcareous ground, ridges and fallow fields-waste ground. The most represented life form was the therophytes, while the most represented stem height was between 10 and 25 cm and the most represented dispersal types were the ballochores and pogonochores. There was a gradual increase in the frequency of the flowered near-endemics till reaching a maximum value from March to May, and then decreased again reaching a minimum value from August to January. Fifty-two species had a distribution in only one phytogeographical region,

while the remaining species had a wide distribution in two or more regions. All near-endemic plants have at least one aspect of economic goods and exposed to at least one type of threats. The most represented good was the medicinal uses, while overcollecting and over-cutting were the most represented threats. Thirty one species of the endemic species are threatened according to IUCN categories (5 critically endangered, 14 endangered and 12 extinct), while 13 species are data deficient. In general, 50 near-endemics were evaluated in the present and previous studies as follows: 27 endangered, 8 rare, 6 critically endangered, 3 vulnerable, 3 data deficient, 1 indeterminate and 2 extinct.

**2017. Abd El-Ghani, M., Huerta-Martínez, F., Hongyan, L. and Qureshi, R. Plant Responses to Hyperarid Desert Environments. Springer.**

This book provides a comprehensive discussion on plant responses in hyperarid regions of Egypt, China, Mexico, and Pakistan. It describes their location, physiographic features, accidental vegetation along two transects, endangered vegetation species, and human impact, variety of plant types (e.g. climbing, succulent, and parasitic). Studies on biotic and abiotic interactions, plant biodiversity, and soil-plant relationships are also covered. Covering a wide range of plant conditions and adaptations, this book analyzes what happens when plants must endure very high temperatures and aridity. Plants have adapted by evolving their physical structure to store and conserve water. Examples are the absence of leaves which reduces transpiration and the growth of extremely long roots, allowing them to acquire moisture at, or near the water table. Plants in hyper-arid habitats have also made behavioral adaptations in order to survive by synchronizing with the seasons of greatest moisture and/or coolest temperatures. For example, desert perennials remain dormant during dry periods of the year, then spring to life when water becomes available. The book includes many color illustrations, and has extensive and up-to-date references for further reading.

**2017. ASRT – NRC. Egyptian Encyclopedia of Wild Medicinal Plants: Volume 1 (*Acacia* - *Alternanthera*). Academy of Scientific Research and Technology, Printshop of Al-Ahram, Cairo.**

This is the first volume of the Encyclopedia of Egyptian Wild Medicinal Plants, issued by Academy of Scientific Research and Technology (ASRT) and National Research Center (NRC). The purpose of this Encyclopedia is to provide detailed information on locally important wild medicinal plants of Egypt and to preserve the traditional knowledge on medicinal plant use. However, it is important to emphasize that the word “monograph” is used as a technical term only. These monographs are not intended to be official pharmacopoeia, and its volumes are not intended to replace the official compendia such as pharmacopoeias, formularies or legislative documents (The English Text of the Egyptian Pharmacopoeia, Published by Fouad I University Press, Cairo, 1953). The first volume contains monographs for 23 wild medicinal plants from *Acacia* to *Alternanthera*. The monographs are not only considered as valuable



scientific references for health authorities, scientists and pharmacists; but also of interest to the general public, as each monograph is provided by an Arabic summary and at least one beautiful photo.

**2016. Ibrahim K, Hosni H and Peterson P. Grasses of Egypt. Smithsonian Institution. Scholarly Press, Washington D.C. pp 201.**

This publication presents keys, descriptions, illustrations, and glossary of the identification of 284 native and naturalized grasses that occur in Egypt. The list of species is primarily based on Cope's (2005) treatment of the Graminae of Egypt. The authors consulted many taxonomic treatments during the preparation of this work, most notable are: Bor (1968), Boulos (1995, 2005), Chaudhary (1989), Clayton et al. (2006), Cope (1982, 2005, 2007), Forman and Perrson (1974), Hafliger and Scholz (1980, 1981), Ibrahim and Peterson (2014), Liu et al. (2014), Peterson et al. (2003, 2010, 2011, 2012, 2014a; 2014b; 2014c; 2014d, 2015), Philips (1995), Romaschenko et al. (2012), Saaerla et al. (2014), Sherif and Siddiqi (1988), Täckholm (1956, 1974), and Wickens (1977). They follow the accepted names in the catalogue of New World Grasses (Soreng et al., 2015a) and a worldwide generic classification based principally on molecular DNA sequence studies (Soreng et al., 2015b). Vegetation characteristics are used to construct the key for identification. Diagrammatic illustrations are presented for each species to emphasize the structural characteristics. Description of species is presented in alphabetical order, and indexes to the scientific and common names and glossary are included.

**2016. Shaltout KH and Eid EM. Important Plant Areas in Egypt: With Emphasis on the Mediterranean Region. Lap Lambert Academic Publishing, Deutschland, Germany, 190 pp.**

This book presents the available information about the important plant areas (IPAs) in Egypt. It includes information about the following items: habitat and species diversity in Egypt, national red list of vascular plants, notes on the network of Egyptian protected areas, list of 20 IPAs and a completed site questionnaire for each IPA, known gaps in the country IPA analysis including 8 additional proposed IPAs that need further studies, and notes on the IPAs and plant conservation issues of immediate urgency in the country. Annexes developed from the available literature and expert opinion include: lists of nationally threatened species used in the analysis; endemics used in the analysis categorized as national, steno- and regional endemics; threatened habitats used in the analysis categorized as national and regional threatened habitats. The annexes include also Google maps for the 20 IPAs and for the 8 additional ones.

**2016. ASRT-EEAA. Conservation and Sustainable Use of Medicinal Plants in Egypt: National Surveys: Volumes 1-4. Printshop of Al-Ahram, on behalf of ASRT & EEAA., Cairo.**

This publication is of five volumes covering the following regions: 1- North Western Coast, 2- North Sinai, 3- Western Desert and Oases, 4- North Eastern Desert and Red

Sea Coast and 5- Halaib Triangle Area. Each volume includes information about the geographical characteristics of the concerned region, its plant life and plant communities, human impact and population description, traditional knowledge and cultivation of the medicinal plants, synopsis on the most important medicinal plants, as well as definition of the knowledge gaps for future studies.

**2015. Nassar MZ and Khairy HM. Guide Photos of Major Phytoplankton Species in the Egyptian Waters of the Red Sea. World Science and Research Publishing. <http://www.wsrpublishing.com>.**

This book is a guide photo for most of the recorded phytoplankton species that identified and classified by many workers at different areas of the Egyptian waters of the Red Sea and some surrounding habitats. These collected data were represented by 207 species classified into 45 genera of Bacillariophyceae (116 species), 15 genera of Dinophyceae (48 species), 11 genera of Chlorophyceae (20 species), 9 genera of Cyanophyceae (19 species), 2 genera of Euglenophyceae (3 species) and one genera of Silicoflagellates (one species). This guide represented about 177 species with recent and accepted names according to the different databases to help and facilitate the identification and classification of the major micro-algal taxa in the Egyptian waters of the Red Sea and the surrounding habitats.

**2014. Rizk AM. Phytochemistry of the Flora of Egypt. Vol. 1: Acanthaceae - Anacardiaceae. Misr University for Science and Technology, Cairo.**

This book is the first in a series of books (Encyclopedia) dealing with the chemical constituents, folk medicine, pharmacological and biological activities of the flora of Egypt. This Encyclopedia is arranged in alphabetical order of the family names. Brief reviews of the families as well as the genera which are represented by species in Egypt are given. Many of the data are tabulated to facilitate its use. This first volume includes the species belonging to the following 9 families: Acanthaceae, Actiopteridaceae, Adiantaceae, terpenoids, quinones, alkaloids, iridoid glycosides and phenolic compounds), Aizoaceae, Alismataceae, Alliaceae, Amaranthaceae, Amaryllidaceae and Anacardiaceae. It is organized in nine chapters; each deals with a single family. Each chapter starts with the characteristic constituents (e.g. steriods, with about 1100 structures, followed by the folk medicine, pharmacological and biological activities of plants of the concerned family. Based on detailed literature data, the structures and biological activities of the isolated natural products are surveyed. Other plants that have not yet investigated are also mentioned, but from the literature and early findings of the related species, may be found to be of value as medicinal or useful plants. At the end of the book, three appendices are attached: moecular structure of some compounds of common occurrence, Common-Latin andLatin-common names of the plant species, and glossary of the medical terms.

**2013. El-Masry, S.A. Contribution to the Seed Characterization of the Weed Flora of Nile Delta. Ph.D. Thesis, Faculty of Science, Tanta University, 294 pp.**

The present study aims at completing work began in winter 2000 to autumn 2005 with collection of seed samples represent 241 species collected by the author. These species relate to 158 genera and 44 families with assessing the variation in seed morphology and germination of the wild flora in Nile Delta. Also, it aims at preparing a consulting herbarium for these species, increasing seed bank initiated in 2007 in Botany Department, Faculty of Science, Tanta University, as a result of our previous work and building up a computerized data base dealing with seed morphological and germination characteristics. The recorded species in the present study were 381 species belonged to 213 genera and 56 families. This contributes 71.4 % of the total species, 75.3 % of the total genera and 72.7 % of the total families in Nile Delta. Thirteen major habitats were identified in the study area. Water courses had the maximum taxic diversity, while sand flats had the minimum. Life form, dispersal type and reproductive activities of the collected species were studied. The collected seeds were qualitatively described (seed shape, colour, outline, texture, ornamentations, hilum shape, position and elevation). Also these seeds were quantitatively determined (length, width, thickness, weight and volume). Seeds of most collected species had short dimensions (length, width and thickness); they were in range of < 2 mm for each parameter. Also the seeds of most species were within weight class of < 1 mg and volume class of < 10 mm<sup>3</sup>. On the other hand, few species were recorded in ranges of high values of all seed dimensions. The collected seeds were germinated to test the seed germination type and percentage. Also plumule length, vigour and days to germination were determined. Relationships between seed quantitative and germination characteristics were tested using simple linear correlation coefficients. All the obtained data helped in the formation of an artificial key for identification of the studied species depending on seed morphological characteristics.

**2013. Hosni H, Hosny A, Shams E and Hamdy R. Endemic and Near-Endemic Taxa in the Flora of Egypt. Egypt. J. Bot.53:357-383.**

The aim of this paper is to provide baseline information on endemism in Egypt. A total of 191 endemic and near-endemic taxa are recorded from Egypt and one or more neighboring countries. Seventy six taxa are believed to be endemic to Egypt of these twenty one are steno-endemic. About 31.6% of endemics are found in the Mountainous Southern Sinai subregion. Sixty one near endemics are selected which are concentrated in four local territories of endemism in Egypt and adjacent countries (NE and SE Libya, NE Sudan, S Palestine, NW Jordan and NE Arabian Peninsula). However, 54 near endemic taxa that are widely distributed or not in the range of these four territories are not included in this work. It was found that the near endemic taxa of Sinai and Southern Palestine are relatively high (50.8%). For each recorded taxon, IUCN category was defined, about 94.7% of the endemics and 98.4 % of the near-endemics are Red Data taxa. Fourteen taxa are believed to be extinct and 118 face threats (5 regionally extinct, 48 critically endangered, 21 endangered, 29 vulnerable

and 15 near threatened). Most endemic and near-endemic taxa belong to *Leguminosae*, *Labiatae*, *Caryophyllaceae* and *Compositae* which is the largest.

**2013. Essa, D. I. Algal diversity of the Egyptian northern lakes. M. Sc. Thesis registered in Faculty of Science, Tanta University.**

The five Northern Lakes of Egypt are of global importance and they are the most productive lakes in Egypt. The present study aims to collect available data on biological (phytoplankton populations) and environmental characters (physico-chemical characters) of the five lakes in order to analyze them in terms of species composition, diversity, behavior and abundance of the common species characterizing each lake. The present list of phytoplankton species recorded in the five Northern Lakes of Egypt comprised 867 species related to 9 algal divisions, 102 families and 203 genera, indicating high species diversity of this group and this area. Bacillariophyta was the most dominant group, while Cryptophyta, Rhodophyta and Phaeophyta were rarely recorded and represented by only one species. Also the changes in phytoplankton and physico-chemical characters of Lake Edku were studied during the period from autumn 2010 to summer 2011. Seasonal samples were collected from nine stations covering the lake. The results showed that the studied area is considered to be eutrophic, due to significant increasing in levels of different nutrient salts than those previously recorded in the same area in the last years. Phytoplankton standing crop and diversity were highly affected by the high amount of pollution effluents into the lake. The species composition of the main algal groups showed distinct variations. The results revealed that, the phytoplankton community in Lake Edku is considered rich in both number of species (121) and annual average of standing crop ( $2213.4 \times 10^3$  cell/l). Its community structure was belonging to five divisions namely: Chlorophyta (38.2%), Bacillariophyta (35.2%), Euglenophyta (13.9%), Cyanophyta (12%), while Dinophyta was rarely recorded 0.7 %. The highest phytoplankton density during studying period in Lake Edku was observed during summer season, while the lowest one occurred during winter.

**2012. Galal, T., Shaltout, K. and Hassan, L. The Egyptian Northern Lakes: Habitat Diversity, Vegetation and Economic Importance. LAP LAMBERT Academic Publishing, Saarbrücken, 157 pp.**

Along the Mediterranean Coast of Egypt, five natural lakes are present: Mariut (Western Coast), Edku, Burullus and Manzala (Deltaic Coast) and Bardawil (Sinai Coast). The floristic features, habitats and plant communities of these lakes were analyzed. A total of 402 species (203 annuals and 199 perennials) belonging to 248 genera and 68 families were recorded in these lakes. The grasses have the highest contribution to the total flora (16.3%), followed by composites (10.9%) and chenopods (9.4%). Floristically, the richest lake was Burullus (224 species and 149 genera). The life forms of the recorded species are ranged sequentially as follows: therophytes (49% of the total recorded species), geophytes–helophytes (14.7%), chamaephytes (14.5%), hemicryptophytes (10.2%), hydrophytes (5.6%), phanerophytes (4.3%) and parasites

(1.8%). The global distribution of the recorded species indicated that seven species are endemic (1.7%) and most of the recorded species are mono-regionals (34.4%). Multivariate analysis is used to analyze the vegetation and environmental variables of 298 sampled stands in Lakes Mariut and Edku (148 and 150 stands, respectively). Seventeen vegetation groups in Lake Mariut and 15 ones in Lake Edku were identified. These groups were separated along the prevailing moisture gradient from the shoreline to the open water. The vegetation groups (i.e. communities) representing the open water zones were less diverse than those of the shorelines. These communities were compared with those of Burullus, Manzala and Bardawil Lakes. A total of 316 species (78.6% of the total species) have at least one aspect of the environmental and/or economic importances.

**2010. Shaltout, K.H., Sharaf El-Din, A. and Ahmed, D.A. Plant Life in the Nile Delta. Tanta University Press, Tanta, 232 pp.**

The present book aims at preparing a recent checklist for the plant species and communities, which characterize Nile Delta. The checklist is analyzed in terms of taxic diversity, life form, dispersal type and sex form spectra, flowering activity, national and global phytogeography, rarity forms, economic potentiality, environmental importance and physical defense. This reference deals also with identifying the vegetation types and the environmental factors that govern the gradual change in vegetation structure. The checklist is supported by constructing a herbarium for the flora of Nile Delta in Botany Department, Faculty of Science, Tanta University; and building up a computerized database dealing with the botany, environment, biogeography as well as the environmental and economic importance of these species. The total number of the recorded vascular species in Nile Delta was 537 species, belonged to 283 genera and 77 families. This contributes 25.3 % of the total flora of Egypt, 38.1 % of the total genera and 63.6 % of the total families. four species was recorded as endemic species (*Echinops taeckholmiana*, *Sonchus macrocarpus*, *Sinapis allionii* and *Trianthema portulacastrum*). Thirteen major habitats dividing into 30 minor habitats were identified in the study area. Therophytes was the most represented life form, followed by geophytes – helophytes. The hydrophytes contribute 77.4 % of the total hydrophytes of Egypt. Mediterranean elements were the most represented within the flora of Nile Delta, but this doesn't mean that the Mediterranean coast of Nile Delta has a Mediterranean territory due to the lack of Mediterranean climate and vegetation. Regarding the environmental importance of the flora of Nile Delta, the segetal and ruderal weeds were the most represented species, while the nitrogen fixers and water purificators were the less represented. Segetals had the maximum contribution to the flora of Nile Delta because the major land use in the region is the agricultures. Ruderals have also a high contribution due to the intensive and extensive human activities that create a variety of extensive urban habitats, where the aggressive weeds are the most adapted to such types of disturbance. Concerning the economic importance, the grazed species were the most represented, followed by the medicinal and human edible species. On the other hand, fuel and timber uses were the less represented. One - hundred and thirty-four vegetation groups identified in Nile

Delta were categorized according to their leading species into 44 associations, which in turn arranged according to their habitat preferability into 6 groups. The high species diversity of the vegetation groups that inhabit the terraces and slopes of water courses could be related to the heterogeneity of their substrates. They often occupy most of the environmental gradient from terraces to open water zones, wastelands, railways, highways, abandoned fields, fields of orchards, summer crops and winter crops, salt marshes, sand dunes and sand flats. This supports the view that increasing habitat heterogeneity increases species diversity.

**2010. Zahran MA. Plant and Vegetation, 4. Climate-Vegetation: Afro-Asian Mediterranean and Red Sea coastal lands. Springer.**

Deserts are unique ecosystems with their own biotic and abiotic components, and are often rich in renewable natural resources, the appropriate management of which can contribute significantly to the sustainable management of desert regions for the welfare of the people. While there are many books on the flora of countries fringing the important desert countries of the Mediterranean and Red Seas, there are few books reporting on their ecophysiology and vegetation ecology. This book presents the vegetation types of the African and Asian countries of the Mediterranean and Red Sea coastal regions, and discusses the ecological threats and economic applications of these critical resources. In particular, it examines the relationships between climate and vegetation, and discuss these within the context of desertification, agro-industrial applications, ecotourism and sustainable development. The book will provide a valuable reference for researchers and graduate students involved in plant ecology, biogeography, economic botany and environmental management in the Afro-Asian Mediterranean and Red Sea coastal regions, as well as other desert regions around the world.

**2009. Boulos L. Flora of Egypt Checklist: Revised Annotated Edition. Al-Hadara Publishing, Cairo 410. pp.**

The first edition of "Flora of Egypt Checklist" was published in 1995 to provide an updated list of the accepted names and principal synonyms of the taxa of native and naturalized vascular plants. The need for a new and revised checklist became obvious, especially after the publication of "Flora of Egypt" in four volumes (1999, 2000, 2002, 2005) which brought numerous taxonomic and nomenclatural changes. The taxonomy and nomenclature in this checklist follow that of the "Flora of Egypt", with extra notes referring to any additions, changes or corrections. These notes may deal with different ranks of taxa. For example, the family Apocynaceae is treated in a wide sense to include Asclepiadaceae and Periplocaceae. Another example: studies of the molecular phylogeny of Araceae and Lemnaceae in recent years have confirmed the long-suspected close relationship of the two families, despite their obvious morphological differences. Family names will appear in this checklist as they were treated in the Flora of Egypt (1999-2005). The above examples of combining two or three families under one family name is given here to attract the attention of the users of this

checklist about up-to-date concepts in taxonomic research based on molecular phylogeny. Twenty-one species are recorded in this checklist as new to the Flora of Egypt. Numerous nomenclatural changes have been made, and are adopted in this checklist. This checklist includes 2145 species and 220 infraspecific taxa of native and naturalized vascular plants. Cultivated plants are excluded, with the exception of 44 cultivated species of grasses (Gramineae) and four cultivated onions (Allium, Alliaceae). The number of families treated here is 129, including 755 genera. Endemic taxa amount to 60, alphabetically listed here under their families, as these families have appeared in the four volumes of the Flora of Egypt (1999-2005). Near-endemic taxa amount to 93, known from Egypt and one neighboring country.

**2009. Zahran M. A. and Willis A. J. The Vegetation of Egypt, 2nd Edition. Springer.**

The position of Egypt at the cross roads between the Middle East and Africa has attracted the attention of naturalists and explorers for many centuries. Yet while there are many studies relating to the ecology and biology of Egyptian vegetation, the first issue of Zahran and Willis' vegetation of Egypt (1992) represented the first attempt to draw this diverse information together. In this second edition, this invaluable text is both updated and expanded to include additional topics such as the role of remote sensing in mapping Egypt's vegetation, and the economic potential for major desert species. Covering each of the four major eco-geographical regions of Egypt (Western Desert, Eastern Desert, Sinai Peninsula, the Nile Region), the book integrates a wealth of detail and represents an important landmark in the vegetation of arid and Mediterranean- type regions. As such, it will provide an essential reference to advanced students and researchers in plant science, ecology, biogeography, climatology, economic botany and remote sensing.

**2009. Ahmed, D. A. Current Situation of the Flora and Vegetation of the Western Mediterranean Desert of Egypt. Ph. D. Thesis, Faculty of Science, Tanta University. 424 pp.**

The present study aims at preparing a recent checklist for the vascular plant species, which characterize the Western Mediterranean Desert. The recorded species in this checklist was 968 species, belonged to 429 genera and 97 families. This contributes 45.7 % of the total flora of Egypt, 58.0 % of the total genera and 80.2 % of the total families, and prepare artificial key for critical families (Compositae and Gramineae). This study aims also at identifying the threat types that govern the gradual change in the economical flora in the study area. The other aims include constructing a herbarium for the flora of the Western Mediterranean Desert in Botany Department, Faculty of Science, Tanta University; and building up a computerized database dealing with the botany, environment, biogeography as well as the environmental and economic importance of these species. The recorded species in the present study were 614 species; this contributes 63.4 % of the total flora of the Western Mediterranean Desert. Twenty species were recorded as endemic species. The habitats were classified depending on the

floristic composition using TWINSpan and ordinated using DECORANA. Wadis had the maximum taxonomic diversity, while Sallum plateau had the minimum. Life form, sex form, flowering activity, national and global phytogeography, rarity forms, introduced species, weeds, economic potentiality, environmental services, conservation measures and physical defense were studied. Six types of threats were identified in the study area. Four-hundred and twelve species in the present study (70.2 % of the total economic species) suffer from at least one type of threats.

**2006. Khedr, A. Regional patterns of rarity and life history elements in the flora of Egypt. *Taekholmia* 26: 141-160.**

The phytogeographic patterns displayed by 2446 taxa of vascular plants, was analyzed in relation to regional abundances (designated as very common, common, rare, or very rare), in 13 geographic regions, native or introduced status, lifespan, life-form and preferred habitat for the flora of Egypt. More than 70% of the entire flora has been classified as either “very rare” (42.2%) or “rare” (28%). Only 3% of the species is introduced species. Land use appears to have a critical effect on plant abundance; intensely populated areas in the Nile region have more common or very common species rather than rare and very rare. Annuals and perennials account for approximately equal fractions of the flora (47% each). The spectrum of life-forms is dominated by herbs (75%), Shrubs and shrublets are well-represented, while trees are poorly represented (1.3%). Floristic diversity was high in the Mediterranean coastal regions and low in all desert areas. Frequency of abundance classes and life history traits varied according to the major habitats (weedy, sandy, saline, freshwater, rocky and gravelly). Implications of these results for conservation policy are discussed.

**2005. Boulos L. Flora of Egypt: Vol. 4: Monocotyledons (Alismataceae-Orchidaceae). Al-Hadara Publishing, Cairo. pp. 617.**

This book is the fourth and last volume in the flora of Egypt. It covers 29 monocot families of native and naturalized plants, comprising 180 genera, 482 species and 29 infra-specific taxa. The largest families are: Graminae (284 species), Cyperaceae (47 species), Hyacinthaceae (31 species) and Alliaceae (26 species). The largest genera are: *Allium* (21 species), *Cyperus* (19), *Bromus* (18), *Eragrostis* (14) and *Bellevalia* (12 species). Several annexes appear in this volume: additions and corrections, keys to major divisions, and to the 128 families treated in the four volumes, a glossary of botanical terms, Latin-vernacular names and vernacular-Latin names; cumulative index to the genera and families in the four volumes.

**2004. Ahmed, D. A. Current Situation of the Flora and Vegetation of Nile Delta Region. M. Sc. Thesis, Faculty of Science, Tanta University, 321 pp.**

The present study aims at preparing a recent checklist for the plant species and plant communities which characterize the Nile Delta. The checklist were analysed in terms of taxic diversity, life forms, flowering periods, dispersal types, sex forms, national and global phytogeography, rarity forms, environmental and economic importance, and physical defense of the recorded species. This study aims also at identifying the



vegetation types and environmental factors that govern the gradual change in vegetation structure. Other aims include preparing a consulting herbarium for these species in Botany Department, Faculty of Science, Tanta University and building up a computerized database dealing with the botany, ecology, biogeography, environmental and economic importance and physical defense of the recorded species. Specimens of the present species were collected from different sites in each location. One hundred and thirty four vegetation groups prevailing all-over the Nile Delta were classified using TWINSpan and ordinated using DECORANA. The vegetation data, as well as the comparable set of soil data were analyzed by Canonical Correspondence Analysis (CCA). The relationships between the community and soil variables were tested using simple linear correlation coefficient. One-way analysis of variance (ANOVA-one) was applied to assess the significance of variation in many floristic, vegetation and variables in relation to the habitat and vegetation types, life forms, major taxonomic group and species-per-family classes. Simple linear regression and correlation coefficients was calculated to assess the nature of relationships between the floristic, vegetation and soil variables. The total number of the recorded vascular species in Nile Delta was 537 species, belonged to 283 genera and 77 families. This contributes 25.3 % of the total flora of Egypt, 38.1 % of the total genera and 63.6 % of the total families. four species was recorded as endemic species (*Echinops taeckholmiana*, *Sonchus macrocarpus*, *Sinapis allionii* and *Trianthema portulacastrum*) Thirteen major habitats dividing into 30 minor habitats were identified in the study area. It is indicated that the therophytes was the most represented life form. The bisexual species were the most represented sex form within the flora of Nile Delta. Ballochoric and pogonochoric species were the most represented, while the cyclochores and barochores were the less represented. SNN cell (small range – narrow habitat -non abundant species) was the less represented in the flora of Nile Delta. The segetal and ruderal weeds were the most represented, while the nitrogen fixers and water purificators were the less represented. First (plants with hairy–leathery leaves or hairy stems and strong–fragrant odour) and second (plants with modified parts such as spines or spinescent branches) groups of physical defense were the most represented within the flora of Nile Delta. One-hundred and thirty–four vegetation groups identified in Nile Delta were categorized according to their leading species into 44 associations, which in turn arranged according to their habitat preferability into 6 groups. The application of TWINSpan on the floristic composition of these vegetation groups led to classify them into 7 major vegetation types. The environmental significance of the DECORANA axes 1 and 2 was investigated by simple linear correlation and stepwise multiple regressions.

**2003. Zahran M. A. and Willis A. J. Plant life in the River Nile in Egypt. Mars Publishing House, Riyadh, KSA.**

Egypt is the gift of the Nile", this is a true statement as Egypt depends totally upon the River Nile' s water for all of its means of life: agriculture, industry and domestic purposes. Accordingly, studies of the River Nile ecosystem in Egypt including its biotic and abiotic components are essential to build up strategies for the controlled use

of the River `s water. This reveals the importance of books dealing with the biota of the River Nile, e.g. plant life, to the welfare of the Egyptian people. The first four parts of the present book present detailed accounts on the general features, biology and ecology, use and control measures of the fresh water macrophytes. Part 5 presents a full scientific report on the freshwater macrophytes growing in the River Nile in Egypt. Particular reference is given to four main hydrophytes: *Ceratophyllum demersum* (submerged), *Eichhornia crassipes* (free-floating), *Polygonum* spp. and *Typha domingensis* (emergents). Other species having ecological, economic and /or historical interests (e.g. *Cyperus papyrus*, *Hymphaea* spp., *Myriophyllum spicatum*, *Azolla filiculoides*) etc. are also described.

**2002. Khedr, A., Cadotte, M.W., El-Keblawy, A. and Lovett-Doust, J. Phylogenetic diversity and ecological features in the Egyptian flora. *Biodiversity and Conservation* 11: 1809–1824.**

Until fairly recently, regional-scale ecological and evolutionary patterns have tended to be ignored as conservation efforts have been concerned with species and their habitats. Here we compare frequencies in the Egyptian flora of particular rank sizes (order, family and genus) with patterns of species abundance (classified as very rare, rare, common, or very common) and an array of life-history attributes. The angiosperm flora of Egypt is represented by 2446 taxa (2088 species), including taxa in 10 subclasses, 51 orders, 120 families, and 742 genera. A high degree of monotypism was observed: four orders are monotypic (each existing as single species), and have very rare overall abundances; 30 families are monotypic (17 of which are very rare or rare); and 354 genera are monotypic (over 70% of which are very rare or rare). Fourteen families (in particular the Resedaceae and Zygophyllaceae) have at least one-fifth of their global species represented in the Egyptian flora. Introduced species in general, and tree, aquatic herb and liana life forms all are especially well represented among monotypic genera. Native taxa are highly represented among rare and very rare abundance classes, while introduced taxa did not differ significantly in their abundance patterns, compared to overall flora values. Few large genera (20 spp.) occur in the flora, with most species concentrated in genera containing 8–19 species per genus. Similarly, few families were highly speciose. Annual and herbaceous species were significantly over-represented, mainly among large, speciose genera and families. However, perennials, trees, shrubs, aquatic herbs, lianas and parasitic species were found mainly in families and genera having very few taxa. Life-history attributes may have important implications to speciation rates. Taxonomically based results, involving abundances and life-history attributes, are discussed in the context of biodiversity and conservation. The remaining endemic subspecies (the Cairo Skipper *Spialiodoris amenophis*) needs an assessment of its conservation requirements. A fourth possible near-endemic subspecies, the Libyan False Baton Blue *Pseudophilotes abencerraguscoloniarum* (if confirmed as a good subspecies) from the north coast is also probably extinct. There are three main hotspots of butterfly diversity in Egypt: the southern Sinai mountains, Gebel Elba and the Mariut region near Alexandria. The first two are well covered by the Protected

Area System (St Katherine PA and Gebel Elba PA respectively); the third has probably been destroyed by the rampant building programme west of Alexandria, and with it the endemic subspecies noted above. A possible hotspot identified around Cairo and further east is probably an artefact of recording effort. Subsidiary hotspots are also apparent. Those of Siwa and Qattara Depression are very under-recorded and it is hard to know without further fieldwork whether this prediction will be borne out. In the mountains behind Wadi Gemal are small mountain areas predicted to have reasonable numbers of butterflies: fortunately, this is contained within the Wadi Gemal PA, but it too needs fieldwork to test the prediction. More recording effort is badly needed to clarify the status of Egyptian butterflies, especially those that are possibly extinct. This assessment provides an agenda for action by decision-makers, rangers and scientists.

**2002. Boulos L. Flora of Egypt. Vol. 3: Verbenaceae-Compositae. Al-Hadara Publishing, Cairo. 373 pp.**

This book is the third of 4 volumes of the flora of Egypt. It includes 16 families of native and naturalized plants (Verbenaceae-Compositae) arranged mainly according to Engler's System, and comprising 174 genera, 450 species and 30 infra-specific taxa. The largest families are: Compositae (228 species), Scrophulariaceae (58 species), Labiatae (55 species), Solanaceae (30 species) and Plantaginaceae (20 species). Some 384 species and infra-specific taxa are illustrated by line drawings in 77 plants by Margaret Tebbs, Magdy El-Gohary, Patricia Davies and Sally Dawson, as well as 128 colour photographs of some species in their natural habitats by the author, Rafik Khalil and Dina Aly. Families and genera are described. Keys to genera and species are constructed to facilitate their identification. For every species, full citations to the accepted name, synonyms if any, description, distribution in Egypt, habitat and general distribution are given. Notes in the economics uses, geographical distribution, types from Egypt, taxonomic and nomenclatural notes on some species are often provided. Indexes to the illustrated taxa and scientific names are presented.

**2000. El-Hadidi, M. N. ed. Flora Aegyptiaca: Volume 1. Palm Press, Cairo.**

This volume includes 6 chapters in 2 parts dealing with the flora of Egypt. The first part comprises accounts on geomorphology, climate and phyto-geographic affinities, main features of the natural vegetation, as well as conservation and threats upon the Egyptian flora and vegetation. The second part comprises keys to the groups of vascular plants represented in the flora of Egypt; an annotated list for the species of this volume; as well as floristic treatment for 171 species belonging to 65 genera and 24 families of vascular cryptogams and seed plants.

**2000. Boulos L. Flora of Egypt. Vol. 2: Geraniaceae-Boraginaceae. Al-Hadara Publishing, Cairo 352 pp.**

This book is the second of 4 volumes of the flora of Egypt. It includes 41 families of native and naturalized plants (Geraniaceae-Boraginaceae) comprising 166 genera, 471 species and 82 infraspecific taxa, arranged according to Engler's system. The largest families are: Boraginaceae 85 species, Euphorbiaceae 55 (of which the genus *Euphorbia*, 41 species, is the largest in the flora of Egypt), Umbelliferae 49, Convolvulaceae 47, Zygophyllaceae 33 and Malvaceae 32 species. Line drawings of 402 species, 2 subspecies and 5 varieties in 71 plants by Margaret Tebbs, Camilla Speight and Magdy El-Gohary, as well as 94 colour photographs by the author, Rafik Khalil and Dina Ali are also provided. Families and genera are described in some detail. Keys to the genera and species are constructed to facilitate their identification. For every species, full citations to the accepted name and synonyms, a concise description, distribution in Egypt, habitat and general distribution are given. Notes in the economics uses, geographical distribution, types from Egypt, taxonomic and nomenclatural notes on some species are often provided. An index to scientific names is given.

**1999. Boulos L. Flora of Egypt. Vol. 1: Azollaceae-Oxalidaceae. Al- Hadara Publishing, Cairo. pp. 419.**

This book is the first of three volumes of the flora of Egypt. It includes 42 families of native and naturalized plants, comprising 719 species and 78 subspecies or varieties arranged according to Engler's system. The largest families in this volume are: Leguminosae 228 species, Cruciferae 102, Caryophyllaceae 87 and Chenopodiaceae 76 species. Original line drawings of 544 species in 67 plants by several artists, and 96 colour photographs by the author are provided. Families and genera are described in some detail. Keys to genera and species are constructed to facilitate their identification. For every species, full citations for the accepted name and synonyms, description, distribution in Egypt, habitat and general distribution are given. Notes on the economic uses, geographical distribution or a discussion on the taxonomy of some species are also provided and an index to scientific names is given.

## 1.2. Zoological Studies

**2016. El-Hennawy, HK. Spiders. Academy of Scientific Research and Technology, Series of Scientific Library, Simplified Scientific Books, Cairo, Egypt (in Arabic).**

This book is of 10 chapters: the first speaks about the position of spiders (Aranieda) in the animal kingdom in general, and Arachnida and Arthropoda in particular, and defines the features of each order of Arachnida and the recorded species in Egypt compared with those in the world (1 565 out of 92 3432 in the world = 1.7 %). The second chapter deals with the morphology and anatomy of spiders, the third describes the spider house, while the fourth describes the spider reproduction. The fifth chapter presents spiders as predators, while the sixth speaks about the poisonous spiders and the seventh about the spider enemies. The habitats of spiders from the desert to water is the subject of the eighth chapter, their classification is presented in the ninth chapter, while the last chapter speaks about the previous studies and history of spiders in Egypt and the world.

**2009. Khalil M. T. and Ibrahim A. M. The red swamp crayfish in Egypt. Publication of the Center of Research & Studies of Protectorates, Ain Shams University, No. 1.**

In this book, the authors present the story of two crayfish species brought to Egypt (the River Nile) by a venture experiment of aquaculture. The experiment was eventually abandoned and the alien species were set free into the favorable habitat of the river and its network of canals. The two species had different fortunes; one flourished and the other succumbed. The main bulk of the book comprises six chapters amounting to a comprehensive treatment that may be summed as: auto-ecology of *Procambarus clarkii* as a naturalized alien species in the Egyptian Nile Basin. The other species *P. zonangulus* eventually disappeared after it was set free from the aquaculture farm. Chapter 1 describes in some detail the morphology and anatomy of the body and its organs. Chapter 2 deals with the processes of growth and reproduction as performed in the new home. These processes, especially processes of reproduction, are not replicas of processes in native home in North America; fecundity seems to fare better in the host habitat where it reproduces twice a year, and not once. Chapter 3 and 4 deal with the eco- physiology of the crayfish, including responses and apparent adaptation to the new environment. These studies provide basic information that form guidelines for management of crayfish expanding populations. Chapters 3, 5 and 6 address issues and uses of crayfish as a resource that provide materials for food, feed, fish-meal, among others. Information embodied in these two chapters provides elements for assessing the cost-benefit balance of introducing the species to wild fishing and future aquaculture enterprise. This is a monographic treatment of a case study of an alien species that became naturalized in the River Nile (Egypt), with being prospects and non-benign impacts on the river and its network of canals. The authors have admirably collated available information with their own data collected during several years of

general ecological surveys and a set of detailed studies on two selected sites. Their syntheses present an integrated treatise on the subject, and set a most welcome example of a treatment that: is based on a broad cover of scientific information, provides evaluation of an alien naturalized species, and sets elements for guidance to ventures that aspire to use crayfish species in aquaculture. It also provides guidance for studies on the innumerable alien plant and animal species that have become elements of the Egyptian biota.

**2007. Gilbert F and Zalat S. Butterflies of Egypt; Atlas, Red Data Listing and Conservation. Ministry of State for Environmental Affairs - Egyptian Environmental Affairs Agency, Nature Conservation Sector, Cairo.**

There are 61 species of butterfly recorded from Egypt, two of them each with two subspecies recorded, making 63 named taxa in total. Two species are endemic to Egypt. The Sinai Blue *Pseudophilotes sinaicus* is considered to be critically endangered under the joint threats of global warming, overgrazing and over-collection of medicinal plants. Action is needed to support Bedouin initiatives to limit grazing, and to solve the problem of over-collection for medicinal purposes. The population of the other endemic, the Sinai Hairstreak *Satyrium jebelia*, must also be very small, and urgently needs reliable assessment- it is probably also critically endangered but is here categorized as data deficient. Three subspecies are also endemic to Egypt, but two of them (the Mariut Skipper *Carcharodus stauderiramses* and the Mariut Verdigris Hairstreak *Tomaresballus mareoticus*) are now probably extinct. They were only recorded from the Mariut region and further west along the Mediterranean coast, and have not been seen for about a century.

**2006. Baha El Din S. A Guide to the Reptiles and Amphibians of Egypt. The American University in Cairo press, Cairo- Ney York.**

Reptiles and amphibians are among Egypt's most prominent wildlife, found in almost every habitat in the country from homes to fields, and are often the only evident life form found in the harshest deserts. For the first time, this guide provides concise, reliable, and up to date information on all 118 species currently recognized from Egypt, with detailed review of their taxonomy, identification, natural history, ecology, and conservation. This volume is based on the author's twenty-year experience with the reptile and amphibian fauna of Egypt and the Middle East, which includes extensive fieldwork and research. In total, the current work adds almost 20 percent to the previously reported fauna from Egypt, and present many taxonomic innovations that are reported and elaborated here for the first time. Each species entry contains concise information including synonymy, taxonomic notes, world and Egypt distributions, distinguishing features, habitat, ecology and conservation status. Over 130 high-quality color photographs and line drawings illustrate all the species dealt with. With easy to use keys, accurate distribution maps, diagnostic illustrations, a comprehensive bibliography, this guide is a valuable tool in the identification, study, and conservation of these fascinating animals.

**2005. Varjabedian KG. Parasitic Nematodes on Fresh Water Fish in Egypt. EEAA, Publication of National Biodiversity Unit. No. 14, Cairo.**

Nematodes fall into two classes, Phasmidea and Aphasmeida according to the presence or absence of phasmids which are sensory pits found at the posterior end of most parasitic forms. In the present book, the author recorded 18 species of nematodes from freshwater fish along the River Nile in Egypt. Description was given to each parasite with its status, whether common, uncommon, or rare and the site of infection in the host fish and whether a new host record or locality are involved. The photos and drawings were in the first place of the author's personal work, if otherwise, the source was mentioned. Among the species recorded, only one species was specific to its host, 12 were uncommon species, while 4 species were common and one was rare. This book contributes to the biodiversity of nematode parasitic fauna infecting freshwater fish of the River Nile in Egypt. These parasites are considered to act as bio-indicators of pollution in the River Nile, thus any disturbance in the ecosystem (such as that caused by water pollutants) can alter the prevalence and distribution of the parasitic fauna in their specific host.

**2003. Hoath R. A Field Guide to the Mammals of Egypt. The American University in Cairo Press, Cairo- New York.**

This is a comprehensive field guide to every mammal species recorded in contemporary Egypt, from Aardwolf to Zorilla. Each species described in detail, with identification features, status, habitat and habits, and with comparisons to similar species. Also, includes all marine mammals recorded in Egyptian waters. Distribution map of every species. Each species meticulously illustrated- bats and sea mammals in black- and- white, all other species in color. Line drawings of whale blows, bat noseleaves and ear structures, and tracks and trails of selected land mammals. It is an indispensable reference work for anyone interested in the wildlife in Egypt, easy to slip into a daypack, and sturdy enough to withstand the rigors of desert travel.

**2001. Porter R and Cottridge D. A Photographic Guide to Birds of Egypt and the Middle East. The American University in Cairo Press, Cairo, New York.**

This book covers 252 species of bird found in Egypt, choosing these from the 470 that have been recorded was not easy. We have concentrated on those which are most familiar (especially the desert and Nile specialties), Which are most likely to be seen by the bird-watching tourist or which, although rare, cannot be omitted as they are important "Egyptian birds". In this respect, it should be noted that Egypt is becoming a popular country in the Middle East for bird watchers who want to see birds that are special to the region or difficult to see elsewhere. Many of the birds included in this book are residents of Egypt. These are joined in Spring by a few Summer visitors, birds that have spent the Winter farther South in Africa and which return to breed in Egypt in the Summer. The total number of breeding birds, residents and Summer visitors is over 150. Then there are those species that travel to the north, in Europe and Asia, and which, as the day get shortens, migrate south to winter in Egypt and the

Middle East, often in large numbers. In addition, there are the passage migrants which fly between their breeding grounds further north and their wintering grounds to the south; for many of these, the Nile Delta and Valley are a fertile corridor where they can refuel and rest on what can often be a difficult journey, involving a crossing of the Mediterranean Sea and Sahara Desert. Finally, there are the rarities, usually referred to as vagrants or accidentals, which for many bird-watchers are the greatest fascination, simply because their occurrence is unpredictable. Egypt has more than its fair share of this large group, which has grown considerably with the intensity of birding activity.



## 2-Flora and vegetation

### 2.1- Nile Region and Wetlands

**2016. Dakhil M. A. Population dynamics and nutrient cycling of *Pistia stratiotes* L. in the water courses of Giza province, Egypt. M.Sc. Thesis, Faculty of Science, Helwan University.**

The present study aimed at evaluating the monthly variation in the population dynamics, including plant density, biomass, morphological parameters and vegetative effort of *P. stratiotes* in the water courses of Giza province, Egypt. It aims also at analyzing the effect of environmental parameters on the spatial and temporal variation in plant foliar and reproductive characteristics. Moreover, it investigates the nutrient dynamics and heavy metals accumulation in the different plant organs as well as their nutritive value. In the present study, a dynamic numerical model was formulated to describe the growth production and the interaction between shoots and roots organs of *P. stratiotes* in Egypt by considering the energy gain and loss of photosynthesis, respiration, mortality and reallocation of materials from shoot to root using first order differential equations. Nine quadrats (each of 0.5 x 0.5 m) were selected monthly along three sites in Al-Sero drain at Giza. Growth measurements, photosynthetic pigments, nutrients, heavy metals and nutritive values were estimated during the period from May 2013 to February 2014. General trends for the shoots biomass, such as the slow initial growth rate followed by a high growth rate, time of peak biomass and decline of biomass due to senescence, were successfully reproduced by *Pistia model*. Many characteristics typical for the roots biomass, such as the increase in the roots biomass during the early growing season due to the translocation of materials from current photosynthesis and shoots dry matters and the reduction of roots biomass during the later period of the season, due to the senescence were also reproduced by the model. The level of agreement between the calculated and actual results indicated that, the model is capable for simulating the shoots and roots biomass of *P. stratiotes* along Al-Sero drain at Giza province.

**2016. Eid, E.M. and Shaltout, K. H. Bioaccumulation and translocation of heavy metals by nine native plant species grown at a sewage sludge dump site. International Journal of Phytoremediation 18 (11): 1075-1085.**

In the present study, nine native plant species were collected to determine their potential to clean up nine heavy metals from soil of a sewage sludge dump site. Almost all nine plant species grown at sewage sludge dump site showed multifold higher concentrations of heavy metals as compared to plants grown at the reference site. All the investigated species were characterized by a bioaccumulation factor (BF) > 1.0 for some heavy metals. BF was generally higher for Cd, followed by Pb, Co, Cr, Cu, Ni, Mn, Zn, and Fe. The translocation factor (TF) varied among plant species, and among heavy metals. For most studied heavy metals, TFs were <1.0. The present

study proved that the concentrations of all heavy metals (except Cd, Co, and Pb) in most studied species were positively correlated with those in the soil. Such correlations indicate that these species reflect the cumulative effects of environmental pollution from soil, and thereby suggesting their potential use in the biomonitoring of most heavy metals examined. In conclusion, all tissues of nine plant species could act as bioindicators, biomonitors, and remediates of most examined heavy metals. Moreover, *Bassia indica*, *Solanum nigrum* and *Pluchea dioscoridis* are considered hyper-accumulators of Fe; *Amaranthus viridis* and *Bassia indica* are considered hyper-accumulators of Pb; and *Portulaca oleracea* is considered hyper-accumulator of Mn.

**2016. Mohammed, M. A. Composition and Function of Weed Communities Associated with Cereal Crops in Menofia Province, Egypt. M. Sc. Thesis, Ain Shams University, Faculty of Women, Plant Ecology Department.**

The main objectives of this study are to study the floristic and vegetation analyses of wheat and maize crops and their associated weeds and the environmental variables affect them. It also evaluates the weed-crop interaction, in terms of density and biomass, and its impact on the crop yield, in addition to the impact of nutrients and trace metals captured by weeds on the nutrient absorption and production of the study crops. Moreover, the impact of weeds on the functional traits of wheat and maize plants was also investigated. Forty-five species (38 annuals and 7 perennials) belonging 42 genera and 21 families were recorded associated with wheat and maize crops. Therophytes were the dominant life form, while pluri-regional and mono-regional taxa were the dominant elements in wheat and maize, respectively. By the application of TWINSpan, 8 and 7 vegetation groups were recorded as common communities in wheat and maize, respectively. The bioaccumulation factor (BF) of trace metals from soil to wheat plant indicated that all trace metals had BF less than unity, except Cu and Cr. While, the translocation factor (TF) showed that all metals had TF less than unity, except Cu. The BF of trace metals by the common weeds associated with wheat plants indicated that these weeds had BF less than one for Co, Cd, Ni and Fe, while had BF more than unity for Mn and Cr. *A. fatua* had the highest BF for Cr, while *P. annua* had the highest of Mn. In addition, *C. niloticus* had the highest BF for Pb and Zn, while *C. murale* had the highest of Cu. On the other hand, the BF of trace metals from soil to maize plant indicated that all trace metals had BF less than unity, except for Co and Cr, while the TF showed that all metals had TF less than unity, except Pb, Cd and Ni. Moreover, the translocation of trace metal from shoot to the grains indicated that Cr and Zn had a value more than one. *D. sanguinalis* had the highest BF for Cu, Pb, Cr, Cd, Ni, Zn and Fe, while *C. arvensis* had the highest of Co.

**2015. Abu-Ziada, M. E. Floristic features of three *Plantago* species communities in the Nile Delta, Egypt. Mansoura Journal of Environmental Science, Mansoura University 44 (3).**

The present study demonstrates a floristic characterization of three selected wild communities of *Plantago* species within the Nile Delta region of Egypt. After regular visits to the different sites of the study area, 60 stands (2 x 5 m each according to the minimal area) were selected for sampling the vegetation types. The stands representing *Plantago lagopus* L. community were sampled in El-Behira Governorate. The stands of *Plantago major* L. community were represented in El-Dakahlia Governorate and El-Sharkia Governorate. The sampled stands of *Plantago squarrosa* Murray community were designed in El-Behira, El-Dakahlia and Kafr El-Sheikh. The total number of plant species in the present study was 105 species, about 66 annual species (62.9%), three biennial species (2.7 %) and 36 perennial species (34.3 %). The total number of the recorded plant species were belonging to 87 genera and related to 28 families. The major families were Poaceae, Asteraceae, Fabaceae, Brassicaceae and Polygonaceae which contributed collectively, about 60% of the total recorded plant species. The other recorded families were represented by relatively low number of species ranged between 1-4 plant species. The majority of the recorded species were therophytes (65.7%), followed by geophytes (16.2%), then hemicryptophytes (11.4%), chamaephytes (3.81%), helophytes (1.9%) and nanophanerophytes (1.0%). The floristic analysis in the present investigation revealed that, 64 species (61.0%) of the total recorded species were Mediterranean taxa, consequently the study area is mainly belonging to Mediterranean Toritory.

**2014. Abd El Ghani M, Hamdy R and Hamed A. Aspects of vegetation and soil relationships around halo-saline lakes of Wadi El-Natrun, Western Desert, Egypt. J Biol Earth Sci 201, 4 (1): 21 -35.**

The relationship between soil parameters and vegetation around the inland saline lakes of Wadi El-Natrun in the Western Desert of Egypt was studied. Twenty-five species in 22 stands constituted the floristic composition included one tree, 3 annuals and 21 perennial herbs. The saline feature of this habitat enabled some salt tolerant species to grow and flourish. Four species (*Juncus acutus* L., *J. rigidus* Desf., *Cyperus laevigatus* L. var. *laevigatus* and *Phragmites australis* (Cav.) Trin. ex Steud. subsp. *australis*) were constantly recorded around the 7 studied lakes which exhibited wide ecological and sociological ranges, while 8 species were confined to only one lake (narrowest sociological range). Based on their frequency values, classification of the recorded species resulted in 5 vegetation groups. Each of these groups was linked to one or more of the soil factors which determines its distribution. Application of Redundancy Analysis (RDA) indicated that  $\text{CaCO}_3$ ,  $\text{Ca}^{+2}$ ,  $\text{SO}_4^{-2}$ ,  $\text{NO}_3^{-}$ ,  $\text{K}^{+}$  and  $\text{Cl}^{-}$  were the most important soil variables affected the vegetation around the studied lakes. It is recommended that conservation measures should be taken to protect the remaining populations throughout Wadi El-Natrun which represents its type locality from extinction.

**2014. Eid, E.M. and Shaltout, K.H. Monthly variations of trace elements accumulation and distribution in above- and below-ground biomass of *Phragmites***

***australis* (Cav.) Trin. ex Steudel in Lake Burullus (Egypt): A biomonitoring application. Ecological Engineering 73: 17-25.**

This study was carried out in some natural stands of *Phragmites australis* (Cav.) Trin. ex Steudel grown in Lake Burullus, a Mediterranean lake in north Egypt, to investigate: (1) the concentration of trace elements in the organs of *P. australis*, (2) the extent of trace elements mobility from sediment to below-ground organs and within the plant, (3) the organs of *P. australis* as potential bioindicators for the contamination of the water and sediment by the trace elements, and (4) the amount of trace elements that released back into the surrounding water after decomposition of dead tissues. Above- and below-ground biomass of *P. australis*, water and sediment were sampled monthly for one year at six sites of Lake Burullus (three sites represent each of the northern and southern parts of the lake) using six randomly distributed quadrats (each of 0.5 × 0.5 m) at each sampling site. The above- and below-ground biomasses of southern sites are significantly higher than that of the northern sites. Above-ground biomass is >2.5 folds of the below-ground biomass in the northern and southern sites. The highest concentration in the below-ground organs is Cu, Fe and Zn; and in the leaf is Cd. The monthly highest values of trace elements are Cu and Fe in February at the beginning of the growing season; and Cd and Zn in January at the end of the growing season. The annual mean of trace element concentrations (in mg kg<sup>-1</sup>) in *P. australis* organs ranged from 11.0 to 23.8 for Cd, from 31.0 to 65.6 for Cu, from 34.4 to 97.3 for Zn, and from 505.0 to 2833.0 for Fe. The mean bioaccumulation factor of all trace elements from the sediment to the below-ground organs is greater than unity for all elements with the following sequence: Cd > Fe > Zn > Cu. Cd has the highest translocation factor from the below-ground to the above-ground organs, while Fe has the lowest. Positive linear correlations are detected between the concentrations of all elements (except Cu) in plant organs, water and sediment. The higher translocation factor of Cd in the above-ground organs of *P. australis* makes it suitable for the phytoextraction of this element from the water and sediment, while the lower translocation factor for Cu, Fe and Zn makes it suitable for their phytostabilization. Thus, all the organs of *P. australis* could act as bioindicators and biomonitors of the examined trace elements.

**2014. El-Werfaly, Musbah. Ecological studies on the vegetation of sand bar of Lake Burullus Protectorate Ph. D. Thesis, Faculty of Science, Domiat Univesity, Domiat.**

The present investigation was carried out on the vegetation cover of sand bar of Lake Burullus Protectorate in northern Nile Delta to study the ecological aspect of the plants. The plant communities of Lake Burullus sand bar were analyzed using 30 stands (each 5x5 m) representing the different habitats by multivariate analysis. Four vegetation groups were identified using TWINSpan analysis. These groups represent the main habitats recognized in the sand bar; group A represents stabilized sand dunes and indicated by *Pancratium maritimum* and *Cyperus capitatus*; group B of sand flat and mobile dunes with *Alhagi gracorum* and *Elymus farctus* as indicator species; group C represents the salt marsh habitat with the indicator species *Arthrocnemum*

*macrostachyum* and *Juncus rigidus*; young fore-dunes are represented by group D that indicated by *Cakile maritima*. These groups are separated mainly on the basis of soil salinity, and age of sand dune formations along CCA-axes 1 and 2, respectively. A proposed management plan on the importance of sand bar in protecting the lake from the future climate change and the new land use system is suggested. Results of this study show that the vegetation cover of this Lake represents the highest areas impacted by human pressures among different locations. The management plan have seven major activities includes: implementation of zonation scheme; establishment of monitoring programme; establish reference collections and data bank; programme of research and studies; public awareness; management of the human activities in Lake Burullus Protectorate; and rehabilitation programme.

**2014. Ismail, M. A. Weed flora of some selected habitats at Fayoum depression. M.Sc. Degree, Faculty of Science, Fayoum University.**

The main aim of this work was to survey the wild weed flora in some selected habitats at Fayoum depression, which represent various habitats in summer and winter seasons. So, we might present an updated databank for the weed flora in Fayoum depression to be guide for the researchers in all the fields related to the weed flora. The main crops of the Fayoum district include wheat, clover, and beet in winter and maize, cotton and durra in summer. The main tress in orchard lands include mango, olive, citrus, guava, banana, and apricots. The sequence of districts according to the total number of recorded species is as follows, Tamiya, Fayoum, Sinnuris, Itsa, Ibshawai and Yussef El-Sedek. It is obvious that *Chenopodium murale*, *Convolvulus arvensis*, *Cynodon dactylon* and *Anagallis arvensis* are the most common weeds in winter. On the other hand, the most common summer weeds include *Cynodon datylon*, *Echinochloa colona* and *Portulaca oleracea*. While, *Cynodon dactylon*, *Convolvulus arvensis* and *Chenopodium murale* are commonly recorded during the whole year.

**2013. Helmy, O. M. Distribution behavior and growth performance of *Trianthema portulacastrum* L. in the Nile Dleta. M. Sc. Thesis, Faculty of Science, Benha University.**

*Trianthema portulacastrum* L. (Aizoaceae) was originally known from Egypt as a very rare plant recorded in the Gebel Elba. Recently, it had been reported to be widely distributed, in crop fields of Egypt. The present study aims to determine the distribution of this species in Nile Delta, to assess the factors that affect its invasion to the study area, and to determine the associated species and plant communities. It aims also at assessing its germination capacity and morphological plasticity through studying several morphological traits. The total number of plant species associated with *Trianthema portulacastrum* was 67 species which belongs to 22 families and 56 genera. The application of TWINSPAN on the floristic composition of the 130 sampled stands led to classify them into 18 groups at level six and six major groups at level three. Each of the 18 vegetation groups, had definite floristic and habitat characteristics: 8 of them are characterized by *Trianthema portulacastrum*, 2 by

*Cyperus rotundus* and 1 by *Echinochloa colona*, 3 by *Amaranthus viridis*, one by *Portulaca oleracea*, and another one by *Amaranthus lividus*. Despite the fact that *Trianthema* is xerophytic plant, it was recorded in various segetal and ruderal habitats (orchards, winter crops, canals and drains). The most effective elements according to CCA biplot were potassium, organic matter and sand. The dispersal type of *Trianthema* belongs to the anemochores or light gliders. Flowering time extend from February to September, while fruiting time extends from June to August. Germination of *Trianthema portulacastrum* seeds was hypogeal and the germination percentage was observed under uniform conditions during five months (from October 2010 to February 2011) before the dormancy of the seeds. The germination percentage was the highest in seeds collected from waste lands and cabbage (74 %), sweet potato (64 %), while the lowest was in corn field (50 %).

**2012. El-Sheikh, M.A., Al-Sodany, Y.M., Eid, E.M. and Shaltout, K.H. Ten years primary succession on a newly created landfill at a lagoon of the Mediterranean Sea (Lake Burullus RAMSAR site). Flora 207: 459-468.**

This study was carried out on the transported bed soil dredged from the outlet of Lake Burullus to the Mediterranean Sea and deposited nearby, forming by this way new land that underwent a primary plant succession. The multi-methodological approach comprised floristic inventories, vegetation sampling and soil composition analyses of the study site in order to detect the crucial parameters controlling the plant resettlement on recently deposited soil as related to time, local micro-topography and substrate characteristics. Floristic composition was assessed for the first 10 years of primary succession (2001–2010) on 18 stands of the area, distributed on basement, slope stands and plateau of the landfill, respectively. Vegetation surveys were the basis of multivariate analyses of the vegetation and soil data using TWINSpan, DCA and CCA. Relationships between the edaphic gradients, floristic composition and species diversity were assessed. Forty-one species were identified (22 annuals and 19 perennials) after ten years development compared with 7 species at the first year. After application of TWINSpan and DCA on the data of the first year of establishment, two simple vegetation groups were recognized and named after their dominant species, *Senecio glaucus* and *Bassia indica*. In comparison, the multivariate analysis of the last year (i.e. after 10 years of succession) led to identify 4 more advanced vegetation groups: *Senecio glaucus*–*Cakile maritima*–*Zygophyllum album*, *Bassia indica*–*Mesembryanthemum nodiflorum*, *Arthrocnemum macrostachyum* and *Phragmites australis*–*Limbarda crithmoides*. These plant communities are comparable to the other communities in the same region, showing the tendency to establish the climax vegetation of Mediterranean coastal areas. The notable edaphic variables that affect the succession of the vegetation groups in the study area were moisture, salinity, organic matter, minerals (Ca, Na, K, Cl, SO<sub>4</sub>), soil texture and human disturbance.

**2012. Abd El-Ghani M, Shehata M, Mobarak A and Bakr R. Factors affecting the diversity and distribution of synanthropic vegetation in urban habitats of the Nile Delta, Egypt. Rend. Fis. Accademia. Lincei 23: 327–337.**

This study examined the major soil attributes that affect the plant species distribution in the urban ecosystem of the north-eastern part of Nile Delta, which represents transition between the irrigated farmlands and the adjoining desert and salt marshes. It has been under human manipulations for more than 30 years. Five major habitats (desert, reclaimed, cultivated, urban and wet) subdivided into 13 minor ones were recognized. Alterations of soil characters by anthropogenic activities of the natural environment for agriculture production have provided a favorable condition for the growth of weedy species. Two-hundred and thirty-one species related to 152 genera and 45 families were recorded; of which 135 species annuals (58.4 %) and 96 perennials (41.5 %). Regarding chorological analysis, Saharo-Arabian attained the maximum value of 23.5 % in Sf, followed by Sudano-Zambezian 20.0 % in W1, Cosmopolitan (16.6 %), Irano-Turanian 11.8 % in each of Hw and Ic, After the application of TWINSPAN classification technique, five vegetation types were identified, and well segregated along the DCA axis one; which reflects the soil moisture, fertility, biotic change, aridity and species diversity gradients. When soil moisture decreases, species diversity increase. It also represents the gradient of human interference, where the full man-made vegetation (wetlands and cultivated lands) occupied the left end of this gradient, where the less disturbed vegetation (reclaimed and urban land) was in the middle and no man-made vegetation (desert land) was in the right end. This gradient is associated with the increase of the relative presence of aridity.

**2012. Bennoba, E. H. Weed flora of the reclaimed lands along the northern sector of the Nile valley Egypt. M. Sc. Thesis, Cairo University, Faculty of Science, Department of Botany and Microbiology.**

The area under study is one of the most recently reclaimed lands. The recorded 150 species in the monitored 19 sites were distributed within 33 families. The species - rich families were: Gramineae (31) compositae (23) Cruciferae (13) Chenopodiaceae (12) and Leguminosae (12). Chorological analysis revealed that the widely distributed species belonging to cosmopolitan, palaeotropical and pantropical chorotypes constituted about 39.3% of the recorded flora.

**2012. Barbary, M. A. Studies on the Riverian Vegetation of Some Islands at Qena Governorate, Egypt. M.Sc. Thesis, Faculty of Science at Qena, South Valley University.**

The present study investigates the floristic composition, ecological features and major factors affecting the distribution and grouping the plant species that present in six sedimentary islands (Kream, Elekaatt, Dandara, Jebbail, Shaworia and AlKlh) located throughout the Nile stream at Qena governorate, Egypt. A total of 161 taxa (157 species) were recorded in the study area. The angiosperms include 160 taxa (156

species) belonging to 28 orders, 52 families and 122 genera, while only one pteridophyte was recorded (*Azolla filiculoides*). Out of these, *Hibiscus diversifolius* Jacq (Malvaceae) recorded as a new record to the flora of Egypt. Moreover, 11 species were recorded for the first time from the upper Egyptian Nile valley. These species include 91 annuals (56.5%) and 70 perennials (43.5%). Therophytes represent 51.6% of the life-form spectrum. The dominance of therophytes seems to be in response to the adverse climatic conditions, moisture deficiency, substrate instability and biotic influence. Pantropical, palaeotropical and cosmopolitan elements (18.6%, 31.1% and 21.7% respectively) were the dominant floristic categories among the total number of species. A high degree of monotypism was observed: 10 orders are monotypic (each existing as a single family genus and species) and fully 32 families were monotypic (60.4%). Vegetation analysis using TWINSPLAN technique classified the 103 stands surveyed in the studied islands into ten vegetation clusters at the sixth level of the hierarchical classification. Each cluster was identified according to its indicator species. The DECORANA ordination categorized these clusters into four main vegetation groups. Among the estimated soil variables, TDS, EC, sodium and phosphate concentrations appeared to be important attributes in characterizing the vegetation clusters.

**2011. Ali M, Hassan S, Shaheen A. Impact of riparian trees shade on aquatic plant abundance in conservation islands. Acta Bot. Croat. 70 (2): 245–258.**

Temperature, acidity, light conditions, total dissolved salts, conductivity, dissolved oxygen, submerged macrophytes and shade and sun path directions were measured at 23 sites along the River Nile banks with *Acacia nilotica* growing at water's edge around the First Cataract Conservation Islands. *Ceratophyllum demersum* and *Potamogeton crispus* were common in the shaded and unshaded zones, *Myriophyllum spicatum* and *Vallisneria spiralis* were found only in the unshaded zone and *Azolla filiculoides* only in the shaded zone. Banks of the sites surveyed were oriented to five directions (NW, SE, NE, SW, N). There is a significant difference in both the type and density of submerged plants growing under the shade of riparian trees (*Acacia nilotica*) as compared to unshaded areas. Water column irradiance is the most influential variable dictating the distribution of submerged plants. The area of the shade provided by riparian trees was affected by environmental and/or plant variables. Environmental variables comprised the daily course of the exposition to sun; and plant variables included the area of the tree crown, the height of the tree and geographical position of the tree in relation to sun exposition. Trees on the west bank of the islands at the SW-NE direction have the highest shading effect. The management of tree vegetation might control incoming solar radiation affecting submerged macrophytes.

**2011. El-Zemeaity, E. A. Ecophysiology and vegetation of terrestrial habitats in Lake Manzala, Egypt. Ph. D. Thesis, Mansoura University, Faculty of Science, Department of Botany.**

The results of the present study indicated that, the total number of plant species recorded in the present study is 56 species belonging to 46 genera and related to 20



families. The family Chenopodiaceae comprises 10 species (17.9 % of the total recorded plant species), followed by family Gramineae 9 species (16.1%), then Compositae 7 species (12.5 %), Cyperaceae 5 species (8.9%). The recorded species include 23 annual species (41.1 %), one biennial species (1.8 %) and 32 perennial species (57.1 %). According to the life-form spectra the majority of the recorded species are therophytes (39.7%), followed by helophytes (23.8%), then geophytes (19.1%), chamaephytes (12.7%). The floristic analysis of the study area revealed that, 17 species (30.4 %) of the total recorded species are pluriregional taxa, 13 species (23.1%) bioregional taxa, 9 species (16.1 %) are cosmopolitan, 7 species (12.5%) are pantropical, 4 species (7.1 %) are palaeotropical, 3 species (5.4 %) are neotropical, 2 species (3.6 %) are Mediterranean, and one species (1.8 %) is Sudano- Zambezi elements. Lake Manzala vegetation is threatened by the desalination of lake due to the high amount of drainage water from minor and major drains. It is necessary to emphasize that Lake Manzala vegetation in fact demand urgent management action to conserve its threatened and unique biodiversity. The framework of Egyptian National Conservation Strategy provided an instructive approach for sustainable utilization of the biodiversity. The threat of genetic erosion in Lake Manzala as a result of desalination could lead to extinction of many under-utilized plant genetic resources.

**2011. El-Kassaby, A. T. Common weeds in rice fields at Manzalla area and their control methods. Journal of Plant Production, Mansoura University. 2 (10).**

Four field experiments were conducted during four successive seasons of 2001, 2002, 2003 and 2004 at EL-Manzalla district, Dakahlia Governorate in the salt affected regions, which close to Manzalla Lake, Egypt. The experiments were conducted to know weeds species associated with rice crop as well as to produce a program for controlling all weeds in rice fields with herbicides without any effect on rice yield. These treatments were included four herbicides with three different rates as well as three mixture combinations, hand weeding at two times at 30 and 45 days after planting and weedy check. Survey of common weed species associated with rice in salt affected regions which close to Manzalla Lake were *Eleocharis geniculata* which was the predominant weed with the highest frequency and density at proportion of 76.6 % weed flora, *Cyperus difformis* which recorded the second rank 10.8 %, the occurrence of *Echinochloa crus-galli* reached 6.5 % and *Ammannia* spp. rank for four number in important 6 % in both seasons. All weed control treatments gave better control number of total weed/m<sup>2</sup>, fresh weight of all weeds/m<sup>2</sup> and dry weight of total weeds g/m<sup>2</sup> as compared with weedy check. The tank-mixed application of bispyribac-sodium plus pyrazosulfuron-ethyl at 16 + 10 g ai/fed released 100 % control of all weeds at 60 days after planting. The results indicated that all weed control treatments significantly increased panicles length (cm), panicles weight (g), 1000-grain weight (g) and grain yield (t/fed). The tank-mixed herbicide of bispyribac-sodium plus pyrazosulfuron-ethyl at 16 + 10 g ai/fed produced the highest grain yield (t/fed), while the lower grain yield (t/fed) produced from the weedy check treatment.

**2010. El-Halawany, E. F. Habitat and plant life in El-Dakahlyia governorate, Egypt. Mansoura Journal of Environmental Sciences, Mansoura University 39 (1).**

The present study provides a detailed description of the floristic and ecological features of the three habitats in El-Dakahlyia Province. These habitats include: Delta Mediterranean coastal belt, cultivated lands and canal banks. The results indicated that, the total number of weeds recorded in the study area is 197 species belonging to 147 genera and related to 47 families. These species include 101 annuals (51.3%), 7 biennials (3.6%) and 89 perennials (45.2%). Therophytes are the most frequent life – form (53.3%). The floristic analysis of the study area revealed that, 46.2% of the total number of the recorded species are Mediterranean element. The application of TWINSpan classification based on the importance values of the different species in the three habitats led to the separation of 12 vegetation groups named after their dominant species. The correlation between the edaphic factors and ordination axes led to the definition of the most effective soil gradients which correlate with the distribution and abundance of the identified vegetation groups in the different habitat types.

**2010. Nwar, S. M. A study on the karyotypes of some common weeds in the Nile Delta region. M. Sc. Thesis, Faculty of Science, Tanta University.**

In the present study, the karyotypes and chromosome numbers of 81 Egyptian species from the Nile Delta belonging to 27 monocot and dicot families were recorded. Karyotypes and chromosome numbers of 23 of the studied species are recorded here for the first time from the Nile Delta. There are new records for chromosome numbers for 22 of the studied species which are not in accordance with previous counts for species from other floras, particularly that of Europe. B-chromosomes were scored in six dicot species and satellites are observed in four species, two of which belonging to dicot and two belonging to monocot. Measurement of chromosomes length of studied species indicated that family Amaryllidaceae belonging to monocot has the longest chromosomes, this family represented by *Pancreatium maritimum* but the shortest chromosomes are recorded in family Euphorbiaceae belonging to dicot, this family represented by *Euphorbia peplus*. Karyotypes of 13 species out from 81 of studied species are observed from different natural habitats and the difference among them are given. Symmetrical Karyotypes are observed in 49 species, but asymmetrical ones are observed in 29. Variation between symmetrical and asymmetrical ksryotypes recorded in two samples for each of two dicot species collected from different habitat, *Vicia monantha* and *sonchus asper*. Polyploidy numbers are recorded in 22 of studied species, distributed in 11 dicot and one monocot families. Two different chromosome numbers recorded in three species from two different habitats, *Polygonum bellardii*  $2n = 16$  from highway in Baltim and  $2n = 24$  from canal in Kafr El-Sheikh, *Silene rubella*  $2n = 24$  from field of winter crop and  $2n = 28$  from canal in El-Santa, *Euphorbia peplus*  $2n = 12$  from field of summer crop in Kafr El-Zyyat and  $2n = 16$  from waste land in Tanta. Differences in karyotypes formulae were recorded among two samples of *Spergularia diandra*,  $2n = 36$  have same chromosomes number and collected from

different habitats (sand dunes in Baltim and field of winter crop in El-Hamul). The same result was observed in six dicot species.

**2010. El-Ameir, Y. M. Phytosociological and autoecological studies on the canal bank vegetation in Egypt. Ph. D. Thesis, Faculty of Science, Mansoura University.**

According to the life-span, the recorded weed flora in this study can be classified under three categories as follows: annuals (53 species = 46.1%), biennials (4 species = 3.5%) and perennials (58 species = 50.4%). Therophytes are the most frequent species in the different habitats of the study area being represented by 57 species (49.6%). The other life-form spectra are: cryptophytes (28.7%), hemicryptophytes (11.3%), chamaephytes (7.0%), and nano-phanerophytes (3.5%). The floristic analysis of the study area revealed that, 49 species (42.6% of the total number of recorded species) are Mediterranean taxa. These taxa are either pluri-regional (24 species = 20.9%), bioregional (16 species = 13.9%) or mono-regional (5 species = 4.4%). It has been also found that, 58 species or about 50.44% of the total number of the recorded species are either cosmopolitan (17.4%), pantropical (16.5%), palaeotropical (12.2%) or neotropical (4.4%). The other floristic categories are poorly represented; each chorotype is represented by a few number of species. In general, the percentage of the cosmopolitan, pantropical, palaeotropical and neotropical elements are obviously comparable in all surveyed habitats of the study area. The Mediterranean elements are highly represented in the drainage canals (37 taxa), followed by the irrigation canals (36 taxa), then River Nile system (14 taxa), northern lakes (11 taxa) and finally Wadi El-Natron (7 taxa). This indicates that, the chorological analysis of the study area is relatively compatible with the north-southward distribution of the climatic belts in Egypt.

**2009. El-Bana M. Factors affecting the floristic diversity and nestedness in the islets of Lake Bardawil, North Sinai, Egypt: implications for conservation. Springer Science & Business Media.**

Island biogeography theory and nestedness are two relevant and important concepts in biogeography and conservation. However, their integration and application has not been examined for maintaining or maximizing species diversity, especially in arid regions. The aim of this study is to investigate the ecological mechanisms related to the observed pattern of floristic diversity and nestedness in the Lake Bardawil islets on the Mediterranean coast of Sinai Peninsula before the execution of the North Sinai Agricultural Development Project (NSADP) that will threaten the ecosystem of the lake. Plant species on 15 islets were identified and categorized into ecological groups related to their life-form, salt tolerance and succulence. Richness of total plant species and their ecological groups were positively correlated with islet area, number of habitats and elevation, and negatively with disturbance index. The temperature calculator detected highly significant nestedness for the entire flora and all ecological groups. Distance from the mainland had no effect on either species richness or nested pattern of total plant species and their ecological groups. Both the analyses of species

richness and nested distribution yielded evidence for a positive species-area relationship. Although nestedness was detected for the entire plant species and their ecological groups, many species and islets exhibited idiosyncratic distribution. Idiosyncrasies could be mainly attributed to demographic stochasticity which is an important character for species interaction and diversity maintenance in arid regions. Therefore, in developing conservation strategies for the Lake Bardawil islets, it is important to incorporate spatial and temporal stability of populations.

**2009. Eid, E. M. Population Biology and Nutrient Cycle of *Phragmites australis* (Cav.) Trin. ex Steud. in Lake Burullus. Ph. D. Thesis, Faculty of Science, Tanta University.**

In Lake Burullus, stand structure and biomass production of *P. australis* were analyzed along the north-south and east-west gradients at monthly intervals over a period of one year (February 2003 until January 2004). The results of the water and sediment characteristics confirm that the north-south gradient mainly represents a fertility gradient, while the east-west gradient is associated with significantly decreasing salinity. All morphological and biomass variables of *P. australis* were significantly different between young and old populations. On average, old populations produced three times more aboveground biomass than young populations. Shoot height, diameter and shoot dry weight significantly increased by approx. 25 to 50% with increasing fertility along the north-south gradient. Shoot density significantly decreased from the north to the south, while it almost doubled along the west-east gradient. The above-ground biomass was 3.5 times higher than the below-ground. Root biomass represented 13 % of the total below-ground, while leaves and panicles 16 and 3 % of the above-ground biomass. FEMME was capable of predicting the growth characteristics with high correlation coefficients between measured and projected values. Remobilization from rhizomes (15 %) and reallocation from leaves (2 %) were of little importance for assimilate production, where 69 % of these assimilates were used for above-ground biomass. Nutrient accumulation by standing crop ranged between 4.1 to 66.0 g m<sup>-2</sup> year<sup>-1</sup> for P and K. Carbon sequestration rate was calculated as 3.2 mol C m<sup>-2</sup> year<sup>-1</sup> for accumulating rhizomes in the soil. This value stresses the importance of *P. australis* stands for carbon sequestration in Lake Burullus. Further, as much as 258 t P and 5522 t N could be removed from Lake Burullus by harvesting *P. australis* aboveground biomass at maximum standing crop. It can be concluded that *P. australis* stands in Lake Burullus are affected by population type and by fertility and salinity gradients as well as by interactions between these factors.

**2008. Sadek, M. A. Ecological Study on the Weed Flora in El-Dakalyia Governorate, Egypt. M. Sc. Thesis, Mansoura University, Faculty of Science, Department of Botany.**

The present study provides a detailed description of the floristic and ecological features of the main habitat types with special reference to the economic potentialities of some weeds growing naturally in El-Dakahlyia Governorate. In eight districts

belong to El-Dakahlyia Governorate, three habitat types namely; Deltaic Mediterranean coast, cultivated land and canal and canal bank habitats were recognized. Two hundred and seven sampled stands were selected to represent the main habitat types in the study area. The vegetation structure of the study area is classified using multivariate techniques (classification and ordination). The economic potentialities of ten selected species grow naturally in El-Dakahlyia Governorate have been studied. These species are *Cyperus difformis*, *Cyperus capitatus*, *Schoenoplectus litoralis*, *Sesbania sericea*, *Bidens pilosa*, *Mentha longifolia*, *Paspalidium geminatum*, *Digitaria sanguinalis*, *Leptochloa fusca* and *Calligonum polygonoides*. Moisture content, dry matter, total ash content, crude protein, crude fat, crude fiber content, total soluble sugars, glucose, sucrose, polysaccharides, nutritive value, quantitative analysis of amino acids and fatty acids as well as some elements were estimated in the studied plants to evaluate their forage potentialities as non-conventional crops or used as a raw material for various uses in industrial and pharmaceutical purposes.

**2008. Shaltout, K. H. and Al-Sodany, Y. M. Vegetation analysis of Burullus Wetland: A Ramsar site in Egypt. Wetlands Ecology and Management 16: 421-439.**

We analyzed the vegetation of Lake Burullus at the Deltaic Mediterranean coast of Egypt, the sand bar between its northern shore and Mediterranean Sea, the water courses that drain into the lake and the wetland around it. Our ultimate aim was to identify threatened species and communities and the environmental factors that affect their distribution in order to formulate a plan for their conservation. The total number of the recorded species was 197 (100 annuals and 97 perennials), including 12 floating and submerged hydrophytes. Three species are endemic to Egypt: two annuals (*Sinapis arvensis* subsp. *allionii* and *Sonchus macrocarpus*) and one perennial (*Zygophyllum album* var. *album*). Thirty-four species are rare all over Egypt (15 annuals and 19 perennials). The lake area included 10 types of habitat (sand formations, salt marshes, lake cuts, terraces, slopes, water edges and open water of the drains, islets, shores and lake). The vegetation was classified into 13 groups (i.e., plant communities). Six groups were dominated or co-dominated by the common reed (*Phragmites australis*); these groups occupied a wide environmental gradient from xeric to hydric habitats. Five other groups were dominated by halophytic species (*Arthrocnemum macrostachyum*, *Suaeda vera*, *Sarcocornia fruticosa*, *Halocnemum strobilaceum* and *Salsola kali*). The remaining two groups were dominated by the emergent *Typha domingensis* and the submerged *Potamogeton pectinatus*. Moisture, salinity and sedimentation were the main factors that governed the plant succession in this wetland.

**2007. El-Masry, S. A. Seed Characterization of the Flora in the Nile Delta Region. M. Sc. Thesis, Faculty of Science, Tanta University, 205 pp.**

The present study aims at assessing the variation in seed morphology and germination of the wild flora in Nile Delta. Also it aims at preparing a consulting herbarium for

these species, initiating a bank for their seeds in Botany Department, Faculty of Science, Tanta University and building up a computerized data base dealing with seed morphological and germination characteristics. Seeds of the collected species varied in their qualitative characteristics such as colour, shape, texture, ornamentation, outline, hilum position, shape and elevation. Sixteen seed shapes were recorded and the most represented was the oval followed by the sub-rounded, while the crescent and polygonal shapes were the less represented. In addition, 10 colours, 7 outlines, 4 textures and 19 ornamentations were recorded in the seeds of the collected species. Brown coloured, curved outlined, smooth textured, non-ornamented seeds were the most common. On the other hand, reddish-brown coloured, notched or wavy outlined, warty textured seeds were the less represented. Rings-warts, colours-warts, pits and sculptures were the less represented ornamentations. Seeds with basal, triangular and elevated hilum were the common observed seeds; while top, line shaped, surfaced hilum were the less represented. Seeds of most collected species had short dimensions (length, width and thickness). They were in range of 0 – 1 mm for each parameter. In addition, the seeds of most species were within weight class of 0 – 1 mg and volume class of 0 – 10 mm<sup>3</sup>. Seeds of 172 species (71.1 % of the total) germinated in lab under uniform conditions. One hundred and twenty one species (70% of them) had epigeal germination and 51 species (30 %) had hypogeal germination. On the other hand, 70 species (29 % of the total species) failed to germinate. Most germinated species ( $\geq 50\%$ ) had a high germination percentage ( $> 80\%$ ), and began to germinate early after 2-6 days. Maximum plumule length is in range of 2-4 cm seedling<sup>-1</sup> for most of the germinated species (33.7 %).

**2007. Galal, T.M. and Khalafallah, A.A. Floristic Composition and Environmental Characteristics of Abu-Za'abal Artificial Wetland, Egypt. *Egy. J. Aquat. Res.* 33 (3): 122-139.**

The aim of the present study is to provide a description of the floristic composition and life form spectrum of the recorded species in Abu-Za'abal Wetland (four lakes). It aims also to analyzing the distribution pattern of the plant species and the environmental factors that affect their distribution. Forty stands were selected to represent the apparent variation in the vegetation physiognomy and habitats of these lakes. Sixty four species (38 annuals and 26 perennials) belonging to 56 genera and 28 families were recorded in Abu-Za'abale Wetland. Gramineae (Poaceae) had the highest contribution, followed by Leguminosae (Fabaceae), Amaranthaceae, Chenopodiaceae and Compositae (Asteraceae). Forty-five species (31 annuals and 14 perennials) were terrestrial weeds, 7 species (2 annuals and 5 perennials) natural plants, 6 species (one annual and 5 perennials) aquatic weeds, while other six (5 annuals and one perennial) escaped from cultivations. Life forms of the recorded species indicated the predominance of therophytes, followed by geophytes-helophytes, phanerophytes, hemicryptophytes, chamaephytes and hydrophytes. Pluriregional taxa were dominated over biregional, and monoregional ones. The dendrogram resulting from the agglomerative clustering technique and DCA ordination of the four lakes based on their floristic, soil and water characteristics indicated that three clusters were

separated: cluster A includes lake IV, B includes lake I and C includes lakes II and III. Lake I had the highest species diversity, while Lake IV had the lowest.

**2007. Galal T.M. and Fawzy, M. Sand dune vegetation in the coast of Nile Delta, Egypt. World Applied Sciences Journal, 2 (5): 427-438.**

The aim of the present study is to analyze the floristic elements and vegetation types of the black sand dunes of north Nile Delta in terms of species composition, diversity and behavior of the common species along the prevailing environmental conditions. Forty-four stands were selected to represent the apparent variation in the vegetation physiognomy and the micro-habitats of the black sand dunes (dune top, dune slopes and interdunes). Sixty-nine species belonging to 63 genera and 26 families were recorded. Therophytes represent 59.5% of the total species, followed by geophytes–helophytes (13.0%), hemicryptophytes (10.1%) and chamaephytes and phanerophytes (8.7%). The floristic categories of the recorded species showed that the bi-regional taxa had the highest contribution represented by 31.9% of the total species, followed by the monoregional (29.0%), pluriregional (27.5%) and cosmopolitan (11.6%). The application of TWINSpan and DCA on the plant cover data estimates of 69 species recorded in the 44 sampled stands in the black sand dunes, led to the recognition of 7 vegetation groups named after the first and occasionally the second dominant species: A) *Chenopodium murale*- *Mesembryanthemum crystallinum*, B) *Senecio glaucus* subsp. *coronopifolius*-*Cynodon dactylon*, C) *Rumex pictus*-*Cakile maritime*, D) *Nicotiana glauca*-*Cakile maritima*, E) *Rumex pictus*-*Silene succulenta*, F) *Elymus farctus*-*Silene succulenta* and G) *Asphodelus viscidulus*-*Elymus farctus*. *Senecio glaucus* subsp. *coronopifolius*-*Cynodon dactylon* group (VG B) had the highest species diversity, while *Nicotiana glauca*-*Cakile maritima* group (VG D) demonstrated the lowest value.

**2007. Kamel, K. A. Ecological studies and adaptive responses of some aquatic in plants in Ismailia Governorate, Egypt. Ph.D. Thesis, Faculty of Science, Suez Canal University.**

The study area is situated in Ismailia governorate, Egypt. This study aimed at identifying, analyzing and classifying the aquatic and canal bank vegetation along the aquatic habitats in the study area. Determination of the adaptive responses of four dominant hydrophyte species *Eichhornia crassipes*, *Typha domingensis*, *Persicaria salicifolia* and *Phragmites australis* to the habitat conditions is given. Sixty randomly selected stands were chosen and analyzed seasonally during the period between sept 2003 and Dec 2004. Four transects were oriented to cover all the variations in habitat zonation of the study area. The relative values of density, frequency and cover for each species were summed up to give its importance value (IV) out of 300 which is used as input data for the TWINSpan, DECORANA and CANOCO classification and ordination programs. Physical and chemical analysis of both water and soil samples were provided. Three different environmental indices were constructed. These were stream aquatic vegetation cover index, topographic terrestrial vegetation index

and the index of hydrophytism. Four biodiversity indices were calculated these were species richness, species turnover, Shannon index and Simpson index. The above mentioned four hydrophytes were selected for studying their adaptive responses to their habitats. The results of this study recorded 151 species belonging to 121 genera and 46 families. Of these species, 40 are hydrophytes and 111 terrestrial ones, while most of these genera are monotypic. The phytogeographical affinities of the most recorded species related to the Mediterranean origin and the dominant life form class was the therophytes. This study revealed the presence of definite growth forms for each of the four-dominant species in relation to hydrologic or edaphic habitat conditions.

**2006. Shaltout, K.H. and Galal, T.M. Comparative Study on the Plant Diversity of the Egyptian Northern Lakes. Egyptian Journal of Aquatic Research. 32 (2): 254-270.**

Five wetland lakes of global importance for migratory birds extend along the Egyptian Mediterranean coast. They are Mariut (63 km<sup>2</sup>) on the western coast, Edku (126 km<sup>2</sup>), Burullus (410 km<sup>2</sup>) and Manzala (1200 km<sup>2</sup>) on the Deltaic coast and Bardawil (650 km<sup>2</sup>) on the Sinai coast. Lake Burullus and parts of Lakes Manzala (i.e. Ashtum Al-Gamil) and Bardawil (i.e. Zaranik) are managed protected areas. Lakes Burullus and Bardawil are declared as Ramsar sites for the conservation of migratory birds. The current status of the vegetation of these lakes was studied on the light of severe human impacts in this region. All these lakes, except Bardawil, receive excessive amounts of agricultural and industrial drainage water that is loaded with different pollutants; in addition there are over-fishing, over-grazing and over-cutting. Some 402 plant species (approx. 19% of the whole Egyptian flora), categorized into 45 plant communities, were identified in these lakes. Five of these species are endemics, while three are near endemics. Lake Bardawil is still characterized by near pristine conditions. On the other hand, Lake Mariut is subjected to severe human impact including pollution, habitat destruction and modification.

**2006. Slema, D. F. Sociological Behavior and Variability among *Pluchea dioscoridis* (L.) DC. Populations in the Nile Delta. M. Sc. Thesis, Faculty of Science, Minufya University, 169 pp.**

The present study aims at evaluating the sociological behaviour of *Pluchea dioscoridis* shrub in relation to the prevailing environmental conditions in Nile Delta and assessing the variability among its populations in its main habitats. One hundred and sixteen stands were selected to represent six major habitats in six locations. The results indicated that *Pluchea dioscoridis* populations in wastelands attained, in average, the largest leaves dimensions and number of inflorescences per branch due to shading, while canal slopes attained the lowest due to high light intensity. The drain terraces attained the smallest shrub height, diameter and size index. Transverse sections of its stem and leaf indicating that wastelands populations attained the largest width of pericyclic fibers, pith width and number of vascular bundles due to the high aridity



and salinity of this habitat; while stem anatomy of drain terraces individuals attained the lowest width of cortex parenchyma, pericyclic fibers, pith parenchyma and number of vascular bundles. This may be due to relative nitrogen and potassium deficiency which affects cell size and number of cells. Its size distribution indicates that the younger individuals are preponderant in the wastelands than the older ones due to successful germination of seeds and establishment of seedlings in this habitat. The viability of seeds was studied by the tetrazolium chloride method. Seed germination was determined under constant and alternating temperatures and indicating that the best constant temperature for germination was 15°C (44.4 %), and the best alternating temperatures was 10/15°C for the seeds collected from the wasteland habitats due to the less viability of seeds. The seedling emergence indicated that drain terraces attained the largest individual height and the lowest leaf dimensions; but canal edges attained the lowest individual height with relatively large leaf dimensions. The results indicated also that January - March may be the active period in its phenological sequence. The effect of density levels was studied and indicated that individuals are larger under low than under high density, which may be due to competitive phenomenon.

**2006. Hussien, T. M. Flora and Vegetation of the Northern Lakes of Egypt. Ph. D. Thesis, Faculty of Science, Helwan University. 285 pp.**

Along the Mediterranean Coast of Egypt, five natural lakes are present: Mariut (Western Coast), Edku, Burullus and Manzala (Deltaic Coast) and Bardawil (Sinai Coast). The floristic features, habitats and plant communities of these lakes were analyzed. A total of 402 species (203 annuals and 199 perennials) belonging to 248 genera and 68 families were recorded in these lakes. The grasses have the highest contribution to the total flora (16.3%), followed by composites (10.9%) and chenopods (9.4%). Floristically, the richest lake was Burullus (224 species and 149 genera). The life forms of the recorded species are ranged sequentially as follows: therophytes (49% of the total recorded species), geophytes–helophytes (14.7%), chamaephytes (14.5%), hemicryptophytes (10.2%), hydrophytes (5.6%), phanerophytes (4.3%) and parasites (1.8%). The global distribution of the recorded species indicated that seven species are endemic (1.7%) and most of the recorded species are mono-regionals (34.4%). Multivariate analysis is used to analyze the vegetation and environmental variables of 298 sampled stands in Lakes Mariut and Edku (148 and 150 stands, respectively). Seventeen vegetation groups in Lake Mariut and 15 ones in Lake Edku were identified. These groups were separated along the prevailing moisture gradient from the shoreline to the open water. The vegetation groups (i.e. communities) representing the open water zones were less diverse than those of the shorelines. These communities were compared with those of Burullus, Manzala and Bardawil Lakes. A total of 316 species (78.6% of the total species) have at least one aspect of the environmental and/or economic importances.

**2006. Farahat, E. A. Vegetation - Environment Relationships in the South Nile Delta. Ph. D. Thesis, Faculty of Science, Helwan University. 211 pp.**

The present study aims at identifying and analysing the plant communities of the different habitats in South Nile Delta, where 271 stands were selected to represent the variation in seven major types of habitat recognized in the study area. Thirteen vegetation groups were recognized after the application of TWINSpan, their ordination using DCA indicated moisture, and human impact gradients. The moisture gradient starts with the xerophytes or drought-tolerant plants that inhabit the dry terraces and slopes of water courses and ruderal habitats (e.g. *Alhagi graecorum*, *Imperata cylindrica*, *Phragmites australis* and *Pluchea dioscorides* groups), pass through the mesophytes that inhabit the ditches, gardens and croplands (e.g. *Chenopodium ficifolium*, *Cynodon dactylon-Paspalum dilatatum* and *Cyperus rotundus -Cynodon dactylon* groups), and the species that inhabit the water edges (e.g. *Phragmites australis*, *Pluchea dioscorides*, *Sorghum bicolor* and *Cyperus articulatus -Cynodon dactylon* groups); and it ends with the pure aquatic communities that inhabit the open water (e.g. *Eichhornia crassipes - Myriophyllum spicatum*, *Vossia cuspidata* and *Vossia cuspidata- Eichhornia crassipes* groups). Different correlations were revealed between the soil-water variables on one hand and the distribution of species on the other hand. Also, the ornamental vegetation of El-Qanatir Park was surveyed and documented.

**2006. Shaltout, K. H., Al-Sodany, Y. M. and Eid, E. M. Biology of common reed *Phragmites australis* (Cav.) Trin. ex Steud.: review and inquiry. Overview Series, Assiut University Center for Environmental Studies (AUCES), Assiut, 54 pp.**

*Phragmites australis* (Cav.) Trin ex Steud. is an important component of the lakes, rivers and wetland habitats. It is a species with high ecological plasticity, growing on soils with different pH, salinity, fertility and texture, on shores and littoral zones with different trophic levels and in peat bogs. This plasticity is assumed to be based on the high number of reed clones, where as each *Phragmites* clone probably has relatively narrow ecological amplitudes in relation to its special site conditions. The clonal composition of a reed stand is believed to be the consequence of special strategies of colonization resulted in a success of only well-adapted genotypes. That is, the clones growing at a particular site are probably well-adapted to those site conditions and possibly do not thrive in other conditions. The rarity of studies that deal with the population biology and evolutionary processes in *Phragmites australis* is probably related to: 1- the long life span of this species, 2- practical difficulties in making controlled crosses and growing plants under experimental conditions, and 3- difficulties in recognizing individual clones in the field. Only variation in chromosome number has been rather extensively studied. In Egypt, *Phragmites* is spreading rapidly, where it occurs in water and wetland of all the phytogeographical regions such as Nile Region, Oases, Mediterranean Coast, Desert, Red Sea and Sinai. The aims of the present article are: 1- to review the existing information about the biology of common reed (*Phragmites australis*), 2- to identify the gaps in the existing information, and 3- to focus the attention of the Egyptian biologists for filling these gaps. Knowledge concerning population biology and evolutionary processes is important for the conservation and management of Egyptian wetlands, where

*Phragmites australis* is considered a key-species for the functioning of their ecosystems.

**2005. Galal, T. M. Flora and Vegetation of the Northern Lakes of Egypt. Ph.D. Thesis, Fac. Sci., Helwan Univ., Cairo, 285 pp.**

Along the Mediterranean Coast of Egypt, five natural lakes are present: Mariut (Western Coast), Edku, Burullus and Manzala (Deltaic Coast) and Bardawil (Sinai Coast). The floristic features, habitats and plant communities of these lakes were analyzed. A total of 402 species (203 annuals and 199 perennials) belonging to 248 genera and 68 families were recorded in these lakes. The grasses have the highest contribution to the total flora (16.3%), followed by composites (10.9%) and chenopods (9.4%). Floristically, the richest lake was Burullus (224 species and 149 genera). The life forms of the recorded species are ranged sequentially as follows: therophytes (49% of the total recorded species), geophytes–helophytes (14.7%), chamaephytes (14.5%), hemi-cryptophytes (10.2%), hydrophytes (5.6%), phanerophytes (4.3%) and parasites (1.8%). The global distribution of the recorded species indicated that seven species are endemic (1.7%) and most of the recorded species are mono-regionals (34.4%). Multivariate analysis is used to analyze the vegetation and environmental variables of 298 sampled stands in Lakes Mariut and Edku (148 and 150 stands, respectively). Seventeen vegetation groups in Lake Mariut and 15 ones in Lake Edku were identified. These groups were separated along the prevailing moisture gradient from the shoreline to the open water. The vegetation groups (i.e. communities) representing the open water zones were less diverse than those of the shorelines. These communities were compared with those of Burullus, Manzala and Bardawil Lakes. A total of 316 species (78.6% of the total species) have at least one aspect of the environmental and/or economic importance.

**2005. Nafea, E. M. On the ecology and sustainable development of the northern Delta lakes, Egypt. Ph. D. Thesis, Mansoura University, Damietta Faculty of Science, Department of Environmental Sciences.**

The major concern of this study is to throw the light on the ecology and sustainable development of the northern delta lakes (Manzala, Burullus and Idku). Sixty sites were chosen (20 sites in each lake) for studying the physicochemical characteristics of the water and sediment, aquatic vegetation, epiphytes on the aquatic plants, bottom fauna, fish diversity and birds diversity. On the other hand, 20 sites at islands of each lake were selected for studying the vegetation analysis. Also 60 sites on the shores of the lakes were studied for their vegetation in different habitats. Soil seed banks were studied in three transects in lakes shores. The results elucidate the following: 1→ Lake Burullus is considered as the cleanest deltaic lakes, 2→ aquatic plants can be used for bio-removal of heavy metals from water and so it can be used in the biocontrol of water pollution, 3→ the bottom fauna can be used as habitat indicators and for monitoring the pollution in the northern lakes, 4→ the epiphytic algae and fauna can be used for monitoring pollution in the northern lakes, 5→ forty five bird species were

recorded in the northern lakes and 23 fish species, and a sustainable management plan for the northern delta lakes was constructed to conserve the biodiversity wealth of these vital lakes using some aquatic plants for water treatment and prevent the illegal fishing, birds hunting, discharge of the polluted water into these lakes.

**2005. Shaltout, K.H., Hassan, L.M. and Galal, T.M. Habitat and Vegetation of Lake Mariut, Egypt. Assiut Univ. J. Bot. Assiut, Egypt. 34 (2): 309-337.**

Along the Mediterranean Coast of Egypt, five natural lakes are present: Mariut (Western Coast), Edku, Burullus and Manzala (Deltaic Coast) and Bardawil (Sinai Coast). Lake Mariut lying to the south-west of Alexandria occupies a small portion of a large ancient lake found in the past time. A total of 198 species belonging to 148 genera and 45 families were recorded. Life forms range from hydrophytes to phanerophytes, with the most species being therophytes (58.1%) followed by chamaephytes (13.1%) and geophytes-helophytes (12.6%). Three main habitats characterized by 10 different zones were recognized in Lake Mariut. Drain slopes and terraces are the most similar zones. The shorelines have the highest diversity, while the open water zones have the lowest. Multivariate analysis of the vegetation and environmental variables of the 148 sampled stands led to the recognition of 17 vegetation groups. These groups were separated based on the moisture gradient from the shoreline to the open water. These groups were separated based on the moisture gradient from the shoreline to the open water. They are named after their diagnostic species as follows: 1: *Arthrocnemum machrostachyum* – *Juncus rigidus*, 2: *Sarcocornia fruticosa*-*Halocnemum strobilaceum*, 3: *Atriplex halimus*- *Tamarix nilotica*, 4: *Bromus rubens* - *Launaea nudicaulis*, 5: *Phragmites australis*, 6: *Atriplex semibaccata* - *Phragmites australis*, 7: *Cynanchum acutum* - *Phragmites australis*, 8: *Volutaria tubiflora*, 9: *Najas marina* v. *armata*, 10: *Phragmites australis* - *Typha domingensis*, 11: *Phragmites australis*, 12: *Eichhornia crassipes*, 13: *Echinochloa stagnina* - *Phragmites australis*, 14: *Ceratophyllum demersum*, 15: *Potamogeton pectinatus*- *Eichhornia crassipes*, 16: *Potamogeton pectinatus*-*Phragmites australis* and 17: *Potamogeton pectinatus*.

**2005. Shaltout, K. H., Ali, M. M., Hassan, L. M. & Galal, T. M. Habitat and vegetation of Lake Edku, Egypt. Taeckholmia 25: 61-90.**

The floristic features and plant communities of Lake Edku were analyzed using 150 sampled stands representing the apparent variation in habitats and vegetation. A total of 114 species of vascular plants were recorded. Life forms range from hydrophytes to phanerophytes, with the most species being therophytes (44.5%) followed by geophytes-helophytes (19.3%) and hydrophytes (12.6%). The phytogeographical distribution shows that the majority of species are bi-regional (31.1%) followed by the pluri-regional (28.6%) and mono-regional species (21.0%). Four main habitats, differentiated into 11 zones, were recognized in this lake; 1- lake proper (includes shoreline, water edge and open water), 2- drain mouths (include terraces, slopes, water edge and open water), 3- islets, and 4- fish farms (include shoreline, water edge and

open water). The vegetation of the drain and fish farm open waters is the most similar among the 11 zones. The drain slopes have the highest species richness (18.5 species/stand), while the lake water edges have the lowest (5.2 species/stand). Multivariate analysis of the vegetation and environmental variables of the 150 sampled stands led to the recognition of 15 vegetation groups. These groups were separated on the basis of the moisture gradient from the shoreline to the open water. They are named after their diagnostic species as follows: 1- *Eichhornia crassipes*, 2- *Echinochloa stagnina-Eichhornia crassipes*, 3- *Ceratophyllum demersum-Eichhornia crassipes*, 4- *Potamogeton pectinatus*, 5- *Cyperus articulatus*, 6- *Typha domingensis*, 7- *Phragmites australis*, 8- *Arundo donax*, 9- *Juncus acutus-Typha domingensis*, 10- *Phragmites australis-Typha domingensis*, 11- *Halocnemum strobilaceum-Sarcocornia fruticosa*, 12- *Rumex dentatus-Suaeda vera*, 13- *Bassia indica-Limbarda crithmoides*, 14- *Centaurea calcitrapa* and 15- *Cynodon dactylon-Medicago polymorpha*. The vegetation groups (i.e. communities) representing the open water zones were less diverse than those of the other groups particularly those of the shorelines.

**2005. Shaltout, K. H., Hassan, L. M. and Farahat, E. Vegetation-environment relationships in south Nile Delta. *Taekholmia* 25: 15-46.**

The present study aims at identifying and analyzing the plant communities of the different habitats in South Nile Delta. Two hundred and seventy one stands were selected to represent the variation in seven major types of habitat recognized in the study area (terraces, slopes, water edges, open water, gardens and nurseries, croplands and ditches, fallow and flooded lands. One hundred and forty four species; belonging to 110 genera, 43 families and 23 orders; were recorded in the study area. The most characteristic families are Gramineae (20.9 %) followed by Compositae (13.9 %), Cyperaceae and Euphorbiaceae (5.6 % for each), Leguminosae and Polygonaceae (4.9 % for each) and Amaranthaceae (4.2 %). Thirteen vegetation groups were recognized after the application of TWINSpan. Their ordination using DECORANA indicates moisture and human impact gradients. The moisture gradient starts with the xerophytes or drought-tolerant plants that inhabit the dry terraces and slopes of the water courses and ruderal habitats (e.g. *Alhagi graecorum*, *Imperata cylindrica*, *Phragmites australis* and *Pluchea dioscorides* groups). Then, passing through the mesophytes that inhabit the ditches, gardens and croplands (e.g. *Chenopodium ficifolium*, *Cynodon dactylon-Paspalum dilatatum* and *Cyperus rotundus-Cynodon dactylon* groups), and the species that inhabit the water edges (e.g. *Phragmites australis*, *Pluchea dioscorides*, *Sorghum bicolor* and *Cyperus articulatus-Cynodon dactylon* groups). It ends with the pure aquatic communities that inhabit the open water (e.g. *Eichhornia crassipes-Myriophyllum spicatum*, *Vossia cuspidata* and *Vossia cuspidata-Eichhornia crassipes* groups). The correlations between the soil and water variables on one hand, and the distribution of common species in the study area on the other hand were assessed.

**2005. EI-Khanagry, S. S. Estimation and distribution of weed flora in strawberry (*Fragaria ananassa duchesne*) fields in Egypt. Mansoura Journal of Pharmaceutical Sciences, Mansoura University 30 (7).**

Weeds are considered a problem in strawberry production areas in Egypt. This study on weed flora is carried out on two methods for strawberry production. The first located in West Della area and Qalubia governorate where the soils fumigated by methyl-bromide (protected cultivation); and the second is in Qalubia, Sharkia and Ismailia governorates where the soils were not fumigated (normal cultivation). The study was conducted during winter seasons from 2000-2001 to 2003-2004. Weeds were estimated randomly on one square meter as random and replicated ten times in every fields. Six parameters were used for evaluating weed species, namely the relative density, general density, general frequency, percentage of infested fields, cumulative number and abundance. The results appeared that total of 112 species were recorded, belonging to 78 genera and 31 families. *Artemisia vulgaris*, *Gslinsogs parviflora* and *Oxalis latifolia* were recorded as new species introduced to Egyptian flora. While, species *Chenopodium murals*, *Conyza bonariensis*, *Cyperus rotundus*, *Digitaria sanguinalis*, *Melilolus indicus*, *Nothoscordon inodorum*, *Oxalis comkulata*, *Poa annua*, *Polypogon monspeliensis*, *Portulaca oleracea*, *Sonchus oleraceus*, *Trienthenia portulacastrom* and *Trifolium supinatum* were evaluated as the most troublesome weeds.

**2004. Maswada, H. F. Ecological Studies on Lake Borollus Protected Area, Egypt. M. Sc. Thesis, Tanta University, Faculty of Agriculture, Department of Agricultural Botany.**

Lake Borollus protected area is characterized by prominent physiographic variations which lead to the distinction of five major habitat types, namely: salt marshes (dry and wet), sand formations (flats, hummocks and dunes), reed swamps, fertile lands (cultivated and non-cultivated) and aquatic habitats. Four major sites have been also chosen to represent the study area. These sites include the Deltaic Mediterranean coast, shorelines, islands and open water of Lake Borollus protected area. The present study provides a detailed description of floristic and ecological features in Lake Borollus protected area. It aims at the following objectives: 1-recognition of the major habitat types and distribution of the plant life in the study area, 2-description and classification of the life-span and life-form spectra of the plant life in the study area, 3-determination of chorotypes of the floristic elements in the study area, 4-quantitative analysis of the vegetational structure in the study area using multivariate techniques of classification and ordination, and 5-analysis of the spatial and temporal variations in edaphic factors to determine the factor or factors controlling the distribution and richness of vegetation in the study.

**2003. Yacoub H. A. Environmental studies on Aquatic plants in Egypt. M.Sc. Thesis, Faculty of Science, Mansoura University.**

This study attempts to find answers to the following questions: why do some macrophytes grow in one area and not in the other? and what is the possibility of their growing in a new habitat with different environmental conditions? The study is divided into three parts. The first part showed significant variation in floristic composition and plant distribution between the study areas. Thirteen species had been recorded in all study sites, 11 were in the River Nile in the Aswan region and only seven were in the Nile Delta in the Damietta branch. CCA ordination diagram showed that water dissolved oxygen, water flow rate, under water light transparency and total dissolved salts are the most important environmental variables that significantly affect the distribution of aquatic macrophytes. The floating species, including *Eichhornia crassipes* and *Pistia stratiotes* mainly grew in moderate and high nutrient contents and in strong light conditions. *Potamogeton nodosus* and *Najas horrida* were found in habitat characterized by high oxygen content while *Potamogeton pectinatus*, *Potamogeton crispus* and *Myriophyllum spicatum* were more resistant to lack of oxygen content. The second part confirmed the findings of the first and showed clearly the spatial variation in the aquatic macrophytes abundance and distribution. The third part aims to assess the natural situation found in the field compared with other situations controlled experimentally. The data showed the response of target species to nutritional stress and also explain why these species have limited ecological amplitudes *Potamogeton trichoides* (present in Aswan region) and *Pistia stratiotes* (present in Nile Delta) were chosen for laboratory culture experiment of primary nutrient environmental factors. It was found that *Potamogeton trichoides* is a eutrophic species capable of surviving in high nutrient contents and significantly negatively affected under phosphate and nitrate deficiencies. *Pistia stratiotes* was present only in Nile Delta, also for reasons not related to water nutrients and needs further studies but related to the high water flow rate that characterized most of the sites in the Aswan region and / or higher water pH in water of the Aswan region.

**2003. Mashaly, I. A and Awad, E.R. Ecological Perspectives on the Weed Flora of orchards in the Nile Delta, Egypt. Botany Department, Faculty of Science, Mansoura Universit, Egypt.**

The present study aims at the analysis of the weed flora associated with the major orchards in the Nile Delta region in relation to the prevailing environmental conditions. Two hundred and forty eight stands were selected to represent the major orchard types during winter and summer seasons in four coastal governorates namely: El-Behira, Kafr El-Sheikh, El-Dakahlia and Damietta. The application of Twinspan classification on the importance values of 123 weed species recorded in 124 stands during winter season led to the recognition of eight vegetation groups. these are: group a: codominated by *Cyperus rotundus* and *Paspalum distichum*. group b: dominated also by *Cyperus rotundus*. group c: codominated by *Stellaria pallida* and *Setaria viridis*. group d: dominated by *Polypogon monspeliensis*. groups e, f and h are dominated by *Cynodon dactylon*. while, group g dominated by *Plantago lagopus*. During summer season, the importance values of 99 weed taxa led to the recognition of seven vegetation groups. these are: group a: dominated by *Echinochloa colona*.

group b: codominated by *Echinochloa colona*, *Paspalum distichum* and *Cynodon dactylon*. group c: dominated by *Digitaria sanguinalis*. group d: dominated by *Eleusine indica*. group e: dominated by *Cynodon dactylon*. group f: codominated by *Cynodon dactylon* and *Cenchrus biflorus*. group g: dominated by *Lotus glaber*. the ordination of sampled stands in orchards of the study area during the two seasons were applied using detrended correspondence analysis (DCA). The vegetation groups are markedly distinguishable and having a clear pattern of segregation on the ordination planes. The application of canonical correspondence analysis (CCA) indicated that the soil variables in both winter and summer seasons are widely affect the distribution and species abundance of weed flora in the study orchards. the most important soil variables controlling the distribution and richness of weed species are: soil texture, porosity, water-holding capacity, organic carbon, electrical conductivity, calcium carbonate, sulphate and the soluble cations .

**2003. Mashaly, I. A. Phytosociological Study on the Weed Flora of Croplands in Kafr El-Shikh Governorate, Egypt. EL-Minia Science Bulletin (Botany Section), 14 (2): 127-153.**

The present investigation provides a phytosociological analysis of the flora associated with the main crops in Kafr El-Sheikh Governorate, Egypt in relation to the controlling edaphic factors. Fifty six stands were chosen to represent main winter and summer crops in the study area. The application of TWINSpan classification on the importance values of 125 species recorded in the 56 stands led to the recognition of six vegetation groups: A and B (*Rumex dentatus* - *Melilolus indicus*), G (*Hibiscus trionum*). D (*Amaranthus lividus* - *Portulaca oleracea*), E and F (*Echinochloa crus-galli* - *Cyperus difformis* - *Ammania haccifera*). These groups are markedly distinguishable and having a clear pattern of segregation on the ordination plane using the Detrended Correspondence Analysis (DCA). The application of Canonical Correspondence Analysis (CCA) showed that most effective edaphic factors controlling the distribution and abundance of species are soil texture, porosity, sulphate, calcium carbonate, calcium and salinity.

**2002. Shaltout, K. and El-Sheikh, M. A. Vegetation of the urban habitats in the Nile Delta region, Egypt. Urban Ecosystems 6: 205-221.**

The present study aims at identifying the plant communities of the urban habitats in Nile Delta region, Egypt. Four hundred and five stands were selected to represent the variation in eight major types of habitat recognized in the study area. Twenty-five vegetation groups were recognized after application of TWINSpan. Their ordination using DECORANA indicates moisture, pH, fertility and texture gradients; the hygrotrophilous communities (the moist and fertile stands) inhabit the wet refuse areas (*Echinochloa stagnina*-*Eichhornia crassipes* group), meso-nitrophilous communities inhabit the dry refuse areas, motor roads and railways (*Pluchea dioscoridis*, *Cynodon dactylon*, *Panicum repens* and *Phragmites australis* groups), mesic-dry subnitrophilous communities occur on sandy soils (*Hordeum murinum*, *Alhagi*



*graecorum* and *Desmostachia bipinnata* groups) and the dry thermophilous communities of new anthropogenic habitats with coarser texture of sandy and infertile soil along the railways and motor roads at the borders of the Nile Delta (*Zygophyllum album* and *Cornulaca monacantha* groups). These results suggest that urban vegetation in Nile Delta is favored where disturbance, nutrient and water resources are more abundant.

**2002. El-Komi, T. M. Evaluation of the Range Plants along the Water Courses in the Nile Delta. Ph. D. Thesis, Faculty of Science, Tanta University, 163 pp.**

The present study aims at determining the phenological behaviour, phytomass, primary production, organic and inorganic contents of dominant species along the water courses in Nile Delta in order to evaluate their nutritive values as fodder plants. Each season, over 400 quadrates were randomly sampled to represent the distribution of the species along 15 canals and 10 drains in 5 localities within study area. The annual net community production of each species was estimated as the difference between the highest and lowest standing crop phytomass. The productivity ratio was calculated after dividing the primary production by the heighest value of standing crop. The present results suggested that some species act as biofilters. The living parts of *Phragmites australis* were considered as fair forage and those of *Persicaria salicifolia*, *Eichhornia crassipes*, *Potamogeton*, *Ceratophyllum demersum* and *Azolla filiculoides* were considered as good forages. On the other hand, the dead parts of all the studied species and living parts of *Imperata cylindrica*, *Desmostachya bipinnata*, *Panicum repens*, *cynodon dactylon* and *Echinochloa stagnina* were evaluated as poor forage. Regarding the value of net energy (NE), the living and dead parts of all species were ranked as excellent forage, except *Potamogeton crispus* which was considered as good forage (NE: 3.45-4.15), and *Ceratophyllum demersum* which was considered as fair forage (NE: 3.10-3.45). Regarding to the value of nutritional ratio (NR), the living and dead parts of six species (*Imperata cylindrica*, *Desmostachya bipinnata*, *Phragmites australis*, *Panicum repens*, *Cynodon dactylon* and *Echinochloa stagnina*) were evaluated as a poor forage (NR<55 Fu/kg) and those of 5 species (*Persicaria salicifolia*, *Eichhornia crassipes*, *Potamogeton crispus* *Ceratophyllum demersum* and *Azolla filiculoides*) were evaluated as an excellent forage (NR>88 Fu/kg).

**2001. Farag-Alla, K. A. Vegetation structure in Lake Manzala, Egypt. M.Sc. Thesis, Faculty of Science, Suez Canal University.**

Total number of species recorded in the 22 stations of this study are 34 species, belong to 32 genera and 21 families. The highest number of species was recorded in Chenopodiaceae (7 species) followed by Graminae (4 species). The highest value among the recorded species was 86.4% for *Phragmites australis* followed 2% for *Arthrocnemum macrostachyum*, 36% for *Typha domingensis*, 32% for *Halocnemum strobilaceum* and *Suaeda peruinosa*, 27% for *Inula crithmoides* and 23% *Potamogeton pectinatus*. Floating fern (water velvet) *Azolla filiculoides* (Azollaceae) that recently

invades the fresh waterways and recorded in the southern stations of Lake Manzala. The highest fresh weight biomass was recorded for *Typha domingensis* as 68.5 kg /m<sup>2</sup>, by 62.8 kg/m<sup>2</sup> for *Phragmites australis*, 48.5 kg/m<sup>2</sup> for *Eichhornia crassipes* 47.5 kg/m<sup>2</sup> for *Arundo donax*. The highest root / shoot ratio was recorded for *Azolla filiculoides* as 5 followed by 1.5 *Sarcocornia fruticosa*, 1.2 for *Arthrocnemum macrostachyum* and 1 for *Halocnemum strobilaceum*. The leaf criteria showed variation between the northern stations and the southern ones. The degree of sclerophylly ranged from 0.3 to 6.7 g. dm<sup>2</sup> in the northern stations and 7.1 g. dm<sup>2</sup> in the southern stations. Degree of succulence ranged from 0.5 to 2.9 g. dm<sup>-2</sup> in the northern stations and 0.65 dm<sup>-2</sup> in the southern stations. Both sectors are showing similar values. Maximal level in the northern stations, ranged from 65.5 to 92%, while in the southern from 86% to 95%. Degree of leaf area development varied from 0.02 to 0.89 dm<sup>2</sup> g<sup>-1</sup> in the northern stations; and from 0.16 to 0.44 dm<sup>2</sup> g<sup>-1</sup> in the southern stations. Heavy metals in the investigated plants recorded a very hazardous level of pollution. The mean value for species richness index in all stations was 0.58, while it was double in the southern stations (1.7). Index of dominance showed much less variation between both of stations (0.34 and 0.36, respectively). Diversity index recorded 0.58 and 0.64, while Shannon diversity index scored 0.67 in both northern and southern stations.

**2001. Galal, T. M. Studies on the River Nile Vegetation in El-Kahira El-Kobra. MSc. Thesis, Faculty of Science, Helwan University.**

The present study aims at analyzing natural vegetation of sedimentary islands, canal banks and cultivated lands along the Nile in El-Kahira El-Kobra. A total of 13 transects were taken, each one comprises one or more sites. Stands were distributed in each site representing the different habitats. A total of 151 species were recorded belonging to 45 families. The most characteristic families are Gramineae represented by 35 species, Compositae by 17 species, Leguminosae by nine species and Cruciferae by eight species. Ferns are represented by only one species. A total of 108 species are recorded from 89 stands. Four main habitat types are recognized in studied islands: Aquatic, flooding, terraces and cultivated plot habitats. Some 107 species are recorded from the Nile banks (Nile River, Irrigation channels and Drainage canals). Two main habitats are recognized from the Nile banks: aquatic and Nile bank habitats. Multivariate analysis is used to analyze vegetation and environmental parameter of the studied sites. Weeds associated with the cultivated plots are studied, of which 56 species are associated with Egyptian clover, 35 species with wheat crops, 28 species with maize, 61 species with the different types of vegetables and 21 species with banana orchards.

**2001. Hassan, L.M., Fahmy, A.G. and Galal, T.M. Wetland Vegetation in Greater Cairo Area, Egypt. Bull. Fac. Sci., Assiut Univ., Assiut, Egypt. 30 (2-D): 299-310.**

A total of 104 stands were distributed in aquatic, flooding, terraces and steps habitats along irrigation and drainage channels as well as water course of the Nile river in

Greater Cairo. Two main seasons (winter and summer) were chosen to carry the vegetation and environmental analysis. Some 107 species of higher plants were recorded, where therophytes represent 48.6% of the total species, while 15.9% are hydrophytes and helophytes. In summer, eight clusters were separated by dendrogram resulted from TWINSpan analysis. Cluster III representing stands of the Nile bank habitats includes the highest number of species (46 species), while cluster VII representing stand of aquatic habitats has only one species namely; *Eichhornia crassipes*. DECORANA analysis separates vegetation clusters into three groups. In winter season, seven clusters were separated by TWINSpan analysis. Cluster IV representing stands of the Nile bank habitats include the highest number of species (75 species), while cluster VII representing stand of aquatic habitat has two species namely; *Eichhornia crassipes* and *Potamogeton crispus*. Physical environmental parameters, total dissolved salts, chlorides, carbonates, bicarbonates, sulfates, calcium, magnesium, sodium and potassium were determined in the two seasons.

**2001. Hassan, L.M., Fahmy, A.G. and Galal, T.M. Environmental Parameters and Vegetation Analysis of Sedimentary Islands, River Nile, Egypt. Bull. Fac. Sci., Assiut Univ., Assiut, Egypt. 30 (2-D): 153-169.**

Some 108 species were recorded in the Nile sedimentary islands (30 islands) in the study area. Multivariate analysis (TWINSpan & DECORANA Programs) is used to analyze the vegetation and environmental parameters. Different habitats (aquatic, flooding, terraces and cultivated plots) are described briefly. Eight clusters were separated by the dendrogram resulted from TWINSpan analysis. Cluster IV represents stands of cultivated habitats includes the highest number of species (72 species) while cluster VIII, which represents aquatic habitat has only one species namely, *Eichhornia crassipes*. Environmental factors (soil texture, pH, total dissolved salts, chlorides, carbonates and bicarbonates, sulphate, sodium, potassium and magnesium) for all sites (89 sites) were separated by DECORANA into four groups; one group represent the aquatic sites, while the other three groups represent flooding, Nile bank terraces and cultivated plots. El Waraq Island (5.5 km<sup>2</sup>) is characterized by the higher number of species (72 species) than the other islands.

## 2.2- Eastern Desert and Sinai

**2017. Saleh, M. Y. Biodiversity of Halophytes in North Sinai Environments. M. Sc. Thesis, Cairo University, Faculty of Agriculture, Department of Agricultural Microbiology.**

The diversity of culturable bacteria associated to the salt-affected plants cover of Mediterranean Sea-affected areas of Egypt was investigated. Ecto- and endo-rhizospheres as well as phyllospheres of tested plants accommodated dense populations of culturable halotolerant bacteria recovered on various salted culture media. From the Lake Bardawil of North Sinai, eleven bacterial isolates were obtained, and their morpho-physiological characterization confirmed their belonging to the genera *Bacillus*, *Enterobacter*, *Pantoea*, *Pasteurella* and *Vibrio*. The majority of isolates exhibited plant growth promoting (PGP) abilities, e.g. N<sub>2</sub>-fixation, P-solubilization, and NaCl tolerance up to 10%. The plant-based-sea water culture medium is successfully introduced to *in vitro* cultivation and *in situ* recovery of associated halophilic microbiome. The ice plant (*Mesembryanthemum crystallinum*) was used, in the form of juice and/or dehydrated plant powder packed in teabags, to supplement the natural sea water. The culture medium, as such without any supplements, supported very good *in vitro* growth of halophilic bacterial isolates. It was also capable to recover the culturable population of bacteria associated to halophytes prevailing in Lake Mariout, Alexandria. When related to the total bacterial numbers, associated the plant roots of *Suaeda pruinosa*, as measured by quantitative-PCR, the culture medium supported significant increases in culturability of halophytes (15.3- 19.5 %) when compared to the conventional chemically-synthetic culture medium supplemented with (11.2 %) or without (3.8 %) NaCl. Based on 16s rDNA sequencing, representative isolates prevailed on such culture medium were closely related to *Bacillus*, *Halomonas*, and *Kocuria*. Seed germination tests on 25-50 % sea water agar, indicated positive interaction of those bacterial isolates with the germination and seedlings' growth of barley seeds.

**2017. Abdelaal, M. Current status of the floristic composition in Wadi Hagul, Northwest Suez Gulf, Egypt. Rend. Fis. Acc. Lincei 28: 81–92.**

The floristic inventory of Wadi Hagul, Eastern Desert of Egypt is being changed at an alarming rate due to recent human disturbance. The present study provides a description of the current status of the floristic data and prevailing plant clusters in the wadi in relation to soil and anthropogenic factors. Floristic sampling was carried out in 30 stands along the wadi and data on soil factors were measured, whereas the anthropogenic threats were scaled for each stand. A total of 98 plant species belonging to 85 genera and 28 families were recorded. On the basis of their conservation status, the collected 98 species categorized into 79 native (45 common, 34 threatened) and 19 introduced species. TWINSAPN classification allowed to identify the four plant clusters: (I) *Launaea spinosa*, (II) *Zilla spinosa*, (III) *Zygophyllum coccineum* and (IV) *Panicum turgidum*. Over-collection, urbanization, over-grazing, introduced species,

military activities, moisture content, organic matter, electrical conductivity, pH, chlorides, sodium and potassium were identified as the most significant factors controlling distribution of plant clusters by canonical correspondence analysis. The variance partitioning revealed that 48% of the total variability was explained by both soil and anthropogenic factors, only anthropogenic variables explained 18%, while soil factors explained 7%, whereas the combined shared effect was 23%. The information in this study will help us to formulate an efficient conservation strategy to prevent further losses of plant diversity along desert wadis.

**2017. Badawy, A. A. Ecological studies on *Origanum syriacum* subsp. *sinaicum* plant in south Sinai, Egypt. M. Sc. Thesis in Agricultural Sciences (Environment and Bio-Agriculture). Faculty of Agriculture, Al-Azhar University, Cairo.**

The present investigation was carried out on the vegetation cover in Saint Katherine protected area to study the ecological aspect and the constituents of the essential oil of *Origanum syriacum* subsp. *sinaicum* in the study area. The main objectives of the study are: 1- Current status of endemic plants in SKP, 2- Vegetation analysis of *Origanum syriacum* subsp. *sinaicum* and associated species in SKP, 3- Assessing the soil factors that affect growth and oil constituents of *Origanum syriacum* subsp. *sinaicum* in study area, 4- Study soil-vegetation relationships in SKP, 5- Prediction of potential suitable habitat for *Origanum syriacum* subsp. *sinaicum* over SPK. This study revealed that: SPK region contained a wide range of micro-habitats and landscapes that are a consequence of varying microclimatic conditions, a wide range of altitudes and variable topography; and SPK is one of the most floristically diverse spots in the middle east and contained 44% of Egypt's endemic plant species. To date, around 1261 species were recorded in Sinai. *Origanum syriacum* subsp. *sinaicum* grown wild in SPK has the mean oil component is Carvacrol. The essential oil percent and its main constituents was changed according to the altitude and soil content of Ca, CaCO<sub>3</sub>, Na, Cl and soil EC values. No considerable differences were observed for the effect of soil texture neither on essential oil or on carvacrol percentage. Twenty compounds were identified as the main constituents of the essential oil which accounted for ca 97% from the total compounds of the essential oil. Carvacrol was identified as the major constituent in all collected plants from different stands and ranged from 74.2% to 92.7 % from the total compounds of the essential oil. P-cymene was identified in the essential oil of all studied stands and ranged from 1.0 % to 6.2 %. The same was observed for γ-terpinene that was identified in the essential oil of all plants in 44 stands and accounted for 1.4 % as minimum level to 7.4% as maximum level from the total compounds. The oxygenated compounds in the essential oil of *Origanum syriacum* were identified as carvacrol, terpinol-4, linalool, borneol, thymol, eugenol, and long pinene epoxide with relative percentage from 76.6% to 94.2 %. The non-oxygenated compounds were ranged from 3.7% to 18.4%, in which P-cymene and γ-terpinene were the main non-oxygenated compounds.

**2016. Salama, F., Abd El-Ghani, M., Gadallah, M., El-Naggar, S. and Amro, A. Characteristics of desert vegetation along four transects in the arid environment of southern Egypt. Turkish Journal of Botany 40: 59-73.**

The floristic diversity and vegetation–environment relations in the southern part of the Eastern Desert, between 26°45'N and 24°1'N and between 32°45'E and 35°00'E and covering a total area of about 54,500 km<sup>2</sup>, were investigated. For this purpose, 142 georeferenced stands distributed in four transects were selected: 22 from Qena-Safaga road (T1), 28 from Idfu-Marsa Alam road (T2), 46 from Aswan-Kharit-Gimal (T3), and 46 from Red Sea Coastal Plain (T4). Altogether, 94 species belonging to 33 families were recorded, and the species richness (SR) varied from one transect to another: 46, 35, 52, and 46 in T1, T2, T3, and T4, respectively. Soil samples were collected from each stand, and the soil texture, soil moisture content, organic matter (OM), electric conductivity (EC), total soluble salts (TSS), pH, and major ions (Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, Cl<sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, and HCO<sub>3</sub><sup>-</sup>) were determined. The soil–vegetation relationships were assessed by both detrended correspondence analysis and canonical correspondence analysis. Both species diversity measurements (SR and H') exhibited significant differences among the separated vegetation groups within each transect. Classification of the vegetation resulted in 6, 7, 4, and 6 vegetation groups for T1, T2, T3, and T4, respectively. Canonical correspondence analysis showed well the relative positions of species and sites along the most important ecological gradients. The segregation of these groups along the first two axes of the biplot demonstrated that soil texture, moisture content, salinity, sulfates, and organic matter contents were highly correlated with the distribution of species.

**2016. Shaltout, K. H. Ahmed, D. A. and Shabana, H. A. Distribution of the associated species with *Phlomis aurea* Decne along an elevation gradient in Southern Sinai, Egypt. Ecologia Mediterranea 42 (1): 65-77.**

The present study aims to assess and identify the plant communities associated with the distribution of *Phlomis aurea* in Southern Sinai in relation to habitats and elevation gradient. It also aims to assess the effect of environmental factors on its distribution to be used for its conservation through rehabilitation or restoration. Sixty-five stands were sampled to represent its distribution. In each stand, plant species, their density, frequency and cover were determined. Sixty-three associated species related to 56 genera and 30 families, of which 12 endemic species and 3 near-endemics, were recorded. Twenty one species were evaluated as threatened species (most of them were evaluated as endangered species). Compositae had the highest contribution. Saharo-Arabian elements were the most represented. Gorges had the highest species richness, while wadi beds had the highest species turnover. Significant positive correlations between altitude and both plant cover and density were detected. Four vegetation groups were resulted after the application of TWINSpan classification and DCA ordination. Three of these groups were characterized by *Achillea fragrantissima* as dominant or codominant species, and one was characterized by *Phlomis aurea*. *Seriphidium herba-album*-*Achillea fragrantissima* group had the highest species richness, while *Achillea fragrantissima* – *Teucrium polium* group had the highest

species turnover, and *Phlomis aurea* – *Seriphidium herba-album* group had the lowest. The soil vegetation relationship resulted from the application of CCA indicated that altitude, calcium, bicarbonate, organic matter and fine gravels were the most effective environmental variables to explain species distribution.

**2016. Hatim, M. Z., Shaltout, K. H., Schaminee, J. H., El-Kady, H. F., Janssen, J. and El-Sheikh, M. A. VegEgypt ecoinformatics: contribution to Sinai flora and vegetation. Rend. Fis. Acc. Lincei. 27: 383-399.**

This study is aimed at collection of all available phytosociological data on vegetation of Sinai Peninsula, a region that is still poorly explored. An overview of the plant communities of Sinai is compiled based on additional field work and inventories. The database for Sinai vegetation will serve as a nucleus for the National Vegetation Databank of Egypt - 'VegEgypt'. Aspects like species richness, species turnover, conservation categories, and endemism were given special attention. The database was set up and analysed using the Turboveg and Juice programs. A matrix of 816 releve's and 496 species belonging to 69 families and 281 genera formed the basis for further analysis. Asteraceae, Poaceae and Fabaceae were the most represented families. The lists contain 52 threatened, 16 endemic and 20 sub-endemic species. The percentage of endemic species is highest in insular floras, peninsulas and mountain chains. The vegetation analysis resulted in 21 associations. The plant associations on sand habitats have the lowest species richness and species turnover due to water scarcity. On the other hand, plant communities or associations inhabiting rocky habitats have the highest species richness and species turnover.

**2015. Abd El-Aal, M. Community associates of the medicinal *Farsetia aegyptia* Turra and its soil correlates in the North-Eastern Desert of Egypt. Mansoura Science Bulletin (Biology), Mansoura Universit. 40 (1).**

The purpose of this study was to describe the floristic composition associated with *Farsetia aegyptia* Turra in the north-eastern desert of Egypt and its relation to edaphic variables. *F. aegyptia* surveyed stands comprises 87 species (54 perennials, 31 annuals and 2 biennials) representing 73 genera in 27 taxonomic families recorded in 25 stands. Family Asteraceae was the most represented family (18 species) and *Launea* was the largest genus (4 species). Therophytes and chamaephytes were the dominant life forms. Chorological analyses revealed that, the Saharo-Sindian chorotypes constitute (80.5%) the main bulk of the recorded flora in the present study. TWINSpan cluster analysis yielded one vegetation group and 2 subgroups named after the first and second dominant species with the highest importance value. group (A) *Haloxylon salicornicum-Farsetia aegyptia*, subgroup (B1) *Zilla spinosa-Zygophyllum coccineum*, and subgroup (B2) *Pulicaria undulata-Zygophyllum coccineum*. DCA ordination supports the distribution of the three vegetation groups along the first 2 axes. Results of CCA ordination elucidated that organic carbon, calcium, magnesium, moisture content, bicarbonates, pH, porosity and soil texture (clay and sand fractions) were the most effective soil variables that controlled the

distribution of vegetation pattern in the present study. Obviously, *F. aegyptia* was separated at the center of CCA-biplot and it showed a positive close relationship with soil texture (clay and sand fractions) and calcium carbonates.

**2014. Salama, F. M., Sayed, S. A. and Abd El-Gelil, A. A. Plant Communities and Floristic Composition of the Vegetation of Wadi Al-Assiuty and Wadi Habib in the Eastern Desert, Egypt. Not Sci Biol 6 (2): 196-206**

Torrential rains (in January 2011) that have swept a limited area in the Eastern Desert, facing Assiut Province (Upper Egypt), resulted in enriching the vegetation in Wadi Al-Assiuty and its tributary Wadi Habib. Vegetation survey carried out shortly after this event (in May) revealed the prevalence of annuals which are hardly recognizable in such usually dry habitats. The normally scarce perennial vegetation has flourished. A total of 66 plant species, 33 perennials and 33 annuals, belonging to 53 genera from 22 different families were recorded. Therophytes are the predominant life form (50%), followed by chamaephytes (21%), phanerophytes (15%), hemicryptophytes (11%) and geophytes (3%). Chorological analysis revealed that Saharo-Arabian (81.8%) constitute the main bulk of the total flora of the studied area. The majority of the perennial species behave similarly to each other in their phenology, and usually perennials sprout at the end of February, become leafy in March, flower in April and produce fruits between April and July. The investigation revealed that the wadis studied are potential shelters of four vegetation groups. Twenty two of the recorded species (33.3%) are omnipresent and had a dominant degree of occurrence ( $Q\text{-value} \geq 0.2$ ). The highest among others were *Zilla spinosa* and *Zygophyllum coccineum* which recorded in 86% and 88% of the studied stands and spread their dominance all over the Eastern Desert of Egypt.

**2014. Salama, F. M., Abd El-Ghani, M., Gadallah, M., El-Naggar, S. and Amro, A. Variations in Vegetation Structure, Species Dominance and Plant Communities in South of the Eastern Desert-Egypt. Not Sci Biol 6 (1): 41-58.**

For two successive years, the floristic diversity and vegetation composition in the southern part of the Eastern Desert of Egypt were investigated through four transects (3 crossing the Eastern Desert and one along the Red Sea). The data collected from 142 stands covering the study area included the species composition, functional groups, chorology and occurrences. A total of 94 plant species belonging to 33 different families were recorded, with Asteraceae, Zygophyllaceae, Fabaceae, Poaceae, Chenopodiaceae and Brassicaceae as the largest families. Shrubs represented the largest functional group (39.4%), while perennial herbs represented the smallest ones (12.8%). Species occurrence revealed that *Zilla spinosa*, *Acacia tortilis* subsp. *raddiana*, *Morettia philaeana*, *Caroxylon imbricatum*, *Zygophyllum coccineum* and *Citrullus colocynthis* had wide ecological range of distribution. Saharo-Arabian chorotype was highly represented (72.6 %) in the flora of this area, eventually as mono-, bi- or pluriregional. Classification of the data set yielded 7 vegetation groups included: (A) *Zilla spinosa*-*Morettia philaeana*, (B1) *Zilla spinosa*-*Citrullus*



*colocynthis-Morettia philaeana*, (B2) *Zilla spinosa*, (C1) *Zygophyllum album-Tamarix nilotica*, (C2) *Zygophyllum coccineum-Tamarix nilotica*, (D1) *Zilla spinosa-Zygophyllum coccineum* and (D2) *Zilla spinosa-Acacia tortilis* subsp. *raddiana-Tamarix aphylla-Balanites aegyptiaca*. Certain vegetation groups were assigned to one or more transects. Detrended Correspondence Analysis (DCA) revealed that electrical conductivity, sodium, potassium, calcium, magnesium, chlorides, moisture content, sulphates, pH, organic matter and gravel were the soil variables that affect the species distribution in this study.

**2014. Youssef, W. F. Vegetation of Wadi Rishrash in the North Eastern Desert. M. Sc. Thesis, Cairo University, Faculty of Science, Department of Botany and Microbiology.**

The present work aimed to study the vegetation-environment relationships in Wadi Rishrash, Eastern Desert of Egypt. A total of 40 stands were studied, using ten quadrates (10 m × 10 m) per stand. Moreover, periodic phenological observations were carried out on 16 species representing the most common plants in the study area. A total of 80 species belonging to 29 families and 71 genera were identified. Asteraceae has the highest contribution to the total flora (16 species). Chamaephytes represented the predominant life form (34%) followed by therophytes (26%) and hemi-cryptophytes (25%). Mono-regional taxa represented 22.5 % of the recorded species. About 53.8% of species were bio-regional, while pluriregional species formed 23.8 % of the total species.

**2013. Abd El-Ghani, M., Salama, F., Salem, B., El-Hadidy, A. and Abdel-Alem, M. Biogeographical relations of a hyperarid desert flora in Eastern Egypt. Afr. J. Ecol. 52: 173–191.**

The floristic composition and geographical elements of the study area were analyzed resulted in 328 species representing 206 genera in 55 families. This study confirmed the record of fourteen species, mostly weeds, which can be considered as new additions to the flora of the study area. Therophytes were the dominant life form, while mono- and bi-regional Saharo-Sindian geoelements were the most represented. Ten species showed dominance with Q-values ranged between 0.802 and 0.2, where *Zilla spinosa* and *Zygophyllum coccineum* were of common occurrence. Application of cluster analysis and DCA ordination techniques produced four major floristic groups (A–D) comprising seven subgroups. The correlation coefficients (r) between the different subgroups revealed high significant correlations (P = 0.01) between floristic group (B) and subgroup (C2) and between subgroups (D1) and (D2). Significant correlations (P = 0.05) occurred between subgroup (D1) and both of (A1) and (C2). Comparing the floristic similarities between this investigation and other relevant studies were presented and discussed. On the other hand, the low similarity index between the study area and Sinai may be attributed to the geographical position of both deserts where Sinai desert is part of the Irano-Turanian region, while the Eastern Desert is a part of the Saharo-Sindian region.

**2013. Abd El-Ghani, M., Salama, F., and El-Tayeh, N. Desert roadside vegetation in eastern Egypt and environmental determinants for its distribution. *Phytologia Balcanica* 19 (2): 233 – 242.**

The purpose of this study was to describe the flora and vegetation at Qift-Qusier roadsides in the central part of the Eastern Desert of Egypt, and to relate floristic composition to edaphic conditions. A total of 61 species (28 annuals and 33 perennials) belonging to 50 genera and 27 families were recorded. On the basis of their presence values, classification of the 61 species recorded in 43 stands by cluster analysis yielded six vegetation groups. The results of CCA ordination indicated that the soil organic matter, Na, K, Ca, and pH were the most important factors for distribution of the vegetation pattern along the road verges in the study area. The DCA and CCA results suggested a strong correlation between vegetation and the measured soil parameters.

**2013. Hatem, M. Z. An inventory of available phytosociological data of Sinai and a field survey of some under-estimated areas. M. Sc. Thesis, Faculty of Science, Tanta University.**

This study aims at collecting the available data about the flora of Sinai and preparing a preliminary list for the plant species. It also aims at building up a computerized database dealing with the data of the recorded species. Field trips were carried out to cover the gap places that were not represented well in the database. The total number of the recorded plant species was 496 related to 281 genera and 69 families. Compositae, Gramineae and Leguminosae were the most represented families. The analysis of the matrix of 816 relevés and the cover estimates of 496 species according to TWINSpan led to identify 21 groups. Their segregation using DECORANA reflects the floristic composition of these groups. Twenty one major habitats were identified in the study area, their classification based on their floristic composition according to TWINSpan led to identify 13 groups. The herb layer was the most represented life form, while the high tree and the moss layers were the less represented ones. Sixteen endemic and twenty near-endemic species were recorded in the present study. The medicinal species were the most represented, while the timber species were the less represented. The sand accumulators were the most represented in the study area, while the soil fixating and salinity tolerant species were the less represented. Fifty three species in Sinai were recorded in the red data list of the vascular plants of Egypt.

**2013. Khafagi, O. A., Hatab, E. E. and Mohamed, A. A. Effect of Spatial Variation on Plant Community Structure in South Sinai, Egypt. *Universal Journal of Environmental Research and Technology*, 3(2): 242-254.**

The effect of spatial variation on plant community structure was studied through the comprehension to eco-geographical and climatic variables. The present study was carried out on four wadis at different elevation (Wadi Gebal at 1722-1916 m above sea level, Wadi Gharaba at 1110-1217 m a.s.l., Wadi Hodra at 600-700 m a.s.l. and Wadi

Khoshbi 20-120 m a.s.l.) in Saint Katherine Protectorate, south Sinai, Egypt between March and September 2011. In this study, we used a multivariate analysis, GIS and descriptive analysis to ensure the best using and orientation for the information. As a result for the available data and analysis, we get good outputs that can help to support any conservation actions for the ecosystem. The indices of Simpson, Shannon-Weiner and Birlouin were used to estimate the floral diversity on 4 locations. Estimates showed that Wadi Gebal had the highest value of Shannon-Weiner diversity index (4.19), while the lowest value (2.7) was recorded in W. Khoshbi. The total vegetation cover was determined to be about 30 % of the total area studied (5000 m<sup>2</sup>). The maximum cover percentage was record in W. Gebal (38%), while the lowest value was 19% recorded in W. Gharaba. Physical and chemical prosperities of soil showed great variation among the different elevation ranks. Results found that soil pH, and organic matter values decreased with elevation, while HCO<sub>3</sub> increased with elevation. W. Gebal is the highest elevated point, it received cool temperature and high rain, while W. Khoshbi is the lowest one in this area, thus it received high temperature and low rains. However, for each 1,000-foot rise in altitude there is a 4°F drop in temperature. It discerned that great variation in vegetation distribution and plant community structure, this variation may result from the variation of elevation, aspect, and slope ranks between different locations. Result for the available data was found that spatial variation play a great role in the variation of plant community structure from variation in altitudes and latitudes that leads to variation in climatic conditions and consequently, makes changes in all ecosystem components.

**2013. Salama, F. M., Abd El-Ghani, M. M, El-Naggar, S. M and Aljarroushi, M. M. Vegetation analysis and species diversity in the desert ecosystem of coastal wadis of South Sinai, Egypt. Journal of Biology and Earth Sciences, 3 (2): B214-B227.**

This study aims to investigate the floristic composition, biological spectrum, chorological affinities, and describes the vegetation inhabiting the main channel and the deltaic part of Wadi Kid as one of the principal coastal wadis in South Sinai. The life-form spectrum in the present study is characteristic of an arid desert region with the dominance of therophytes (30.4 % of the total) and chamaephtyes (26.1 %), followed by hemicryptophytes (26.1 %), phanerophytes (14.5 %), geophytes (1 .5%) and parasites (1 .5%). Phytogeographically, the Saharo-Arabian element forms the major component of the floristic structure. The investigation revealed that Wadi Kid is potential shelters of 5 vegetation groups. Detrended Correspondence Analysis (DCA) represented the distribution of the recognized groups along the first two axes. Canonical Correspondence Analysis (CCA) indicated that clay, coarse sand, electric conductivity, chlorides, magnesium and calcium were the main soil parameters which determined the distribution of vegetation in the study area.

**2013. Salama, F. M, Abd El-Ghani, M. and El-Tayeh, N. A. Vegetation and soil relationships in the inland wadi ecosystem of central Eastern Desert, Egypt. Turk J Bot 37: 489-498.**

In January 2010, torrential rains that had suddenly swept away a limited area in the Eastern Desert facing Qena Province in Upper Egypt resulted in the enriching of the vegetation of some extremely dry wadis at this location. A vegetation survey carried out shortly after this event, in April, revealed the prevalence of annuals in considerable abundance, which are hardly recognizable in such usually dry habitats. The normally scarce perennial vegetation had flourished, too. A total of 32 species, 11 annuals, and 21 perennials that belong to 27 genera and 15 families were recorded. The life-form spectrum in the present study is characteristic of an arid desert region with the dominance of chamaephytes (31% of the recorded species) and therophytes (28%), followed by hemicryptophytes and phanerophytes (19 % for each). Phytogeographically, the Saharo-Arabian element forms the major component of the floristic structure. The investigation revealed that the wadis studied are potential shelters of 4 vegetation groups. Detrended correspondence analysis represented the distribution of the 4 vegetation groups along the first 2 axes. Canonical correspondence analysis indicated that the distribution of vegetation in the study area was mainly controlled by gravel, pH,  $\text{SO}_4^{-2}$ , chlorides,  $\text{K}^{+1}$ ,  $\text{Mg}^{+2}$ , and total soluble salts.

**2013. Salama, F. M, Abd El-Ghani, M., El-Naggar, S. and Aljarroshi, M. Vegetation dynamics and species distribution patterns in the inland desert wadis of South Sinai, Egypt. ecologia mediterranea 39 (2): 93-110.**

The present study aims to investigate the variation in vegetation and species diversity in three inland wadis (Wadi Solaf, W. Romana and W. El-Akhdar) which drain their water from surrounding high mountains to the main channel of Wadi Feiran in South Sinai. It attempted to compare the floristic diversity between these wadis to recognize the different distribution patterns of species, and to assess the role of the edaphic factors which control the distribution of the plant communities. Forty-five sample plots were selected to represent as much as possible the variation in the vegetation, and georeferenced using GPS techniques. A total of 116 species (45 annuals and 71 perennials) belonging to 95 genera and 37 families were recorded, with Asteraceae, Brassicaceae, Fabaceae, and Zygophyllaceae represented the species-rich families. Therophytes constituted the main bulk of the flora, followed by chamaephytes, phanerophytes and hemicryptophytes. As part of the Saharo-Arabian region, the Saharo-Arabian chorotype dominated the others. Classification of the vegetation resulted in 5 vegetation groups: (A) *Zilla spinosa*, (B) *Artemisia judaica-Zilla spinosa*, (C) *Artemisia judaica*, (D) *Anabasis articulata-Artemisia judaica-Fagonia mollis*, and (E) *Fagonia mollis-Zilla spinosa*. Species richness was significantly negatively correlated with chlorides, while the Shannon's diversity index showed significant negative correlation with chlorides and positively correlated with calcium. Vegetation-soil relationships were assessed by Canonical Correspondence Analysis (CCA) using 13 soil factors indicated that gravel, coarse sand, fine sand, silt, clay, sodium and

chlorides were the key soil variables that affect the distribution of plant communities in the inland wadis of South Sinai.

**2013. Shabana, H. A. Variability among *Phlomis aurea* Decne populations in Southern Sinai. M. Sc. Thesis, Faculty of Science, Tanta University. 245 pp.**

*Phlomis aurea* Decne. (Lamiaceae) is an endemic species, restricted to the high altitudes in southern Sinai. The present study aims to evaluate its ability to adapt with different environmental conditions and assess the variability among its populations in the main habitats (morphological characteristics and protein pattern of seed storage). Sixty five stands were sampled to represent the variation among its populations. In each stand, associated species were listed, the individual dimensions, morphological characteristics, density per 1000 m<sup>2</sup>, frequency (%) and cover (%) of species were estimated. Species richness was measured. The grazing and topography (elevation and aspect) were assessed. In each stand, three soil samples were collected to determine the soil texture and chemical characteristics. The application of TWINSpan classification technique on the floristic composition of the 65 stands led to classify them into 14 vegetation groups at level 4. The dominant species are: *Phlomis aurea*, *Achillea fragrantissima* and *Teucrium polium*. Wadi beds have the highest species richness. Thirty-four species from the associate species were grazed. The highest individual's number of *Phlomis aurea* was at elevation between 1750 – 1850 m asl (above sea level). *Phlomis aurea* populations distributed at NE (43.1 %), E (26 %). Altitude, calcium, clay, bicarbonate, organic matter, and fine gravel are the most effective environmental variables in the species distribution. *Phlomis aurea* individuals grow well in the moist-shade habitats. Mature dry seeds from 30 accessions of this plant were used for protein analysis according to SDS-PAGE technique. This produced 20 protein bands; the common bands are 3, which could be used as fingerprints for *Phlomis aurea*. It can be suggested that seed storage protein patterns are slightly affected by aspect direction and altitude, and not affected by habitats and sites.

**2013. Mohamed, S. A study on the vegetation in several transects across the Red Sea coast-eastern desert: ecotone between Safaga and south Qussier. Ph. D. Thesis, Faculty of Science at Qena, South Valley University.**

Ecotones are transition zones between the neighbors acting as sensitive indicators of environmental changes. Red Sea – Africa ecotone (as chemo ecotone) is a major ecotone of three countries (Egypt, Sudan and Eritria, along Red Sea shoreline) (about 2200 km<sup>2</sup>). Red sea - Eastern desert ecotone is extending to about 1000 km. The present study is concerned with a part of this ecotone from port Safaga until 50 km southern Qusseir city. This study conducted between June 2011 and May 2012 deals with the floristic composition and vegetation distribution in the area between eastern desert and red sea coast. The study covers 98 stands inside deltas of 13 wadis that represent the main sites in this area. A total of 45 species (38 perennials and 7 annuals) belonging to 24 families, representing 38 genera were recorded. The most characteristic families were Leguminosae (6 spp), Zygophyllaceae (5 spp),

Compositae (4 spp), Boraginaceae and Graminae (3 spp. for each). The most dominating species were *Z. coccineum*, *T. nilotica*, *Z. Spinosa* and *N. retusa* which had the highest presence values within the study area. Thirty-two species were attributed to the desert ecosystem, 11 restricted to the coastal ecosystem and 2 species as ecotonal species. Based on data hitherto presented in this study, it is clear that the chemocotone is controlled by soil sodicity, soil texture fractions which played great role in distribution of the vegetation. Halophytes and xero-halophytes had high ability to accumulate in inorganic solutes. This gave them the advantage to tolerate the high soil sodicity. These helped the coastal halophytic species to grow in the ecotone. On the other hand, the xerophytic species was depended more on the organic osmolytes and compatible inorganic solutes ( $K^+$  and  $Ca^{2+}$ ). Therefore, the ability of xerophytic species to survive in the ecotone was associated with their ability to select potassium in a medium enriched with sodium.

**2012. El-Haty, M. M. Human Impact on the Vegetation of South Eastern Desert, Egypt. M.Sc. Thesis, Faculty of Science at Aswan, South Valley University.**

Eighty-three Angiospermic species were recorded in the present study belong to 27 families. Forty-one species are annuals, while forty-one species perennials and one is a parasite. Among the recorded species, thirteen species are monocotyledonous and seventy are dicotyledonous. Leguminosae is the largest family represented by sixteen species followed by Gramineae (twelve species). Both Compositae and Cruciferae are represented by six species, Zygophyllaceae by five species, followed by each of Asclepiadaceae, Boraginaceae, Chenopodiaceae by four species. Both Euphorbiaceae and Polygonaceae contain three species, each of Amaranthaceae, Caryophyllaceae, Tamaricaceae by two species, each of Balanitaceae, Capparaceae, Cleomaceae, Convolvulaceae, Cucurbitaceae, Cyperaceae, Geraniaceae, Liliaceae, Malvaceae, Orobanchaceae, Resedaceae, Umbelliferae and Urticaceae by one species. TWINSpan and DCA techniques were used to identify the community patterns of vegetation in the study area. Eighty-eight stands were classified by TWINSpan into sixteen vegetation clusters based on the similarity of species composition.

**2012. Galal, T. and Fahmy, A. Plant diversity and community structure of Wadi Gimal protected area, Red Sea Coast of Egypt. African Journal of Ecology 50: 266–276.**

The present study deals with the analysis of the floristic composition and plant diversity of Wadi Gimal protectorate. Its major aim is to identify community types and environmental factors that affect their growth and distribution. These quantitative data provide rangers with knowledge that is necessary for monitoring and managing plant communities within the protected areas, as well as restoration of vegetation-depleted habitats. Twenty-seven stands were selected along the length of Wadi and its tributaries. Thirty-five species were recorded in Wadi Gimal; with Poaceae as the dominant family and Phanerophytes dominating over other life forms. Saharo-Arabians were the predominant chorological element. Six vegetation groups were

recognized in Wadi Gimal *Zilla spinosa* (VGC) which inhabited the Wadi bed had the highest species richness, species turnover, relative evenness and relative concentration of dominance. *Capparis sinaica* (VGA) which inhabited the mountain slope had the lowest species richness, relative evenness and relative concentration of dominance, while *Salvadora persica* group had the lowest species turnover. *Phoenix dactylifera*–*Hyphaene thebaica* (VGF) which dominated the deltaic part of Wadi, had the highest salinity; whilst *Acacia ehrenbergiana* (VGE) which dominated the upper-stream part of the Wadi had the lowest value of salinity.

**2012. Khafagi, O. A., Hatab, E. E. and Omar, K. A. Challenges Towards *Hypericum sinaicum* Conservation in South Sinai, Egypt. *Jordan Journal of Biological Sciences*, 6 (2): 117 – 126.**

*Hypericum sinaicum* is one of the near-endemic plant species in Saint Katherine Protectorate (Found only in Sinai and Northwest Saudi Arabia). There are many challenges to the conservation of this species. The aim of this study is to: (1) identify and rank the different threats, and to identify their underlying root causes, as well as the barriers, affecting the conservation of the medicinal plants specially *Hypericum sinaicum* within the rich areas of SKP, and (2) compare and reassess documented by Assi (2007) in the same area. Some 237 circles with diameter 10 m were established to cover all environmental gradients with equal distance between each other. At each point we recorded all factors within the field that may become threat to the plant community. Results found that drought, feral donkeys and over-collection are the most harmful threats for *Hypericum sinaicum* in Saint Katherine Protectorate. Most of root causes come from lack of awareness, weak law enforcement, lack of suitable strategies, weak financial support and lack of stakeholders' cooperation.

**2012. Khafagi, O., Hatab, E. E. and Omar, K. Ecological Niche Modeling As a Tool for Conservation Planning: Suitable Habitat for *Hypericum sinaicum* in South Sinai, Egypt. *Universal Journal of Environmental Research and Technology*, 2 (6): 515-524.**

Prediction and mapping of potential suitable habitat for threatened and endangered species is critical for monitoring and restoration of their declining native populations in their natural habitat, artificial introductions, or selecting conservation sites, and conservation and management of their native habitat. We used technique called maximum entropy distribution modeling or Maxent for predicting potential suitable habitat for *Hypericum sinaicum*, a threatened and endangered species in Saint Katherine Protectorate (SKP), South Sinai, Egypt, using small number of occurrence records. Our objectives were to: (1) predict suitable habitat distribution for threatened herb *H. sinaicum* using a small number of occurrence records to inform conservation planning in Saint Katherine Protectorate; and (2) identify the environmental factors associated with *H. sinaicum* habitat distribution. Results showed that the environmental variable with highest gain when used in isolation is BIO9 (Mean Temperature of Driest Quarter). The approach presented here appears to be quite

promising in predicting suitable habitat for threatened and endangered species with small sample records, and can be an effective tool for biodiversity conservation planning, monitoring and management.

**2011. Abd El-Ghani, M., Abo El-Kheir, M., Abdel-Dayem, M. and Abd El-Hamid, M. Vegetation analysis and soil characteristics of five common desert climbing plants in Egypt. Turk J Bot 35: 561-580.**

This study is aimed to characterize Egyptian desert vine flora and compare it with that of deserts in other continents, such as Australia and North America. Specifically, 5 common climbing desert plants (*Citrullus colocynthis*, *Cocculus pendulus*, *Cucumis prophetarum*, *Pergularia tomentosa*, and *Periploca angustifolia*) were selected for this study. The floristic composition, vegetation heterogeneity, and chorological affinities of the associated species of the studied climbing plants were quantitatively analysed. In general, Leguminosae, Convolvulaceae, Cucurbitaceae, and Asclepiadaceae are the most species-rich families of the climbing plants in Egypt. The comparison of all desert climbing plants in Egypt to those found in the deserts of other continents (specifically, the Australian, Sonoran, and Chihuahuan deserts) revealed the same dominant plant families. The chorological analysis of the associated flora indicated the abundance of the Saharo-Arabian chorotype within the major growth forms. Classification of the vegetation associated with the 5 climbing plants yielded 4 vegetation groups, each linked to 1 or more of the studied climbing plants. Both DCA and CCA were used to assess the soil-vegetation relationships; results indicated that gravel, coarse sand, Na<sup>+</sup>, SO<sub>4</sub><sup>-2</sup>, Cl<sup>-</sup>, and NO<sup>-3</sup> were the most important factors for the distribution of the vegetation patterns of the studied desert vines.

**2011. Galal, T. Size structure and dynamics of some woody perennials along elevation gradient in Wadi Gimal, Red Sea coast of Egypt. Flora 206: 638–645.**

The population structure of 10 common woody perennials was investigated in terms of size distribution, height, diameter and density in Wadi Gimal along the Red Sea coast of Egypt. It was attempted to assess the effect of elevation on the size, distribution and density of the studied species. These species are: five trees (*Acacia tortilis* subsp. *raddiana*, *Acacia tortilis* subsp. *tortilis*, *Balanites aegyptiaca*, *Tamarix aphylla*, and *Tamarix nilotica*), two shrubs (*Leptadenia pyrotechnica* and *Nitraria retusa*) and three shrublets (*Pulicaria undulata*, *Zilla spinosa*, and *Zygophyllum coccineum*). The size estimations were then used to classify population into six size classes: 20–80 cm for shrublets, 100–500 cm for shrubs, and 2–10 m for trees. The absolute and relative frequency of individuals and mean height, diameter and height to diameter ratio per individual in each size class were determined. Density of occurrence of most species, except *B. aegyptiaca*, decreased as elevation increased. The height-to-diameter ratio was less than unity for most of the recorded species except *T. nilotica*. Several forms – including, positively and negatively skewed, inverse J-shaped, bell shaped and more or less J-shaped distributions – were recognized along the different elevations. The size structure of some species was positively related with soil variables, such as *T. nilotica*



with sulphate, while some others were negatively significant related to the substrate characteristics, such as *Z. spinosa* with salinity.

**2011. Khafaga, O., Hatab, E. E. and Omar, K. Predicting the potential geographical distribution of *Nepeta septemcrenata* in Saint Katherine Protectorate, South Sinai, Egypt using Maxent. *Academia Arena*, 3 (7).**

Accurate modeling of geographic distributions of species is crucial to various applications in ecology and conservation. Distribution data on threatened and endangered species are often sparse and clustered making it difficult to model their suitable habitat distribution using commonly used modeling approaches. We used a novel method called maximum entropy distribution modeling or Maxent for predicting potential suitable habitat for *Nepeta septemcrenata*, a threatened and endangered species in Saint Katherine Protectorate (SKP), South Sinai, Egypt, using small number of occurrence records. Our objectives were to: (1) predict suitable habitat distribution for threatened herb *Nepeta septemcrenata* using a small number of occurrence records to inform conservation planning in Saint Katherine Protectorate; and (2) identify the environmental factors associated with *N. septemcrenata* habitat distribution. Results showed that the environmental variable with highest gain when used in isolation is BIO19 (Precipitation of Coldest Quarter). The approach presented here appears to be quite promising in predicting suitable habitat for threatened and endangered species with small sample records and can be an effective tool for biodiversity conservation planning, monitoring and management.

**2010. El-Bana, M.I., Shaltout, K.H., Khalaf, A. and Mosallam, H. Ecological status of the Mediterranean *Juniperus phoenicea* L. relicts in the mountains of north Sinai, Egypt. *Flora* 205: 171-178.**

*Juniperus phoenicea* L. is listed as threatened tree by IUCN RedList. In Egypt, *J. phoenicea* L. is the only conifer tree that is restricted to the three mountains of northern Sinai: Gabal El-Halal, Gabal El-Maghara and Gabal Yelleq. As a Mediterranean relict, it has been included in a national list as target for conservation and management. To provide baseline information for the development to conservation strategy, the present study aims at comparing the isolated populations of *J. phoenicea* and their associated plant composition and diversity at the three mountains. The application of TWINSPLAN and DCA analysis techniques has resulted in identifying of four vegetation types associated with juniper, and each could be related to a specific geomorphologic habitat on a topographic gradient. *Chiliadenus montanus* and *Zygophyllum dumosum* characterized the slopes of smooth-faced rock outcrops in Wadi Abu Seyal (at 350–470 m altitude of Gabal El-Halal), *Deverra tortuosa*, *Ephedra aphylla* and *Gymnocarpos decander* inhabited together with the target species the soil pockets of north-facing slope in Neqeb Abu-Hamam (at 600–700 m altitude of Gabal El-Halal), *Stachys aegyptiaca* and *Moricandia nitens* characterized the juniper occurrences in the runnels of Wadi Arar (at 450–560 m altitude of Gabal El- Maghara), and *Artemisia herba-alba*, *Atriplex halimus* and

*Reaumuria hirtella* represent the stands on slope runnels (at 900–960 m of Gabal Yelleq). The two vegetation types recognized at Gabal El-Halal had, on average, the highest species diversity, juniper density and cover. Juniper shows generally poor conditions of vitality at higher elevation (600–960 m) with a higher proportions of old and recent dead trees, and with the predominance of male individuals, as compared with the populations of Gabal El- Maghara and Gabal Yelleq. In contrast, the juniper populations at lower elevation (350–470 m) of Gabal El-Halal proved to be in best condition with mostly living foliage and reproductive branches. The differences in rock types and elevation among the three mountains reflect serious limitation on recruitment of *J. phoenicea* due to moisture availability. The results of this study showed that this plant is an endangered species and its conservation in northern Sinai mountains is a priority. For a successful conservation of this community it is highly recommended to preserve in particular the suitable habitats at Gabal El- Halal, but also the others merit conservation measures.

**2010. Salama, F. M, Ahmed, M. K, El-Tayeh, N. A and Hammad, S. A. Vegetation analysis, phenological patterns and chorological affinities in Wadi Qena, Eastern Desert, Egypt. Afr. J. Ecol., 50: 193–204.**

The present study, which was conducted between 2009 and 2010, provides an analysis of the floristic composition, life forms, phenology, chorological spectrum and analysis of the vegetation in the deltaic part of Wadi Qena using multivariate analysis techniques. Twenty-five stands were sampled to represent, as much as possible, the vegetation variation in the study area. A total of 54 species (nineteen annuals and 35 perennials) belonging to 47 genera and nineteen families were recorded. The largest families were Fabaceae and Brassicaceae (nine and seven, respectively), Asteraceae and Poaceae (six for each), Chenopodiaceae (five), and Zygophyllaceae (four). Therophytes are the predominant life form (37%), followed by chamaephytes (24%), phanerophytes (18.5%), hemicryptophytes (9.3%) and cryptophytes (5.5%). Chorological analysis revealed that Saharo-Arabian (48%) and the Sudano-Zambeian (19.2%) chorotypes constitute the main bulk (67.2%) of the total flora of the studied area. The majority of the perennial species behave similarly to each other in their phenology, and usually perennials sprout at the end of February, become leafy in March, flower in April and produce fruits between April and July. Three main vegetation groups resulted from classification of the dominant vegetation. Canonical correspondence analysis revealed that magnesium, potassium and pH were the most effective soil variables.

**2010. Shaltout, K. H., Sheded, M. G. and Salem, A. I. Vegetation spatial heterogeneity in a hyper arid Biosphere Reserve area in north Africa. Acta Botanica Croatica 69 (1): 31-46.**

Ninety eight species of angiosperms belonging to 34 families were identified in Wadi Allaqi Biosphere Reserve (S. E. Egypt): 33.7% annuals and 66.3% perennials. The members of Leguminosae contributed 19.4% of the total flora, considering the most

dominant family in Wadi Allaqi. Three herbaceous species were recorded for the first time in this region: *Iphiona scabra*, *Chenopodium album* and *Lotus deserti*. Eight vegetation clusters were obtained and categorized into 4 distinct groups according to soil composition and chemical characteristics (concentration of bicarbonates, calcium, magnesium and chlorides), and intensity of inundation by the water of Lake Nasser.

**2009. Ali, H. E. Conservation of Plant Diversity of Serbal Mountain, South Sinai, Egypt. M. Sc. Thesis, Suez Canal University, Faculty of Science, Botany Department.**

Serbal Mountain is the most dramatic peak in Sinai and the fifth highest mountain in Egypt. A considerable percentage of its flora is categorized either as endemic species (e.g. *Anarrhinum pubescens*, *Hypericum sinaicum*, *Polygala sinaica*), extremely endangered species (e.g. *Ballota kaiseri*, *Muscari neglectum*), endangered species (e.g. *Buffonia multiceps*, *Kichxia acerbiana*), or vulnerable species (e.g. *Crataegus x sinaica*, *Bituminaria bituminosa*). It harbors many tree species which grow in hundreds (e.g. *Acacia tortillis*, *Colutea isertia*, *Pistacia khinjuk*) and many other which have medicinal importance (e.g. *Adiantum capillus-veneris*, *Hypericum sinaicum*, *Mentha longifolia*). Many disturbances due to human impact are recorded throughout the Serbal Mountain, including over-grazing, over-collection, feral donkeys, over-cutting for fuel wood, land conversion (construction of new settlements, infrastructure, cultivation areas and digging new wells), other land use, tourism, and solid wastes (due to urbanization and tourism activities). Each site may have its specific order of threats. These dangerous problems lead to destruction of natural habitats and the disappearance of plant communities in which many threatened species are found. In this study, Serbal Mountain is characterized by a high diversity of plant species. Hundred and fifty four species belonged to 44 taxonomic families and 118 genera were recorded. Flora of Serbal Mountain includes 25% annuals (37 species), 35% perennials (54 species), 19% frutescent (29 species), 16% shrubs (25 species), 3% trees (5 species) and 2% biennials (4 species). The recorded species in the 97 stands are 145 species including 11 endemic species and 8 near endemic species. The vegetation of Serbal Mountain is divided into eight vegetation assemblages recorded in the Serbal Mountain area dominated by *Pistacia khinjuk*, *Seriphidium herba-album*, *Colutea istria*, *Zilla spinosa* - *Heliotropium arbainense*, *Anabasis articulata*, *Acacia tortilis*, *Artemisia Judaica*, *Lycium shawii* and *Fagonia mollis*. The results of the diversity of Serbal Mountain revealed that Shaq Sha'arany gorge is the most diverse site due to its rugged conditions. The assessment of the conservation status of the recorded species revealed that 71 species are threatened (22 vulnerable, 36 species endangered and 13 critically endangered) which have to be protected from threats facing them. From the threatened species 8 are endemics (*Ballota kaiseri*, *Bufonia multiceps*, *Polygala sinaica*, *Origanum syriacum* subsp. *sinaicum*, *Anarrhinum pubescence*, *Hyoscyamus boveanus*, *Silene leucophylla* and *Silene schimperiana*), while 6 species are near endemics (*Galium sinaicum*, *Kickxia macilenta*, *Micromeria sinaica*, *Nepeta septemcrenata*, *Phagnalon sinaicum* and *Pistacia khinjuk*). At the end

of this study a conservation plan has been suggested for conserving the threatened, endemic and medicinal plant species.

**2009. Lovett-Doust, J., Hegazy, A., Hammouda, O. and Gomaa, N. Abundance-occupancy relationships and implications for conservation of desert plants in the northwestern Red Sea region. *Community Ecology* 10 (1): 91- 98.**

Abundance-occupancy relationships were determined for desert plants in the northwestern Red Sea region, at both the whole landscape, and individual habitat levels. Some 58 stands (having a total of 66 species) were studied, using ten quadrats (10 × 10 m<sup>2</sup>) per stand. The relation was positive and highly significant at both scales, but stronger at habitat level than across the regional landscape. Niche-breadth was estimated as the number of habitats occupied regionally by a species, and was significantly related to both abundance and occupancy. Niche breadth explained just 10.1% of variation in abundance but some 56.2% of variation in occupancy. Using empirical data, we tested whether those abundance-occupancy relationships diverged significantly from a theoretical null model. Relationships diverged significantly from the null model at both regional landscape and habitat levels. Applications of abundance-occupancy relationships for plant conservation showed that 36% of the species in the study region is at risk of extinction.

**2009. Hegazy, A., Hammouda, O., Lovett-Doust, J. and Gomaa, N. Variations of the germinable soil seed bank along the altitudinal gradient in the northwestern Red Sea region. *ActaEcologicaSinica* 29: 20–29.**

The variations in the size, composition and diversity of the germinable soil seed bank were studied along an altitudinal gradient in the northwestern Red Sea region. The standing vegetation and the germinable seed bank were studied in 58 stands distributed along the altitudinal range from sea level to coastal mountain peaks. The classification of the germinable seed bank by the two-way indicator species analysis (TWINSPAN) led to the recognition of five groups representing different altitudinal ranges. Detrended correspondence analysis (DCA) shows that these groups are clearly distinguished by the first two DCA axes. The results demonstrate significant associations between the floristic composition of the seed bank and the edaphic factors such as CaCO<sub>3</sub>, electrical conductivity, organic carbon and soil texture. Species richness, Shannon index of diversity and the size of the germinable seed bank show a hump-shaped curve along the altitudinal gradient, whereas evenness shows a weak increase with elevation increasing. Beta diversity of the seed bank declines with altitude increasing. The similarity between the standing vegetation and the seed bank approaches a U-shaped pattern along the elevation gradient. About 34.8% of the species that constitute the standing vegetation are vulnerable to elimination from the standing vegetation because they are not represented in the seed bank. Soil seed bank can be used for restoration of the vegetation at some of the degraded sites.

**2008. Hegazy, A., Hammoud, O., Lovett-Doust, J. and Gomaa, N. Population dynamics of *Moringa peregriana* along altitudinal gradient in the northwestern sector of the Red Sea. *Journal of Arid Environments* 72: 1537– 1551.**

*Moringa peregriana* (Forssk.) Fiori is a desert tree of economic and medicinal importance. Because of the severe drought and the over-exploitation of seeds and cutting of trees for firewood, the species is threatened. The survival, mortality and reproduction were studied for eight populations of *M. peregriana* distributed along the species altitudinal range (550–1000 m a.s.l.) in the northwestern sector of the Red Sea. Survivorship curves, life tables and fecundity schedules are constructed for the studied populations. Populations are dominated by adult individuals and the seedling recruitment is extremely limited. The survivorship curves approach Deevey type III in which the highest mortality occurs in the early life stages. The highest expectation for future life is exhibited by juveniles. The net reproductive rate (R<sub>0</sub>) ranges from 0.0023 to 0.0040. The intrinsic rate of increase per capita per year (r) varies between 0.121 and 0.081, suggesting that the populations are declining and their survival cannot be ensured without conservation measures. The plant density, seed output, average number of seeds per individual (bx), net reproductive rate (R<sub>0</sub>) and intrinsic rate of increase (r) of populations decrease significantly with elevation. The phenological development of *M. peregriana* is delayed with increasing altitude. The results indicated that the populations of *M. peregriana* in the northwestern sector of the Red Sea are threatened, in particular those located at the highest elevations of the species altitudinal range. Due to the very limited seedling recruitment, conservation efforts should be directed mainly to the established individuals. Efforts should be made to minimize the uncontrolled exploitation of the species by local people. *In situ* and *ex situ* conservation of *Moringa* populations are strongly recommended.

**2008. Shaltout, K.H., Sheded, M.G. and Salem, A.H. Phytomass prediction of some woody plants in Wadi Allaqi Biosphere Reserve, S-E Egypt. *Proc. 5th Inter. Conf. Biol. Sci. (Botany)*: 82-88.**

Size-phytomass relationships of three desert woody plants in Wadi Allaqi Biosphere Reserve, South-East Egypt [*Acacia ehrenbergiana* Hayne, *Acacia tortilis* subsp. *Raddiana* (Savi) Brenan and *Tamarix nilotica* (L.) Delile] were assessed using regression analysis. The application of this technique indicated that the volume of *Acacia ehrenbergiana*, *Acacia tortilis* subsp. *raddiana* and *Tamarix nilotica* is more closely fitted with the weight of their shoots and roots than the diameter or height. The volume also showed small variation between the actual and predicted weight of shoot and root systems; and thus can be considered as a better estimator for the phytomass of these plants. The over or under-estimation of the phytomass applying the logarithmic equations may be related to an error resulting from antilog transformation. The three investigated species have high height: diameter ratio (e.g. the plant tends to expand vertically more than horizontally). The root: shoot ratio is within the range of woody plants. The decrease of this ratio with the increase of size may be due to an increase of non-harvestable parts of the root system with the size increase.

**2007. Hegazy, A., Lovett-Doust, J., Hammouda, O. and Gomaa, N. Vegetation distribution along the altitudinal gradient in the northwestern Red Sea region. Community Ecology 8 (2): 151- 162.**

The distribution of plant communities and the pattern of species diversity were studied along an altitudinal gradient in the northwestern Red Sea region. A total of 58 stands were studied, using ten quadrats (10 m × 10 m) per stand. The classification of vegetation using the two Way Indicator Species Analysis (TWINSPAN) identified five groups representing different altitudinal ranges. Detrended Correspondence Analysis (DCA) clearly distinguished these groups by the first two DCA axes. Edaphic factors such as soil texture, CaCO<sub>3</sub>, organic carbon, and electrical conductivity contribute to the distribution of plant communities. Species richness, Shannon-index of diversity and evenness show a hump-shaped curve along the altitudinal gradient, whereas beta diversity decreases with elevation. Variation in the diversity and the distributional behavior of plant species and plant communities in the study area may be attributed to the change of water resources, climatic factors, edaphic variables and anthropogenic pressures along the elevation gradient. The implications of the results are discussed and recommendations are suggested for conservation and sustainable utilization of vegetation.

**2007. Heneidy, S and Waseem, M. Rehabilitation of degraded coastal Mediterranean rangelands using *Panicum turgidum* Forssk. Acta Bot. Croat. 66 (2): 161–176.**

*Panicum turgidum* Forssk. is a widely distributed species in the Egyptian desert. This species meets all criteria for a multipurpose plant and is capable of being used in the rehabilitation of degraded ecosystems. The paper presents the most suitable methods for the propagation of and testing the possibility and capacity of germination and growth of different populations of *Panicum turgidum*. Besides investigating the socioeconomic value of this species through the documentation and survey of its traditional uses, the study illustrates the importance of *P. turgidum* for the local inhabitants as a very important fodder plant, for both domestic and wild animals. The main benefit from propagating this plant is an increase in grazing potentialities and reduction of the use of artificial feed. The results of the present study show that individuals propagated by direct seed sowing attained the highest values of growth parameters, followed by those propagated by rhizomes, then those propagated by seedlings. The most suitable method for propagating it, in this region, is by grains and the best time is the first week of June. The results also show that *P. turgidum* populations collected from the eastern desert attained the highest germination percentage and maximum values of growth parameters upon cultivation. Thus, eastern desert populations are recommended as a good source of grains for rehabilitation programs.

**2007. Mosallam, H. Assessment of Target Species in Saint Katherine Protectorate, Sinai, Egypt. Journal of Applied Sciences Research, 3 (6): 456-469.**

Sinai Peninsula has the geographical importance and uniqueness of being the meeting place of Asia and Africa. One hundred and twenty-four species, belonging to 108 genera and 42 families were tabulated in Saint Katherine protectorate which is the only entirely terrestrial protectorate in Sinai Peninsula. Forty-seven of the recorded species were the target species of medicinal plant conservation project, of which eleven endemic species. Asteraceae has the highest contribution of the total flora (15.3%), followed by Lamiaceae (10.5%), Caryophyllaceae (8.1%), Poaceae (7.3%) and each of Brassicaceae and Fabaceae (5.7%). With regard to their habitats, they could be arranged into 11 groups, of which rocky and stony are the most represented. Fortunately, two new enclosures were monitored for the first time in wadi Abu-Tweita. Thirty-five percent of the target species were found inside these two enclosures. Fifteen locations of soil characteristics supporting most of the target species at St. Katherine protectorate were analyzed. Significant differences in soil variables were detected among the 15 localities in several soil attributes, like pH, clay, Mg, K, sand and gravel, respectively. Forty-seven species were protected inside 48 permanent enclosures (37 old, 9 new and the two first-time monitored enclosures) were selected throughout St. Katherine protectorate to represent the different environmental habitats in fifteen locations. These species are 2 geophytes (*Adiantum capillus-veneris* and *Equisetum ramosissimum*), of which 50% is pluri-regional, 4 phanerophytes (*Cotoneaster orbicularis*, *Crataegus x sinaica*, *Moringa peregrine* and *Pistacia khinjuk*), of which 50% is pluri-regional and 25% is endemic, 5 therophytes (*Bufonia multiceps*, *Caylusea hexagyna*, *Plantago sinaica*, *Primula boveana* and *Silene linearis*) of which 40% is bi-regional, 20% is mono-regional and 20% is endemic. Thirty six chamaephytes, of which 30.6% is mono-regional, 27.8% is bi-regional, 25% is endemic and 8% is pluri-regional. The size distribution of 20 species among the target species approximate one of the 6 following size distributions: 1) more or less inverse J-shaped distribution, 2) positively skewed distribution towards the small individuals, 3) more or less J-shaped distribution, 4) bell shaped distribution, 5) bimodal size distribution and 6) stationary size distribution.

**2006. Salem, A. H. I. Demographic Study on the Woody Vegetation in Wadi Al-Allaqui, South-East, Egypt. M. Sc. Thesis, Faculty of Science, South-Valley University at Aswan, 180 pp.**

The aims of the present study are: to analyze the dynamics of the woody plant populations in Wadi Allaqi (South East, Egypt) through demographic survey of these woody plants; to assess the relationships between size variables of the studied species and the weights of their organs; and to generate regression equations for predicating the phytomass components of these plants using the non-destructive techniques. This study is of special importance for the populations of trees and shrubs that are continuously subjected to overuses, cutting, overgrazing and other constraints. According to TWINSPAN classification of the surveyed stands, 8 clusters of stands similar in terms of their vegetation, are objectively identified. Ninety eight species of angiosperms belonging to 34 families were identified in the study area: 33.7 % annuals

and 66.3 % perennials. There is approximately perfect relationship between the size and age of *Acacia ehrenbergiana*, *Acacia tortilis* subsp. *raddiana* and *Tamarix nilotica*. The size frequency distribution of *Acacia ehrenbergiana*, *Tamarix nilotica*, *Salsola imbricata* and *Leptadenia pyrotechnica* populations were either inverse J-shaped or positively skewed size frequency distribution which may represent rapidly-growing population with high reproductive capacity. On the other hand, *Acaciatortilis* subsp. *raddiana*, *Calotropis procera*, *Acacia tortilis* subsp. *tortilis* and *Balanites aegyptiaca* have a tendency towards the J-shaped or negatively skewed distribution which characterized the declining populations (because the population has a large proportion of larger individuals than the smaller ones; i.e. limited regeneration capacity). In the present study, the habitats of midstream and downstream parts of Wadi Allaqi had the highest total phytomass of *Acacia ehrenbergiana*. On the other hand, a medium to low phytomass of this plant is recorded in the midstream part. It is worth mentioning that the downstream part of Wadi Allaqi has the highest total phytomass of *Tamarix nilotica*. *Acacia tortilis* subsp. *raddiana* is considered as one of most threatened species in Wadi Allaqi due to the widespread uses.

**2006. Abd El-Ghani, M. and Abdel-Khalik, K. Floristic Diversity and Phytogeography of the Gebel Elba National Park, South-East Egypt. Turk J Bot 30: 121-136.**

The floristic composition and phytogeographical analysis of the Gebel Elba National Park in the south-east corner of Egypt were studied using multivariate analysis techniques. Its flora was poorly documented; therefore, 5 recent expeditions between 1998 and 2004 were carried out, which resulted in the collection of 179 species that belong to 51 families. Six major wadis (sites) were investigated to cover adequately the territory of the Park (35,600 km<sup>2</sup>) and to attain a complete inventory of its vascular flora as possible. The floristic composition and species diversity among the wadis showed variations in species richness, yet W. Yahameib was the most diversified. The most species-rich families were Compositae (12%), Leguminosae (9%), Gramineae (6.7%), Caryophyllaceae, Convolvulaceae and Euphorbiaceae (4.4% for each). This study revealed that the Gebel Elba Park is more diverse compared with other, well-studied phytogeographic territories in Egypt. Ninety-two species (51.4%) demonstrated a certain degree of consistency, where they were exclusively recorded in or confined to a certain wadi (site) or group of wadis. The life-form spectrum was dominated by therophytes, denoting a typical arid desert flora, while phanerophytes, chamaephytes and hemicryptophytes were of equal importance. The distribution of the phytogeographic elements in the distinguished life-form categories showed the prevalence of the Saharo-Arabian geoelement (48%), whereas the Sudano-Zambezian and Mediterranean geo-elements ranked second, with 19.6% and 14 %, respectively. Therefore, the Gebel Elba Park represents a continuation of the Sudanian tropical region, which still needs further intensive study. A very special study undertaken to examine the diversity-altitude relationships along an altitudinal gradient in W. Yahameib revealed that the highest diversity occurred at middle altitudes on the mountain, which may be more typical of arid mountains in desert regions.



**2006. Andersen, G. How to detect desert trees using CORONA images: Discovering historical ecological data. Journal of Arid Environments 65: 491–511.**

Lack of appropriate historical data has seriously impeded research into the extent and effects of deforestation in arid lands, but the declassification of CORONA satellite images has now made it possible to study long-term changes in arboreal vegetation. The potential and limitations of such images for long-term vegetation studies are scrutinized in the light of this research. High-resolution images (ca. 2.7 m) from 1965 are compared to field data (2003) of individually mapped wadi trees (*Acacia tortilis* and *Balanites aegyptiaca*) from 20 different sites in the Eastern Desert of Egypt. Of trees mapped in 2003 (canopy area CA 46 m<sup>2</sup>) 70% was detected in the imagery. A spatial classification shows that between 9% and 55% of the population was concealed by landscape elements that reduce image contrast. The study indicates that 97% of the population mapped in 2003 was already present in 1965 and that trees grow slowly and are older than previously assumed. Pollarded trees were detected in the imagery, and the resultant reduction in CA may lead to misinterpretations in change analyses.

**2005. Guenther, R., Gilbert, F., Zalat, S., Salem, K. and Volunteers of Operation Wallacea in Egypt. Vegetation and Grazing in the St. Katherine Protectorate, South Sinai, Egypt. Egyptian Journal of Biology, 7: 55-66.**

Plants were surveyed in the St. Katherine Protectorate of South Sinai, Egypt. The most frequently recorded plant species include: *Artemisia herba-alba*, *Artemisia judaica*, *Fagonia arabica*, *Fagonia mollis*, *Schismus barbatus*, *Stachys aegyptiaca*, *Tanacetum sinaicum*, *Teucrium polium* and *Zilla spinosa*. Dominant plant families were Compositae, Graminae, Labiatae, and Leguminosae. Communities with a high grazing pressure had a lower overall plant vigour. A strong negative correlation was found between plant vigour and grazing pressure. Twelve plant families showed heavy grazing pressure, including Resedaceae, Caryophyllaceae, Polygalaceae, Juncaceae, Solanaceae, Geraniaceae, Ephedraceae, Globulariaceae, Urticaceae, Moraceae, Plantaginaceae, and Salicaceae.

**2004. Shaltout, K. H., Al- Sodany, Y. M., Sheded, M. G. and El-Kady, H. F. Vegetation analysis of the Egyptian Red Sea coastal land. Taeckholmia 24 (1): 1-20.**

The present study identifies 11 vegetation groups (i.e. plant communities) along the Egyptian Red Sea coastal plain. These groups are: *Panicum turgidum*, *Zygophyllum coccineum* – *Zilla spinosa*, *Zilla spinosa*, *Zygophyllum coccineum* – *Limonium axillare*, *Fagonia indica*, *Avicennia marina*, *Acacia tortilis* subsp. *raddiana* – *Zilla spinosa*, *Juncus rigidus*, *Zygophyllum album* – *Nitraria retusa*, *Balanites aegyptiaca* and *Salvadora persica*. The vegetation groups that inhabit the wadi beds occupy the negative part of the DECORANA axis 1 and those that inhabit the mangroves and wet habitats occupy the extreme positive part of the same axis. This study indicates also that the *Salvadora persica* group had in general low species diversity, while that of

*Zygophyllum coccineum* – *Zilla spinosa* had the highest species diversity. These results were discussed and compared with the previous related studies. A scheme was suggested for the successional relationships between the identified plant communities.

**2003. Shaltout, K. H., Sheded, M. G., El-Kady, H. F. and Al- Sodany, Y. M. Phytosociology and size structure of *Nitraria retusa* along the Egyptian Red Sea coast. *Journal of Arid Environments* 53: 331-345.**

The present study aims at analyzing the phytosociological behavior and size structure of *Nitraria retusa* (Forssk.) Asch shrub along the Egyptian Red Sea coast in relation to the prevailing environmental gradients. The application of TWINSPLAN and DCA multivariate techniques led to identifying five vegetation groups associated with the distribution of this plant in this region. These groups are named after their characteristic species as follows: *Typha domingensis*, *Zygophyllum coccineum*–*Zilla spinosa*, *Tamarix nilotica*–*Zilla spinosa*, *Nitraria retusa*–*Zygophyllum album* and *Nitraria retusa*. The two groups of *Nitraria retusa* had, on average, the lowest species diversity and their stands had the highest soil salinity and clay contents. In general, the population of this plant is characterized by relative preponderance of the small-sized individuals (i.e. juveniles), particularly in the sites of medium positions along the prevailing salinity gradient. On the other hand, the juveniles are highly stressed in the stands of hypersalinity. The negative relationship between the density and size of this plant suggests that its size is density-dependent.

**2002. Kamel, W., Gazar, M., Zalat, S. and Gilbert, F. Flora of St Katherine Protectorate: key to families and genera. *Egyptian Journal of Biology*, 4: 45-75.**

An illustrated key to families and genera of the flora of St Katherine Protectorate is provided to facilitate the identification of the unique flora of the area, based on five years of collecting mainly in the mountains and wadis surrounding the town of St Katherine. The key includes 43 families and 141 genera. The families represented by largest numbers of genera in the protectorate are: Compositae (15 genera), Labiatae (11), Leguminosae (10) and Boraginaceae (9).

**2000. Marie, A. M. A model for the use of GIS in vegetation mapping of a phytogeographical region in Egypt. Ph.D. Thesis, Faculty of Science, Al- Azhar University.**

The present study is an attempt to apply the GPS and GIS methodology in geographical methodologies of vegetation mapping as well as vegetation analysis of the main plant communities in the isthmic desert. It has been chosen as it is geographically, geomorphologically and climatologically distinct from all other sub regions of Da in Egypt. Generally, the climate of the isthmic desert is characterized by extreme aridity and high temperature. Regarding physical soil analysis of the 76 stands taken during the visits, it is evident that there are 14 stands which are gravely and 14 stands with medium gravel. These 28 stands represent the gravely plains of the isthmic desert. However, there are 16 stands with coarse and fine sand which represent the

sandy plains of the area. Nevertheless, the remaining 32 stands represent the calcareous plains which are the fans, wadi – beds and terraces of the wadis of the study area. Regarding the chemical analysis of the studied stands, their TSS, pH, organic carbon, Cl, SO<sub>4</sub>, K<sup>+</sup>, Na<sup>+</sup>, Ca<sup>++</sup> and Mg<sup>++</sup>, are remarkably variable depending on the habitat type. Results of CO<sub>3</sub> contents are obvious within the area, they showed definite variation depending on the habitat type of the studied stands, indicating that CO<sub>3</sub> plays a major role in the distribution of species and their communities in our Egyptian desert areas. Regarding the vegetation analysis of the 76 stands taken during the visits, results revealed definite plant communities representing the landscape in each stand of the isthmic desert. However, the use of GPS system of collecting data that are used in GIS system of analysis revealed 42 maps which clarify distribution of the characteristic species in their habitat types.

## 2.3-Western Desert and Oases

**2016. Abbas, M. S., Afefe, A. A., Hatab, E. E. and Gaber, E. I. Vegetation-Soil Relationships in Wadi El-Rayan Protected Area, Western Desert, Egypt. Jordan Journal of Biological Sciences, 9 (2):97 – 107.**

The present study provides an analysis of the soil and vegetation composition at 10 sites in Wadi El Rayan Protected Area and concentrates on the environmental factors that affect plant species distribution. A total of 17 vascular plant species belonging to 13 botanical families was recorded. Poaceae, Chenopodiaceae, and Zygophyllaceae were the largest families identified. Chorological analysis revealed that 47% of the studied species are Pluri-regional, 41% are Bi-regional and 12% are Mono-regional. The recorded species extend their distribution all over the Saharo-Arabian (33%) followed by Irano-Turanian (24%), Mediterranean (22%), Palaeotropical (8%), Sudano-Zambezian (5%), Neotropical (5%), and Euro-Siberian (3%). The life-form spectrum revealed that the phanerophytes (35%) and geophytes-helophytes (23%) are the most frequent, followed by chamaephytes (18%), therophytes (12%), hemicryptophytes (6%), and helophytes (6%). The dominant species were *Phragmites australis*, *Tamarix nilotica* and *Zygophyllum album*; while the co-dominant species were *Juncus rigidus*, *Nitraria retusa*, *Alhagi graecorum*, *Typha domingensis*, *Zygophyllum coccineum* and *Eucalyptus camaldulensis*. Variation in species diversity among different locations were evident, the Northeast of the Lower Lake (9 species), followed by the Southwest of the Lower Lake and the Northeast of the Upper Lake (6 species each) showed highest species richness. The Southeast of the Lower Lake showed the lowest recorded species richness (one species). Detrended Correspondence (DCA) and Canonical Correspondence Analyses (CCA) were used to examine the relationship between the vegetation and soil parameters (pH, electric conductivity, CaCO<sub>3</sub>, organic matter and relative concentrations of cations). CCA analysis showed positive correlations of species with sites along the most important ecological gradients. Both ordination techniques indicated the importance of these ecological factors on the distribution of the vegetation pattern in the area.

**2016. Afefe, A. A., Hatab, E. E., Abbas, M. S. and Gaber, E. I. Assessment of Threats to Vegetation Cover in Wadi El Rayan Protected Area, Western Desert, Egypt. International Journal of Conservation Science, 7 (3): 691-708.**

Wadi El Rayan is located in the African Sahara eco-region of the Palearctic eco-zone, the world's largest hot desert. The total area of Wadi El Rayan is 1759 km<sup>2</sup>. The objective of the present study is to enrich the knowledge on the vegetation cover along the shores of Wadi El Rayan lakes and to identify the different threats, underlying causes and recommended solutions for the conservation of natural vegetation cover in Wadi El Rayan Protected Area (WRPA). Based on field surveys, we found that current pressures of human activities on natural vegetation include overgrazing, irresponsible tourism, land encroachment, water pollution, water over-use, fire, and habitat change and destruction. The reduction of water levels due to decreased water incoming is

considered the main threat facing ecosystems and biodiversity in the lakes area. We found that the perimeter of the lower lake has decreased from 48.6 km<sup>2</sup> in 2007 to 34.1 km<sup>2</sup> in 2013 (a loss of 29.8 % of the total lake area), due to lake decreased water level. The most underlying causes of vegetation loss in the study area were found to be the lack of awareness, weak law enforcement, lack of suitable strategies, weak financial support and lack of stakeholders' cooperation. Survey results show that vegetation cover in the area of the connecting channel and northeastern of the lower lake represents the highest impacted area by human pressures compared to other locations. Moreover, the role of WRPA is important in achieve good cooperation between governmental authorities, local community, and owners of different economic activities and in finding new ways to improve potential future cooperation with other stakeholders. We also provide some suggested activities for conserving vegetation cover in WRPA.

**2015. Abd El-Ghani, M. and Hamdy, R. Habitat diversity and floristic analysis of Wadi El-Natron Depression, Western Desert, Egypt. *Phytologia Balcanica* 21 (3): 351 – 366.**

Despite the actual desertification in Wadi El-Natron Depression nitrated by tourism and overuse by nomads, 142 species were recorded. Sixty-one species were considered as new additions, unrecorded before in four main habitats: (1) croplands (irrigated field plots); (2) orchards; (3) wastelands (moist land and abandonedsalinized field plots); and (4) lakes (salinized water bodies). The floristic analysis suggested a close floristic relationship between Wadi El-Natron and other oases or depressions of the Western Desert of Egypt.

**2015. Shaltout, K.H., Hosni H.A., El-Fahar R.A. and Ahmed D.A. Flora and vegetation of the different habitats of the western Mediterranean region of Egypt. *Taekholmia* 35: 45-76.**

The present study aims to assess the relation between the floristic composition and the different habitats characterizing the western Mediterranean region of Egypt, determine the community types that dominate the study area; and evaluating the rarity of the recorded species. Nine hundred and sixty eight species (belonged to 429 genera and 97 family) were recorded; 363 species were restricted to one habitat, while only one species occurred in all the 13 habitats. Asteraceae had the highest contribution, followed by Fabaceae, Poaceae and Brassicaceae. The most represented life form was therophytes, while parasites were the least. Six habitat groups were resulted after the application of TWINSPAN and DCA. Mediterranean elements were the most represented, followed by Irano-Turanian, but Sudano- Zambezian elements were the least. Twenty endemics and 21 near endemic species were recorded. Species which had small geographical distribution, narrow habitat specificity and were non-abundant (SNN) were the most represented, while species that had large geographical distribution, wide habitat specificity and non-abundant (LWN) were the least. Forty one species were recorded as introduced species in the study area. The recent land use

led to the emergence of new invasive species, which may severely affect the plant diversity and community structure of the study area.

**2014. Ahmed, D. A., Shaltout, K. H. and Kamal, S. A. Mediterranean sand dunes in Egypt: threatened habitat and endangered flora. Life Science Journal 11 (10): 946-956.**

The present study aims at assessing the flora and vegetation of the Western Mediterranean sand dunes, a threatened habitat in North Egypt. It aims also to evaluate the threats upon species and habitats in the study area. One hundred and ten species were recorded, therophytes were the most represented life form followed by chamaephytes, while parasites were the least. one endemic (*Zygophyllum album*) and four near endemics (*Centaurea alexandrina*, *Centaurea glomerata*, *Onopordum alexandrinum* and *Plantago crypsoides*) were recorded, in addition to 9 species of unique occurrence to this habitat in the study area. Two trends of multivariate analysis (TWINSPAN and DCA) were applied to the floristic composition of 124 stands and led to identify 24 vegetation groups at level six and 8 vegetation groups at level three: group I (*Echinops spinosus* - *Launaea fragilis* subsp. *fragilis*) characterized the partially stabilized dunes, groups II (*Echinops spinosus* - *Allium erdelii*) and V (*Echinops spinosus* - *Thymelaea hirsuta*) in the stabilized dunes, group III (*Ammophila arenaria* - *Ononis vaginalis*) in the embryonic dunes and group IV (*Crucianella maritima* - *Erodium crassifolium*) in the coastal ridges. In addition, group VI (*Launaea nudicaulis* - *Thymelaea hirsuta*) characterized the embryonic and stabilized dunes as well as the salt affected parts, group VII (*Lygeum spartum* - *Nitraria retusa*) in the partially stabilized dunes, salt affected parts and coastal ridges and group VIII (*Ammophila arenaria* - *Crucianella maritima*) in the embryonic and stabilized dunes and the coastal ridges. Ninety two species suffer from at least one type of threats, 66 species suffer from habitat loss due to the construction of summer resorts, 64 species from over-collecting and over-cutting to be used for medicinal and fuel purposes, while only 10 species suffer from disturbance by cars or trampling. On the other hand, 10 species suffer from one type of threats, 29 species from two threats, 31 species from three threats, while only three species from six types of threats.

**2012. Hamed, A. B. Floristic analysis and vegetation structure of Wadi El-Natron Area: Western Desert, Egypt. M. Sc. Thesis, Cairo University, Faculty of Science, Department of Botany Taxonomy and Flora.**

Wadi Elnatron considered among the important depressions in the Western Desert for land reclamation and utilization. Altogether 142 species belonging to 108 genera in 35 families were recorded in this wadi. The species-rich families were: Gramineae (35), Compositae (17), Chenopodiaceae (11) and Cruciferae (9). Chorological analysis revealed that the widely distributed species belonging to cosmopolitan.

**2011. Abd El-Ghani, M., Bornkamm, R., El-Sawaf, N. and Turkey, H. Plant species distribution and spatial habitat heterogeneity in the landscape of urbanizing desert ecosystems in Egypt. Urban Ecosystem 14: 585–616.**

Information on the urban flora and vegetation in the industrial new cities in Egypt are insufficient and far from complete. For this reason, this study was undertaken as the first attempt to fill this gap of knowledge. For two successive years (2004 and 2005), a reconnaissance survey was conducted in four new industrial cities: 6<sup>th</sup> October, El-Sadat, Burg El-Arab and 10<sup>th</sup> Ramadan; aiming at: (1) recognizing the floristic composition and vegetation structure of each of the studied cities; (2) identifying the main urban habitats dominating the studied cities; (3) comparing the vegetation of the urban habitats at the boundaries of each city, where desert soil merges gradually with the agricultural land, with that at its centre (purely agricultural land); and (4) analyzing, quantitatively, the vegetation groups (plant communities) that characterize the urban habitats. A total of 189 permanent stands in the four cities were selected to represent the apparent variation in the different habitats. These stands were distributed as follows: 49 in 6<sup>th</sup> October, 37 in El-Sadat, 45 in Burg El-Arab, and 58 in 10<sup>th</sup> Ramadan. Altogether, 305 species of the vascular plants constituted the main synanthropic flora and the total number of species varied from 171 in Burg El-Arab, 157 in 10<sup>th</sup> Ramadan, 144 in Sadat and 132 to 6<sup>th</sup> October. The largest families that formed the main bulk of the recorded flora were Gramineae, Compositae, Leguminosae, followed by Euphorbiaceae, Chenopodiaceae, Cruciferae, Cyperaceae, Umbelliferae and Solanaceae. Five main urban habitats (from inner city toward outskirts) were distinguished: lawns, home gardens, public gardens, waste lands and desert outskirts. The most species-rich habitat was the waste lands (172 species), while the total number of species varied from 104 in the lawns and 113 home gardens, to 123 in the desert and 133 in the public gardens. Generally, the recorded synanthropic flora within the five main urban habitats can be classified into: (1) cultivated plant species that included ornamentals, hedges, shade plants, fodder plants, vegetables and fruits; (2) canal banks, salinized area sand wetland plants; (3) xerophytic plants of the outskirting desert; and (4) weeds of arablelands. Application of multivariate analyses techniques to 4 floristic data matrices yielded 22 TWINSpan vegetation groups in the cities, and 26 in the five habitats, clearly separated along the first two axes of DCA.

**2011. Khatab, K. A. Molecular diversity and chemoecology of *Haplophyllum tuberculatum* (Forssk.) A. Juss. (Rutaceae) in the Western Mediterranean coastal desert of Egypt. M.Sc. Thesis, Faculty of Science, Alexandria University.**

The present study reported that the application of three different approaches to the study of diversity within *Haplophyllum tuberculatum* (Forssk.) A. Juss. (Rutaceae) was highly accepted. These approaches are macro- and micro-morphological characters, molecular markers (seed storage protein (SDS-PAGE) and RAPD) and allelopathy as a chemical marker. Twenty-seven OTUs representing nine growth forms (GF1-GF9) of *Haplophyllum tuberculatum* were collected from six natural sites along the Mediterranean coastal desert of Egypt (from Alex to Matruh). The collected specimens were selected in order to cover the most dominant habitats within the range of genus

distribution. The investigated OTUs were subjected to cluster analysis based on 44 morphological, 44 anatomical and 114 molecular characters. It is notable that all OTUs that are collected from the same population are grouped together in the dendrogram before any joining with OTUs from other populations, which implies that the studied habitats are real entities. The following points can be concluded from the present study: 1- *H. tuberculatum* OTUs can be discriminated into two ecotypes, ECT7 (which collected from Abo-Tamr village) and the rest of the studied ecotypes; 2- ECT7 was characterized by some morphological variables and also was distinguished molecularly with high percentage of polymorphism and number of specific bands (4); 3- *H. tuberculatum* electro-phenogram resulted from seed bulked samples of the same ecotype was uniform to some extent with minor level of diversity. In spite of that, ECT3 and ECT4 were separated from the other ecotypes. The seed protein profiling of the studied populations reveals 8 common bands, which can be used as fingerprints. In the meantime, the collected samples reveal relatively low level of polymorphism (ranges from 0 to 11%) and consequently low level of genetic diversity which denotes that this species is probably in its way to extinction; and 4- three different ecotypes (ECT3, ECT5 and the rest of the studied ecotypes) were allelopathically distinguished using allelopathy as a chemical marker. The allelopathic effect is prominent in *Lepidium sativum* compared with *Raphanus sativus* indicating the resistance of the latter to the allelochemicals extracted from *H. tuberculatum* aqueous extract ecotypes.

**2010. Ahmed, M. A. Vegetation of South Western Desert, Egypt. Ph. D. Thesis, Faculty of Science at Aswan, South Valley University.**

Seventy-nine Angiosperm species were recorded in the present study belong to seventy-one genera and twenty-five families. Fifty-four species are (including one hydrophyte) and twenty-five species are perennials. Twenty-four species are monocotyledonous and twenty-five species are dicotyledonous. Graminae is the largest family represented by seventeen species followed by leguminosae with seven species. Both Compositae and Chenopodiaceae were represented by six species each, Cyperaceae by five species, cruciferae by four species and each of Amaranthaceae and Palmae by three species. Each of Solanaceae, Euphorbiaceae, Boraginaceae and Polygonaceae comprise two species. The families with only one species are: Portulacaceae, Resedaceae, Haloragidaceae, Malvaceae, Juncaceae, Molluginaceae, Convolvulaceae, Cuscutaceae, Capparaceae, Typhaceae, Cucurbitaceae and Primulaceae. TWINSpan and DCA techniques were used to identify the community patterns of vegetation in the study area: 124 stands were classified by TWINSpan into 11 vegetation clusters based on the similarity of species composition.

**2010. Ahmed, H. T. Synanthropic vegetation and plant species diversity in the urban environment of some new cities in Egypt. Ph. D. Thesis, Cairo University, Faculty of Science, Department of Botany and Microbiology.**

Information on the urban flora and vegetation in the industrial new cities in Egypt are insufficient. For this reason, this study was undertaken as the first attempt to fill this



gap of knowledge. For two successive years (2004 and 2005) A reconnaissance survey was conducted in four new industrial cities 6<sup>th</sup> October, Elsadat, Burg Elarab and 10<sup>th</sup> Ramadan.

**2009. Youssef, A., Morsy, A., Mossallam, H. and Abd Al-Latif, A. Vegetation analysis along Alamain- Wadi El- Natrun Desert Road. Australian Journal of Basic and Applied Sciences, 3 (1): 167-176.**

This work was conducted along Alamain - Wadi-El Natrun desert road of the western desert in Egypt. The study area extends about 133 km from Marina – Alamain (on the Mediterranean coastal region) in the north to Wadi El-Natrun in the south. The main objective was to investigate the effect of environmental characteristics on the importance value indices and size structure of species and density per hectare. In the two different studied habitats: 1) sandy flat and 2) non-saline depression habitats. The phytosociological study of this road was based on the analysis of vegetation in 50 stands using Braun-Blanquet technique. Out of fifteen perennial species along the study area, three species named *Cornulaca monacantha*, *Artemisia monosperma* and *Anabasis articulata*, had higher species density, respectively. The sandy flat habitat indicated the highest density of *Artemisia monosperma* and *Asphodelus microcarpus* species (1740 and 1567 ind./ha, respectively), while in the non-saline depression habitat, *Fagonia glutinosa* had the lowest population density (125 ind./ha). Data of the present study revealed that annuals had the highest contribution than perennials. Regarding the life form spectra, therophytes have the highest records of 43%. *Anabasis articulata* recorded the highest IV and frequency values (49.3 and 60 %).

**2006. El-Kenany, E. Phenotypic plasticity and genetic differentiation between ecological populations of *Polygonum equisteforme* Sibth & Sm. in Egypt. Ph. D. Thesis, Faculty of Science, Alexandria University.**

The main objectives of this study is to provide some clue on how the different populations of the studied species respond to different environmental conditions, which plant populations of the different geographical areas show more plasticity in response to various environmental conditions, how do local adaptation and individual tolerance contribute to the distribution and abundance of the study species and how fast do plants from different habitats reach reproductive maturity when cultivated. Results obtained from the preliminary germination experiments of the seeds collected from different sampled sites, exhibited high germination percentages at 15°C, which seems to be similar to the temperature favored for the germination of seeds in the natural habitat. The germination percentages of the seeds in three tested soil types (sand, clay or mixture of both) showed that the soil mixture is the best choice which is supported by the high germination percentages obtained in most of the cases. It is worth to mention that measures of many attributes of wild populations of both Nile Delta and north Sinai sections have approximately similar trends (e.g heights of plant, lengths of branch and lengths of internode). However, in most cases, of the above measured attributes showed higher values than those of the two provinces of the western section. The present study points out many important remarks of which:

population of Nile Delta section is considered the one with the most plastic response among different conditions. Seed size and reserve of *Polygonum equisetiforme* are environmentally induced rather than genetically fixed characters. Meanwhile, similarity in the protein pattern in the analyzed samples of *Polygonum equisetiforme* suggests the absence of genetic variation within different individuals collected from different geographical areas and reveals that the protein pattern of the study species tends to be a genetically fixed character rather than affected by the environment. The present study illustrated that there was a plastic response in the timing of flowers production for the plants of the *ex-situ* experiments, which was a month earlier compared to the wild populations to ensure faster reproduction and complete life history in the new environment. Meanwhile, wild individuals produce a large number of flowers to encounter numerous interacting stresses for survival. Variability in the geographical distribution of *Polygonum equisetiforme* could reflect the varied capacities of its populations to maintain performance and reproductive fitness under diverse environmental conditions. The present study also showed that the individuals of *polygonumequisetiforme* allocate resources as a support for vegetative growth rather than reproductive output in the successive progenies in response to *ex-situ* cultivation. Study of anatomy revealed that anatomical structure and arrangement of tissues and layers in *polygonumequisetiforme* are probably genetically fixed as they exhibited the least change affected by environmental changes.

**2006. Salem, B. and Waseem, M. A study on Moghra oasis by remote sensing. Assiut Univ. J. of Botany 35 (2): 337- 367.**

Six major land cover classes, representing the most prevailing land cover types in Moghra oasis was distinguished using the unsupervised classification for the satellite image of the oasis. Most of the study area is covered by dry salt marshes and sand dunes covering an area of about 565.5 ba accounting for about 40.1% of the total area represented in the classified image. These land cover classes were found to represent nine major habitats in which the plant communities were combined. These habitats support the growth of about 22 species, 9 of which were newly recorded in the present study. All species are perennial, belonging to 14 families, half of which belong to family Graminae, Chenopodiaceae and Compositae. These species related to 3 different life- forms, the majority of which are chaemaephytes (54.6 %), while the remaining 54.6 % are either geophytes or phanerophytes. About half of the species recorded are vulnerable to endangered in conservation status, this highlights the need for extensive efforts to limit the threats exerted on these species especially from grazing pressure. Sand dune slopes habitat was found to support the largest number of species compared to the other habitats (11 species) and hence it attained the largest cumulative average conservation value, followed by the salt marches. Any future efforts for conservation should focus on the sand dune slopes and salt marches habitats of Moghra oasis as priority which is subjected to some environmental threats. The main threats are represented in the grazing pressure exerted on its vegetation cover, particularly during the period from May to October each year.

**2005. Baayo, K. A. Phytosociological and floristic studies on Sallum Area, Egypt. Ph.D. Thesis, Assiut University, Faculty of Science, Botany Department.**

The present study deals with the floristic analysis, vegetation composition and its relation to environmental variables in the Sallum area along the Mediterranean coastal land of Egypt. The study area lies between 25° 07' -26° 17' of the Eastern longitudes and 31° 36' - 31° 14' of the Northern latitudes, and extends for about 121.5 km from Sallum on the Egyptian - Libyan frontier to El Bisri east Sidi Barrani on the Mediterranean coast. One hundred and thirty three stands (20 x 30 m) were selected to represent as much as possible the variation in the vegetation and geo-referenced using GPS. The recorded taxa were classified according to the life - from spectrum and chorological affinities in the study area. Stratified random sampling method was employed. For each stand, a floristic - count list was taken from five 25 m<sup>2</sup> quadrat. In each quadrat, the occurrence and the number of individuals of each species were recorded, and then used to calculate absolute density and frequency of the encountered plant species. In each stand, the plant relative cover was determined using line-intercept method. Soil samples were analysed to estimate fourteen environmental variables: sand, silt, clay, soil reaction (pH), organic matter (OM), electric conductivity (EC), total soluble salts (TSS), moisture content (MC), total carbonate (CaCO<sub>3</sub>) sodium (Na<sup>+</sup>), potassium (K<sup>+</sup>), Calcium (Ca<sup>++</sup>), Magnesium (Mg<sup>++</sup>) and altitude (Alt). Data analysis includes: Classification and Ordination of samples. Plant species mapping was performed using both GPS and GIS methods.

**2003. Abdel-Rahman, S. M. Population dynamics of *Artemisia monosperma* in the Omayed biosphere reserve (Egypt). M.Sc. Thesis, Faculty of Science, Alexandria University.**

The main objective of the present study is to obtain baseline data on the population structure of *Artemisia monosperma* and to evaluate the effect of disturbance on its characteristics in the habitat of non saline depression in Omayed area. Sampling process was done along five transects distributed in three arbitrary locations representing east, intermediate and west directions. Seven permanent plots were established in these locations for monthly measurements of *A. monosperma* characteristics. *A. monosperma* displayed considerable temporal and spatial variations in the population attributes examined in the present study. Concerning the temporal variations, the abundance of this species increased in the recent years in comparison with records of the previous related studies. It is clear that the increase in the abundance of *A. monosperma* in the present study was on the expense of the other species. This could be attributed to its high potentiality in disturbed areas as well as to an allelopathic effect which was recorded in many *Artemisia* species. *A. monosperma* dominated the western location with the highest value of absolute density recorded during 1998, while it overwhelmingly dominated the eastern location during 1999. There was a general trend of declining the average number of individuals allocated to the different size classes of the plant in all locations. The exception was for the individuals of the large size class in the eastern location, which survived the whole study period. On the other hand, up to 71% death

of small individuals in one season were recorded in the intermediate location. Increasing the distance from the main road, as a focal area of disturbance, was associated with decreasing the number of *Artemisia* individuals, especially of small and medium sizes, decreasing the total seed output, and the percentage of new vegetative activity as well as the flower budding and flowering phases. The mean number of seedlings in the sampled plots, the number of produced seeds and the progression of phenological activities decreased with the increase of distance from the main road. There was also a clear difference in the mean number of seedlings in the three sampled locations, where the highest mean number of seedlings was recorded in the eastern location, while the lowest was recorded in the intermediate location (coinciding again with similar trend of seed production). Evaluating the spatial variability in mortality ratio of *Artemisia* population indicates that the eastern location had smaller ratio of losses (death) compared with the other locations. The heavy losses of individuals in the intermediate and western locations (at least half the small and one third the medium individuals) could be attributed to the higher human impacts and exposure to climate hazards.

**2003. Hammouda, S. K., Heneidy, S. Z. and El-Kady, H. F. Effect of ploughing on plant species abundance and diversity in the northwestern coastal desert of Egypt. Biodiversity & Conservation 12: 749–765.**

This study focuses on the effect of ploughing on plant abundance, vegetation cover, species richness, and taxonomic diversity during the growing seasons (winter and spring) of 1992 and 2000 in the habitat of inland plateau (natural habitat), 21 km south of Mersa-Matrouh (Egypt). Ninety-five species belonging to 27 families were recorded. High percentages of life-forms and a large number of species were recorded in ploughed and unploughed stripes in the winter and spring of 2000. Higher averages of importance values (IVs) and absolute frequencies were recorded for most perennial and annual species in the unploughed stripes compared with the ploughed ones. This may be attributed to crop failure and consequently unfavourable soil conditions. On the other hand, some shrubby species (e.g. *Noaea mucronata* and *Haloxylon scoparium*) and perennial herbs (e.g. *Gynandris sisyrinchium*) attained higher IVs in the ploughed stripes compared with unploughed ones. This may be attributed to the cultivation of *Prosopis juliflora* trees in the elevated part of the ploughed stripes, which have an ecological role in protecting and enriching the soil with organic matter, thus favoring the growth of these shrubs and perennial herbs. Higher species richness and diversity were associated with low concentration of dominance and low taxonomic diversity in the spring of 2000 in ploughed and unploughed stripes compared with the winter of 1992, for both perennials and annuals. The lowest taxonomic diversities were exhibited in the spring of 2000 for ploughed and unploughed stripes where the vegetation had the largest number of congeneric species and confamilial genera. Higher species richness and diversity characterized the vegetation of the unploughed stripes, especially in winter and spring 2000, as compared with those of ploughed ones. The present study also

reveals low species richness and diversity of therophytes in winter for both ploughed and unploughed stripes.

**2002. El-Dakak, R. A. Plant species diversity of the rocky ridges in the western Mediterranean coastal desert of Egypt. M. Sc. Thesis, Alexandria University, Faculty of Science.**

Biodiversity in the western Mediterranean coastal region of Egypt has been dealt with comparing plant species diversity in different habitats and communities, however there is relatively little information available for species diversity of the habitat of the habitat of rocky ridges.

**2001. Heneidy, Z. and El-Darier, S. Vegetation Diversity of Nilson's Island. Alexandria, Egypt. J. Bot. 41 (2): 255-266.**

A number of off shore islands is distributed along the Mediterranean Sea coast of Egypt. Nilson's Island (Total area = 300 ha.) is one of these islands which located in Abu-Kir Bay (a semi-circular shallow basin of about 20 m maximum depth and lies west of the Rosetta mouth of the River Nile) and is about 8-10 km away from the shore. In the past, the island had an important position from military point of view and nowadays it has developed a considerable role in the internal tourism. The calm seaside (southwestern side) of the island is more affected by human activities including industrial and agricultural discharge from Lake Edku compared with the exposed side (at north and southeast side) to the open sea action.

From the scientific point of view, the island has a particular ecological interest due to exposition to both open and calm sea effects surveying the literature reveals that there are meager information concerning with the plant and animal life of this island, which may indicate a lack in the basic knowledge on vegetation structure and species distribution. Such knowledge is very important as they are considered prerequisites for applying a management plan to secure proper conservation of both plant and animal life there. The present study therefore is an endeavor describe the structure and diversity of the island vegetation, and their relationships with some environmental and edaphic factor.

**2001. Ibrahim, R. I. Genetic Diversity of Ecological Populations of Some *Trigonella* Species (Family Leguminosae) in Egypt. M. Sc. Thesis, Alexandria University, Faculty of Science.**

Plant genetic resources are being eroded through destruction and degradation of natural habitats, intensification of cultivation of arable lands, expansion of cultivation into marginal areas, replacement of land races by new cultivars, woodcutting, and overgrazing of natural pastures and range lands. In general, habitat degradation and fragmentation may restrict gene flow and result in genetic differentiation among populations that previously did not exist. In turn, this may affect the life history traits and the probability of species extinction. Such massive destruction of genetic resources is particularly evident in the Middle East, and the need for conservation of these resources is urgent. This region is the center of origin of many crops and fodder

plants and one of the richest centers of legumes (more than 2,000 species) in the Northern Hemisphere. In the local floras there are many plant species which can be considered as wild ancestors or close relatives of cultivated legumes, and a source of desirable genes for cultivated varieties and the supply of new crops as species of: *Trigonella*, *Vicia*, *Lathyrus*, *Trifolium*, *Onobrychis*, *Medicago*, *Melilotus*, *Lotus* and *Orthnithopus*. Besides, the populations of these species include genetic traits of adaptation to environmental stresses, like drought and salinity resistance, that can be valuable in genetic engineering of cultivated varieties. The genus *Trigonella* includes species of considerable economic value. *T. fenum-groecum* has been considered as one of the most important medicinal plants since very ancient times.

## 2.4- Other Publications

**2014. Shawky, R. A. Comparative ecological studies on representative areas of the coasts of The Red and Mediterranean Seas, Egypt. Ph. D. Thesis, Mansoura University, Faculty of Science, Department of Botany.**

This thesis provides an ecological study on the Red and Mediterranean Seas coastal lands which are represented by five locations: Sidi Abd El-Rahman, Baltim, El-Sheikh Zuwaied, Wadi Homath and Wadi El-Gimal. Vegetation survey and soil are sampled in 44 stands representing the study area, where the estimation of species importance value (i.e. summation of the relative values of density, cover and frequency of species). The physical and chemical characteristics of soil samples were determined for each stand. Hundred and nineteen plant species (89 perennials and 30 annuals) belonging to 36 families were recorded in the study area. In the Mediterranean coastal land, the total number of the recorded plant species is 108 species belonging to 87 genera related to 33 families. The characterized family is Poaceae (17 species = 15.7%). In the Red Sea coastal land, the total number of the recorded plant species is 26 species belonging to 24 genera related to 14 families. The characterized family is Chenopodiaceae (7 species = 26.9%). Six life forms characterized the plant life of the Mediterranean Sea coastal land: chamaephytes, hemicryptophytes, phanerophytes, therophytes, geophytes and helophyte. The majority of the recorded species are chamaephytes (34.3%) and the lowest are helophytes (0.9%). Five life forms characterized the flora of the Red Sea coastal land: phanerophytes, chamaephytes, hemicryptophytes, geophytes and therophytes. The majority of the recorded species are chamaephytes (34.7%) and the lowest are geophytes (3.9%). The chorology of the plant species revealed four geographical elements: African (Sudanian), Asiatic (Irano-Turanian), Afro-Asiatic (Saharo-Arabian) and Euro-Afro-Asiatic (Mediterranean and Eurosiberian). In the Mediterranean Sea coastal land, 54 species (59.2%) are monoregional elements. These taxa are either Saharo-Arabian (28 species = 25.9%), Mediterranean (27 species = 25.0%), Tropical and Irano-Turanian (3 species = 2.8% each), Sudanian (2 species = 1.9%) and Eurosiberian (1 species = 0.9%). On the other hand, few species are pluriregional elements (Mediterranean, Eurosiberian, Saharo-Arabian). In the Red Sea coast, 17 species (about 65.4%) are monoregional elements. These taxa are either Saharo-Arabian (12 species = 46.2%), Mediterranean (3 species = 11.5%) and Sudanian (2 species = 7.7%). Also, the pluriregional elements are few (Mediterranean, Irano-Turanian, Saharo-Arabian). The classification of stands using (TWINSPAN) led to recognition of 9 groups at the Mediterranean Sea coastal land dominated by *Ammophila arenaria*, *Tamarix nilotica*, *Halocnemum strobilaceum*, *Juncus rigidus*, *Juncus acutus*, *Nitraria retusa*, *Euphorbia paralias* and *Elymus faractus*. On the other hand, 8 groups were recognized at the Red Sea coastal land dominated by *Avicennia marina*, *Panicum turgidum*, *Atriplex farinosa*, *Limonium axillare*, *Aeluropus lagopoides*, *Zygophyllum album*, *Alhagi graecorum*, *Juncus rigidus* and *Phragmites australis*.

**2010. Hussein, N. R. The Biodiversity for the Weed Flora of Family Gramineae in Egypt with Special Reference to Fruits and Pollen Grains. M. Sc. Thesis, South Valley University, Faculty of Sciences, Department of Botany.**

The present work deals with 34 species belonging to 25 genera of 11 tribes from the total 19 tribes among Gramineae in Egypt; Andropogoneae, Aristideae, Arundineae, Aveneae, Brachypodieae, Bromeae, Eragrostideae, Paniceae, Poeae, Stipeae and Triticeae. The study depended on using herbarium specimens collected and kept in the Botany Department Herbarium of Faculty of Science, South Valley University in Qena, (QNA a proposed agronym) and with some plant samples received on loan from CAI herbarium (Cairo University). The plants are collected from 5 of the total 7 phytogeographical regions defined in Egypt; the Mediterranean region, Nile valley, Red Sea region, Sinai Peninsula and from Gebel Elba in south Egypt. Also the plants have been defined and named scientifically according to the available known sources. Taxa of eleven tribes studied by four means of modern taxonomic tools revealed in four chapters with an introduction; generally; of the identification of Gramineae, phytogeography, economic importance, historical notes in the systematic of Gramineae and a scope on the thesis and its general aims. Accomplished with a preamble of the nomenclature and the collection of the studied taxa (Chapter ONE).

**2010. Mahdy, R. A. Patterns of floristic diversity and environmental correlates of some succulent plants in Egypt. M. Sc. Thesis, Cairo University, Faculty of science, Department of Botany Microbiology.**

In a trial to compare the floristic composition of succulent plants of the arid region in countries neighboring to Egypt showed that Egypt had the highest number of succulents (82 species) followed by Palestine and Saudi Arabia (51 species for each), Libya (48 species) and Sudan (47 species) The 82 known succulent species in Egypt can be classified into 59 leafy succulents and 23 stem succulents.

**2010. Shalaby, I. T. K. Variability among *Nitraria retusa* (Forssk.) Asch. Populations in Some Regions in Egypt. M. Sc. Thesis, Faculty of Science, Tanta University.**

The present study aims at identifying the distribution behaviour of *Nitraria retusa* (Forssk.) Asch. in Egypt to evaluate its adaptability and assessing the significance of variations in its population characteristics such as: dimensions of individuals, size structure of its populations, density, standing-crop phytomass, morphological characters and soil characteristics in response to different geographical regions and habitats types in Egypt. One hundred and forty stands were sampled to represent the environmental variations associated with its distribution range in Egypt (Mediterranean and Red Sea coasts, Oases and depressions of Western Desert and Sinai). In general, the population of this plant is characterized by relative preponderance of the small-sized individuals (i.e. juveniles) particularly in the sites of medium positions along the prevailing salinity gradient. On the other hand, the juveniles are highly stressed in the stands of hyper-salinity. The negative relationship



between its density and size suggests that its size is density-dependent; thus could be explained as a competitive phenomenon. This study indicated that *N. retusa* is characterized by a phenotypic plasticity in response to different environmental conditions. It also tolerates wide salinity gradients ranging from  $> 5$  to  $\geq 25$  mS  $\text{cm}^{-1}$ . Despite *N. retusa* showed a low germination percentage, the populations from Siwa and coastal sand dunes attained the maximum values (40 and 38.5 %, respectively).

**2006. Faried, A. M. The Biodiversity among the Weed Flora of Urticaceae - Caryophyllaceae in Egypt with Special Reference to Fruit and Seed. M. Sc. Thesis, Assiut University, Faculty of Science, Botany Department.**

The present work deals with the biodiversity among the weed flora of Urticaceae-Caryophyllaceae in Egypt, with special reference to fruit and seed. It includes 38 weedy species (comprising 3 subspecies) in 17 genera and 8 families. The families representation are as follows: Ultracaceae (3 species in 2 genera). Santalaceae (1 species). Polygonaceae (14 species in 4 genera). Nyctaginaceae (1 species). Molluginaceae (1 species). Aizoaceae (2 species in 2 genera). Portulacaceae (1 species, including 3 sub species) and Caryophyllaceae (13 species in 5 genera).

### 3- Alien Flora

**2017. Eid, E., Shaltout, K. and Al-Sodany, Y. Population Ecology of *Ipomoea carnea*. Lap Lambert Academic Publishing, Saarbrücken, Germany, 119 pp.**

*Ipomoea carnea*, a native of South America, grows in dense populations along river beds, banks, canals and other waterlogged (wetland) areas. It has become a naturalized species along canals, drains, road sides and field edges in the Nile Delta. This study aims at providing an overall review of the literature about this species, reporting ecological conditions in its habitats and evaluating its adaptability to different environmental conditions in the middle and north Nile Delta. It aims also at assessing the variation in its population characteristics such as natality, mortality, propagation potentiality, morphogenesis of the leaves, flowers, fruits, seed production, and standing crop phytomass in relation to habitat types, and evaluating the nature of correlation between these characteristics and the prevailing environmental variables. Fifty stands were established to cover seven habitats. The measurements and estimations were carried out during the period from June 1999 to May 2000. In each stand, a number of ramets were permanently marked to estimate monthly variation in the different variables such as phenology, the height and diameter of the ramet canopy, number of flowers, leaves, fruits and inflorescences. The size distribution of the whole population was calculated, and the mean seed mass and volume in each habitat were calculated. Transverse sections of stem, root, leaf, and seed coat of the young and old plants were prepared to describe and compare the anatomical structure between the young and old plants. At the end of calendar year, clippings of three randomly marked permanent ramets were harvested in each stand to determine their fresh and dry weights. The leaf area was determined for the harvested ramets using Leaf Area Meter. These results indicated significant differences between *Ipomoeacarnea* populations in different habitats, also its flowering time exhibited differences. It is indicated also that the size frequency distributions of *Ipomoea carnea* populations in different habitats tend to approximate the negative skewed distributions, where the big ramets are more preponderant than the small ones. Population natality varies in relation to habitat and time.

**2017. Eid, E. M. and Shaltout, K. H. Growth dynamics of water hyacinth (*Eichhornia crassipes*): a modeling approach. Rend. Fis. Acc. Lincei 28: 169–181.**

The present study aims to develop a dynamic numerical model to describe the growth and interactions between the shoot and root systems of *Eichhornia crassipes* along the irrigation canals in the Nile Delta, Egypt. While carrying out this study, the shoot and root biomasses of *E. crassipes* were sampled monthly from April to November 2014 over three irrigation canals in the Nile Delta, using five randomly distributed quadrats (each 0.5 × 0.5 m) at each canal. Two state variables shoot and root systems biomasses, were considered to follow the growth of *E. crassipes*. The biomass of each organ was simulated to incorporate the net growth of the plant as a function of photosynthesis, respiration, mortality and translocation from the shoot to the root

system. After validating the model with data from the Nile Delta, it was verified using four independent sets of published field data: 19\_500S (Brazil), 19\_570N (Mexico), 29\_380N (USA) and 30\_330N (China). The level of agreement between the simulated values and actual field data indicated that the model was capable of simulating the total biomass of *E. crassipes* over a wide range of latitudes. Global sensitivity analysis showed that of all the parameters that were used, the model was most sensitive to the maximum photosynthetic growth rate. Based on our results, we recommend the following: first, if *E. crassipes* is used to remove water pollution or in animal feed, manure, mulch, or the production of biogas, pulp and paper, then its stands should be harvested at peak net production. Second, if the main purpose of its management is to suppress its growth or eradicate the plant from an irrigation canal, then the harvest should be at the point of the minimum net production.

**2017. El-Barougy, R. F. Phylogenetic Diversity and Performance of the Invasive Species *Ipomoea carnea* Jacq. in the Nile Delta. Ph. D. Thesis, Faculty of Science, Damietta University.**

To uncover which combination of traits are most effective for predicting invasion success three different urban habitat types along the Nile Delta invaded by *Ipomoea carnea* (convolvulaceae) were studied over two years, Ten plant traits were measured at monthly intervals along an invasion gradient in each habitat. The present findings revealed that there was a positive significant relationship between invader performance traits and its phylogenetic relatedness to the resident species in all recipient – invaded communities. Furthermore, species rich–communities with high phylogenetic diversity contributed to highly invader performance. Moreover, these results exhibited facilitation patterns that contrasting with biotic resistance hypothesis. Also, the present findings revealed that functional diversity has a greatest predictive power with highly positive significant effect on community water capture. It's speculated that the present findings can be applied whereas highly invaded communities with native species distantly related to the invasive species *I. carnea*. Given any successful management attempt to control this noxious weed needs clear understanding the link between traits and its survival. It's believed that these findings will be of interest to a broad audience including mechanisms that control this invader success. Applications in the field of plant invasion will not be in the main focus, since a model will be built and recommended management of any invasive species.

**2017. El-Barougy, R., Cadotte, M., Khedr, A., Nada, R. and Maclvor, J. Heterogeneity in patterns of survival of the invasive species *Ipomoea carnea* in urban habitats along the Egyptian Nile Delta. *NeoBiota* 33: 1–17.**

Plant traits are critical for understanding invasion success of introduced species, yet attempts to identify universal traits that explain invasion success and impact have been unsuccessful because environment-trait-fitness relationships are complex, potentially context dependent, and variation in traits is often unaccounted for. As introduced species encounter novel environments, their traits and trait variability can determine

their ability to grow and reproduce, yet invasion biologists do not often have an understanding of how novel environments might shape traits. To uncover which combination of traits are most effective for predicting invasion success, we studied three different urban habitat types along the Nile Delta in Egypt invaded by the Pink Morning Glory, *Ipomoea carnea* Jacq. (Family: Convolvulaceae). Over two years, we measured ten plant traits at monthly intervals along an invasion gradient in each habitat. No single trait sufficiently explained survival probability and that traits linked to invasion success were better predicted by the characteristics of the invaded habitat. While the measured traits did influence survival of *I. carnea*, the importance of specific traits was contingent on the local environment, meaning that local trait-environment interactions need to be understood in order to predict invasion.

**2016. Eid, E., Youssef, M. and Shaltout, K. Population characteristics of giant reed (*Arundo donax* L.) in cultivated and naturalized habitats. *Aquatic Botany* 129: 1–8.**

In the present study, we analyzed the variability among naturalized and cultivated giant reed (*Arundo donax* L.) populations in terms of density, morphology and primary production along the prevailing environmental gradient in Nile Delta, Egypt. For this purpose, a sampling was carried out in homogeneous and monospecific *A. donax* stands in Nile Delta. The samples were collected to represent the cultivated (planted habitat) and naturalized populations in four habitats (canal banks, waste lands, road and railway sides). Each habitat was represented by 3 stands; and in each stand, density, morphology and biomass were recorded using five randomly distributed quadrats (each of 0.5 × 0.5 m). The results had indicated a significant variation in density, morphological and biomass parameters between naturalized and cultivated populations. Generally, naturalized populations along the railway and roadsides (the less moist habitats) had the minimum values for most measured population parameters, while the cultivated populations (the moistest habitat) had the maximum. The dependence of shoot height, number of branches and panicle length on shoot density indicated the density-size effects. Density, morphology and biomass of *A. donax* were correlated significantly with some soil properties such as salinity, pH, organic matter and nitrogen. The regression technique was applied to develop equations for predicting the biomass of *A. donax* shoots from more easily determined shoot height and shoot basal diameter. These methods were time-saving, so the equations might be useful in evaluating management techniques which were used for monitoring of this species.

**2016. Shaltout, K. H, Hosni, H. A, El-Kady, H. F, El-Beheiry, M. A and Shaltout, S. K. Composition and pattern of alien species in the Egyptian flora. *Flora* 222: 104-110.**

The present study aims to determine the alien and invasive species in the Egyptian flora, their origin and lags between the time of the first record and that of rapid growth. A list of alien species was prepared from literature, field trips and herbaria.

The national distribution was gathered from the literature, while the global distribution was assessed according to the system of Good who divided the globe into six kingdoms, three subkingdoms and thirty nine floristic regions. The year of the first record was detected by searching in the references, and sometimes by checking herbarium sheets deposited in national herbaria. The final list included 136 species classified into three categories: 49 casuals, 81 naturalized and 6 invasive species. Most of these species occur in the Nile region (108 species = 79%) mainly due to the increasing human activities. Four natural and eight anthropogenic habitats were supporting the distribution of these species. Many of these species belong to the Boreal and Palaeotropical Kingdoms. Forty nine species matched with each of the periods of 1850–1900 and 1950–2000. Time lags of the invasive species ranged between 15 (*Azolla filiculoides*) and 181 years (*Dalbergia sissoo*). The dynamic patterns of alien species over a long period ( $\geq 500$  years) as well as the role of hybridization in their spreading will be assessed in a future study.

**2014. Shaltout, S. K. Ecological study on the alien species in the Egyptian flora. M. Sc. Thesis, Faculty of Science, Tanta University.**

The present study aims to address the following questions: which plant species are considered alien in the Egyptian flora? what is the origin of these alien species? which alien species are considered invader, and what are their time lags? what is the relation between the degree of invasiveness and propagule types and sizes? and what are the phenological sequences of these species? A list of the alien species was prepared from literature reviewing, field trips and herbaria consultation; it includes 137 species arranged according to Engler system. Five categories of alien species were recognized: casuals (50 species), naturalizers (50 species), weeds (31 species), invaders (5 species) and transformer (1 species). Twelve major habitats supporting the distribution of these species: 4 natural and 8 anthropogenic habitats, cultivation fields are the most represented. The most represented life form is the therophytes, that of sex form is the bisexual and that of the dispersal types are the ballochore and microsclerochore. Thirty-eight species had a distribution in only one hytogeographical region. Many of the alien species belong to the Boreal Kingdom followed by the Palaeotropical Kingdom. Forty-three species have at least one aspect of the environmental services, while 111 species have at least one aspect of economic goods. These alien species have three modes of physical defense: sticky latex with unpleasant taste and odor, spiny organs, and hairy leathery leaves or stems. These species belong to 20 origins: 14 in the old world and six in the new world (the plants from South America are the most represented). The date of introduction covers a period of 250-300 years (1750 up till now). Forty-nine species matched with the period of 1850-1900, followed by 1950-2000 (42 species) and 1900-1950 (19 species). Time lags of the invasive and transformer species ranged between 5 -181 years.

**2013. Hamada, F. A. Taxonomical, Ecophysiological and Phytochemical Studies on *Solanum diphyllum* L. and *Desmodium tortuosum* (Sw.) DC. M. Sc. Thesis, Faculty of Science, Aswan University.**

The present study reveals the most important morphological, anatomical and phytochemical properties, in addition to the ecological factors pre-requisite for seed germination of two new introduced plants in the Egyptian flora. These plants are: *Solanum diphyllum* L belongs to Solanaceae and *Desmodium tortuosum* (SW) DC belongs to Leguminosae. The general introduction represents the importance of the two families and summarized the aims of the study, followed by the methods that have been used in order to perform the current research. The first chapter concerned with studying *Solanum diphyllum* L representing the literature review about previous research on the phylogeny, classification position, phytochemistry and seed germination of *Solanum* genus. Detailed morphological and anatomical features have been described. Moreover, the presence of lenticel-like structures has been detected on the leaves and stems which could be a response to the plant defence needs and/or may be a result of an adaptation to its surrounding environment. The second chapter concerned with studying *Desmodium tortuosum* (SW) DC representing a literature review about the previous research on the phylogeny, classification position, phytochemistry and seed germination of the genus *Desmodium*. A detailed morphological and anatomical features have been described. Moreover, similarities with its close affinities in its genus and with other species within its family were mentioned. The presence of variable stomatal and trichomal types on the epidermis could represent morphological and anatomical defense and physiological adaptation to its surrounding environment. In addition, *Desmodium tortuosum* seed morphology and anatomy revealed how its seed dormancy breakdown happened.

**2012. Shaltout, K.H., El-Komi, T. M. and Eid, E. M. Seasonal variation in the phytomass, chemical composition and nutritional value of *Azolla filiculoides* Lam. along the water courses in the Nile Delta, Egypt. Feddes Reprtorium 123 (1): 37-49.**

The present study aims to assess the phenological behaviour, phytomass production, chemical composition and nutritional value of *Azolla filiculoides* in the water courses of the Nile Delta, Egypt. The sampling process was carried out seasonally using twenty-five plots (each of 1 × 1 m) distributed along 15 irrigation canals and 10 drainage canals in the study area. Sprouting of *A. filiculoides* had its maximum activity during winter, vegetative growth during spring and summer and withering during autumn. Maximum seasonal phytomass (285.2 g DW m<sup>-2</sup>) was found during spring. The annual mean was significantly higher in drainage canals (278.3 g DW m<sup>-2</sup>) than in irrigation canals (144.4 g DW m<sup>-2</sup>). The concentrations of Ca, Mg and Na in *A. filiculoides* from drainage canals were significantly higher than in those from irrigation canals. Regarding the type of water courses, there were no significant differences in organic contents and nutritive values between the irrigation and drainage canals. The analysis of growth characteristics indicated that *A. filiculoides* can grow quite well in drainage canals; its macro-nutrient (N, Ca, Mg, Na and Fe)

contents are high enough to allow it to be used as a bio-fertilizer. On the other hand, *A. filiculoides* could be considered as a 'nutrients and heavy metals remover' especially in drainage canals for waste water treatment if the plant is harvested during its maximum phytomass. As feed supplement for animals, this plant could be considered as excellent forage due to its high levels of carbohydrate, protein, crude fat, total digestible nutrients and the lower crude fiber contents.

**2011. Shaltout, K. H., El-Beheiry, M. A., El-Kady, H. F. and Keshta, A. E. Distribution of the naturalized species *Dalbergia sissoo* Roxb. Ex. DC. in Nile Delta, Egypt. *Taekholmia* 30: 121-141.**

Seventy six stands were sampled to represent the variation among *Dalbergia sissoo* populations in Nile Delta. These stands represent the distribution of the naturalized populations of *Dalbergia sissoo* in five urban habitats (canal edges, road sides, road dividers, field edges and drain banks) recognized in the study area. Fourteen vegetation groups were recognized after the application of TWINSPAN. *Phragmites australis* (P= 52.6 %) was the main associated species in nine groups, while each of *Imperata cylindrica* (P = 38.2 %) and *Pluchea dioscoridis* (P = 35.5%) in two groups. The significant edaphic variables which affected the distribution of *Dalbergia sissoo* were: iron, manganese, magnesium and potassium. These results suggest that urban vegetation in Nile Delta region is favored where disturbance, nutrient and water resources are more abundant.

**2010. Shaltout, K.H., Al-Sodany, Y.M. and Eid, E.M. Growth behaviour of the invasive species *Ipomoea carnea* in the Nile Delta, Egypt. *Hydrobiologia* 656: 187-197.**

*Ipomoea carnea* Jacq., a native shrub of South America, grows in dense populations along river beds, river banks, canals and other water logged areas. It has become naturalised along canals, drains, road sides and field edges in the Nile Delta, Egypt. The rapid growth rate, spread and adaptability from xeric to aquatic habitats indicates that this plant may potentially become a disastrous invasive species in Egyptian water bodies. Fifty established stands covering seven habitats (railway sides, waste lands, road sides, drain and canal banks, road dividers and field edges) in the Nile Delta were used in this experiment. In each stand, 20 ramets were permanently marked to estimate the monthly variations in such growth variables as phenology, height and diameter of the ramet canopy, number of flowers, leaves and fruits. The results showed a significant variation in growth variables relative to habitat types. Generally, *I. carnea* populations along the railway sides and field edges had the lowest values for most variables; while those of the road dividers, road sides and canal banks produced the highest values. The growth of *I. carnea* follows a seasonal pattern where the highest values for most growth variables were obtained during September and October and the lowest were recorded during June and July. The greatest flower and fruit production was observed between September and December. Similarly, it was shown that the flowering time varied in relation to habitat types; it began earlier on road sides and

canal banks, but later on railway sides, road dividers and waste lands. Leaf areas of *I. carnea* populations in the wet habitats (e.g. drain and canal banks) were higher than those in other habitats.

**2010. Keshta, A. E. Population Ecology of *Dalbergia sisso* Roxb. Ex DC. in Nile Delta. M. Sc. Thesis, Faculty of Science, Tanta University.**

*Dalbergia sissoo* was introduced to Egypt for ornamental and timber purposes. It has become naturalized along canals, drains, road sides, road dividers and field edges in Nile Delta, Egypt. The rapid growth rate, spread and adaptability from xeric to aquatic habitats indicated that this plant may potentially become a disastrous invasive species in Egyptian water bodies. The results of the first part of this thesis indicated that *Dalbergia sisso* populations of the drain banks were characterized by the largest height (7.7 m ind<sup>-1</sup>), diameter (6.0 m ind<sup>-1</sup>) and size index (6.8 m). Field edges population were characterized by the largest density (362.1 inds 1000 m<sup>2</sup>) and height to diameter ratio (2.1). The trunk diameter is considered to be the best estimator for above ground phytomass prediction. Budding has its maximum activity during March (62.4%), vegetativeness during September- November and May- August (100 %), flowering during April (72.6%), new fruiting during June (34.5 %) and deciduousness during February (66.1%). Grazing is the most pronounced type of disturbance (82.9%). Sprouting phase was not observed during the year of observation. The second part aims at identifying the plant communities of the different habitats in Nile Delta region, Egypt. One hundred and six stands were selected to represent the spatial and habitat variation in the study area. Twenty-one vegetation groups were recognized after application of TWINSpan. Their ordination using DECORANA indicates acidity, fertility and texture gradients; the hygro-nitrophilous communities (the moist and fertile stands) inhabit the wet refuse areas (*Echinochola stagnina*, *Eichhornia crassipes* group), meso-nitrophilous communities inhabit the road sides and field edges (*Pluchea dioscoridis*, *Cynodon dactylon*, *Imperata cylindrica* and *Phragmites australis* groups), mesic-dry sub-nitrophilous communities occur on sandy soils inhabit road divider (*Convolvulus arvensis* and *Bassia indica* groups).

**2009. Al-Sodany, Y.M., Shaltout, K.H. and Eid, E.M. Demography of *Ipomoea carnea*: an invasive species in the Nile Delta, Egypt. International Journal of Agriculture & Biology 11 (5): 501-508.**

*Ipomoea carnea* was introduced to Egypt for ornamental purpose. It naturalized as a species along canals and drains, road sides, railways, waste lands and field edges in the Nile Delta. The rapid growth rate, spread and adaptability from aquatic to xerophytic habitats indicate that this invasive plant may potentially become another ecological disaster like water hyacinth. The present work monitored the demography of *I. carnea* populations at two locations in Nile Delta in terms of size structure (natality, mortality, survival and demographic flux) and assessed its standing crop and the correlation between its population characters and the prevailing environmental variables. Fifty permanent stands were established to represent the micro-variations in



seven habitats, where *I. carnea* occurs at both locations. The height from the ground and average diameter of the canopy for each permanent marked ramet (4355 ramets) were estimated monthly and its volume was calculated as a cylinder. The results revealed that sexual propagation of *I. carnea* from seeds is less common than vegetative propagation from decumbent branches. The variation in population natality varied in relation to habitat and time. *I. carnea* sprouts suffered relatively higher mortality rates than adult plants, indicating the sensitivity of the sprouts to temporal variation in some environmental factors. Months of July and January indicated negative values of demographic flux as a result of the increasing mortality and decreasing natality. In contrast, June had maximum value as no sprout and adult mortalities was noted in this month. The size distribution of *I. carnea* populations had negative skewed shape, where the big individuals (i.e., mature) exceeded the small ones (i.e., juveniles). Its biomass of *I. carnea* was higher than the other species in the same habitats in the Nile Delta.

**2002. Eid, E. M. Population Ecology of *Ipomoea carnea* Jacq. in the Nile Delta Region. M. Sc. Thesis, Faculty of Science, Tanta University, 118 pp.**

*Ipomoea carnea*, a native of South America, grows in dense populations along river beds, banks, canals and other waterlogged (wetland) areas. It has become a naturalized species along canals, drains, road sides and field edges in Nile Delta. This study aims at providing an overall review of the literature about this species, reporting ecological conditions in its habitats and evaluating its adaptability to different environmental conditions in Nile Delta. It aims also at assessing the variation in its population characteristics such as natality, mortality, propagation potentiality, morphogenesis of the leaves, flowers, fruits, seed production, and standing crop phytomass in relation to habitat types, and evaluating the nature of correlation between these characteristics and the prevailing environmental variables. Fifty stands were established to cover seven habitats. The measurements and estimations were carried out during the period from June 1999 to May 2000. In each stand, a number of ramets were permanently marked to estimate monthly variation in the different variables such as phenology, height and diameter of the ramet canopy, number of flowers, leaves, fruits and inflorescences. The size distribution of the whole population was calculated, and the mean seed mass and volume in each habitat were recalculated. Transverse sections of stem, root, leaf, and seed coat of the young and old plants were prepared to describe and compare the anatomical structure between the young and old plants. At the end of calendar year, clippings of three randomly marked permanent ramets were harvested in each stand to determine their fresh and dry weights. The leaf area was determined for the harvested ramets using Leaf Area Meter. These results indicated significant differences between *Ipomoeacarnea* populations in different habitats, also its flowering time exhibited differences. It is indicated also that the size frequency distributions of *Ipomoea carnea* populations in different habitats tend to approximate the negative skewed distributions, where the big ramets are more preponderant than the small ones. Population natality varies in relation to habitat and time.

## 4-Bryophyta

**2015. El-Saadawi, W., Shabbara, H., Khalil, M. and Taha, M. An annotated checklist of Egyptian mosses. *Taekholmia* 35: 1-23.**

The present list of Egyptian mosses includes 181 taxa in 56 genera, 17 families and 10 orders. Synonyms reported only from Egypt are given in separate list. The distribution of 81 mosses in the 11, hitherto, surveyed phytogeographical territories regarding the number of recorded taxa. Pottiaceae, Bryaceae and Funariaceae dominate the Flora. *Pohlia lescuriana* (Sull.) Ochi is a new record to Egypt. Other relevant annotations are also given.

**2013. El-Saadawi, W., Shabbara, H. and El-Sakaty, S. Mosses of the Egyptian Conservation Areas: II. Omayed Protected Area. *Cryptogamie, Bryologie*, 34 (1): 61-71.**

Twenty-nine moss taxa are recorded, for the first time, from Khashm El-Aish plateau in Omayed Protected Area (OPA), Mediterranean coast, Egypt. Sixteen of them represent new records to the western Mediterranean coast (Mm) and six [*Aloina brevirostris* (Hook. et Grev.) Kindb., *Entosthodon* cf. *commutatus* Durieu et Mont., *Didymodon cordatus* Jur., *Tortella flavovirens* (Bruch.) Broth., *Tortula cuneifolia* (Dicks.) Turner, *T. muralis* Hedw. var. *aestiva* (Hedw.) Brid.] to Egypt bringing their totals to 63 and 170 taxa, respectively. OPA represents 0.07% of Egypt's area, but sustains over 17% of its moss flora. The most frequent genera are *Tortella*, *Didymodon* and *Bryum*. The largest genera are *Didymodon*, *Bryum* and *Tortula*. The Pottiaceae represent ca. 76% of the flora and comprises over 70% of taxa recorded with sporophytes. Similarity of the bryoflora of OPA is mainly with Sinai and Isthmic Desert in Egypt.

**2013. El-Saadawi, W., Abou Salama, U. and Taha, M. Mosses of the Egyptian conservation areas: III. Two new Pottiaceae records to Saint Catherine Protected Area and Egypt. *Taekholmia* 33: 37-46.**

Two species of Pottiaceae; *Anoetangium handelii* Schiffn. and *Hymenostylium crassinervium* Broth. & Dix. are recorded here for the first time from Egypt (Saint Catherine Protected area, Southern Sinai). *Anoetangium* Schwägr is a new genus to Egypt. Descriptions, illustrations and distribution comments on both species are given.

**2013. El-Saadawi, W., Abou Salama, U. and Taha, M. Mosses of the Egyptian Conservation Areas: III- Tow new Pottiaceae records to Saint Catherine Protected Area and Egypt. *Taekholmia* 33: 37-46.**

Two species of Pottiaceae *Anoetangium kandelli* Schiffn. and *Hymenostylium crassinervium* Broth & Dix are recorded here for the first time from Egypt (Saint Catherine Protected Area – South Sinai). *Anoetangium* Schwägr is a new genus to Egypt. Descriptions, illustrations and distribution comments on both species are given.

**2013. El-Saadawi, W., Shabbara, H. M. and El-Sakaty, S. I. Mosses of the Egyptian Conservation Areas: II. Omayed Protected Area Cryptogamie, Bryologie 34 (1): 61-71.**

Twenty-nine moss taxa are recorded, for the first time, from Khashm El-Aish plateau in Omayed Protected Area (OPA), Mediterranean coast, Egypt. Sixteen of them represent new records to the western Mediterranean coast (Mm) and six [*Aloina brevirostris* (Hook, et Grev.) Kindb., *Entosthodon* cf. *commutatus* Durieu et Mont., *Didymodon cordatus* Jur., *Tortella flavovirens* (Bruch.) Broth., *Tortula cuneifolia* (Dicks.) Turner, *T. muralis* Hedw. var. *aestiva* (Hedw.) Brid.] to Egypt bringing their totals to 63 and 170 taxa, respectively. OPA represents 0.07% of Egypt's area but sustains over 17% of its moss flora. The most common taxa are species of *Tortella*. The most frequent genera are *Tortella*, *Didymodon* and *Bryum*. The largest genera are *Didymodon*, *Bryum* and *Tortula*. The Pottiaceae represent ca. 76% of the flora and comprise over 70% of taxa recorded with sporophytes. Similarity of the bryoflora of OPA is mainly with Sinai and Isthmic Desert in Egypt.

**2013. ROS, R. M et al. Mosses of the Mediterranean, an annotated checklist. Cryptogamie, Bryologie, 34 (2): 99-283.**

The names of all mosses published up to the end of August 2011 in the countries of the Mediterranean basin, the Macaronesian Islands and Bulgaria are compiled in an annotated checklist. The list comprises accepted names and synonyms, and provides explanatory annotations for ambiguous and disputed names. Literature references supporting the reports in each individual area are given only for taxa reported once or in a single locality. A total of 1168 accepted species and 81 infraspecific taxa are reported from the whole area.

**2007. El Saadawi, W. and Shabbara, H. Hepatics of Egypt. An annotated checklist. Taeckholmia 27: 133-147.**

The hepatic list of Egypt includes 13 species in six genera, five families and two orders. *Riccia* is represented by seven species, *Marchantia* by two and the other four genera by one species each. Only *Riccia cavernosa*, *R. frostii* and *Marchantia debilis* are rather common and widespread in the country. The 13 species were collected from only 8 out of the 17 phyto-geographical territories into which Egypt is divided.

**2006. Shabbara, H. and El-Saadawi, W. Mosses from Gebel Maghara with new records for Isthmic Desert and Egypt. Cryptogamie, Bryologie, 27 (2): 285-295.**

Thirty-two moss taxa are recorded from Gebel Maghara. Sixteen of them are new records to the Isthmic Desert bringing the total to 47 taxa. Four species are new records to Egypt. About half the Gebel Maghara taxa occur also in the Mediterranean region, while only about a quarter in the Nile region.

**2003. Abou Salama, U. and El-Saadawi, W. Mosses of the Egyptian Oases: Dakhla and Kharga. *Lindbergia* 28: 148-151.**

Recent collections of mosses from Dakhla and Kharga Oases (western desert of Egypt) have resulted in an increase in the number of mosses known from the former oasis from three to five and in the report of 10 mosses, for the first time, from the latter oasis. The moss flora of each oasis is distinct from the other and together they show more ties with Sinai and northern Africa than with the Nile region. The total number of mosses for the oasis's territory is increased from 4 to 14, and that of Egypt from 170 to 173.

**2003. El Saadawi, W., Shabbara, H., Refai, S. and Abou Salama, U. Mosses of different phytogeographical territories of Egypt. *Bocconeia* 16 (1): 133-146.**

Recent bryological research in Egypt resulted in a remarkable enlargement of our knowledge about the moss flora of this country. The distribution of the 175 moss taxa, hitherto, reported from Egypt, in the world indicates the existence of various bryofloristic elements reflecting the diversity of the flora. The 175 taxa represent 145 species belonging to 45 genera, 14 families and nine orders; all under class bryopsida and all are reported from 12 out of the 15 phyto-geographical territories to which the country is divided. References to variations in floristic aspects of moss floras of studies phyto-geographic territories as well as to parameters believed to be responsible for these variations were made.

**2002. Refai, M., Abou-Salama, U. and El- Saadawi, W. Contributions to the moss flora of the Egyptian oases. 3. Bahariya oasis. *Taekholmia* 22 (2): 121- 130.**

Ten moss species are reported for the first time from Bahariya oasis (Western Desert of Egypt). Six of them belong to *Bryum*, two to *Funaria* and one each to *Didymodon* and *Brachymenium*. The number of mosses known from the Libyan and Nubian territories is raised from 30 to 35. Notes on habitats, reproductive structures and fruiting are given. Floristic comparisons showed more taxa in common with northern Africa countries and Sinai than with the Nile land.

**2001. Abou-Salama, U. and El-Saadawi, W. Contributions to the moss flora of the Egyptian Oases. 1. Farafra Oasis. *Taekholmia*. 21(2): 283-290.**

Twelve moss species are reported for the first time from Farafra Oasis (Western Desert of Egypt). Eight of them belong to *Bryum* of which *Bryum inclinatum* is a new record to Egypt. The number of mosses known from the Oases territory is raised from 15 to 23 species. Floristic comparisons show more elements in common with Northern Africa and Sinai than with the Nile Region.

**2001. Refai, M. S. Contribution to the moss flora of the Egyptian Oases. 2. Siwa Oasis. *Taekholmia* 21 (2): 291-302.**

Ten moss species are reported as pioneer species of the bryoflora in Siwa Oasis. All taxa except *Bryum* species are new records to Libyan Oases territory, while *Tortella*

*inclinata* is a new record to Egypt. This brings the total number of fully identified Egyptian mosses to 176 entities and that of Egyptian Oases to 30 mosses. *Bryum bicoloris* recorded fruiting for the first time in Egypt. Notes on habitats, sex organs and fruiting are given. Key for the recorded species and illustrated drawings for *Tortella inclinata* and *Bryum bicolor* are also provided.

**2000. Abou Salama, U.Y. Mosses of the Egyptian Conservation Areas: I- Gebel Elba Protectorate. Phytomorphology 50 (1): 47-58.**

Five moss species representing five genera, three families and three orders are recorded from Gebel Elba protectorate. Three of these taxa are new to Egypt, and 4 are new to Gebel Elba. Comparisons show that the Gebel Elba moss flora is distinct from moss floras of other phytogeographical regions of Egypt, as well as some neighboring countries.

**2000. Refai, M. and El- Saadawi, W. Contributions to the moss flora of the Isthmic Desert, Sinai; Egypt. Taeckholmia 20 (2): 139-146.**

Sixteen moss species are reported as new records from Gebel Dalfa and Ain Qadies of the Isthmic Desert in Northern Sinai, among these seven species are new records to the Isthmic Desert; while *Trichostomum brachydontium*, is a new record to the flora of Egypt. This brings the total number of fully identified mosses known from Isthmic Desert to 32 taxa. Notes on habitats, fruiting, sex organs and gemmae are given.

**2000. Shabbara, H., Abou-Salalla, U., Refai, M. and El- Saadawi, W. Notes on the bryoflora of the different phytogeographical territories of Egypt. Proc. 1<sup>st</sup> International conference of Biology (ICBS), Faculty of Science, Tanta University 1: 366-378.**

The number of fully identified mosses reported from Egypt is at present 168 entities included in 139 species, 44 genera and 14 families. Bryaceae, Merceyoidaceae (Pottiaceae), Funriaceae and fissentaceae grow in most of phytogeographical territories of the country. Bartramiaceae grows in five territories, but mainly in Cairo area; Brachytheceaceae in four territories, but mainly in mountainous southern Sinai. Dicranaceae, Splachnobryaceae, Amblystegiaceae and Timmielloideae (Pottiaceae) grow in two territories each. Grimmiaceae, Encalyptaceae and Cinclidotaceae are restricted to mountainous Southern Sinai; Ditrichaceae and Orthotrichaceae to Nile Fayum.

## 5- Agrobiodiversity

**2018. Shalaby, A. I. Environmental assessment of the artificial forests in the western desert of Egypt. M. Sc. Thesis, Faculty of Science, Tanta University.**

The present study aims at determining of the density and phytomass of the trees and shrubs that constitute the Sadat forest, in addition to assess the environmental impact of the artificial afforestation on the natural vegetation in the study area and soil characteristics. The studied tree species are *Eucalyptus camaldulensis*, *Eucalyptus citriodora*, *Khaya senegalensis* and *Dalbergia sissoo* as single species, and *Casuarina* species as mixed species. The results revealed that most of the total biomass was accounted for stem biomass in *E. camaldulensis* and *E. citriodora* (> 65% for each) and *Casuarina* species (> 55%). Forty-six understory weed species belong to 18 families were recorded in this study as understory vegetation. The most characteristic families were *Gramineae* (14 species = 32.6 %), followed by *Compositae* (7 species =16.27 %). It is observed that the majority of recorded species are therophytes (60.6 %), followed by chamaephytes (19.6 %) and geophytes (10.9 %). The highest number of weed species was recorded in spring season (35 species), but autumn has the lowest number of recorded species (27 species). There were no specific weeds grow under each tree species. There were no associated understory species with *Casuarina* trees in the studied forest. Outside the forest, *Artemisia monosperma* had the highest cover (67.7 %) all over the year, while *Bassia indica* had the lowest cover (0.2 %). The application of the two-way indicator species analysis (TWINSPAN), on the cover estimate of the recorded species 124 stands (after removing 2 stands with weed cover < 0.5%) leads to recognition of 6 vegetation groups according to the indicator species in each group and overstory vegetation type. Only two groups out of the six groups were dominated by desert native plants, while the others were dominated by agricultural weeds. Soil characteristics were different among the studied species influenced the distribution of weed species.

**2017. El-Saied, A., El-Ghamery, A., Khafagi, O., Powell, O., Silcock, J., and Bedair, R. Agro-ecological assessment of Siwa Oasis arable lands. *Taeckholmia* 37: 1-15.**

A critical foundation of sustainable agriculture is to understand different agro-ecosystems components and to investigate relations between different species and environmental factors affecting their presence and expansion. The flora of Siwa Oasis agro-ecosystems was investigated and assessed. A total of 132 stands (66 in spring and another 66 in summer) were chosen to represent the study area and its soil properties during spring and summer. Cover of each species and foliage projective cover of each stand was visually estimated. Species richness, diversity and evenness were calculated for each stand. Soil analyses showed that stands could be differentiated geographically. Vegetation and soil relationships were explored using different ecological multivariate techniques. TWINSPAN classification resulted in four ecological groups in spring and four more groups in summer. DCA and DCCA

clustered stands in a similar manner to the ecological groups extracted from TWINSpan classification. Indicator species and correlated soil characteristics of each group were identified. Salinity, crop type, water availability, shade and human intervention are the major factors affecting the diversity and richness of the vegetation communities in Siwa Oasis cultivated land. Some of the species recorded are of high economic importance, highlighting a valuable opportunity to cultivate problematic soils with nontraditional crops.

**2016. Shaltout, K. H, Farahat, E. A and Shalaby, A. I. Effect of a desert planted forest on the understory plant diversity: implication to conservation. Rend. Fis. Acc. Lincei 27:711–719.**

The present study aimed to assess the potential role of desert tree plantations for biodiversity conservation of native vegetation. For this purpose, we compared diversity and composition of understory vegetation in a managed desert plantation in Egypt with adjacent natural vegetation. In 126 stands, we estimated the diversity indices of the understory vegetation associated with five tree plantations inside and outside the forest. The results showed that therophytes had the highest contribution to the total flora of the study area (45.7 %), followed by chamaephytes (21.7 %). The weed species were the main components inside the forest (37 species). In the stands of *Eucalyptus camaldulensis* and *Khaya senegalensis*, the agricultural weeds were the most abundant followed by natural weeds. Spring season was the main flourishing season for weeds followed by autumn. *Dalbergia sissoo* had the highest values for species richness (8.8) and the lowest for species turnover (2.5). On the contrary, *Casuarina* spp. had the lowest values of species richness (3.0) and the highest of species turnover (7.3) and Simpson index (12.3). Establishment of the forest leads to remarkable loss and changes in the biodiversity of natural desert vegetation and vegetation composition, respectively. Many ruderal weeds colonized the adjacent desert habitats. From this study, we concluded that forest managers should pay attention for the conservation and retention of existing native vegetation during their design for the desert plantations.

**2015. Ammar, E. E. Current situation of agro-biodiversity in Nile Delta. M. Sc. Thesis, Faculty of Science, Tanta University.**

This study aims at preparing a recent checklist for the ornamental and crop plant species and their habitats in Nile Delta and its outskirts. The lists were analyzed in terms of taxonomic diversity, growth and sex forms, flowering activity, propagation methods, economic potentiality, and national and global floristic distribution. It aims also at identifying the crop groups and the environmental factors that govern the gradual change in crop structure. In addition, the herbarium sheets of the collection for cultivated plants in the Nile Delta were prepared and kept in Faculty of Science Herbarium Tanta University (TANE), and a computerized data base dealing with the botany environment and economic importance of these species was built. In the present study, 255 field Visits were conducted to many locations in the study area



during the period from summer 2012 to summer 2014 (155 for ornamental plants and 100 for crop plants). Based on the studied floristic composition, the 150 gardens of ornamental plants and 98 regions of crops were classified using TWINSPLAN analysis and ordinate by using DECORANA analysis. The total number of ornamental plants in the study area was 2392, belonging to 940 genera and 176 families. The most represented families were Fabaceae (252 species = 10 % of the total species), and Asteraceae (131 species = 5.5 %). On the other hand, the total number of crop plants was 171 species, belonging to 99 genera and 44 families. The most represented families were Poaceae (19 species = 11.1 % of the total species), and Fabaceae (17 species = 10 %). For ornamental plants, 7 main habitats were identified: gardens, fields, rocky soil, moist soil, green houses, road sides and aquatic bodies. Trees and shrubs were the most dominant growth forms and the decoration was the most dominant good, while shading was the most dominant environmental service. For crop plants, there were four main habitats: fields of summer crops, fields of winter crops, fields of late summer crops and orchards. Herbaceous plants were the most dominant growth form, while feeding was the most dominant good, and drought tolerance was the most dominant environmental service. Most ornamental plants belong to Palaeotropical Kingdom, while most crops belong to Boreal Kingdom. For both ornamental and crop plants, bisexual was the most dominant sex form, and seeds were the most propagation method. There was a gradual increase in the frequency of the flowered ornamental and crop species from December till May, and then decreased again reaching a minimum value in November. Crops were classified commercially into nine groups as follows: sugar crops, cereals, fodder crops, fiber crops, legumes, oil crops, medicinal crops, fruits and vegetables. Botanic gardens in Nile Delta conserve more than 80 wild species (3.4 % of the total Egyptian flora), 33 of them occur in one garden. Most of these species are herbaceous plants distributed in the Nile region including the Delta. According to their conservational status, five species were rare, four endangered, three vulnerable and one indeterminate. Fifteen species were alien species; ten were naturalized, four were casual species and one was invasive species.

**2015. Hussein, E. A. Composition, Distribution Patterns and Divergence of the Street Tree communities in the Greater Cairo City, Egypt. M. Sc. Thesis, Faculty of Education, Biological & Geological Sciences Department.**

In the present study, the floristic composition of the Greater Cairo City was analyzed in order to evaluate the current status of species diversity and arborescent components of the flora via surveying the distribution patterns and divergence of the street tree communities. Field data and floristic composition were gathered throughout intensive fieldwork during winter 2012 to summer 2014. A complete refined checklist of the recorded species was prepared and their life-form spectra were identified. The total recorded number of vascular plants was 378 species belonging to 264 genera and 79 families. The majority of species were belonging to Fabaceae (36 species), Asparagaceae, Poaceae (21 species each), Moraceae (19), Asteraceae (17) Euphorbiaceae and Malvaceae (15 species for each), Arecaceae (14), Lamiaceae (11

species). Urban parks were mainly semi-natural sites with less human modifications than street habitats. The findings imply that human-oriented functions could accumulate species diversity in urban parks to a high level. Comparing with streets, urban parks were blessed with a better environment condition with subdued negative growth factors. Both site limitations and deleterious human impacts were less arresting, and more management inputs and cares were regularly introduced to foster tree performance. Road islands habitats represents, in most cases; transitional areas of public gardens. They shared a high percentage of herbs (99 and 83 species respectively) comparable to street verges. The weed assemblages in the shaded, cool and humid habitats were rich in the weed species especially shade-tolerant plants such as *Euphorbia peplus* and *Oxalis corniculata* that thrive in the dense shade of these habitats. Urban parks habitat marked by the presence of greatest biological diversity between all habitats, it included some ornamental plants e.g. *Cassia javanica* subsp. *Nodosa* and *Platyclus orientalis*; shade plants e.g. *Ficus* spp., *Melaleuca ericifolia* and *Brachychiton discolor*; hedge plants e.g. *Dodonaea viscosa*, *Duranta erecta* and *Hibiscus rosa-sinensis*; fruit plants e.g. *Casimiroa edulis*, *Citrus* spp. and *Mangifera indica*; medicinal plants e.g. *Aloe vera*, *Mentha sativa*, *Rosmarinus officinalis* and *Ocimum basilicum*; poisonous plants e.g. *Melia azedarach* and *Cynanchum acutum*; vegetables e.g. *Solanum lycopersicum* var. *lycopersicum*, *Malva parviflora* and *Eruca sativa*; timber plants e.g. *Eucalyptus camaldulensis*, *Dalbergia sissoo* and *Cassia fistula*; oil plants e.g. *Olea europaea* var. *europaea*; fiber plants e.g. *Bombax ceiba* and *Ceiba pentandra*.

**2015. El-Beheiry, M., Ahmed, D., Ammar, E. and Shaltout, K. Diversity of crop plants in Nile Delta, Egypt, *Taekholmia*, 35: 77-97.**

This study aims to answer the following questions: 1- what are the crop diversity and distribution in Nile Delta and its outskirts? 2- what are their annual cyclic distribution? and 3- what are the economic goods and environmental services which they offer? One hundred field trips were conducted to many districts in Nile Delta including Greater Cairo and Alexandria during summer 2012 to spring 2014. One hundred and seventy three crop species belonging to 99 genera and 44 families were recorded. Poaceae was the most represented family, where *Cucumis* was the most represented genus. Herbaceous plants were the most represented, followed by trees and shrubs. The period from March to May was characterized by the highest flowering activity. Most of the species were propagated by seeds (86.9%), followed by cutting (13.2%). Twenty two groups of crops were resulted after the application of TWINSPAN and DCA: 6 groups occurred in only one district, 3 in 2 districts, and another 3 in > 10 districts. Group 10 that included 13 districts had the highest species richness (67.9 species region-1), while G 11 that included 20 districts had the highest species turnover (3.7). Of the 173 crop species recognized in Nile Delta, 82.1 % had at least one potential or actual economic good. Food plants were the most common crops, while grazing plants were the least. In addition, 64.2 % of the crop species had at least one environmental service; cold-tolerant plants were the most represented, while the sand accumulators were the least. This study is the first attempt to evaluate the agro-

diversity in Nile Delta and introduces for the scientific community a baseline data for evaluating the agro-biodiversity in Egypt as a whole.

**2014. Mohamed, A. A., Habeeb, H. R. and Azer, S. A. Survey, evaluation and documentation of the cultivated plants in Aswan Botanic Garden, Egypt, Bull. Faculty of Agriculture, Cairo University, 65: 21-37.**

The aim of this study was to survey, evaluate and document the cultivated perennial plants in Aswan Botanical Garden, Egypt. A total of (361) species belong to (263) genera and (88) families were collected and identified with regional floras and available checklists. The most common families were Leguminosae followed by Palmae, Moraceae and Bignoniaceae. Leguminosae and Palmae were represented by 46 (12.7 %) and 28 (7.8%) species, while Moraceae and Bignoniaceae were represented by 20 (5.5%) and 17 (4.7%) species. Sixteen and 14 species were recorded for Myrtaceae and Euphorbiaceae, and 10 species for each of Apocynaceae and Labiatae. Moreover, 6 families were represented by 3 species, 11 families by 2 species, while 42 families were represented by one species. The trees, shrubs and perennial herbs were represented by 192 (53.2%), 75 (20.8%) and 29 (8.0%) species, respectively. Climber shrubs, fan palms, and feather palms were represented by 27 (7.5%), 15 (4.2%) and 13 (3.6%) species respectively. Succulents, palm-like and woody grasses were represented by 7 (1.9%), 2 (0.6%) and one (0.3%) species, respectively. However, the cultivated annual herbs were not recorded because of the unstable presence of the observed plants. On the whole, Aswan Botanical Garden can serve as a resource of knowledge and guide for distribution of the cultivated species. Further floristic and ecological studies are needed to conserve this invaluable area.

**2013. Norfolk, O., Eichhorn, M., Gilbert, F. Traditional agricultural gardens conserve wild plants and functional richness in arid South Sinai. Basic and Applied Ecology 14: 659–669.**

Maintaining agricultural diversity is important for the conservation of rare species and for preserving underlying ecosystem processes on which small holder farmers rely. The positive effects of crop diversity are well documented in tropical systems, but the conservation potential of arid agricultural systems is less clear. This study assesses the impact of three arid agroforestry systems on plant diversity and functional richness in South Sinai, Egypt: mountain orchard gardens, modern town gardens and low desert date-palm gardens. We surveyed plants (cultivated and wild) within gardens and control plots of natural habitat and allocated each plant eight biological traits that are recognized as being linked with major ecosystem processes. Species diversity was quantified using three measures (Hill's numbers) and total species diversity was significantly higher within gardens than in the surrounding habitat at all three levels of diversity and across the three agroforestry systems. Species similarity was high between gardens and the surrounding habitat, and there was a strong overlap in the functional traits of wild plants and cultivated non-tree species. Despite the clear presence of trees within the gardens, the community weighted trait means (CWMs)

showed that chamaephytes were the dominant life-forms in both the gardens and the natural habitat. Functional richness differed between the three agroforestry systems, but was significantly higher within the gardens. Functional richness has been linked to increased productivity and CWMs showed that plants within the gardens were considerably taller than outside, suggesting higher biomass accumulation. These findings suggest that Bedouin agricultural practices are not having a negative effect on the flora of the region and that the continuation of these indigenous farming practices can actively benefit rare wild plants in the region. On a wider scale, this study supports the view that small holder farms and home gardens can be valuable tools in conservation, preserving local species and maintaining ecosystem functioning.

**2013. Labib, T., El-Hadidi, M. N., Aboel Atta, A. I. and Loutfy, M. H. A documentary study for the Orman Botanical Garden, Egypt. I. A. A check list for the taxa of Gymnospermae, *Taekholmia*, 23 (1): 45-60.**

An updated and revised list of the cultivated gymnosperms in the orman garden is provided. It gives records to trees belonging to 9 families, 17 genera and 31 species. A brief morphological description and available nomenclatural data were given for each taxon. Most of the reported taxa are over 100 years old. Eight taxa were recently introduced.

**2012. El-Ansary, H. Towards a DNA barcode library for Egyptian flora, with a preliminary focus on ornamental trees and shrubs of two major gardens. *Versita* 10: 46-56.**

The flora of Egypt comprises over 2000 species which requires an accrued conservation effort. A successful preservation of such an impressive diversity requires the development of accurate identification tools. In this study, I provide the first attempt to reach this objective using molecular approach known as DNA barcoding, and reconstructing the first barcode library for Egyptian flora. Specifically, the use of *matK* and *rbcLa* genes as barcodes for trees and shrubs in two main gardens in Egypt was studied. Some 152 specimens (145 species) were collected mainly from Antoniades and Orman gardens and sequenced. Sequencing success was 93.5 % in *rbcLa* whereas *matK* showed lower percentage (74.4%). Using *matK* sequences taxa were correctly assigned by 97.2, 86.8 and 49.1 % on the levels of family, genus and species, respectively. Also *rbcLa* revealed 99.3, 86.1 and 51.8 % on the levels of family, genus and species, respectively. Furthermore, both markers provided us with a species and occasionally subspecies level discrimination tool in many investigated cases and a DNA barcode library for 152 specimens of the 145 species of trees and shrubs common in two main historical gardens in Egypt.

**2012. Farahat, E. and Linderholm, H. Ecological impacts of desert plantation forests on biodiversity. *African Journal of Ecology*.**

This investigation involves the comparison of the diversity of understory vegetation of four desert planted forests with the adjacent desert areas. Spatial and temporal

variations in species composition and structure were compared, and alpha and beta diversities were compared for the field data collected from sampled sites. The diversity of native desert species decreased from 66% in desert areas to 44% of the total recorded plants inside the forests. Meanwhile, the percentage of agricultural weed species increased in forests to >twofold more than that recorded in desert areas. Plant communities in forest stands shared <50% of their species with adjacent vegetation in desert stands. The percentage of variation in species composition was >340% in some forests compared with the desert areas. Alpha and beta diversities were significantly higher in forest stands than in the desert. Spatial and temporal variations in species diversity were correlated with type of tree canopy and irrigation system. Planted forests had significant negative effects on the diversity of native desert shrubs and trees. Using flood irrigation and more spacing between trees might help in conserving the floristic diversity of desert.

**2012. Farahat, E., Shaltout, K., El-Kady, H. and Shalaby, A. Allometric equations to predict the total aboveground biomass of tree species in a planted forest in Egypt. Feddes Reprtorium 123 (1): 27-36.**

The aim of this study is to estimate the total aboveground biomass (TAGB), stem height (H), diameter at breast height (dbh) and basal area of five tree species (ages 7–8 years) irrigated by municipal sewage water in the Egyptian-Chinese friendship forest, Sadat City, Egypt. From the biomass data that obtained through destructive sampling, models for predicting aboveground biomass were developed. The highest values for stem density and height were estimated for *Eucalyptus citriodora*, while the lowest for density was obtained for *Dalbergia sissoo* and stem height for *Khaya senegalensis*. The highest values for basal area and dbh were obtained for *Casuarina* spp., while the lowest were recorded for *Dalbergia sissoo*. *Eucalyptus camaldulensis* had the highest stand stem biomass and TAGB (55.5, 83.9 t DW ha<sup>-1</sup>, respectively). In addition, *Casuarina* spp. had the highest leafy branches biomass (32.5 t DW ha<sup>-1</sup>), while *Dalbergia sissoo* had the lowest values for all tree components. All the generated allometric equations had high correlation coefficients at high probability levels. Moreover, the results revealed that not only the dbh data can be used as independent variable for biomass determination, but also stem height and size index are recommended for biomass estimation.

**2010. Hamdy, R. A study of plant distribution in nine historical gardens in Egypt. Garden History 38: 267-314.**

Throughout history, Egypt has been influenced by many cultures and civilizations, much of which has been reflected in the development of its agriculture and gardens. Today there is no trace of these old Arab gardens, and those which still exist were created from the early nineteenth century at the time of the ruler Mohammed Ali (1805–1848). This study traces the history, structure and development of nine historic gardens in or bordering Aswan, Great Cairo and Alexandria; and it identifies and analyses the taxonomic diversity of the plants growing in each garden.

**2008. Hegazy, A. K., Medany, M. A., Kabieli, H. F. and Maez, M. M. Spatial and temporal projected distribution of four crop plants in Egypt. *Natural Resources Forum*, 32: 316-326.**

This study focuses on the management of the local agro-ecosystems in order to adapt planting or sowing practices for the projected climate change scenarios. It is projected that there will be increased air temperature throughout all four seasons in the coming 100 years, from the southern towards the northern parts of Egypt. The objective of this study is to investigate the influence of that increased air temperature on the spatial and temporal distribution of four of the major economic crops in Egypt. The study species are cotton (*Gossypium barbadense* L., cv. Giza 89), wheat (*Triticum aestivum* L., cv. Gemiza 9), rice (*Oryza sativa* L., cv. Sakha 101) and maize (*Zea mays* L., cv. Hybrid 10). Optimum air temperature allowing maximum growth for each of the study crop cultivars and the current and projected air temperature patterns in the future years were used for projection of the seasonal and crop distribution maps in the years 2005, 2025, 2050, 2075 and 2100. Results showed that sowing dates of a target crop may be managed in order to allow maximum predicted planting area in the same region. The current maximum area suitable for planting the Cotton crop in Egypt (104,000 fadden/year<sup>-1</sup>; (fadden = 0.96 hectare or 0.42 acre) showed few variations over the coming hundred years. In this case, the sowing dates should be changed from the hotter months (February to April) to the cooler months (January to February). Alternatively, a great reduction in the area planted by wheat crop was predicted in the coming 100 years. Despite the early planting, a reduction of about 147,000 fadden/year<sup>-1</sup> was projected by the year 2075. On the other hand, with earlier sowing dates, the maximum areas that are planted by rice and maize may not be greatly affected by the projected increase in air temperature.

**2008. Heneidy, S. Z and Marzouk, R. I. Biodiversity and Taxonomic Evaluation of the Botanic Garden, Faculty of Science, Alexandria University. *Assiut University Journal of Botany* 37 (1): 47-83.**

The present study aims to identify and classify the plant species in the Botanic Garden of the Faculty of Science, Alexandria University (BGFSAU), and to evaluate its species richness and taxonomic diversity. The garden were classified into 9 horticultural and life form categories and the highest families contribution is attained by trees and shrubs (40%) and the lowest families is attained by palm and palm-like (2%). The present study recorded 109 families, 313 genera, 411 species. The most dominant family is Leguminosae with 25 genera and 31 species. The species richness (alpha-diversity) of the plant species in the study area is 514 species / ha, while the value of species turnover (beta -diversity) is 0.8. Concerning taxonomic diversity, both species/genera (S/G) and genus/family (G/F) ratios are calculated. According to food, timber, fiber, perfume, oil, dyes and other uses in descending order for species number. The highest percentage is for decoration (53%), followed by medicinal purposes (20%). This garden is characterized by its high diversity, so the conservation of its plant diversity is an enormous challenge and national responsibility.

**2006. Farahat, E. and Galal, T.M. Species composition and community structure of Edfina Public Park, Egypt. Proc. 4<sup>th</sup> Int. Con. Biol. Sci. (Botany): 11-21.**

The present study aims at identifying and analyzing the species composition and community structure in Edfina Public Park, in the northwestern section of the Nile Delta, Egypt. Ornamental vegetation was studied in 11 gardens of Edfina Park. The number of individuals per species was also estimated. Fifty five ornamental species; belonging to 49 genera and 28 families, represented by 1335 individuals in all the gardens of the Park, were recorded. The most represented families are Moraceae (35.1 %), Palmae (31.9 %) and Myrtaceae (8.7 %). On the other hand, Leguminosae and Agavaceae have weak representation in the gardens (4 % and 3.4 %). Moreover, 5 families are represented by 2 species, and 16 families are represented by only one species. The classification of these species into the common horticultural categories indicates that perennial and annual herbs have the lowest contribution to the recorded species (4 species and 4 individuals in Sewan garden), while trees and shrubs have the highest contribution (33 species with 733 individuals in all the gardens). The application of TWINSpan classification technique on the cover estimates of 74 understory weed species recorded in 66 stands representing all the gardens, led to the recognition of seven understory vegetation groups. These groups were named after their leading species as follows: A- *Centaurea calcitrapa*, B- *Avena fatua*-*Chenopodium murale*, C- *Phyla nodiflora*-*Cynodon dactylon*, D- *Hordeum murinum* subsp. *leporinum*-*Cynodon dactylon*, E- *Cynodon dactylon*-*Malva parviflora*, F- *Poa annua*-*Cynodon dactylon* and G- *Poa annua*. Due to the history and plant wealth of this Park, it is important to develop and re-activate its role as promising educational and cultural park for the local community of Nile Delta.

**2007. Hamdy, R. S., Abd-Ghani, M. M. Youssef, T. L and El-Sayed, M. The floristic composition of some historical botanical gardens in the metropolitan of Cairo, Egypt. African Journal of Agricultural Research 2 (11): 610-648.**

In this article, we studied the historical background of six major historical botanic gardens that were established by the Khedive Ismail (1863-1879) in the second half of 19th century in Cairo city, and report their floristic composition. These gardens were Zohriya, Aquarium, Ezbekiya, The Zoo, Orman and Horreya. In addition, the present status of these six gardens was addressed in particular, area, land use, landscape architecture and the taxonomic diversity of the plants growing in each garden. The distribution patterns of the recorded species were also presented using the multivariate analysis techniques (classification and ordination). An updated annotated list of cultivated species in these gardens will be provided.

**2006. Springuel, I. The desert garden: a practical guide. The American University in Cairo Press. Cairo – New York.**

The content of this book is based on scientific information, though the scientific terminology has been simplified to be more comprehensible to the general reader. However, some specific botanical terms are still used, with explanations either in the

text or in the end notes. The common English name of the plants are used for preference, with Latin names given in brackets. Some plants growing in the wild have only local names and don't have English names, while some are given different names by different desert trips. The book begins with an outline of the vegetation of the Eastern and Western Egyptian deserts and the Nile Valley in order to provide readers with general information on the habitats where most of the plants described in this book are found in the wild. The Sinai and Gebel Elba Mountain areas are very rich in floristic diversity and endemic species but are not within the scope of this book. Knowing how the plants adapt to the dry conditions prevailing in arid lands can help in the maintenance of garden and alleviate concern. Adaptation to the aridity is covered in Chapter 3. Indigenous plants can contribute to a great variety of gardens and land-escaping. In chapters 4 and 5, recommendations are given for selecting suitable plants according to the type of garden. Nevertheless, the actual arrangement of the plants has to be decided by the owner or garden manager for each specific garden, depending on factors such as the amount of land available, and the surrounding scenery and environment.

**2006. Farahat, E. A and Galal, T. M. Species composition and community structure of Edfina Public Park, Egypt. *Proc. Con. Biol. Sci. (Botany)*, 41: 11-21.**

The present study aims at identifying and analyzing the species composition and community structure in Edfina Public Park, in the northwestern section of the Nile Delta, Egypt. Ornamental and understory vegetation were studied in 11 gardens of Edfina Park. The number of individuals per species was also estimated. Fifty five ornamental species; belonging to 49 genera and 28 families (represented by 1335 individuals in all the gardens of the Park), were recorded. The most represented families are Moraceae (35.1 %), Palmae (31.9 %,) and Myrtaceae (8.7 %). On the other hand, Leguminosae and Agavaceae have weak representation in the gardens (4 % and 3.4 %, respectively). Moreover, 5 families are represented by 2 species, while 16 families are represented by only one species. The classification of these species into the common horticultural categories indicates that perennial and annual herbs have the lowest contribution to the recorded species (4 species and 4 individuals in Sewan garden), while trees and shrubs have the highest contribution (33 species and 733 individuals in all the gardens). The application of TWINSpan classification technique on the cover estimates of 74 understory weed species recorded in 66 stands representing all the gardens, led to the recognition of seven understory vegetation groups. These groups were named after their leading dominant species as follows: A- *Centauria calcitrapa*, B- *Avena fatua-Chenopodium murale*, C- *Phyla nodiflora-Cynodon dactylon*, D- *Hordeum murinum* subsp. *leporinum-Cynodon dactylon*, E- *Cynodon dactylon-Malva parviflora*, F- *Poa annua-Cynodon dactylon* and G- *Poa annua*. Due to the history and plant wealth of this Park, it is important to develop and re-activate its role as promising educational and cultural park for the local community of Nile Delta.



**2005. Shaltout, K. H. and Farahat, E. A. Ornamental vegetation of Qanater Public Park. *Assiut University Journal of Botany*, 34 (2): 219-244.**

The present study aims at identifying and analyzing the ornamental vegetation of Qanater Public Park in the southern section of the Nile Delta, Egypt. One hundred and twelve ornamental species; belonging to 91 genera and 45 families (represented by 4449 individuals) were recorded in the Qanater Public Park. The highly represented families are Leguminosae (14.2 %), Palmae (8%) and Moraceae (7.1%). Each of Apocynaceae, Myrtaceae and Verbenaceae are represented by 6 species (5.3%). Moreover, 8 families are represented by 2 species, while 27 families are represented by only one species. The classification of these species according to the common horticultural categories indicates that trees and shrubs have the highest contribution (80 species, 3513 individuals), while cycads (palm-like) have the lowest contribution to the recorded species (1 species, 7 individuals). Many species recorded in Qanater Park were not recorded in the old gardens in Greater Cairo and some of them are very rare in Egypt such as *Sarcocephalus cordatus*. The ground weed flora associated with the ornamental plants in the Park, were identified and analyzed. Due to the history and plant wealth of this Park, it is important to develop and activate its role for the local community of Greater Cairo as an educational and cultural park.

**2004. El-Sheikh, M. A., El-Halawany, E. F. and Shaltout, K. H. Flora and Vegetation of Qanater Public Park, Southern Nile Delta, Egypt, *Journal of Environmental Sciences*, 27 (2): 137-158.**

The present study aims at identification of the synanthropic flora and description of woodland vegetation in the gardens and flower beds of Qanater Public Park (south of Nile Delta, Egypt). Due to the history and plant wealth of this Park, the authors referred to develop and activate its role as an educational and cultural park.

**2001. Zalat, S., Semida, F., El Banna, S., Sayed, E., Alqamy, H., Behnke, J., James, M. and Gilbert, F. Spatial variation in the biodiversity of Bedouin gardens in the St. Katherine Protectorate. *Egyptian Journal of Biology*, 3: 147-156.**

Three wadi systems in St. Katherine Protectorate (south Sinai, Egypt) were surveyed for spatial variation in the biodiversity of plants, flying insects and ground insects in August-September, 2000. Plant diversity and species richness were significantly different among the systems (St. Katherine and Gebal systems were more diverse than Gharaba system), and each system had characteristic groups of plant species. There were no significant differences in the diversity of flying insects among systems, perhaps because of their mobility: nevertheless St. Katherine system had the highest diversity, and Gharaba the lowest. In contrast, ground insects showed a different pattern of diversity: there were significant differences among systems, with the highest diversity and species richness recorded in Gharaba system. The results indicate that St. Katherine Protectorate is biologically very heterogeneous even among adjacent wadi

systems that are physically very close and apparently have similar physical structure. This has important implications for conservation and management.

## 6- Phytoplankton

**2017. Khairy, H.M., Shaltout, K.H., El-Sheekh, M.M. and Eassa, D.I. A Checklist of Diatom Species Reported from the Egyptian Mediterranean Lakes. Annual Research & Review in Biology 19 (4): 1-29.**

A clear and concise checklist of the diatom species for the five Egyptian Mediterranean Lakes (Mariut, western section; Edku, Burullus, Manzala, Deltaic section and Bardawil, North Sinai) has yet been documented over 40 years of cited bibliography (also with their synonyms names). A total of 390 diatom species belong to 67 genera and 38 families have been recorded. The most recorded diatom genera were *Nitzschia* (Family: Bacillariaceae) and *Navicula* (Family: Naviculaceae). This diatom list has aided in identifying the original species, accepted names, synonyms and their habitat.

**2016. Mohamed, A. B. Algal flora, cyanotoxins and potential health hazards in fish farms in Sohag Province. Ph. D. Thesis, Sohag University, Faculty of Science, Botany Department.**

This thesis investigated an important issues related to the presence of phytoplankton and cyanotoxins in fish farms including: (1) Environmental factors favoring phytoplankton growth and cyanotoxin production in fish farms at Sohag Governorate; (2) The capability of Tilapia fish to ingest and digest phytoplankton, particularly cyanobacteria; (3) The potential accumulation of cyanotoxins in *Tilapia* fish organs; and (4) Evaluation of human exposure risk to cyanotoxins through fish consumption. We gathered valuable data and the results are summarized as follows: 1. Nutrient concentrations and temperature were the dominant environmental factors that influence phytoplankton community and successional patterns in fish farms; 2. The results of H-index showed that cyanobacteria had lower diversity of species than total phytoplankton, particularly in summer and autumn months.

**2015. Khairy, H.M., Shaltout, K.H., El-Sheekh, M.M. and Eassa, D.I. Algal diversity of the Mediterranean lakes in Egypt. International Conference on Advances in Agricultural, Biological & Environmental Sciences, London, UK: 147-154.**

The five Mediterranean Lakes of Egypt (Mariut, Edku, Manzala, Burullus and Bardawil) are of global importance as they are internationally important sites for wintering of the migrating birds, providing valuable habitat for them and they are an important natural resource for fish production in Egypt. The present study aims to collect the available data on phytoplankton populations and environmental characters (physico-chemical characters) of these five lakes in order to analyze their species composition, diversity, behavior and abundance of the common species that characterizing each lake. The present phytoplankton list comprised 867 species related to 9 algal divisions, 102 families and 203 genera. Bacillariophyta was the most dominant group, while Cryptophyta, Rhodophyta and Phaeophyta were rarely

recorded and represented by only one species. The species diversity of the five lakes can be arranged descendingly as follows: Manzala (383 spp.) > Mariut (376 spp.) > Bardawil (333 spp.) > Burullus (247 spp.) > Edku (183 spp.). The highest number of unique species was recorded in Bardawil (208 spp.) followed by Manzala (128 spp.), then Mariut (85 spp.), Burullus (76 spp.) and Edku (6 spp.). The highest number of unique species in Lake Bardawil may be attributed to its hyper saline nature compared with the other oligotrophic lakes. This may also due to the lower human impact around it associated with low level of water pollution.

**2015. Hassan, M. M. Factors Affecting Phytoplankton Species Succession and Growth in River Nile at Fayoum Governorate. M. Sc. Thesis, Fayoum University, Faculty of Science, Botany Department.**

The present thesis deals with the study of changes in number and type of algae and its relation to the physico-chemical nature of the River Nile. Samples were collected from the intake of some water treatment plants in Fayoum Governorate, samples were collected from seven sampling sites to a large extent covering the stream of River Nile branches in Fayoum Governorate. The work plan was as follows: sub surface water samples were collected at monthly intervals for one year (October 2011 to September 2012) to follow physic-chemical and biological changes that may occur in the River Nile water. Water samples were collected from specific sites that were chosen to cover the study area of the River Nile at Fayoum Governorate. The results obtained in this study can be summarized in the following points: physico-chemical changes of River Nile water and biological changes of River Nile water. Algae count, algae identification and chlorophyll content were determined. The total algal count ranged between 394- 16344 Org/ml. Five algal groups were found during the study period and their counts ranged between 0-27 Org/ml, 0-38 Org/ml, 0-434 Org/ml, 57-1053 Org/ml and 280-15863 Org/ml for Dinophyta, Euglenophyta, Cyanophyta, Chlorophyta and Bacillariophyta respectively. During this study 54 species were observed 22 of them belonging to Chlorophyta, 18 to Bacillariophyta, 10 to Cyanophyta, 3 to Euglenophyta and only one to Dinophyta. Chlorophyll a concentration ranged from 0.2 to 17.53  $\mu\text{g/L}$  during the study period. A general and collective conclusion that we can withdraw from our study is that algal numbers may change in the raw Nile water according to the time and season of the year, in addition to the site of sample collection. Therefore, analysis should be conducted over yearly cycles. Dominance and diversity of algal species in aquatic ecosystem specify the quality of the ecosystem to different human uses. Study algal community structure of aquatic ecosystem is a key factor in determining water treatment technology used in Drinking Water Treatment Plant. The presence of different algal groups with high numbers during various seasons in the river Nile has led to a re-evaluation of traditional treatment technologies.

**2012. Salim, E. H. Investigations on microalgae and cyanotoxins in surface raw and drinking water. M. Sc. Thesis, Mansoura University, Faculty of Science, Department of Botany.**

The present study represents an integrated research investigating the phytoplankton and water quality in addition to cyanotoxins at places supplying raw water for drinking water treatment plants providing potable water to about three million capita at Dakahlia governorate, Egypt. A total of 177 planktonic algal taxa belonging to different 66 genera were identified in the study area. In terms of species number, the following planktonic algal groups were recorded: Chlorophyceae (66 taxa), Bacillariophyceae (56 taxa), Cyanophyceae (37 taxa), Euglenophyceae (10 taxa), Cryptophyceae (4 taxa), Dinophyceae (3 taxa) and one taxa for Chrysophyceae. This study paid considerable attention for the biological characterization of water quality in both study areas. A number of biological indices were used for this purpose including: trophic state (TSI), diversity (H'), saprobity (S), compound eutrophication (NC), trophic diatom (TDI), generic diatom (GDI), and diatomic (Id) indices. In general, most of these indices, especially diatom independent indices gave reasonable indication about water quality coping with that indicated by the physico-chemical and biological parameters. Since blue green algae (Cyanobacteria) are the sole source of natural cyanotoxins in freshwater, the study paid great attention at investigating the composition and abundance of Cyanophyceae. During this study, the blue green algal community was mainly represented by Chroococcales, followed by Oscillatoriales and Nostocales. In addition, only 9 species (*Aphanocapsa delicatissima*, *Chroococcus dispersus* var. *minor*, *C. minor*, *Coelosphaerium dubium*, *Merismopedia punctata*, *Microcystis aeruginosa*, *Oscillatoria formosa*, *O. limnetica*, *O. minima*) persistent during the whole period of study, exhibiting marked seasonal and local variations. Total microcystins in raw water displayed obvious and local variations with maximum concentrations exceeding the WHO guideline recorded during summer at both study areas. Total microcystins concentration in potable water was almost below the WHO guideline (except one sample collected from study area 1 during summer). Seven cyanophyceae species (*Anabaena khannae*, *Anabaena oryzae*, *Planktolyngbya borgerti*, *Planktolyngbya limnetica*, *Nostoc linckia*, *Pseudanabaena limnetica*, *Westiellopsis prolifica*) were isolated and their biomass content of microcystin-LR and-YR were measured using HPLC technique which prove successful and accurate quantification of microcystins.

**2011. Mohammed, R. G. Screening for some algae producing antimicrobial agents. M. Sc. Thesis, University of Beni Suef, Faculty of science, Department of Botany.**

The recent work indicated that cyanobacteria are an exciting source of novel bioactive compounds, with a high number of the purified metabolites demonstrating activity. In this study, three species of blue green algae were isolated from fresh water in Beni-Suef city (*Nostoc commune*, *Oscillatoria granulate* *Lyngbya purpurea*) and they have exhibited antagonistic activity against Gram Positive and Gram negative bacteria and filamentous fungi. Three experimental organisms have their own specific conditions for the production of the active antibiotics. The data indicated that: *N. commune* produced the antagonistic material maximally at 10 days of incubation; where *O. granulata* and *L. purpurea* produced its antagonistic material maximally at 14 and

16 days during incubation respectively. Both the growth and antimicrobial activity were higher in shaken than in static cultures for *N. commune*, *O. granulate* and *L. purpurea*. M18 medium was recorded to be the best medium for growth and antibiotic production by three species; while PH 8 was the best pH for growth and antibiotic production by three species and methanol was the best solvent for extraction of the antagonistic produced by *N. commune*. The antimicrobial activities produced by the experimental organism (*N. commune*) were subjected to series of experiments aiming to identify its chemical composition. The antimicrobial activity was purified using preparative TLC and silica gel column chromatography. The chromatographic studies of one-gram total alcoholic extract of *N. commune* resulted in the isolation and purification of four compounds. The four compounds were long chain alc, sterol, triterpen and long chain fatty acid. The four compounds were tested for their biological activities against *Bacillus subtilis*, and showed that compound C was active with *Bacillus subtilis*; while compounds A, B and D were not active against it. In the present work we used UV spectra, NMR, IR and Mass spectra data to elucidate the chemical composition of the antimicrobial activities produced by *N. commune*, but we need more chemical analyses to elucidate the complete structure of the obtained and purified compound from our isolates due to the very small amount obtained from these fractions in *N. commune*.

**2009. Ali, A. I. Biodiversity of order Naviculales (Bacillariophycophyta) in Egypt. Ph. D. Thesis, Ain Shams University, Faculty of Science.**

The present work concerned with the study of biodiversity of order Naviculales in Egypt. Examination of 154 diatom samples collected from different aquatic habitats in Egypt has been carried out. A total of 146 diatom taxa related to 18 genera and 4 families belonging to order Naviculales were identified in this study. Three taxa of the total recorded ones have been considered as unknown species and 35 taxa have been considered as new records to Egypt. All the identified taxa were morphologically described and photographed using light microscope. The ecology and geographical distribution in Egypt so far as known were given for each taxon. Synonyms of the recorded taxa were given when sufficient data are available. Identification keys are constructed for the various taxonomic categories below the order level. Family Naviculaceae (represented by 12 genera) was the dominant family and *Navicula* has the greatest diversity (34 taxa). The most widespread taxa that recorded in the present study were *Navicula cryptocephala*, *Navicula cryptocephala* var. *veneta*, *Navicula cuspidata*, *Navicula cuspidata* var. *ambigua*, *Amphora coffaeiformis*, *Gomphonema parvulum*, *Navicula rhychocephala*, *Navicula gastrum*, *Navicula pygmaea* and *Diploneis ovalis*. Alkaliphilous taxa were the dominant during the present work. The identified naviculoid diatoms in the present study could be classified according to their salinity tolerance into three forms: oligohalobous, mesohalobous and euhalobous. The eco-diatomical analysis indicated that many naviculoid diatoms could be used as indicators of different degrees of pollution: oligosaprobic,  $\beta$ -meso-saprobic,  $\alpha$ -meso-saprobic and  $\alpha$ -meso-/polysaprobic systems. The results of the present study reflected and emphasized on the importance of naviculoid diatoms not only due to their

remarkable diversity and prevalence, but also due to their great value as bioindicators of many ecological parameters.

**2009. Dessouki, S. A. Phytoplankton flora as a response of drainage input in El-Salam Canal, Egypt. Mansoura Journal of Biology, Mansoura University 36 (2).**

There was a considerable variation of water quality in El-Salam canal; Hadous drain and Damietta branch of River Nile - Egypt. These resulted in the variation of phytoplankton flora at study area. Sixty seven species of phytoplankton were recorded at River Nile with maximum mean individual numbers. Bacillariophyta was predominant group followed by Cyanophyta, Chlorophyta, Euglenophyta and Dinophyta. Hadous Drain sustained maximum mean species number (72 species) but with low mean individual number. Meanwhile, El-Salam canal have local variation in phytoplankton standing crop (32-65 species). Cyanophyta or Chlorophyta were the predominant groups followed by Bacillariophyta and Euglenophyta in both El-Salam and Hadous drain water. Phycological monitor (diversity, saprobic indices and saprobic quotient) indicate that Hadous Drain has relative high polluted water, and El-Salam canal water was more polluted than River Nile water. The matrix of biological (phytoplankton number and biomass standing crops) parameters and environmental variables of 36 samples were subjected to canonical corresponding analysis and multivariate cluster analysis. The results indicated that water quality of El-Salam Canal water was badly affected by the dumping of Hadous drain water.

**2006. El-Adl, M. F. Phycological studies on El-Salam Canal and Sahl El-Tineh region, Egypt. Ph. D. Thesis, Mansoura University, Faculty of Science in Damietta, Department of Botany.**

The main objective of the present study was to monitor water quality of El-Salam canal and and Tineh plain and realize to which extent the Hadous drainage affected the pollution status of El-Salam canal and its extension, using the physicochemical and phycological criteria to assess the water quality. The bimonthly sampling collection was started from November 2002 to November 2003. The investigation of the physicochemical properties of water displayed great local variations due to the difference in nature and quantity of the discharged wastes. A total of 201 taxa belonging to 76 different algal genera; 32 Cyanophyta, 56 Chlorophyta, 26 Euglenophyta, 1 Xanthophyta and chrysophyta and 79 Bacillariophyta were identified. Total phytoplankton standing crop (cell number) was mainly represented by Bacillariophyta (72 %), Chlorophyta (22.5 %), which represented by the bloom of *Chlorella vulgaris* var. *vulgaris* at two sites. Generally, diversity index indicates that this area has moderate pollution and saprobic index indicated slightly contaminated (mesosaprobic). The statistical analyses reflect the effect of the water quality of El-Salam canal and its extension by Hadous drain. Also, the results of AGPT test indicate that El-Salam canal water is actually injured and deteriorated heavily by various pollutants, especially heavy metals from Hadous drain and fish feeding.

**2004. Ahmed, G. G. Ecological Studies on Algal Communities in Relation to Environmental Factors at El-Kharga Oasis, New Valley, Egypt. M. Sc. Thesis, Minia University, Faculty of Science, Department of Botany.**

Physicochemical water analysis and algal investigations of 15 selected water bodies in wells (cold and hot), agricultural drainage canals, rice fields and sewage oxidation ponds at El-Kharga Oasis, New Valley, Egypt have been conducted monthly during the period June 1998- May 2000. The studied areas were located in the city El- Kharga and the surrounding areas. Throughout the period of study, a total of 233 taxa have been recorded of which 63 were Cyanophytes, 69 Chlorophytes, 19 Euglenophytes, 2 Pyri-hophytes and 80 Bacillariophytes representing 27.0%, 29.6%, 8.1%, 0.9% and 34.3% of the total number of taxa respectively. Taxa that attained large frequency of occurrence were, *Chroococcus turgidus*, *Oscillatoria* sp., *O. subbrevis*, *O. terebtriformis*, *Closterium hanumeri*, *Cosmariuin laevae*, *Denticula tenuis*, *Gomphonerna parvulurn*, *Nitzschia thermalis* and *N. umbonata*. The highest number of taxa was recorded in agricultural drains. Sewage oxidation ponds had slightly smaller number of taxa than in agricultural drains. The least number of taxa was recorded in the hot wells. Diversity of species agreed with the number of taxa being the highest at agricultural drains and the lowest at hot water wells.

**2002. Shehab, R. A. Ecophysiological Study on Some Freshwater Algae in Some Polluted Regions of Ismailiya Canal. Ph. D. Thesis, Ain Shams University, Faculty of Education.**

Lately, there was an increase in the industrial activities and many factories were established on banks of the Ismailiya Canal as one of the main River Nile tributaries in many regions. It is expected that the industrial waste water effluents discharged to Ismailiya Canal (from the gelatine and colloids; petroleum refining; fertilizers and chemicals factories and water purification station of Moustorod) induce complicated pollution problems. The present study-work was planned therefore, to follow up change that might take place in total algal count, species composition and its distribution in the Ismailiya Canal water at these regions. The physico-chemical characteristics of water were also analyzed. Sampling was carried out from September,1996 to August 1997. The effect of different concentrations of the industrial wastes of the previous factories and petroleum on total count, species composition and diversity of algal populations in Ismailiya Canal water cultures was studied *in vitro*. The physiological activities of two selected algal species, namely *Phormidium autumnale* and *Chiarella vulgaris* were also investigated after being subjected to various levels of these industrial wastes and petroleum under controlled conditions.

**2001. Abdel-Baky, J. M. Effect of some Wastes on the Algal Biodiversity in the Delta Region of the River Nile. M. Sc. Thesis, Mansoura University, Faculty of Science, Department of Botany.**



River Nile is a very important inland water, where it considered as the life artery of Egypt. Nile Delta is one of the highly crowded region lengthwise River Nile. Thus, Nile water in this region was subjected to different pollution sources due to different agriculture, industrial and other human activities. This study is an integrated research effort investigating the effects of different wastes on the community structure and algal biodiversity, as well as water quality in Delta region of River Nile.

## 7- Bacteria and Viruses

### **2018. Abdel-Azeem, A. M., Mouchacca, J. and Berlant, S. R. Fungi in Egypt: A Galaxy to Discover (in Press).**

At the present time the total fungal names recorded in Egypt amounts to 2477, a figure exceeds that of the higher plants developing in this country. This marked figure resulted from an exhaustive revision of all the existing literature and information sources established since the year 1813. On the kingdom level, Fungi came first by 2230 species, followed by Chromistan fungal analogues (186 spp.) and Protozoan fungal analogues (61 spp.). The Ascomycota form the single largest group within this checklist, with about 1762 species, of which about 158 are lichen-forming, and about 1000 known from their conidial (asexual) states. Ninety species belonging to Chytridiomycota, 27 to Blastocladiomycota, 70 to Zygomycota, 48 to Glomeromycota and 233 to Basidiomycota. Fungi are considered to be in urgent need of conservation on the grounds that it is a traditionally neglected taxon which has legal protection in few countries. Current threats upon fungi include: destruction of forests worldwide, habitat fragmentation, changes in landuse, pollution, anthropogenic climate change and over-exploitation of commercially attractive species. Formal fungal conservation efforts in Egypt began in the early 2010s with idea of establishing the Arab Society for Fungal Conservation (ASFC) that aimed at promotion, protection and development of ecosystems, habitats and wildlife, and raise awareness of the importance of fungal conservation. Egyptian fungal biodiversity may benefit from many general conservation efforts, but many specific fungus values are also overlooked. We advocate increased interaction between scientists, politicians, conservation coordinators and practitioners, for greater promotion of fungi and their conservation and ecosystem services, and for preparing the Egyptian fungal Red-List. We also in urgent need to integrate the fungal-animal-plant relationships for best conservation efforts.

### **2015. Azzam, M. I. Eco-Diversity of Aquatic Bacteria and viruses Isolated from River Nile and Drainage Water in Egypt. Ph. D. Thesis, Ain Shams University, Faculty of Agriculture, Department of Agricultural Microbiology.**

The present study aims to study the biodiversity of bacteria and viruses resulting from some physical, chemical and biological factors to know the differentiation between the autochthonous and allochthonous microorganisms. On the light of the previously mentioned objective, water samples were collected in July 2010. These samples were subjected to physico-chemical and microbiological analysis. Quantitative biodiversity for microorganisms indicated that the standard plate count bacteria at 22°C and 37°C in all collected water samples recorded high values and varied regionally. The highest value was recorded at El-Rahawy drain outlet. Bacterial indicators (e.g. total and fecal coliform and fecal streptococci) in all collected water samples exceeded the international permissible limits. *Salmonella* sp. strains were isolated from only drains outlets. The water quality index revealed that, El-Rahawy and Sabal drains have a very

bad water quality, while the upstream of El-Rahawy drain water was medium. Identification of bacteria involved isolation of 225 isolates, out of which 212 isolates were identified into 7 different species belonging to 3 main bacterial groups. These species were: *Citrobacter freundii*, *Enterococcus faecalis*, *Escherichia coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Salmonella* sp. and *Staphylococcus aureus*. Statistical study revealed the predominance of *E. coli*. The antibiotic sensitivity test was performed using 20 commercially prepared antibiotic discs belonging to 11 different groups. The identified bacterial isolates either from drains or Rosetta branch showed multiple antibiotic resistance against the individual antibiotics used with different percentages. The DNA isolated from the three *P. aeruginosa* isolates were amplified by PCR conventional method using specific primers sequences for 16s rDNA gene in *P. aeruginosa*. Water samples collected from Rosetta branch and drainage outlets were examined for the presence of phages specific for *E. coli* and *P. aeruginosa*. The obtained results showed the presence of specific phage for *E. coli* strain B3 and 1 and *P. aeruginosa* strains B2 and 101 using the spot test technique.

**2014. Abd El Fattah, M. Bacterial Oral Flora in diabetic and non-diabetic patients. Suez Canal Veterinary Medicine Journal 19 (1).**

Diabetes mellitus is a common and growing global health problem leading to several complications. Twenty two saliva samples were aseptically collected and cultured from patients at a public health clinic at Ismailia city, Egypt. Gram positive non spore forming bacilli were detected in 27 % of samples in two populations consisting of sixteen diabetic patients (three patients of type 1 and thirteen patients of type 2) and six non diabetic patients. *Bacillus subtilis*, *Streptococcus pyogenes* (Group A streptococcus), *Streptococcus agalactia* (Group B streptococcus), and *Enterococcus faecalis* were isolated from diabetic patients by 36 %, 13%, 4% and 4% respectively. *Pseudomonas aeruginosa* was detected in four per cent in non diabetic patients.

**2013. Hanna, A., Youssef, H., Amer, W., Monib, M., Fayez, M. and Hegazi, N. Diversity of bacteria nesting the plant cover of north Sinai deserts, Egypt. Journal of Advanced Research 4 (1): 13-26.**

North Sinai deserts were surveyed for the predominant plant cover and for the culturable bacteria nesting their roots and shoots. Among 43 plant species reported, 13 are perennial (e.g. *Fagonia* and *Pancreatium* spp.) and 30 annuals (e.g. *Bromus* and *Erodium* spp.). Eleven species possessed rhizo-sheath, e.g. *Cyperus capitatus*, *Panicum turgidum* and *Trisetaria koelerioides*. Microbiological analyses demonstrated: the great diversity and richness of associated culturable bacteria, in particular nitrogen-fixing bacteria (diazotrophs); the majority of bacterial residents were of true and/or putative diazotrophic nature; the bacterial populations followed an increasing density gradient towards the root surfaces; sizeable populations were able to reside inside the root (endorhizosphere) and shoot (endophyllosphere) tissues. Three hundred bacterial isolates were secured from studied spheres. The majority of nitrogen-fixing bacilli isolates belonged to *Bacillus megaterium*, *B. pumilus*, *B.*

*polymexa*, *B. macerans*, *B. circulans* and *B. licheniformis*. The family Enterobacteriaceae represented by *Enterobacter agglomerans*, *E. sackazakii*, *E. cloacae*, *Serratia adorifera*, *S. liquefaciens* and *Klebsiella oxytoca*. The non-Enterobacteriaceae population was rich in *Pantoea* spp., *Agrobacterium rdiobacter*, *Pseudomonas vesicularis*, *Pseudomonas putida*, *Stenotrophomonas maltophilia*, *Ochrobactrum anthropi*, *Sphingomonas paucimobilis* and *Chryseomonas luteola*. *Gluconacetobacter diazotrophicus* was reported inside root and shoot tissues of a number of tested plants. The dense bacterial populations reported speak well to the very possible significant role played by the endophytic bacterial populations in the survival, in respect of nutrition and health, of existing plants. Such groups of diazotrophs are good candidates as bio-preparates to support the growth of future field crops grown in deserts of north Sinai and irrigated by the water of El-Salam canal.

**2008. El-Sayed, M. A., El-Shanshoury, A. R., Sweilm, M. and Abd El-Salam, M. M. Microbiological and Physicochemical Properties of Carbamate Insecticides Treated Soil. Journal of Agronomy and Crop Science 170(4):217 – 223.**

Treatment of clay loam soil with carbaryl (sevin), thiodicarb (larvin) and methomyl (lannate) at field and 10 folds the recommended doses showed a variable effect on population of total bacteria, azotobacters and nitrifying bacteria, in addition to the soil content of total soluble salts; the effect differed according to the herbicide and the dose level. The bacterial population was significantly increased in the first five days of treatment, and then a decrease was recorded. The increase in the microbial population and total soluble salts were proportion to the levels of the insecticides. Moreover, supplementation of glucose to the soil caused substantial increase over that in the insecticide and/or glucose free soils.

**2008. Ragab, T. S. Biodiversity of Rhizobia in North Sinai Desert. M. Sc. Thesis, Cairo University, Faculty of Agriculture.**

*Acacia saligna* trees and 9 different wild herbaceous legumes grown in El-Ahrash protectorate, North Sinai, were surveyed for nodulation. Sixty five rhizobia were isolated from naturally occurring root-nodules of *Acacia saligna* trees and the different wild annuals. According to their cultural, morphological and physiological characteristics as well as SDS-PAGE of total cell proteins, the isolates were phenotypically categorized into two distinct groups. The first includes those isolated from *Acacia saligna* which were differentiated into three distinct clusters. The second group comprises isolates from wild annual legumes; analysis of their phenotypic characters building dendrograms divided them into two distinct clusters. Eight rhizobial isolates representing the various *Acacia*-rhizobia clusters were examined for inoculation of *Acacia saligna* seedlings grown in sandy soil plastic bags under sunlight or shade conditions. After 6 months, all seedlings, whether inoculated or not, formed from 4 to 87 nodules seedling-1 with lower number recorded with uninoculated seedlings. In the sunny nursery, Ac 22p and Ac18p were the most infective isolates inducing the formation of up to 87 and 75.6 nodules seedlings-1 with maxima nodule

biomass, shoot and root length and biomass. Shading severely affected nodulation of *Acacia* seedlings either with indigenous or introduced rhizobia. Uninoculated seedlings formed 17 nodules seedling<sup>-1</sup> under sunlight and 4.4 nodules seedling<sup>-1</sup> under shade conditions. Seedlings grown in the shaded nursery showed a very poor growth after 6 months. A promoting effect on growth of *Acacia* seedling roots was displayed by the isolates Ac-22p, Ac-23s, Ac-17s and Ac-17f where significantly taller roots were recorded with seedlings drenched with these bacterial inocula. For the first time in Egypt, sugarcane bagasse pith was used as rhizobia inocula carrier. Data recommended pre-sterilization of bagasse pith incorporated in the inocula formula. Survival of rhizobia in pith-based inocula was good or better than that recorded with peat based inocula. Instead of the imported Irish peat moss, the present data recommend sugarcane bagasse pith for rhizobial inoculant formulation.

**2007. El-Shanshoury, A. R. Growth Promotion of Wheat Seedlings by *Streptomyces atrolivaceus*. Journal of Agronomy and Crop Science 163(2): 109 – 114.**

Treating grains and roots of wheat seedlings with supernatants of different aged cultures of *Streptomyces atrolivaceus* stimulated plant growth. The treatment resulted in increased shoot elongation, shoot fresh and dry weights, and root fresh and dry weights but suppressed the depth of the root system. The supernatants resulted in increased shoot DNA but not root DNA. Shoot and root contents of RNA and protein were also enhanced. Effects probably caused by activity of plant growth regulators.

**2005. Kenawy, A. M. Molecular Biodiversity and Symbiosis of Common Bean Rhizobia in Egyptian soils. M. Sc. Thesis, Alexandria University, Institute of Graduate Studies and Research, Department of Environmental Studies.**

In this study, 100 common bean native rhizobial isolates were isolated from three different cultivation regions in Egypt: Ismailia (FLSwedatc. EL Wasfia and Darysa), Giza (Kerdasa) and EL-Menofia (Ashnion and FJ Shoohada). Seventy seven isolates succeeded to renodulate the common bean plants (Cultivar Bronco) in the authentication test. The other isolates lost the capacity nodulate the common bean plants.

## 8- Fungi and Lichens

**2013. Khalil, A., El-Sheikh, H. and Sultan, M. Distribution of Fungi in Mangrove Soil of Coastal Areas at Nabq and Ras-Mohammed Protectorates. International Journal of Current Microbiology and Applied Sciences 2: 264-274.**

The mycobiota composition of the mangrove soil located in coastal area at Red Sea in Egypt was investigated in twenty four soil sample were collected. Almost all samples showed clay, sandy to sandy loam texture. pH of the soil samples ranged from 7.5 to 8.9 and water content ranged from 8% to 9%. The filamentous fungi of each soil sample were examined using two isolation methods. Fifteen fungal species belonging to nine genera were identified. Results showed that most of the genera detected belonged to the Ascomycotina with fewer proportions belonging to the Deuteromycotina and Zygomycotina. The frequent species were in decreasing order; *Aspergillus*, *Cladosporium*, *Alternaria*, *Penicillium*, *Rhizopus*, *Absidia*, *Acremonium*, and *Trichoderma*. One-way Analysis of Variance (ANOVA) test showed significant differences of richness and diversity of mycoflora between sites likewise pH and Na ion of soil analysis. In Egypt as well as in other developing countries, the information on diversity of fungi associated with mangrove soil is limited. Thus, this study was conduct to elucidate the distribution and diversity of fungal species associated with selected mangrove areas.

**2013. Migahed, F. Distribution of Fungi in the Sandy Soil of Egyptian Beaches. Pakistan Journal of Biological Sciences 31 (2): 860-866.**

The mycobiota of the sandy soil of Egyptian beaches was investigated in thirty six sand samples collected from nine different localities in Egypt. The filamentous fungi were identified and assigned to thirty one genera and fifty one species. Greater populations as well as a wider spectrum range of fungal genera and species were obtained in sandy soil of Alexandria beach, while Balteem beach was the poorest one. The total count of the genus or species did not always follow the number of cases of isolation. Most of the genera detected belonged to the Deuteromycotina with fewer proportions belonging to the Ascomycotina and Zygomycotina. The genera of highest incidence and their respective numbers of species were: *Penicillium* (35.7%, 6 spp.) and *Aspergillus* (30.3%, 16 spp.). The species which showed the highest incidence in all cases was *P. chrysogenum*, followed by *P. citrinum*, *A. flavus*, *Chaetomium murorum* and *Trichoderma viride*. Several other genera and species were detected at quite low occurrence.

**2013. Abdel-Azeem, A. and Salem, M. A checklist of Egyptian fungi: 1. Protozoan fungal analogues. Mycosphere 4 (4): 794-807.**

Records of Egyptian fungi are scattered through a wide array of journals, books, dissertations, and preliminary annotated checklists and compilations. By screening all available sources of information, it was possible to delineate 61 taxa, including 3 varieties, belonging to 29 genera of protozoan fungal analogues that have been

reported from Egypt. A provisional key to the identification of reported taxa is given. This is the first species list of protozoan fungus-like analogues from Egypt.

**2012. Hassan, M. H. Studies on fungi in banana fields in Assiut. M Sc. Thesis, Assiut University, Faculty of Science, Botany Department.**

The current work was designed to study the biodiversity of fungi in the environments of banana plantations in Assiut area. Two hundred and seventy samples (air 36), (soil 78), (leaf 78) and (root 78) were collected from 6 fields of banana plantations from different localities in Assiut government during 6 seasons from April 2007 to June 2008, and assayed for fungi using 3 isolation media and 2 incubation temperature (28°C and 45°C).

**2011. Moustafa, A. and Abdel-Azeem, A. An annotated checklist of Ascomycota reported from soil and other terricolous substrates in Egypt. Journal of Basic & Applied Mycology 2: 1-27.**

By screening of available sources of information, it was possible to figure out a range of 310 taxa that could be representing the Egyptian Ascomycota up to the present time. In this treatment, concern was given to ascomycetous fungi of almost all terricolous substrate, while phytopathogenic and aquatic forms are not included. According to the scheme proposed by Kirk et al. (2008), reported taxa in Egypt belong to 88 genera in 31 families, and 11 orders. In view of this scheme, very few numbers of taxa remained without certain taxonomic position. It is also worthy to mention that among species included in the list, 28 are introduced to the ascosporic mycobiota as novel taxa based on type materials collected from Egyptian habitats. The list includes also 19 species which are considered new records to the general mycobiota of Egypt. When species richness and substrate preference, as important ecological parameters, are considered, it has been noticed that Egyptian Ascomycota shows some interesting features noteworthy to be mentioned. At the substrate level, clay soils, came first by hosting a range of 108 taxa followed by desert soils (60) taxa. At the taxonomic level, sordariales, compared to other orders, accommodated the greatest number of taxa (92 taxa) followed by eurotiales (61 taxa). Chaetomiaceae and trichocomaceae are by far the richest families by housing 61 taxa. At the generic level, *Chaetomium* occupied the first place among all reported genera by including 51 species followed by *Arthroderma* (15 spp.). Provisional keys to the identification of the reported taxa are given.

**2010. Abdel-Azeem, A. The history, fungal biodiversity, conservation, and future perspectives for mycology in Egypt. IMA Fungus 1 (2): 123–142.**

Records of Egyptian fungi, including lichenized fungi, are scattered through a wide array of journals, books, and dissertations, but preliminary annotated checklists and compilations are not all readily available. This review documents the known available sources and compiles data for more than 197 years of Egyptian mycology. Species richness is analysed numerically with respect to the systematic position and ecology.

Values of relative species richness of different systematic and ecological groups in Egypt compared to values of the same groups worldwide, show that our knowledge of Egyptian fungi is fragmentary, especially for certain systematic and ecological groups such as *Agaricales*, *Glomeromycota*, and lichenized, nematode-trapping, entomopathogenic, marine, aquatic and coprophilous fungi, and also yeasts. Certain groups have never been studied in Egypt, such as *Trichomyces* and black yeasts. By screening available sources of information, it was possible to delineate 2281 taxa belonging to 755 genera of fungi, including 57 myxomycete species as known from Egypt. Only 105 taxa new to science have been described from Egypt, one belonging to *Chytridiomycota*, 47 to *Ascomycota*, 55 to anamorphic fungi and one to *Basidiomycota*.

**2009. El Sharouny, H., Gherbawy, Y. and Abdel-Aziz, F. Fungal diversity in brackish and saline lakes in Egypt. Nova Hedwigia 89: 437-450.**

Aquatic filamentous fungi were surveyed from two brackish and two saline lakes in Egypt. Ninety-seven fungi (40 ascomycetes, 55 anamorphic fungi and 2 basidiomycetes) were identified from 764 fungal collections recorded from 545 samples collected from Lakes Edku, Marriott, Burullus and Quaron. Of these, 70 are new records for Egypt. This study represents the first report of aquatic fungi from the four lakes. Fungal communities in the four lakes were markedly different. Common fungi recorded at the four lakes are: *Periconia prolifeca*, *Clavatospora bulbosa*, *Cirrenaliaba siminuta*, *Panorbis viscosus* and *Clavatosporahalima*. Specious genera were: *Cirrenalia*, *Phoma*, *Aniptodera*, *Achaetomium*, *Pleospora* and *Zalerion*. Higher fungal diversity was recorded from the two brackish lakes than those recorded from the saline lakes. In general, there was a decrease in fungal diversity with increasing salinity. Anamorphic fungi dominated the mycobiota at the four lakes and this is in harmony with the published data.

**2008. Farghaly, M. S. Biodiversity and some physiological studies of myxomycetes in Upper Egypt. M. Sc. Thesis, Department of Botany, Sohag University.**

The present investigation was designed for studying biodiversity, seasonal fluctuation and substrates relationship of myxomycetes in upper Egypt. Study the relation of some environmental factors on the appearance and distribution of myxomycetes was recorded. Ultrastructure of fruiting bodies of some myxomycetes species were examined by scanning and transmitting electron microscopy.

**2007. Ali, E. H. Biodiversity of zoosporic fungi in polluted water drainages across Nile Delta region, Lower Egypt. Acta Mycol. 42 (1): 99-111.**

Thirty-four identified in addition to five unidentified species appertaining to ten genera of zoosporic fungi were identified and isolated from eighty four polluted water samples, which were randomly collected from different polluted sites of the water drainages along the Niles Delta in Lower Egypt. Baiting sesame seeds culture



technique was employed for the recovery of zoosporic fungi. The genera: *Pythium* and *Saprolegnia* showed the broadest spectra of species diversity, where *Aqualinderella* was only represented by one species. *Saprolegnia delica* and *Dictyuchus carpophorus* were the most dominant isolated zoosporic fungal species where they were highly occurred especially at the hyper-polluted waters with the heavy metals. These two species could be considered as indicators for the response of the structure and function of microbial communities for water pollution. Several zoosporic fungal species were rarely encountered. Both *Aqualinderella fermentans* and *Pythium rostratum* were recovered in moderate frequency of occurrence. Water samples which had high concentrations in heavy metals were the poorest in the species diversity of zoosporic fungi. Despite that, fungal species belonging to the family Saprolegniaceae flourished in hyper polluted water samples whilst those belonging to the family pythaceae predominated in more diluted water samples. Also, the prevalent species; *S. delica* and *D. carpophorus* were not affected by heavy metals concentrations being as indicators for water pollution with the heavy metals. PH values of the polluted water samples had no influence on the occurrence of zoosporic fungi. Water samples characterized by high organic matter content and low total soluble salts were the richest in zoosporic fungal species.

**2006. Seaward, M. and Sipman, H. An updated checklist of lichenized and lichenicolous fungi for Egypt. Willdenowia 36 (Special Issue): 537-555.**

A revised lichen checklist for Egypt, the first to be published since 1901, is presented. It is based on a detailed literature survey supported by a limited study of herbarium material. The list includes 163 taxa of lichenized and lichenicolous fungi, six of which are newly recorded for the country. Synonymic interpretation, a short historical background and a comprehensive bibliography are also provided. The total lichen flora of Egypt is estimated to comprise no more than 250 species with a remarkably poor representation of many common groups, such as Parmeliaceae.

**2005. Abdullah, Q. Y. Studies on Freshwater Fungi in Assiut (Egyt) and Sana'a (Yemen). Ph. D. Thesis, Assiut University, Faculty of Science, Botany Department .**

The first part of this investigation has focused on study the occurrence, distribution and biodiversity of zoosporic fungi inhabiting either surface water or submerged mud in Assiut (Egypt) and Sana'a (Yemen). Some physico-chemical characteristics (Temperature, pH, dissolved oxygen, organic matter and total soluble salts of the experimented samples) were determined as fresh water indicators. The temperature of surface water samples collected from Assiut Districts ranged between 14.0 (Alqusiya) -23.5 °C (Alghanyim); pH between 5.6 (Alqusiya) to 9.1 (Manfalut); total soluble salts between 105 mg/L (Alqusiya) and 499 mg/L (Alghanyim). The contents of organic matter ranged between 15.0 mg/L (Abnub) and 92.5 mg/L (Dairut), and the dissolved oxygen of water samples ranged between 5.0 mg/L (Abnub) and 9.2 mg/L (Alfateh).

The temperature of surface water samples collected from Sana'a (Yemen) ranged between 12.0 (Alwady) - 21.8 °C.

**2004. Abdel-Aziz, F. A. Biodiversity of Aquatic Fungi: From the River Nile to the Sea. Ph. D Thesis, Botany Department, Faculty of Sciences -South Valley University.**

This investigation has been carried out to document the biodiversity of higher aquatic fungi at seven sites in Egypt of which three are freshwater, two brackish and two saline sites.

**2004. EL-Prince, E. Mycological Flora of Commercial Hen's Eggs in Assiut, Egypt. EL-Minia Science Bulletin. Botany Section 15 (1): 203 - 217.**

A total of 225 samples of commercial hen's eggs were collected randomly from different groceries and farmer houses in Assiut City, and examined to evaluate the mycological flora of both shells and egg contents. The mycological analysis revealed that 38 of egg shell and 21 content samples were positive for molds. Molds identification revealed that 66 species belonging to 10 genera were isolated from egg shells, while 58 species belonging to 9 genera were identified from egg contents.

**2000. Abu El-Soud, S., Assawah, S. and Bedaiwy, M. Survey of mushrooms and polypores fungi in Delta region of Egypt. ICBS. 1: 525-545.**

A survey for mushrooms and polypores fungi were carried out over twelve months during September 1998 to August 1999 in fifteen localities belonging to three governorates in the Delta region of Egypt. Thirteen species of mushrooms belonging to 10 genera were identified. These genera were *Agrocybe*, *Armillaria*, *Coprinus*, *Drosella*, *Hebeloma*, *Hygrophorus*, *Lepiota*, *Leptonia*, *Panaeolus* and *Tricholoma*. Seven species belonging to 4 genera of polypores were collected (*Bjerkandera*, *Fomes*, *Ganoderma* and *Phellinus*). The abundance of mushrooms and polypores was correlated to the locality and season of collection. Saturated and unsaturated fatty acids, total protein, ash content and some elements (Pd, Cd, Mg and K) were estimated in some selected polypores fungi.

**2000. Bedaiwy, M., Mahmoud, Y. and Abu El-Soud, S. Isolation of New Gasteromycetes fungi species in Egypt. Egypt. J. Microbiology, 35 (2): 190-197.**

Seven species of gasteromycetes were collected from 8 different localities inside Gharbia governorate from September 1995 to September 1996. The species were found to belong to three genera; *Scleroderma*, *Lycoperdon* and *Pisolithus*.

**2000. Abdel-Wahab, M. A. Biodiversity of Fungi in Subtropical Mangroves. Ph. D. Thesis, South Valley University, Faculty of Science.**

This investigation have been carried out to study the several aspects of ecology and taxonomy of subtropical mangrove fungi in Hong Kong and Egypt.

## 9-Arachnida

**2017. Hassan, M. and Eissa, S. Surveillance Studies on Spiders in AL-Gharbia Province (Egypt). Egypt. J. Exp. Biol (Zool.) 13 (2): 265-271.**

Spiders are one of the more diverse arthropod taxa, ranking seventh in global diversity, which makes them a fascinating group to study. The correct identification of many spider species is considered problematic due to complex variation in morphology. The Egyptian spider fauna are incompletely revised due to plenary studies on this group in Egypt from different localities. Samples of spiders were collected during 6 months (2/2016 - 8/2016) from six different sites represented Gharbia Province (30.881°N, 31.06°E), Egypt. Sampling of spiders using hand picking, sweep net and pitfall trap methods revealed total 157 specimens. A proposed key was designed to facilitate identification of the collected families, genera and species using their taxonomic characteristics of each. The present study reported list of total 15 families, 19 genera and 15 species of spiders.

**2013. Ahmed, R. A. Mites associated with red palm weevil, *Rhynchophorus ferrugineus* Olivier (Curculionidae: Coleoptera) in Egypt. M. Sc. Thesis, Cairo University, Faculty of Agriculture, Acarology Department.**

Biodiversity and seasonal fluctuation of the mite families associating with the red palm weevil, *Rhynchophorus ferrugineus* olive (coleoptera: curculionidae). Thirteen mite species belonging to 10 families and 2 suborders were found associated with the adults . Ten mite families belonging to 2 suborders were collected from the red palm weevil *Rhynchophorus ferrugineus* (order: Coleoptera) and their habitat from Ismailia governorate in Egypt. Suborder Gamasida included 8 families.

**2011. Hamed, N. A. Factors Affecting Abundance and Diversity of Some Soil Mites (Acari) in Different Soil Types in Ismailia Governorate, Egypt. Agricultural Research Journal Suez-Canal University 11 (1).**

Factors affecting the abundance and diversity of soil mites in Ismailia Governorate were studied during twelve successive months from October 2008 to September 2009. It was carried out in four different localities cultivated with mango trees at three different depths. Results showed that there were 35609 individuals of soil Acari belong to four suborders were obtained; Oribatida, Actinedida, Gamasida, Acaridida. Oribatid mites obviously constituted the highest percentage of the total mite fauna, constituted about 40 % in the four soil types. The highest mean abundance of soil mite species were recorded in April ( $125.9 \pm 22.7$ ), while the lowest abundance was recorded in September ( $58.7 \pm 4.0$ ). The highest mean abundance recorded in litter was ( $112.8 \pm 10.1$ ), while the abundance of soil mites recorded in the soil depth 0-10 cm was ( $79.9 \pm 4.1$ ) higher than their mean abundance in deeper soil depth ( $2.9 \pm 54.6$ ).

**2009. Abou-Tayesh, M. A. Survey and Seasonal Abundance of Acari Associated with Stored Onion (*Allium cepa* L.) and Insects Occurring in Field, Egypt. Journal of the Advances in Agricultural Researches, Alexandria University.**

Results revealed that 11 mite species belonging to four families and three suborders were found associated with the onion during storage. Among them, three species are of Acaridida, five of Actinedida and three of Gamasida. High population densities of mites occurred in summer and autumn while low populations existed in spring and winter. Acaridida was found to occur in great abundance and also dominated other acari groups in number since was found to be like most 79.3% of all numbers, while, Gamasida constituted with 7.3%. Actinedida 13.4% came in-between. A survey was carried out at Kafr El-sheikh and Menoufyia regions during vegetative growth of onion crop. Results revealed recording 11 species of insects at Kafr El-Sheikh while, at Menoufyia region it was only 10 species of insects were captured. These insects could be classified as follows: 1. harmful: three insect species belonged to three families and two orders in Kafr El-Sheikh and Menoufyia during both seasons; 2. beneficial: six insect species belong to four families and three orders obtained in Kafr El-Sheikh region during the two seasons, While at Menoufyia region 5 insect species belong to 4 families and 3 orders found during the two seasons: and 3. visitor insects: two insect species belong to two families and two orders were obtained at Kafr El-Sheikh and Menoufyia regions in two seasons. Diversity values of suborder Acari was 0.98, 1.46 and 1.04 for Acaridida, Actinedida and Gamasida mites at Menoufyia region in the first season, respectively. In the second season, it was 1.02, 1.15 and 1.09, in the onion stored, respectively. The diversity values of insects during vegetative growth of onion crop were 0.73 - 0.46 - 1.50 - 1.42 and 0.52 - 0.65 for insect pests, beneficial and visitor insects at Kafr El-Sheikh region, respectively. While, at Menoufyia region they were 0.77 - 0.72 - 1.57 - 1.63 and 0.43 - 0.61, respectively.

**2009. Ramdan, A. S. Anthropogenic activity impacts on the biodiversity of ground fauna in Port Said area. Ph. D. Thesis, Suez Canal University, Faculty of Science, Department of Zoology.**

The present study was aimed to evaluate the impact of three human activities: agriculture, industry and animal rearing on the ground fauna of southern area of Port Said. This study also investigated the respective effects of habitat type, landscape context of habitats and climatic factors on ground fauna assemblages. To achieve this study, five localities were chosen, one industrial, one cultivated, one animal rearing and two controls. Sampling effort curves of 20 pitfall traps are adequate reflection of the species diversity of the sampling sites. A total of 27845 individuals belonging to 110 species were caught throughout the study period. The maximum number of species was collected from the animal rearing sites; while the lowest ones from the cultivated sites. The diversity of ground animals varied spatially and significantly among different study sites. Otherwise, there was no difference in the temporal scale in Simpson diversity index among months during the study period. There was a highly

significant difference between different study sites in species richness. Thus, Rear-A site was the highest of species richness (76 species); while the Ind-A site was the lowest one (33 species). Also, the species richness varied significantly along times during the study period; September-2005 had the maximum species richness (69 species), but December-2004 and March-2005 had the minimum (39 species). There was no significant difference among orders of the ground fauna in terms of species richness; while there was a highly significant difference between them in terms of number of species. The highly represented order was Araneida at industrial, animal rearing and cultivated sites. The study has shed light on one of the most important regions of Egypt. The habitat heterogeneity of the region clearly affects species diversity and community composition. It illustrates the fact that this area needs much more attention in order to promote its conservation via a sustainable management programme.

**2008. Abou-Tayesh, M. A. Survey of Soil Acarina and Collembola Inhabiting Onion (*Allium cepa*, L.) at two Locations in Egypt. Agricultural Research Bulletin, Kafr El-Sheikh 34 (4): 1020-1034.**

The investigated fields were grown up with Onion crop (*Allium cepa*, L.) fauna was recorded till 20 cm soil deep. An investigation that lasted for seven months in two seasons was conducted aimed to survey the occurring soil arthropods and the diversity between species and families within the recorded organism in the two selected sites. Results revealed in recording 12, 10 and 15 species of collembolan, predacious mite and miscellaneous mite (respectively) belonging to 33 families from Desouk city, while, Sadat city region, recorded 9, 8 and 12 species of collembola, predacious mite and miscellaneous mite, respectively belonging to 26 families. *Tulbergia callipygos* (Borner), *Amblyseius gossipi* (El-Badry) and *Rhizoglyphus echinopus* (F. and R.) were the dominant species under onion crop in two seasons.

**2008. El-Sharabasy, M. Preliminary study on the occurrence of soil mites in Sinai Peninsula, Egypt. Mansoura Journal of Biology, Mansoura University 35 (1).**

This investigation was carried out for the first time to evaluate the distribution ecology of soil mites fauna at El-Maghara region, Sinai Peninsula. Egypt. Soil samples to depth 20 cm were collected from different materials. Eighteen soil mite species belonging to 18 genera and 17 families were found. Gamasida were represented by 7 families, while here Actinedida. Acaridida and oribatida were represented by 7, 1 and 3 mite species, respectively. Shannon - Wiener index ( $H'$ ). Pielou's ( $J'$ ) and dominant analysis were estimated. Actinedid mites have been found as numerically among the soil mites (7 species and 222 individuals).

**2005. Zaher, M. and El-Hennawy, H. Survey and populations of spiders and other arthropods in cucurbit and legume fields in Al-Kanater (Egypt). Serket 9 (3): 91-100.**

Survey on spiders and other arthropods inhabiting fields of four legume and five cucurbit crops, as well as seasonal abundance of spiders were investigated at Al-Kanater Agricultural Research Station during one year. Sixteen spider families, of about 33 genera and 33 species were recorded. Spring showed the greatest number of spider taxa (29) followed by 22 in summer, while autumn recorded the lowest number (15). Other associated arthropods included three classes, 10 orders and about 40 genera, i.e. one order of Crustacea, three of Chilopoda (Myriapoda), and six of Insecta which included about 40 species in more than 33 genera and 22 families.

**2004. Abd El-Moniem, H. E. Ecological and Taxonomic Studies on Some Spiders of South Sinai. M. Sc. Thesis, Suez Canal University, Faculty of Science, Department of Zoology.**

Using pitfall traps, wandering spiders (Arachnida: Araneae) were sampled in a nested design from three different localities in the mountainous arid ecosystem of South Sinai at low, middle, and high altitudes. Each locality was represented by four different sites (20X15 m), and each site had twelve individual traps distributed systematically. Habitat type and altitude were clearly different among the three localities. Spiders' diversity per trap varied spatially and temporally among the different localities and sometimes within localities. Altitude, relative humidity, and temperature had different effects on spiders' diversity and appear to have either positive or negative correlations with the abundance of different recorded families. Habitat heterogeneity within a locality may also affect spiders' diversity. The different localities had distinct and characteristic groups of spiders responding to altitude and habitat characteristics.

**2003. Abdelmoniem, H., Zalat, S., El-Naggar, M. and Ghobashy, A. Spider diversity in relation to habitat heterogeneity and an altitudinal gradient in South Sinai, Egypt. Egyptian Journal of Biology 5: 129-137.**

Using pitfall traps, wandering spiders (Arachnida: Araneae) were sampled in a nested design from three different localities in the mountainous arid ecosystem of South Sinai at low, middle, and high altitudes. Habitat type and altitude were clearly different among the three localities. Spider diversity per trap varied spatially and temporally among and sometimes within localities. Altitude, relative humidity, and temperature had different effects, either positive or negative with the abundance of different families. Habitat heterogeneity within a locality may also affect spider diversity. The different localities had distinct and characteristic groups of spiders responding to altitude and habitat characteristics.

**2003. Hussein, A. M. Biodiversity of spiders in weeds of vegetable field margins in Menofiya Governorate, Egypt. Annals of Agricultural Science, Moshtohor 41 (1).**

In the agro-ecosystems of Menoufiya Governorate pit-fall traps were used for sampling spiders (Araneae) in 2 areas. The first was a kidney bean field crop *Phaseolus vulgaris* and the second a fallow of 2 weed species *Cyndon dactylon* and

*Paspalum paspalodes*. The survey aimed to evaluate spider biodiversity in both areas. The results showed an increase in both species and families in the weed area as ten families were recorded against 4 in bean field. Lycosidae were the most abundant family in both areas, followed by Clubionidae, Dysderidae and Gnaphosidae in weeds, and followed by Linyphiidae in bean crop. Lycosidae represented 41.6% and 84% of the total spider populations in the weed area, and 61% and 91% in kidney bean plantation in spring and autumn seasons, respectively. Reproduction rate was concentrated during autumn in the weed area. Weeds environment seems to be a suitable habitat for the spiders as reserves of this important biocontrol agent against different pests in vegetable plantations.

**2003. Sharshir, F. A. Ecological Studies on Soil Mites and Flora in Three Protected Islands and Peninsula (Bar Bahary) North Borolos Lake, Baltim, Kafr El-Sheikh Journal of Agricultural Research, Kafr El-Sheikh University 29 (4): 657 - 671.**

One-year investigation was carried out in four areas in Borolos Protectorate (130,000 fedan). These are the Peninsula (Bar Bahary) and three islands of the Borolos lake that located at the up-most line of Kafr El-Sheikh governorate and the lake opens on the Mediterranean Sea . The tested area were covered with wild different herbage species: *Suaeda vera*, L., *Arthrocnemum macrostachyoides*, L., *Halocnemum strobilaeum*, L., *Halimianne partulacoides*, L. and *Zygophyllum aegyptium* L. The objectives of the present investigation were to record the soil mites. At every sampling date, a cylinder of 10 cm width by 20 cm depth was taken from soil under the pulled plants to represent the soil sample. Results recorded 24 species of halophytic plants from four localities and soil mites of suborders, Gamasida, Actinedida, Acaridida and Oribatida. Actinedida was the dominant in soil (45.6%). The total species from Bar Bahary (31.1%), El-Kodia (25.0%), El-Makataa (23.4%) and El-Mahgara (20.5%); all were recorded from *Suaeda vera* (23.7%), *Arthrocnemum macrostachyoides* (22.9%), *Halocnemum strobilaeum* (12.8%), *Halimianne partulacoides* (20.5%) and *Zygophyllum aegyptium* (20.1%). The highest numbers of mites occurred in summer season (33.9%), followed by autumn (30.1%), then spring (21.6%), while winter had the least (14.3%).

## 10- Insects

**2014. Power, A., Zalat, S. and Gilbert, F. Nowhere left to go: The Sinai Hairstreak *Satyrium jebelia*. J Insect Conserv 18: 1017–1025.**

High-mountain endemics with very restricted ranges are likely to have a high risk of extinction under the various scenarios of global warming. Endemic to the high mountains of the St Katherine Protectorate in South Sinai (Egypt), the Sinai Hairstreak *Satyrium jebelia* is just such a species. For the first time, its population size was estimated and its distribution and that of its larval food plant (*Rhamnus dispermus*) were mapped. The total world population in 2012 was estimated to be 1,010 individuals, perhaps divided into six smaller sub-populations of varying size. Its moderate dispersal ability and the relatively close proximity of the sub-populations may indicate meta-population structure, but more data are needed. Aspects of hostplant and habitat quality were significant predictors of the presence of Sinai Hairstreaks on individual trees. No immediate threats are evident except global warming: if current climate-change predictions for Egypt are correct, the quality of habitat and plant diversity will decrease in the St Katherine Protectorate, with obvious long-term conservation implications.

**2013. James, M., Gillbert, F. and Zalat, F. Thyme and isolation for the Sinai baton blue butterfly (*Pseudophilotes sinaicus*). Ecologia 134: 445-453.**

The distribution of the narrowly endemic butterfly was studied. Potential habitat within its region was first located, and then the quality of that habitat assessed. Degree of shelter diversity of plant species and resource area of an individual food plant all affected habitat quality and together were used to develop an index of habitat quality and together were used to develop an index of habitat suitability applicable to each site.

**2012. El-Surtasi, E. I. Impact of anthropogenic activities on the ground insect's biodiversity in New Damietta region, Egypt. M. Sc. Thesis, Mansoura University, Faculty of Science in Damietta, Department of Zoology.**

New Damietta is a recently reclaimed and developed region along coastal Mediterranean Sea. The importance of this region is attributed to holding projects such as industry, fish cultures, resorts and tourism, urbanization, port, animal rearing and agricultural activities. Due to the rapid development in this region, it was necessary to investigate the impact of all these anthropogenic activities and related habitat factors on the biodiversity. Insects were collected using pitfall traps from 10 different sites in New Damietta for a period of two successive years (2007-2009), where each sampling site had twenty traps distributed systematically in a grid arrangement. Seven sampling sites among the ten sites represented four different types of anthropogenic impact (agricultural, animal farms, tourism, and urbanization) and the three other sites were used as control sites. The results revealed extreme significant differences of spatio-temporal variation in species diversity, abundance, and richness. A total of 20,200



specimens were trapped, representing 137 species from 31 families and 9 orders. The species of family Formicidae (28 spp.) and order Coleoptera were the dominant. The results clearly identify the impacts of anthropogenic activities on the insect's biodiversity, where the sites with no anthropogenic activities showed the highest species diversity and richness in control sites comparing with the disturbed ones. Site impacted with touristic activities was characterized with the highest ground dwelling insects, ant abundance and beetle evenness; in addition to lowest diversity (Simpson index) and evenness of the ground dwelling insect and ants. Moreover, agricultural habitat (guava and palm trees) had the highest ant evenness and diversity (Shannon index) of the ground dwelling insects. Regarding to urbanized impact sites, the city site with less impact had higher species richness; while the others varied in their degree. Coastal urbanized site harboured the lowest one in species richness of the ground dwelling insect fauna. While, the other city urbanized site recorded the lowest value of Simpson diversity, abundance and species richness of beetle fauna with the highest value of ant evenness. The most abundant and lowest evenness indices values of beetle species were detected at animals rearing farm. Additionally, classification and ordination analyses (DCA and TWINSpan) differentiated between control sites and their impacted sites in addition to detection of 17 species of beetles and ants as bio indicators. The physical and chemical soil characters, flora and climatic factors have an important role in reflection of insect community diversity.

**2012. Salem, A. A. Population Fluctuations of Cereal Aphids and Their Associated Hymenopterous Parasitoids in Wheat Fields. Minia Journal of Agricultural Research and Development 32 (2).**

In Egypt, wheat is the most important crop for direct human consumption and for animal feed. The present work was carried out at Abnoub location, Assiut Governorate throughout two successive wheat growing seasons (2010 and 2011). Survey studies of arthropod fauna in wheat fields revealed the presence of 34 insect and mite species belonging to 17 families and 9 orders as well as some unidentified species of true spiders belonged to order Araneida. The number of pests represented 13 species belonging to 8 families and 5 orders. Maximum numbers of aphids on wheat plants were recorded during the 3rd week of January and February, respectively in two seasons. On other side, highest numbers of parasitoids (mummies on plants) were recorded during the end of March 2010, while in 2011 recorded during the 2nd week of March. Using sweep-net method, results indicated that the dominant percentages of parasitoids was higher than those of aphids which represented 65.6 and 60.4 % during 2010 and 2011 seasons, respectively. *Diaeretiella rapae* was the most dominant and abundant primary parasitoid species represented 40.2 and 31.5 % during 2010 and 2011, respectively. Maximum parasitism (95.7%) was recorded during the 2nd week of March in 2010 season, while in 2011 recorded during the 3rd week of March (87.7%). Generally, hymenopterans parasitoids may be play an important role in controlling the cereal aphids in wheat fields.

**2012. Assi, R. M. Impact of agricultural practices on soil fauna in Egypt and Nigeria. M. Sc. Thesis, Cairo University, Institute of African Research and Studies, Department of Natural Resources.**

This study was conducted in the seasons of planting maize and wheat in Mahala during the period from June 2008 to May 2009 to study the impact of agricultural practices on the intensity and activity of soil fauna and the impact of these practices on the biological balance and order environment. The collected soil fauna by pitfall traps drilling number 40 trap every month throughout the study period and collected random samples of soil every season of the year with 10 samples and conducted by some tests soil chemical properties soil pH of the soil salts in the soil- electrical conductivity- the proportion of organic matter in the soil.

**2010. Bayoumy, M. H. Efficiency of certain parasitoids as bioagents against some scale insects. Ph. D. Thesis, Mansoura University, Faculty of Agriculture, Department of Economic Entomology.**

This study aims to study the followings: 1- effectiveness of the main diaspidid parasitoids under natural conditions, 2- influence of temperature and relative humidity on the parasitoids' populations, 3- influence of some ecological factors on host-parasitoid relationships, 4- effect of cold storage on post-storage survival rates, and 5- suitability of classical biological control for *Q. perniciosus* using the native parasitic wasps to Egyptian fauna. *Aphytis diaspidis* and *E. perniciosi* are the most dominant parasitoids of *Q. perniciosus* in Egypt and Austria, respectively. The effect of different parasitoid species in reducing *Q. perniciosus* population was higher in Egypt than Austria; however, the population of *Q. perniciosus* seems to be regulated in Austria because the complementary effect of different mortality factors with special reference to extreme winter temperature. *Aphytis diaspidis* has to be considered as a promising agent in future biological control programs for both *Q. perniciosus* and *H. latania*, because it is an extrinsically effective competitor, it had a higher intrinsic rate of increase than its hosts, and develops more than one generation to each host generation. The accumulative intrinsic rate of increase steeply declined in the day of 21<sup>th</sup> after wasp emergence. This result has to be considered in future biological control programs. Suitable temperature for both mass rearing and bio-control programs of *E. citrina* is 20 °C. At this temperature, it has the highest searching rate, killing power, attack rate, daily ovi-positional rate with regular distribution of its eggs among hosts, and the lowest handling time. Once, to reduce the detrimental effects of cold storage, old pupae of two days before emergence must be storing not more than 7 days on 10 °C. *Encarsia citrina* seems to be a weak density dependent mortality factor (type I response) and *E. perniciosi* an inverse density mortality factor (type II). Suitable temperature for *E. perniciosi* activity and reproduction is 25 °C. *A. diaspidis* was efficient at a low host infestation degree of *Q. perniciosus* and *E. citrina* at a middle infestation. Finally, manipulation of the native parasitoids, *A. diaspidis* and *E. citrina* by mass rearing and timing release techniques might improve the quality of pest control. However, importation of *E. perniciosi* as an excellent specialist bio-control agent to support the role of native parasitoids in Egypt considers the most important

requirements, otherwise the cosmopolitan widespread polyphagous *Q. perniciosus* might be become a serious problem in several fruit farms in Egypt.

**2010. Gilbert, F., Rashad, S. and Kamel, M. Monitoring of the endemic Sinai Baton Blue butterfly *Pseudophilotes sinaicus* in the St Katherine Protectorate, South Sinai. Egyptian Journal of Biology 12: 18-26.**

Results of the monitoring of the Sinai Baton Blue butterfly in its stronghold of Farsh Shoeib on Gebel Safsafa in the St Katherine Protectorate between 2004-9 is analysed to compare them with the detailed study of Mike James in 2002-3. The butterfly appears to have a three-year population cycle, with its population crashing regularly to very low levels. The conservation implications are discussed.

**2009. Abd El-Wahab, A. S. Seasonal abundance of aphids on three common bean varieties at Qalyubia governorate, Egypt. Journal of Agricultural Science, Mansoura University 34 (9).**

This investigation was conducted at Qaha Agricultural Station, Qalyubia governorate to survey the aphid fauna on three common bean varieties; bronco, polista and contender and to study their seasonal abundance and the impact of varieties and sowing dates during the growing seasons 2005/2006 and 2006/2007 on the infestation rates with aphids. The obtained results revealed, 11 different aphid species in both growing seasons; *A. kondoi* was recorded for the first time in Egypt. From 6 to 9 species were recorded on the different plantations. *Aphis fabae* was the most common aphid species recorded in a relatively high number, followed by *A. craccivora*. *A. pisum* was the most dominant, although its general average was not very high, while both of *Aphis fabae* and *A. craccivora* were the most common aphids on Nile plantation throughout the period of study on all varieties. Generally speaking, the obtained results declared that aphid infestation was high in the Nile plantation than in the summer. Common bean plant variety contender was the least infested ones.

**2009. Galal, L. A. An initial study on arthropod succession on exposed human tissues in Assiut, Egypt. Mansoura Journal of Forensic Medicine and Clinical Toxicology, Mansoura University XVII (1).**

Forensic entomology uses different stages of arthropods as an entomological evidence at death scene to estimate the postmortem interval (PMI) using either succession waves or maggot age and its development. The arthropod succession patterns are greatly affected by temperature and humidity. Their development rate also differs physiologically depending on their geographical origin. Therefore, the knowledge of local fauna is very useful in forensic investigations. Data from other areas having both different environmental and faunal characteristics might provide insufficient degree of accuracy. The aim of this study is to document arthropod fauna and succession pattern in relation to decomposition stages of human left over parts in Assiut, during spring-summer season. The experiment was performed during spring-summer season. Human left over parts from orthopedic theatre were used. Specimens were placed in a box,

floored with soil and protected with scavenger-exclusion cage and placed upon the roof of Faculty of Medicine, Assiut University Campus. Inspection of the specimens was done and at each visit flying insects, larvae and crawling species were collected. Immature stages were reared in the laboratory till adult stage in order to be identified. The results of main insect groups were discussed in relation to decomposition stages. Many insect species were identified and the following orders were represented: Diptera (Calliphoridae, Sarcophagidae, and Muscidae), Coleoptera (Dermestidae) and Hymenoptera (Formicidae). Preliminary documentation of entomofauna of Assiut city (arid, urban environment) revealed that Diptera was the predominant group followed by Coleoptera. *Chrysomya albiceps* was the predominant species and the only *Calliphora* species found to colonize the human tissues.

**2009. Mahmoud, R. S. Bioecological Studies on Scale Insects and mealy bugs Occurring on Ornamental plants in Alexandria Governorate. Ph. D. Thesis, Alexandria University, Faculty of Agriculture (Saba Basha).**

Insect pests are regarded as one of the important injurious factors responsible for deterioration of ornamental plants in Egypt. Amongst, scale insects constitute one of the common insect pests of ornamental plants which are extensively cultivated in Egypt and play an important role in the national economy . Scale insects (Hemiptera: Coccoidea) are sap feeding pests of many agricultural crops and ornamental plants. They are common on ornamental trees and shrubs. Occasionally they build up in large enough numbers to cause serious damage or death to the host tree. Scales do not resemble typical insect pests, so they often go unnoticed until a large population has developed and caused damage. The main harmfulness of scale insects consists in sucking the plant sap which affects the growth, leads to defoliation, withering of shoots or the entire plant. A secretion of honey dew which coats the plant surface impedes the assimilation and photosynthesis. One of the most common groups of scale insects attacking ornamental plants is called mealy bugs. Mealy bugs are prevalent pests in green houses and interior plants capes such as shopping malls, conservatories, hotels and office buildings. Mealy bugs cause great losses to growers and retailers as millions of pounds per year for control costs and crop damage or loss. Damage is caused due to feeding of mealy bugs on host tissues and injecting toxins or plant pathogens into host plant. In addition to the secretion of a waste product, honeydew, which is a syrup, sugar liquid that falls on the leaves, coating them with a shiny, sticky film. Honey dew serves as a medium for the growth of sooty mold fungus that reduces or inhibits the plant's photosynthetic abilities and ruins the plant's appearance. Feeding by mealy bugs can cause premature leaf drop, dieback, and may even kill plants if left unchecked. In this concern *Orthezia insignis* is a mobile scale insect, which can do considerable damage to *Lantana* sp.*O. insignis* produces copious amounts of honey dew. While yellow sage (*Lantana camara*) is occasionally sold as a house plant and may also be planted outdoors in the summer. All parts of the plant are quite toxic, and poisoning may occur year-round but is most common in summer and fall. The fruit of *L. camara* may poison humans if ingested, occasionally resulting in death. Its leaves were poisonous. Children who ingested green berries became ill and

died. Care should be taken to keep children as well as family pets away from this plant. Sheep, cattle, horses, and humans are sensitive to the effects of the plant. Vice versa, it is widely used as a traditional medicine for the treatment of infectious diseases.

**2009. Elbanna, S., Zalat, S. and Gilbert, F. Patterns of resource use by milkweed insects in Sinai. Egyptian Journal of Biology, 11: 58-70.**

Plant morphology and defensive chemistry are related to the insect community of herbivores on *Gomphocarpus sinaicus* (Boiss.) (Apocynaceae) in Sinai (Egypt). There appears to be significant variation among individual plants in the components of their chemical defences. The different components of the community respond differently to plant characters; plant defence appears to be an important determinant of the relative abundances of the insect species. The data showed an indications of different relationships of the insect herbivores to levels of chemical defences, especially aphids. While weevil and bug densities covaried, those of aphids varied more independently, and possibly inversely. The community is compared with the much better known North American herbivore community on plants of the sister-genus *Asclepias*.

**2008. Hamouda, S. H. Predators in Middle Egypt. Minia Journal of Agricultural Research and Development. 28 (2): 193 - 211.**

Field observations on insects associated with three broad bean cultivars were carried out during 2005/2006 growing season. using direct count and sticky trap techniques. Five insect pests and two common predators were recorded on all broad bean cultivars. The dominant pest was cowpea aphid, (*Aphis craccivora* Koch) which represented about 70% of the insect fauna followed by the leaf miner, (*Liriomyza trifolii* Burgess) which represented by about 13.4%. However, green peach aphid (*Myzus persicae* Suz.), onion thrips (*Thrips tabaei* Lin) and the leafhopper, (*Empoasea decipiens* Paoli) showed low occurrence during the whole growing season. Numbers of the two associated predators, i.e. the lady bird beetle, *Coccinella undecimpunctata* L. and anthocorid bug, *Orius albidipennis* Reut. showed positive correlation with their preys which reflected that these insect predators unable to suppress the key pest, *A. craccivora* . In addition, the high infestation by *A. craccivora* occurred during the critical vegetative growth stage with insignificant differences between Giza 2, Giza 429 and Wally broad bean cultivars. Therefore, the broad bean fields must be examined every 3-7 days to avoid heavy infestation by aphids.

**2008. Abdel-Gahny, G., Zalat, S., Abo-Ghalia, A. and Semida, F. Ecological studies of some insects associated with Bedouin settlements in St Katherine Protectorate, South Sinai, Egypt. Egyptian Journal of Biology 10: 95-103.**

Two wadi systems in the southwestern part of the St Katherine Protectorate were surveyed for one year to record the seasonal abundance and food preference of the most common troublesome household pests in Bedouin villages (the oriental hornet *Vespa orientalis* and cockroaches). There was no significant difference between wadis

in wasp and cockroach abundance, even though they differ in altitude, Bedouin density and type of tourism impact. The wasp was abundant from April to November, peaking during August, and disappearing between December and March. Cockroaches were very abundant in houses, peaking in August, and reaching a minimum in winter. The abundance of *Vespa orientalis* has important implications for wild bees, and the huge numbers of cockroaches have health implications for Bedouin.

**2008. Zalat, S., Gilbert, F., Fadel, H., El-Hawagry, M., Saleh, M., Kamel, S. and Gilbert, J. Biological explorations of Sinai: flora and fauna of Wadi Isla and Hebran, St Katherine Protectorate, Egypt. Egyptian Journal of Natural History 5: 6-15.**

A comprehensive survey was accomplished for two of the most important and beautiful wadis in the Sinai, Wadi Isla and Hebran. The biodiversity of the two wadis are surveyed including plant species and their associated insects, spiders and scorpions. The list includes 20 plant families with 51 species, 8 insect orders with 54 families and 138 species, and 4 arachnid orders with 17 families and 23 species. The highest number of recorded species were those of *Coleoptera* and *Hymenoptera*.

**2007. Newbold, T., Meregalli, M. and Colonnelli, E. Redescription of a weevil *Paramecops sinaitus* (Coleoptera: Curculionidae: Molytinae) from the Sinai and an ecological study of its interaction with the Sinai milkweed *Asclepias sinaica* (Gentianales: Asclepiadaceae). Eur. J. Entomol. 104: 505–515.**

We collected specimens of *Paramecops sinaitus* (Curculionidae: Molytinae) from south Sinai in Egypt, which enabled us to make the first complete description of this species. We also include some taxonomic remarks on the genus. *Paramecops solenostemmatidis* is a synonym of *Paramecops sinaitus*. We propose the new combination *Paramecops sogdianus*, based on *Perihylobius sogdianus*, which would make *Perihylobius* and *Paramecops* synonymous. Like other *Paramecops* species, *P. sinaitus* appears to share a close interaction with Asclepiads, in this case the Sinai milkweed *Asclepias sinaica* (Boiss.) Muschl. (Asclepiadaceae). We investigated the oviposition behaviour of female weevils to test whether it is linked to larval performance, as predicted by coevolutionary theory. We found that female oviposition preference was positively related to plant size and to the volume of the seed follicles in which the eggs were laid. The survival of eggs was negatively related to plant size, perhaps due to plant differences in the production of defensive cardenolides. Larval survival was not related to plant size but increased with follicle volume, probably as a result of competition for food. *Paramecops* is relatively sedentary and nocturnal in its behaviour. Night-time observations of behaviour showed that weevils were more active at lower temperatures.

**2006. Semida, F., Elbanna, S., Zalat, S. and Gilbert, F. Insect-plant interaction in Sinai ecosystem. Entomology 7: 173-183.**

The weevil paramacops and its host plant were chosen for this study. Behaviour of the weevil was observed. Chemistry of both the insect and the host plant was investigated as well. The current study revealed that the insect starts its activity during early night and increasing its feeding activity from 8 pm up to 11 pm, with a peak of activity at 10 pm. Other activity patterns were investigated as well.

**2004. Abdel-Dayem, M. S. Diversity and spatial distribution of ground and tiger beetles (Carabidae, Coleoptera) in the Sinai Peninsula, Egypt. Bull. Ent. Soc. Egypt 81 (57).**

The carabid beetle fauna was investigated and analyzed in Sinai Peninsula for the first time through many expeditions and field trips since 1992 until 2004, in addition to a critical examination of previously published data and collected specimens. Twenty two carabid species were newly recorded from Sinai; these newly recorded species increased the known species to 98 species inhabiting different habitats in Sinai including the protected areas. Sinai Peninsula harbors 7 endemic species out of 44 in all over Egypt. The carabid fauna was compared with the total fauna of Egypt (45.6% of Egyptian fauna) and its different geographical regions. The composition and structure of the carabid species and their spatial distribution in relationship to different geomorphological parts and different habitats was illustrated. Moreover, the fauna of protected areas were analyzed and compared with the whole fauna. These data about the biodiversity of carabid species will help the decision makers to put the management and conservation plans.

**2003. El-Duweini, F. K. Survey of insects and mites associated with soybean and maize in various intercropping systems. Mansoura Journal of Agricultural Science 28 (2).**

The surveyed arthropods on soybean plants and polyculture of soybean and maize at two locations representing middle Egypt revealed the presence of 117 insect species belonging to 58 families from 11 orders (of which 9 species of order orthoptera belonging to 4 families), classified as 44 phytophagous species of economic importance (37.0%) and 33 insect species as visitors, pollinators, non-pest and saprophagous (28.0%). However, natural enemies (predators and parasites) were presented by 40 species (35.0%) and acarina by 4 species (2 of them were classified as phytophagous mites and the others as predators). in maize/soybean intercropping systems, maize is infested mostly with the same pests, where a partial taxonomic list shows that the insect fauna consists of 43 families from 11 orders in addition to mites (3 families); pest species were classified as: 9 species as foliage feeders, 3 as stem borers, 2 as root feeders, 5 as ear feeders, 1 as leaf miner, 10 as sap-suckers and 22 as natural enemies (13 predators and 9 parasites). Four species of acarina belonging to 3 families (2 phytophagous and 2 predators) were recorded.

**2001. Mohamed, S., Zalat, S., Radi, R., Gadalla, S. and Sharaf, M. Taxonomy of ant species collected by pitfall traps from Sinai and Delta regions, Egypt. Egyptian Journal of Natural History 3: 40-61.**

The present study includes the identification and the taxonomic status of 27 species belonging to 30 genera and 3 subfamilies of Egyptian formicid ants. These species are collected from south Sinai and Delta region using pitfall traps. Illustrated keys to the subfamilies, genera and species are presented. In addition, the geographical and local distributions and synonyms are given to genera and species.

**2001. Semida, F., Abdel-Dayem, M., Zalat, S. and Gilbert, F. Habitat heterogeneity, altitudinal gradients in relation to beetle diversity in South Sinai, Egypt. Egyptian Journal of Biology 3: 137-146.**

Using pitfall traps, ground-dwelling beetles (Coleoptera) were sampled in a nested design from three different localities in the mountainous arid ecosystem of South Sinai at low, middle and high altitudes. Each locality was represented by three different 20x20 m sites, and each site had twenty individual traps distributed systematically. Habitat type and altitude were clearly different among the three localities and to a less extent within localities. Species diversity varied spatially and temporally among the different localities and sometimes within localities. Altitude was positively correlated with beetle species diversity, and habitat heterogeneity within a locality may also play a role in influencing species diversity. The different localities had distinct and characteristic groups of species responding to altitude and habitat characteristics.

**2000. El-Hawagy, M., El-Moursy, A. and Gilbert, F. The tribe Anthracini Latreille (Bombyliidae, Diptera) from Egypt. Egyptian Journal of Biology 2: 97-117.**

Synonyms, names of types, global and local distribution and type-localities are given for all recorded species and subspecies of the Egyptian Anthracini. Taxonomic keys to genera and species of these flies are constructed according to the recent taxonomic status. The present study revealed the presence of 2 genera including 31 species and subspecies under the tribe Anthracini. In addition to 4 undescribed species of Efflatoun Bey. This work includes new synonyms, combinations, records in the Egyptian fauna, in addition to new designations of lectotypes and paralectotypes in the collection of the entomologic society of Egypt.



## 11- Fishes

2017. Gerovasileiou, V., Akel, E., Akyol, O., Alongi, G., Azevedo, F., Babali, N., Bakiu, R., Bariche, M., Bennoui, A., Castriota, L., Chintiroglou, C., Crocetta, F., Deidun, A., Galinou-Mitsoudi, S., Giovos, I., Gökoğlu, M., Golemaj, A., Hadjioannou, L., Hartingerova, G., Insacco, S., Katsanevakis, P., Korun, J., Lipej, L., Malegue, M., Michailidis, N., Mouzai, T., Ovalis, P., Petović, S., Piraino, S., Rizkalla, S., Rousou, M., Savva, I., Şen, H., Spinelli, A., Vougioukalou, K., Xharahi, E., Zava, B. and Zenetos, A. **New Mediterranean Biodiversity Records. Mediterranean Marine Science. 18 (2): 355-384.**

This Collective article presents information on 37 taxa belonging to 6 Phyla and extending from the western Mediterranean to the Levantine Sea. The new records were found in 10 countries as follows: **Algeria:** first reports on the presence of the fish species *Lesueurigobius sanzi*, *L. friesii*, *L. suerii* and *Luvarus imperialis*; **France:** first record of the alien nudibranch *Godiva quadricolor*; **Italy:** first record of an adult-sized red emperor snapper *Lutjanus sebae* from the southern Tyrrhenian Sea; first record of the pantropical rhodophyte *Chondria curvilineata* and the Lessepsian fish *Siganus luridus* from southern Sicily; record of a large pregnant female Dusky shark *Carcharhinus obscurus* off Sicily; **Albania:** first record of the fish *Ruvettus pretiosus*, new records of the alien molluscs *Conomurex persicus*, *Bursatella leachii*, *Dendostrea* cf. *folium*, *Fulvia fragilis* and *Ruditapes philippinarum* and additional report of the alien bivalve *Pinctada imbricata radiata*; **Montenegro:** first record of the sea slug *Thecacera pennigera* in the Adriatic Sea; **Greece:** first record of the invasive calcarean sponge *Paraleucilla magna* in Greek waters; occupancy estimation of the established cryptogenic rhodophyte *Ganonema farinosum*, the alien crustacean *Percnon gibbesi* and the alien fish species *Fistularia commersonii*, *Siganus luridus*, and *S. rivulatus* along the Cretan coastline; first record of the alien mollusc *Sticteulima lentiginosa* in Greek waters suggesting a westward unintentional expansion of this species; **Turkey:** photographic evidence of interactions of the monk seal *Monachus monachus* with sea-cage farms in the Turkish Aegean Sea and first record of the yellow boxfish *Ostracion cubicus* in the Turkish Mediterranean; **Cyprus:** first records of the rare speleophilic fish *Thorogobius ephippiatus* and *Grammonus ater* in Cyprus, extending the known distribution of the latter Mediterranean endemic species eastwards; first records of the alien fish *Kyphosus vaigiensis* and the alien crustacean species *Macrophthalmus indicus* and *Carupa tenuipes* as well as additional records of the alien echinoderm *Diadema setosum* and the alien ascidian *Symplegma brakenhielmi* in the country; **Lebanon:** first report on the presence of the four alien fish species *Cephalopholis taeniops*, *Equulites popei*, *Pseudupeneus prayensis* and *Sphoeroides pachygaster*; **Egypt:** first record of the Lessepsian fish *Synchiropus sechellensis* in the Egyptian Mediterranean waters.

**2017. Haroun, E. K. Akel and Paraskevi K. Karachle. The Marine Ichthyofauna of Egypt. Egyptian Journal of Aquatic Biology & Fisheries 21(3): 81-116.**

This work is the result of a compilation of the Egyptian ichthyofauna, aiming to provide a basis for monitoring and assessing potential biodiversity changes in the area. The main sources used were peer-reviewed papers and grey literature (i.e. unpublished reports, theses, conference proceedings, among others), FishBase and the Global Biodiversity Information Facility. Overall, 956 fish species (71 Elasmobranchii, 2 Holocephali and 883 Actinopteri) have been recorded to date from the Egyptian marine waters. Of those, 592 species are present only in the Red Sea, 263 species are present only in the Mediterranean Sea, and the remaining 101 species are reported from both seas. In addition to those 956 fishes, 52 species have been reported based on photos, but these records require further documentation with samples. Finally, for 64 species, which are listed in FishBase as belonging to the ichthyofauna of Egypt, no publication or museum sample report verifying their presence in Egypt could be traced. Thus, their presence remains questionable until further evidence becomes available.

**2016. Farag, M. M. Deep-sea ichthyofauna from Eastern Mediterranean Sea, Egypt: Update and new records. Egyptian Journal of Aquatic Research 42: 479–489.**

This work sheds light on deep sea resources that update the list of deep-sea ichthyoids fauna with new records from the Egyptian coast, Mediterranean Sea. Fish samples were collected from April to November 2015 at depths of 350–750 m using deep red shrimp bottom trawlers. The presented fauna was constituted mainly of deep red shrimp (*Aristeomorpha folicea* and *Aristeus antennatus*) as target species followed by by-catch and discards which were represented by 36 fish species; Of them, 21 species were recorded previously. The rest of the species, were new ichthyofauna identified in fifteen species including 4 cartilaginous species (*Centrophorus uyato*, *Etmopterus spinax*, *Hydrolagus mirabilis* and *Chimaera monstrosa*); while the other 11 species were bony fishes (*Chauliodus sloani*, *Diaphus metopoclampus*, *Sudis hyaline*, *Microstoma microstoma*, *Chlorophthalmus agassizi*, *Avocettina infans*, *Argyropelecus hemigymnus*, *Notacanthus bonaparte*, *Lampanyctus crocodilus*, *Centrolophus niger* and *Nettastoma melanurum*). *Centrophorus uyato* was reported for the first time in the Levant Basin. The present findings added new species to the Egyptian ichthyofauna and raised the total known deep-water fauna to 38 species, enhancing knowledge about such species requires continuous monitoring and studies on deep sea resources.

**2014. Mashaly, M. I. Ecological impacts on biodiversity of helminth parasites on certain cichlid and clariid fish in different localities at River Nile and Lake Manzala in Egypt. PH. D. Thesis, Mansoura University, Faculty of Science, Department of Zoology.**

A total of 1520 specimens of the cichlid fish; *Oreochromis niloticus*, *O. aureus*, *Sarotherodon galilaeus* and *Tilapia zilli* and clariid catfish, *Clarias gariepinus* were examined at seasonal intervals in the three sites between summer 2012 to spring 2013 (Beni-Suif, El-Mansoura, and Lake Manzala). From this study it can be concluded that during summer, the prevalence mainly showed its maximum values of different fish species at different study sites, followed by a gradual decline during autumn and reaching its minimum values during winter, then followed by increase of the prevalence values noticed in spring season. The prevalence and mean intensity values of different parasites in cichlid fish, *O. niloticus*, *O. aureus*, *S. galilaeus*, *T. zilli* and clariid catfish, *C. gariepinus* display higher values in River Nile (Beni-Suif and El-Mansoura) comparing with Lake Manzala. The results showed that, the prevalence and mean intensity values of crustacea and acanthocephala were nil in Lake Manzala during the investigation period. The disappearance of some parasites in Lake Manzala may be due to the relatively high levels of some heavy metals, pH, salinity, minerals, ammonia, nitrites and nitrates. It was evident that water temperature, pH value, dissolved oxygen, chromium, calcium, bicarbonates, potassium and total dissolved phosphorus showed high significant correlations with the prevalence and mean intensity values. Parasites can be considered as suitable tools to investigate host ecology, where the close relationships between the parasitic organisms and their hosts may lead to use of parasites as biological indicators for environmental pollution. Strict control enforced by laws regulation should be applied over polluted industrial wastewater, agricultural drainage water and sewage water debouches into the River Nile and Lake Manzala. All these sources of water input affect the physiochemical characteristics of water, sediments, biological components, fish production and human health.

**2013. Hamam, E. M. Fish Stock Assessment of Some Commercial Fishes in the River Nile in Upper Egypt. M. Sc. Thesis, Assiut University, Faculty of Science, Department of Zoology.**

The River Nile is considered one of the most important fishery resources in Egypt. However, most of the commercial fish species inhabiting the Nile did not have enough attention and research necessary to develop and manage its fishery resources. The present study was performed to assess fish stocks of fisheries of some fish species of River Nile and this study has been suggested due to the importance of the River Nile for fish production to Egypt, so many of the techniques of modern statistical methods were used in this study. Data concerning the total production catch, total teleosts fishes catch, commercial fish species catch (*tilapiines*, *Bagrus* sp. fishes, *Clarias gariepinus* and *Synodontis schall*) and fishing effort expressed as a number of fishing boats in the River Nile were obtained from the statistical reports of the General Authority for development of Fish Resources. In conclusion, River Nile represents economically and

environmentally an important aquatic ecosystem and must be in protection against pollution and reduction of its aquatic area. More efforts are required in terms of scientific academic and social projects and economic and political strategic plans in concern with its fisheries, the social life of fishermen, the water quality drained in and conservation of its biodiversity.

**2012. Mostafa, W. S. Food relations between larvae of economic fishes and zooplankton in some Egyptian coastal areas of the Mediterranean Sea. Ph. D. Thesis, Mansoura University, Faculty of Science at Damietta, Department of Zoology.**

This thesis consists of six chapters. Chapter one is an introduction deals with the importance of fish fries in natural habitat and as seeds for finfish culture and its relation to zooplankton in marine habitat, as it refers briefly to the studies made about similar researches in Mediterranean Sea in general, and the Egyptian waters in particular. Chapter two describes the study area and the sampling stations, methods of determination of some hydrographic parameters, identification and abundance of zooplankton. Chapter three describes the water quality parameters of Damietta coast especially those affect the distribution and abundance of zooplankton and fish fries as temperature, salinity, transparency, pH, DO, nutrients and phytoplankton biomass. In this chapter, it was found that salinity, phytoplankton biomass, and nitrogenous nutrients were the most important parameters. Chapter four describes the structure, diversity, and abundance of the total zooplankton and the most important groups with the mention of the dominant species. Also, this chapter includes details of the statistical relations between the different parameters of zooplankton community (standing crop, dominant groups and dominant species) and the physico-chemical parameters. Chapter five describes the distribution and abundance of the larvae of five commercial fishes for one year in relation to the prevailing environmental conditions. The main object of this part was to find the most preferable food item for fish larvae. Copepods, especially the calanoid species were the most selected by fish fries. Chapter six includes three experiments done to evaluate the effects of various dietary microalgae on survival, maturation, sex ratio, total nauplii production and nutritional components of the copepod *Gladioferens imparipes*. These experiments indicated that this copepod has a potential for mass culture and can be used as a highly nutritious food in larviculture.

**2011. Elhaweet, A., Fishar, M., Geneid, Y. and Abdel-Moula, E. Assessment of fisheries and marine biodiversity of Sallum Gulf, Egypt. International Journal of Environmental Science and Engineering (IJESE) 1: 21-34.**

A research cruise was carried out to assess the fisheries and marine biodiversity of the Gulf of Sallum, with a view for the protection, conservation, and management of its resources. To achieve this aim, the Egyptian Research Vessel “*Salsabil*” was used, deploying otter bottom trawl for fisheries data, CTD for collecting environmental parameters, and a bottom grab sampler for obtaining samples of benthos fauna.

Moreover, diving was used to survey the under-water sea grass beds. The Gulf of Sallum supports a wide range of ecosystems, from the rich sea grass meadows and rocky reefs of the coastal zone, to the little seamounts. It is thus considered as a great resource for many economic fish species. Seagrass plants were found forming from scattered small areas to dense vegetation that covered extended areas of the sea floor. The macro-benthic community in the investigated area consisted from 57 species belong to seven groups, while fish populations contained more than 90 species. Species richness was closely correlated to depth, organic matter concentrations and sediment characteristics. Some invasive polychaete and introduced fish species were recorded in the present study, moreover few considered as threatened species. Using GIS analysis to the survey result showed that diversity of seagrass beds, benthic fauna and fish species in the Gulf could be divided into two sections. First section lies to the west of 25° 30'E longitude; contains the highest species composition, while second section (eastward of 25° 30' E) contains the lowest species composition. It was recommended, therefore, to declare the first section as a marine protected area (MPA). As the results of this study, the Gulf of Sallum was declared as the first marine Egyptian protected area in the Mediterranean Sea by the Egyptian Prime Minister's decision No. 533 for the year 2010.

**2011. El-Mahdy, S. M. Fish Stock Assessment of the Fisheries of Some Fish Species of Lake Manzala, Egypt. M. Sc. Thesis, Assiut University, Faculty of Science, Department of Zoology.**

Lake Manzala is one of the important lakes in Egypt, which is located in the eastern Nile Delta and its fish production is half of the fish production of the North Delta Lakes (some 30% of fish production in Egypt) .The present study was performed to assess fish stocks of fisheries of some fish species of Lake Manzala due to its importance for fish production to Egypt (many techniques of modern statistical methods were used in this study). Collection of population parameters of tilapiine species (*Oreochromis niloticus*, *Oreochromis aureus*, *Sarotherodon galilaeus* and *Tilapia zillii*) were obtained from literature. These basic fishery data represent five periods of lake fisheries namely: latest 1960s, earliest 1980s, latest 1980s, earliest 1990 and earliest 2000. In conclusion, Lake Manzala represents economically and environmentally an important aquatic ecosystem and must be in protection against pollution and reduction of its aquatic area. More efforts are required in terms of scientific, academic and social projects. Economic and political strategic plans in concern with its fisheries, the social life of fishermen, the water quality drained in and conservation of its biodiversity should be taken into account.

**2011. Bassem, S. M. Aquatic Insects and Fish Diversity in the River Nile as Bioindicators of Zoonotic Diseases. Ph. D. Thesis, Ain Shams University, Faculty of Science, Department of Entomology.**

River Nile is considered the main source of water in Egypt. In the last decades, it was subjected to different types of pollution. The most important pollution sources were

agriculture run-off, domestic and industrial effluents. Therefore, the present study was conducted for using some aquatic insects and fish as bio-indicators of some zoonotic bacteriological pollutants (Aeromonads group; total vibrios and Salmonellae group) in the River Nile during one year (February 2009- January 2010) at different pollution sites. Aquatic insects and fish samples were collected and identified from the River Nile at different pollution. In the main stream of River Nile (reference point); the collected aquatic insects were *Appasus urinator* and *Enallagma vansomereni*, while fish samples were *Oreochromis niloticus*. In the mixed point of agriculture drain; the collected aquatic insects were *Appasus urinator* and *Hydaticus leander*. Fish samples were *Oreochromis niloticus*. In the mixed point of wastewater; the collected aquatic insects were *Eristalis* sp, and fish samples were *Silurus triostegus*. Total vibrios by MPN-TCBS method were determined in water collected from different pollution sites. Total vibrios were not detected in water collected from the main stream of River Nile before branches (control site). While the average values of total vibrios (MPN/100ml) recorded in water was  $1.0 \times 10^4$  and  $2.7 \times 10^3$  in the mixed point of agriculture drain and the mixed point of wastewater, respectively. Total vibrios were determined by MPN/gm<sup>-1</sup> in aquatic insects collected from River Nile at different pollution sites during one year (February 2009- January 2010). The average MPN/gm<sup>-1</sup> of total vibrios recorded in aquatic insects was  $1.4 \times 10^3$ ,  $1.7 \times 10^5$  and  $1.3 \times 10^5$  in the main stream of River Nile before branches, the mixed point of agriculture drain and the mixed point of wastewater, respectively. Also, total vibrios were determined in fish collected from different pollution sites in River Nile in 3 organs (muscle, liver and gills). Muscle did not contain any *Vibrio* spp in the different sites. In the main stream of River Nile before branches, liver did not contain any *Vibrio* spp. The average MPN/gm<sup>-1</sup> values of total vibrios in liver isolated from fish collected from the mixed point of agriculture drain and the mixed point of wastewater were:  $2.9 \times 10^4$  and  $6.2 \times 10^3$ , respectively. The average MPN/gm values of total vibrios in gills isolated from fish collected from the main stream of River Nile (reference point), the mixed point of agriculture drain and the mixed point of wastewater were:  $3.8 \times 10^3$ ,  $1.0 \times 10^4$  and  $2.5 \times 10^4$ , respectively. It was found that 425 total vibrios were isolated from aquatic insects, fish and water collected from River Nile at different pollution sites from which only 202 isolates were +ve *Vibrio* spp. when tested by PCR. Aeromonads were determined in tilapia fish (muscle, liver and gills) collected from the main stream of River Nile. The incidence of Salmonellae was studied in water, aquatic insects and fish collected from River Nile at different pollution sites. Samples were detected by MPN technique and confirmed by PCR techniques.

**2004. Eskandar, A. F. Biological studies on the main cichlid fishes of the Nozha Hydrodrome, Alexandria, Egypt. Ph. D. Thesis, Benha University, Faculty of Sciences, Department of Zoology.**

Members of family cichlidae are considered as an important food source in Egypt forming about 46% of total inland catch and representing 63% of the total fish catch in EI-Nozha Hydrodrome during the period from 1997-2001. The present investigation deals with the biological and fishery studies of the main cichlid species (*Oreochromis*

*aureus*, *Sarotherodon galilaeus* and *Tilapia zillii*) in El-Nozha Hydrodrome during the period from January 1998 to December 1999. The analysis of data comprised biometric, growth studies, food and feeding habits, reproduction and fishery analysis including the population dynamics of these cichlid species. Generally, all cichlid species at El-Nozha Hydrodrome were not subjected to over-fishing and it is advised not to increase the exploitation rate in case of *S. galilaeus* and *T. zillii* to prevent over fishing of these fishes, since the yield per recruit at their current yields nearly reached the values of their maximum economic yield. From the economic point of view, the regular supply of fresh water from El-Mahmoudiah Canal into the basin is considered to be useful for creating good environment for transplantation of *O. niloticus*. Such introduction of this species will increase the productivity of cichlid fishes in the Hydrodrome as this species is characterized by higher weight compared with those of other cichlid species having the same lengths.

## 12- Reptiles, Amphibians and Mammals

**2016. Soutan, A., Attum, O., Hamada, A., Hatab, E., Ahmed, S. E., Eisa, A., Sharif, I. A., Nagy, A. and Shohdi, W. Recent observation for leopard *Panthera pardus* in Egypt. Mammalia.**

An adult male leopard *Panthera pardus* was killed in Elba Protected Area in south-east Egypt. This record represents the first confirmed observation in Egypt during the past 65 years, and the first confirmed record in this region. We visited the surrounding areas where the leopard was killed and in areas where tracks were observed by local people to follow the animal's movement and describe the habitat. The external measurements and the morphology are also described and a tissue sample was preserved for genetic analysis.

**2015. El-Gabbas, A., Baha El Din, S., Zalat, S. and Gilbert, F. Conserving Egypt's reptiles under climate change. Journal of Arid Environments 127: 211-221.**

Climate change has caused range shifts and extinctions of many species in the recent past. In this study, the effects of climate change on Egyptian reptiles were investigated for the first time using species distribution models. Maxent was used to model the current and future distributions of suitable habitats for 75 terrestrial reptile species from Egypt. The modelled distribution for current suitable conditions for each species was projected into the future at three time slices using two emission scenarios from four global circulation models and under two assumptions of dispersal ability. Climate change is expected to vary in its effects spatially, with some areas characterized by increased species richness while others show declines. Future range changes vary among species and different future projections, from the entire loss to large gains in range. Two species were expected to become extinct in at least one future projection, and eight species were expected to lose >80% of their current distribution. Although Protected Areas have greater conservation value, on average, compared with unprotected areas, they appear inadequate to conserve Egyptian reptiles under expected climate change.

**2014. Bajer, A., Alsarraf, M. and Bednarska, M. *Babesia behnkei* sp. nov., a novel Babesia species infecting isolated populations of Wagner's gerbil, *Dipodillus dasyurus*, from the Sinai Mountains, Egypt. Parasites & Vectors 7: 572.**

Although a number of new species of *Babesia/Theileria* have been described recently, there are still relatively few reports of species from Africa. In this study, based on the evaluation of morphology and phylogenetic relationships, we describe a novel species from Wagner's gerbil, *Babesia behnkei* n. sp. Rodents (n = 1021) were sampled in four montane valleys (wadis) in 2000, 2004, 2008 and 2012 in the Sinai Mountains, Egypt. The overall prevalence of *Babesia* spp. was highest in the Wagner's gerbil (*Dipodillus dasyurus*; 38.7%) in comparison to the prevalence in the spiny mice species, *Acomys dimidiatus* and *A. russatus*. Morphological investigations were conducted for the comparison of trophozoites of the novel species of *Babesia* with the



*B. microti* King's 67 reference strain. Thirty-two isolates derived from *D. dasyurus* over a 9-year period (2004-2012) from two wadies (29 isolates from Wadi Gebel and 3 from Wadi El-Arbaein) were investigated by microscopic, molecular and phylogenetic analysis. A near-full-length sequence of the 18S rRNA gene and the second internal transcribed spacer (ITS2) region were amplified, sequenced and used for the construction of phylogenetic trees. A novel species of *Babesia* was identified in two isolated populations of *D. dasyurus*. Phylogenetic analysis of 18S rDNA and ITS2 sequences revealed that *B. behnkei* n. sp. is most closely related to *B. lengau* from cheetahs in South Africa and to Nearctic species found only in North America (the pathogenic *B. duncani* and *B. conradae*), and that it is more distant to the cosmopolitan rodent parasite *B. microti*. Trophozoites of *B. behnkei* were smaller and less polymorphic than trophozoites of *B. microti*. In conclusion, *Babesia behnkei* n. sp. is a novel species of the 'Duncani group' maintained in isolated populations of *Dipodillus dasyurus* occurring in the Sinai Mountains of Egypt.

**2013. Ibrahim, A. A. Amphibians of Egypt: a Troubled Resource: Chapter 29. Basic and Applied Herpetology 27: 107-117.**

Amphibians in Egypt are represented by only nine species. Some species (*Amietophrynus regularis*, *Bufo boulengeri*, *Ptychadena mascareniensis*, and *Pelophylax bedriagae*) are well-known and common. Distributions of *Duttaphrynus dodsoni* and *Hyla savignyi* are limited, *Amietophrynus kassasii* is common and restricted, while *Ptychadena schillukorum* appears uncommon and localized. Egyptian amphibians are, in part, poorly studied; some are threatened, others have declined or disappeared at various localities. Over-harvesting, habitat destruction, predation, overuse of pesticides, and road-kills are main causes of population decline. In 2010, the Egyptian government issued a resolution prohibiting exportation of *Pelophylax bedriagae* taken from natural habitats for three years - at least - to allow rehabilitation of populations; the local CITES committee had previously issued a similar declaration in 2009. Limitation of quantities of *Amietophrynus regularis* used for dissection in Egyptian universities and scientific agencies was also requested by the Secretary of the Egyptian Environment. These decrees and declarations seem to have been successful during the past few years.

**2012. Sayed, N. H. Genetic Diversity among Eight Egyptian Snakes (Squamata-Serpents: Colubridae) Using RAPD-PCR. Life Science Journal 9 (1): 423-430.**

Genetic variations between 8 Egyptian snake species, *Psammophis sibilans sibilans*, *Psammophis sudanensis*, *Psammophis schokari schokari*, *Psammophis schokari aegyptiacus*, *Spalerosophis diadema*, *Lytorhynchus diadema*, *Coluber rhodorhachis* and *Coluber nummifer* were conducted using RAPD-PCR. Animals were captured from several localities of Egypt (Abu Rawash-Giza, Sinai and Faiyum). Obtained results revealed a total of 59 bands which were amplified by the five primers OPB-01, OPB-13, OPB-14, OPB-20 and OPE-05 with an average 11.8 bands per primer at molecular weights ranging from 3000-250 bp. The polymorphic loci between both species were 54 with 91.5 %. The mean band frequency was 47% ranging from

39% to 62% per primer. The similarity matrix value between the 8 species was ranged from 35% to 71% with an average of 60%. The genetic distance between the 8 colubrid species was ranged from 29% to 65% with an average of 40%. Dendrogram showed that, the 8 snake species are separated from each other into two clusters. The first cluster contains 4 species of *Psammophis*. The second cluster includes 4 species of *Spalerosophis*, *Coluber* and *Lytorhynchus*. *Psammophis sibilans* is sister to *Psammophis sudanensis* with high genetic similarity (71%) and *Psammophis schokari schokari* is sister to *Psammophis schokari aegyptiacus* with high genetic similarity (70%). The *Coluber rhodorhachis* are clustered and closer to *Spalerosophis diadema* (70%) than to *Coluber nummifer* (57%). Therefore, the evolutionary history of snakes still remains controversial. It is concluded that, the similarity coefficient and the genetic distance between the 8 snake species indicates that, they are not identical and separated from each other.

**2009. Newbold, T., Gilbert, F. and Zalat, S. Climate-based models of spatial patterns of species richness in Egypt's butterfly and mammal fauna. Journal of Biogeography 36: 2085–2095.**

The aim of this study is identifying areas of high species richness is an important goal of conservation biogeography. In this study we compared alternative methods for generating climate-based estimates of spatial patterns of butterfly and mammal species richness. Data on the occurrence of butterflies and mammals in Egypt were taken from an electronic database compiled from museum records and the literature. Using Maxent, species distribution models were built with these data and with variables describing climate and habitat. Species richness predictions were made by summing distribution models for individual species and by modelling observed species richness directly using the same environmental variables. Estimates of species richness from both methods correlated positively with each other and with observed species richness. Protected areas had higher species richness (both predicted and actual) than unprotected areas. Our results suggest that climate-based models of species richness could provide a rapid method for selecting potential areas for protection and thus have important implications for biodiversity conservation.

**2008. Lithy, U. K. Ecological Factors affecting Biodiversity, Activity and Parasitic infection of some lizards inhabiting different Egyptian habitats. M. Sc. Thesis, Beni-Suef University, Faculty of Science, Zoology Department.**

The present study was carried out to determine the effect of climatic factors on the biodiversity, activity and parasitic infection of some burrowing reptiles (Genus *Acanthodactylus*) inhabiting at the different territories of the Egyptian desert, where reptile species diversity in arid lands is influenced by a variety of abiotic (Air, soil temperature at different depths and soil moisture) and anthropogenic factors (food and water availability). The present study aimed also to determine the effect of human impacts on biodiversity, distribution and activity of these reptiles. A total of 875 living reptiles belonging to family Lacertidae order Squamata were recorded from 5-different

territories in the Egyptian deserts, Giza, Wadi El-Natroun, Balteem and Borg El-Borolos. The different climatic factors of the studied territories were recorded to scrutinize the microhabitats of *Acanthodactylus* sp. in order to inspect the relationship between the ecological factors and the parasitic abundance, distribution and percentage of infection with Haemogregarines. *Acanthodactylus* lizards were divided into three species; *Vithodactylus boskianus*, *Acanthodactylus scutellatus* and *Acanthodactylus rdalis*. The highest number recorded in Borg El-Borolos (313) and the lowest one was in Wadi El-Natroun (90). Seasonally, the highest number was during spring (237) and the lowest during autumn (185). Haemogregarine type 1: the parasite was elongated lying parallel to the longitudinal axis of the erythrocytes. The immature forms (Trophozoites) were free from the granules and the mature ones (Gamonts) showed numerous granules. The host red blood cells showed distinct cytological responses towards the mature and immature forms of this parasite. Haemogregarine type 2 has three blood forms, the immature form (small trophozoite); racket like appearance, had a faint red stained nucleus that occupied the central part of the rounded racket shape. This form had a noticeable hypertrophic effect on the host erythrocytes with a great shift of its nucleus to the other border of the cell. The second intermediate form representing the elongated trophozoite, while the third mature form (gamont) was sausage-shaped and was enclosed within a delicate capsule. The elongated trophozoite had no effect on the infected erythrocytes except for the elongation and displacement of the host cell nucleus parallel to the parasite, mobile gamonts caused large hypertrophic to them and severe fragmentation to their nuclei. Haemogregarine type 3 showed much elongated less slender form, their cytoplasm attained a very faint blue stain with no granulation or vacuolation.

**2008. Obady, Y. H. The relation between foot anatomy in some amniota and chordata diversity in locomotion pattern. M. Sc. Thesis, Mansoura University, Faculty of Science, Department of Zoology.**

Amphibians, reptiles, aves and mammals inhabit a wide diversity of environments and display locomotor patterns that are habitat specific. Special attention was paid to the way the substrates differ across the habitats, and how their habitat differences are correlated to the different patterns of locomotion. The present study aims to: 1- discuss the homology of the carpus and tarsus, sesamoids and digital reduction. 2- a morphogenetic approach to the origin and organization of the tetrapod limbs. 3- to find out the relationship between the skeletal structures and various mode of locomotion. 4- how their habitat differences are correlated to the different patterns of locomotion. A great deal of variations was recorded in the present study on pads of manus and pes of animals, which may be correlated with functional demands. These pads differ in form and position among these animals. These variations may confirm the correlation between the position, form and structure of the pads with the habitat and habit types of each animal. Variation was occurred from group to group in foot skeletal elements in adult limbs, which may be reflecting the specialized method of locomotion. During terrestrial locomotion, frogs use two distinct gaits: slow crawling behavior and fast

jump. In amniotes, the quadrupedal tetrapod species use a diverse variety of limb postures during terrestrial locomotion. The normal terrestrial locomotion study of the present birds revealed that the ten species have different locomotor behaviors. However, the investigated mammals have three patterns of locomotion. For comparison, the osteometric measurements were subjected for univariate, bivariate and multivariate analyses. The pentadactyle nature of the fore- hindlimbs is evident in all the present lizard and mammals except in *J. orientalis*. So, due to the results of the present work and according to the aforementioned discussion and the studies mentioned by different authors, these results may be reflecting the different life styles employed by the present animals.

**2006. Bajer, A., Harris, P. and Behnke, J. Local variation of haemoparasites and arthropod vectors, and intestinal protozoans in spiny mice (*Acomys dimidiatus*) from four montane wadis in the St Katherine Protectorate, Sinai, Egypt. *Journal of Zoology*. 270 (1): 9-24.**

Haemoparasite infections and infestations with potential arthropod vectors were assessed in spiny mice *Acomys dimidiatus* from four wadis in the arid montane region of the southern Sinai in Egypt in late summer 2000. Five taxa of haemoparasites (*Haemobartonella* spp. 80%, *Hepatozoon* sp. 20.6%, *Trypanosoma acomys* 17.5%, *Bartonella* spp. 2.5% and *Babesia* sp. 1.9%) were recorded. Additionally, infections with two intestinal protozoa, *Cryptosporidium* cf. *Parvum* and *Giardia* sp., were quantified, both with similar prevalence (17.0 and 17.6%, respectively). Some 18% of mice carried fleas (*Parapulex chephrensis* and *Xenopsylla dipodilli*) and 32.1% had lice (*Polyplax oxyrrhyncha* and *Polyplax brachyrrhyncha* combined). Marked differences in the prevalence and abundance of infections were detected between the four wadis, particularly with respect to *T. acomys*, *Hepatozoon* sp. and fleas, which were largely aggregated in just two of the four sites (Wadis Gharaba and Tlah). In contrast, the intestinal protozoa were more common, and abundance was higher, in Wadi El Arbaein. Intrinsic factors also contributed to a variation in prevalence, with strong age-dependent increases in the prevalence and abundance of *Hepatozoon* sp., higher mean species richness, prevalence of *C. cf. parvum*, and abundance of *Giardia* and *Hepatozoon* spp. in female mice. *Haemobartonella* spp. showed an age-dependent reduction in abundance and higher abundance among male mice. A weak association was found between the prevalence of *T. acomys* and its putative flea vector. The single extrinsic factor in the study, site of capture, was more important than the intrinsic factors in explaining variation in the prevalence and abundance of haemoparasites, intestinal protozoa and arthropod vectors. In the high mountains of southern Sinai, the parasite fauna of spiny mice is distinct in each wadi, and hence we expect the parasites to exert spatially different co-evolutionary pressures on their hosts, with a resultant variation in host life histories.

**2004. Jbehnke, J., Harris, P. and Bajer, A. Variation in the helminth community structure in spiny mice (*Acomys dimidiatus*) from four montane wadis in the St Katherine region of the Sinai Peninsula in Egypt. Ul. Miecznikowa 1: 02-096.**

We compared helminth communities in spiny mice (*Acomys dimidiatus*) from 4 wadis in the arid montane region of the southern Sinai in Egypt, in a 4-week period in late summer. Total helminth species richness was 14 (8 nematodes, 5 cestodes and 1 acanthocephalan) with 94% of mice carrying at least 1 species and an overall mean species richness of 1.9. The most prevalent parasites were *Protospirura muricola* (47.8%) and *Dentostomella kuntzi* (46.3%). One larval cestode, *Joyeuxiella rossicum*, represents a new host record. The helminth community was dominated by intestinal nematodes (88.7%) of which 58.2% were arthropod-transmitted heteroxenic species. At the component community level, 70% of the worms were recovered from mice in just two wadis (Gharaba and Tlah) and 48.6% of intestinal nematodes were from Wadi Gharaba. Although only 7 species of helminths were recorded from Wadi Gharaba, this site gave the highest Berger-Parker dominance index because of *P. muricola* which was also dominant in Wadi El Arbaein, while *Syphacia minuta* was the dominant species in Wadis Gebal and Tlah. At the infra-community level, mean species richness and Brillouin's index of diversity were highest in Wadi Tlah and lowest in Wadi Gebal, and the former was age dependent. Whilst mice from different wadis differed in the nematodes that were most common, those from Wadi Gharaba carried the highest mean number of worms/mouse. The abundance of *P. muricola* in particular varied markedly between sites: Wadi Gharaba was distinct as the site showing the highest mean worm burden whereas mice from Wadi Gebal were uninfected. None of the directly transmitted oxyuroid nematodes showed significant variation in abundance between wadis. Overall, the single extrinsic factor in the study site of capture was more important than the intrinsic factors in explaining variation in helminth communities in the region. We conclude that in the high mountains of southern Sinai, each wadi is distinct in terms of its rodent parasites, and hence we expect spatially different coevolutionary pressures on their hosts, with resultant variation in life-histories.

## 13- Alien Fauna

**2017. Abdelnaby, F. First record of family Pisionidae (Polychaeta) from Gulf of Aqaba Egypt. Egypt. J. Exp. Biol. (Zool.), 13(1): 109-114.**

Four species of Pisione and Psionidens were collected from Gulf of Aqaba, Egypt 3/2010- 3/2011, within the project of Egyptian surface coastal waters of the Aqaba and Suez Gulf , as well as the Red Sea to study water quality and bacterial indicators for pollution, these spp. are: *Pisione guanche* and *Pisione wolfi* (San Martín et al., 1999) , *Pisione africana* (Day, 1963) , and *Pisionidens indica* (Aiyar and Alikunhi, 1940) , This is the first record of these species from Egyptian waters, also family Pisionidae are reported in the present study for the first time from Gulf of Aqaba, Egypt. It is suspected that the origin of *P. guanche* may be Red Sea, and then transported by ballast water to Cuba where it recorded.

**2016. Halim, Y. and Abdel Messeih, M. Aliens in Egyptian waters. A checklist of ascidians of the Suez Canal and the adjacent Mediterranean waters. Egyptian Journal of Aquatic Research. 42, 449–457.**

Checklists of the alien ascidian fauna of Egyptian waters are provided covering the Suez Canal, the adjacent Mediterranean waters and the Gulf of Suez. Enrichment in ascidian species of the Suez Canal seems to have been on the increase since 1927. The distinctly uneven distribution pattern in the Canal appears to be directly related to the ship traffic system. Earlier reports on alien ascidian species in the Mediterranean are compared and discussed. Of 65 species recorded from the Mediterranean waters of Egypt in all, four are Erythrean migrants and four potentially so. *Polyclinum constellatum* Savigny, 1816 is a new record for the Mediterranean Sea.

**2016. Nagar, L. R. and Shenkar, N. Temperature and salinity sensitivity of the invasive ascidian *Microcosmus exasperatus* Heller, 1878. Aquatic Invasions 11 (1): 33–43.**

Environmental factors, such as temperature and salinity, are known to influence distribution patterns and invasion success in ascidians. The solitary ascidian *Microcosmus exasperatus* Heller, 1878 has a wide global distribution and can be found in both tropical and sub-tropical waters. In the Mediterranean Sea, it is considered to be an invasive species introduced through the Suez Canal, with a restricted distribution in the eastern Mediterranean. Despite its global distribution, the environmental tolerances of this species are poorly known. We examined the effect of varying temperature and salinity on the survival of adult individuals of *M. exasperatus* in a laboratory setting to partially determine its environmental tolerance range. In addition, it's global and local distribution as well as the seasonal abundance in 'Akko Bay (northern Mediterranean coast of Israel) was examined. Field observations and laboratory experiments show that *M. exasperatus* is able to tolerate a temperature range of 12– 30 °C, and salinity of 37– 45, but it survived poorly in salinity of 33– 35 and temperatures > 32 °C. Considering this relatively wide tolerance range of *M.*

*exasperatus* to temperature and salinity together with the anticipated rise in anthropogenic disturbances, we expect this species to further spread into new locations along the Mediterranean coast.

**2015. Dorgham, M. and Hamdy, R. The Role of Alien Polychaetes along the Alexandria Coast, Egypt. Int. J. Environ. Res., 9(1): 141-150.**

The alien polychaetes are widely distributed in the whole Mediterranean Sea as well as in the Egyptian waters. The objective of this study is to highlight the distribution and abundance of the alien polychaetes along the Alexandria coast, their contribution to the total polychaete community and the changes they caused in the community structure. Through monthly sampling, polychaetes were collected at four sites of different ecological characteristics During June 2005 - May 2006 from hard substrates at 0.5-1.0 m depth and from soft bottom of the intertidal zone. Ten alien species were recorded from the study area, five of them (*Linopherus canariensis* Langerhans, 1881, *Loimia medusa* Savigny in Lamarck 1818, *Syllis schulzi* Hartmann Schröder 1960, *Phyllodoce longifrons* Ben-Eliahu 1972 and *Leodice antennata* Savigny in Lamarck, 1818) were found for the first time in the Egyptian waters. Six species were widely distributed in the study area demonstrating considerable different count on both the spatial and temporal scales, with total count fluctuating between 10 - 18810 ind/m<sup>2</sup>, constituting 14.3-45.5% of the total polychaetes, and peaks occurring in different times at the sampling sites. *Syllis schulzi* and *Pseudoneries anomala* were the major components, accounting for 53.4 and 41.5% of the alien polychaetes, and of pronouncedly less contribution was *Linopherus canariensis* (3.8%), in addition to occasional active contribution of *Hydroides elegans* and *Loimia medusa*, which displayed at times up to 22 and 19%, respectively at some sampling sites.

**2014. El-Serehy, H. A., Al-Misned, F. A., Abdel-Rahman, N. S. and Al-Rasheid, K. A. Tintinnids (Ciliophora: Choreotrichia) of the Suez Canal and their transmigration process between the Red Sea and the Mediterranean Sea. Aquatic Ecosystem Health & Management, 17(4): 454-462.**

On its route from the Mediterranean in the north to the Red Sea in the south, the Suez Canal crosses three different lakes which represent different habitats, and in some cases, hinder the migration of the fauna and flora from one sea to the other. Tintinnid species-specific abundance was determined at monthly intervals from 10 stations in the Suez Canal. A total of 18 species were recorded in the canal water, all Indo-Pacific in origin. Six of these species have been introduced to the Mediterranean, while 11 are new geographical records for the Suez Canal. Most species exhibited a seasonal cycle with low winter and high spring and summer densities. Tintinnid affinities and differences between the eastern Mediterranean and Red Sea were discussed in the light of the results of distribution studies of the eighteen species of Tintinnid carried out over a complete year. These observations point to the role of the canal as a selective barrier and/or as a link in the migration of Tintinnid protozoa. While cases of migration from one sea to the other are more likely to occur in either direction, those

concerning species of Indo-Pacific origin are more successful and numerous. Meanwhile, the Suez Canal acts as a local endemic habitat by itself.

**2013. Dorgham, M. M., Hamdy, R., El-Rashidy, H. H. and Atta, M. M. First records of polychaetes new to Egyptian Mediterranean waters. *Oceanologia*, 55 (1): 235–267.**

Nineteen benthic polychaete species were recorded for the first time in the intertidal zone of the Alexandria coast, south-eastern Mediterranean Sea. They belong to Syllidae (7 species), Hesionidae (3 species), Serpulidae (2 species) and 7 other families (one species each). Of these species, *Eunice miurai* Carrera-Parra & Salazar-Vallejo 1998 appears to be new to the Mediterranean Sea; while four of the alien species earlier recorded in the Mediterranean were found for the first time in Egyptian waters: *Opisthosyllis brunnea* Langerhans 1879, *Loimia medusa* Savigny 1822, *Syllis schulzi* Hartmann-Schröder 1960 and *Phyllodoce longifrons* BenEliahu 1972. The newly recorded species demonstrated markedly different patterns of frequency of occurrence and numerical abundance. *Spirobranchus triqueter* Linnaeus 1758, *S. schulzi*, *L. medusa* and *Salvatoria clavata* Claparède 1863 were permanent and abundant species in fouling samples along the Alexandria coast. *Saccocirrus papillocercus* Bobretzky 1872 persisted in the sediments at two sites, with a much higher count at the stressed one, while *Protodrilus* sp. inhabited sediments at two other sites throughout the year, sometimes in very high numbers. In addition, the alien species found earlier, *Brania arminii* Langerhans 1881, *Odontosyllis fulgurans* Audouin & Milne-Edwards 1833 and *O. brunnea* Langerhans 1879, were frequently observed along the Alexandria coast.

**2011. Halim, Y. And Rizkalla, S. Aliens in Egyptian Mediterranean waters. A check-list of Erythrean fish with new records. *Mediterranean Marine Science*, 12 (2):479-490.**

The historical role of the Suez Canal as a pathway for migrations between the Red sea and the

Mediterranean is recalled. A check-list of 42 immigrant Erythrean fish in Egyptian Mediterranean waters is given. The list comprises four new records. 17 of the immigrant species are commercially exploited, whereas 15 are known from single records. While the Erythrean fish as invasive species are beneficial to local fisheries, in our view, they do not have an important impact upon the ecosystem.

**2009. Ibrahim, A. M. and Khalil, M. T. The Red swamp crayfish in Egypt. Center of Research and Studies of Protectorates, Ain Shams University. No. 1.**

Issues of invasive species have become prominent topics among the studies on biodiversity. These species of plants, animals and micro-organisms are transported by humans, advertently or inadvertently, to areas far beyond their natural geographical ranges. The new territories may provide particularly favourable habitat conditions, often away from natural enemies prevalent in their homeland; and those alien species



become naturalized and may outperform indigenous species. Studies on biodiversity losses recognize "invasive species" as one of the causes of these losses. This book is a monograph treatment of a case-study of an alien species that became naturalized in River Nile (Egypt), with benign prospects and non-benign impacts on the river and its network of canals. The authors have admirably collated available information with their own data collected during several years of general ecological surveys and a set of detailed studies on two selected sites. Their syntheses present an integrated treatise on the subject, and set a most welcome example of a treatment that is based on a broad cover of scientific information, provides evaluation of an alien naturalized species, and sets elements for guidance to ventures that aspire to use crayfish species in aquaculture. It also provides guidance for studies on the innumerable alien plant and animal species that have become elements of the biota of Egypt. In this treatise, the authors present the story of two crayfish species brought to Egypt (River Nile) by a venture experiment of aquaculture. The experiment was eventually abandoned and the alien species were set free into favourable habitat of the river and its network of canals. The two species had different fortunes; one flourished and the other succumbed. The main bulk of the book comprises six chapters amounting to a comprehensive treatment that may be summed as: auto-ecology of *Procambarus clarkia* as a naturalized alien species in the Egyptian Nile Basin. The other species *P. zonangulus* eventually disappeared after it was set free from the aquaculture farm. Chapter 1 describes in some detail the morphology and anatomy of the body and its organs. Chapter 2 deals with processes of growth and reproduction as performed in the "new home". These processes, especially processes of reproduction, are not replicas of processes in "native home" in North America, fecundity seems to fare better in the host habitat where it reproduces twice a year, and not once. Chapter 3 and 4 deal with the eco-physiology of the crayfish, including responses and apparent adaptation to the new environment. These studies provide basic information that form guidelines for management of crayfish expanding populations. Chapter 5 and 6 address issues of uses of crayfish as a resource that provide materials for food, feed and fish-meal. Information embodied in these two chapters provides elements for assessing the cost-benefit balance of introducing the species to wild fishing and future aquaculture enterprise.

## 14- Birds

### **2018. Habib, M. Sandwich Terns breeding at Port Fouad, Egypt, in June 2017. Dutch Birding 40: 168-171.**

Sandwich Tern *Sterna sandvicensis* started breeding in the Mediterranean basin as recently as the 1950s, by colonizing Camargue, Bouches-du-Rhône, France, in 1956, Ebro Delta, Tarragona, Catalunya, in 1971, Valli di Comacchio, Emilia-Romagna, Italy, in 1979 and Evros Delta, Greece, in 1981. The Mediterranean population grew rapidly. In Spain, 3796 pairs were nesting in 2007, nearly all at Ebro Delta and l'Albufera de València. In French Mediterranean coastal areas, there were 2272 pairs in 2014, including 1941 at Étang de Thau, Hérault. In Egypt, the species was a fairly common passage visitor to the Mediterranean and Red Sea coasts until 2017, and a fairly common winter visitor and scarce non-breeding summer visitor along the Mediterranean. In July 2013, however, fledglings apparently accompanied by adult Sandwich were seen at a roosting site near Port Said and they were identified as the species' first-ever fledglings for Egypt. Since then, I regularly checked a promising looking site for breeding Sandwich close to a roosting site of adults and juveniles, until I found a breeding colony in June 2017 on a different location at Port Fouad salinas, 15 km east of the roosting site. This paper details this first confirmed breeding record of Sandwich in Egypt.

### **2018. Habib, M. I. Breeding Status of Ospreys in Egypt (Red Sea) from 2012 to 2018. Proceedings of Conferences, Raptors Conservation, Suppl. 1.**

The World population of Western Osprey (*Pandion haliaetus*) include four subspecies: *P. h. haliaetus*, American Osprey *P. h. carolinensis* (North America; vagrant in Europe) and *P. h. ridgwayi*. A fourth taxon is now generally considered a separate species, Eastern Osprey *P. cristatus*. *P. h. haliaetus* is the subspecies breeding in Egyptian Red Sea. A new series of Osprey surveys started in early June of 2012 and ended in July of 2018. The main goal was to survey the local resident breeding Ospreys. We also visited three wintering areas in Malaha, Aswan and Lake Nasser. We found breeding and nesting Ospreys in most of the visited Islands at the Red Sea, with nests located mostly on sand dunes, but also on roof tops. A total of only 39 pairs were confirmed breeding in the Red Sea and South Sinai provinces, and 16 non-local Osprey were observed at the wintering sites, which make Egypt important as a stopover area for Osprey during migration. We found that Ospreys *are* territorial, and pairs start courtships and nest building from the first week of December in south of Egypt to the first week of January in north of Egypt. The Osprey's nests are normally used in successive years by the same pair, adding new twigs every year. Osprey's diet consists entirely of fish and they mainly forage at reef flats and reef edges, feeding chicks with preferred fish species. Birds from the resident Red Sea population tend to be distinctly smaller and lighter in plumage than birds from the European population. This fact was already noted and a suggestion to separate subspecies was made. The main threat to the breeding population is a human disturbance on the Red Sea coasts and islands, as

e.g. development and building of new resorts at the coast. A further artificial nests project at Red Sea Coast is highly recommended with the goal to replace the nests lost due to a tourism development, and to increase the Egyptian population to the previous level.

**2018. Habib, M. I., Megally, M and Pröhl, T. Breeding behaviour of Desert Owl in Egypt. Dutch Birding 40: 82-89.**

Recent research on vocalizations, plumage and genetics has shown that the owl formerly known as 'Hume's Owl' are actually two species: Omani Owl *Strix butleri* (from eastern Oman, north-eastern United Arab Emirates, southern Pakistan and north-eastern Iran) and Desert Owl *S hadorami*. The range of the latter encompasses eastern and southern Israel, Palestinian Territories, Jordan, through Sinai, to eastern Egypt, and much of the Arabian Peninsula. In Egypt, it was previously described as a rare and local breeding resident in a few wadis and oases of southern Sinai. Since then, recent surveys by Baha el Din and Baha el Din (2001) have found a more extensive distribution within Egypt. Desert Owl appears to be fairly widespread in the mountains of south Sinai, from fairly low to higher attitudes with pairs located in favourable habitats such as those with palm trees. Most occur around the Monastery of St Katherine, where there are possibly several pairs. In the Eastern Desert, a total of 10 Desert Owls was observed at six locations during four consecutive breeding seasons from 1997-2000. In this paper, we present results of a survey of breeding Desert Owls in all formerly known locations in the Sinai and the Eastern Desert, as well as in other seemingly suitable wadis in the Red Sea and South Sinai governorates, especially in sites not surveyed during previous studies. Unfortunately, some sites known to have been previously occupied were not allowed to visit, especially in the Sinai.

**2017. Habib, M. New breeding colony of Yellow-legged Gull at Port Fouad, Egypt, in May 2016. Dutch Birding 39: 86-87.**

During recent decades, gull populations have increased dramatically in Europe, North America and Australia, probably as a result of an increase in food availability derived from human activities. In the Mediterranean basin, Yellow-legged Gull *Larus michahellis* has undergone a widespread increase in the last few decades. In Egypt, Yellow-legged is a fairly common winter visitor to the Mediterranean coast, lakes and the Suez Canal area including Hurghada. It is a scarce, non-breeding summer visitor to other parts of the country. At a lagoon east of El Alamein, a breeding colony of 10-15 pairs was found on an island on 7 May 1985 and again on 18 May 1986, when 25 pairs were counted. These were the only breeding records so far. The El Alamein area has since been developed and the breeding site there has disappeared. On 25 May 2016, while surveying nesting colonies of Common Tern *Sterna hirundo* at Port Fouad, I found a new breeding colony of Yellow-legged. Surveys and counts took place from 25 May to 4 June 2016. Most of the area was surveyed using binoculars. Photographs were taken and resulting images were used for checking counts and identification. Counts took place between 08:00 and 12:30. For breeding colonies, the count units

used were apparently occupied nests. Identification was mainly based on wing pattern of the adults, colour of upperparts, colour of bare parts, and head and bill shape.

**2017. Habib, M. Surveys of White-eyed Gull on islands in Red Sea, Egypt, and notes on behavior. Dutch Birding 39: 13-21.**

White-eyed Gull *Larus leucophthalmus* is a monotypic species endemic to the Red Sea basin and the Gulf of Aden, breeding colonially on inshore islands and islets. The total population size has been estimated at 12,000 - 13,000 breeding pairs (36,000 - 39,000 individuals), equaling 37,000 - 44,000 individuals, excluding Eritrea that was not included in the surveys. The species is resident, although there is some evidence that part of the population moves southwards in winter; it is certainly scarcer in the extreme north of the Red Sea in winter than in summer. Local movements in Saudi Arabia have not been studied and occurrence outside the Red Sea basin is limited. Inventories of seabirds breeding on the Egyptian Red Sea islands were presented. In addition, observations were presented along the Egyptian Red Sea coast during spring 1982, with notes on breeding and migratory species. A report on the northern Red Sea islands was produced, representing the most comprehensive survey of breeding seabirds in this area since; this included an appendix of records from a visit to Wadi El Gamal island and Hamata mangroves in September 2000. The population in Egypt included 50 pairs on Tiran island (at the entrance of the Gulf of Aqaba) and 1500-2000 pairs on islands off Hurghada and at the mouth of the Gulf of Suez, as estimated in 1983 and 1984. It was reported that 30% of the world's population breeds on islands at the mouth of the Gulf of Suez. Baha El Din (1999) estimated the population in the Egyptian Red Sea at 10,000 individuals whereas the total number of Egyptian breeding pairs was estimated at 2700-3000. The aim of the present study was to survey all islands located in Egypt's Red Sea governorate for breeding White-eyed Gulls, especially the islands missing from previous studies, eg, Zabargad and Rocky islands.

**2016. Habib, M. Update on breeding status of Red Sea Spoonbill in Egypt. Dutch Birding 38: 69-74.**

Eurasian Spoonbill *Platalea leucorodia* breeds in Africa, Asia and Europe. A number of subspecies is recognized: nominate *P l leucorodia* (hereafter *leucorodia*) breeds in western Europe (Atlantic population), Central Europe (Pannonian population), and south-eastern Europe and large parts of Asia (the latter population is sometimes distinguished as *P l major*). *P l archeri* (Red Sea Spoonbill; hereafter *archeri*) breeds along the coasts of the Red Sea and Gulf of Aden from Egypt to Somalia and in Saudi Arabia and Yemen; while *P l balsaci* (Mauritanian Spoonbill; hereafter *balsaci*) breeds only at Banc d'Arguin, Mauritania. The latter two subspecies are resident and their respective world populations are very small, with a few 1000 breeding pairs at most. This paper documents recent surveys of *archeri* in Egypt in 2012-2014.

**2016. Habib, M. Surveys of breeding Saunders's Terns at Ras Sudr, Egypt, in 2014-2015. Dutch Birding 38: 75-79.**

I described the discovery of the first breeding Saunders's Tern *Sternula saundersi* in Egypt, at Ras Sudr, in the western part of South Sinai Governorate (29.448°N, 32.730°E). The first breeding birds were found in July 2012; in this year, 12 adults and two nests containing eggs were found. In 2013, 45 adults with one-week old chicks were counted. In 2014 and 2015, I conducted further surveys of the breeding population. The purpose was to count the population, to study the ecology and to produce recommendations for protecting the breeding and nursery ground areas and to deliver these recommendations to the Egyptian Environmental Affairs Agency (EEAA). This paper summarizes the results of these surveys about the world distribution of the species, migration, wintering areas and its status in the Western Palearctic (WP), including previous records in Egypt.

**2015. Arcilla, N., Soutan, A. and Zalat, S. Advanced Autumn Stopover Dates of Palearctic Passage Migrants in South Sinai, Egypt. Ornithology & Avian Biology International Journal 1 (1).**

Anthropogenic global climate change is correlated with increasing evidence of rapidly shifting avian migration phenology. Many spring migrants are arriving earlier on their breeding grounds, while the trend in autumn departures is less uniform, with both early and delayed departures reported. The ecological and evolutionary consequences of these changes are poorly understood, and empirical data are lacking for many regions. We contribute new empirical data on advanced autumn migration dates for eight species of Palearctic passage migratory birds in South Sinai, Egypt, along a major biannual bird migration route. We conducted some 270 field hours of surveys in regional wadis (ephemeral river beds), mountains, plains, and oases from elevations from 645 to 2650 m above sea level. We detected a total of 63 individual passage migrants from nine passerine species. For eight of the nine species, first autumn record dates were at least two to six weeks earlier than those documented 20 years previously. Populations of many long distance Palearctic migratory bird species are declining, and changing conditions in passage stopover regions may contribute to declines. Both migratory and resident birds in South Sinai face unprecedented conservation threats, including anthropogenic climate change and habitat loss.

**2015. Habib, M. Surveys of Chestnut-bellied Sandgrouse in Egypt in 2013-14. Dutch Birding 37: 95-97.**

Chestnut-bellied Sandgrouse *Pterocles exustus* is native to large parts of sub-Saharan Africa and western Asia, from Mauritania and Senegal to Somalia and Tanzania and from Saudi Arabia to Pakistan and India; six subspecies are recognized. The subspecies *P. e. floweri*, endemic to central Egypt, was rediscovered in 2012. In Egypt, the species was reported as abundant in the Nile valley and in bordering deserts between November 1853 and January 1854. It was considered to be the most abundant sandgrouse species in Egypt in the late 19<sup>th</sup> century, but it was found to be 'certainly scarce' by 1929. At that time, the species was still found in several scattered locations

in the Nile valley, between the eastern fringes of the Delta in the north to Luxor in the south. The last 20<sup>th</sup> century record was on 4 March 1979, when ca 10 were found between Isna and Idfu, south of Luxor. In early March 2012, a team of Austrian and German ornithologists discovered four individuals near Al-Bahnasa in Minya province. On 22 March 2012, ca 100 were seen near the original site. In August 2014, a birder from the Hala'ib (or Halayeb) Triangle, in the south-eastern corner of Egypt close to the Sudanese border (this area is disputed between Egypt and Sudan), 750 km from Minya, photographed Spotted Sandgrouse *P senegallus* with one male Chestnut-bellied. This record may indicate that *floweri* (occasionally) occurs as far as southern Egypt, but the record could also represent an overlooked population still surviving or a vagrant from northern Sudan (*P e exustus*) or even the Arabian Peninsula (*P e erlangeri*; the nearest coast is c 200 km across the Red Sea).

**2014. Habib, M. Large Common Tern colony at Port Said, Egypt, in May 2013. Dutch Birding 36: 25-26.**

Common Tern *Sterna hirundo* is a migratory species with a circumpolar distribution, breeding in most of Europe, Asia and North America, except for the extreme north and south of these regions. In Egypt, it is a fairly common passage visitor along the Mediterranean coast, Red Sea coast and the Nile in spring from mid-March to mid-June and in autumn from early August to mid-October, whilst it is a scarce non-breeding summer visitor to the Mediterranean coast, the Gulf of Suez and the northern Red Sea. In May 1990, a nest with two eggs, situated at the periphery of a Slender-billed Gull *Chroicocephalus genei* colony, was photographed and 11 alarming adults were observed at El Malaha, just east of Port Said. This represented the first known breeding of Common Tern in Egypt, with at least five breeding pairs. In August 2012, while surveying Little Tern *Sternula albifrons* nesting colonies in the Port Said region, I found Common Tern parents feeding fledging chicks. After several earlier visits, this was the first time I observed breeding behaviour of the species in this area. This encouraged me to search for breeding Common Terns the next year. On 24 May 2013, I searched for nests along a 50 km stretch of shoreline, finally locating a colony west of Port Said. I revisited this colony for two more days, on 25-26 May, to monitor the chicks and nests. The area was surveyed using binoculars and a telescope. Photographs were taken using a digital bridge camera and were used for checking the counts and identification. All counts took place between 08:00 and 13:30. For breeding colonies, the count units used were 'apparently occupied nests (AON). The Common Tern colony was located at 'Drainage Lake': a shallow hyper saline lake with small, scattered sandy islands, with the water coming from two main delta discharge drains crossing Lake Manzala (31°16'45"N, 32°13'9"E). Here, the terns were nesting on small patches of exposed sand. The total area occupied by nesting terns (and other breeding birds, notably waders) was c 3 km<sup>2</sup>. A maximum of 273 Common Terns were counted, with 270 nests estimated at the colony. During the count, most nests were attended by a single parent and only three nests were observed with two parents; probably, the other adults of the breeding pairs were feeding away from the colony. This colony is significantly larger than the suggestion of at least five breeding pairs

found at El Malaha in 1990. Its discovery is highly noteworthy for Egypt, and constitutes an important addition to the rather scattered selection of breeding colonies of the species in the Middle East, at the southern range of its world breeding range. Birds in general are under wide threat in Egypt, especially from disturbance, shooting and trapping, and degradation of habitats, especially for breeding. This area in particular is subject to disturbance by feral dogs, but so far, it is a muddy substrate difficult to access by humans, so it is naturally protected. In order to safeguard this significant colony for the future, signs could be posted to prevent people entering the area during the breeding season, especially when birds are nesting and raising chicks. The site should also be monitored every year, and any disturbances noted. Disturbance by feral dogs could constitute a problem and, if necessary, should be controlled. Natural predation of eggs or chicks, by foxes or other mammalian or avian predators, could also constitute a threat to the viability of the colony. Such issues can only be determined through regular monitoring. However, monitoring itself can also serve as a disturbance factor for breeding birds so must be executed with great care.

**2014. Habib, M. Saunders's Terns breeding at Ras Sudr, Egypt, in 2012-2013. Dutch Birding 36: 20-24.**

Saunders's Tern *Sternula saundersi* breeds as far north as 24°N on scattered locations on islands and along the shores of the southern Red Sea south to Yemen (including Socotra) and Somalia, as well as around the Persian Gulf to north-western India, Sri Lanka and the Maldives. North-eastern African birds move south as far as Tanzania in winter, and birds around the Red Sea also move south within the breeding range. Birds in south-eastern Somalia, North Sudan and Socotra are resident. Other populations appear to migrate eastwards to the west coast of India, Sri Lanka, the Laccadives and the Maldives, Seychelles and Malaysia. Described as arriving as early as February and leaving in October, its breeding colonies are little known. It is conceivable that it breeds on islands in the extreme southern Egyptian Red Sea. On 27 May 1982, six 'little terns' (Little Tern *S. albifrons* or Saunders's) were noted calling and displaying mobbing behaviour on an island off Marsa Suma. Saunders's has not been proven to breed in the northern Red Sea, but there are three sight records (of four birds) from Eilat (an adult in June 1988, another adult during April-July 1989 and two adults in May 2001), while further individuals suspected of being this species have been seen in a summering flock of Little Terns at Eilat on a couple of subsequent occasions. This includes a record from March 2007 which has been submitted to the Israel Rarities and Distribution Committee. However, it is suspected that the species might possibly be overlooked in the Gulf of Aqaba. In Egypt, two were observed at Ras Mohammed, southern Sinai, on 10 May 1992 and, on 18 September 1991, five resting birds were seen on a sand-bar just south of this location. In May 1982, a dried carcass was found in the nest of a Western Osprey *Pandion haliaetus* at Gezira Mahabis along the Red Sea coast. Also in Egypt, there are several other reports of birds from scattered sites over the years, including Tawila Island off El-Gouna, as well as from the town of Suez as recently as 2006, but these sightings have not been documented. If Saunders's Tern were to breed within the Arabian part of the Western Palearctic, Kuwait in the

east (where breeding has been suspected in the past; and Egypt in the west would be the obvious choices, especially Egypt with its high densities of seabird colonies (predominantly White-eyed Gulls *Larus leucophthalmus*, Bridled Terns *Onychoprion anaethetus* and White-cheeked Terns *Sterna repressa*).

**2013. Habib, M. Egyptian Vulture *Neophron percnopterus* breeding and stop over at Red Sea, Egypt. Vulture Multi-species Action Plan Workshop, 25-29 October, National Park of Monfragüe – Spain.**

The Egyptian vulture (*Neophron percnopterus*) is a rare breeding resident in most parts of the country, except in the extreme southeastern corner where it is common. Breeding has been documented at Gebel Elba, Gebel Abrag, Gebel Abu Hareigal, and Wadi El-Allagi. The birds are generally migrating visitors from late August to early June, and considerable numbers visit in the autumn and spring, mainly through the Sinai and Eastern Desert. In 1982, 437 Egyptian vultures were recorded at Suez, and a year later 1,189 individuals were counted in the same area. A few migrants (*Neophronneophron percnopterus*) presumably winter in the country.

**2013. Habib, M. Lammergeyer (*Gypaetus barbatus*): Breeding and Visits to the Red Sea, Egypt. Vulture Multi-species Action Plan Workshop, 25-29 October, National Park of Monfragüe – Spain.**

The lammergeyer (*Gypaetus barbatus*), also known as the bearded vulture or ossifrage, is a rare breeding resident and migrant to the southern Sinai and the Red Sea mountains. A specimen from the Gebel Elba area appears to be related to the East African form, *G. b. meridionalis*, and those from the central Red Sea mountains and Sinai were identified as *G. b. aureus* or *G. b. barbatus* by. Near Suez, R. G. Bijlisma recorded a possibly immature specimen in 1982.

**2013. Habib, M. Lappet-faced vulture *Torgos tracheliotus* breeding At Red Sea, Egypt. Vulture Multi-species Action Plan Workshop, 25-29 October, National Park of Monfragüe – Spain.**

The lappet-faced vulture (*Torgos tracheliotus*) is a subtropical and marginally Palearctic. It has withdrawn from parts of its former range and is now restricted to Africa and Arabia, breeding or residing in some African countries including Egypt. This vulture often stays in one place, although the adults can be nomadic at times. They live in dry savannahs, thorn bushes, arid plains, deserts with scattered trees, in Wadis, and on open mountain slopes. In Egypt they are rare and local breeding residents in the Eastern Desert.

**2011. Ibrahim, W. A. An overview of bird migration studies in Egypt. Ring 33 (1-2): 55-75.**

This is an overview of ornithological studies carried out in Egypt since the beginning of 20<sup>th</sup> century till the present time made on the basis of several more or less general publications. Geographical location and climate descriptions give the background



information about the area. The literature overview stresses especially problems connected with the migration of passerines, but wider avi-faunistic background is discussed as well. Special attention is paid to passerines' strategy of migration through the Mediterranean Sea and Sahara Desert, its direction and timing, as well as to the factors affecting passerines migration and bird ringing in Egypt. In conclusion, it is stressed that the studies on bird migration were done sporadically, from time to time and from one place to another, and there is a dramatic lack of permanent ringing/ bird migration study field stations, despite the fact that some suitable and promising localities have been found, in which the studies have been carried out since 2001 by the SE European Bird Migration Network in Cooperation with some protected areas managements.

**2011. Stwepniewski, K., White, M. and Megalli, M. Autumn migration of passerines in Bahariya Oasis in Egypt- where do they come from and where do they go? Ring 33 (1-2): 27-36.**

We present the results of studies on directional preferences of passerines migrants in Bahariya Oases, Western Desert, Egypt. Field work was conducted in August and September 2010. Birds were mist-netted, ringed and tested in Busse's orientation cage; in total 66 tests were analyzed. The most pronounced direction was W, which was surprising and remains unexplained. Southern directions were also prominent, particularly SW; among the northern directions NW were distinct and NE less so. Our results are in line with those at other ringing stations in Egypt, suggesting a common migration pattern in this region. They also allow for tracking probable migration routes through Bahariya. Birds may arrive at the oasis from the Nile Delta and Mediterranean Coast, then the majority head SW towards Lake Chad, while others may fly directly S or SE towards the Nile Valley. Bahariya Oases appears to be an important crossing point of passerines migration routes across the Sahara and it is important to continue further studies in this area.

**2011. Zaniewicz, G. and Chrus'ciel, J. Burullus ringing station (N Egypt) - ringing results and seasonal bird migration dynamics in 2005- 2007. Ring 33 (1-2): 77-87.**

Burullus ringing station is one of the several stations belonging to the SEEN organization (SE European Bird Migration Network). This station is situated close to the border of Burullus Protected Area in the northern part of Egypt and it started work in 2005. Birds were collected during two spring and three autumn seasons. Birds were caught in mist-nets, which were placed mainly in reedbeds. Over 12 thousands of birds from 74 species were caught and ringed during five migratory seasons. Many of them were also tested for directional preferences in Busse's cage.

**2010. Abdou, W. General pattern of the passerine bird's migration and their distribution in different protected areas in Egypt. Ph. D. Thesis, Faculty of Science, Tanta University, Tanta, Egypt.**

Crossing the Mediterranean Sea and Sahara was very interesting question to answer. A lot of scientists tried to answer this question as Sahara extends from the Atlantic coast in the west to the Saudi Arabian Peninsula in the east leaving no way to fly around. The Sahara north to south covers about 2000 km of extremely inhospitable land with stony, rocky desert, mountain depression and very few oases. To cross this barrier, birds would have to fly continuously for 30 to 40 h. Birds crossing Egypt on their migration between the breeding and the wintering grounds may divide their journey into phases of flights and stopovers before and after crossing the ecological barriers. The organization of the journey in flight bouts and stopovers is likely to depend on the availability and quality of potential stopover sites, on short term environmental factors and on various selection pressures. The main goal of this study is to investigate strategy of passerines crossing Egypt during migration seasons (autumn and spring). The study contains faunistical information about mainly passerine species migrating in some sites on the different protected areas of Egypt. These are Burullus, Wadi El Rayan, Sharm El Sheikh, Aswan and Wadi Gemal. Passerine ringing techniques was used to investigate the seasonal migration dynamics for passerines in different sites in Egypt. About 2000 individuals of birds out of 117 species in Spring season and about 11000 individuals of birds out of 103 species in autumn were caught to study the migration strategy of passerines across Egypt as critical locality in one of the main migration flyways between Europe, Asia and Africa. The ecological and biological similarity between different stations was investigated. The result shows that the numerical and ecological similarity was variable within seasons and between different areas. The passerines species diversity in the different stations was also a question of the study, where species diversity in some sites varies between seasons, in addition to variable diversity of different sites. The results showed that, in Egypt passerines start to migrate on the beginning of March with relatively high peak of migration, but sometimes even earlier in some sites, where passerines may start to migrate in the end of February. Passerine species generally finish migration at the end of April to the second week of May. Timing and distance of migration can be influenced by different origin of passing birds and latitude of breeding population. General pattern of birds movements indicated that, passerines migrating across Egypt, are originated from different destinations (i.e. mixed populations). Passerines are not migrating along the Nile Valley as main flyway, but the results showed to main flyways, the birds use to arrive from the north (as well as northwest and northeast) and depart to the south (but SE and SW) during the autumn migration and from SW and SE to NE-N-NE in the spring.

**2009. Sheta, B. M. Impact of some human activities on the biodiversity of different species of birds at Damietta region, Egypt. M. Sc. Thesis, Mansoura University, Faculty of Science in Damietta, Department of Zoology.**

The present study aims to assess the impact of some human activities on the bird community. Birds were sampled, using line transect and point count method, in six different localities on Damietta coast, Egypt, for 15 months (from July 2007 to September 2008). The localities represent three different human activities (cultivation, urbanization and artificial fish farm) in addition to one control locality. Each locality was represented by two separated line transect, each one from 1 to 1.5 km. Habitat type and plant covers were clearly different among the localities and to less extent within localities. Species diversity varied spatially among the different localities and varied temporally during the study period. Nevertheless, the control site had the highest richness and abundance while agriculture site had the lowest richness and urbanized site had the lowest abundance. In contrast, urbanized site recorded the highest species evenness, while sparsely vegetated fish farm site (deserted and densely vegetated fish farm) had the lowest one. Otherwise fish farm site had the highest diversity, while agriculture site had the lowest one. The different localities had distinct and characteristic groups of species responding to human activities. Our results suggest that the use of bird species as bioindicator is workable concept for biodiversity assessment in the landscape scale, cultivation and fisheries as well as in control site. The results are presented the importance of this area as a shelter for breeding and migratory birds to be taken into account in conservation plans in Egypt.

**2008. Newbold, T., Collins, S. and Behnke, J. Sentinel behaviour and the watchman's call in the Chukar at St Katherine Protectorate, Sinai, Egypt. Egyptian Journal of Biology 10: 42-53.**

Foraging in a group potentially allows individuals to reduce anti-predator vigilance without increasing predation risk. Individual vigilance may be further reduced if group members take turns at watching for predators, acting as sentinels or guards. Because the presence or absence of sentinels must be monitored to ensure that the group is guarded at all times, the conditions favouring the evolution of coordinated vigilance are probably very specific. We studied groups of chukars, *Alectoris chukar* (Gray, 1830) (Phasianidae), a desert species reported to adopt a sentinel system, to see whether this was the case. Individuals identified as sentinels behaved significantly differently from other group members, occupying prominent positions and being vigilant significantly more than foraging group members. The largest individuals became sentinels most frequently, yet were not more vigilant than smaller individuals, while they were on guard. Sentinels that ended a bout of vigilance were usually replaced quickly; a soft call was heard during a significant number of exchanges. We conclude that chukars do have a sentinel system of vigilance. A vocalisation, similar to the watchman's call seen in other species, seems to play a role in coordinating vigilance behaviour.

**2008. White, M., Mohammed, A., Dauphin, N., Gilbert, F., Zalat, S. and Gilbert, H. Recent surveys of resident breeding birds in the St Katherine Protectorate, south Sinai, Egypt. Sandgrouse 30: 190-200.**

We report records of 25 species of resident breeding birds in St Katherine Protectorate, south Sinai, Egypt in 2006, 2007 and spring 2008. We note a number of chronological and geographical discrepancies in the distributions and abundances of these species in reference to earlier surveys and records. Located in the southern Sinai mountains, St Katherine Protectorate is an important area for both breeding and migratory birds and requires ongoing protection, appropriate management, and more detailed research in ecology and community-based conservation. A number of bird species that formerly appeared to be common in the St Katherine Protectorate were detected only rarely or were not detected at all in recent surveys. Remaining bird populations are threatened by overgrazing, illegal hunting and the demands placed on water supplies by development associated with a recent increase in tourism.

**2007. White, M., Gilbert, F. and Zalat, S. Bird surveys and distance sampling in St Katherine Protectorate, South Sinai, Egypt in 2007. Egyptian Journal of Biology 9: 60-68.**

Operation Wallacea and BioMAP Egypt conducted bird surveys and distance sampling in St Katherine Protectorate in June and July 2007. 18 repeat surveys in St Katherine City estimated bird abundance, diversity and density. Thirty three species were recorded, 17 during expeditions and 18 in St Katherine City. Rock Dove *Columba livia*, Laughing Dove *Streptopelia senegalensis* and Sinai Rosefinch *Carpodacus synoicus* had the highest abundance and density in the repeated St Katherine surveys. A number of bird species that formerly appeared to be common in St Katherine Protectorate were detected only rarely or were not detected at all in recent surveys. Mourning Wheatear *Oenanthe lugens* and a number of Hooded Wheatear *Oenanthe monacha* were observed in a variety of surveys, but had probably been missed in 2006. A pair of Bonelli's Eagle *Hieraetus fasciatus* was observed in Wadi Arbaein for the second year running. Early migrant warblers were noted on stopover in mid-July, such as Olive-tree Warbler *Hippolais olivetorum* and Orphean Warbler *Sylvia hortensis*. Remaining bird populations are threatened with increasing pressure from overgrazing, settlement, expanding tourism, illegal hunting and demands placed on scarce water resources. St Katherine Protectorate is an important area for both resident and migratory birds, and requires ongoing protection, management, and further research.

**2005. Meakin, K., de Kort, S., Gilbert, H., Gilbert, F., Zalat, S., Mohi, L., Ibrahim, S., Griffin, J. and Volunteers of Operation Wallacea in Egypt. Monitoring birds, reptiles and butterflies in the St Katherine Protectorate, Egypt. Egyptian Journal of Biology 7: 66-95.**

Fifty-two bird species were recorded during transect and point count surveys of wadis in the St Katherine Protectorate in the mountainous southern region of the Sinai, Egypt. Two species are new to Egypt: Rock Nuthatch (*Sitta neumeyer*) and Rock

Sparrow (*Petronia petronia*). There were several other notable species: migrants such as Arabian Warbler (*Sylvia leucomelaena*) and Upcher's warbler (*Hippolais languida*); and residents such as Verreaux's Eagle (*Aquila verreauxi*), Hume's Tawny Owl (*Strix butleri*) and Striated Scops Owl (*Otus brucei*). Estimates of bird density and descriptions of each wadi are given. Species diversity of wadis within the Ring dyke geological feature bounding the central mountain plateau was not significantly different from wadis outside. Species composition and numbers of individuals varied according to the distribution of water sources, natural trees and Bedouin gardens especially in fruit. These features appear to be particularly important as staging posts for migrants. Numbers of some birds increased around tourist areas. Observations of seven species of reptile and ten species of butterfly including endemics are also presented. Recorded numbers of all groups depended heavily on the time of day.

**2001. Manlius, N. The ostrich in Egypt: past and present. Journal of Biogeography, 28: 945-953.**

This article tracks the evolution of the distribution of ostrich populations, *Struthio camelus* L. in Egypt from the Late Pleistocene up to present times with a view to establishing a series of distribution maps for the historical period. An attempt is then made to describe and interpret these maps. We compiled all the information about the presence of the ostrich in Egypt collected from the study of fossil remains, archaeological materials and from the narrative of travelers since the fourteenth century. From the accounts of these travelers, three maps showing the location of this bird in this country are established: from the end of the fourteenth century to the end of the seventeenth century; from the beginning of the eighteenth to the end of the nineteenth century; and lastly, for the twentieth century. The ostrich was abundant and broadly distributed in Egypt in the past. However, it has been constantly in decline. It disappeared from the north of the country and lived only in the southeast up to the end of the nineteenth century. The birds reappeared in the latter region at the beginning of the 1960s up to 1991 before disappearing from the country. The principal reasons for the decline of the ostrich in Egypt are the aridity caused by climatic changes and intensive hunting by humans. It is possible that this bird was not sighted in the country between the beginning of the twentieth century and the 1960s, not because it had disappeared, but most probably because it was sufficiently discrete to be noticed.

## 15-Zooplankton

**2016. Khalifa, N. and Bendary, R. Composition and Biodiversity of Zooplankton and Macrobenthic Populations in El-Rayah El-Menoufy, Egypt. International Journal of Applied Environmental Sciences 11(2): 683-700.**

Due to the importance of irrigation canals of River Nile as a source of drinking and irrigation water; an ecological study was carried out to show the abundance and diversity of zooplankton and macrobenthic invertebrates in relation to some environmental variables in El-Rayah El-Menoufy (one of the main irrigating canals of Nile Delta). The study also aimed to assess the seasonal changes in zooplankton and macrobenthos species richness, evenness and diversity. A sharp increase in total zooplankton density in spring season (average, 1868 Ind. l<sup>-1</sup>) and a marked decrease in summer and winter seasons (with average of 203 and 54 Ind. l<sup>-1</sup> respectively) suggests seasonal changes in the trophic conditions of El-Rayah El-Menoufy water. Rotifers formed a main component of zooplankton which indicates eutrophic state of El-Rayah El-Menoufy. *Keratella cochlearis* was the main rotifer in spring and winter, *Brachionus calyciflorus* and *Epiphanes macrura* dominated in summer and *Collotheca pelagica* flourished in spring and autumn. *Vorticella campanula* was the most abundant protozoan; it appeared in spring, summer and autumn with highest population density of 149 Ind. l<sup>-1</sup> in autumn. Macrobenthic invertebrates was represented by three groups; Mollusca (9 species), Annelida (4 species) and Arthropoda (3 species). Low taxon richness of macroinvertebrate in sediment of El-Rayah El-Menoufy with 16 species; may be due to pollution discharged from cities and cultivated lands. Among molluscs, *Cleopatra bulimoides* was the most dominant species except in summer season, *Melanoides tuberculata* flourished in summer and autumn, *Corbicula fluminalis* and *Theodoxus niloticus* were common. The predominance of oligochaetes due to the abundance of *Limnodrilus udekemianus* during the study period and it was the sole form of annelids in autumn. *Chironomus* sp. was the most common arthropod and it flourished in summer at sites with relatively low dissolved oxygen values. The Principal Component Analysis (PCA) showed that the dominant zooplankton species were struggle ones that can tolerate changes in physico-chemical variables. The PCA indicated that most of macrobenthos species were positively influenced by temperature and pH, and negatively with Electrical Conductivity (EC) and Dissolved Oxygen (DO).

**2016. Mohammad, W. A. Impact of Some Ecological Factors on Zooplankton Communities at Assiut, Egypt. Ph. D. Thesis, Assiut University, Faculty of Science, Department of Zoology.**

The present investigation was designed in two parts (field and laboratory). The field part was performed to study the impact of some ecological factors such as, temperature, PH, conductivity and dissolved oxygen on the density and abundance of zooplankton community in the River Nile at Assiut city. In the laboratory part, the common cladoceran species *Simocephalus vetulus* was chosen as a model animal to

study the effect of UV-A as an important ecological factor on biochemical, histological and morphological changes. To achieve the above goals, qualitative and quantitative samples of zooplankton were collected monthly for one year (April 2011 - March 2012) from four different sites distributed on the River Nile at Assiut city. To study the vertical distribution of zooplankton community, monthly samples were collected from different depths. Individuals of the cladoceran *S. vetulus* were exposed, in the laboratory, to different doses of UV-A for 15, 30 and 60 minutes. The most important results are summarized in the following points. In all investigated sites, the studied ecological factors showed significant differences except for dissolved oxygen concentration. fourty zooplankton taxa were recorded in the River Nile during the period of investigation, these taxa included 5 groups (Cladocera, Copepoda, Rotifera, Ostracoda and other group of insect larvae and aquatic mites). Cladocera was the most dominant group, while *Bosminalon girostris* was the most dominant cladoceran species, and *Daphnia longispina* was the least dominant. Site I showed the highest density and richness of zooplankton community, while site III showed the highest diversity of species. Seasonal abundance of total zooplankton showed the highest peak in winter, while the lowest peak was observed in summer and the analysis indicated that water temperature is considered as one of the most important factors affecting the distribution of zooplankton. There was a negative relation between the total species density and temperature. The total density of zooplankton recorded the highest average at the surface water level 0-0.5 m depth; this density decreased with depth and attained slight increase at 1-1.5 m depth. The same observation was noticed for the Cladocera group. After exposure to UV-A radiation, the intestinal cells of *S. vetulus* showed obvious changes at low doses for 15 minutes. With increasing the exposure time to 60 minutes, most of the intestinal cells became vacuolated, fragmented with disruption of cellular membrane and cell contents. Hyperplasia and karyolysis were noticed after 60 minutes of exposure. High doses of UV-A caused a decrease in the total protein contents in the irradiated groups, while lipid peroxidation and the activity of Catalase enzyme increased. The activity of superoxide dismutase showed an increase only after 60 minutes of exposure. Glutathione content in *S. vetulus* showed significant decrease after the first period of exposure, but significant increase was observed after 60 minutes. Nitric Oxide increased only after 15 minutes of irradiation. Radiation induced morphological changes in the exoskeleton of *S. vetulus* with the appearance of irregular distances between stripes of the carapace. UV-A radiation for 60 minutes caused signs of cuticle breakdown and malformation in the spines of carapace.

**2013. Abdulgabar, F. A. Ecological and Taxonomical Studies on Zooplankton Communities Inhabiting Al-Ibrahimiya Canal at Assiut Governorate, Egypt. M. Sc. Thesis, Assiut University, Faculty of Science, Department of Zoology.**

The present investigation was designed to carry out the following points: 1- make a survey of the major zooplankton taxa inhabiting Al-Ibrahimiya Canal at Assiut, Egypt: during one year (January 2011 - December 2011); 2- study the effects of some ecological factors including air and water temperature, pH, dissolved oxygen, turbidity and conductivity on the abundance and the distribution of the collected zooplankton

taxa; 3- study and compare the seasonal changes, diversity, distribution and the abundance of zooplankton taxa in the three investigated sites (also in the littoral and the pelagic zone of the studied sites); 4- deduce the difference between the state of Cladocera that inhabited Al-Ibrahimiya canal before 23 years and now; 5- deduce the difference between the state of Copepoda that inhabited Al-Ibrahimiya canal before 16 years and now; and 6- deduce the model equations which govern the density of the studied taxa. Zooplankton communities in Al-Ibrahimiya Canal at Assiut, during the period of collection comprised 73 taxa including 5 groups. Rotifera was the most important group (23 taxa belonging to, at least, 16 genera), followed by Cladocera (18 species), and Copepoda (10 adult species, *Nauplius* larvae and Copepodite stages). New genera, species and orders have been identified for the first time in freshwater of Assiut Governorate and they are as follows: 16 genera of Rotifera; 11 of them have been identified for the first time in Assiut; 10 species of the 16<sup>th</sup> genera of the rotifers have been identified, 9 of them have been identified for the first time in Assiut; a new order of insects (Plecoptera) was recorded for the first time in freshwater of Assiut; and aquatic spiders were recorded for the first time in Assiut.

**2007. Mageed, A and Heikal, M. Importance of aquatic macrophytes for invertebrate diversity in large subtropical reservoir. *Limnologia* 37: 155–169.**

The abundance and preferences of individual invertebrate populations (including zooplankton) closely associated with the substrates provided by aquatic plant structures and open-water areas of Lake Nasser were quantified in this study in order to gain understanding of the importance of submerged macrophyte for invertebrate diversity, and their relation to water properties. The following water parameters were measured: temperature, pH, dissolved oxygen (DO), total dissolved salts, electrical conductivity, turbidity, total suspended solids, carbonate, bicarbonate, nitrate, nitrite, phosphate, sulphate, silica, potassium, total hardness, calcium and magnesium. Five macrophyte species were recorded: *Myriophyllum spicatum*, *Najas horrida*, *Potamogeton schweinfurthii*, *Potamogeton pectinatus* and *Vallisneria spiralis*. In total 67 invertebrate species were recorded, comprising 39 Rotifera, 12 Cladocera, 4 Copepoda, 4 Insecta, 2 Protozoa, 2 Ostracoda and one species of Turbellaria, Tardigrada, Annelida and Nematoda. Thirty-seven species were exclusively epiphytic; 11 species were collectively planktonic and 19 species were found in both habitats. The greatest abundance of epiphytic invertebrates occurred in association with *N. horrida* – *P. schweinfurthii* community. The results indicated that total suspended solids (TSS), PH and NO<sup>2</sup> are the most influential water variables on the distribution of the aquatic macrophyte samples and their invertebrate communities. Also, the study indicates that water variables have a higher impact on the aquatic macrophytes than on the associated invertebrate populations. P, NO<sub>3</sub>, K, Na, Mg, Cl and DO were the most influential water variables that dictate the distribution of invertebrate groups recorded in the open-water zone. Water temperature, electric conductivity, pH, NO<sub>2</sub>, SO<sub>4</sub>, SiO<sub>3</sub>, CO<sub>3</sub> and turbidity have a lesser influence of the distribution of the invertebrates recorded in this zone.



## 16- Marine Biology

### 16.1. Botanical Studies

**2018. Abbass, S., Madkour. F. and Abu-Elregal, M. Checklist of phytoplankton species in the Egyptian Red Sea Coast of Hurghada. Egyptian Journal of Aquatic Biology & Fisheries 22 (2): 93- 101.**

Surface phytoplankton samples were collected at twelve stations of Hurghada coast of the Red Sea. Phytoplankton samples were conducted monthly during the period from August 2014 to July 2015. The phytoplankton population was diversified accounting 138 species which comprised mainly of two groups; dinoflagellates (67species) and diatoms (64 species), and the rest of species (7 species) belong to other four groups. The dominant genera, in terms of the number of species, were *Tripos*, *Protoperidinium* and *Gonyaulax* for dinoflagellates; while *Chaetoceros*, *Rhizosolenia* for diatoms. The present study added 35 new records to the proper Red Sea. Of these species, 17 species of diatoms and 15 dinoflagellates in addition to 2 species of coccolithophores and one species of Chlorophyceae.

**2018. Farghaly, M. Diversity of seaweeds and seagrasses in the Egyptian Mediterranean coastal eco-zones. J Coast Zone Manag. 21.**

The Egyptian Mediterranean coastal area lies between Sallom West and Rafah East, about 1100 km, enjoying a high economic value and ecological variability. They offer a wide variety of valuable habitats and ecosystem services that have always attracted humans and human activities. Egypt has a promising plan for the management of Mediterranean coastal area including the improvement of fisheries and aquaculture. Macrophytes provide the fuel of life to the coastal ecosystems. Substrates, salinity, water temperature and water transparency are the most important factors controlling the marine algal biodiversity. Environmental conditions are variable within the 100 m depth of the water along the Egyptian coast. It is closer to the shore to the west and the distance gradually increases to the east. At Port Said, it is furthest from the shore and further east it becomes closer again. This is caused by the alluvial cone that has built up in front of the mouth of the Nile in the Delta area. So, the macrophyte community structures are variable. Although, there were many works on the coastal vegetation, the marine macrophytes were scarcely and occasionally explored. Many lists had been published from Alexandria, some from Port Said, but still the image of distribution along the western and Sinai coasts are vague. We investigated the floristic elements and vegetation types in terms of species composition as well as diversity and adaptation in the different environmental conditions along the coast of Egypt on the Mediterranean. Seasonal field investigations, observations and collections of seaweeds, seagrasses and associated blue-greens were carried out in the Western Egyptian coastal area (2000-2010). About 410 taxa; 30 blue greens and 380 seaweeds were encountered in this work. Comparison and analysis of data collected, with

occasional collections as well as previously recorded data and measurements demonstrates five eco-zones for the distribution of benthic vegetation along the Egyptian Mediterranean coast. The five zones are different in the environmental conditions supporting life, reproduction and distribution of seaweeds as well as their diversity. Five species of seagrasses had been encountered in this study for their support of life to many epiphytic algal species as well as the blue greens inhabitants in their meadows. These findings helped in drawing a good picture on the diversity and distribution of macrophytes in time and space, quantitatively and qualitatively. The resulted lists with the knowledge of the dominant currents gave an idea of the possibility of migration for many species from the western basin via the Tunisian and Libyan coasts. This can contribute to the knowledge and development for best practices in managing coastal zones in the Egyptian Mediterranean.

**2018. Shaltout, K. H., El-Bana, M. I. and Eid, E. M. Ecology of the Mangrove Forests along the Egyptian Red Sea Coast. LAP Lambert Academic Publishing.**

The main aim of the present book is to collect, analyze and document baseline environmental information about the Egyptian mangrove (*Avicennia marina* and *Rhizophora mucronata*) sites along the Red Sea coast. Geologically, the coastal plain of the Red Sea is composed of several kinds of sedimentary rocks, exemplified by the Miocene limestone. The lines of coral reefs along the coast reflect the uplift of the Red Sea coast during the Pleistocene. Climatologically, the Egyptian Red Sea coast belongs to the category of "Warm Coastal Deserts". The annual mean temperature varies between 23.2 °C at Hurghada in the north and 25.8 °C at Ras Banas in the south. Rainfall increases in the same direction from 3.2 mm yr<sup>-1</sup> at Hurghada and Quseir to 17.4 mm yr<sup>-1</sup> at Ras Banas). Ten major coastal and marine habitats are recognized, of which the mangrove swamps are prominent. The stresses upon these habitats include oil pollution, sewage, municipal and industrial wastes, construction activities, dredging, sedimentation, touristic activities and watershed torrents. Twenty eight mangrove sites containing a total of 525 ha have been identified along the Egyptian Red Sea coast. Unfortunately, the data are scarce about the pure and mixed populations of *Avicennia marina* and *Rhizophora mucronata* far to the south at Shalateen and Halayeb. Analysis of the mangrove (*Avicennia marina*) soil collected from different sites along the Red Sea coast, reveal the possibility of the rehabilitation of the deteriorated mangrove sites taking into consideration the following points: 1- mangrove can be grown in the semi-closed bays, where the wave action is minimal, or in other areas protected from severe wave action; 2- depth of the embayments used for mangrove planting must be at least one meter thickness of sediments; 3- soils used must be of fine sand and mud, with low carbonate content, high organic matter and relatively low salinity; and 4- spreading of embayments along the Red Sea coast should be examined to delineate their availability for mangrove culturing. Some recommendations and management guidelines are included such as: 1- classification of mangrove areas according to their level of degradation; 2- future threats, prioritization of actions and selection of sites suitable for mangrove restoration programmes should be based on feasibility studies; 3- establish clear objectives for management; and 4-

implement environmental impact assessment for all projects likely to affect mangrove communities. Other recommendations and management actions are: 1- refinement of the mangrove area estimates using satellite images in combination with ground surveys; 2- filling the gaps in the assessment of environmental factors; 3- estimating the standing-crop phytomass using the non-destructive regressions techniques; 4- assessing the population structure and regeneration capacity of the mangrove species; 5- a GIS-based study of the coastal topography should be carried out; 6- prohibition and restriction of present activities causing mangrove degradation; 7- control of mangrove pollution and elimination of pollutants and their potential threats; and 8- establishing longterm mangrove monitoring programmes to monitor natural and human-induced changes.

**2016. Ismaiel, B. S. Integrated Field Studies and Remote Sensing Approach for Mapping Seagrasses and Mangrove Habitats, Red Sea, Egypt. Ph. D. Thesis, Ain Shams University, Faculty of Women for Arts, Science and Education, Botany Department.**

The present work aimed to integrate between the traditional (field study) and modern methods (Remote Sensing Techniques) for monitoring beds of seagrasses and mangrove forests and studying the periodical changes of the seagrass beds and mangrove forests corresponding to the progressive anthropogenic impacts. In addition, to assess using the seagrass beds as biomonitoring agent for heavy metals pollution in coastal zone of Hurghada and Safaga. To achieve the target of the study, field monitoring for 41 stands of Seagrass beds in Hurghada and Safaga were carried out from 2013 to 2015. Floristic composition of the stands was studied and the biodiversity indices were calculated. Seagrasses density, biomass and photosynthetic pigments were estimated. Multiple satellite images of the spectra and the field data were used to estimate seagrasses distribution in two training and applied sites. In addition, + ETM, TM, MSS, OLI and Spot satellites for determination the temporal changes of seagrasses cover areas from 1972 to 2014 were used. The analysis and image processing were applied using software: ERDAS 2010 and Arc GIS 10.3. Seawater, sediments and seagrass tissues were collected from four sites located in Hurghada and Safaga to investigate the possibility of using seagrasses as bioindicator for heavy metals pollution. The main results can be summarized as follow: field monitoring identified five species of seagrasses in the sampled stands; *Halophila stipulacea* (Forssk.) Asch., *Halodule uninervis* (Forssk.) Boiss., *Halophila ovalis* (R.Br.) Hook. F., *Thalassodendron ciliatum* (Forssk.) Hartog and *Syringodium isoetifolium* (Forssk.) Hartog. All the recorded seagrasses are belonging to tropical indo-pacific bioregion. Satellite images clarified the changes in coverage areas of seagrasses and mangrove habitats parallel to human urbanization along the Red Sea Coast. The highest reduction in seagrasses and mangrove coverage are occurred from 1990 to 2004, the period where the Red Sea Coasts howed the highest stress of urbanization. Heavy metals analysis in seawater indicated that Fe is the dominant metal. The dominant order of heavy metals in the fine granules of the sediments in the studied sites was Fe>Zn>or<Mn>Cu>or<Pb>Cd. The results clarified that the

concentrations of heavy metals in seagrass organs vary from species to species and from site to site. *H. uninervis* had the capability to bioconcentrate Cu and Cd in their leaves; *H. stipulacea* had high ability to bioconcentrate Cd in their roots, rhizomes and leaves; *H. ovalis* concentrated Cu and Pb in leaves but Cd in rhizomes and *T. ciliatum* bioconcentrated Cd with higher BCF value in rhizomes. Translocation of heavy metals from roots to rhizomes is highly active in SFP site for *H. stipulacea* and *H. uninervis* and from roots to rhizomes and rhizomes to leaves for *H. ovalis*. The highest density of *H. stipulacea* and *H. uninervis* was recorded in SFP site, but recorded the lowest biomass, while, *H. ovalis* recorded its highest density and biomass in this site. *H. stipulacea*, *H. uninervis* and *H. ovalis* contain their highest chl a content in Gasous sites and chl. b in Hurghada, but their highest carotenoids content was in SFP site. This result indicated that seagrasses were affected by bio-concentration of heavy metals in their tissues, however they have the ability to resist their risks by increasing carotenoids in their tissues.

**2016. El Shaffai, A. Field Guide to Seagrasses of the Red Sea, Second Edition. IUCN (International Union for Conservation of Nature) Publications Services, Rue Mauverney, Gland, Switzerland.**

The purpose of this publication is to provide naturalists, resource managers and scientists with a simple guide to identify all species of seagrasses in the Red Sea. Each species is described in detail using photographs and diagnostic features. Key features are those that distinguish a particular species from most other species, whereas diagnostic features belong only to that species. This guide begins with a description of habitats in the Red Sea that support seagrasses, followed by an introduction to the features of sea grasses used for identification. Each seagrass species is then described individually. These species are grouped into two families: Cymodoceaceae and Hydrocharitaceae. Within each family, species are listed alphabetically.

**2015. Farghaly, M. S. and El-Shoubaky, G. A. Synopsis of Biodiversity and Distribution of Macrophytes along the Suez Canal in Time and Space. International Conference on Plant, Marine and Environmental Sciences (PMES-2015), Kuala Lumpur (Malaysia).**

The large project of the new Suez Canal, started by August 2014, will change many aspects in its characteristics especially the biological. We need to establish a picture of the existing fauna and flora, in order to build a base line on which we can follow any possible changes. Development of the physiognomy and Hydrography along the Suez Canal had been occurred during the last 20 years especially in the Northern part. The marine vegetation of the Eastern branch North of the Suez Canal with the new container Port was the object of intensive investigations 2000/2011; 100 taxa of seaweeds, 20 of Blue-greens and 3 Sea-grasses had been collected. This contribution helped us to complete a good knowledge about the macro-phytes inhabiting the canal as well as an expectation of a future role in migration between the Red Sea and the Mediterranean. We could have a final figure of the Suez Canal benthic flora as a

conclusion of 30 years investigations on the Marine flora of the Suez Canal region. Discussion and analysis with the previous works on these major benthic primary producers illustrate a good speculation and best understanding of the development of the flora in time and space. Our list from the Northern branch added some 40 species to the previous recorded macrophytes from the Suez Canal. We present hereby our vision on the diversity and distribution of these plants through 4 eras in 5 different Ecozones.

**2015. Labib, W. and Abou Shady, A. Ecological Studies of Macroalgae in Alexandria Mediterranean Waters. Egypt. J. Exp. Biol. (Bot.), 11 (2): 169 – 180.**

Extensive commercial and residential development over past decades added to the list of anthropogenic disturbances to water quality along the coastal region of Alexandria. Three sites were selected along Alexandria coast to maximize possible differences in seawater types. The floristic analysis has allowed the identification of 29 macroalgal species. Rhodophyta were the richest taxon (13 species), followed by chlorophyta (10 species), and phyophyta (6 species). The algal flora was closer to cold, temperate nature than tropical. Quantitative differences in species richness across the three sites reflect their entity, and dependent upon frequency of abiotic measured parameters and geographic features. Nutrient concentrations introduced significant changes in macroalgal populations. Macroalgae overall growth was often nitrogen limited. The proportion of red species increased with increasing environmental quality, in contrast to green species whereby proportions increase with decreasing quality status. The high percentage of cosmopolitan species denotes a strong character of environmental instability. The different sites might be exclusive holder of some species. The percentage coverage (abundance) indicated Chlorophyta the main constituent (44.2-50.8%), followed by Rhodophyta (41.7–48.4%), while Phaeophyta (2.5– 9.6%) exhibited restricted occurrences to relatively less polluted area.

**2014. El Shaffai, A., Hanafy, M. and Gab-Alla, A. Distribution, Abundance and Species Composition of Seagrasses in Wadi El-Gemal National Park, Red Sea, Egypt. Indian Journal of Applied Research 4 (3).**

Distribution, coverage and species composition of seagrasses along the shoreline of Wadi El-Gemal National Park (WGNP) in the southern of Egyptian Red Sea coast were studied. Twenty six meadows of seagrass were marked, mapped and seagrass diversity and abundance were investigated. Eleven species of seagrasses were recorded; four species were new records to the whole Red Sea, the Egyptian waters of the Red Sea and WGNP. *Halodule pinifolia* (Miki) den Hartog is newly recorded to the whole Red Sea, while *Enhalusa coroides* (L.f.) Royle, represents a new record to the Egyptian waters of the Red Sea. *Halophila decipiens* Ostenfeld and *Cymodocea serrulata* (R. Brown) Ascherson were recorded for the first time in the area of WGNP. The total area of meadows estimated 1783 ha with range of 498.2 to 0.024 ha. The seagrass coverage ranged between (82.5% ± 8.7 and 17.5% ± 8) in different sites. However, the higher overall mean coverage was recorded at sheltered sites than

exposed sites. *H. stipulacea* was the most dominant species. The total coverage of seagrass found to be higher at shallower and deeper waters, rather than the middle depths of 5-20 m. The highest richness value was 1.001 in front of Wadi El-Gemal catchment basin, while the depth of 0-5 m had the highest richness and evenness (1.495).

**2011. Omar, S. A. Ecological study of mangrove forests (*Avicennia marina* (Forssk) vierh.) in south Sinai, Egypt. M.Sc. Thesis, Faculty of Science, Mansoura University.**

Vegetation structure and demography of Sinai mangrove was studied on two different bases: 1- comparing differences in mangrove community structure in each of defined habitat types and 2- study changes in mangrove community structure along line belt transect passing from land side to sea side and perpendicular to shore line by measuring individuals total height, basal area, first branching, crown diameter, aerial roots density and height, flowers and seeds production terminal buds density, individuals volume and densities of saplings at different age classes. Some of remarkable differences reflected that mangrove of sand mound habitats are generally healthier and more productive of flowers and seeds than the mangroves of the other habitats. Regarding the second pattern, these structural parameters increased gradually passing from landward to record their maximum values at the forest end at seaward. Several signs of passive impacts were observed such as cutting branches, grazing, fishing and pollution especially oil pollution. Shore line mangroves are more subjecting to various forms of pollution derived with sea surface currents if compared with other habitat mangroves. Geographical location, dominant wind direction and shore line extension are a limiting factor make mangroves of some locations are more exposed to pollution than other locations.

**2011. El Shaffai, A. A. Studies on the seagrass ecosystems in Wadi El-Gemal National Park Red Sea. M Sc. Thesis, Suez Canal University, Faculty of Science, Marine Science Department.**

Ecological studies were carried out on seagrass communities in Wadi El-Gemal National Park in the southern of Egyptian Red Sea coast. A total of 26 meadows of seagrass were marked, mapped and seagrass diversity and abundance were investigated. Eleven species of seagrasses were recorded; four species were new records to the whole Red Sea, the Egyptian waters of the Red Sea and WGNP. *Halodule pinifolia* (Miki) den Hartog is newly recorded to the whole Red Sea (Red Sea proper, Gulf of Suez and Gulf of Aqaba), while *Enhalus acoroides* (L.f.) Royle, represents a new record to the Egyptian waters of the Red Sea. *Halophila descipiens* Ostenfeld and *Cymodocea serrulata* (R. Brown) Ascherson were recorded for the first time in the area of WGNP. The meadows areas ranged between 0.024 ha and 498.2 ha with total area estimated 1783.08 ha. The higher overall mean coverage was recorded at sheltered sites than exposed ones. The total coverage of seagrass found to be higher at shallower and deeper waters, rather than the middle depths of 5-20 m.

*Halophila stipulacea* was the most dominant species in both 26 studied sites and the 5 studied depths (0-25m). Eight sites were selected to study the seasonal variations through 6 seasons between fall 2006 to winter 2008. *Thalassodendron ciliatum* (Hamata) had the highest biomass, while *Halophila decipiens* (Ras Bughdadi A) had the lowest value. Twelve species of associated macroalgae were recorded at different studied sites. Seagrasses and algae showed obvious seasonal changes with nearly unimodal seasonal pattern. A total of 45 macro-invertebrate species were recorded. Faunal composition showed regional differences. Most of the species were recorded at Hamata site. Species similarity between different sites appeared to be low. The algal epiphyte biomass was greatest during spring 2007 at Qulaan site which was dominated with *Thalassia hemprichii*. The lowest biomass recorded during winter 2007 at Ras Bughdadi C site which was dominated by *Cymodocea serrulata*.

**2009. Elnwshy, N., Abichou, H., Labiadh, M. and Zalat, S. A Promising Vegetation Type to Sustain Development in Drylands. Journal of Arid Land Studies 19-1: 113- 116.**

Due to the increasing harsh climate, only few species of halophytic plants were able to survive in such a harsh environment and high salinity of soil and water which all prevail in the study area of the research. The area is a warm coastal desert where drylands and wetlands sit side by side. Mangrove (*Avicennia marina*), showed potential indicators for having useful functions for both coastal and arid regions environment in parallel. Therefore, this paper addressed the potential impacts of the correlative functions of *A. marina* that contribute to the sustainability of dryland development compared with the other abundant plants species. The study implemented GIS analysis; field visits, literature, and group discussion with the local inhabitants of the region. The study demonstrated that the vegetation in the study area consisted of 3 main types, where *A. marina* was mostly the most prevailing. In some sites, it has been adapted to becoming completely terrestrial, and an efficient instrument in biologic dune fixation against sand encroachment and wind erosion. It was also shown to be a valuable promoter to other associated economic activities like ecotourism and indigenous activities to emerge. In conclusion, *A. marina* might be an alternative and/or additional species of vegetation in coastal drylands where other species are difficult to grow, they can provide a number of environmental and economic benefits; of which, is to control sand encroachment and biodiversity depletion and to promote living standards of Bedouins. It is therefore, recommended to consider embracing *A. marina* vegetation in dryland management strategies where it is applicable.

**2007. Madkour, F. and El-Shoubaky, G. Seasonal distribution and community structure of macroalgae along Port Said coast, Mediterranean Sea, Egypt. Egypt J. Aquat Biol & Fish 11 (1): 221 – 236.**

Seasonal variations in macroalgae community inhabiting Port Said coast were investigated during the period from summer 2004 to spring 2005. Species composition and percent cover of macroalgae were studied in four sites distributed along the coast, representing different habitats. Some hydrographic parameters (temperature, salinity, pH, dissolved oxygen, phosphate, nitrite, nitrate and silicate) were measured to determine the water characteristics influencing the studied sites. The study revealed the presence of 55 species, of them, 17 species have not been recorded previously in this area. The macroalgae comprised 31 species of Rhodophyta, 21 of Chlorophyta and 3 of Phaeophyta. Of the recorded species, 16 species occurred as epiphytes; most of them belonging to Rhodophyta. The most abundant species were *Cladophora prolifera*, *Enteromorpha compressa*, *E. prolifera*, *E. flexuosa*, *E. intestinalis*, *E. ralfsii*, *Ulva fasciata* and *U. rigida* from Chlorophyta, and *Gelidium crinale* and *Hypnea cornuta* from Rhodophyta. There were relatively seasonal and spatial differences in the distribution patterns of species composition and abundance. Autumn and summer were the most diversified seasons. Site I which was away from any effluent, rich and diversified flora were observed relative to the other sites, with the highest abundance especially in Rhodophyta. The influence of the brackish water of Lake Manzala was obvious on the vegetation at site IV and sometimes at site III.

**2004. Mostafa, H. M. Preliminary Descriptive Survey of the Impact of Coastal Enlargement on the Submerged Marine Flora of Alexandria, Egypt. Bulletin of the Faculty of Science, University of Alexandria 43: 195 – 201.**

During the last two years, the Governorate of Alexandria has been working extensively in the project of coastal road (corniche) enlargement along Alexandria coast. The coastal area has been affected due to such enlargement. The final stage included the area between Sporting and Shatby. A preliminary survey of the main floral associations was made before and after enlargement of that area. The area was characterized by its limited sandy beaches and rocky bottoms. Before coastal enlargement, different algal associations and small patches of the seagrass *Cymodocea nodosa* were recorded. These floral communities constituted mostly the main diet for coastal fishes and benthic invertebrates. The rocky bottom of the area represented natural wave breakers that normally protected the shoreline. After refilling of the area, the floral associations have been totally destroyed accompanied with most probably changing water circulation.



**2002. KhalafAllah, A. Ecological adaptation of *Avicennia marina* plants growing at Qussier, Red Sea coast, Egypt. Ph. D. Thesis, Faculty of Girls, Ain Shams University.**

Mangrove plants are tropical and subtropical plants growing under waterlogging, saline and heat stresses. The present investigation deals with the ecological adaptation of *Avicennia marina* plants in Al-Qussier region. The survey dealt with five sites which exhibit two forms fringe or lagoon. In these sites *Avicennia marina* plants are protected from wind by hills and from tide action by wide tidal flat areas and sandbars. Water and soil of mangrove are highly saline due to the presence of high concentrations of sodium and chloride ions. Clay represents the main component of the mangrove landward soils, while fine sand is the main component of the mangrove seaward soils. *Avicennia marina* seed dispersal is affected by geomorphology of sites, tide action, water temperature, water salinity, water depth, light and shade, buoyancy, longevity, and seed viability. *Avicennia marina* is an evergreen and crypto-viviprous plant which develop flowers and fruits during the year cycle. Fruiting differed from season to season and from site to site. Lagoon sites are characterized by higher canopy cover, pneumatophore numbers and height than fringe sites. *Avicennia marina* trees of more than 1m height represent the dominant class in the five sites. *Avicennia marina* plants are morphologically and anatomically adapted to waterlogging stress by developing pneumatophores, the presence of air lacunae in root and stem and chlorenchymatous tissue in the pneumatophores. They are adapted to salinity stress by preventing entrance of salts and by salt recreation through salt glands. They are adapted to heat stress by developing hairs on the stem and leaves and thick layer of cuticle. *Avicennia marina* plants are eco-physiologically adapted to the environmental stresses by balancing their water relations: increasing water content, succulence, and decreasing transpiration rate. Salt balance achieved by recreating excess and accumulated salts and by excluding excessive salt absorption by roots. This plant is metabolically adapted to stresses by producing high concentrations of soluble compounds as sugars and amino acids which play important roles in osmoregulation and reducing the harmful effect of the stresses.

## 16.2- Zoological Studies

**2018. Abdelmeneam, B. E., Ahmed, M. I., Madkour F.F. and Hanafy M. H. Phylogenetic relationships and taxonomy of three species of family Lethrinidae in the Red Sea, Egypt. Egyptian Journal of Aquatic Biology & Fisheries, Zoology 6131, 22(1): 15-22.**

Species of family Lethrinidae are of a great commercial importance in Egypt. Recent researches proved that we are far from having a full list of the family species diversity in Egypt. The purpose of this study was to clarify the phylogeny of commercial fish species of family Lethrinidae in the Egyptian Red Sea. Three commercial species of Lethrinidae (*Lethrinus mahsena*, *Lethrinus nebulosus* and *Monotaxis grandoculis*) were obtained from northern Red Sea proper. Samples were identified based on morphological characters. Identification was confirmed using DNA barcoding technique. DNA extraction was performed using Phenol-chloroform extraction method. In PCR, About 655 bp were amplified from the 5' region of the COI gene from mitochondrial DNA, then successful amplifications were sequenced. By combining our sequence results with sequences of some species of Family Lethrinidae submitted to the Gene-Bank, phylogenetic trees were constructed using p-distance Neighbor-Joining method. Results indicated that the use of DNA barcoding technique for emperor fish and big eye bream identification was successful, not only between different species of the family, but also within species, indicating the possible presence of cryptic species complex and the possible discovery of new genetic diversity. Of the three examined species from the Egyptian coasts; *Monotaxis grandoculis* showed the lowest genetic differences. *Marine Biology* showed the highest variation.

**2018. Abdelsalam, K. and Mona, M. First record of Brachyuran crab *Eurycarcinus integrifrons* de Man, 1879 from the Egyptian Mediterranean Sea. Cahiers de Biologie Marine 3 (59).**

The present study deals with the first record of alien crab *Eurycarcinus integrifrons* de Man, 1879 collected from the Egyptian coasts of the Mediterranean Sea during May 2016. It is the first work describing the male specimen in the Mediterranean Sea. This crab species affiliates to family Pilumnidae, under the Decapoda infra-order Brachyura. A re-description compiled with more detailed taxonomical information, and distribution of the recorded species are provided.

**2018. Ng, P., Abosalem, K., Mona, M. and Nour El-Deen, M. A synopsis of *Eurycarcinus* A. Milne-Edwards, 1867 (Decapoda, Brachyura, Pilumnidae). Crustaceana 91 (4): 471-487.**

The taxonomy of the intertidal pilumnid crab *Eurycarcinus* A. Milne-Edwards, 1867 is reviewed in the present work. Characters that define *Eurycarcinus* and distinguish it from the allied genera *Heteropanope* Stimpson, 1858, *Pilumnopeus* A. Milne-Edwards, 1867, and *Benthopanope* Davie, 1989 are discussed. *Eurycarcinus* can be distinguished from these genera by the smooth features of the carapace, shape and

form of the male pleon, and structure of the male thoracic sternum, notably the shapes of sternites 1- 4 and whether sternite 8 is exposed when the pleon is closed. Of the four species of *Eurycarcinus*, *E. bengalensis* Deb, 1999, is here assigned to *Heteropanope*. Furthermore, *Eurycarcinus* species are known for certain only from the western Indian Ocean.

**2018. Sadek, M. A., Madkour, F. F, Ismail, A. and Hanafy, M. H. Comparative morphology on some sclerectanian corals in Arabian Gulf and the Egyptian Coast of the Red Sea.**

The present study aimed to examine the morphological variations occur in the same species of some sclerectinian corals inhabiting Red Sea and Arabian Gulf to establish basic understand the lineage between scleractinian coral species in such geographic region. One hundred and twenty six specimens of the most abundant sclerectinian corals inhabiting the Egyptian coasts along Red Sea and Gulf of Aqaba and Arabian Gulf were collected. Mico- and macro-morphological identification was used to identify and investigate coral species at selected sites. Eight species were recorded (*Acropora pharaonis*, *Acropora humilis*, *Acropora digitefra*, *Pocillopora verrucosa*, *Stylophora pistillata*, *Porites harrisoni*, *Platygyra daedalea*, *Favia pallida*) belong to six genera. Analysis of variance has been made for the corallite and branch measurement with sites. The preset study revealed that corallite diameters are highly influenced by geographic distribution in all species except corallite of *Stylophora pistillata*. Branch diameters are highly influenced ( $p < 0.05$ ) by geographic distribution only in *Acropora humilis* and *Acropora digitefera*, while *Acropora pharaonis*, *Pocillipora verrucosa* and *Stylophora pistillata* did not vary among sites. Comparing specimens collected from Arabian Gulf with those from Red Sea and Gulf of Aqaba, corallite and branch measurements of *Stylophora pistillata* and *Platygyra deadalea* were very near and morphological characters were identical. Corallite and branch measurements of *Favia pallida* were very close at all locations. Only in Red Sea specimens (Fanous), costa and paliform was absent.

**2017. Gerovasileiou, V., Akel, E. et al. New Mediterranean biodiversity records. Medit. Mar. Sci., 18 (2): 355-384.**

This collective article presents information on 37 taxa belonging to 6 Phyla and extending from the western Mediterranean to the Levantine Sea. The new records were found in 10 countries as follows: Algeria: first reports on the presence of the fish species *Lesueurigobius sanzi*, *L. friesii*, *L. suerii* and *Luvarus imperiali*; France: first record of the alien nudibranch *Godiva quadricolor*; Italy: first record of an adult-sized red emperor snapper *Lutjanus sebae* from the southern Tyrrhenian Sea; first record of the pantropical rhodophyte *Chondria curvilineata* and the Lessepsian fish *Siganus luridus* from southern Sicily; record of a large pregnant female Dusky shark *Carcharhinus obscurus* of Sicily; Albania: first record of the fish *Ruvettus pretiosus*, new records of the alien molluscs *Conomurex persicus*, *Bursatella leachii*, *Dendostrea* cf. *folium*, *Fulvia fragilis* and *Ruditapes philippinarum* and additional report of the alien bivalve *Pinctada imbricata radiata*; Montenegro: first record of the sea slug

*Thecacera pennigera* in the Adriatic Sea; Greece: first record of the invasive calcarean sponge *Paraleucilla magna* in Greek waters; occupancy estimation of the established cryptogenic rhodophyte *Ganonema farinosum*, the alien crustacean *Percnon gibbesi* and the alien fish species *Fistularia commersonii*, *Siganus luridus*, and *S. rivulatus* along the Cretan coastline; first record of the alien mollusc *Sticteulima lentiginosa* in Greek waters suggesting a westward unintentional expansion of this species; Turkey: photographic evidence of interactions of the monk seal *Monachus monachus* with sea-cage farms in the Turkish Aegean Sea and first record of the yellow boxfish *Ostracion cubicus* in the Turkish Mediterranean; Cyprus: first records of the rare speleophilic fish *Thorogobius ephippiatus* and *Grammonus ater* in Cyprus, extending the known distribution of the latter Mediterranean endemic species eastwards; first records of the alien fish *Kyphosus vaigiensis* and the alien crustacean species *Macrophthalmus indicus* and *Carupa tenuipes* as well as additional records of the alien echinoderm *Diadema setosum* and the alien ascidian *Symplegma brakenhielmi* in the country; Lebanon: first report on the presence of the four alien fish species *Cephalopholis taeniops*, *Equulites popei*, *Pseudupeneus prayensis* and *Sphoeroides pachygaster*; Egypt: first record of the Lessepsian fish *Synchiropus sechellensis* in the Egyptian Mediterranean waters.

**2017. El-Gayar, S., El-Nsaf, E., El-Naggar, H. and Mona, M. Intertidal Macro-benthos diversity and their relation with tourism activities at Blue Hole Diving Site, Dahab, South Sinai, Egypt. SYLWAN 161 (11).**

The Blue Hole Dahab is spectacular famous dive site in Egypt. It receives intense visits from diving and snorkeling lovers. During the visits, some bad practices from visitors which affecting on ecosystem stability and may be led to decreasing the biodiversity in this important site. So, the objective of this work was to evaluate the effect of tourism activities on the diversity of macro-benthos communities along intertidal zone of the Blue Hole Diving Site for stand on the status of this place, especially after the excessive increase in tourism rates. During the period from winter 2016 to autumn 2016, several field trips were done to Blue Hole. Ninety one macro-benthos taxa were recorded along investigated site during the four seasons of sampling. *Planaxis salcatus*, *Nerita* spp., *Barbatia trapezina* and *Ophiocoma scolopendrina* were the main dominant species during study period. It appears that the tourism activities at Blue Hole change the species dominance between compared areas. In addition to presence of high percent reach to 31.8 % differences (68.3 % similarity) in species recorded between compared areas. The high impacted area has very low abundance and diversity than low impacted one. The data of diversity indices was reflecting the effects of tourism activities on species distribution among low and high impacted areas. All results concluded that the anthropogenic activities that result from intense tourism at Blue Hole Diving Site can be led to biodiversity degradation and ecosystem damage. So, this article is display this problem on stockholders and recommends of taking this important problem in consideration and create a solutions to avoid the collapse of this important place such as placement a maximum numbers of daily visit or close the place for a certain period to restore its spirit and vitality.

**2017. Guerriero, G., Rabbito, D., Alwany, M., Madonna, A., Temraz, T., Sulaiman, O., Bassem, S., Trocchia, S., Abdel-Gawad, F. and Ciarcia, G. Fisheries and biodiversity along Mediterranean Sea: Italian and Egyptian coast overview. Euro-Mediterr J Environ Integr 2: 16.**

Mediterranean fish species living along Italian (Gaeta) and Egyptian (Alexandria) coasts were analyzed using DNA barcodes for molecular identification. Mitochondrial Cytochrome c Oxidase subunit 1 (COI) gene was sequenced from 31 different marine species to test whether the morphology-based assignment of individuals into 19 families, 6 orders was supported by DNA-based species delimitation and Neighbor Joining cladogram. All COI rRNA gene barcodes were matched with reference sequences of expected species, according to morphological identification. Neighbor joining tree was drawn based on COI rRNA gene and the majority of specimens clustered in agreement with their taxonomic classification. Our results updated Mediterranean edible fish knowledge providing graphical resources, taxonomical and bioinformatics references, improving the genetic fish database and the basic molecular information to strengthen the science–policy interface for biodiversity and ecosystem services as conservation, blue economy, and long-term human well-being.

**2017. Hamdy, R. and Langeneck, J. Diversity and ecology of crustaceans from shallow rocky habitats along the Mediterranean coast of Egypt. Mar Biodiv: DOI 10.1007/s12526-017-0787-z**

Spatio-temporal patterns of the distribution of crustaceans from shallow hard bottoms along the Alexandria coast (Egypt, Mediterranean Sea) were studied during a complete year cycle and also in relation to potential drivers of change (biotic and abiotic), including variation in habitat forming species. Overall, the crustacean assemblages appeared poor, including only 14 species belonging to Amphipoda (five species), Isopoda (five species), Tanaidacea (two species), Cirripedia and Decapoda (one species each). The distribution patterns of crustacean assemblages appeared significantly variable both in the spatial and in the temporal dimension on a rather unpredictable basis, albeit variation was related to changes in dominant algal and invertebrate habitat formers. High variability and low species richness observed suggest that the analyzed assemblages are selected by local unfavorable environmental conditions. In fact, the crustacean hard bottom fauna is composed by a bulk of tolerant forms, including the dominant *Tanais dulongi*, *Apohyale perieri*, *Dynamene bidentata*, *Sphaeroma serratum*, *Elasmopus pecteniscrus*, and *Jassa marmorata*. Their spatio-temporal dynamics, as well as those of the remaining species, and correlations with the variation of habitat formers and environmental variables are reported. This is a baseline assessment of the crustacean diversity along the Mediterranean coast of Egypt, thus having paramount importance for understanding the predicted future changes of biodiversity for the area.

**2017. Ismail, M. E., Ahmed, M. I, Hanafy, M. H and Madkour, F. F. Examination of Genetic Diversity of Spinner Dolphin (*Stenella Longirostris*) using *cox 1* at the Southern Egyptian Coast of the Red Sea. International Journal of Engineering Science and Computing, 7 (9): 14801- 14806.**

Spinner dolphins *Stenella longirostris* is one of the most important and attractive animals in the southern Egyptian coast of the Red Sea. The knowledge about their genetic diversity in the Egyptian coast is very poor. The current study is focusing on the molecular characterization of *S. longirostris* in Egyptian Red Sea which found near their resting area. Samples were collected from a free ranging dolphin during the period between February and April 2017. The collection process was using biopsy pole system. The samples were analyzed using *coxI* gene to identify their genetic diversity. Aligning samples collected from Egypt with samples of the same species obtained from Gene-Bank showed a clear divergent between samples in the same species. The analysis indicating the possibility of the population being reproductively isolated from surrounding spinner dolphin population.

**2017. Ismail, H.A, Hanafy, M.H, Madkour, F.F and Ahmed, M.I. Distribution of Soft Corals in the Egyptian Coasts of the Red Sea and Gulf of Aqaba. International Journal of Engineering Science and Computing 7 (9): 14944- 14950.**

Red Sea is a resource-rich area with a distinctive coral reef ecosystem where soft corals represent the most diverse species. Knowledge of soft coral biodiversity and its distribution in the Egyptian coast of the Red Sea and Gulf of Aqaba are limited, so this study aimed to elucidate soft coral distribution and abundance at these areas. Eight sites along these areas were surveyed using transect of 25-meter length of the point intercept transect (PIT) in three depths; (0-5m), (5-10m) and (10-15m) in all sites during summer 2015 and only two sites; Lighthouse and Marsa Eqla, were additionally surveyed in winter. Eleven genera belong to three families were recorded. Of them the five genera; *Sinularia*, *Sarcophyton*, *Lobophytum*, *Nephthea* and *Xenia* were considered the most common at all selected sites. *Xenia* represented the most abundant genus (112 ind./trans.) at Gulf of Aqaba, while *Sinularia* (71 ind./trans.) were common at the Red Sea, but *Lobophytum* showed the rare genus in this study. The diversity and abundance of soft corals decreased from north to south might be due to topography of the Red Sea and the increase of human impacts.

**2017. Osman, E. and Smith, D. Thermal refugia against coral bleaching throughout the northern Red Sea. Global Change Biology 2017: 1–11.**

Tropical reefs have been impacted by thermal anomalies caused by global warming that induced coral bleaching and mortality events globally. However, there have only been very few recordings of bleaching within the Red Sea despite covering a latitudinal range of 15° and consequently it has been considered a region that is less sensitive to thermal anomalies. We therefore examined historical patterns of sea surface temperature and associated anomalies (1982–2012) and compared warming trends with a unique compilation of corresponding coral bleaching records from

throughout the region. These data indicated that the northern Red Sea has not experienced mass bleaching despite intensive Degree Heating Weeks (DHW) of  $>15^{\circ}\text{C}$ -weeks. Severe bleaching was restricted to the central and southern Red Sea where DHWs have been more frequent, but far less intense (DHWs  $<4^{\circ}\text{C}$ -weeks). A similar pattern was observed during the 2015–2016 El Niño event during which time corals in the northern Red Sea did not bleach despite high thermal stress (i.e. DHWs  $>8^{\circ}\text{C}$ -weeks), and bleaching was restricted to the central and southern Red Sea despite the lower thermal stress (DHWs  $< 8^{\circ}\text{C}$ -weeks). Heat stress assays carried out in the northern (Hurghada) and central (Thuwal) Red Sea on four key reef-building species confirmed different regional thermal susceptibility, and that central Red Sea corals are more sensitive to thermal anomalies as compared to those from the north. Together, our data demonstrate that corals in the northern Red Sea have a much higher heat tolerance than their prevailing temperature regime would suggest. In contrast, corals from the central Red Sea are close to their thermal limits, which closely match the maximum annual water temperatures. The northern Red Sea harbours reef-building corals that live well below their bleaching thresholds and thus we propose that the region represents a thermal refuge of global importance.

**2016. Abbas, E., Abdelsalam, K., Geba, K., Ahmed, H. and Kato, M. Genetic and morphological identification of some crabs from the Gulf of Suez, Northern Red Sea, Egypt. Egyptian Journal of Aquatic Research. 42, 319–329.**

Most crab species inhabiting the Red Sea have not been characterized morphologically and genetically. In the current work, five different crab species were collected from the northern part of the Egyptian Red Sea. They were morphologically identified through description of colors, dentations of the carapace and shapes of chelipeds and pereopods. They were also genetically characterized by the partial sequencing of the barcode region in the mitochondrial cytochrome oxidase subunit I (COI) gene, which is known to be hyper-variable among different crab species. Morphological and genetic characterization identified the crab species as: *Charybdis (Charybdis) hellerii* (A. Milne-Edwards, 1867), *Charybdis (Charybdis) natator* (Herbst, 1794), *Portunus (Portunus) pelagicus* (Linnaeus, 1758), *Liocarcinus corrugatus* (Pennant, 1777), and *Atergatis roseus* (Ruppell, 1830). This is the first record of *L. corrugatus* in the Egyptian Red Sea, despite being previously recorded in the Indian and Atlantic Oceans as well as in the Mediterranean Sea. DNA barcoding with precise morphological identification was effective in characterizing the crab species collected from the Egyptian Red Sea water.

**2016. Ibrahim, A. R. Biodiversity of Some Invertebrates of Mangrove Ecosystem in South Sinai, Egypt. M. Sc. Thesis, Ain Shams Universit, Faculty of Education, Department of Biological Sciences and Geology.**

The present study aims to determine the presence and diversity of the species composition of macro-invertebrate fauna: Cnidaria, Crustacea, Mollusca and Echinodermata inhabiting the mangrove ecosystem (*Avicennia marina*) at Nabq and Ras Mohamed Protectorates, South Sinai. Moreover, the distribution status, overall abundance, seasonal variations, population density, species richness, zonation, and similarity in faunal composition between the different studied sites are also considered. The specimens of the present work are collected seasonally from five mangrove swamps, one from Ras Mohamed protectorate and the other four swamps from Nabq Protectorate (Gharqana, Arwashia, El-Manqata and Abu Zubad). During the present study, three types of habitats at mangrove ecosystem (rocky, sandy and muddy habitats) are accommodated different species of macro-invertebrates. Macro-Invertebrates of mangrove ecosystem in Ras Mohamed and Nabq approximates 122 species belonging to 97 genera, 59 families, 16 orders. Mollusca have the highest number of species, being 108 species (88.6%) belonging to 86 genera and 50 families: 69 species of Gastropoda, 38 species of Bivalvia and one species of Polyplacophora. Crustacea is the second group, it is represented by 11 species) (9%) belonging to 9 genera and seven families. Echinodermata comes after Mollusca and Crustacea, it represented by two species (1.6%) belonging to one genus. The number of species is declined during autumn and winter to 88 species: one cnidarian, ten crustaceans and 77 molluscans for the autumn; and one cnidarian, nine crustaceans, 76 molluscans and two echinoderms for the winter. During spring, the lowest number of species is recorded, being 76 species, of which one species of Cnidaria, nine of Crustacea, 64 of Mollusca and two s of Echinodermata. The population density of macro-invertebrate species in different seasons is represented in Ras Mohamed and Nabq Protectorates. The richness value of macro-invertebrate species at Ras Mohamed is minimum in summer, but maximum in autumn. On the other hand, at Nabq Protectorate the minimum richness value recorded at Arwashia in winter and the maximum value was recorded at El-Gharqana in winter. Mangrove communities of the five sites include faunal assemblage of many species. Some groups exhibit clear zonation in distribution (crabs and molluscs), others are just visitors but the majority is resident.

**2016. Farrag, M., El-Haweet, A. and Moustafa, M. Occurrence of puffer fishes (Tetraodontidae) in the eastern Mediterranean Egyptian coast - filling in the gap. Bio Invasions Record 5 (1).**

The occurrence of puffer fish species along the Egyptian Mediterranean coast was evaluated using samples obtained from the commercial fishing operations during 2012-2015. Six species were identified: *Lagocephalus sceleratus* (Gmelin, 1789), *Lagocephalus suezensis* Clark and Gohar, 1953, *Lagocephalus guentheri* Miranda Ribeiro, 1915, *Lagocephalus lagocephalus* (Linnaeus, 1758), *Torquigener flavimaculosus* Hardy & Randall, 1983 and *Sphoeroides pachygaster* (Müller



& Troschel, 1848). Of these, *L. guentheri*, *L. suezensis*, *S. pachygaster* and *T. flavimaculosus* were recorded for first time in the Egyptian Mediterranean waters. Puffer fishes were captured from sandy, rocky and muddy-bottom habitats from shallow waters to more than 150 m deep.

**2016. Zakaria, H. W., Hassan, A. M., Abo-Senna, F. M. and El-Naggar, H. A. Abundance, distribution, diversity and zoogeography of epipelagic copepods off the Egyptian Coast (Mediterranean Sea). Egyptian Journal of Aquatic Research 42: 459–473.**

The abundance, distribution and diversity of epipelagic copepods were studied along the Egyptian Mediterranean Coast during April, August, 2008, February, 2009 and 2010. The geographical distribution and ecological affinities of the recorded species are presented in order to follow up the migrant species that recently entered in the study area. Copepoda was the most dominant zooplankton group, representing 74.1% of the total zooplankton counts. The annual averages of copepod abundance in the coastal, shelf and offshore zones were 699.3, 609.7 and 555.7 ind.m<sup>-3</sup>, respectively. Spring was the most productive and diversified season. Some 118 copepod species were identified in the study area; among them twelve species are recorded in the Mediterranean Sea for the first time and 41 species are new records in the Egyptian Mediterranean waters. The community was dominated by *Oithona nana*, *Calocalanus pavo*, *Nannocalanus minor*, *Clausocalanus arcuicornis* and *Paracalanus parvus*. The study area could be considered as a cross road for migration process from Atlantic Ocean in the west and Indian Ocean via Red Sea and Suez Canal from the south. In addition, the maritime activities in the Mediterranean Sea may have contributed into the change of copepod diversity in the study area where some species could have come to the Egyptian Coast from other water systems via ballast water.

**2015. Attalla, T. M., Kotb, M. M., Hanafy, M. H. and Mohammed, S. Z. Status of the fringing coral reefs in the southern Egyptian coast of the Red Sea. Egypt. J. Aquat. Biol. & Fish., 19 (4): 51-67.**

Study of the effect of human impact and sheltering condition on corals and fish assemblages was carried out in twenty nine reef sites at the area between Marsa Umm El-Grifate and Marsa Shuna, Red sea. Total living covers, total coral cover, and total recruitment colonies were recorded and exhibited higher percentages of occurrence on the exposed and un-impacted sites than on the sheltered and impacted ones. In contrary, the covers of algae, dead and bleached coral colonies were found to be higher on the sheltered and impacted reefs than on the exposed and un-impacted ones. In total, 117 fish species belong to 24 families were recorded. Although, carnivore fish were dominating the food web, the most abundant groups were found to be herbivore and planktivore fishes. Total fish abundance was higher in the shelter sites than in the exposed ones, while the abundance of herbivores, carnivores, and piscivores were higher in the sheltered and impacted sites than in the exposed and un-impacted ones. Total coral cover and total recruitments were negatively correlated to algal cover.

Total fish abundance was positively correlated to total living cover and negatively correlated to total coral cover. Herbivores fish abundance was positively correlated to total coral cover and total recruitments, but it was negatively correlated to algal cover. Moreover, planktivores fishes were negatively correlated to the total coral cover and total recruitments. This study strongly recommended to organize the fishing activities along the southern Red Sea, in addition to regulate the rapid coastal development to this part of the Red Sea.

**2015. Eladawy, A., Nadaoka, K., Negm, A., Saavedra, O. C. and Hanafy, M. Assessment of Long Term Thermal Stress on Egyptian Coral Reefs Based on Remotely Sensed Sea Surface Temperature Data. International Journal of Environmental Science and Development, 6 (12): 938-946.**

Red Sea tourism is highly dependent on the natural resources especially the diversity of Egyptian coral reefs. Local coral bleaching monitoring framework was applied in this study to investigate the threats. The target area included the six richest spots of coral reefs in terms of bio-diversity and tolerance to various stresses. Assessment of the applicability and accuracy of remotely sensed sea surface temperature (SST) data in the region were assessed by comparing them with *in situ* measurements. The annual and seasonal sea surface temperature (SST) trends have been investigated. Twenty three years (1990-2013) of SST data were used to assure accurate estimation of the monthly maximum mean (MMM) of SST Climatology. In addition, the Hot Spots were calculated for each location during last 23 years. A thermal stress index degree heating weeks (DHW) was calculated in order to assess the accumulative effect of heat stress. This work suggests the bleaching threshold limit for each location based on the long-term analysis. The thermal analysis results were in close agreement with the recorded bleaching events (2010 and 2012). Moreover, they revealed some historical events which may be not recorded properly.

**2014. Belal, A. M. and Ghobashy, M. A. Macrobenthic Invertebrates in the Intertidal Zone at both Sides of the Suez Gulf. International Journal of Marine Science, 4 (48): 1-11.**

Macrobenthic invertebrates were sampled in Suez Gulf 's branches (Eastern and Western sides) from winter 2009 to autumn 2010. A total of 76 species of benthic invertebrates were recorded. The spatial distribution showed that the highest density of individuals was estimated in the stations of the western side. There were 57023 and 38784 animals / m<sup>2</sup> recorded for the western and the eastern sides, respectively. The stations in the eastern side were distinguished by the high number of species (75 species). The temporal distribution showed that winter and spring gave the highest number of both individuals and species number. Otherwise the lowest number of species and density were found in autumn and summer. Rocky substrates contained higher fauna than the sandy beds.

**2014. Dimech, M., Mahmoud, H. and El Haweet, A. Stock assessment of the alien species Brushtooth lizard fish, *Saurida undosquamis* (Richardson, 1848) in the Egyptian Mediterranean coast. Egyptian Journal of Aquatic Research 40: 443-450.**

The exploitation status of *Saurida undosquamis* (Richardson, 1848) from the Egyptian Mediterranean coast was assessed. Fish samples (3444 specimens) that ranged between 9 and 36 cm total length were collected from commercial trawlers. The information used for the assessment of the stock consisted of catch length structure, length–weight relationship and Von Bertalanffy's growth parameters. The vector of natural mortality (M) by age was calculated using the PROBIOM Excel spreadsheet; while total (Z) and fishing (F) mortalities, length cohort analysis and Beverton and Holt Yield per recruit analysis were performed by FiSAT, LFDA and Vit 4 win programs in order to estimate the limit and target reference points of stock exploitation. The results revealed that the average fishing level of *S. undosquamis* (0.575) was higher than the biological reference points F 0.1 (0.247) and F max (0.368).

**2014. Di Sciara, G., Smeenk, C., Rudolph, P., Addink, M., Baldwin, R., Cesario, A., Costa, M., Feingold, D., Fumagalli, M., Kerem, D., Goffman, O., Elasar, M., Scheinin, A. and Hadar, N. Summary review of cetaceans of the Red Sea. IWC: Bled-Sloven.**

The cetacean fauna of the Red Sea is still poorly known. Direct observations combined with a review of the literature suggest that thirteen species of Cetacea occur in the Red Sea: two mysticetes (*Balaenoptera edeni* and *Megaptera novaeangliae*), and eleven odontocetes (*Delphinus capensis tropicalis*, *Globicephala macrorhynchus*, *Grampus griseus*, *Orcinus orca*, *Pseudorca crassidens*, *Sousa plumbea*, *Stenella attenuata*, *S. coeruleoalba*, *S. longirostris*, *Tursiops aduncus*, and *T. truncatus*). Of these species, only nine are acknowledged as regularly occurring in the region. For three species presumed to have occurred in the Red Sea on the basis of past accounts (*Balaenoptera acutorostrata*, *Physeter macrocephalus*, and *Steno bredanensis*), we found no clear evidence of their presence in the region and recommend to consider their occurrence doubtful until more knowledge is available. Although Red Sea cetaceans may be considered today among the world's least impacted by man, mainly due to the low human densities along the region's desert coasts, observed increases in activities particularly in the northern portion of the region, such as tourist and coastal development, fishing, shipping, and hydrocarbon extraction, suggest the need for a greater effort at collecting knowledge of the local cetacean populations, their ecological characteristics, potential threats and conservation status.

**2013. El-Haweet, A. Biological studies of the invasive species *Nemipterus japonicus* (Bloch, 1791) as a Red Sea immigrant into the Mediterranean. The Egyptian Journal of Aquatic Research 39: 267-274.**

The rate of fish invasion into the Mediterranean Sea has increased in recent decades; collectively they have significant ecological and economic impacts in the eastern Mediterranean. One of this species is Japanese thread fin bream *Nemipterus japonicus* that gradually get abundance in the Egyptian Mediterranean coast bottom trawl catch. During 2011, monthly samples of *N. japonicus* caught off Abu Qir area, Alexandria-Egypt, were used to estimate some biological parameters of this immigrant species. Females were more abundant than male in the catch deviated to smaller size than male. Spawning season extended from April to November with highest activities in July. Maximum observed age was 3 years for both sexes with no significant difference between their lengths at age. Length-at-age was fitted to the Von Bertalanffy growth models.

**2013. El-Masry, E. and Omar, H. Preliminary studies on habitat and diversity of some sea urchin species (Echinodermata: Echinoidea) on the southern Levantine basin of Egypt. Egyptian Journal of Aquatic Research 39: 303–311.**

For many years the sea urchin (Echinodermata: Echinoidea) diversity and habitat in the Mediterranean Levantine basin lacked complementary data despite the critical role they have as keystone species to any marine ecosystem. As the first step of the present study two stations were selected along Alexandria coast for investigation: Miami area and Abou Qir Bay. Around 200 individuals were collected monthly from each station from April 2012 till April 2013 using Scuba diving. The comparison between the two stations included the inhabiting sea urchin community and the present associated macrobenthic fauna and flora. The results showed a great similarity between the two stations in relation to the sea urchin species in these two areas as well as the surrounding habitat. This study aims to combine the morphology and the molecular tools along with data gathered from the habitat of the sea urchin present in these two stations to clear uncertainties in species identification of the sea urchin community found along the coast of Alexandria. The results showed four apparent morphologically different sea urchin specimens. To ensure our findings DNA extraction and Polymerase Chain Reaction (PCR) methods were used, where the amplified 16S mitochondrial DNA products from all four sea urchin groups showed four sets of bands with different sizes, which suggest that these four groups might belong to four different species. Furthermore, the morphological characters along with the resulting DNA bands cleared uncertainties about two species (*Paracentrotus lividus* and the *Arbacia lixula*). The other two sea urchins were thought to be *Psammechinus microtuberculatus* and *Sphaerechinus granularis*.

**2012. Abd El Ghaffar, B. A. Studies on Helminth Parasites of Some Mediterranean Sea Fishes from Alexandria Sea Shores. M. Sc. Thesis, Alexandria University, Faculty of Science.**

Fish is one of the most valuable sources of protein. Worldwide, people obtain about 25% of their animal protein from fish and shellfish. About 35% of all fish is eaten fresh, chilled or frozen. It is also cured, canned (16% each) or turned into oil and fish meal (32%). Fish is a low-fat food, with a great content of proteins, vitamins (A, D, B and K) and minerals (calcium, phosphorus, magnesium, selenium and copper). It has been reported that fish is excellent and safe for long-term treatment of asthma, where Omega 3 fatty acids prevent strokes. Their impact on blood is that they help preventing blood to over coagulate and thus brain blood vessels are less probable to clot. They prevent headache and over time help to ease the migraines. Almost all fish are potential host to a wide range of parasites. Most of the fish parasites do not cause much harm to the host when present in small numbers. However, they grow and reproduce fast under ideal living conditions. When the population of fish parasites grows beyond a certain limit, it can be life-threatening. Parasites are commonly infectious, and thus, can infest other fish living in the same water body. Infected fish may transmit parasite to humans and other animals. Therefore, it is very important that infected fish must be identified and treated. Furthermore, fish parasites attract increasing interest of parasite ecologists as potential indicators of environmental quality, due to the variety of ways in which they respond to anthropogenic pollution. It is almost impossible to control parasitic infections in most sea-food products that are harvested from the wild. Fortunately, the bulk of the parasitic organisms that lives in or on marine fish occupies certain portions, such as visceral organs that are disposed when the fish are prepared as food. However, a number of parasites commonly occurs in fish flesh and of these; several species can infect humans. Such infections only occur if the fish is consumed raw or lightly marinated and has not been frozen before preparation. Cooking kills the parasite and renders infected fish safe for human consumption. Because potential human pathogens occur in the marine-fish flesh, there is a need for parasite detection and identification for effective diagnosis and treatment of human infection and for methods of ensuring the safety of marine-fish products.

**2012. Dorgham, M. M., Elsherbiny, M. M. and Hanafi, M. H. Vertical distribution of zooplankton in the epipelagic zone off Sharm El-Sheikh, Red Sea, Egypt. *Oceanologia*, 54 (3): 473–489.**

The purpose of the present study was to track the seasonal vertical distribution of zooplankton abundance in the epipelagic zone off Sharm El-Sheikh, Red Sea. Zooplankton samples were collected seasonally within the depth ranges of 0–25, 25–50, 50–75, 75–100 m at a single station off Sharm El-Sheikh City. The present study is an attempt to expand knowledge about the structure as well as the vertical distribution of the epipelagic zooplankton community in the Gulf of Aqaba in general, and in its southern part in particular. The results indicate the occurrence of 52 copepod species and several species of other planktonic groups in the study area. The zooplankton standing crop fluctuated between 1124 and 4952 organisms m<sup>-3</sup>. Copepods appeared to

be the predominant component, forming an average of 86.5 % of the total zooplankton count, and with other groups demonstrated a markedly different seasonal vertical distribution. Twelve bathypelagic copepod species were reported during the present study, and five species were new to the area, having migrated northwards from the main basin of the Red Sea.

**2012. Hanafy, M. H. Effects of recreational scuba diving and snorkeling on coral reefs of the sheltered bays of the Red Sea, Egypt. *Egypt. J. Aquat. Biol. & Fish.*, 16 (4):43-56.**

Due to the scarcity of the proper access point to the deep waters by divers and snorkelers, bays and lagoons are used as sheltered marine areas in the southern Egyptian Red Sea and are represented very valuable recreational areas. With the recent booming in tourism along the Egyptian coast of the Red Sea, the sheltered bays and lagoon reefs are tremendously impacted by recreational SCUBA diving activities. Three bays with similar environmental and topographic characteristics, but with different levels of diving and snorkeling activities were selected to study the impacts of recreational SCUBA diving on sedimentation rate, substrate analysis, coral cover, diversity, coral recruitment and coral reef fish assemblages. In addition to the expected physical damage causes by incidental contacts to corals by divers, the results showed that increasing sedimentation rate as a result of intensive SCUBA diving also caused a serious impact on coral reef communities of the surveyed bays. Highest sedimentation rate was estimated at the over-dived site of the Marsa Um El-Gurifat (approximately 51,000 divers per year). Walking and standing of divers on the sea floor was disturbing the fine sediments of the bay floor, increasing turbidity and sedimentation rate on the nearby coral reefs of the bay. High sedimentation rate on the reefs of Marsa Um El-Gurifat caused the following: reducing the coral cover; overgrown soft coral that dominated coral cover, reducing the recruitment of new coral colonies, increasing dead coral cover, increasing the macroalgal cover especially on the reef flat areas, decreasing the diversity of hard coral and coral reef fishes, shifting the fish assemblage toward higher occurrence of herbivore fishes comparing with corallivore and carnivore ones.

**2012. Hanafy, M. H. Nesting of marine turtles on the Egyptian beaches of the Red Sea. *Egypt. J. Aquat. Biol. & Fish.*, 16 (2): 59-71.**

Nesting of two species; the hawksbill *Eretmochelys imbricata* and the green turtle *Chelonia mydas* on the Egyptian beaches of the Red Sea were studied. The nesting seasons were extended from May to July with a peak in June for the hawksbill and from June to August with a peak in July for the green turtle. Separate nesting grounds for both species with minimum overlap were observed. In total, 38 beaches were surveyed and classified according to the density of nests and tracks. Out of the 38 surveyed beaches, 8 totally offshore beaches were classified as valuable nesting grounds for the hawksbill and 14 beaches for green turtles (inshore and offshore sites). The quantitative estimation of nesting level (i.e. density of nests and tracks) indicated

that there are 3 most valuable nesting offshore beaches for the hawksbill and 8 sites for the green turtle (3 inshore and 5 offshore). During 2001-2008, the nesting activities were estimated quantitatively based on the density of true and false nests as well as the dimensions of tracks, nests and female turtle at the most valuable nesting sites (Small and Big Giftun Islands for hawksbill, Zabarged Island, Ras Bagdadi and Umm El-Abas, for green turtles). Hatching percentages, clutch sizes as well as egg and hatchling sizes for both species were estimated.

**2011. Ahmed, A. I., Mohammed, D. A. and Hanafy, M. H. Distribution and species composition of the littoral interstitial free living nematodes in the northern Red Sea, Egypt. Egypt. J. Aquat. Biol. & Fish., 15 (2): 159- 177.**

Free living nematodes represent the most abundant and diversified group of the interstitial meiobenthos in the northern Red Sea, where their contribution ranged between 38 and 100% of total count of all interstitial organisms. Nematodes distribution, abundance and species composition in the Egyptian Red Sea were studied during winter, 2006. Nematodes abundance ranged between 8 and 163 organisms / 10 cm<sup>-2</sup>. The intertidal zonation was investigated and showed increasing in the average density of nematodes toward low tide mark (sublittoral zone). A total of 79 nematode species were recorded; xyalid and oncholaimid were the most abundant families contributing 12% for each of total nematodes count. Densities of nematodes were affected by the grain size of the sediment, TOMs and redox potential. Also, pollution and landfilling have the most drastic effect on their abundance and diversity.

**2011. Hanafy, M. H., Mohammed, D. A. and Ahmed, A. I. Seasonal distribution of the littoral interstitial meio-fauna in the northern Red Sea, Egypt. Egypt J. Aquat. Biol. & Fish., 15 (2): 35- 51.**

Meio-faunal composition, distribution and seasonal abundance in the northern Egyptian Red Sea were studied during the period from spring 2006 to winter 2007. Significant seasonal variation in the density was recorded ( $P < 0.001$ ) and ranged between 100 and 130 organisms / 10 cm<sup>2</sup>. The meio-faunal assemblage in the area of study was well diversified including 141 species. The principal taxonomic groups were free living Nematoda (68%) followed by Harpacticoida (12%), Polychaeta (10%) and Ostracoda (4%) in term of their densities. The exposure to wave actions and the sediment characteristics were the most important factors for structuring the meio-faunal community.

**2010. Mohamed, T. A., Dar, M. A. and El-Saman, M. I. Distribution patterns of hard and soft corals along the Egyptian Red Sea Coast. Egyptian Journal of Aquatic Research 36 (4): 543-555.**

Distribution, diversity and evenness indices of hard, soft coral forms and genera relative to the geographic distribution as well as local oceanographic conditions were studied in twelve sheltered and exposed localities along the Egyptian Red Sea Coast, starting from Ras Al-Behar in the north to Shlataan in the south. Distribution of hard and soft corals was controlled by many factors such as water temperature, turbidity

and oxygen content. In the exposed areas, hard corals formed the highest percentage cover being 28.4 - 41.7 %; 6.9 - 42.9 %; 0.07 - 13.8 %; 0.0 - 6.2 % for the branching, massive, hydrocorals and solitary forms, respectively. The sheltered areas, on the other hand recorded the highest percentage cover for the branching forms being 22.1 - 71.2 %. Among the soft corals, the finger shape as well as the dendrites had the highest percentage cover in the exposed areas being 0.0 - 12.3 %; 0.2 - 39.6 % for the finger shape and dendrites, respectively; while the mushroom and carpet forms were highly distributed in the sheltered areas indicating that branching hard corals as well as mushroom and carpet soft corals were more adaptable to the high polluted sites in the sheltered zones. The other hard and soft coral forms were more flourished and can survive the intensive surge waves in the exposed areas. Among the branching forms, *Acropora* recorded the highest percentage covers in the sheltered areas being 7.3 - 31.7 % followed by *Pocillopora* (0.0 - 35.8 %); while *Stylophora* recorded the highest values (3.6 - 43.2 %) in the exposed areas. *Porites* corals were the dominant massive genus in both exposed and sheltered areas being 3.6 - 26.9 %; 2.1 - 21.4 %, respectively. *Sarcophyton* was the dominant soft corals in the sheltered areas being 0.20 - 15.35%; while *Heteroxenia* was common in the exposed areas being 0.0 - 24 %. Evenness index (J) recorded its highest values in sheltered and exposed areas at Safaga and El-Fanadir being 0.95 and 0.99, respectively, indicating a northward increase in quantity and diversity of corals.

**2010. Hamza, D. Genetic diversity and structural variations of some clams (Family: Veneridae). Ph. D. Thesis. Zoology Department, Faculty of Science, Benha University.**

Clams are considered one of the favourite seafoods specially for the people who mainly inhabit the cities which located along the marine coasts. They have high value of protein and fair amount of calcium and iron. In Egypt, many of the most commercially important are venerid clams. Seven venerid species were recorded in this study, *Callista florida*, *Dosinia radiata*, *Gafrarium pectinatum*, *Paphia undulata*, *Tapes decussatus*, *Venerupis aureus* and *Venerupis pullastra*. These species were classified previously by morphological characters under four subfamilies and six genera. *Tapes decussatus* was the common species at the different stations. Some venerids which collected from Suez and Ismailia, had some shell abnormalities. The ecological studies revealed that, there are marked differences in the physicochemical parameters of sea water between stations (Marsa Matrouh, Alexandria, Ismailia and Suez). Also, the heavy metals content in sea water, sediment, soft tissues and shell of the common clam showed marked differences between stations. Marsa Matrouh samples revealed the lowest heavy metal concentrations, while Suez had the highest of Cd, Cu, Fe, Mn, Ni and Pb; and Alexandria had the highest concentrations of Co and Zn. The sequence of metal concentrations was, water < shell < sediment < soft tissues for all metals; except with Cd which was: water < sediment < shell < soft tissues. TPHs concentration in sea water at Suez recorded higher level than that of Ismailia, while at Marsa Matrouh and Alexandria the concentrations were under the limit of chromatography detection. In the genetic diversity experiments of this study, a



particular amplification program was suitable for detecting a high degree of genetic variations in the RAPD-PCR analysis of the venerid clams. The value of genetic similarity index revealed no significant differences in the genetic diversity between Marsa Matrouh, Alexandria and Ismailia. On the other hand, the genetic similarity values between Suez and Matrouh and between Suez and Alexandria were 0.43 and 0.42, respectively.

**2008. Abu El-Regal, M., Ahmed, A., El-Etreby, S., El Komi, M. and Elliott, M. Abundance and Diversity of Coral Reef Fish Larvae at Hurghada, Egyptian Red Sea. *J. Aquat. Biol. & Fish* 12 (2): 17 -33.**

The larvae of coral reef fishes have been studied in Hurghada at the Egyptian Red Sea on exposed and sheltered inshore and offshore sites. Ichthyoplankton samples were taken by plankton net of 0.5 mm mesh size on a monthly basis from January to December 2005. The total abundance of fish larvae at all sites was 1993/1000 m<sup>3</sup>. There were significant differences in larval abundance between sites and months. The sheltered inshore site (H3) showed a significantly higher abundance of all sites, whereas the exposed inshore Abu Sadaf site had the lowest abundance. The most abundant 10 taxa were *Atherinomorus lacunosus* (Atherinidae), *Spratelloides delicatulus* (Clupeidae), *Gerres oyena* (Gerreidae), *Hypoatherina temmincki* (Atherinidae), *Petroscirtes mitratus* (Blennidae), *Vinciguerria mabahiss* (Phosichthyidae), *Ennea pterygius* sp. (Tripterygiidae), *Mulloidides flavolineatus* (Mullidae), *Benthos emapterotum* (Myctophidae) and Gobiidae, forming about 82.5% of all collected larvae. The most dominant species was *Atherinomorus lacunosus*, contributing 19 % of all taxa with a total abundance of 113 larvae/1000 m<sup>3</sup>. Larvae of families Siganidae and Soleidae were the least abundant both with 0.23 larvae/1000 m<sup>3</sup>.

**2007. Alwany, M., El-Etreby, S, G. and Hanafy, M. H. Distribution and abundance of butterfly fishes along the Gulf of Aqaba, Egypt. *Journal of Fisheries and Aquatic Science*, 2(6): 395-402.**

The distribution and abundance of butterfly fishes were examined along the Egyptian coast of the Gulf of Aqaba, Red Sea. The total number of butterfly fish species recorded at different sites was 9 species belonging to 2 genera (in addition to 2 species recorded outside the transect on non-reef area). Site 6 (in the south) has the highest number of species at different depths, while site 1 (in the north) has the lowest number. In general, the northern sites (1 and 2) had the lowest number of individuals and species compared with the southern ones. There are two obvious patterns of butterfly fishes distribution relative to depth along the Gulf of Aqaba. The first pattern shows the total number of individual fish's increases slightly at the Reef Edge (RE) and then decreases with depth. The second pattern, the number of species of butterfly fish showed an increase until reached a highest abundance under 15 m depths. The dominance of the butterfly fish species at different sites along the Gulf of Aqaba was alternated between two species, *Chaetodon paucifasciatus* and *C. austriacus*.

Generally, *C. paucifasciatus* was the most abundant butterfly fish species along the Gulf of Aqaba (37.0% of total butterfly fish populations), followed by *C. austriacus* (29.6%). *C. paucifasciatus* the only species of butterfly fishes recorded on all depths at all sites.

**2007. Roupahel, T. and Hanafy, M. Discovering the Animals, Plants and Habitats of Egypt'S Red Sea Reefs. LIFE Red Sea Project - EEAA, Cairo.**

This guide to discovering the animals, plants and habitats of Egypt's Red Sea reefs is intended to provide a simple basic introduction to some of the physical features and species of plants and animals that are associated with Egypt's coral reefs. Visitors, residents, and students who are unfamiliar with this component of Egypt's coastal ecosystems will find the information in this booklet interesting and useful for understanding these unique and lovely environments, and will gain an appreciation of their value and the importance of protecting them. Readers who wish more detail on some topics discussed in this guide are directed to the references included under the section, further reading.

**2006. Abd-Allah, H. O. Biological and Ecological Studies on some Holothuroidian Species (Echinodermata) from the Red Sea, Hurghada, Egypt. M. Sc. Thesis, Assiut University, Faculty of Science, Department of Zoology.**

Although the echinoderms have been the subject of various investigations by many authors, those of the Red Sea species have received little attention till now. Sea cucumbers (*Holothuroidea*) are marine animals that present in the group of echinoderms. They are distributed from the shore to the greatest depths. Deposit-feeding holothurians are prominent members of many shallow and deep benthic communities. Increasing attention is being given to the effects of international trade on the environment, especially in situations where biodiversity conservations is opposed to exploited industries such as fisheries. In this thesis, effect of habitat conditions on abundance, distribution and population structure of three important holothurian species in Red sea (Hurghada) were studied: (*Holothuria atra*, *Holothuria hawaiiensis* and *Bohadschia vitiensis*).

**2006. Hanafy, M., Gheny, M., Roupahel, A., Salam, A. and Fouda, M. The Dugong, *Dugong dugon*, in Egyptian waters: distribution, relative abundance and threats. Zoology in the Middle East 39: 17–24.**

This paper presents the results of an interview survey used to identify the distribution and relative abundance of Dugongs (*Dugong dugon*) in Egypt's Red Sea during 2001, 2002 and 2003. The survey area ranged from Hurghada, immediately south of Gulf of Suez, to Shalatin, about 200 km north of the Sudan border. Respondents, such as fishermen, were asked pre-prepared questions to determine the number of Dugongs observed per sighting, the length class of individuals, the month of observation and the location. Important feeding habitat, defined in part by the presence of Dugong feeding trails, was identified during a concurrent seagrass survey. Dugongs occurred

throughout the survey area, but apparently in very low numbers. The maximum and minimum numbers reported were 17 in 2002 and 12 each in 2001 and 2003. Some individuals may have been counted more than once per annum. There was no evidence of annual change in the number of Dugong sightings, but a statistically greater number of sightings were made in summer compared with winter. Two hypotheses are proposed to explain this variation, but they are not mutually exclusive. The first is that Dugongs undertake winter movements to warmer waters. The second is that winter sea conditions made it harder to observe Dugongs. Important feeding habitat in the Wadi El-Gemal Hamata Protected Area was confirmed by the presence of Dugong feeding trails in seagrass meadows. Known and predicted threats to this species in Egypt are loss of seagrass meadows, net entrapment and boat strikes.

**2006. Zakaria, H. W. The zooplankton community in Egyptian Mediterranean waters: A Review. *Acta Adriatica*, 47 (2): 195-206**

The zooplankton community in Egyptian Mediterranean waters is reviewed in light of recent and historic data. Results indicate that the average annual standing crop of zooplankton sharply dropped from 28750 individuals  $m^{-3}$  in 1962 to 3723 individuals  $m^{-3}$  in 1966, 1685 individuals  $m^{-3}$  in 1970-71, and a minimum of 1206 individuals  $m^{-3}$  in 1984-85. The drop is a result of decreased fertility in the area after construction of the Aswan High Dam. In the present study, 184 Copepoda species, 20 Appendicularia species, 25 Siphonophora species, 21 Hydromedusa species, fifteen Amphipoda species, and seven Chaetognatha species were recorded in Egyptian Mediterranean waters, some of which immigrated to the Mediterranean through the Suez Canal.

**2004. Habib, M. Corals of Egypt. USAID, Academy for Educational Development and EEAA.**

Coral reefs of the Red Sea are among the most beautiful, photographed and studied in the world. While more than a third of the world's coastlines are formed by coral reefs, special circumstances present in the Red Sea, which exist in another body of water on earth, that created the ideal conditions for a coral reef ecosystem. This book is intended to deepen the reader's appreciation of the unique and wondrous life forms that make up coral reefs in the Red Sea. It is designed for the recreational marine-life explorer as well as the marine scientist, and shows, through simple explanations and striking photography, exactly what makes the Red Sea corals so special. The first two chapters of this book provide a general overview of the Red Sea and its corals from a geological, biological, and ecological standpoint. Chapters four and five are devoted to discuss the threats posed by human and other activities, and what can be done about them. Coral reefs represent a tremendous economic resource as a tourist attraction, but tourism itself poses a continuous challenge to the protection of the reefs. In general, this book is a basic guide to the identification and classification of the hard and soft corals of the Red Sea, with photographs taken by the author. They are presented to enhance the experience of snorkelers' divers. Every visitor has a role to play in

preserving the delicate ecosystem of the Red Sea, and it is hoped that the information and photographs in this book will help in this process.

**2003. Hamza, D. S. Surveillance and Biological Studies on Limpets Inhabiting Egyptian Water. Ph. D. Thesis, Banha University, Faculty of Science.**

Limpets are various gastropod snails, with a low conical shell, adhere tightly to rocks with their strong foot. Most limpets have a definite place of their own on the same rock, and roam up at night to mate and scrape algae off rocks with their radula then return to the same spot. In spite, using limpets as a diet; their shells for jewelry and recently using Keyhole limpet hemocyanin (KLH) as a promising tumor vaccine carrier, very limited studies are known about them in Egypt. So, this study planned to throw light on their taxonomy, anatomy and sperm forms of dominant species. In addition, ecological investigations and histological and histopathological investigations of some organs of the dominant species were carried out. Eleven limpet species were recorded during the present study at different habitats of the Egyptian marine water, one of them was recorded for the first time in Egypt. These species belonging to 2 subclasses (Prosobranchia and Pulmonata); 2 orders (Archaeogastropoda and Basommatophora); 3 families (Patellidae, Fissurellidae and Siphonariidae) and 4 genera.

**2001. Ali, A. A. Human impacts on coral reefs along the Egyptian Red Sea Coast. Ph. D. Thesis, Banha University, Faculty of Science, Department of Zoology.**

The effects of different human activities on coral reefs were investigated at seven selected locations along the northern Red Sea of Egypt. Reef surveys indicated that all observed coral damage (coral death, coral breakage, algal overgrowth and coral diseases) was most frequent within the upper ten meters depth. The anthropogenic disturbance of various sorts was the main cause of reef damage because severe oceanographic and climatic changes are extremely rare in the study area. Sixteen physico-chemical variables were assessed in the present study. Enhanced sewage discharge, seepage of wastewater and terrestrial sediment input seems to be the main causes of enhanced nutrient concentrations at location III (Marine Biological Station). Impacts of eutrophication on coral reefs are increased dominance of macroalgae which compete with corals for substrate and overgrow living coral tissue, and increased concentration of total suspended particulate matter in the water column. Heavy sedimentation was associated with a significant reduction of live hard coral cover, hard coral density, species richness, species diversity, evenness index and population density of zooxanthellae, and increased coral mortality and coral diseases. Landfilling concomitant with building activities, beach enhancements and land reclamation were the most significant anthropogenic factors responsible for increased terrestrial sedimentation at the northwestern Gulf of Suez (locations I and II). Total carbonate and organic matter contents in reef sediments were significantly varied among the studied locations. Concentration of total petroleum hydrocarbons in reef sediments showed significant variation among the sampled locations with a range of  $52.9 \pm 8.3$  -

$1.4 \pm 0.01 \text{ } \mu\text{g g}^{-1}$ . The higher levels of petroleum hydrocarbons were probably attributed to the massive oil spillage associated with the different petroleum activities in the Gulf of Suez. On the other hand, the lower concentrations of petroleum hydrocarbons in the area of Hurghada may be attributed to the fact that this area is protected from the prevailing southerly currents which presumably carry the oil with it, by projected head lands and cluster of islands. The increasing oil concentration was significantly accompanied with decreasing live hard coral cover, hard coral density, species richness, species diversity, evenness index and zooxanthellae density, and increasing dead coral cover.

### 16.3- Phytoplankton and Zooplankton Studies

**2017. Abd-Elhamid, W. S. Ecological Studies on Some Marine Gelatinous Zooplankton in the Egyptian Coasts. M. Sc. Thesis, Port Said University, Faculty of Science, Department of Zoology.**

The main aim of the present work was to provide a classification informations, biogeographic distribution, a quantitative and qualitative study of different species of planktonic cnidarians (hydromedusae and scyphomedusae), and ctenophores in the Egyptian Red Sea, at Hurghada coast during August 2014 to July. The recorded number of gelatinous zooplankton during the present study included 24 species, constituting about 22% of all recorded zooplankton community in the study area. Hydromedusae were the dominant component among gelatinous zooplankton, consisting on the average about 74.3% of the total gelatinous zooplankton (18 species), followed by scyphomedusae 15.6% (3 species). Of the all 21 species, belong to Phylum Cnidaria, twelve were the first record in the Egyptian Red Sea. Of them, 10 species (*C. octonaria*, *C. noliformis*, *E. gegenbaueri*, *E. mira*, *E. bigelowi*, *L. fijiana*, *L. clausa*, *O. ocellata*, *P. porpita* and *S. bedoti*) belong to Superclass Hydrozoa, and only one (*P. punctata*) belong to Superclass Scyphozoa. Only three species belong to the Phylum Ctenophore were recorded, two species (*M. leidy* and *P. pileus*) were recorded for the first time in the Egyptian Red Sea during the present study. Temporal variations in the mean abundance of recorded gelatinous zooplankton species indicated that three species only dominated the community. The siphonophores *D. chamissonis* (28 %) and the hydromedusa *A. hemistoma* (22 %) of the total catch densities. Other abundant species such as *P. pileus* (12 %) which belongs to phylum Ctenophora has not been previously reported in Red Sea Egyptian water. Other scyphomedusae *A. aurita* recorded with highest peak in April 2015. The analysis of the spatial distribution of gelatinous zooplankton species showed that the three gelatinous species (*A. hemistoma*, *A. aurita* and *D. chamissonis*) were observed at all sectors of study area. The current study indicated that, the highest abundance of recorded gelatinous species was recorded at offshore sites than inshore sites. This may be according to their depths range from 50 – 300 m, while the diversity was high at inshore and offshore sites due to the 33% of recorded species considered as a costal species. This coastal community formed of *L. tetraphyla*, *C. contorta*, *E. mira*, *E. gegenbaueri*, *E. quadrivalvis*, *Obelia sp.*, *L. clausa* and *P. punctata*.

**2016. Elkarnshawy, S. H. Ecological and Physiological Studies on the Interaction Between Macroalgae and Phytoplankton of Alexandria Mediterranean Coast (Egypt). Ph. D. Thesis, Tanta University, Faculty of Science, Department of Botany.**

Alexandria coastal ecosystems experience a high degree of progressive pressure from anthropogenic activities; over  $183 \times 10^6 \text{ m}^3$  of untreated domestic sewage and waste waters of different origins discharged annually into the sea via several outlets along the coast. The high anthropogenic stress in Alexandria coastal ecosystems creates numerous ecological challenges. Phytoplankton and seaweeds are the most important primary producers in coastal marine ecosystems, which competes for resources, showing extreme sensitivity and immediate reaction towards environmental forces and others as grazing and allelopathic interactions. Yet, most of the previous phytoplankton studies in Alexandria coastal waters were restricted to hot spots of chronic eutrophication. Meanwhile, a complete database of macroalgal taxonomy, temporal and spatial distribution, and the environmental impacts on macroalgae dynamics seem obscure, and relatively sparse. The objectives of this study are focused on the regional and temporal variations of phytoplankton and macroalgae assemblages, and production and quantification of environmental causes of variability. The applicability, utility and efficacy of phytoplankton and macroalgae for assessing water quality status in such temperate marine systems are among the major goals. The interaction between the two groups is determined experimentally through allelopathic activity. The need for such types of long-term monitoring is becoming increasingly important due to many threats facing natural communities. To achieve the purposes of this study, three stations of different ecological entities: span for about 26 km along the coastline were chosen; Abu Qir site at the east, Sidi Gaber in the middle and Qaitbey at the west. The selected sites assumed to be a slight polluted, modest stressed area, and highly polluted areas. The sampling stations were operated for eight months between January and November 2013 (Twice per season). The measured environmental parameters include surface water temperature, salinity, dissolved oxygen, pH, and the analysis of the dissolved inorganic nutrients ( $\text{NH}_4$ ,  $\text{NO}_3$ ,  $\text{NO}_2$ , PO and  $\text{SiO}_4$ ). Also, Chlorophyll contents are measured. Statistical analyses, eutrophication assessment, trophic and ecological indexes (Shannon 's diversity index, evenness or equitability and Margalef richness index), as well as floristic composition value of macroalgae community were calculated.

**2016. Ibrahim, D. M. Studies on Mediterranean Sea floor microalgae, Egypt. Ph. D. Thesis, Ain Shams University, Faculty of Science, Botany Department.**

Paleo-environmental analysis offers potential to understand Mediterranean climate changes, an early review of lake-level reconstruction proposed an east-west contrast is still elusive. Temperature records of the Mediterranean Sea have shown significant warming during the last decades. The changes in sea water temperature occur both at the surface and at depth, and are not uniformly distributed; this report increased the necessity for a high resolution study of the paleoclimate and the interpretations using diatoms of the bottom sediments. Totally, 79 taxa belonging to three different

divisions (Bacillariophyta, Chlorophyta and Ochrophyta), 5 classes, 21 orders, 32 families and 33 genera were identified from 274 sediment samples taken from 70 sediment sites (through piston coring techniques at different depths and localities) along the eastern wing of the Mediterranean Sea. The sediment samples were provided by British Petroleum Company, (El Maadi-Egypt). The aim of this work was to explore the diversification of the diatoms and other microalgal community structure and related ecological determinants along a converging region in the Mediterranean Sea within the Egyptian boundaries. This comes with relevance to a paleo-environmental reconstruction and interpretation of the changes in the diatom community due to the different combined pressure of climate changes and human impact on this water body. From the whole identified taxa, 73 taxa belonged to division Bacillariophyta, 4 to division Ochrophyta (Silicoflagellates) and 2 to division Chlorophyta. Species rarity is of particular importance in the overall configuration of species diversity. Rare species constitute an important component of species richness and are a focus of many ecological theories and controversies. If rare species constitute a large component of species richness, they may play a vital role as the safety net for community conservation and diversity. For the studied samples across the Mediterranean Sea, autochthonous species were: *Achnanthes brevipes*, *A. exigua*, *Cocconeis britannica*, *C. costata*, *C. placentula*, *Diploneis coffaeiformis*, *D. bombus*, *D. nitiscens*, *Epithemia sorex*, *Grammatophora angulosa*, *G. oceanica*, *Mastogloia rostrata*, *Navicula radiosa*, *N. gastrum*, *N. recens*, *Nitzschia granulata*, *N. longissima*, *N. reinholdii*, *Rhicosphenia abbreviata*, *R. curvata*, *Sceptroneis caduceus*, and *S. pupa* (i.e. 27.8% of the species identified are autochthonous).

**2014. Nassar, M. and Khairy, H. Checklist of Phytoplankton Species in the Egyptian Waters of the Red Sea and Some Surrounding Habitats (1990-2010). Annual Research & Review in Biology 4 (23): 3566-3585.**

This review describes the phytoplankton species in the Egyptian waters of the Red Sea and some surrounding habitats namely; Gulf of Suez, Aqaba Gulf and Suez Canal as well as the species abundance during the period from 1990 to 2010. Although many reviews on the phytoplankton species had been done for some areas of the world, a clear and concise list of the phytoplankton species for Red Sea waters (Egypt) has recently not documented. This review aims to provide a checklist of phytoplankton species found as their names and abundance appear in the cited literature, as well as their current valid, accepted names and their common synonyms. This will allow for a better understanding of the presumed phytoplankton species documented around the areas of Red Sea waters (Egypt). The phytoplankton species reported in this review are collected from the different published sources that represent the years spanning 1990-2010.



**2005. Moustafa, W. S. Zooplankton community in Damietta harbor. M. Sc. Thesis, Mansoura University, Damietta Faculty of Science, Department of Zoology.**

This thesis consists of five chapters. The introduction deals with the importance of zooplankton in marine habitat as it refers briefly to the studies made about the same subject in Mediterranean Sea in general and the Egyptian waters in particular. Chapter one describes the study area and the sampling stations, measuring methods of some hydrographic parameters, identification and abundance of zooplankton. Chapter two describes the water quality parameters of Damietta Harbor specially those affect zooplankton abundance and community (e.g. temperature, salinity, transparency, pH, DO and phytoplankton biomass). Chapter three describes the structure of zooplankton communities and diversity, while chapter four describes the zooplankton standing crop in general and each dominant group in particular indicating the monthly and spatial variation of standing crop throughout the year and its relation to the variations in ecological parameter. Chapter five deals with the monthly and spatial variation of the abundance of the dominant species in Damietta Harbor. Also, the local and world distribution of these dominant species are indicated.

**2004. Abdel Aziz, N. E. The Changes of Zooplankton Community in A Chronic Eutrophic Bay on Alexandria Coast, Egypt. University 43: 203-220.**

The quantitative population density and community structure of zooplankton' were studied monthly (October 1999 - September 2000) in the Eastern Harbour of Alexandria, an area which suffered long-term eutrophication due to continuous discharge of domestic wastes. The present study revealed that the zooplankton dynamics in the harbour has experienced serious variations relative to changes of the ecological conditions. In terms of zooplankton abundance, the harbour could be divided into an inner part, harbouring more dense population usually affected by domestic wastes, and an outer low productive part which is less affected by the wastes. The similarity analysis demonstrated two communities in the harbour over the year, the first one appeared in the inner part with similarity of 76.0 - 81.6%, and the other one in the outer part (similarity: 68.1 - 79.8%). Meanwhile, the association of species showed markedly different seasonal patterns, reflecting the effect of seasonal changes in the water circulation and in the ecological conditions. The inter-annual records indicated significant changes in zooplankton community in the Eastern Harbour due to fundamental development of its trophic state resulted from the modification of the sewer system of Alexandria City during the past 50 years. This was clearly detected from the pronounced long-term variations of the diversity, dominance of species, the timing of seasonal peaks and relative abundance of the major zooplankton groups.

**2004. Emara, A. M. and Belal, A. A. Marine Fouling In Suez Canal, Egypt. Egyptian Journal of Aquatic Research 30: 189-206.**

The marine fouling was investigated in the Bitter lakes and Lake Timsah for one year through four seasons, began during autumn 2002 till summer 2003 at different eight stations. The first five stations (I-V) represented the Bitter lakes namely, Shandora, Kabret, Fanara, Fayed, and Devresoir, while the last three stations (VI-VIII) represented Timsah Lake namely, Ismailia sweet canal, North western and North eastern of Timsah Lake. The settlement of marine fouling organisms, species composition and seasonal abundance in addition to the total biomass  $100 \text{ cm}^{-2} \text{ panel}^{-1}$  achieved by immersed test panels over 2 series on an iron frame below 2 m depth to know the nature of fouling organisms on the panels and buoys. These groups are, Algae, Hydroids, Bryozoa, Polychaeta, Cirripedia, Amphipoda, Isopoda, Decapoda in addition to Mollusca and Ascidia. Different main sources of pollution flow into the study area; fishing and swimming due to the human activity, agricultural effluents and domestic drainage and land-based activities of Ismailia City. Timsah Lake lies in a half-way of the Suez Canal, especially Ismailia, its water is salty but fresh water, coming from the Nile through Ismailia canal reduces its salinity and its pH value which change the nature of these organisms in the investigated area. The effect of pollution on Timsah Lake plays an essential role of the appearance of some molluscs, gastropod limpet (*Patella caerulea*), Bivalvia (*Brachidontes variabilis* and *Modiolus auriculatus*) which considered as biomonitor of pollution in this lake. Also, the total biomass is depending upon temperature, season of immersion, kind of substrate, color and duration of exposure. The structure of the total fouling community of the test panels was examined, using measures of statistical analysis of species diversity, evenness and dominance. The diversity and evenness increase during winter and decrease during summer, arranged in the following sequence, winter > autumn > spring > summer of the season levels; while among main groups were arranged as follow polychaeta > Isopoda > Amphipoda > Cirripedia > Decapoda.

**2001. N. E. Zooplankton Community under the Stress of Polluted Land-Based Effluents in Abu Qir Bay, Alexandria, Egypt. Bulletin of the Faculty of Science, University of Alexandria 41: 57-73.**

Zooplankton distribution and community structure were studied monthly from April 1998 to March 1999 in the southwestern part of Abu Qir Bay, which is the most polluted area in the Bay. A total of 119 species were recorded comprising fresh, brackish and marine species. Copepods formed the largest constituent of zooplankton (52.6%) followed by tintinnids (27.8%) and rotifers (7.7%). The community had a highly diversity (Shannon-Weaver index, 1.04 - 2.56) and high population density (annual average of  $90 \times 10^3$  organisms/nr'). Cluster analysis of the zooplankton community revealed different patterns of similarity between the sampled stations, indicating the role of water circulation in the distribution of different zooplankton components in the Bay, and the significant effect of the land based effluents on the community structure in Abu Qir Bay. Several species were found to be considered as

hydrological and ecological indicators, particularly in the vicinity of area affected by the industrial and domestic wastes.

**2000. Hussein, N. R. Ecological and Physiological Studies on Phytoplankton in Some Coastal Areas around Alexandria. Ph. D. Thesis, Alexandria University, Faculty of Science.**

The main target of this work is to estimate the eutrophication status and how it is related to the physico-chemical conditions, phytoplankton community structure, including spatial and monthly distribution, chlorophyll-a biomass and diversity of community in the area behind Kayet Bey to El-Silsila (Alexandria). Also this work comprised laboratory culture experiments of some planktonic species (*Navicula cryptocephala* Kutz. and *Melosira varians* Ag.) isolated from the area of investigation to study the effect of sewage water and some of its individual components (nutritive elements) on the growth of the two organisms. The investigated area located at the western part of Alexandria coastal waters extends from the eastern part to El-Silsila (about 12 km<sup>2</sup>), it includes the main sewer of Kayet Bey which discharges minimally treated wastewater (93 MLD) directly to the sea through a 700-meter sea outfall discharge. Also, it comprises discharged minimally treated wastewater of El-Silsila (58 MLD). Another source of water pollution is caused by the fishing boats.

## 17- Paleobiology

### 17.1- Botanical Studies

**2018. Nour El-Deen, S. and Thomas, R. First record of fossil Trachycarpeae in Africa: three new species of *Palmoxylon* from the Oligocene (Rupelian) Gebel Qatrani Formation, Fayum, Egypt. *Journal of Systematic Palaeontology*, 16 (9): 741-766.**

Based on a survey of the fossil wood flora of Gebel Qatrani (Rupelian, Fayum, Egypt), three new species of palm stem are described: *Palmoxylon araneus* Nour-El-Deen, El-Saadawi & Thomas sp. nov., *Palmoxylon elsaadawii* Nour-El-Deen & Thomas sp. nov. and *Palmoxylon qatraniense* Nour-El-Deen, El-Saadawi & Thomas sp. nov. The specimens are the first petrified palm wood to be reported from the deposits in the upper sequence of the Gebel Qatrani Formation. They are characterized by fibrovascular bundles with two vessels, the presence of a ground parenchyma sustained growth, fibrous bundles, globular echinate phytoliths, radiating parenchyma, and multiseriate scalariform thickening of metaxylem elements. Palaeo-climatic inferences and comparisons with similar fossil stems are discussed for each of the three taxa. Comparisons with extant palms allow identification of these species to tribal Trachycarpeae and subfamilial Coryphoideae levels. They are the first representatives of tribe Trachycarpeae on the African continent. An attempt is also made to explain migration events and discuss the current and fossil distribution of the tribe in Africa.

**2017. El-Saadawi, W., Ziada, N., El-Faramawi, M., Kamal El-Din, M. and Loutfy, M. The Cairo Petrified Forest revisited. *Review of Palaeobotany and Palynology* 238: 34–42.**

The study of the wood flora of the Oligocene Cairo Petrified Forest (CPF) protected area is resumed here after five years. The study added seven Fabaceae species *Afzelioxylon welkitii*, *Copaiferoxylon matanzensis*\* - Caesalpinoideae, *Andiroxylon aegyptiacum*\* sp. nov. -Faboideae, *Dichrostachyoxylon palaeonyassanum*\*, *D. royaderum*\*, *D. zirkelii*\* and *Mimosoxylon tenax* - Mimosoideae as new records to the area; five of them (asterisked) as new records to Egypt; while one of which is new to science. Descriptions and illustrations are given for these five asterisked species. Descriptions of the other reported species were given in earlier publications mentioned in the text. Affinities and comparisons are given for the studied species. Climatic interpretations based on the anatomical features of all the CPF fossil taxa are presented. Moreover, the relationships and comparisons with the nearest living relatives are discussed.

**2017. El-Saadawi, W., Kamal El-Din, M., El- Faramawi, M., and Ziada, N. The Tale of the Cairo Petrified Forest. Egyptian Environmental Affairs Agency - OUDA. pp. 35.**

The study of geological formations can help in filling the missing gaps in the fossil record. Such locations are considered as heritages which must be protected. These sites may be Protected Areas such as the Cairo Petrified Forest (CPF) or Natural Heritages such as Wadi El-Hitan in Fayum. The present booklet includes the location of Cairo Petrified Forest (CPF) and its declaration as a protected area, naming of fossil plants, origin, geologic age and discovery of CPF, wood Flora of CPF, photos of some fossil species and their nearest living relatives, other petrified forests in Egypt, petrified forests worldwide, conclusion as well as list of selected and additional references. Fossilization represents a deviation of the natural process, decomposition; which is a requirement for the environments to function. Organisms normally become fossilized under certain conditions favoring preservation. Fossils are well preserved if the organism was readily buried after death in anaerobic conditions because in the presence of oxygen, the organisms are partially decomposed before being fossilized. In other areas, fossils may be undetected in some formations because of poor outcrops of the formation or the scarcity of specimens. It became known that silica is responsible for the rigidity of the silicified wood, while iron, manganese and carbon give it exquisite and beautiful colors comparable to the so-called gems jasper and opal. Fossil wood may also contain a type of resin known as copal, found in extant and fossilized species belonging to the legume family, which is dominating the CPF. It became also known that the record of past life is found in many forms, each being somehow dependent upon the original morphology of the organism, the type of material in which it was embedded and the chemical forces which affected it after burial. Accordingly, plant fossils are usually found in one of the following categories; compressions, impressions, casts, molds and petrifications; where they are represented in the Department of Botany, Faculty of Science, Ain Shams University and in Departments of Geology of almost all Egyptian Universities.

**2017. Mohamed, M.F and Shabana, M. E. Cenozoic Calcareous Nannofossils from the Egyptian Sediments. Egyptian Journal of Geology 71, Special Publication No. 3.**

This work is aimed to study the calcareous nannofossil registered in the Paleogene and Neogene Egyptian sediments as a practical guide of calcareous nannofossils. It is worth to mention that, this work is a synthesis of many years work (1982-2016) and the authors have been assisted by many colleagues. Calcareous nannofossils are an exceptional microfossil group, with living counterparts, coccolithophores. Coccolithophores are one of the main groups of marine phytoplankton playing key roles in the marine ecosystem as primary producers and in marine biogeochemistry as producers of organic carbon, carbonate and dimethyl sulphide. In addition, they are major sediment formers, key biostratigraphic marker fossils and valuable indicators of palaeoceanographic change and an inconceivably abundant fossil record being the primary component of many marine types of sediment laid down in the last 220

million years. Coccolithophores produce two very different types of coccoliths: heterococcoliths, which are formed of a radial array of complex crystal-units; and holococcoliths, which are formed of numerous minute euhedral crystallites (ca. 0.1  $\mu\text{m}$ ). We now know that both types are products of respectively haploid and diploid life-cycle phases and form via very different bio-mineralisation processes. Their small size allows for age determinations of even very small samples such as ditch cuttings sidewall cores. This book contains four chapters; the first provides general information concerning calcareous nannofossils and techniques. Chapter two provides the studied areas in Egypt and the biostratigraphic zonation. The materials are collected from many surface and subsurface locations in Egypt (Eastern Desert, western Desert, Nile Valley and Nile Delta area, Sinai and Gulf of Suez). The standard calcareous nannofossils biozones of Martini (1971) and Okada & Bukry (1980) with some additional bioevents were used in the studied sequences (from Paleocene to Pliocene). The third and fourth chapters concerned with the classification and taxonomic notes of the Paleogene and Neogene calcareous nannofossils that recorded in many studied sections. The classification of Perch-Nielsen (1985) is used herein (family in alphabetic order). A total of 14 families and 44 genera and 224 species are identified (Paleogene and Neogene).

**2016. El-Saadawi, W., Osman, R., El-Faramawi, M., Bkhat, H. and Kamal-El-Din, M. On the Cretaceous mangroves of Bahariya Oasis, Egypt. *Taeckholmia* 36: 1-15.**

Petrified stems (rhizomes) of a fern are described from Late Cretaceous (Cenomanian) beds in Bahariya Oasis. The discovered stems are related to *Paradoxopteris stromeri* Hirmer (fern rachis) and to *Weichselia reticulata* Stokes & Webb. (fern pinnae); both already known from also Cenomanian beds of this Oasis. Haloed axes are described from Late Cretaceous (Campanian) beds, i.e. younger than the beds containing the petrified stems. Comments on the nature of these axes, the affinities of the stems and the palaeo-environments of the area in the two mentioned geologic ages (Cenomanian & Campanian) are given.

**2016. El-Saadawi, W., Darwish, M., Kamal El-Din, M. and Youssef, S. The First Record of Fossil Rubiaceae Wood from Egypt. *Egypt. J. Bot.* 56 (3-1): 723 -732.**

A fossil dicot wood specimen is described from the lower Miocene of Gebel El-Khashab Formation in the west of Giza Pyramids, Egypt. Anatomical characters suggest affinities with Rubiaceae. Comment is given on the distribution of Rubiaceae fossil wood in the world, particularly in Africa.

**2016. Darwish, M., Kamal El-Din, M. and El-Saadawi, W. On the Fossil Wood Flora of Wadi Ankebieh, Egypt, with Two New Records. Egypt. J. Bot., 56 (3-1): 679 – 692.**

Two fossil dicot wood species (*Dichrostachyoxylon royaderum* - Fabaceae and *Ficoxylon cretaceum* - Moraceae) are reported and described for the first time from the Oligocene of Wadi Ankebieh in Egypt. Comments are made on the distribution of the fossil wood flora of Wadi Ankebieh in Egypt, other African countries, the world and on the palaeo-climate under which the trees had lived.

**2015. Kamal El-Din, M., Darwish, M. and El-Saadawi, W. Novelties on Miocene woods from Egypt with a summary on African fossil woods of Fabaceae, Malvaceae and Dipterocarpaceae.**

Petrified woods of *Bombacoxylon owenii* (Malvaceae / Bombacoideae), *Cynometroxylon* sp. cf. *C. holdenii* (Fabaceae / Caesalpinioideae) and *Dipterocarpoxyton africanum* (Dipterocarpaceae) are described from the early Miocene of Egypt. Fossil wood related to Dipterocarpaceae is a new record to Egypt, while that of *Cynometroxylon* sp. cf. *C. holdenii* is new to the African flora. A warm tropical palaeo-climate with minor seasonality in precipitation is suggested for the original growth site. A list of 147 African species of Fabaceae, 16 of Malvaceae, and 7 of Dipterocarpaceae is given with remarks.

**2015. Nour El-Deen, S. N. Studies on the fossil flora of Gebel Qatrani, Fayum, Egypt. M.Sc. Thesis, Faculty of Science, Ain Shams University.**

Two hundred and fifty specimens of petrified woods were collected from Gebel Qatrani formation. They were assigned to at least 16 species from 11 genera of 4 families of angiospermic woods, besides at least 10 wood morphotypes have not yet been identified. The three fossil palm woods recorded are significant because the specimens were the first to be reported from the deposits of the upper sequence of Gebel Qatrani formation. Only a few fossil plants are so far known from this sequence. As a result of this study, an amended description of the *Palmoxylon lacunosum* is also given to better encompass its entire anatomical features. The systematic treatment includes full descriptions, illustrations, detailed comparisons and affinities with related fossil and modern species. Paleo-climatic inferences are given. The present study also enumerates the other so far known fossil plants from the Gebel Qatrani formation. It represents the first survey of its kind (in Egypt), it includes the largest number of specimens collected ever from one locality.

**2014. El-Saadawi, W., Kamal-El-Din, M., Wheeler, E., Osman, R., El-Faramawi, M. and El-Noamani, Z. Early Miocene Woods of Egypt. IAWA Journal 35 (1).**

Thirty-eight silicified eudicot wood samples were collected from a single locality in the early Miocene Gebel El-Khashab Formation exposed along the Cairo - Bahariya Oasis Desert Road of Egypt. This locality is remarkable because it is dominated by trunks of *Bombacoxylon*, family Malvaceae (32 samples). Whether this reflects the composition of the original regional vegetation or is a result of sorting during transport prior to fossilization is not known. These woods are characterized by having few, wide vessels, functional traits consistent with the tropical, warm humid climate suggested for the early Miocene of North Africa. Additionally, there is one sample each of wood resembling *Terminalioxylon* (Combretaceae) and *Cynometroxylon* (Leguminosae/Caesalpinioideae). Affinities of four other samples could not be determined. A list of all Miocene wood species of Egypt known to date is given along with general interpretations of the paleoclimate in the region and suggestions for future work.

**2014. El-Saadawi, W., Kamal El-Din, M., Darwish, M. and Osman, R. African Miocene dicot woods with two new records for this epoch from Egypt. Taekholmia 34: 1-24.**

A summary is given on the African Miocene dicot woods. Egypt is the second richest African country after Ethiopia in Miocene dicot woods. Fabaceae is the largest family regarding the number of wood species in Africa and Egypt. Miocene dicot woods from Wadi El-Natron in Egypt were examined and two new records: *Dalbergioxylon dicorynioides* - Fabaceae and *Sapindoxylon stromeri* - Sapindaceae are reported. Xylotomical features indicate that the former was a large tree, while the latter was a shrub or small tree and that a non-seasonal tropical palaeo-climate is suggested for the Miocene of the growth area.

**2014. Nour-El-Deen, S., Osman, R. and ELSaadawi, W. Some doubtful locality records of *Palmoxylon* from Gebel Qatrani Formation, Fayum, Egypt. Taekholmia 34: 67-76.**

In the present note, there are provided details on the doubtful data on the occurrence of some fossil palm species in Gebel Qatrani Formation, Fayum, Egypt. It provides a critical review of the preliminary list of fossil palm wood given by El-Saadawi (2006). It is concluded that only two species, i.e., *Palmoxylon geometricum* Sahni and *P. pondicherriense* Sahni, are considered valid from this locality. While, in the absence of independent confirmation, all other records of *Palmoxylon* are highly doubtful and preferably disregarded altogether.



**2013. El-Saadawi, W. E., Kamal El-Din, M. M., El-Faramawi, M. W. and Ziada, N. A. *Terminalioxylon edwardsii* from the Oligocene of Egypt, with a review of the genus in Africa. *Taeckholmia* 33: 47-63.**

Petrified wood resembling modern wood of *Terminalia* (Combretaceae) is described from the Oligocene of the Cairo Petrified Forest, Egypt. On the bases of xylotomical homologies, the fossil wood is attributed to *Terminalioxylon edwardsii*. A summary is given on *Terminalioxylon* and Combretaceae, with inferences on palaeo-climate.

**2013. Kamal El-Din, M., Darwish, M. and El-Saadawi, W. Fossil palm woods of Egypt: New *Palmoxylon* records with a summary on macrofossil African *Arecaceae*. *Palaeontographica Abt. B.* 290 (1-3): 41:61.**

Descriptions, comparisons and affinities are given for: *Palmoxylon deccanense*\* SAHNI, *P. geometricum* SAHNI, *P. pondicherriense* SAHNI, *P. Prismaticum* SAHNI, *P. pyriforme* SAHNI, and *P. sagari*\* SAHNI, based on the study of transverse and longitudinal sections prepared from the trunks according to well-known palaeobotanical techniques. All seven species are middle Miocene new records to Siwa Oasis, while those asterisked are new to Egypt. The number of palm stem species known from Egypt, accordingly, increase from 12 to 16 and that of African from 24 to 28. Brief comments on the macro-fossil palm records of Africa particularly Egypt, palaeogeography and palaeo-climate are given. Stems are the dominant fossil palm organs in Africa and particularly in Egypt. Based on our present knowledge, Egypt is the richest African country in the number of recorded macrofossil palm remains.

**2011. El-Saadawi, W., Kamal-El-Din, M., Attia, Y and El-Faramawi, M. The wood flora of the Cairo Petrified Forest, with five Paleogene new legume records for Egypt. *Review of Palaeobotany and Palynology* 167: 184–195.**

Scattered palaeo-botanical information pertaining to the Cairo Petrified Forest in the Eastern Desert is summarized here, for the first time since over 150 years. Examined wood specimens recently collected from the Cairo Petrified Forest belonged to seven legume species of which five are new records for Egypt, bringing the total known from this Forest to twenty-one species and from Egypt to sixty species. Descriptions and affinities of the seven species, the distribution of the twenty-one species and palaeo-climatic inferences are given with relevant comments.

**2010. El-Saadawi, W., Kamal-El-Din, M., El-Faramawi, M. and El- Noamani Z. Fossil palm woods of Egypt 111. A new site for *Palmoxylon aschersoni* Schenk and *P. wadiai* Sahni. *Taeckholmia* 30: 145- 159.**

Petrified monocotyledonous wood specimens of *Palmoxylon aschersoni* and *P. wadiai* are reported and described for the first time from the Cairo-Baharyia Desert road in Egypt. They are compared to earlier descriptions of specimens assigned to these species from Egypt and other parts of the world. Relevant comments regarding fossil palm remains in Egypt and Africa are given.

**2008. Fadl, M. A. Analysis of Plant Macroremains from Al Kom Al Ahmer in Upper Egypt. Ph. D. Thesis, Beni-Suef University, Faculty of Science, Botany Department.**

The thesis deals with the ethno-archaeobotany and reconstruction of the plant life in Predynastic Hierakonpolis (3800-3500 B.C.) which was one of the pioneer cities of the ancient Egyptian civilization. A total of 70 plant species were retrieved from 304 samples which were subjected to different preservation processes (desiccation and charring) through which archaeo-botanical remains incorporated into our context. Flora of the Nile Valley included 44 species (21 weeds of cultivated lands, 13 tree or shrub, 10 weeds, reeds or rush plants of waste places and canal banks). Desert habitat included 14 species (four trees or large shrubs, eight small shrubs or under shrubs and two annuals) grow in wadis beside Hierakonpolis. *Acacia nilotica*, *Tamarix nilotica*, *T. aphylla*, *Ficus sycomorus*, *Balanites aegyptiaca* and *Ziziphus spina-christi* were the most important trees recorded in Hierakonpolis. Apart from *Ficus sycomorus*, which grows in the Nile Valley only; they constitute the frutescent of vegetation in the Nile Valley and in Wadi Abul-Suffian. In the Nile Valley, *Ceruana pratensis*, halfa garsses and common reed were the main constituents of the suffrutescent layer; Bermuda grass (*Cynodon dactylon*), rye (*Lolium* spp.), Crabgrass (*Digitaria sanguinalis*) Black nightshade (*Solanum nigrum*), Willow-leaved knot weed (*Persicaria salicifolia*), *Coronopus niloticus*, *Cotula anthemoides*, *Crypsis alopecuroides*, *Crypsis schoenoides*, *Lathyrus hirsutus*, *Brachiaria* sp., *Potentilla supine*, *Setaria verticillata*, *Rumex pulcher* and *Rumex dentatus* contributed to the ground layer. In the desert Wadi area, *Tamarix aphylla*, *T. nilotica* and *Balanites aegyptiaca* represented the frutescent layer; *Capparis decidua*, *Hammada elegans*, *Pulicaria crispa*, *Hyoscymus muticus* and *Zygophyllum coccineum* formed the suffrutescent layer; *Cleome chrysantha*, *Cyperus aucheri*, *Morettia philaena*, *Astragalus vogelii* *Fagonia bruguieri* and *Stipagrostis obtusa* formed the ground layer. The presence of remains of tamarisk trees in the Wadi area indicate that the soil water content was high to support the growth of these trees. Analysis of floristic categories of the flora of Predynastic Hierakonpolis shows that Saharo-Sindian was the most effective element on the flora, it was represented by 50 species (68.5%) of the total species: Two mono-regional species, 25 biregional species (19 extend to the Sudano-Zambeian element, three extend to the Irano-Turanian element and three extend to the Mediterranean element). Saharo-Sindian taxa which were tri or Pluriregional were represented by 23 species (31.5%). Biregional Irano-Turanian and Mediterranean were occurred by two species. *Cotula anthemoides* was Sudano-Zambeian and extended to Sino-Japanese regions. The flora was weakly affected by north elements from Irano-Turanian and Mediterranean regions. It is very important to mention that, in the Nile Valley the effect of rainfall of vegetation is doubtful as the water of the Nile has the major effects. A total of 33 species are new records to Predynastic Hierakonpolis, 13 species of them are new records to the historical flora of Egypt viz: *Morus* sp., *Boerhavia diffusa*, *Hammada elegans*, *Agathophora alopecuroides*, *Moricandia nitens*, *Lobularia maritima*, *Gynandropsis gynandra*, *Fagonia bruguieri*, *Zygophyllum coccineum*, *Tamarix tetragyna*, *T. passerinoides* and *Stipagrostis obtusa*.

**2006. El-Saadawi, W. On the fossil flora of Jebel Qatrani area, Fayum, Egypt. *Taeckholmia* 26: 131-140.**

Reference is made to about 200 species of fossil plants and plant fragments previously reported from Upper Eocene to Pleistocene / Holocene strata of Jebel Qatrani area in northern Fayum Depression. The fossils belong to algae, pteridophytes and angiosperms. Comments are made on the origin of the flora, palaeo-environment and palaeo-climate.

**2006. Manniche, L. An Ancient Egyptian Herbal. The American University in Cairo Press, Cairo-New York.**

No complete ancient Egyptian herbal has been yet found, but few fragments dating from the second century AD survive. Some come from an illustrated herbal papyrus written in Greece, but found and used in Egypt. Others are part of a herbal written in a late form of the Egyptian language. It is without illustrations, but composed so as to give the name of the plant, its habitat and main characteristics, and the purpose for which it was used. These were manifold, for apart from their medicinal application, flowers, seeds and fruits, leaves, roots, bark and chips of wood found use in cosmetics and perfumery; in cookery; in the house as ornaments or in preparations. In the present work all these parts of vegetation are often loosely referred to as "herbs".

**2005. El-Saadawi, W. A fossil rhizome at the mangrove site of Wadi Hitan, Egypt. *Taeckholmia* 25: 129-136.**

A dichotomized rhizome fragment comparable to that of *Nypa fruticans* Wurmbr., but much smaller in size, is reported from the late middle Eocene Camp White layer which represents a prominent mangrove root horizon at the top of Gehannam Formation in Wadi Hitan, west of the Fayum Depression. Botanical and palaeobotanical illustrations and comments are given and suggestions are made.

**2004. El-Saadawi, W. E. and Kamal El-Din, M. M. *Terminalyoxylon* species from Gebel Qatrani formation at Widan-el-Faras, Fayum, Egypt. *Taeckholmia* 24 (1): 63-78.**

*Terminalyoxylon intermedium* and *T. primigenium* are reported for the first time from south of Widan-el-Faras; the type locality of the Oligocene Gebel Qatrani Formation. The former species is a new for this formation. Description of the two reported species and a key for identification of the four species of *Terminalyoxylon*, hitherto, known from Egypt are given. Comments are made on the distribution of the *Terminalyoxylon* species in Egypt and the world, on the palaeoclimate of the Gebel Qatrani formation, on the Combretaceae fossils in Egypt and Africa, and on other relevant aspects of the fossil flora of Gebel Qatrani Formation.

**2004. EL-Saadawi, W., Youssef, S. and Kamal-EL-Din, M. Fossil palm woods of Egypt: II. Seven Tertiary *Palmoxylon* species new to the country. Review of Palaeobotany and Palynology 129: 199–211.**

Descriptions, comparisons and affinities are given for the following Late Eocene–Early Miocene new to Egypt: *Palmoxylon compactum* Sahni, *Palmoxylon geometricum* Sahni, *Palmoxylon indicum* Sahni, *Palmoxylon pondicherriense* Sahni, *Palmoxylon pyriforme* Sahni, *Palmoxylon rewahense* Sahni and *Palmoxylon wadiai* Sahni. Comments on the geologic ages of the compared *Palmoxylon* species, Indian plate migration, palaeo-geography and palaeo-climates are given.

**2004. Kamal El-Din, M. M. and El-Saadawi, W. E. Two Leguminosae Woods from the Miocene of Gebel Ruzza, Egypt. IAWA Journal 25 (4): 471– 483.**

Early Miocene fossil woods of Gebel Ruzza, Egypt, were examined and two new records (*Cynometroxylon schlagintweitii* and *Afzelioxylon welkitii*) for Egypt are reported. A hot wet palaeo-climate is suggested for the Early Miocene collection site. The literature on fossil dicot woods from Egypt is summarized.

**2004. Kedves, M., El-Saadawi, W. and Youssef, S. Fossil Gymnosperm wood from Aswan Area. Plant Cell Biology and Development 16: 23-28.**

Fossil woods were collected from two localities of late Cretaceous age to the West of Lake Nasser (Aswan area). In this contribution, the anatomy of two samples are described. The preservation is not so well but, the remnants are without doubt of gymnospermous origin. Based on some wood anatomical data, earlier characteristics are observed, similar to the recent Podocarpaceae taxa.

**2004. Kedves, M., Youssef, S., El-Saadawi, W. and Mostafa, R. A new *Agathoxylon* data from the late Cretaceous of Kharga Oasis, Egypt, investigated with combined methods. Taekholmia 24 (1): 43-49.**

Slides prepared from an almost well- preserved silicified tree trunk from the Late Cretaceous of Kharga Oasis were investigated with both light and polarization microscopy. Based on light microscopy, this wood remnant is of a tropical gymnospermous origin. Its distinct annual rings indicated periodicity in the climate. The polarization microscope revealed fine details concerning the areolate pitting of the radial walls of the tracheids. Taking into consideration the general aspect of the wood anatomy and the pitting of the cross-fields, some similarity but not identify may be presumed with the *Agathoxylon lifiyii* Youssef, El-Saadawi, Kedves and Mostafa, described earlier from the same locality.

**2004. Youssef, S. and El-Saadawi, W. Fossil wood from the Nubian sandstone of Kharga Oasis, Egypt. *Taeckholmia* 24 (1): 51-61.**

A new petrified wood material from the late Cretaceous of the area between Kharga and Dakhla Oasis, Western Desert of Egypt proved to be quite similar to *Metapodocarpoxylon* Dupéron - Laudoueneix et pons, which is wide spread from the Middle Jurassic up to the Upper Cretaceous of Northern Gondwana. Comments on its association with *Agatoxylon* and the palaeo-climate are given in addition to information about all fossil gymnosperm wood species reported from Egypt.

**2003. El-Saadawi, W., Darwish, M. and Abd El-Azeem, S. Permanent plant remains from Wadi El-Dome, Western side of the Gulf of Suez, Egypt. *Taeckholmia* 23 (1): 83-97.**

Impressions of fragments of stems and leaves of Sphenophyta, Pterophyta and Cordaitophyta are reported and described from the permian of Wadi El-Dome, Western side of the Gulf of Suez, Egypt; which are new records for Wadi El- Dome. while *Annularia* is a new record for Egypt. The rocks are barren of spores or pollen grains.

**2003. Kamal El- Din, M., Mahmoud, A. and El- Saadawi W. Cedar wood remains at Mersa Gawasis archaeological site, Red Sea, Egypt. *Taeckholmia* 23 (2): 105-111.**

Microscopic examination of boat wood remains found at the archaeological site of the only known Ancient Egyptian port *S3 ww* (Mersa Gawasis) on the Red Sea, confirmed that they belong to Cedar. Further collection and investigation of boat woods and woods used as fuel in furnaces (to smelt copper) by Ancient Egyptian at *S3 ww* port are worthwhile.

**2002. Barakat, H. N. Guide Botanique de l'Egypte Ancienne. Centre Français de Culture et de Coopération, Ambassade de France en République Arabe d'Egypte, Le Caire (in Arabic and French).**

This guide deals with the plants of ancient Egypt. It includes selected numbers of plant species that are known from Ancient Egypt based on plant traces found in the Pharonic tombs. These traces are perfect evidence for the occurrence of these plants in that era. The plants were selected to include ornamental and decoration plants and flowers. A brief description is written to each plant to include its important characteristics, origin, date of introduction to Egypt, short historical note, uses in Ancient and modern Egypt, and a simple line drawing.

**2002. El- Saadawi, W., Youssef, S. and Kamal El- Din, M. Fossil palm woods of Egypt. I- *Palmoxylon aschersoni* Schenk and *P. libycum* (Stenzel) Kräusel. *Taeckholmia* 22(2):143-153.**

*Palmoxylon aschersoni* and *P. libycum*, were described, based on investigation of specimens collected from new sites in Egypt, these were compared with earlier finds and differences noted. Distribution of the two species in Africa and their affinities are given.

**2000. Darwish, M., Strougo, A. and El- Saadawi, W. Fossil plant remains from Oligocene (?) of Farafra Oasis, Egypt. *Taeckholmia* 20(2):147-157.**

Well preserved fragments of fossil leaves of *Dipterocarphyllum*, Cyperaceae, Gramineae and a pod-like fruit are described from Oligocene (?) of Farafra Oasis, Egypt.

**2000. Youssef, S., El-Saadawi, W., Kedves, M. and Mostafa, R. Wood Anatomy of a Silicified Trunk from the Kharga Oasis, Egypt. *Plant Cell Biology and Development* 12: 30 – 39.**

This paper presents the detailed LM anatomy of a gymnospermous fossil wood from the Late Cretaceous layers of the Kharga Oasis. The pitting of the radial wall of the tracheids is of an early "araucarioid" type. In comparison to the previous fossil wood data, the following anatomical characteristics may be emphasized: 1. The ray cells are 3 - 52 cells high. 2. The great number (21, 24) of the pits in the cross fields. 3. The transverse walls of the longitudinal parenchyma cells are smooth. Based on these LM characteristic features this fossil wood is described as *Agathoxylon lifiyii* sp. nov.

## 17.2- Zoological Studies

**2018. Youssef, M. and El-Sorogy, A. Agglutinated foraminifera from the Campanian-Maastrichtian Kiseiba Formation in the Kurkur area, Egypt. Arabian Journal of Geosciences 11: 171.**

The upper Campanian to upper Maastrichtian sedimentary sequence of the Kiseiba Formation in south Western Desert is sampled and described in two surface sections (Sinn El Kaddab and Wadi Abu Siyal). Forty-four agglutinated foraminiferal species are identified from 42 samples in the studied succession. The benthic foraminiferal assemblages are dominated by agglutinated foraminifera which comprise more than 90% of the assemblage. The agglutinated foraminifera are subdivided into five morphogroups (A, B, C, D, E) according to shell architecture, integrated with the supposed microhabitat and feeding strategy. The foraminiferal assemblage is assigned to mixohaline shallow water environments. These assemblages with *Ammoastuta megacribrostomoides* and *Ammotium bartheli* suggest lagoonal environments with considerably reduced salinity in warm climates and high runoff for the late Campanian-Maastrichtian interval.

**2017. Orabi, O. H, El-Badry, A. A and Badr El-Din, A. M. Benthic foraminifera for heavy metal pollution monitoring: A case study from Burullus Lagoon of Egypt. Marine Pollution Bulletin 121: 411–417.**

Sources of heavy metals pollution in the Burullus Lagoon include phosphate fertilizers, sewage and oil spills from fishing boats. The benthic species identified in this lagoon are *Adelosina carinata striata* (Wiesner), *Quinqueloculina boschiana* (d'Orbigny), *Quinqueloculina seminulum* (Linnaeus), *Ammonia tepida* (Cushman) and *Elphidium excavatum* (Terquem). *A. tepida* is the most dominant species in the lagoon. It constitutes more than 97% of the total benthic foraminiferal assemblages reflecting tolerance to the very low salinity in the Burullus Lagoon. The intensity of deformation was severe exhibiting a peculiar change in the coiling direction in *A. tepida* with increase in cadmium concentration. *A. tepida* exhibited a great morphological variability and the recorded morphological abnormalities show high spire giving the spiroconvex test, additional chamber, aberrant chamber shape and size, twisted tests with elongated axes of rotation and complex deformities, whereas *E. excavatum* showed additional calcite secretion (tumors).

**2017. El-Kahawy, R. M and Abd El-Wahab, M. Environmental factors controlling benthic foraminiferal distribution in Hurghada area, Red Sea coast, Egypt. Geophysical Research Abstracts 19.**

Benthic foraminiferal assemblages were investigated at Hurghada on the Red Sea coast of Egypt, to determine the distribution and their common environmental factors that control on this distribution. Forty three sediment samples were collected and environmental factors (TC, pH, and salinity, water depth, grain size, organic matter and carbonate content) were measured. Faunal abundance (14-1755 tests/g) with an average 709 tests/g, and faunal diversity (6-39 specimens) with an average of 31

specimen. Cluster analysis was divided the Hurghada site into four distinct biotopes based on the faunal data: Biotope (1) is dominated by a *Quinqueloculina seminula*, *Quinqueloculina laevigata*, and *Triloculina terquemiana* assemblage. Biotope (2) is dominated by a *Sorites marginalis* and *Triloculina trigonula* assemblage. Biotope (3) is dominated by *Amphistegina lessonii*, *Ammonia beccarii* and *Elphidium* spp assemblage. Biotope (4) is dominated by a *Peneroplis planatus*, *Coscinospira hemprichii*, *Sorites orbiculus* and *Neorotalia calcar* assemblage. Some of the recorded foraminiferal tests showed abnormalities in their apertures, coiling and shape of chambers. The distribution of benthic foraminiferal species is governed by environmental factors such as salinity, temperature, substrates-type, water depth and pH. *P. planatus* and *C. hemprichii* positively correlate with extreme salinity and temperature, indicating that these species reflect a warm, arid climate conditions. Aside, the heavy metals (Cu, Cd, Zn, Pb, Ni and Mn) concentrations in the sediment samples were analyzed using ICP-OES. The comparative study between the faunal content and the heavy metals enrichments in each sample displayed positive character indicating the worsening of the environmental conditions.

**2014. Orabi, O. H and Khalil, H. M. Calcareous benthonic foraminifera across the Cretaceous/Paleocene transition of Gebel Um El-Ghanayem, Kharga Oasis, Egypt. Journal of African Earth Sciences 96: 110-121.**

The studies of benthic calcareous foraminifera of the Maastrichtian–early Paleocene Dakhla Formation in Gebel Um El-Ghanayem (Western Desert, Egypt), improve reconstruction of depositional environments of these successions. In total, 68 taxa of benthic foraminifera were identified in the studied succession. The late Maastrichtian assemblages (Zone CF3) are dominated by calcareous foraminifera with tapered tests, this tapered taxon *Loxostomum applinae*, *Loxostomum tegulatum* various dentalinid taxa, and *Buliminella cushmani* dominate in CF3 Biozone. We thus interpret these faunas as being dominated by in faunal morphogroups suggesting a moderately eutrophic environment. Danian assemblages are characterized by abundant epifaunal trochospiral species, such as *Cibicidoides abudurbensis*, *Cibicidoides farafraensis*, and *Gyroidinoides girardanus*.

**2013. Madkour, H. A. Recent benthic foraminifera of shallow marine environment from the Egyptian red sea coast. Global Advanced Research Journal of Geology and Mining Research 2 (1): 05-014.**

Sixty-nine samples have been collected from three coastal lagoons Abu-Shaar, Umm al-Huwaytāt and Marsa Shūni Lagoons along the Egyptian Red Sea coast. Coastal lagoons are areas of hyper- saline waters protected by linear barrier reefs. Seagrasses and algae are widely distributed especially in Marsa Shūni Lagoon on the soft muddy and sandy carbonate sediments on the flanks of the reefs and channels between them. The distinctive species are taxonomically identified in the marine sediments of the shallow marine environments from the coastal lagoons are carried out along the Egyptian Red Sea. They compared with the benthic foraminiferal assemblages of the other parts of the northern Red Sea coast and the Eastern Mediterranean. Their



percentage distribution is relatively similar to that of other littoral assemblages of the Red Sea coast. This resemblance is less marked with that of the Eastern Mediterranean Sea coasts.

**2013. Sallam, M. Benthic foraminifera from the Oligocene offshore Nile Delta, Egypt and its implications. *Micropalaeontology* 59: 167-175.**

The detailed micro-morphological analysis carried out on four offshore Oligocene (Tineh Formation) Nile Delta successions revealed the identification of 44 foraminiferous species and subspecies. Nine benthic and 2 planktonic zones are identified. The established benthic zonation has been chrono-stratigraphically calibrated with those based on the planktonic foraminiferal ones. This sequence is assigned to Oligocene (Chatian), and possibly extends to the upper part of Rupelian. A remarkable feature of the Oligocene succession is the most complete absence of planktonic foraminifera in its major lowest part, a situation that caused a difficulty subsistence with remarkable paucity of complete absence of any calcareous fauna, probably related to deposition in carbon dioxide-rich marine conditions hostile to the precipitation of any calcareous material and caused by volcanic activity, lowered temperature or situation under the lysocline or carbonate-compensation depth.

**2012. Zalmout, I. S., Antar, M. S., Abd-El Shafy, E., Metwally, M. H., Hatab, E. E. and Gingerich, P. D. Priabonian Sharks and Rays (Late Eocene: Neoselachii) From Minqar Tabaghbagh in The Western Qattara Depression, Egypt. *Contributions from the Museum of Paleontology, University of Michigan*, 32 (6): 71-90.**

A Priabonian (late Eocene) neoselachian fauna of sharks and rays is known from marine strata in the foothills of Minqar Tabaghbagh, near the southwestern corner of the Qattara Depression in the Western Desert of Egypt. Neoselachian remains were collected from the lower glauconitic shales and mudstones of the Daba'a Formation, which is a western equivalent of the Qasr El-Sagha Formation found in the eastern part of the Western Desert. Neoselachians studied here are macro-scale, collected on the surface, and known either from teeth or rostral remains. Taxonomic evaluation shows that the neoselachians belong to five orders, 11 families, 19 genera, and 24 species. The species are: *Hexanchus agassizi*, *Carcharias* sp., *Otodus* cf. *O. sokolowi*, *Brachycarcharias* cf. *B. twiggsensis*, *Macrorrhizodus praecursor*, *Xiphodolamia serrata*, *Alopias alabamensis*, *Alopias* sp., *Abdounia* aff. *A. minutissima*, *Misrichthys stromeri*, *Carcharhinus* sp. 1, *Carcharhinus* sp. 2, *Galeocerdo* sp. 1, *Galeocerdo* sp. 2, *Negaprion frequens*, *Negaprion* sp., *Physogalus* sp., *Rhizoprionodon* sp., *Anoxypristis* sp., *Propristis schweinfurthi*, *Pristis lathamii*, *Myliobatis* sp. 1, *Myliobatis* sp. 2, and an indeterminate sting ray spine. Teeth of *Otodus* cf. *O. sokolowi* and *Macrorrhizodus praecursor* are the most abundant remains recovered from the locality. Recovery of *Xiphodolamia serrata* confirms the late Eocene age of the faunal Minqar Tabaghbagh assemblage. *Xiphodolamia serrata*, previously known only from Priabonian late Eocene Tethyan deposits of central and north Africa and western Asia, is reported from Egypt for the first time. Taxa recovered from the base of the Daba'a Formation

have been reported from late Eocene Tethyan deposits of Iran, Syria, Jordan, Egypt, Morocco, Angola, Nigeria, Europe, and North America. The Tabaghbagh fauna is important strati-graphically because it enables surface and subsurface correlation of late Eocene sedimentary deposits across the Western Desert of Egypt, to the Arabian Peninsula and western Asia in the east, and to African sites farther to the west and south.

**2010. Hamama, H. H. Systematic, ontogenetic variations, population of molluscan fauna and their environmental impact on the islands of the El-Burullus lagoon, North Nile Delta, Egypt. Mansoura Journal of Environmental Sciences, Mansoura University 39 (3).**

Twenty-three surface, ditch and core samples were collected from a number of islands in El-Burullus lagoon to define holocene molluscan biofacies present in these islands, determine their spatial and geographic distribution and to assess the environmental impact on the habitat of the fauna. In addition, the chemical analysis of the trace elements of the shells is studied to show the relation between the shell composition and the enclosing sediments. the quantitative examination and statistical analysis of faunal data were undertaken to refine interpretations of the present environmental conditions affecting these islands. This is important because all modern Nile lagoons are undergoing very rapid change (reduction in size and pollution) because of accelerated human activity. Eight molluscan bivalve and gastropod species represented by 1123 specimens were identified and described. Four identified bivalve species are assigned to *Ostrea edulis*, *Cerastoderma glaucum*, *Abra ovata* and *Corbicula fluminalis*. The gastropods belong to *Odoxus niloticus*, *Melanoides tuberculata*, *Bittium reticulatum* and *Hinia reticulata* species. the ontogeny of most studied species is dealt with through plots of measurements of a number of specimens.

**2007. Youssef, M., Madkour, H., Mansour, A., Alharbi, W. and El-Taher, A. Invertebrate shells (mollusca, foraminifera) as pollution indicators, Red Sea Coast, Egypt. Journal of African Earth Sciences 133: 74-85.**

To assess the degree of pollution and its impact on the environment along the Red Sea Coast, the most abundant nine species of recent benthic foraminifera and three species of molluscan shells have been selected for the analysis of Fe, Mn, Zn, Cu, Pb, Ni, Co, and Cd concentrations. The selected foraminiferal species are: *Textularia agglutinans*, *Amphisporus hemprichii*, *Sorites marginalis*, *Peneroplis planatus*, *Borelis schlumbergeri*, *Amphistegina lessonii*, *Ammonia beccarii*, *Operculina gaimairdi*, and *Operculinella cumingii*. The selected molluscan shells are: *Lambis truncata* and *Strombus tricornis* (gastropods) and *Tridacana gigas* (bivalves). The inorganic material analysis of foraminifera and molluscs from the Quseir and Safaga harbors indicates that foraminifera tests include higher concentrations of heavy metals such as Fe and Mn than molluscan shells. These results are supported by the black tests of porcelaneous foraminifera and reflect iron selectivity. The Cd and Pb concentrations in molluscan shells are high in the El Esh Area because of oil pollution at this site. The

Cu, Zn, and Ni concentrations in the studied invertebrates are high at Quseir Harbor and in the El Esh Area because of the strong influence of terrigenous materials that are rich in these metals. The heavy metal contamination is mostly attributed to anthropogenic sources.

**2005. Alegret, L., Ortiz, S., Arenillas, I. and Molina, E. Palaeoenvironmental turnover across the Palaeocene/Eocene boundary at the Stratotype section in Dababiya (Egypt) based on benthic foraminifera. Terra Nova, 17: 526–536.**

The Global Stratotype Section and Point for the Palaeocene/ Eocene (P/E) boundary was defined at Dababiya Quarry (Egypt) at the base of the carbon isotope excursion (CIE). We present the first detailed analysis of Palaeocene–Eocene benthic foraminifera from Dababiya, in order to infer the palaeoenvironmental turnover across the P/E boundary. At Dababiya, the CIE coincides with a major turnover in foraminiferal assemblages; the last occurrence of *Angulogavelinella avnimelechi*, at the base of the CIE, may be correlated to the main phase of extinction of deep-sea benthic foraminifera. Benthic foraminifera indicate that stressful conditions such as oxygen deficiency, carbonate dissolution, and changes in food supply persisted at the sea floor over most of the CIE interval. The main phase of recovery of benthic foraminifera is recorded c. 250 cm above the P/E boundary, and it may be linked to increased productivity and oxygenation at the sea floor.

## 18- Goods and Services

### 18.1. Carbon Sequestration

**2018. Sanderman, J., Hengl, T., Fiske, G., Solvik, K., Adame, M., Benson, L., Bukoski, J., Carnell, P., Cifuentes-Jara, M., Donato, D., Duncan, C., Eid, E., Ermgassen, P., Lewis, C., Macreadie, P., Glass, L., Gress, S., Jardine, S., Jones, T., Sanders, E., Spalding, M. and Landis, E. A Global Map of Mangrove Forest Soil Carbon at 30 m Spatial Resolution. *Environ. Res. Lett.* **13**.**

With the growing recognition that effective action on climate change will require a combination of emissions reductions and carbon sequestration, protecting, enhancing and restoring natural carbon sinks have become political priorities. Mangrove forests are considered some of the most carbon-dense ecosystems in the world with most of the carbon stored in the soil. In order for mangrove forests to be included in climate mitigation efforts, knowledge of the spatial distribution of mangrove soil carbon stocks are critical. Current global estimates do not capture enough of the finer scale variability that would be required to inform local decisions on siting protection and restoration projects. To close this knowledge gap, we have compiled a large geo-referenced database of mangrove soil carbon measurements and developed a novel machine-learning based statistical model of the distribution of carbon density using spatially comprehensive data at a 30m resolution. This model, which included a prior estimate of soil carbon from the global Soil Grids 250m model, was able to capture 63% of the vertical and horizontal variability in soil organic carbon density (RMSE of 10.9 kgm<sup>3</sup>). Of the local variables, total suspended sediment load and Landsat imagery were the most important variable explaining soil carbon density. Projecting this model across the global mangrove forest distribution for the year 2000 yielded an estimate of 6.4 Pg C for the top meter of soil with an 86–729 Mg C ha<sup>-1</sup> range across all pixels. By utilizing remotely-sensed mangrove forest cover change data, loss of soil carbon due to mangrove habitat loss between 2000 and 2015 was 30–122 Tg C with >75% of this loss attributable to Indonesia, Malaysia and Myanmar. The resulting map products from this work are intended to serve nations seeking to include mangrove habitats in payment-for-ecosystem services projects and in designing effective mangrove conservation strategies.

**2017. Omar, S. A. Evaluation of Atmospheric Carbon Dioxide Sequestration in Mangrove Ecosystem in South Sinai, Egypt. Ph. D. Thesis, Faculty of Science, Mansoura University, Mansoura, Egypt.**

This study was concerned with evaluation of the overall above-ground, below-ground and mangrove sediment organic carbon stock for mangrove ecosystem in all habitats mainly distributed along the Gulf of Aqaba in two protected areas (Nabq and Ras-Mohammed) in South Sinai (Egypt). The obtained results were compared with ten year's old planted mangrove, non-mangrove mud flats and hyper-saline ecosystem of the Salt Lake in Ras-Mohammed National Park. Study went further to evaluate the role of these ecosystems in process of atmospheric CO<sub>2</sub> sequestration. Selection of the most accurate, coast efficient and environmentally friendly technique was of the main tasks of this study, where low temperature loss on ignition (°C 375/17 hrs.) was the most ideal technique compared to high-temperature loss on ignition (°C 550/2 hrs.) and wet digestion with potassium dichromate. Soils contributed with at least 80% of total organic carbon stock of intertidal mangrove habitat as compared to the salt plain mangrove which attained values up to 90.3%. Percentages of soil organic carbon in the studied habitats reached the highest value 3.4% in intertidal mangrove and minimum was 0.4 % in the non-mangrove mud flats of sample dry weight. The ten years old mangroves contained a total carbon stock (in standing biomass and soil carbon) of value 41% of the mature intertidal mangrove. This study proved the role and importance of mangrove ecosystem in carbon sequestration, an important asset for mitigation of the expected climate change. Restoration/rehabilitation programs on previously depleted sites are more efficient than on non-mangrove sites. Mangroves of the intertidal habitat contributed by 95% of carbon sequestration process in South Sinai mangrove (116.9 ton of carbon per year), where the overall carbon sequestration of Egypt mangroves are 1207.5 ton of carbon per year, considering that all mangrove sites of Egypt have the same sequestration potential.

**2017. Eid, E. M, Moghanm, F. S and Shaltout, K. H. Effect of the different types of land-use on the distribution of soil organic carbon in north Nile Delta, Egypt. Rend. Fis. Acc. Lincei 28: 481–495.**

In Egypt, the need for accurate information on soil organic carbon (SOC) content has increased due to the importance of SOC stocks for sustainable use of natural resources and to meet the requirements of the Kyoto Protocol. Thus, the objectives of the present study are: (1) to quantify the vertical distribution of the soil bulk density (SBD) and SOC content in the soil of north Nile Delta, Egypt under different types of land-use; (2) to provide estimates of the carbon sequestration rate (CSR) of those soils under different types of land-use; and (3) to establish a baseline data on SOC stocks for future studies on SOC dynamics. Ten sampling stations were selected to represent the north Nile Delta during May 2014. In each of the sampling station, 4 sampling sites were selected to represent the virgin lands, 4 to represent fish farms and 12 to represent crop lands (four cultivation histories: 5, 15, 30 and 50 years 9 three crop types: clover *Trifolium alexandrinum*L., sugar beet *Beta vulgaris*L., and rice *Oryza sativa*L.). Effect of crop type was significant in relation to SBD, SOC content, and

SOC stock. In general, SOC stock increases as the number of years of cultivation increases. The SOC stock under crop land and fish farm were 1.6 and 1.5 times as that of virgin land. Rice was the crop with lowest SBD and highest SOC stock. The average CSR of crop land was 352, 134, 88 and 62 g C m<sup>-2</sup> year<sup>-1</sup> for 5, 15, 30 and 50 years of cultivation, respectively. The highest CSR (545 g C m<sup>-2</sup> year<sup>-1</sup>) was observed in crop land cultivated for 5 years by rice, while the lowest (21 g C m<sup>-2</sup> year<sup>-1</sup>) was observed in crop land cultivated for 50 years by sugar beet. On the other hand, the average CSR of fish farm was 143 g C m<sup>-2</sup> year<sup>-1</sup>. In conclusion, the conversion of virgin land into crop land or fish farm contributed to SOC sequestration.

**2017. Eid, E.M, Keshta, A. E, Shaltout, K.H, Baldwin, A. H and Sharaf El-Din, A. A. Carbon sequestration potential of the five Mediterranean lakes of Egypt. Fundam. Appl. Limnol. 190/2: 87–96.**

The objectives of the present study were (1) to quantify the vertical distribution of the sediment bulk density (SBD), the sediment organic carbon (SOC) concentration, and the SOC density in the five northern lakes of Egypt (Bardawil, Manzala, Burullus, Edku and Mariut); (2) to estimate the carbon sequestration rate (CSR) and carbon sequestration potential (CSP) of these lakes; and (3) to establish a baseline data on SOC pools for future studies on SOC dynamics. Our hypothesis was that each of the above mentioned parameters varied among the five lakes. The mean SBD of Lake Bardawil was the highest, while that of Lake Manzala was the lowest. The mean SOC concentration of Lake Mariut was the highest, while that of Lake Edku was the lowest. We developed a negative exponential function between SBD and SOC concentration for each of the five lakes, where SBD increased and SOC concentration decreased with sediment depth. Considering the entire sediment profile (0 – 30 cm), the mean SOC density of Lake Mariut was the highest, while that of Lake Edku was the lowest. Significant differences in SOC pools were found among the five lakes, with the highest value obtained in Lake Mariut and the lowest in lakes Edku and Manzala. Based on the area of the five northern lakes of Egypt and their CSR, the CSP ranged from 0.95 Gg C yr<sup>-1</sup> in Lake Bardawil to 7.79 Gg C yr<sup>-1</sup> in Lake Manzala. Thus, it is necessary to protect and restore these lakes for carbon sequestration, as well as other ecosystem services that currently lack effective protection.

**2017. Plan Bleu. Economic Assessment of Ecosystem Services Provided by Mediterranean Wetlands in Terms of Climate Regulation. Plan Bleu, Valbonn.**

As part of Med-ESCWET, economic valuation was completed for three regulating ecosystem services associated with climate change adaptation: the coastal storm protection service, the flood control service, and the carbon sequestration service. Four Mediterranean pilot sites were identified to value these services in Croatia, France, Egypt and Turkey. It should be noted that this is not about giving monetary value to services without a market price, but about creating a common language so that policy makers can consider the environment as a natural capital on which most business sectors depend. Economic valuation is an exercise combining ecology, economics,

hydrology and sociology, and requires prior biophysical assessment which is vital for the soundness of the study. Hydro-periods (water budget and storage capacity) and flood pulsing (rhythm) in the areas studied need to be taken into account in the assessment. They determine the constitution of hydro-morphic soils and some of the wetland's functionalities that influence the ecosystem services. In line with the data, available resources and the limitations of the chosen economic techniques, the following study illustrates the interest of an ecosystem-based climate change adaptation approach via wetlands. By doing so, it strengthens a view that is already recognized and encouraged across the world, particularly by the Convention on Biological Diversity (CBD), and at the Mediterranean level (IUCN, UNEP/MAP).

**2016. Eid, E. M and Shaltout, K. H. Distribution of soil organic carbon in the mangrove *Avicennia marina* (Forssk.) Vierh. along the Egyptian Red Sea Coast. *Regional Studies in Marine Science* 3: 76-82.**

The objectives of the present study are: (1) to quantify the vertical distribution of the soil bulk density (SBD), soil organic carbon (SOC) content and SOC density in the soil of the mangrove forests in comparison with a reference site along the Egyptian Red Sea Coast; (2) to provide estimates of the carbon sequestration rate (CSR) and the carbon sequestration potential (CSP) of mangrove forests in Egypt; and (3) to establish a baseline data on SOC pools for future studies on SOC dynamics. Sampling was carried out in three stations along the Egyptian Red Sea Coast. The sampled station was classified to mangrove and reference (mud flat) stands. In each of the sampling station, five sampling sites were selected to assure representative samples to each of the mangrove and mudflat stands. Three soil cores were taken in each sampling site and were pooled together into one composite core per sampling site. In total, 120 soil samples were collected, i.e., one sample from each four soil layers (0–10, 10–20, 20–30 and 30–40 cm) at each of the 30 sampling sites (15 sampling sites per each of mangrove and mud flat stands). The mean distribution of SBD in the mangrove and mud flat stands increased significantly with depth. SOC content in the mangrove stands declined significantly with depth from 20.0 g C kg<sup>-1</sup> at depth 0–10 cm to 11.4 g C kg<sup>-1</sup> at depth 20–30 cm. SOC content in the mud flat stands declined significantly with depth from 9.0 g C kg<sup>-1</sup> at depth 0–10 cm to 1.9 g C kg<sup>-1</sup> at depth 30–40 cm. The stand type affected significantly the SOC pool, where the total mean of SOC pool of the mangrove stands (8.5 kg C m<sup>-2</sup>) was higher than that of the mud flat stands (2.6 kg C m<sup>-2</sup>). The average CSR of the mangrove stands (6.1 g C m<sup>-2</sup> year<sup>-1</sup>) was higher than the mud flat stands (2.0 g C m<sup>-2</sup> year<sup>-1</sup>).

**2013. Eid, E.M. and Shaltout, K.H. Evaluation of carbon sequestration potentiality of Lake Burullus, Egypt, to mitigate climate change. Egyptian Journal of Aquatic Research 39: 31-38.**

With the increase of atmospheric carbon dioxide, there is a growing public and scientific concern over the carbon sequestration potential of various ecosystems, especially wetlands. Many scientists have suggested that the sequestration of carbon dioxide in soil organic carbon could contribute significantly to adhere with the Kyoto Protocol in stabilizing the atmospheric abundance of carbon dioxide and other greenhouse gases to mitigate the risks of global warming. The objectives of the present study are: to assess the distribution of soil organic carbon in vegetated and un-vegetated sites in a Mediterranean lagoon (i.e. Lake Burullus) in Egypt; to give an accurate estimation of soil organic carbon stock in this lake in order to meet the requirements of the Kyoto Protocol; and to provide estimates of its carbon sequestration potential. In the present study, soil organic carbon content decreased from 22.0 g C kg<sup>-1</sup> at the depth of 0–10 cm reaching a minimum of 10.2 g C kg<sup>-1</sup> at the depth of 20–30 cm. Soil organic carbon content was significantly higher in the vegetated sites than in the un-vegetated sites especially in the surface horizon. The soil organic carbon stock ranged between 760.6 Gg C in the vegetated sites and 2420.2 Gg C in the un-vegetated sites, with total soil organic carbon storage of 3180.8 Gg C. The average carbon sequestration rate of the vegetated sites was higher than the un-vegetated sites (14.9 and 8.6 g C m<sup>-2</sup> year<sup>-1</sup>). Based on the area and carbon sequestration rate, the total carbon sequestration potential of Lake Burullus was 4.04 Gg C year<sup>-1</sup>. The present study concluded that, Lake Burullus could be instrumental in formulating efficient strategies related to carbon sequestration and reduction of greenhouse gas emissions in Mediterranean wetlands.

**2013. Beshay, N. S. Impact of the Different Pollution Sources on the Carbon Storage Potentialities of Lake Mariut. M.Sc. Degree, Faculty of Science, Alexandria University.**

The main objective of this study is to determine the role of Lake Mariut in carbon sequestration and reducing the atmospheric carbon content. The specific objectives are to: 1- Determine the contents and distribution of the organic carbon in the sediments and vegetation of the studied basins; 2- Evaluate the carbon storage capacity of the studied basins; 3- Compare between the investigated basins in terms of their carbon storage and analyze the impacts of the different pollution sources on the storage capacity of the studied basins; and 4- Provide basic information that could be used in subsequent research on the importance of Lake Maruit as carbon sink. Carbon sequestration rate (CSR) varied considerably among the studied three basins of Lake Mariut. The average CSR of the studied basins could be arranged according to the following order: SW basin > NW basin > F.F basin. The results of carbon sequestration potential CSP (Gg/year) indicated also that the highest CSP values are found during the years from 2008-2010, then begin to decline in the previous years. However, S.W basin acquired different trend where the years 1995-2008 attained higher CSP values than the years 2008-2010. The highest CSP was recorded for S.W basin (117.2



Gg/year) followed by N.W basin (30.3 Gg/year) and F.F basin (6.8 Gg/year). Increased carbon storage in the lake sediments could be depending on two processes. First water logging which can greatly retard organic matter decomposition, leading to accumulation of organic matter. Second, the burial of some fraction of the increased primary production due to eutrophication. Net primary production in the lake has probably been increased by man's N and P loading in lake. These released nutrients may re-enter the water column and possibly deliver more organic carbon to the sediments. Due to these reasons, Lake Mariut has potential abilities to store organic carbon. Lake Mariut is a hypertrophic lake because its average phosphorus concentration in was of 1.93 mg/l (P in hypertrophic lake /0.1) which situates the lake about 20 times above hyper-trophia. According to the data collected from the present study, emergent species *Phragmites australis* and *Typha domingensis* dominate the vegetation of the S.W. basin; while submerged species *Potamogeton pectinatus* and *Ceratophyllum demersum* dominate the vegetation of N.W. basin. TOC contents of the recorded species are arranged as follows: *Phragmites australis* > *Typha domingensis* > *Echinochloa stagnina* > *Potamogeton pectinatus* > *Ceratophyllum demersum* > *Najas marina* > *Eichhornia crassipes* > *Pistia stratiotes*. This finding is concomitant with plant biomass recorded for the investigated species and clearly demonstrates the remarkable increase in carbon storage capacity of S.W. basin than the others.

## 18. 2. Bioremediation

**2018. Farahat, E. A. and Galal, T. M. Trace metal accumulation by *Ranunculus sceleratus*: implications for phytostabilization. *Environmental Science and Pollution Research*. 25 (5): 4214–4222.**

This study investigated the growth response of *Ranunculus sceleratus* to pollution and its capacity to accumulate trace metals to be used as a phytoremediator for polluted water in Lake Maruit, Egypt. Three basins (main basin, fish farm and southwestern basin) representing the natural distribution of the plant as well as the pollution loads into the lake, were chosen for collecting plant and sediment samples. In each basin, ten quadrats (0.5 m × 0.5 m), distributed equally along two sites, were selected for measuring growth parameters, nutrients and trace metals concentrations. The highest shoot biomass (610 g m<sup>-2</sup>) was recorded in the main basin, while that of the root (236 g m<sup>-2</sup>) was in the fish farm. *R. sceleratus* displayed high concentrations of Cu and Pb (27.7 and 9.9 mg kg<sup>-1</sup>), and phytotoxic concentrations of Mn (2508.0 mg kg<sup>-1</sup>) in their roots compared with shoots. The bioaccumulation factor (BF) for the studied metals was > 1, and in the decreasing order: Ni (27.1) > Zn (20.0) > Cd (16.4) > Cu (7.7) > Mn (3.9) > Pb (3.6). The translocation factor of all analyzed trace metals was < 1. The ability of *R. sceleratus* to accumulate Mn, Ni, Cu and Pb in its roots showed the potential suitable use of this species for phytostabilization of these metals (mainly Mn) in contaminated water bodies.

**2018. Shao, W., Ebaid, R., Abomohra, A. and Shahen, M. Enhancement of *Spirulina* biomass production and cadmium biosorption using combined static magnetic field. *Bioresource Technology*, 265:163–169.**

The effect of static magnetic field (SMF) on *Spirulina platensis* growth and its influence on cadmium ions (Cd<sup>2+</sup>) removal efficiency were studied. Application of 6 h day<sup>-1</sup> SMF resulted in the highest significant biomass productivity of 0.198 g L<sup>-1</sup> day<sup>-1</sup>. However, 10 and 15 mg L<sup>-1</sup> of Cd<sup>2+</sup> resulted in significant reduction in biomass productivity by 8.8 and 12.5%, respectively, below the control. Combined SMF showed 30.1% significant increase in biomass productivity over the control. On the other hand, increase of initial Cd<sup>2+</sup> concentration resulted in significant reduction of Cd<sup>2+</sup> removal efficiency, representing 79.7% and 61.5% at 10 and 15 mg L<sup>-1</sup>, respectively, after 16 days. Interestingly, application of SMF for 6 h day<sup>-1</sup> enhanced Cd<sup>2+</sup> removal efficiency counted by 91.4% and 82.3% after 20 days for cultures with initial Cd<sup>2+</sup> concentration of 10 and 15 mg L<sup>-1</sup>, representing increase by 6.3 and 25.3%, respectively, over the SMF-untreated cultures.

**2018. Mansour, K. H. Evaluation of some aquatic macrophytes for their capacity to remove water pollutants from the main water courses in Greater Cairo, Egypt. M.Sc. Thesis, Helwan University.**

The present study assessed the significant seasonal variation in the accumulation potential of five emergent species to sequester heavy metals in the different organs.

Plant density, morphology, biomass and photosynthetic pigments were markedly affected by heavy metals contaminated wetlands. The results of the pigment analysis of *C. articulatus* and *C. alopecuroides* shoot showed that chlorophyll a, b and carotenoids were markedly reduced in polluted plants. In *V. cuspidata* and *M. longifolia*. Carotenoids were significantly reduced in polluted plants, while chlorophyll contents were not affected. The pigment content of *T. domingensis* showed that chlorophyll b and carotenoids were significantly reduced under pollution stress. The study species can sequester large amounts of nutrients compared with other similar species. The contribution of these plants to nutrient removal is often temporary due to the release of nutrients through leaching at its senescence. Moreover, the nutritive values of the above-ground shoots of all species lie within the range of nutritive value of sheep, goat, dairy cattle and beef cattle. Seasonal variation is pronounced in different heavy metals concentration of an investigated plant; however, the effect of season is not uniform for these metals or for the investigated organs. The study species showed fluctuations in its accumulation potential for heavy metals. Most heavy metals were retained in the underground parts, which suggest potentiality of this plant for metals phytostabilization. The results of current study indicate that, harvesting season and location affected the yield and chemical composition of *M. longifolia* essential oil. The main oil components of the dry aerial parts were isomenthone, cis-piperitenone oxide, menthone, pulegone followed by  $\beta$ -caryophyllene, cis-piperitone epoxide and 1,8-cineole.

**2017. Abo-Shady, A. M., Khairy, H. M., Abomohra, A., Elshobary, M. E. and Essa, D. Influence of algal bio-treated industrial wastewater of two companies at Kafr El -Zayat city on some growth parameters of *Vicia faba*. Egypt. J. Exp. Biol. (Bot.), 13(2): 209 – 217.**

In Delta region, water quality is greatly affected by effluents of wastes and suspended materials as a result of population increasing and the widespread in the industrial factories building along the Nile River. Salt and Soda Company and El-Malyaa Company of Kafr El-Zayat City were chosen for our study as they drain their wastes directly into the Rosetta branch that contain high levels of suspended and dissolved solids, nutrients and organic matters. Microalgae play a great role in bioremediation of wastewater in addition to generating biomass for different applications. In this study two micro-algal species *Scenedesmus obliquus* and *Micractinium reisseri* (JN169781) were tested for bioremediation of the polluted water drained in the Nile River by the above mentioned two companies. The results showed the ability of *S. obliquus* and *M. reisseri* (JN169781) in reducing the hazards of wastewater of the two companies. Irrigation of *Vicia faba* (Giza 100) by treated wastewater caused marked increase in the different measured growth parameters. In addition, the pigments content (Chl a, Chl b, Carotenoids), as well as, protein and carbohydrates contents were markedly increased. This increase was referred to the presence of high levels of essential nutrients such as nitrogen and phosphorus in treated wastewater, in addition to bioremediation potentiality of the both organisms. On the other hand, there was a slight inhibitor y effect of raw untreated wastewater on some measured growth

parameters of the plant. This effect could be attributed to the presence of heavy metals or the hazards of physic-chemical parameters in untreated wastewater.

**2017. Galal, T.M, Eid, E. M., Dakhil, M. A. and Hassan, L. M. Bioaccumulation and rhizofiltration potential of *Pistia stratiotes* L. for mitigating water pollution in the Egyptian wetlands. Int. J. Phytoremediation.**

The bioaccumulation and rhizofiltration potential of *P. stratiotes* for heavy metals were investigated to mitigate water pollution in the Egyptian wetlands. Plant and water samples were collected monthly through nine quadrats equally distributed along three sites at Al-Sero drain in Giza Province. The annual mean of the shoot biomass was 10 times that of the root. The concentrations of shoot heavy metals fell in the order: Fe > Mn > Cr > Pb > Cu > Zn > Ni > Co > Cd; while that of the roots were: Fe > Mn > Cr > Pb > Zn > Ni > Co > Cu > Cd. The bio-concentration factor (BCF) of most investigated heavy metals, except Cr and Pb, was greater than 1000, while the translocation factor (TF) of most investigated metals, except Pb and Cu, did not exceed one. The rhizofiltration potential (RP) of heavy metals was higher than 1000 for Fe, and 100 for Cr, Pb and Cu. Significant positive correlations between Fe and Cu in water with those in plant roots and leaves, respectively were recorded, which, in addition to the high BCF and RP, indicate the potential use of *P. stratiotes* in mitigating these toxic metals.

**2017. Galal, T. M., Gharib, F. A., Ghazi, S. M., Mansour, K. H. Phytostabilization of heavy metals by the emergent macrophyte *Vossia cuspidata* (Roxb.) Griff.: a phytoremediation approach. Int. J. Phytoremediation 19(11): 992–999.**

The present study was conducted to investigate the potential of *Vossia cuspidata* as a phytoremediator to accumulate heavy metals from polluted water bodies. Thirty-two quadrats, distributed equally in eight sites (six polluted sites along Ismailia canal and two unpolluted sites along the Nile River) were selected seasonally for plant, water and sediment investigations. Winter plants recorded the highest values of shoot height, diameter, and leaf width, but the lowest shoot density. Plants collected in autumn had the lowest values of leaf length, width and area, while those in spring had the highest shoot density, with the lowest shoot height. Summer populations had the highest fresh and dry plant biomass, while winter plants had the lowest. Fresh production and dry biomass of *V. cuspidata* in the unpolluted water River Nile were significantly higher than the polluted canals. Chlorophyll a and carotenoids were reduced under pollution stress. Spring plants accumulated the highest concentrations of Cr, Cu and Pb in their root, and the lowest Al, Cd, Cr and Zn in their shoot. The bioaccumulation factor for most investigated metals, except Al, Cr and Fe was greater than 1, while the translocation factor of all metals was less than 1, therefore this plant is considered to be a potential for phytostabilization of these metals.

**2017. Galal, T.M., Gharib, F.A., Ghazi, S.M., Mansour, K.H. Metal uptake capability of *Cyperus articulatus* L. and its role in mitigating heavy metals from contaminated wetlands. Environ. Sci. Poll. Res. 24: 21636–21648.**

Wetland plants are biological filters that play an important role in maintaining aquatic ecosystem and can take up toxic metals from sediments and water. The present study investigated the seasonal variation in the accumulation potential of heavy metals by *Cyperus articulatus* in contaminated watercourses. Forty quadrats, distributed equally in 8 sites (six contaminated sites along Ismailia canal and two uncontaminated sites along the River Nile) were selected seasonally for sediment, water and plant investigations. Autumn was the flourishing season of *C. articulatus* with the highest shoot density, length and diameter as well as aboveground biomass, while summer showed the least growth performance. The photosynthetic pigments were markedly reduced under contamination stress. *C. articulatus* plants accumulated concentrations of most heavy metals, except Pb, in their roots higher than the shoots. The plant tissues accumulated the highest concentrations of Fe, Cd, Ni and Zn during autumn; while Cu and Mn during spring and Cr and Co during winter. It was found that Cd, Cu, Ni, Zn, Pb and Co had seasonal bioaccumulation factor (BF) > 1 with the highest BF for Cd, Ni and Zn during autumn, Co, Cu and Pb in winter, spring and summer, respectively. The translocation factor of most heavy metals, except Pb in spring, was < 1 indicating potential phytostabilization of these metals. In conclusion, autumn is an ideal season for harvesting of *C. articulatus* biomass in order to monitor pollution in contaminated wetlands.

**2015. Dawah, A., Soliman, A., Abomohra, A., Battah, M. and Anees, D. Influence of alum on cyanobacterial blooms and water quality of earthen fish ponds. Environ Sci Pollut Res, 22: 16502–16513.**

Eruption of blue-green algal blooms occurs frequently in eutrophic lakes and fish ponds, with associated unpleasant odor and horrid scums. In the present study, we conducted a pre-test experiment in 3 m<sup>3</sup> outdoor concrete ponds to determine the optimum concentration of aluminum sulfate (alum) required for reduction of the cyanobacterial blooms without negative effect on fish growth. As a consequence, 10 mg L<sup>-1</sup> alum was named as the optimum concentration that was applied in 1000 m<sup>3</sup> earthen fish ponds. Obtained results showed that Secchi disc values significantly increased from 10 to 24 cm after 14 days of alum application. Alum-treated ponds showed a reduction in total phytoplankton counts by 94 and 96 % compared to the corresponding controls after 10 and 14 days, respectively. Abundance of blue-green algae in the treated ponds was decreased by 98 % compared to the corresponding control after 14 days of alum application. Consequently, dissolved oxygen, pH, total phosphorus, orthophosphate, and chlorophyll *a* content declined significantly. Our study revealed that using 10 mg L<sup>-1</sup> of alum is an effective way to control cyanobacterial blooms in eutrophic waters, especially in fish ponds, without negative effect in water quality.

**2015. Galal, T. M. and Shehata, H. S. Bioaccumulation and translocation of heavy metals by *Plantago major* L. grown in contaminated soils under the effect of traffic pollution. *Ecological indicators* 48: 244-251.**

The present study was performed at a heavy-traffic affected soil to examine the efficacy of bioaccumulation and translocation potentials of heavy metals by the naturally growing weed *Plantago major*. Heavy metals were analyzed in soil as well as in plant below- and above-ground parts along different distances from a heavy-traffic highway. All the investigated soil heavy metals, except Cd, varied significantly, while pH and EC had no significant difference, with increasing distance from the highway. Likewise, there was a significant decrease of heavy metals in plant below- and aboveground parts. In addition, no significant difference between most soil and root heavy metals at 20 and 100 m as well as those at 500 and 750 m distance from the highway. The bioaccumulation factor (BF) of all heavy metals, except Cd and Sr, were less than unity at most distances. However, Cd showed relative BF decline with the distance in contrast to Sr, which increases as distance from the highway increases. On the other hand, the translocation factors (TF) of Cd, Co, Cu, Pb and Zn were higher at the distances far from the highway, while that of Fe, Cr and Sr were higher near the highway. Furthermore, the enrichment factor (EF) showed small variations, among the investigated heavy metals, with varying distances from the pollution source. It was found that soil Fe, Al, Cr, Ni, Sr, V and Zn had significant positive correlation with all investigated heavy metals in *P. major* roots. The higher TFs of Cd, Fe and Pb in *P. major* shoots makes it suitable for phytoextraction from soil, while the lower ratios of Al, Mn, V, Co, Ni, Cr, Zn, Cu and Sr make it suitable for their phytostabilization. Therefore, this plant can be used as a bioindicator and biomonitor for traffic related heavy metals.

**2015. Galal, T.M. and Shehata, H.S. Impact of nutrients and heavy metals capture by paddy weeds on the growth and production of rice crop (*Oryza sativa* L.) irrigated with different water sources. *Ecological indicators* 54: 108-115.**

The present study aims at evaluating the impact of nutrients and heavy metals capture by weeds on the nutrient absorption and productivity of rice irrigated with different water sources. Plants were sampled from five farms; three irrigated with water from canals, receiving wastes discharge, and two with groundwater. The production of rice was higher in farms irrigated from canals than ground water, while the biomass of *Echinochloa crus-galli* and *Convolvulus arvensis* had a reverse trend. Moreover, *Cyperus deformis* produced large biomass, in contrast with *Eclipta alba*, in farms irrigated with canals water. Rice accumulated the lowest amounts of N, P, K, Ca and Mg as well as lower concentrations of heavy metals. *C. arvensis* accumulated the highest concentrations of N, P and Sr and lower concentrations of the remaining heavy metals, while *C. deformis* accumulated moderate nutrients, but higher heavy metals concentrations. Rice had bioaccumulation factors (BAF) less than unity for all heavy metals except Pb. However, *C. deformis* had higher BFA for most heavy metals with the highest values of Pb and Zn, *C. arvensis* had the highest of Sr and *E. crus-galli* had the highest of Cd. The CCA indicated that most soil variables have a least effect on *O.*

*sativa*, *E. crus-galli* and *E. alba*. In conclusion, weeds can cause harm to rice with the following order: *C. arvensis* > *E. crus-galli* > *E. alba* > *C. deformis*.

**2015. Galal, T.M. and Farahat, E.A. The invasive macrophyte *Pistia stratiotes* L. as a bioindicator for water pollution in Lake Mariut, Egypt. *Environmental Monitoring and Assessment*, 187(701).**

The present study was conducted to evaluate the potentiality of the aquatic macrophyte *Pistia stratiotes* to accumulate trace metals, perspective of phytoremediation, and the probability for using it as a bioindicator for the different pollution types. Plants were collected from the different Lake Mariut basins (main basin, south-west, north-west and fish farm), through five quadrats each, for measuring some growth parameters such as plant density, rosette diameter and height, root length, number of living and dead leaves per individual, and leaf length and width. In addition, nutrients and heavy metals in plant organs as well as water samples were analyzed. The bioaccumulation and translocation factors of trace metals were calculated. Water physicochemical data of Lake Mariut showed significant variations of all variables, except temperature and pH as well as Cd metal, among the lake basins. Fish farm was characterized by the highest plant density, individual size, biomass as well as the number of living leaves, while the north-west basin had the lowest, except the number of dead leaves. In contrast to trace metals, *P. stratiotes* accumulated concentrations of macronutrients in the leaves higher than in roots. The bioaccumulation factors of the investigated metals, except Cu, were greater than one, while the TFs of all trace metals were less than unity, and this may render *P. stratiotes* suitable for rhizofiltration. In addition, the significant positive correlation of Ni and Cd in water with those in plant roots and leaves as well as the growth response of this plant to the different pollutants may suggest its potential use as bioindicator for these pollutants in water.

**2014. Elsilk, S., El-Shanshoury, A. R. and Perihan, S. A. Accumulation of some heavy metals by metal resistant avirulent *Bacillus anthracis* PS2010 isolated from Egypt. *African Journal of Microbiology Research* 8(12):1266-1276.**

The bacteria with a high growth rate were isolated from polluted industrial waste water. The bacteria *Bacillus anthracis* PS2010 have variable resistant to heavy metals such as Cd, Cu, Co, Zn and Pb. Out of which the minimal inhibitory concentrations were 0.6, 2.0, 0.8, 4.0 and 3.0 mM, respectively. The potent bacterium has optimal bio-sorption capacity raised according to the metal, incubation temperature, pH of the solution and contact time. Under optimal conditions, the bacterium was capable of taking up the heavy metals Cd, Cu, Co, Zn and Pb at 3.41, 2.03, 4.75, 5.22 and 6.44 mg g<sup>-1</sup> dry weight. Transmission electron microscopy showed accumulation of Pb metal external to bacterial cells. The mechanism of heavy metal tolerance in *Bacillus anthracis* PS2010 is chromosomally encoded. *Bacillus anthracis* harbored no plasmid.

**2014. Galal, T.M. and Shehata, H.S. Evaluation of the invasive macrophyte *Myriophyllum spicatum* L. as a bioaccumulator for heavy metals in some watercourses of Egypt. *Ecological indicators* 41: 209-214.**

*Myriophyllum spicatum* was evaluated as a bioindicator for water quality and its ability to accumulate nutrients and heavy metals from the watercourses of Egypt. Six stations on Ismailia canal (S1-S3), receives industrial pollutants, and Nile River (S4-S6), the water stem of Egypt, were selected along different distances from the pollution discharge point. The DWSC of the aboveground shoots of *M. spicatum* changed significantly with the distance from the discharge point on Ismailia Canal. It was indicated that there is no significant difference between DWSC of *M. spicatum* shoots from S6 and S5, on one hand, and S6 and S1, on the other hand. It was indicated that there is no significant difference in sediment Mn, Cd, Pb and Ni between S1 and S6, while N, P and K are significantly different. The concentrations of the investigated heavy metals in sediments had the sequence of (Fe > Mn > Cu > Zn > Pb > Ni > Cd), while in plants was (Mn > Fe > Zn > Cu > Ni > Pb > Cd). The bioaccumulation Factor (BF) was more than unity for all heavy metals except Pb. Moreover, the order of uptake capability was in the order Ni > Mn > Cd > Fe > Zn > Cu > Pb. There was a significant positive correlation between plant Fe and Cu with sediment Fe, N with Cd and P with Zn. The high accumulation of heavy metals by *M. spicatum* renders this species suitable to be used as a bioindicator and biomonitor for water quality.

**2013. El-Shanshoury, A. R., Elsilk, S. and Ateya, P. S. Uptake of some heavy metals by metal resistant *Enterobacter* sp. isolate from Egypt. *African Journal of Microbiology Research* 7(23): 2875-2884.**

The bacteria displaying a high growth rate were isolated from polluted industrial waste water. The bacteria *Enterobacter* sp. had variable resistant to heavy metals such as Cd, Cu, Co, Zn and Pb. Out of which the minimal inhibitory concentrations were 0.4, 1.0, 1.0, 2.0 and 3.0 mM, respectively. The potent bacterium had optimal biosorption capacity raised according to the metal, incubation temperature, pH of the solution and contact time. Under the optimal conditions, the bacterium was capable of taking up the heavy metals Cd, Cu, Co, Zn and Pb at 2.69, 1.87, 3.56, 4.3 and 5.6 mg g<sup>-1</sup> dry weight, respectively. Transmission electron microscopy showed accumulation of Pb within and external to bacterial cells. The mechanism of heavy metal tolerance in *Enterobacter* sp. was plasmid encoded; the occurring band marked at RF had values of about 2700 Kbp.

**2013. Shaltout, K.H., Galal, T.M. and El-Komy, T.M. Nutrients and heavy metals accumulation in the aboveground biomass of two perennial grasses along the water courses of Nile Delta, Egypt. *Egypt. J. Bot.*, 3rd International Conf, Helwan Univ.:201-218.**

The present study aims at comparing the ability of *Cynodon dactylon* and *Panicum repens* to accumulate nutrients and heavy metals in their aboveground biomass. The above ground parts were collected seasonally from 25 quadrats along the water



courses of the Nile Delta. The shoot biomass of both species and their contents of organic and inorganic contents as well as the nutritive value were estimated. The phenological behavior of the studied species indicated a great seasonal variation, but similar pattern in drains and canals. They had the same seasonal pattern of biomass with maximum in autumn and minimum in winter. The living parts of *P. repens* had higher biomass than that of *C. dactylon*, which had the ability to accumulate more concentrations of inorganic and organic elements. The living and dead parts of *P. repens* accumulated more concentrations of Cu, Mn, Zn and Pb than those of *C. dactylon* during winter; while the dead parts of both species accumulated the highest concentrations during autumn. The dead parts of *C. dactylon* had the highest Ca/P ratio, while the living parts had the highest Ca/Mg during summer and the lowest of Ca/P during autumn. The above ground phytomass of both species were evaluated as poor forage.

**2013. Shaltout, K.H., Galal, T.M. and El-Komy, T.M. Biomass, nutrients and nutritive value of *Persicaria salicifolia* Willd. in the water courses of Nile Delta, Egypt. Rend. Fis. Acc. Lincei, 25: 167–179.**

In the present study we evaluate the biomass and nutritive value of the living and dead shoots of *Persicaria salicifolia* and their capacity to accumulate heavy metals and nutrients to be used as phytoremediator. The living and dead parts attained their highest phytomass during autumn. The dead parts accumulated higher amounts of copper, manganese and zinc than the living parts. On the other hand, the living parts had higher amounts of carbohydrates, ether extract, crude fibers and total protein. Due to its higher nutritive value, the living parts were considered excellent forage. Furthermore, the plant in the drains accumulates more nutrients and heavy metals than that in the canals. Some constituents (calcium, iron, digestible crude protein and crude fibers) had significant positive correlation with phytomass. The ability of the dead parts of *P. salicifolia* to accumulate higher values of nutrients renders this plant as a powerful phytoremediator for removal of pollutants from the aquatic ecosystems.

**2013. Shaltout, K.H., Galal, T.M. and El-Komy, T.M. Phenology, biomass and nutrients of *Imperata cylindrica* and *Desmostachya bipinnata* along the water courses in Nile Delta, Egypt. Rend. Fis. Acc. Lincei, 27: 215–228.**

Pollution with heavy metals is a major environmental problem, and plants that accumulate these metals might provide efficient and ecologically sound approaches for their removal. Therefore, the present study was conducted to investigate the phenological behavior and the potential to accumulate nutrients and heavy metals in the above-ground phytomass of two perennial grasses (*Imperata cylindrica* and *Desmostachya bipinnata*) along the watercourses in Nile Delta, Egypt. Twenty-five quadrats were selected seasonally, to represent the growth of the two grasses, along canals and drains of the Nile Delta. The phenological behaviour of the studied species showed similar seasonal trends along the canals and drains. The average annual biomass of the living and dead parts of *D. bipinnata* ( $1901.3 \text{ g m}^{-2}$ ) was higher than that of *I. cylindrica* ( $1626.4 \text{ g m}^{-2}$ ). *D. bipinnata* accumulated higher concentrations of

Na, and K (14.3, 26.2 mg g<sup>-1</sup>), while lower Ca, Mg, N, P and Fe (14.2, 11.4, 10.8, 0.3 and 1.4 mg g<sup>-1</sup>) than *I. cylindrica* (12.8, 24.8, 14.4, 14.7, 11.6, 0.4 and 2.0 mg g<sup>-1</sup>). The living parts of *I. cylindrica* accumulated the highest contents of carbohydrates and proteins during autumn and spring, respectively, while those of *D. bipinnata* had the highest ash content, but the lowest lipids during summer. *D. bipinnata* accumulated higher concentrations of Cu and Mn, but lower of Zn and Pb, than *I. cylindrica* in their living and dead parts. Heavy metals, except Zn, had BF more than unity, however the uptake capability was in the order: Pb > Mn > Cu > Zn for *I. cylindrica*, while Pb > Cu > Mn > Zn for *D. bipinnata*. The analysis of the nutritive values for the two studied grasses evaluated them as poor forage. Finally, the high bioaccumulation factors of both species for Mn, Cu and Pb, in addition to their ability to accumulate the highest concentrations of macro- and micronutrient in the dead parts renders these species to be a powerful phytoremediator for the removal of these metals from contaminated ecosystems.

**2008. Galal, T.M., Farahat, E.A and Fawzy, M. Submerged macrophytes as bioindicators for pollution in Lake Mariut along the Mediterranean coast of Egypt, *Ecologia Mediterranea* 34: 83-91.**

The fact that Lake Mariut is the only coastal lake in Egypt with no natural connection to the Mediterranean Sea has further aggravated the situation through the accumulation of pollutants in the lake. The effect of different pollution sources on the composition and distribution of submerged aquatic plant communities in Lake Mariut, Egypt was studied. Heavy metals, nitrates, nitrites and phosphorus in the water and sediments were investigated for their effect on the dry weight standing crop (DWSC) of submerged macrophytes and its spatial distribution. Seven stations (comprised 20 sites) were selected to represent the different pollution sources. The species-environmental data were analyzed using Canonical Correspondence Analysis (CCA). Only five submerged macrophytes were recorded in Lake Mariut. There was an apparent variation in the DWSC of the recorded species according to the pollution source. *Potamogeton pectinatus* and *Ceratophyllum demersum* were the best growing species with maximum DWSC, while *C. muricatum*, *Myriophyllum spicatum* and *Najas marina* subsp. *armata* were weakly growing in most stations particularly the heavily polluted ones. CCA showed that water nitrite, iron, phosphate, salinity and sulphate as well as sediment copper and cadmium are the most effective variables. *C. demersum*, dominated the agricultural polluted areas, occupied high levels along water phosphate and sulphate gradients and low levels along water and sediment copper, chromium and lead. On the other hand, *P. pectinatus*, characterizes the industrial polluted areas, occupied a high level along soil cadmium and low levels along water copper and chromium.

### 18.3. Biofuel

**2018. Abomohra, A., El-Naggar, A. H. and Baeshen, A. A. Potential of macroalgae for biodiesel production: Screening and evaluation studies. Journal of Bioscience and Bioengineering, 125 (2): 231-237.**

Nowadays, biofuel production is a fast expanding industry and is facing a growing dilemma about a feedstock source capable of keeping up with demand. Recently, macroalgae have been attracting a wide attention as a source for biofuel. In the present study, ten macroalgae were collected and screened as biodiesel feedstocks. As a result of their high biomass production and relatively high lipid content, *Ulva lactuca*, *Padina boryana* and *Ulva intestinalis* showed the highest significant lipids and fatty acid methyl esters (FAMES) areal productivities among the studied species. Saturated fatty acids (SAFs) showed insignificant differences in the selected species, with noticeably significant higher polyunsaturated fatty acids (PUFAs) content in *U. lactuca* by 4.2 and 3 times, with respect to *P. boryana* and *U. intestinalis*, respectively. The recorded increase in PUFAs was attributed to higher content of C16:4n-3, C18:3n-3 and C18:4n-3. By lipid fractionation, *P. boryana* showed significant higher concentration of neutral lipids (37.7 mg gL<sup>-1</sup> CDW, representing 46.7% of total fatty acids) in comparison to *U. lactuca* and *U. intestinalis*, which showed 16% and 17% lower neutral lipid

fractions, respectively. In addition, biodiesel characteristics of the studied macroalgae complied with that of international standards. Furthermore, oil-free residual biomass can be readily converted into fermentable sugars or biogas due to its high carbohydrates content, which adds to the economics of macroalgae as biofuel feedstock. In conclusion, the present study confirmed that macroalgae represent an attractive alternative renewable feedstock for biodiesel and other biofuels.

**2018. El-Sheekh, M., Abomohra, A., Eladel, H., Battah, M. and Mohammed, S. Screening of different species of *Scenedesmus* isolated from Egyptian freshwater habitats for biodiesel production. Renewable Energy xxx:xxx-xxx.**

Nowadays, microalgae are widely discussed as a promising feedstock for biodiesel production due to the legitimate concerns about the consequences of using edible oils. Selection of the most suitable microalgal species relies on several key parameters such as growth rate, lipid productivity and fatty acid profile. In the present study, different species of *Scenedesmus* were isolated and compared for their efficiency as biodiesel feedstocks. *S. obliquus* showed the highest biomass productivity of 0.102 g CDW L<sup>-1</sup> d<sup>-1</sup> at stationary phase. However, *S. intermedius* showed the highest significant lipid content of 400.9 mg g<sup>-1</sup> CDW. Regarding lipid productivity, *S. obliquus* was the most lipid productive strain at stationary phase with up to 24.9 mg L<sup>-1</sup> d<sup>-1</sup>, representing 23.9 % significant increase over that of *S. intermedius*. In addition, cetane number and iodine value of *S. obliquus* FAMES were 54.1 and 110.4 g I<sub>2</sub> 100 g<sup>-1</sup>, respectively. Moreover, FAMES of *S. obliquus* showed kinematic viscosity and specific gravity of 1.9–6.0 mm<sup>2</sup> s<sup>-1</sup> and 0.88g cm<sup>-3</sup>, respectively, which are in accordance with the

international standards. Among the different studied species of *Scenedesmus*, the present study nominated *S. obliquus* as a promising renewable feedstock for biodiesel production.

**2018. Wang, S., Uzoejinwa, B. B., Abomohra, A., Wang, Q., He, Z., Feng, Y., Zhang, B. and Hui, C. Characterization and pyrolysis behavior of the green microalga *Micractinium conductrix* grown in lab-scale tubular photobioreactor using Py-GC/MS and TGA/MS. Journal of Analytical and Applied Pyrolysis 135:340–349.**

Nowadays, microalgae are widely discussed as a promising feedstock for biofuel production. For higher crude bio-oil yield with good quality, microalgal biomass productivity and bio-oil characteristics are essential parameters. However, the same microalgal species has different chemical compositions at different growth phases. Therefore, the present study aimed to identify the best growth phase for high biomass productivity and optimal bio-oil production from the green microalga *Micractinium conductrix* via Py-GC/MS and TGA/MS analysis. *M.*

*conductrix* was grown in a tubular photobioreactor and harvested at early (EEP), middle (MEP), late (LEP) and stationary phases (STP). LEP showed the maximum significant ( $P \leq 0.05$ ) biomass productivity of  $0.058 \pm 0.004 \text{ g L}^{-1} \text{ d}^{-1}$ , with maximum significant lipid and carbohydrate contents ( $28.7 \pm 1.1$  and  $42.9 \pm 1.2 \%$  dw, respectively). TGA/MS results confirmed that biomass harvested at MEP and LEP showed higher extent of conversion or mass loss reaction via thermal degradation with the lowest residual solid products. In addition, the hydrocarbon fragments in gaseous products ( $\text{H}_2$ ,  $\text{C}_2\text{H}_6$ ,  $\text{CH}_4$ ,  $\text{C}_2\text{H}_4$ ) from TGA/MS analysis were found to be released more abundantly at LEP. Moreover, Py-GC/MS results revealed that thermal decomposition of biomass harvested at LEP resulted in the highest significant relative contents of aliphatic hydrocarbons (41.2%) with lowest nitrogen-containing compounds (6.3%). The present study showed the significant impact of harvest time of microalgae on products characteristics of thermal decomposition and nominated LEP as the optimum growth phase to harvest *M. conductrix* for upgraded bio-oil production.

**2017. Abomohra, A., El-Sheekh, M. and Hanelt, D. Screening of marine microalgae isolated from the hypersaline Bardawil lagoon for biodiesel feedstock. Renewable Energy 101: 1266-1272.**

Recently, microalgae have been attracting a wide attention as a source of high-lipid feedstock to produce biodiesel. A total of twenty one halophilic microalgae were isolated from the hypersaline Bardawil lagoon North Sinai, Egypt. Nine of them were further characterized with respect to biomass and fatty acid productivities. Biomass productivity as cellular dry weight (CDW), fatty acid content and, consequently, fatty acid productivity of the chlorophyte *Tetraselmis elliptica* was the highest among all tested strains ( $0.122 \text{ g CDW L}^{-1} \text{ d}^{-1}$ ,  $77.4 \text{ mg g}^{-1} \text{ CDW}$  and  $14.1 \text{ mg L}^{-1} \text{ d}^{-1}$ , respectively). Lipid fractionation showed that total lipids represented  $13.0 \text{ mg g}^{-1} \text{ CDW}$  and neutral lipids represented 37% of the total lipids with corresponding iodine

value of 70.3 g I<sub>2</sub> 100 g<sup>-1</sup> oil. In all fractions, C16:0 and C18:1n-9 were predominant, being as high as 31 and 20% of total fatty acids in neutral lipids, 26 and 24% of total fatty acids in polar lipids and 28 and 26% of total fatty acids in phospholipids, respectively. This study demonstrates that the halophilic microalga *T. elliptica* isolated from hypersaline water is a promising species for biodiesel feedstock.

**2016. Abomohra, A., Jin, W., Tu, R., Han, S., Eid, M. and Eladel, H. Microalgal biomass production as a sustainable feedstock for biodiesel: Current status and perspectives. Renewable and Sustainable Energy Reviews 64: 596–606.**

Nowadays, fossil fuels including coal, oil, and natural gas are the world's primary energy sources required for industry, lighting, transportation and heating. The needs increased dramatically due to the vast expansion in human population and economy. In contrast, a greenhouse gas emission is a serious problem arose from such uses that might lead to potentially catastrophic changes in the earth's climate. In addition, fossil fuels are limited non-renewable resources that will run out in few decades. These factors motivated many researchers to develop a new renewable energy sources that could replace fossil fuels. Biodiesel is considered as the best can be used for this purpose. Recently, microalgae were discussed as a promising feed stock for biodiesel production. This review presents a critical overview of engineered challenges compilations related to microalgal biomass production. In addition, advantages and current limitations of biodiesel production, quantitative and qualitative feasibility of microalgal biodiesel, and its economic feasibility are discussed.

**2016. Abomohra, A. I., Abo-Shady, A. M., Abd El-Moneim, A. M., Khairy, H. M. and Marey, R. S. Effect of different culture media on the growth and lipids of the green microalgae, *Scenedesmus obliquus* and *Micractinium reisseri* as a feedstock for biodiesel production. Delta J. Sci. 37:176 -182.**

The aim of this study was to investigate the growth, lipid content and lipid productivity of the biodiesel promising microalgae *Scenedesmus obliquus* and *Micractinium reisseri* grown in batch culture using four different freshwater growth media, namely Chu-10, KC, Flory and Kuhl's medium to identify the most suitable medium for high lipid production for each species. The Results confirmed that Kuhl and KC showed the highest biomass productivity for *S. obliquus* and *M. reisseri* (0.05 and 0.07g L<sup>-1</sup> d<sup>-1</sup>). The Lipid content and lipid productivity were estimated at four different growth phases (early, middle, late exponential and stationary phase). The results revealed that, *M. reisseri* showed the highest lipid productivity at stationary phase (17.08 mg L<sup>-1</sup>d<sup>-1</sup>), while *S. obliquus* showed lipid productivity of 12.61 mg L<sup>-1</sup>d<sup>-1</sup> which was insignificant with that at the late exponential phase (12.55 mg L<sup>-1</sup>d<sup>-1</sup>). The fatty acids profile of *S. obliquus* and *M. reisseri* at stationary growth phase showed that both of them were suitable as feedstock for biodiesel production because of their high saturated fatty acids content that represented by 81.3 and 72.5 %

of the total fatty content, respectively. Palmitic acid (C16:0) was represented by 15.7 and 16.1 % in the two studied species, respectively that increase the biodiesel quality for each strain. This study suggests *M. reisseri* cultivated on KC medium to provide high lipid productivity which offers a promise to be one of the sources of biodiesel.

**2015. Battah, M., El-Ayoty, Y., Abomohra, A., Abd El-Ghany, S. and Esmael, A. Effect of Mn<sup>2+</sup>, Co<sup>2+</sup> and H<sub>2</sub>O<sub>2</sub> on biomass and lipids of the green microalga *Chlorella vulgaris* as a potential candidate for biodiesel production. Ann Microbiol, 65:155–162.**

The present study examined the effect of heavy metals (Mn<sup>2+</sup> and Co<sup>2+</sup>) and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) on biomass, lipid content and lipid productivity of *Chlorella vulgaris*. Manganese chloride at 2 μM, 10 μM and 12 μM increased the lipid content significantly by 14 %, 16 % and 15 %, respectively, above the corresponding controls after 8 days of incubation, resulting in a significant (18 %) increase in lipid productivity with respect to the control at 12 μM manganese chloride. All applied concentrations of cobalt nitrate increased the lipid content up to 25 % more than the corresponding controls. The optimum concentration of cobalt nitrate for high lipid productivity was 2.5 μM, which resulted in a 22 % increase in lipid productivity over the control. Furthermore, lipid productivity was increased significantly by 29 % over the control when 4 mM hydrogen peroxide was included in the culture medium. Additionally, the proportion of total saturated fatty acids extracted from *Chlorella vulgaris* treated with 12 μM manganese chloride, 2.5 μM cobalt nitrate and 4 mM hydrogen peroxide ranged between 40 % and 45 % of total fatty acids. The present study concluded that heavy metals and oxidative stress efficiently increased the lipid productivity of the promising biodiesel feedstock chlorophyte *Chlorella vulgaris*. In addition, the type and proportion of individual fatty acids meet the biodiesel standards.

## 18.4. Other Goods and Services

**2018. Shaltout, K. H. Reed Products from Lake Burullus, Egypt. Finlayson CM et al. (eds.), the Wetland Book. Springer Science & Business Media B.V.**

Lake Burullus is a shallow, brackish, Mediterranean coastal lagoon situated between the two branches of the Nile that form its Delta. It is one of the Protected Areas of Egypt, registered as a Ramsar site and Important Bird Area. It has an area of 410 km<sup>2</sup>, maximum length and width of 47 and 14 km. Its depth varies between 0.4 and 2 m. Common reed *Phragmites australis* (Cav.) Trin. ex Steud in Lake Burullus offers provisioning service products as it is high-quality livestock forage and silage during its early growth stages, while at maturity it becomes tough and unpalatable. It was an important source of matting in ancient Egypt and is still widely used for this purpose, used as a soil binder to prevent erosion, valued resource for thatching and construction of windbreaks for crop protection and nets for fishing and capture of birds. It is reported as a folk medicine for treating leukemia, bronchitis, cholera, diabetes, dropsy, gout, rheumatism and typhoid, antiemetic for acute arthritis, jaundice and food poisoning. Potential additional uses include production of paper pulp; some success has been achieved in Sweden in growing and harvesting *P. australis* for energy production. In South America, the natives have used its stems to make arrow shafts, prayer sticks, weaving rods, pipe stems, screens, and nets. Unfortunately, the area of common reed in Lake Burullus decreased by about one third in one decade (1988 - 1998). However, its management in Lake Burullus should include periodical partial removing between the islets in order to avoid lake fragmentation into four disconnected basins. Anyhow, reed harvesting in Lake Burullus can hold back succession processes.

**2018. Alsherif, E. Exploration of unconventional fodder for arid land Rehabilitation. Arid Land Research and Management 32 (3): 337-350.**

Exploring new wild plant species of economic importance with tolerance to harsh environmental conditions in arid countries may be a viable option to improve forage yield. The present study was conducted during two consecutive years and aimed to investigate the nutritional values of eleven selected wild fodder species, six annuals, and five perennials. Detailed analyses of the nutritional values during two different seasons for perennials and two different growth stages for annuals are presented. The results showed that most studied plants have high nutritional values compared with earlier studies on taxonomically related species growing in different arid areas. The mean content of dry matter, ash, crude protein and lipids was 27, 13, 14, and 3.5%, respectively. Neutral detergent fiber, acid detergent fiber, lignin, cellulose and hemicellulose were 44, 26.5, 6.2, 20.2, and 13.7%, respectively. The studied species showed means of 43 and 49% for *in vitro* dry matter disappearance (IVDMD) for perennials and annuals, respectively. In general, there were slight differences between the 2 years for both perennials and annual species and significant differences among different seasons for perennials and between growth stages for annuals. The study

strongly recommends further detailed experimental studies on *A. graecizans*, *Boerhavia diffusa* and *Cymbopogon schoenanthus*, which showed more crude protein, a low fiber content and high IVDMD, as unconventional forage crops in arid lands.

**2016. Shaltout, K. H. Economic and Environmental Values of Mangroves in Arabic Region. The First Saudi Conference on Environment: Sustainable Management of Natural Resources. King Khalid University & Center of Prince Sultan Ben Abd El-Aziz for Environmental and Touristic Research and Studies. Abha, Saudi Arabia.**

The complex nature of mangrove ecosystems, their productivity and biodiversity, their role in physical coastal processes, and their close linkage to adjacent ecosystems cannot be considered in isolation from their value to humans. Meanwhile, adjacent human activities, on land and sea, have also greatly changed human perceptions of the importance of mangroves. It is critically important for the future of mangroves and the benefit of human societies that the roles and values of mangroves in coastal societies are properly evaluated and promulgated. This review article aims to review the services offered by the mangrove forests (*Avicennia marina*, *Rhizophora mucronata* and *Bruguiera gymnorrhiza*) in the Arab region (i.e. along the Red Sea coast including the Gulfs of Suez and Aqaba, and the Aden and Arabian Gulfs) in the forms of ecosystem goods, services and non-material values. Goods are defined as the organisms and their parts and products that grow in the wild and used directly for human benefit (they are properties of a single species) such as using the mangroves in production of timber, tannins and dyes; and as a fuel wood, fisheries products, human food, forage resource, agriculture, raw materials, medicinal uses and genetic diversity. Services are indirect valuable ongoing streams of environmental benefits provided by thriving ecosystems as a whole such as: coastal protection, phyto-remediation, conservation of biodiversity, salt conversion, carbon sequestration and microclimate mitigation, energy resources and groundwater resources. Non-material values are psychological or emotional benefits that can be properties of either single species or whole ecosystems which include: recreation and ecotourism, uniqueness and heritage, and scientific-educational values.

**2015. Bidak, L. M., Kamal, S. A., Waseem A. M., Halmy, S. and Heneidy, S. Z. Goods and services provided by native plants in desert ecosystems: Examples from the northwestern coastal desert of Egypt. Global Ecology and Conservation 3: 433–447.**

About one third of the earth's land surface is covered by deserts that have low and variable rainfall, nutrient-poor soils, and little vegetation cover. Here, we focus on the goods and services offered by desert ecosystems using the northwestern coastal desert of Egypt extending from Burg El-Arab to El-Salloum as an example. We conducted field surveys and collected other data to identify the goods and services provided by native plant species. A total of 322 native plant species were compiled. The direct services provided by these native plants included sources of food, medicine, and energy; indirect vegetation services included promotion of biodiversity, water storage,



and soil fertility. The plant diversity in this ecosystem provided economic service benefits, such as sources of fodder, fuel-wood, and traditional medicinal plants. Changes in land use and recent ill-managed human activities may influence the availability of these services and strongly impact biodiversity and habitat availability. Although deserts are fragile and support low levels of productivity, they provide a variety of goods and services whose continuing availability is contingent upon the adoption of rational land management practices.

**2015. Yahia, A. A. Ecological study and economic potentialities of some species of genus *Zygophyllum* in Egypt. M. Sc. Thesis, Mansoura University, Faculty of Science, Department of Botany.**

The current study provides a particular characterization of the floristic and ecological features and economic potentialities of five selected *Zygophyllum* species: *Zygophyllum decumbens*, *Zygophyllum simplex*, *Zygophyllum coccineum*, *Zygophyllum aegyptium* and *Zygophyllum album* growing naturally along the Deltaic Mediterranean coast and North Galala deserts, Egypt. The number of the plant species recorded in the current study was 135 species belonging to 40 genera and related to 14 families. Asteraceae, Poaceae, Chenopodiaceae and Fabaceae are the prime four families which represent about 51.1 % of the total registered plant species in the study area. These species include 75 perennials (55.6%), 3 biennials (2.2%) and 57 (42.2%) annuals. The life-forms of these species were ranked as follows: therophytes, cryptophytes, hemicryptophytes, chamaephytes, nanophanerophytes and parasites. About 65 species (about 48.2% of the total species) were Mediterranean taxa. These taxa were either Biregional (29 species = 21.5%), Pluriregional (21 species = 15.6%) or Monoregional (15 species = 11.1%). It has been also found that, 34 species (25.2% of the total species) were Saharo-Sindian taxa. Application of (TWINSPAN) resulted in recognition of 4 vegetation groups: A comprises 16 stands codominated by *Zygophyllum coccineum* and *Zilla spinose*, B includes 14 stands codominated by *Zygophyllum simplex*, *Zygophyllum coccineum* and *Haloxylon salicornicum*, C consists of 23 stands dominated by *Zygophyllum aegyptium* and D includes 17 stands dominated by *Zygophyllum coccineum*. The economic potentialities of these species have been estimated. The allelopathic bioassay of *Zygophyllum* spp was detected by investigating the phytotoxic effects of phenolic extracts on seed germination and seedling development (shoot and root) of two targeted nuisance weeds. In *Echinochloa crus-galli*, *Zygophyllum simplex* attained the highest allelopathic potential on seed germination, *Zygophyllum album* had the highest on shoot growth and *Zygophyllum aegyptium* had the highest on root growth at concentration 40 g/l. On the other hand, in *Lactuca sativa*; *Zygophyllum aegyptium* had the highest on seed germination, *Zygophyllum coccineum* had the highest on shoot growth and *Zygophyllum simplex* had the highest on root growth at concentration 40 g/l. The antioxidant activity was estimated using DPPH free radical scavenging activity for testing the radical scavenging activity of the five methanolic *Zygophyllum* extracts. It has been founded that the extract of *Zygophyllum album* showed a moderate antioxidant activity, while other *Zygophyllum* extracts showed weak scavenging activity.

**2015. Dawood, S. H. Ecological studies and evaluation of economic importance of some species of family Asteraceae in Egypt. M. Sc. Thesis, Mansoura University, Faculty of Science, Department of Botany.**

The area chosen for the present study is located in Nile Delta (canal bank and Deltaic Mediterranean coast) and inland desert (Cairo-Suez desert road and wadi Hagul) of Egypt. The total number of the recorded plant species surveyed was 182 species belonging to 144 genera and 37 families. Asteraceae, Poaceae, Chenopodiaceae, Fabaceae and Brassicaceae were considered the major families as they contribute collectively about 55.5% of the total species. The recorded species include 82 annuals (45.1%), 3 biennials (1.7%) and 97 perennials (53.3%). These species are grouped under six life forms as follows: therophytes (85 species = 45.2%), cryptophytes (32 species = 17.0%), chamaephytes (30 species = 15.96%), hemicryptophytes (26 species = 13.8%), phanerophytes (11 species = 6.0%) and parasites (one species = 0.6%). The floristic analysis of the study area revealed that, 88 species (48.4% of the total species) are Mediterranean taxa. These taxa are either Pluriregional (38 species = 20.9%), Biregional (30 species = 16.5%) or Monoregional (19 species = 10.4%). It has been also found that, 38 species (about 20.9% of the total species) are either Cosmopolitan (8.8%), Pantropical (5.0%), Palaeotropical (5.0%) or Neotropical (2.2%). On the other hand, the Monoregional Saharo-Sindian element is represented by 34 species (18.7%). The application of TWINSpan led to the recognition of 4 vegetation groups: G A was dominated by *Retama raetam*, G B was codominated by *Diploaxis harra* and *Bassia muricata*, G C was codominated by *Senecio glaucus* and *Rumex pictus*, while G D was codominated by *Cynodon dactylon* and *Phragmites australis*. The quantitative determination of the secondary chemical constituents (tannins, saponins, flavonoids, alkaloids and phenolics) have been determined. The DPPH free radical scavenging activity of the studied plant extract were also estimated. The extract of *Nauplius graveolens* showed strong scavenging activity (IC<sub>50</sub> < 1 mg/ml). The allelopathic bioassay of *Reichardia tingitana*, *Nauplius graveolens*, *Picris asplenioides* and *Urospermum picroides* was investigated by studying the phytotoxic effects of their aqueous and methanolic extracts on seed germination and seedling growth of *Echinochloa crus-galli*.

**2015. Al-Ghanoudi, G. A. Non-conventional fiber resources from plants naturally growing in different habitats of Egypt. M. Sc. Thesis, Faculty of Science, Mansoura University.**

The present study provides a detailed description of the floristic and ecological features and economic potentialities of five wild species growing naturally in the Nile, Wadi Hagoul and Cairo-Suez desert road of Egypt (*Retama raetam*, *Desmostachya bipinnata*, *Imperata cylindrica*, *Thymelaea hirsuta* and *Leptadenia pyrotechnica*). The present thesis are aiming at throwing more light on the non-conventional plant resources for fiber industry in both coastal and inland parts and to find out the relationships between such vegetation types and surround environmental factors. The total number of species recorded in the present study was 176 species belonging to 141 genera and 35 families. Each of Asteraceae and Poaceae comprises 63 species (35.8%

of the total species, followed by Fabaceae 14 species (8.0%), and Chenopodiaceae 13 species (7.4%). These four families representing collectively about 51.1% of the total species in the study area. The recorded species include 83 annuals (47.2%), 3 biennials (1.7%) and 90 perennials (51.1%). The life-forms are grouped under six types as follow: therophytes (86 species = 46.5%), geophytes and hemicryptophytes (22 species = 11.9 % each), helophytes (17 species = 9.2 %), chamaephytes (27 species = 14.6 %) and nanophanerophytes (11 species = 6.0 %). The economic potentialities of the 5 selected species have been studied, and their moisture content, dry matter, total ash, crude lipid, crude fiber, total nitrogen, crude protein, total soluble sugar, cellulose, lignin and total carbohydrates have been estimated in their shoots. On the other hand, the macro elements were also determined in all the investigated plants. Also, their fiber contents and characteristics have been detected. Fiber length showed wide range of variations, where *Thymelaea hirsuta* attained the highest value in length. It varies from 0.52 – 3.15 mm (mean value = 1.55 mm). The lowest value in length (0.67 -1.56 mm) was attained in *Imperata cylindrica* with a mean value of 0.69 mm. Fiber width showed little variations, it varies from 5.5 – 9  $\mu\text{m}$  in *Desmostachya bipinnata* (mean value = 7.45  $\mu\text{m}$ ) and from 4.5 – 9  $\mu\text{m}$  in *Imperata cylindrica* and *Retama raetam* (mean value = 6.90  $\mu\text{m}$ ). Optical properties showed that the birefringence of *Desmotachya bipinnata* fibers (0.03) is relatively higher compared with those of the fibers of other species. The other plant species were 0.012, 0.0015, 0.0013 and 0.0001 in *Thymelaea hirsuta*, *Imperata cylindrica*, *Retama raetam* and *Leptadenia pyrotechnica*, respectively. Such results may indicate the potentialities of these naturally growing desert plants as non-conventional crops for fiber production.

**2012. El-Shanshoury, A. R., Elsilk, S. and Ebeid, M. E. Rapid biosynthesis of cadmium sulfide (CdS) nanoparticles using culture supernatants of *Escherichia coli* ATCC 8739, *Bacillus subtilis* ATCC 6633 and *Lactobacillus acidophilus* DSMZ 20079T. African Journal of Biotechnology 11(31):7957-7965.**

Cell-associated biosynthesis of cadmium sulfide (CdS) nanoparticles has been reported to be rather slow and costly. In this study, we report on a rapid and low cost biosynthesis of CdS using culture supernatants of *Escherichia coli* ATCC 8739, *Bacillus subtilis* ATCC 6633 and *Lactobacillus acidophilus* DSMZ 20079T. The synthesis was performed at room temperature in the laboratory ambience and CdS nanoparticles were formed within 24 h. Ultraviolet (UV)–visible spectroscopy study revealed the build-up of absorption bands at 419.5, 381.5 and 362.5 nm for *E. coli* ATCC 8739, *B. subtilis* ATCC 6633 and *L. acidophilus* DSMZ 20079T, respectively for assisted synthesis of CdS nanoparticles. X-ray diffraction (XRD), transmission electron microscopy (TEM) and fluorescence spectral analyses were performed to ascertain the formation of CdS nanoparticles. Individual nanoparticles as well as few aggregates having the size of 2.5 to 5.5 nm were found. The process of extracellular and fast biosynthesis may help in the development of an easy and eco-friendly route for the synthesis of CdS nanoparticles.

**2012. El-Shanshoury, A. R., Elsilk, S., Ateya, P. S. and Ebeid, M. E. Synthesis of lead nanoparticles by *Enterobacter* sp. and avirulent *Bacillus anthracis* PS2010. *Annals of Microbiology* 62(4).**

The bacteria *Enterobacter* sp. and *Bacillus anthracis* (avirulent strain) were isolated from a lathe workshop and industrial waste water, respectively. The ability of both isolates to synthesize lead nanoparticles was studied. The relationship between the amount of polysaccharides secreted and metal deposited was demonstrated. The more polysaccharides secreted, the less metal deposition occurred. Examination of cells with X-ray diffraction (XRD), energy dispersive X-ray (EDX) and electron microscopy (EM) after lead treatments revealed changes in cell size and surface. The cell surface of *Bacillus anthracis* PS2010 decreased relative to cell volume. XRD and EDX indicated that cells of *Enterobacter* sp. were able to synthesize lead oxide (PbO) nanoparticles within the periplasmic space, while *B. anthracis* cells were found to be able to synthesize lead sulfide (PbS) nanoparticles extracellularly.

**2012. Elshoni, W., Abokamer, A., El-Shanshoury, A. R. and Ragy, S. Production of plantaricin by *Lactobacillus plantarum* SR18. *Journal of Microbiology, Biotechnology and Food Sciences* 1(6): 1488-1504.**

Out of 86 lactobacilli previously screened in our laboratory, *Lactobacillus plantarum* SR18 isolated from yoghurt revealed the largest detected inhibition zone against the selected indicator *Streptococcus salivarius* 5. The obtained electrophoretic patterns revealed that *L. plantarum* SR18 was free from plasmids. Exposure of 6 h growing *L. plantarum* culture to T- 8M, 3B ultraviolet B lamp (8w, 220v & 312 nm) for 2 h and subsequent growth for further 24 h resulted in an increase of cell-bound bacteriocin titer reached 2 fold at 12 h. Whereas bacteriocin secreted in the culture filtrate was not affected by UV irradiation. Plantaricin SR18 production was maximal (12800 AU/ml) between 12 and 18 h by incubation of the culture at 37°C and pH 5-7 in candle jar (CO<sub>2</sub>). The bacteriocin bound to the cells and that secreted into the culture filtrate of *L. plantarum* SR18 were precipitated by 75% ammonium sulphate, dialyzed and further purified by Gel filtration on Sephadex G-100. The specific activities (AU/mg protein) were increased by a factor of about 5.3 and 2.35 for plantarcins purified from proteins bound to the cell of *L. plantarum* SR18 (plantaricin SR18 a) and that secreted into the culture filtrate (plantaricin SR18 b), respectively. Gel filtration of plantaricin SR18a resulted in moderate antibacterial activity (3200 AU/ml) and very high activity (25600 AU/ml) of plantaricin SR18b.

**2012. Shaltout, K. and Ahmed, D. Ecosystem services of the flora of Southern Mediterranean Desert of Egypt. *Ethnobotany Research & Applications* 10: 403-422.**

The present study aims to evaluate the economic plant species in the Western Mediterranean Desert of Egypt according to the goods and services that they offer and identifying the threat types that govern their gradual change in the study area. Of the 969 species recognized in this region, 548 have at least 1 potential or actual good

(56.6% of the total species). Medicinal plants were the most commonly identified, while timber plants were the least. In addition, 338 species (34.9% of the total species) have at least 1 environmental service. Sand accumulators were the most common services, while water purifiers were the least. 411 species (75.0% of the total economic species) suffer from at least 1 type of threat. 267 species suffer from the over-collecting and over-cutting (65.0% of the total threatened species), while 36 species suffer from disturbance by cars or trampling (8.8% of the total threatened species). Physical defenses against threats were noted and sorted into 6 groups of species. Among those, species with hairy leathery leaves and hairy stems were the most represented, while the hidden species were the least common.

**2012. Heneidy, S. Rangelands in Arid Ecosystem. Diversity of Ecosystems: 127-166, INTECH, Croatia.**

The world's rangelands constitute an important global resource. Range has been defined by the society for range management as land which supports vegetation useful for grazing on which routine management of that vegetation is through manipulation of grazing rather than cultural practices. Grazing are biological systems controlled by: a- the biotic factors of climate and site, b- the management inputs and decisions of man, and 3- internal regulatory mechanisms involving feedback. General introduction for dry lands in which, most of rangelands are distributed, refer to areas with primary productivity limited by water. They cover about 40% of the land surface and contain about one fifth of the human population. This population is typically convergent on areas with relatively lower aridity, further intensifying the stresses on these marginal lands. The concept of marginality applies to these dry lands in a socio-economic sense, where the inhabitants commonly suffer poverty and lack of resources. Anthropogenic activities are almost entirely responsible for these factors. Included with, over-utilization of vegetative cover through improper rangeland management, poorly planned conversion of rangelands to croplands through irrigation schemes, and degradation of soil quality through salinization and input of chemical pollutants. The impacts of these factors on the human society are quite profound and often lead to trans-migration to other eco-regions as well as social and political strife. Thus approaches for management of dry lands resources must be viewed in the broader socio-economic context by providing the opportunities for local communities to explore viable, alternative livelihoods while maintaining their own culture land societal fabric. Many approaches for managing the scarce water resources are available and form the underpinnings of overall resource management in drylands. These include water harvesting techniques, safe re-use of treated wastewater for irrigation, improving ground water recharge and deficit irrigation. Newer approaches of drylands aquaculture using brackish water and ecotourism also hold considerable promise for the future.

**2010. Shaltout, K.H., Galal T.M. and El-Komy T.M. Evaluation of the nutrient status of some hydrophytes in the water courses of Nile Delta, Egypt. *Ecologia Mediterranea* 36 (1): 77-87.**

The nutritive values of three dominant hydrophytes along the water courses in Nile Delta, Egypt (*Echinochloa stagnina*, *Eichhornia crassipes* and *Ceratophyllum demersum*) were evaluated in terms of estimating their phytomass, organic and inorganic chemical compositions. Shoots were collected seasonally from 25 permanent stands representing the distribution of the three species along 15 canals and 10 drains distributed in 5 localities within the Nile Delta. Living and dead parts and total phytomass were estimated. Their inorganic (Na, K, Ca, Mg, P, Cu, Mn and Pb) and organic (carbohydrates, total nitrogen, total protein, ether extract, digestible nutrient, digestible energy, metabolized energy and net energy) contents were estimated. The vegetative phase of *E. stagnina* extended during winter, spring and summer; while flowering and fruiting during autumn (Fig. 2). On the other hand, *E. crassipes* and *C. demersum* attained their maximum flowering during spring and maximum fruiting during summer, while maximum vegetative phase during autumn and winter. *E. stagnina* had the highest mean annual phytomass, while *C. demersum* had the lowest. The living parts of *C. demersum* had the highest concentrations of Na, Ca and Mg; while the living parts of *E. crassipes* had the highest of K and N. *C. demersum* had the ability to accumulate more concentrations of heavy metals than the other studied species. *E. crassipes* had the highest values of total carbohydrate and total proteins, while *E. stagnina* had the highest of crude fibers and *C. demersum* had the highest of ether extract and ash contents. The living parts of *E. crassipes* and *C. demersum* were considered as excellent forages, while the dead parts of all species and the living parts of *E. stagnina* were evaluated as poor forage.

**2009. Brading, P., El-Gabbas, A., Zalat, S. and Gilbert, F. Biodiversity Economics: The Value of Pollination Services to Egypt. *Egyptian Journal of Biology* 11: 46-51.**

Pollinator populations are under severe pressure worldwide because of man-made intensification in land use, including the use of pesticides and fertilizers. The majority of wild and crop plants are fully or partially dependent on pollinators for their reproduction. Loss of pollinators has already caused measurable declines in the populations of many wild plants in Europe. Many Egyptian crops are fully or partially dependent on pollinators for their yields, and data exist on the market values of Egyptian crops. We therefore use these to estimate the 2004 costs to the Egyptian economy of a catastrophic loss of pollinators. The annual cost to the Egyptian economy of losing its pollinators would be approximately LE 13.5 billion (\$2.4 billion), 3.3% of the 2003 GDP.

**2009. Heneidy, S. and Halmy, M. The nutritive value and role of *Panicum turgidum* Forssk. in the arid ecosystems of the Egyptian desert. Acta Bot. Croat. 68 (1): 127–146.**

*Panicum turgidum* is one of the most drought resistant plants in the Egyptian desert. Five habitat types were selected for the present study: sand dunes (North Sinai and in Wady El-Natrun), gravel desert, coastal plain, and water runnels of a wadi bed (South Sinai and Eastern Desert). About 47.4% of the studied sites were subjected to high grazing pressure, 26.3% to moderate grazing pressure; the remaining 26.3% were subjected to low grazing pressure. Concentration of the nutrients (K, Na, Ca, P and Ca/P ratio) in the grazeable parts of *P. turgidum* populations exhibited insignificant variability between habitats and phytogeographical regions. Meanwhile, concentration of potassium showed significant variability between the phytogeographical regions. Ca/P ratio of the grazeable parts of *P. turgidum* was significantly related to the soil silt and organic matter content. The percentage of crude protein was higher than the minimum required for the maintenance of the grazing animals (i.e. *P. turgidum* has a good or excellent forage quality). Due to its high nutritive value and ease of cultivation, *P. turgidum* grains could be considered as a potential crop, which may serve as a supplementary food to the common cereals. It worth noting that the variation in the nutritive values among the cultivated populations was insignificant as all the cultivated populations had a high nutritive value, indicating the effect of edaphic factors on the wild population nutritive value which was proved also from the correlation between the edaphic factors and nutritive variable.

**2008. El-Adl, G. Efficacy of some Selected Algae as Fodder in Fish Farms. M. Sc. Thesis, Mansoura University, Faculty of Science, Department of Botany.**

This study aimed to determine the efficacy of some selected algae as a fodder in fish farms (Nile tilapia fish farm, which is the most common in Egypt.) This thesis studied the water column properties in the study area during annual cycle of fish farming from April to October 2004. In addition of isolation and identification of microalgae from the study area, biochemical analysis of microalgae, determination of algal growth and carrying out toxicity test for algal metabolic solution on tilapia larvae aiming to select the non toxic strains and test it on the monosex tilapia fingerlings. In addition of that, similarity index, diversity index and water pollution were calculated. Upon results, *Chlamydomonas globosa* and *Nostoc spongiaeforme* isolates gave zero percent mortality to tilapia larva in addition of, *Nostoc spongiaeforme* and *Stigeoclonium lubricum* cause significance increase in tilapia fingerlings. Data were analyzed statistically using SPSS, MVSP and CANOCO software to calculate the significance increases, cluster analysis and CCA analysis, respectively.

**2006. El-Banna, G. O. Plant life of the different habitats in the north Nile Delta of Egypt: ecology and fodder potentialities. Ph.D. Thesis, Faculty of Science, Mansoura University.**

The present study provides a detailed description of the floristic and ecological features of the main habitats types in the northern section of the Nile Delta region. These habitats include: deltaic Mediterranean habitat, cultivated land habitat and irrigation and drainage canal habitats. The weed vegetation and the flora associated with these major habitats have been surveyed to cover all physiographic variations in the study area. The other main objectives of the present study is evaluating the phytochemical composition, nutrient status and nutritive value of some selected weeds to detect their fodder potentialities to be used as forage for animals in the summer season. Two hundreds and ten sampling quadrats were selected to represent the major habitat types in the four provinces of the study area namely: El-Dakahlia, Damietta, Kafr El-Sheikh and El-Behira. In each habitat, the floristic analysis, the quantitative analysis of vegetation and the analysis of variation in environmental factors were conducted to estimate the physiographic and vegetational variations in north Nile Delta. The results of the present study indicate that, the total number of weeds recorded in the study area is 238 species belonging to 173 genera and related to 54 families. Gramineae, Compositae, Leguminosae, Chenopodiaceae, Cruciferae and Cyperaceae are the main families and representing collectively about 56.7% of the total number of recorded species in the study area.

**2004. Halmy, M. W. The role of *Panicum turgidum* in the ecological and socioeconomic rehabilitation of degraded arid ecosystems of Egypt. M.Sc. Thesis, Faculty of Science, Alexandria University.**

The present study aims at: 1- assessing the variation in the nutritive value among the studied populations of *Panicum turgidum* and its relation to soil characters, 2- investigating the socioeconomic value of this species through the documentation and surveying of its traditional uses and the mutual relationships between it and the local inhabitants, 3- assessing the genetic diversity among its populations in Egypt using an extensive array of gross morphological characters and seed proteins analysis, 4- detecting the most suitable methods for its propagation and 5- testing the possibility, practicability and capacity of germination and growth of different populations of this species in the degraded arid ecosystems of the north western Mediterranean coastal desert of Egypt. In the course of this study, all the obtained results demonstrate that *Panicum turgidum* can play an important role in the rehabilitation of the degraded ecosystems in the western Mediterranean coastal region of Egypt. In addition, *Panicum turgidum* grains could be considered as a potential crop which may serve as a supplementary food beside the common cereals. This might help to alleviate the current food gap in the arid regions. *Panicum turgidum* could be considered as a valuable source of genetic resources because of its tolerance to extreme desert conditions that could be used in the genetic improvement of cereal crops.



**2004. Heneidy, S. Z. and Bidak, L. M. Potential uses of plant species of the Coastal Mediterranean Region, Egypt. Pakistan J. of Biological sciences 7 (6): 1010-1023.**

Two hundred and thirty species belonging to forty eight families were recorded in the study area. The families of high representation are composite (17%), Leguminosae (11.4%), Gramineae (10.5%) and Chenopodiaceae (7.95). Sixty two % of the studied species are common and about 24.9 % are occasional, while 13% are rare. Sixty % of the studied species are perennials (includes 1.8 and 12.7% phanerophytes and geophytes, respectively), 2.2% are biennials and 40.2% are annuals. All rare and most of occasional species and even some of the common ones are going to disappear as a result of over uses. Most of the studied species are multipurpose species in our daily lives. For example, 89% of the studied species have medicinal value, 80% are used as forage (40 % highly palatable species), Ten and half % are edible for human and birds, 16.6% are aromatic sources, while 31% are used as fuel wood and energy sources. Eighty nine % of the studied species have multi-ecological uses such as sand accumulation, windbreak, reducing the erosion, increase the fertility of soil, shading, as refuge of some plant species, salinity tolerant and save as microclimate effect. This type of study has the potential to provide guidance for developing appropriate management techniques for arid lands and for transferring, exchanging and propagating of multipurpose species to combat desertification in Egypt and arid land countries.

**2004. Sarhan, M. I., Hanafy, M. H. and Fouda, M. M. Economics and Sustainable Use of Samadai Reef “Dolphin House “, Marsa Alam, Red Sea, Egypt.**

An experimental, precautionary management scheme is being implemented during 2004 at a very small place called Samadai Reef “Dolphin House”, Red Sea, Egypt. The management goal is to ensure the indefinite future enjoyment of the Red Sea biodiversity for the benefit of local community in a sustainable fashion. The described successful effort is a pioneer experiment opening the way to the development of an innovative approach to eco-tourism, with a potential of generating over one US\$ million of direct government revenues every year, and much greater revenues for the local tourism industry. The management of Samadai provides a strong case for the conservation of marine biodiversity in Egypt and elsewhere.

**2002. Heneidy, S. Z. Browsing and nutritive value of the most common range species in Matruh area, a coastal Mediterranean region, Egypt, Ecologia Mediterranea.28 (2): 39-49.**

The grazing system in Matruh area is studied during the wet and dry seasons during two years. The study reveals that the area is occupied with 39 perennial and 43 annual species, chamaephytes are the most dominant life-forms. The area (which include 32 sampling sites ) composed of 5 different habitats. About 38 % of the studied sites are suffering from high grazing pressure. In addition, 66% of the habitats are found to be

good pastures. Moreover, based on abundance and palatability, 5 to 7 species were considered as indicator (key) species in each site. *Atriplex halimus* and *Asphodelus ramosus* are the most common ones. Further, about 51% of the perennial species are highly palatable. Grazing value was high for 69 of the perennials and 49% of the annuals. Therefore, the pasture condition and the quality in the study area can be considered good. The average level of the digestible crude protein (DCP, 5.7%), total digestible nutrients (TDN, 67%), gross energy (GE, 3,976 kcal kg<sup>-1</sup> DM), digestible energy (DE, 3,74 kcal kg<sup>-1</sup> DM), and metabolizable energy (ME, 2,824 kcal kg<sup>-1</sup> DM), indicates that the present pasture is able to meet the feed demands of the grazing animals which receive most of their energy requirements. The energy content is however equivalent 0.84 of the Scandinavian feed unit. Multipurpose.

**2001. Abd El-Aziz, G. Ecological Studies and Economic Potentialities of some Weed Flora of Damietta Area, Egypt. M. Sc. Thesis, Mansoura University, Faculty of Science, Department of Botany.**

The present study provides a detailed description of the floristic and ecological features in Damietta Province. In four districts, the weed vegetation in three habitat types (canal and drain banks, orchards and field crops) and two seasons (winter and summer) have been surveyed to cover all the physiographic variations in the study area.

## 19- Chemistry and Pharmacology

### 19.1- Botanical studies

**2018. El-Ziletny, H. A. Ecological and phytochemical studies on the arable weed *Malva parviflora* L. in its different habitats. Ph.D. Thesis, Faculty of Girls, Ain Shams University.**

The present study aimed to identify the common communities associated with *Malva parviflora* (common mallow), their distribution, diversity and environmental factors affected them. It aimed also at investigating the population dynamics, phytochemical, molecular and biological characteristics of the study species. Twelve habitats were selected for collecting plant data, sampling and analysis of the study plant. One hundred and forty-one species were recorded associated with *M. parviflora*; therophytes were the dominant life form, and Pluri-regional elements were the dominant chorological element. The application of TWINSpan led to the recognition of 14 vegetation groups; VG (B) had the highest species richness. Cultivated mallow had the highest plant density, while that from the desert roadsides had the longest root, drain bank plants had the highest shoot, and agricultural roadside plants had the longest petiole. The highest chlorophyll a and total chlorophyll were recorded in agricultural roadsides, while the highest chlorophyll b was in the cultivated plants. The highest contents of root N, P and K were recorded in cultivated mallow, agricultural roadsides and canal banks, respectively, while in shoot they were recorded in cultivated mallow, agricultural roadsides and cultivated crop. The highest concentration of  $\text{Fe}^{2+}$  was recorded in orchards plants, while the highest  $\text{Cr}^{3+}$  and  $\text{Mn}^{2+}$  were recorded in salt marshes,  $\text{Cu}^{2+}$  in the desert land, and  $\text{Co}^{2+}$  and  $\text{Ni}^{2+}$  in canal bank plants. The BF of heavy metals in *M. parviflora* fell in the order:  $\text{Zn}^{2+} > \text{Mn}^{2+} > \text{Fe}^{2+} > \text{Ni}^{2+} > \text{Pb}^{2+} > \text{Cr}^{3+} > \text{Co}^{2+} > \text{Cd}^{2+}$ , while the TF was in the order:  $\text{Fe}^{2+} > \text{Mn}^{2+} > \text{Pb}^{2+} > \text{Co}^{2+} > \text{Cd}^{2+} > \text{Ni}^{2+} > \text{Cr}^{3+} > \text{Zn}^{2+}$ . The health risk index (HRI) for most investigated heavy metals, except Cd had values less than 1 for both adult and children. The phytochemical screening of the ethanolic and chloroform extract of *M. parviflora* in the different habitats showed the presence of cardiac glycosides, flavonoids, amino acids, phenolic compounds, cellulose and hemicelluloses. The GC/MS analysis revealed the presence of two main active compounds: Physangulidine A and L-proline. The germination of wheat grains was significantly affected, while that of clover seeds was not affected by applying *Malva* water extract. The electrophoretic analysis of total protein extracts showed that the 12 accessions produced 11 bands; 4 of them are polymorphic and 7 were monomorphic. The most active extract against the investigated bacteria and fungi was the ethanol extract, followed by chloroform, methanol and benzene, while diethyl ether extract had no effect.

**2018. Farahat, E.A. and Galal, T.M. Trace metal accumulation by *Ranunculus sceleratus*: implications for phytostabilization. *Environmental Science and Pollution Research*. 25 (5): 4214–4222.**

This study investigated the growth response of *Ranunculus sceleratus* to pollution and its capacity to accumulate trace metals to be used as a phytoremediator for polluted water in Lake Maruit, Egypt. Three basins (main basin, fish farm and southwestern basin) representing the natural distribution of the plant as well as the pollution loads into the lake, were chosen for collecting plant and sediment samples. In each basin, ten quadrats (0.5 m × 0.5 m), distributed equally along two sites, were selected for measuring growth parameters, nutrients and trace metals concentrations. The highest shoot biomass (610 g m<sup>-2</sup>) was recorded in the main basin, while that of the root (236 g m<sup>-2</sup>) was in the fish farm. *R. sceleratus* displayed high concentrations of Cu and Pb (27.7 and 9.9 mg kg<sup>-1</sup>), and phytotoxic concentrations of Mn (2508.0 mg kg<sup>-1</sup>) in their roots compared with shoots. The bioaccumulation factor (BF) for the studied metals was > 1, and in the decreasing order: Ni (27.1) > Zn (20.0) > Cd (16.4) > Cu (7.7) > Mn (3.9) > Pb (3.6). The translocation factor of all analyzed trace metals was < 1. The ability of *R. sceleratus* to accumulate Mn, Ni, Cu and Pb in its roots showed the potential suitable use of this species for phytostabilization of these metals (mainly Mn) in contaminated water bodies.

**2018. Mansour, K. H. Evaluation of some aquatic macrophytes for their capacity to remove water pollutants from the main water courses in Greater Cairo, Egypt. M.Sc. Thesis, Helwan University.**

The present study assessed the significant seasonal variation in the accumulation potential of five emergent species to sequester heavy metals in the different organs. Plant density, morphology, biomass and photosynthetic pigments were markedly affected by heavy metals contaminated wetlands. The results of the pigment analysis of *C. articulatus* and *C. alopecuroides* shoot showed that chlorophyll a, b and carotenoids were markedly reduced in polluted plants. In *V. cuspidata* and *M. longifolia*. Carotenoids were significantly reduced in polluted plants, while chlorophyll contents were not affected. The pigment content of *T. domingensis* showed that chlorophyll b and carotenoids were significantly reduced under pollution stress. The study species can sequester large amounts of nutrients compared with other similar species. The contribution of these plants to nutrient removal is often temporary due to the release of nutrients through leaching at its senescence. Moreover, the nutritive values of the above-ground shoots of all species lie within the range of nutritive value of sheep, goat, dairy cattle and beef cattle. Seasonal variation is pronounced in different heavy metals concentration of an investigated plant; however, the effect of season is not uniform for these metals or for the investigated organs. The study species showed fluctuations in its accumulation potential for heavy metals. Most heavy metals were retained in the underground parts, which suggest potentiality of this plant for metals phytostabilization. The results of current study indicate that, harvesting season and location affected the yield and chemical composition of *M. longifolia* essential oil. The main oil components of the dry aerial parts were isomenthone, cis-piperitenone oxide,

menthone, pulegone followed by  $\beta$ -caryophyllene, cis-piperitone epoxide and 1,8-cineole.

**2017. Ebaid, E., Elhussainy, E., El-Shourbagy, S., Ali, S. and Abomohra, A. Protective effect of *Arthrospira platensis* against liver injury induced by copper nanoparticles. *Orient Pharm Exp Med*, 17:203–210.**

Although copper oxide nanoparticles (nano-CuO) are one of widely used engineered nanoparticles, their human and animal exposure led to particular structural changes in tissues and organs. The present study was undertaken to examine the protective effects of the blue-green microalga *Arthrospira platensis* against nano-CuO-induced hepatotoxicity in albino rats. Results showed that nano-CuO injection led to significant reduction in serum albumin level with a significant increase in alanine transaminases (ALT) and aspartate transaminases (AST) activities after 24 h of administration. In addition, nano-CuO administration resulted in significant increase in malondialdehyde (MDA) level and catalase (CAT) activity, with a significant reduction in reduced glutathione (GSH) level. Administration of *A. platensis* alone did not significantly alter the normal levels of aminotransferase enzymes, antioxidants or oxidative stress marker. However, pretreatment with *A. platensis* prior to nano-CuO intoxication attenuated the levels of ALT, AST (liver function markers) and MDA (lipid peroxidation marker). It also normalized the levels of both hepatic enzymatic and non-enzymatic antioxidants (CAT and GSH, respectively). In conclusion, the present study confirmed the hepatotoxicity of nano-CuO at 10 mg kg<sup>-1</sup> administration dose. However, administration of *A. platensis* could represent a significant protective mechanism against hepatotoxicity.

**2017. Galal, T.M, Eid, E.M., Dakhil, M.A. and Hassan, L.M. Bioaccumulation and rhizofiltration potential of *Pistia stratiotes* L. for mitigating water pollution in the Egyptian wetlands. *Int. J. Phytoremediation*.**

The bioaccumulation and rhizofiltration potential of *P. stratiotes* for heavy metals were investigated to mitigate water pollution in the Egyptian wetlands. Plant and water samples were collected monthly through nine quadrats equally distributed along three sites at Al-Sero drain in Giza Province. The annual mean of the shoot biomass was 10 times that of the root. The concentrations of shoot heavy metals fell in the order: Fe > Mn > Cr > Pb > Cu > Zn > Ni > Co > Cd; while that of the roots were: Fe > Mn > Cr > Pb > Zn > Ni > Co > Cu > Cd. The bio-concentration factor (BCF) of most investigated heavy metals, except Cr and Pb, was greater than 1000, while the translocation factor (TF) of most investigated metals, except Pb and Cu, did not exceed one. The rhizofiltration potential (RP) of heavy metals was higher than 1000 for Fe, and 100 for Cr, Pb and Cu. Significant positive correlations between Fe and Cu in water with those in plant roots and leaves, respectively were recorded, which, in addition to the high BCF and RP, indicate the potential use of *P. stratiotes* in mitigating these toxic metals.

**2017. Galal, T.M., Gharib, F.A., Ghazi, S.M., Mansour, K.H. Phytostabilization of heavy metals by the emergent macrophyte *Vossia cuspidata* (Roxb.) Griff.: a phytoremediation approach. *Int. J. Phytoremediation* 19(11): 992–999.**

The present study was conducted to investigate the potential of *Vossia cuspidata* as a phytoremediator to accumulate heavy metals from polluted water bodies. Thirty-two quadrats, distributed equally in eight sites (six polluted sites along Ismailia canal and two unpolluted sites along the Nile River) were selected seasonally for plant, water and sediment investigations. Winter plants recorded the highest values of shoot height, diameter, and leaf width, but the lowest shoot density. Plants collected in autumn had the lowest values of leaf length, width and area, while those in spring had the highest shoot density, with the lowest shoot height. Summer populations had the highest fresh and dry plant biomass, while winter plants had the lowest. Fresh production and dry biomass of *V. cuspidata* in the unpolluted water River Nile were significantly higher than the polluted canals. Chlorophyll a and carotenoids were reduced under pollution stress. Spring plants accumulated the highest concentrations of Cr, Cu and Pb in their root, and the lowest Al, Cd, Cr and Zn in their shoot. The bioaccumulation factor for most investigated metals, except Al, Cr and Fe was greater than 1, while the translocation factor of all metals was less than 1, therefore this plant is considered to be a potential for phytostabilization of these metals.

**2017. Galal, T.M., Gharib, F.A., Ghazi, S.M., Mansour, K.H. Metal uptake capability of *Cyperus articulatus* L. and its role in mitigating heavy metals from contaminated wetlands. *Environ. Sci. Poll. Res.* 24: 21636–21648.**

Wetland plants are biological filters that play an important role in maintaining aquatic ecosystem and can take up toxic metals from sediments and water. The present study investigated the seasonal variation in the accumulation potential of heavy metals by *Cyperus articulatus* in contaminated watercourses. Forty quadrats, distributed equally in 8 sites (six contaminated sites along Ismailia canal and two uncontaminated sites along the River Nile) were selected seasonally for sediment, water and plant investigations. Autumn was the flourishing season of *C. articulatus* with the highest shoot density, length and diameter as well as aboveground biomass, while summer showed the least growth performance. The photosynthetic pigments were markedly reduced under contamination stress. *C. articulatus* plants accumulated concentrations of most heavy metals, except Pb, in their roots higher than the shoots. The plant tissues accumulated the highest concentrations of Fe, Cd, Ni and Zn during autumn; while Cu and Mn during spring and Cr and Co during winter. It was found that Cd, Cu, Ni, Zn, Pb and Co had seasonal bioaccumulation factor (BF) > 1 with the highest BF for Cd, Ni and Zn during autumn, Co, Cu and Pb in winter, spring and summer, respectively. The translocation factor of most heavy metals, except Pb in spring, was < 1 indicating potential phytostabilization of these metals. In conclusion, autumn is an ideal season for harvesting of *C. articulatus* biomass in order to monitor pollution in contaminated wetlands.

**2017. Gouda, H. M. Phytochemical studies on *Opuntia littoralis* Englem. from the western Mediterranean coast of Egypt. M.Sc. Thesis, Helwan University.**

The present study was carried out on the autecology of *Opuntia littoralis* at Wadi Maged, on the northwest Mediterranean coast, Matrouh Governorate to investigate its growth performance, morphology, phytochemical constituents and biological activity of the plant extracts. The chemical investigation of the ethanolic extract of cladode and fruit juice of the plant showed the presence of kaempferol, quercetin, gallic acid, ferulic acid, chlorogenic acid, kaempferol-3-O-rhamnoside-7-O-glucoside, luteolin and 8-carbomethoxy-5-hydroxyl-6-methylisoflavone. Meanwhile, the compound 8-carbomethoxy-5-hydroxyl-6-methylisoflavone was isolated from the ethanolic extract of cladode for the first time for the family Cactaceae. Pharmacopial constants such as water content, ash and crude fibers; beside total carbohydrates, total lipids, total nitrogen and total protein content for each of cladodes and fruits were determined during the growth seasons at the study period. Protein amino acids; free and combined sugars and lipids content for cladodes and fruits were investigated to determine their constituents. The antimicrobial, cytotoxicity and anti-diabetic activities were determined for the cladode and fruit extracts. The cytotoxic investigation of the successive extracts of the plant against breast carcinoma cell line (MCF-7) showed low cytotoxic activity. While the ethyl acetate, chloroform and ethanol 70% extracts of the cladode showed the best effect on all the tested micro-organisms (Gm +ve and Gm -ve bacteria) and fungi. The results the ethanolic extract indicated that 70% of the fruit has strong antidiabetic activity against diabetes mellitus type 2.

**2017. Hussien, M. H. Phytochemical and biochemical studies of *Ipomoea aquatica*. Ph. D. Thesis, Sohag University, Faculty of Science, Chemistry Department.**

The investigation on medicinal plants aims for searching of new and bioactive natural products, studying the chemical diversity and biochemical activity of secondary metabolites, explaining the substances which play roles in the medical use of plants as well as finding their pharmacological targets. The *Ipomoea aquatica* contains various bioactive constituents, such as phenols, flavonoids, terpenoids and saponins as well as it is used in traditional herbal medicine for leucoderma, leprosy, fever, bronchitis and liver complaints. The present study aims to develop and find the best conditions to identify the bioactive compounds from the plant's extract in different fractions. Thus, different techniques were used for this purpose, such as HPLC and HPTLC, UPLC-QTOF/MS and LC-SPE-NMR. Results from HPLC and HPTLC approaches were compared. This comparison can be used as a guide to determine the best conditions for separation and purification of the active constituents from this plant by one or both approaches. The HPLC fingerprints, developed on two coupled chromolith RP-18e columns, using a gradient mobile phase starting at MeOH/H<sub>2</sub>O/TFA (5:95:0.05) (v/v/v) which showed more peaks than other tested columns and mobile phases.

**2017. Mohammed, M. E. Phytochemical and Biological Studies of Certain Cultivars of Strawberry (*Fragaria x ananassa* Duch.) Family: Rosaceae Growing in Egypt. M. Sc. Thesis, Beni-Suef University, Faculty of Pharmacy, Pharmacognosy Department.**

*Fragaria* L. is a genus which is a unique within the Rosaceae that has basic chromosome of  $x = 7$  with a small basic genome size  $x=7$  and comprised of 20-30 species, only 23 species of them are wild including 13 diploids ( $2n = 2x = 14$ ), four tetraploids, one hexaploid, and four octoploids, *Fragaria x ananassa* is an octoploid species with 56 chromosomes ( $2x = 8n = 56$ ). This species called pineapple or pine strawberry where its smelling like pineapple (*Ananas*). Strawberries are perennial, herbaceous, low-growing plants. Strawberries are capable of vegetative propagation via the production of runners (stolons), which are trailing above ground stems that can take root at their nodes to establish new, clonal daughter plants. Strawberry is a very important crop all over the world due to its nutritional value and organoleptic characteristics and its gainfulness. Egypt is an important country in the production of strawberries and its industry in Egypt increased very fast, because this country can export fresh fruits to Europe during the cold season from mid-November to mid-February and the main production areas of Egypt found in the Nile Delta. The present study includes the following: Part I: DNA fingerprinting of five cultivars of strawberry (*Fragaria x ananassa* Duch.) and botanical study of strawberry. Part II: Phytochemical study of the leaves and fruits of five cultivars of strawberry (*Fragaria x ananassa* Duch.). Part III: Biological study of the leaves and fruits of two cultivars (Festival and Red Merlin) of strawberry (*Fragaria x ananassa* Duch.).

**2016. Abomohra, A., El-Shouny, W., Sharaf, M. and Abo-Eleneen, M. Effect of Gamma Radiation on Growth and Metabolic Activities of *Arthrospira platensis*. Braz. Arch. Biol. Technol. Vol. 59.**

This work aimed to study the influence of gamma radiation on the growth and production of some active substances of *Arthrospira platensis*. Biomass production was significantly inhibited ( $p \leq 0.05$ ) by 21 and 34%, with respect to the control at 2.0 and 2.5 kGy, respectively. Chlorophyll-a content showed 11% reduction at 2.5 kGy compared to the control. As a result of growth and Chl-a inhibition, chlorophyll productivity recorded a continuous significant decrease below the control in the cells exposed to 1, 1.5, 2 and 2.5 kGy by 8, 12, 15 and 25%, respectively after 15 days of incubation. In addition, phycobillins productivity showed significant decrease by 10 and 36% below the control at 2 and 2.5 kGy of gamma radiation, respectively. Protein production decreased significantly by 24 % at 1.5 kGy; low doses of gamma irradiation (0.5, 1.0 and 1.5 kGy) induced carbohydrate production by 106, 246 and 146%, respectively. Lipid content increased significantly over the control at 0.5 kGy of gamma irradiation by 22%, which was decreased at higher doses. Interestingly, carotenoid productivity showed significant increase at all used gamma doses up to 155% over the control.



**2015. Abdou, A M. Bio-Guided chromatographic fractionation of *Lycium shawii* Roem and Schult, Family Solanaceae, growing in Egypt. M. Sc. Thesis, Ain Shams University, Faculty of Pharmacy, Department of Pharmacognosy.**

*Lycium* is a genus of the nightshade family (Solanaceae), comprises about 90 species of thorny shrubs, long shoots with alternate leaves or short shoots with cluster of leaves, usually terminating in a spine. Genus *Lycium* occurs worldwide and has its natural range on all temperate and tropical continents, with centers of diversity in southern South America, southern Africa and southwestern North America. In Egypt; the genus is represented by three species distributed in the Arabian Desert (east of the Nile), the Red Sea coastal region, Gebel Elba and surrounding mountains and the south east corner of Egypt at the Sudan frontier. Phytochemical studies concerning *Lycium* species had attracted the attention of many authors. Although ca. 90 species of *Lycium* are distributed all over the world, only twelve species had attracted the attention of several authors from the phytochemical and biological point of view, *Lycium shawii* has not studied well as compared with other *Lycium* species. Thus, it is interesting to carry out diverse biological studies on *Lycium shawii* growing in Egypt to rationalize its possible use as a medicinal plant. The present study includes two parts: part I: study of the biological activities of *L. shawii* and part II: phytochemical screening.

**2015. El-Shouny, W., Sharaf, M., Abomohra, A. and Abo-Eleneen, M. Production Enhancement of Some Valuable Compounds of *Arthrospira platensis*. Journal of Basic and Environmental Sciences 2:74 – 83.**

*Arthrospira platensis* is a nontoxic edible cyano-bacterium which contains high amounts of various valuable nutrients such as essential amino acids, essential fatty acids and carotenoids. It also contains compounds having medicinal effects, such as phycocyanin and different polysaccharides. The present study examined the effect of nitrogen, phosphorus, sulfur and salinity on biomass, lipid, protein, carbohydrate and phycocyanin productivities of *Arthrospira platensis*. Decreasing nitrogen to 50 % than the concentration mentioned in the modified Zarrouk medium resulted in a reduction of biomass, lipid, protein, carotenoids and phycocyanin productivities by 20, 12, 20, 2 and 32 %, respectively. While, 100 % phosphorus deficiency enhanced lipids and carotenoids productivities by 128 % and 64 %, respectively, with 25 % reduction in biomass. In addition, sulfur limitation led to 280 % increase in carbohydrate productivity with insignificant changes in biomass productivity. Finally, increasing salinity caused significant increase of lipid, carbohydrate and carotenoids productivities up to 93, 84 and 64 %, respectively. Whereas, increasing salt concentration, increased lipid and carotenoid productivities. The present study showed that phosphorus and sulfur deficiencies and high salinity increased the productivity of some valuable products of *Arthrospira platensis*. Therefore alteration of growth conditions changes its nutritional compounds. This means that we could obtain *Arthrospira* with different nutritional composition by altering the composition of cultivation medium.

**2015. Galal, T.M. and Shehata, H.S. Bioaccumulation and translocation of heavy metals by *Plantago major* L. grown in contaminated soils under the effect of traffic pollution. *Ecological indicators* 48: 244-251.**

The present study was performed at a heavy-traffic affected soil to examine the efficacy of bioaccumulation and translocation potentials of heavy metals by the naturally growing weed *Plantago major*. Heavy metals were analyzed in soil as well as in plant below- and above-ground parts along different distances from a heavy-traffic highway. All the investigated soil heavy metals, except Cd, varied significantly, while pH and EC had no significant difference, with increasing distance from the highway. Likewise, there was a significant decrease of heavy metals in plant below- and aboveground parts. In addition, no significant difference between most soil and root heavy metals at 20 and 100 m as well as those at 500 and 750 m distance from the highway. The bioaccumulation factor (BF) of all heavy metals, except Cd and Sr, were less than unity at most distances. However, Cd showed relative BF decline with the distance in contrast to Sr, which increases as distance from the highway increases. On the other hand, the translocation factors (TF) of Cd, Co, Cu, Pb and Zn were higher at the distances far from the highway, while that of Fe, Cr and Sr were higher near the highway. Furthermore, the enrichment factor (EF) showed small variations, among the investigated heavy metals, with varying distances from the pollution source. It was found that soil Fe, Al, Cr, Ni, Sr, V and Zn had significant positive correlation with all investigated heavy metals in *P. major* roots. The higher TFs of Cd, Fe and Pb in *P. major* shoots makes it suitable for phytoextraction from soil, while the lower ratios of Al, Mn, V, Co, Ni, Cr, Zn, Cu and Sr make it suitable for their phytostabilization. Therefore, this plant can be used as a bioindicator and biomonitor for traffic related heavy metals.

**2015. Galal, T.M. and Shehata, H.S. Impact of nutrients and heavy metals capture by paddy weeds on the growth and production of rice crop (*Oryza sativa* L.) irrigated with different water sources. *Ecological indicators* 54: 108-115.**

The present study aims at evaluating the impact of nutrients and heavy metals capture by weeds on the nutrient absorption and productivity of rice irrigated with different water sources. Plants were sampled from five farms; three irrigated with water from canals, receiving wastes discharge, and two with groundwater. The production of rice was higher in farms irrigated from canals than ground water, while the biomass of *Echinochloa crus-galli* and *Convolvulus arvensis* had a reverse trend. Moreover, *Cyperus deformis* produced large biomass, in contrast with *Eclipta alba*, in farms irrigated with canals water. Rice accumulated the lowest amounts of N, P, K, Ca and Mg as well as lower concentrations of heavy metals. *C. arvensis* accumulated the highest concentrations of N, P and Sr and lower concentrations of the remaining heavy metals, while *C. deformis* accumulated moderate nutrients, but higher heavy metals concentrations. Rice had bioaccumulation factors (BAF) less than unity for all heavy metals except Pb. However, *C. deformis* had higher BFA for most heavy metals with the highest values of Pb and Zn, *C. arvensis* had the highest of Sr and *E. crus-galli* had the highest of Cd. The CCA indicated that most soil variables have a least effect on *O.*

*sativa*, *E. crus-galli* and *E. alba*. In conclusion, weeds can cause harm to rice with the following order: *C. arvensis* > *E. crus-galli* > *E. alba* > *C. deformis*.

**2015. Galal, T.M. and Farahat, E.A. The invasive macrophyte *Pistia stratiotes* L. as a bioindicator for water pollution in Lake Mariut, Egypt. *Environmental Monitoring and Assessment*, 187(701).**

The present study was conducted to evaluate the potentiality of the aquatic macrophyte *Pistia stratiotes* to accumulate trace metals, perspective of phytoremediation, and the probability for using it as a bioindicator for the different pollution types. Plants were collected from the different Lake Mariut basins (main basin, south-west, north-west and fish farm), through five quadrats each, for measuring some growth parameters such as plant density, rosette diameter and height, root length, number of living and dead leaves per individual, and leaf length and width. In addition, nutrients and heavy metals in plant organs as well as water samples were analyzed. The bioaccumulation and translocation factors of trace metals were calculated. Water physicochemical data of Lake Mariut showed significant variations of all variables, except temperature and pH as well as Cd metal, among the lake basins. Fish farm was characterized by the highest plant density, individual size, biomass as well as the number of living leaves, while the north-west basin had the lowest, except the number of dead leaves. In contrast to trace metals, *P. stratiotes* accumulated concentrations of macronutrients in the leaves higher than in roots. The bioaccumulation factors of the investigated metals, except Cu, were greater than one, while the TFs of all trace metals were less than unity, and this may render *P. stratiotes* suitable for rhizofiltration. In addition, the significant positive correlation of Ni and Cd in water with those in plant roots and leaves as well as the growth response of this plant to the different pollutants may suggest its potential use as bioindicator for these pollutants in water.

**2014. El-Shaieb, N. R. Conservation of Some Threatened Medicinal Plants Growing in Sinai, Egypt. M. Sc. Thesis, Suez Canal University, Faculty of Science, Department of Botany.**

Floristically Saint Catherine area is mainly of Irano-Turanian chorotype, and is characterized by many species such as: *Adiantum capillus-veneris*, *Hypericum sinaicum*. The vegetation as a whole is subjected to depletion by over-grazing over-cutting, and uprooting for fuel and medicinal uses. These severe impacts lead to environmental deterioration including disappearance of pastoral plant communities, dominance of unpalatable communities, extinction of rare and endemic species, paucity of trees, and soil erosion. The present study aimed to: study the distributional behavior of some threatened medicinal plants, figure out the seed characteristics and germination and storage behavior of the studied species, and recommend appropriate conservation measurements. *Origanum syriacum*, *Teucrium polium*, and *Verbascum sinaicum*, were selected for the present study. One-hundred seventy-seven stands were selected in thirteen localities. In each stand, total plant cover and physiographical features (elevation, slope degree and exposure degree, and nature of soil surface), and

soil were sampled for physical and chemical analyses. The results of the present study revealed that Saint Catherine area is characterized by a high diversity of plant species. Seventy-seven species belonging to twenty-eight taxonomic families were collected and identified. These species include 40% geophytes (31 species), 21% therophytes (16 species), 21% phanerophytes (16 species), 15% chamaephytes (12 species), and 3% hemicryptophytes (2 species). The recorded seventy-seven species included thirty species vulnerable, sixteen are endangered, sixteen species common, fourteen species rare, seven endemic, and five are critically endangered. Data of vegetation and environmental variables were subjected to multivariate analyses using TWINSpan for classification and CCA for ordination. Four main assemblages were recognized as a result of classification.

**2014. Galal, T.M. and Shehata, H.S. Evaluation of the invasive macrophyte *Myriophyllum spicatum* L. as a bioaccumulator for heavy metals in some watercourses of Egypt. Ecological indicators 41: 209-214.**

*Myriophyllum spicatum* was evaluated as a bioindicator for water quality and its ability to accumulate nutrients and heavy metals from the watercourses of Egypt. Six stations on Ismailia canal (S1-S3), receives industrial pollutants, and Nile River (S4-S6), the water stem of Egypt, were selected along different distances from the pollution discharge point. The DWSC of the aboveground shoots of *M. spicatum* changed significantly with the distance from the discharge point on Ismailia Canal. It was indicated that there is no significant difference between DWSC of *M. spicatum* shoots from S6 and S5, on one hand, and S6 and S1, on the other hand. It was indicated that there is no significant difference in sediment Mn, Cd, Pb and Ni between S1 and S6, while N, P and K are significantly different. The concentrations of the investigated heavy metals in sediments had the sequence of (Fe > Mn > Cu > Zn > Pb > Ni > Cd), while in plants was (Mn > Fe > Zn > Cu > Ni > Pb > Cd). The bioaccumulation Factor (BF) was more than unity for all heavy metals except Pb. Moreover, the order of uptake capability was in the order Ni > Mn > Cd > Fe > Zn > Cu > Pb. There was a significant positive correlation between plant Fe and Cu with sediment Fe, N with Cd and P with Zn. The high accumulation of heavy metals by *M. spicatum* renders this species suitable to be used as a bioindicator and biomonitor for water quality.

**2013. Bidak, L. M., Heneidy, S. Z., Shaltout, K. H. and Al- Sodany. Y. Current Status of the Wild Medicinal Plants in the Western Mediterranean Coastal Region, Egypt. The Journal of Ethnobiology and Traditional Medicine. Photon 120: 566-584.**

The Mediterranean basin integrates different ecosystems which climates vary from humid, semi humid, and arid to hyper arid. These ecosystems are under extreme and increasing pressure from direct human intervention. Natural causes play a minor role in Mediterranean region, while man induced causes play by far a major role. One hundred and eighty-eight plant species was recorded as medicinal species in the

western Mediterranean region. Most of these species are declined in their abundance as a result of human impact. Forty seven species are of high threats, 15 species are of medium threats and 40 species are of low threats. Four species were recorded as endangered (*Aegilops kotschyi*, *Biscutella didyma*, *Bryonia cretica* and *Gagea fibrosa*), and one was recorded as vulnerable (*Prasium majus*). *Colchicum ritchei* has been changed from being rare in the past to be common in the present. The present study recorded that habitat loss, exploitation by the researchers, desert dwellers, herbalists and agriculture expansion are the most effective factors. This study was prompted by concern that harvesting was leading to the extinction of these valuable plant species. Building restores lead to reduce the pressures of the collection of medicinal plant species by the local community. Behaviors and awareness of researches and local communities should be taken into consideration in any future development plans in the region. It is very important to encourage the local communities and other user of ecosystem in the study area; first of all, how to conserve and save the natural resources before using the vegetation and other resources especially in arid systems.

**2013. Sharaf, A. A., Khafagi, O. A., Hatab, E. E. and Moursy, M. M. Effect of Altitudinal Gradients on the Content of Carbohydrate, Protein, Proline and Total Phenols of Some Desert Plants in Saint Katherine Mountain, South Sinai, Egypt. Middle-East Journal of Scientific Research 14 (1): 122-129.**

The present study was carried out to show the effect of altitudinal gradients on total soluble carbohydrate, water soluble protein, proline and total phenols of five plant species in Saint Katherine Mountain under natural conditions. All Analyses were carried out through five different altitudes: 1800, 2000, 2200, 2400 and 2600 m asl for five species (*Nepeta septemcrenata*, *Seriphidium herbaalbum*, *Tanacetum sinaicum*, *Ballota undulata* and *Teucrium polium*). An obvious variation was recorded as regards the biochemical constituents of the plants among the different elevation ranks in all species. The maximum of total soluble carbohydrate was recorded in *Teucrium polium* at elevation from 1800-2000, while the maximum of water soluble protein was recorded in *Nepeta septemcrenata* at elevation from 1800-2000. At the same time, *Seriphidium herba-album* attained the maximum of free proline at elevation from 2200-2400 and the maximum of total phenols at elevation from 1800-2000.

**2013. Takla, S. S. Phytochemical Investigation of Some Amaryllidaceae Plants. M. Sc. Thesis, Alexandria University, Faculty of Pharmacy, Department of Pharmacognosy.**

This work consists of four parts dealing with the phytochemical investigation of two Amaryllidaceae plants, namely, *Narcissus papyraceus* and *Narcissus tazetta*.

**2013. El- Bishbishy, M. H. Pharmacognostical and biological studies of certain plants belonging to family Juglandaceae. Ph. D. Thesis, Cairo University, Faculty of Pharmacy, Department of Pharmacognosy.**

US Food and Drug Administration (FDA) ranked the six healthiest nuts from healthiest to healthy as walnuts, almond, cashews, pecans, brazil nuts and macadamia nuts. Therefore, walnut (*Juglans regia* L) and pecan plant were selected for this study. The wide geographical distribution of the pecan plant (*Carya illinoensis* Wangenh. K. Koch) and its long history of cultivation worldwide have led to the development of a great diversity of varietal types.

**2013. Elkhateeb, E. A. Genetic Diversity of Medicinal Plants of Asteraceae in Egypt. M. Sc. Thesis, Tanta University, Faculty of Science, Department of Botany.**

*Achillea* L. is a major genus in tribe Anthemideae of the family Asteraceae. In Egypt, the genus is represented by two species; *Achillea fragrantissima* (Forssk.) Sch. Bip and *Achillea santolina* L. Samples of 29 populations of *A. fragrantissima* and *A. santolina* L. were collected from their natural habitats as mature flowering plants, through 2009 to 2012, from different localities in Egypt. These include 20 populations of *A. fragrantissima* coded as F1 to F20 and nine populations of *A. santolina* coded as S1 to S9. Eighteen quantitative morphological traits were measured and the states of ten qualitative traits were scored for 29 populations of *A. fragrantissima* and *A. santolina*. Morphological criteria showed low similarity between the populations of *A. fragrantissima* and the populations of *A. santolina*. Many of the measured quantitative morphological traits of the 20 populations of *A. fragrantissima* indicated the differentiation of populations collected from the high mountains and Wadis of South Sinai, and the other comprising populations that were collected from localities in more dry and flat areas in middle Sinai and the northern part of the eastern desert. On the other hand, two populations of *A. santolina* (S8 and S9) that collected from dry localities in Burg El-Arab are distinguished from the other seven populations that were collected from more wet parts closer to the Mediterranean coast.

**2013. Kurgat, E. Evaluation of *in vitro* Antimicrobial and Biological Screening of Extracts from Some Medicinal Plants, M. Sc. Thesis, Alexandria University, Faculty of Science.**

As reported by WHO, about 70-80% of the world populations, particularly in the developing countries, rely on non-conventional medicine in their primary healthcare as reported by WHO. In recent years, there has been growing interest in alternative therapies and the therapeutic use of natural products, especially those derived from plants. About 25% of the drugs prescribed worldwide come from plants,<sup>121</sup> such active compounds being in current use. Of the 252 drugs considered as basic and essential by WHO, 11% are exclusively of plant origin and a significant number are synthetic drugs obtained from natural precursors. WHO estimates that up to 80% of the population in Africa makes use of traditional medicine as well as about 65% of the

world's population. African traditional medicine is the oldest and most diverse of all medical systems. In Africa, the heads of state and government of the OAU recognized that about 85% of the African population resort to it for their health delivery needs. Plants have formed the basis for traditional medicine systems, which have been used for thousands of years in countries such as China and India. Since the WHO estimates that 80% of the world's inhabitants rely mainly on traditional medicine systems for their health care, plant products have played an important role in health care systems of the remaining 20% of the population and this mainly resides in developed countries. Drugs have been discovered by use of chemical studies which are directed at isolation of active substances from plants used in traditional medicine. Traditional systems are more culturally acceptable and are able to meet psychological needs in a way western medicine does not. Two principle mechanisms of action have been proposed for natural antioxidants. The first is a chain-breaking mechanism, by which the primary antioxidant donates an electron to the free radical present in the system (e.g., lipid radical). The second mechanism involves removal of ROS initiators (secondary antioxidants) by quenching chain-initiating catalysis. Alpha-glucosidase inhibitors act by delaying the liberation of D-glucose of oligosaccharides and disaccharides from dietary complex carbohydrates and retard glucose assimilation, reducing postprandial plasma glucose levels.

**2012. EEAA. Conservation and sustainable use of medicinal and wild plants in Saint Katherine Protectorate in Egypt. The Medicinal Plants Conservation Project in Egypt, Ministry of State for Environmental Affairs, United Nations Development Programme (UNDP), Global Environment Facility (GEF).**

Conservation and Sustainable Use of Medicinal Plants in Arid and Semi-arid Ecosystems Project was supported by the United Nations Development Program and the Global Environment Facility over 8 years, from 2003 to 2012. The main target is to develop the capacity of the Sinai community to cultivate and harvest medicinal and aromatic plants in abandoned orchards and gardens inside the nature protectorate. Several approaches were used when difficulties arose in convincing the local community to grow medicinal plants instead of relying on gathering local wild plants. One approach was to inform about the danger which medicinal and aromatic plants may be exposed to because of random gathering. Focus was also put on the benefits of cultivating the most vulnerable plants in order to save them. Lastly, regarding the economic aspect, using organic farming methods and modern irrigation systems can maximize the utilization of the available water for medicinal plant production similar to the wild plants. This publication documents the experience of the project in conservation and sustainable use of medicinal and aromatic plants over 9 years of technical work. It covers the following subjects on the medicinal plants in St. Katherine Protectorate: propagation, rehabilitation, cultivation and detailed information about the medicinal plants.

**2012. Ali, N. H. Bioactive Metabolites Produced by Endophytic Fungi Isolated from Some Medicinal Plants in Egypt. Ph. D. Thesis, Assiut University, Faculty of Scienc, Department of Botany.**

This investigation has been conducted to: 1- study the occurrence and diversity of endophytic mycobiota of eleven common medicinal plants in Egypt; 2- determine of antimicrobial activities of ethanol and aqueous extracts of common endophytic fungal isolates; 3- detect the abilities of selected endophytic fungi for kojic acid production as atherapeutic compound; and 4- evaluate of the abilities of selected endophytic fungi to produce L-asparaginasa and L-glutaminasa as anticancer agents.

**2011. Mohamed, E. A. Antioxidant activity of *Enteromorpha compressa*. M. Sc. Thesis, Cairo University, Faculty of Science, Department of Botany and Microbiology.**

The green macroalgae, *Enteromorpha compressa* (Linnaeus) Nees, *Ulva lactuca* Linnaeus and *E. linza* (Linnaeus) Ag. were seasonally collected from Abuqir bay at Alexandria, Egypt. This work aimed to investigate the seasonal environmental conditions which control growth, predominance or disappearance as well as the antioxidant activity of these green seaweeds. The recorded seasonal growth and distribution were in the order: spring > summer > autumn > winter.

**2011. Fikry, S. S. Phytochemical and Biological Studies on Certain Plants belonging to Family Crassulaceae. M. Sc. Thesis, Ain Shams University, Faculty of Pharmacy, Department of Pharmacognosy.**

Family crassulaceae is a large family, widely distributed in cosmopolitan, especially southern Africa, except Australia and West pacific. It comprises about 35 genera and 1500 species. In traditional medicine, the juice of *Kalanchoe* is used for the local treatment of bruises, wounds, boils, insect bites, ear infection, dysentery fever, abscesses, coughs, skin diseases, cholera, urinary diseases, tissue injuries, arthritis and gastric ulcers. In this thesis, two species that are presently cultivated in Egypt as ornamental plants have been selected. *Kalanchoe thyrsiflora* Harv. and *Kalanchoe marmorata* Baker were selected as plants for research as little could be traced in literature. Main goal of the thesis is phytochemical investigation of different extracts of both plants in a biologically guided manner in an effort to fractionate and separate hopefully new compounds of interesting chemical structure and effective biological activity. This study is divided into three chapters: The first chapter includes: DNA profiling of *Kalanchoe thyrsiflora* Harv. and *Kalanchoe marmorata* Baker using Random Amplified Polymorphic-DNA (RADP-PCR) Technique. Chapter two includes: biological study of the different leaf extracts and subfractions of *Kalanchoe thyrsiflora* Harv. and *Kalanchoe marmorata* Baker viz. cytotoxic activity. Chapter 3 comprises: phytochemical investigation of different leaf extracts of *Kalanchoe thyrsiflora* Harv. and *Kalanchoe marmorata* Baker.



**2011. Mohamed, N. A. Allelopathic Effect of Plant Extract of *Acacia* and Salinity Stress on Phytochemical Contents of Some Medicinal Plants. M. Sc. Thesis, Zagazig University, Faculty of Science, Department of Botany.**

Introducing new and effective drugs against diseases derived from plants are widely believed as plant derived compounds, they are abundant and show ranges of bioactivity and diversity. Enhancement of such compounds help in introducing new herbal and conventional drugs. Using allelopathic and salt stresses to enhance the phytochemical contents of medicinal plants as alternate route of genetic engineering and breeding projects may contribute to make use of stress response mechanism in enhancing biological active compounds in plants. The family Asteraceae is one of the plant families which produce diverse classes of bioactive compounds including acetylenes and flavonoids which possess diverse biological activity. *Bidens pilosa* is a member of family Asteraceae which produces diverse phytochemical classes of biological activity of which polyacetelens and flavonoids. This plant is collected from natural habitat. The status of the species and its variations in physiological performance in different habitats were studied in selected sites of geographically different areas of Sharqia Governorate. The surveys were conducted in two different growth stages (flowering and senescence) of the plant during 2009–2010. The frequency and density of the plant was higher in the moist habitats with higher organic carbon.

**2011. Gad, S. S. Immuno-pharmacological Study on some Egyptian Marine Algae Using Stimulated Cultured Macrophage. M. Sc. Thesis, Cairo University, Faculty of Pharmacy, Department of Pharmacology & Toxicology.**

The sea is a huge source of a lot of compounds waiting to be correctly inserted in our life by an appropriate mean. Extraction of these compounds as well as their production is not an easy way, yet it is our big next aim, not only on the medical field searching for just a new pharmacologically active drug, but also for nutrition. The algal extract proved to be of a quite importance in that area of research, with their great diversity (green, red and brown). Using two different extracts of two brown algae (*Sargassum asperifolium* and *Sargassum dentifolium*) revealed huge and great pharmacological results including results of: extract of *Sargassum asperifolium* showing: an increase in the macrophage proliferation index. A decrease in the production of the inflammatory mediators (NO and TNF- $\alpha$ ). An increase in the angiogenesis mediator PDGF production.

**2010. El-Sayed, A. M. Phytochemical and Biological Studies of Certain Members of Family Anacardiaceae Grown in Egypt. Ph. D. Thesis, Faculty of Pharmacy, Cairo University.**

Medicinal plants currently used in traditional medicine in the developing countries are now receiving much scientific attention. The employment of bioassay–guided isolation techniques has added another dimension to the search of new drugs. The structural diversity of the natural constituents in these medicinal herbs make them valuable

source of novel compounds against chronic diseases. In Egypt, although there is an extensive body of literature addressing the distribution of hepatic viral infection in the country, there is few published work on morbidity related statistics to such chronic problem. The Hepatitis C virus is the main cause of liver epidemic in Egypt (the highest country of wide prevalence of viral C infection in the world). Spices and herbs are used in food primarily because they impart desirable flavor and aroma. The presence of several natural constituents in these herbs with known biological effects such as vitamins, phenols, carotenoids, phytoestrogens and terpenoids is our concern in this study to develop phyto-pharmaceuticals suitable and /or with superior activities. The family Anacardiaceae enjoys considerable economic importance because it encompasses important edible fruits such as fruits of Mango (*Mangifera indica* L.), Cashew nuts (*Anacardium occidentale* L.) and Pistachio nuts (*Pistacia vera* L.). The resin known as Mastic is obtained from *Pistacia lentiscus* L. Sumac (*Rhus coriaria* L.) and wild plum (*Harpephyllum caffrum* Bernh ex CF Krauss) are African medicinal plants belonging to Family Anacardiaceae and traditionally used to control several human diseases. Sumac is sold in the Egyptian herbal market and used to flavor the cooking of meat. It is also reputable for treatment of several diseases including diabetes and ulcers. *Harpephyllum caffrum* Bernh ex CF Krauss is an ornamental plant cultivated in several locations in Egypt such as El-Orman and Zoo Gardens. It has been reported to treat an array of human diseases including hypertension and diabetes. In South Africa, it is usually applied in a form suitable for facial saunas, skin diseases and others. Both plants are suggested for this study in order to shed light on their phyto-constituents and establish their beneficial effects with regard to some health problems in Egypt.

**2010. Farag, M. E. Ecology, ethnobotany and floristic composition of the medicinal plants at Sallum (Egypt) and Gebel Akhder (Libya). Ph. D. Thesis, Faculty of Science, Alexandria University.**

The study area is considered rich in medicinal plants which are used in traditional medicine, especially the Gebel Akhder region which contains about 50% of the total medicinal plants recorded in Libya. The present study deals the ecology, floristic composition and some vegetative attributes, as well as their interrelationships with some environmental and soil factors. The study was extended to explore the folkloric medicine via an ethnobotanical survey to identify the heritage cultural knowledge related to medicinal plants and their traditional uses. This will provide valuable information for the future conservation and management strategies of these natural resources in the Sallum and Gebal Akhder regions. In Sallum, 103 species were recorded, belonging to 94 genera and 44 families, while in Gebal Akhder, 347 species were collected, belonging to 271 genera and 88 families. Of these, 14 endemic species were recorded and 7 new species were recorded to the flora of Libya. At Sallum, results showed that the vegetation is characterized by the presence of a high percentage of chamaephytes, while in Gebel Akhder the vegetation is characterized by the presence of a high percentage of therophytes and chamaephytes. Sallum had the lowest species diversity with 103 species (22 annuals and 81 perennials), compared

with 236 species in Gebel Akhder (87 annuals and 149 perennials). In Sallum, 14 informants were completed open ended questionnaires, where the number of mentioned species was 25 belonging to 20 families and 25 genera, all were traditionally used for human health care. Thirty–nine types of ailments treated by these plants were mentioned. In Gebel Akhder, 54 informants completed open ended questionnaires, where the number of the species mentioned was 188 belonging to 73 families and 175 genera, all were traditionally used for human health care. One hundred and ninety – two types of ailments treated by these plants were mentioned. In Sallum, the shoots are the most cited medicinally used plant part, while the leaves were in the Gebel Akhder. The dominant herbal formula was prepared by decoction. About 67% of the interviewed persons acknowledged the use of *Asphodelus aestivus* to treat many different diseases. In Gebel Akhder, about 81% of the interviewers acknowledged the use of *Helichrysum stoechas* to treat many different diseases. Among the species demonstrating the highest relative importance values was *Thymus capitatus*. The results of the chemical analysis of the selected plants from Sallum showed the highest total flavonoids were found in *Haplophyllum tuberculatum* with 669 mg/100g. The highest total phenolics were found in *Peganum harmala* with 3985 mg/100g and the highest of alkaloids was found in *Peganum harmala* and *Haplophyllum tuberculatum* with 2.0% and 0.1% respectively. On the other hand, the highest content of essential oils was detected only in *Haplophyllum tuberculatum* with 0.04 ml/100g. The results of chemical analysis of selected plants from Gebel Akhder showed the highest total flavonoids and phenolics were in *Arbutus pavarii*, with 1967 mg/100g and 15532 mg/100g(respectively). The highest percentage of alkaloids was found only in *Cyclamen rohlfsianum* with 0.1%. On the other hand, the highest content of essential oils was found in *Rosmarinus officinalis* with 0.6 ml/100g.

**2008. Abd El-Wahab, R., Zaghloul, M., Kamel, W. and Abdel Raouf, M. Diversity and distribution of medicinal plants in North Sinai, Egypt. African Journal of Environmental Science and Technology 2 (7): 157-171.**

The present study aims to assess plant diversity and distribution of medicinal plants in relation to environmental factors at three geomorphological districts (Mediterranean coast, anticlines, and inland) and five main habitats (salt marshes, sand dunes, sand plains, wadis, and gorges) in North Sinai. The results revealed that North Sinai harbors 281 species with high taxonomic diversity (species/genera =1.5) and high percentage of rare and very rare species (67%). Mediterranean coastal district and anticlines district are more diverse than inland district. Medicinal plants constitute 43% of North Sinai flora. Species richness, Shannon-Weiner, and Margalef indices measurements indicated that gorges are the most diverse habitat in North Sinai followed by wadis. Plains have intermediate diversity followed by sand dunes. The lowest diversity indices were recorded at salt marshes habitat. Beta diversity measurements, using Wilson and Schmida index, indicated significant changes in floristic compositions between different habitats. The lowest changes were among sand plain, wadi, and gorge habitats. North Sinai habitats support about 100 to 120 medicinal plant associations. The main dominant species include *Artemisia monosperma*,

*Arthrocnemum macrostachyum*, *Lycium shawii*, *Retama raetam*, *Stipagrostis scoparia*, *Tamarix nilotica*, *Zygophyllum album*, and *Zygophyllum dumosum*. Soil physical properties in addition to soil salinity and topographic variations are the main driving factors controlling the distribution of medicinal plants in North Sinai. About 60% of medicinal plants are threatened due to intensive collection and other human activities. The threatened medicinal plants including *Acacia pachyceras*, *Acacia tortilis*, *Anastatica hierochuntica*, *Asclepias sinaica*, *Capparis spinosa*, *Chiliadenus montanus*, *Citrulus colocynthis*, *Ephedra alata*, and *Juniperus phoenicea* along with their habitats should have the first priority in management and conservation plan of medicinal plants in North Sinai. Public and private involvement in management and utilization of medicinal plants in sustainable way is essential to combat human pressures on these valuable natural resources.

**2007. Nassr-Allah, A. A. Egyptian flora providing power activity as antioxidants and anti-carcinogenic agents. Mansoura Journal of Agricultural Science - Mansoura University 32 (11).**

Natural products from plants are rich sources which were used for treating a number of diseases instead of chemical therapy. Meanwhile, many of the pharmacological principles currently used as anticancer agents have been initially isolated from plants, especially which grow in dry weather area like Egypt. Therefore, some Egyptian flora extracts were used for this study such as leaf of *Luffa aegyptiaca*, *Solenostemma arghel*, *Cassia acutifolia*, *Ocimum basilicum*, *Colocasia antiquorum*, *Beta vulgaris* and fruit of *Capsicum frutescens*, as antioxidants activity using DPPH radical method and for anticancer (acute myeloid leukemia and acute lymphocyte leukemia all *in-vitro* study) and Ehrlich Ascites Carcinoma cells (EACC, *in-vivo* study). The results showed that EACC derived tumor growth was reduced by the *Solenostemma arghel* hot water extract and death was delayed for 29 days. On the other hand, in *in-vitro* experiments the extracts could kill the majority (66-90%) of abnormal cells among primary cells harvested from patients, especially hot water extract of *Solenostemma arghel* DNA fragmentation patterns within treated cells inferred targeted cell death by apoptosis were detected. Therefore, the mechanism on tumor cells may due to promote apoptosis, cause DNA damage, or denature proteins. On the other hand, most of extracts showed significant elevation as anti-oxidant derivatives. In conclusion, metabolic flora compounds could use as drug for harmful diseases such cancer without side effect.

**2006. Matloub, A. A. Phytochemical Study on Certain Marine Algae. Ph. D. Thesis, Cairo University, Faculty of Pharmacy, Department of Pharmacognosy.**

The objectives of this study are to identify the chemical constituents as well as screen biological and pharmacological activities of some marine brown: *Padina pavonia* (L.) Gaill. and *Hydroclathrus clathratus* (C. Agardh) Howe collected from Red sea shore (Hurghada). This study includes two main parts. Part I: phytochemical study of the algal thalli which includes: 1- preliminary phytochemical screening, of the different

chemical constituents in these algae; 2- determination of minerals, trace elements and halide contents of the ash prepared from the algae to reveal its potential as a source of minerals; 3- study of the volatile constituents to determine their chemical nature; 4- investigation of the lipoidal matter to find out their chemical constituents; 5- study of the carbohydrate contents to reveal the nutritive value of the alga under investigation; 6- determination of the protein and amino acid contents to reveal the nutritive value of the algae under investigation; 7- study of the hexane extract using column chromatographic analysis; 8- study of the hydrocarbon fractions eluted from column chromatography using GC/MS analysis; and 9- isolation, purification and identification of the terpenoid compounds. Part II: bioactivity studies of the algal thalli which include: 1- antimicrobial activity, 2- insecticidal and antiviral activity, 3- evaluation of LD50, 4- pharmacological screening, and 5- cytotoxicity screening.

**2003. Al- Ghamdy, M. M. A study of the ecology and ethnomedicine of some plant species in the north western Mediterranean coast of Egypt. M.Sc. Thesis, Faculty of Science, Alexandria University.**

Ethnomedicine is that part of ethnoecology, which is concerned with the medicinal plant. The rural people throughout the western Mediterranean coastal region of Egypt rely, to some extent, on medicinal plants due to its abundance in their surroundings, their effectiveness, lack of modern medical alternatives in some districts and cultural preferences. The present study is an attempt to document the plants used in phytotherapy in some social communities distributed along the western Mediterranean coastal region of Egypt. Recently, some traditional practices have taken root through information provided by satellite receivers, television, radio and to a lesser extent books. Otherwise, the continued and massive arrival of foreigners has also contributed applications and knowledge previously unknown in the area. Unexpectedly, the more urbanized, human intensified, and health care maintaining locations such as Burg El-Arab–El-Hammam location attains the maximum number of mentioned medicinal species compared with the rural locations such as Sallum, which is still characterized by completely lacking of such health care centers. Surprisingly, some plants common and recorded to herbal practice in early Arabic and Islamic medicine, Chinese, Indian and in Europe for long time were not being used in the surveyed area. Among such plants are *Ammi visnaga*, *Avena fatua* and *Anastatica hierochuntica*. There are a number of preparations which are most commonly and conveniently used in herbal medicine in the study area. Infusion, decoction, poultice or cataplasm, fomentation and hydrotherapy are the most dominant preparations in the study area. Mostly, the surveyed medicinal uses in the present study indicate that the most dominant herbal formula was the simple, while complex herbal formulas were rarely used. The herbal remedies are simple and include in most cases a decoction of the plant parts to be taken orally. In some cases, local remedies by hot suspension of mashed plant parts were applied. The total number of field-surveyed species in all locations was 124 species. Burg El-Arab – El-Hammam and Omayed –Alamein locations attained the highest number (54 and 53 respectively). Among of the 124 species surveyed in the

study area only 20 species was acknowledged by the local inhabitants to be used for disease treatment. Such low ratio may indicate that the medicinal plants in the region are subjected to great stress. The conservation of the different sites in the study area will be crucial to the continued availability of traditional medicinal plants. Such conservation will require a new policy in economy, socio-economy, agriculture and constructions to relieve and minimize the risk upon these areas. Consequently, it is strongly recommended that phytochemical and pharmacological studies must be completed in order to confirm the validity of the plant folk-medicinal use.

## 19.2-Zoological Studies

**2016. Ezz El-Arab, M. A. Studies on sponges associated with coral reefs in the northern Red Sea, Egypt. Ph. D. Thesis, Zoology Department, Faculty of Science, Tanta University.**

During the present study, 43 species belong to 2 classes (Demospongiae and Calcarea, have been collected and identified from 25 branched sites. Demospongiae was the largest represented with 41 species assigned to 28 genera and 24 families, while the class Calcarea represented with 2 species assigned to 2 genera and 2 families. The site of Elphinstone and MBS recorded the highest species diversity followed by Shaab El-Deer and Abu-Galawa; while the lowest species diversity was in Tobia El-Kebir, followed by Marsa Tondoba. The present study showed that sponge populations are more diverse and commonly found throughout most study sites. There were non-significant correlations of the abiotic factors opposed the quantitative estimates of the sponges. The seasonal variation and the population dynamics were evaluated at 3 study sites. The sponge population percent fluctuated between the lowest value in spring and the highest in autumn at marine biological station. The sponge population percent fluctuated between the lowest value in winter and the highest in autumn at Shaab El-Deer; while at Gasos Soraya fluctuated between the lowest value in autumn and the highest in spring. Primmorphs were obtained from species of *Hemimycale aff. arabica*; *Stylissa carteri* and *Crella spinulata*. A long term primmorphs culture *in vitro* was maintained, where primmorphs of *Crella spinulata* and *Stylissa carteri* could be kept for three months and recorded sizes from 1.5-2 mm. Primmorphs of *Crella spinulata* were more tolerant to have extension for six months and recorded 202.5 mm. *Hemimycale aff. arabica*, *Stylissa carteri* and *Crella spinulata* have provided bioactive reagents represented by the mesohyl and the primmorphs ethyl acetate extracts, which posses varied potent anti-tumor activities. The reagents have cytotoxic activities, include the cell cycle arrest and suppress the colony formation ability of liver cancer cell line. The present study hypothesized that the primmorphs extracts are the most conventional and have a promising potential in the treatment of Hepatocellular Carcinoma (HepG2).

**2015. El-Saify, M. H. Secondary Metabolites from the Red Sea Marine Invertebrates *Phyllospongia* and *Lobophytum* Species. Ph. D. Thesis, Beni Suef University, Faculty of Pharmacy, Pharmacognosy Department.**

Natural products play a highly significant role in drug discovery, which has been reviewed recently. The oceans (the mother origin of life) cover over 70% of the earth's surface and contain over 300,000 described species of plants and animals. The oceans have been the source of structurally unique natural products with diverse pharmacological activities. The diversity in species is extraordinarily rich on coral reefs, where there are around 1,000 species per m<sup>2</sup> in some areas (Indo-Pacific Ocean has the world's greatest tropical marine biodiversity). This study is of 3 parts: part I: chemical and biological investigation of the marine sponge *Phyllospongia lamellosa*

collected from the Red Sea (Hurghada). Sponges are the largest source of new marine natural products reported annually and they have been providing a vast of bioactive compounds for the pharmaceutical industry since the 1950s. Sponges are well represented in the marine environment, with over 7000 species described, ranging from shallow-water to those inhabiting depths of over 8000 m, with some deep-water species. So, this study concerned with isolation of active metabolites from *Phyllospongia lamellosa*. Part II: chemical and biological investigation of the soft corals *Lobophytum pauciflorum* collected from the Red Sea (Hurghada). Soft corals are found worldwide, more in tropical than temperate reefs, mainly in mid depths of 5-30 m, temperature of 24- 35°C and PH of 8.2- 8.4. Soft corals of the genus *Lobophytum*, a marine invertebrate of the subclass Alcyonaria, are rich source of diterpenes, lipids, sesquiterpenes and hydroxylated steroids. Cembrane diterpenes previously isolated from *Lobophytum* species; have shown diverse biological activities as cytotoxic, antiarthritic, anti-inflammatory and antibacterial. Previous works encourage us to collect the marine soft coral *Lobophytum pauciflorum* from the Red Sea (Hurghada) for phytochemical and biological screening. Part III: isolation, chemical profiling of marine derived microorganisms and biological screening. Microorganisms, and in particular the bacteria, showed a deep effect on developing chemistry and medical science. Since the discovery of penicillin in 1929, extensive studies of mainly soil derived bacteria and fungi revealed that microorganisms are a rich source of structurally-unique, bioactive substances.

**2012. Abd-Elrazek, A. E. Bioactive Constituents of selected Red Sea Sponges. M. Sc. Thesis, Suez Canal University, Faculty of Pharmacy, Department of Pharmacognosy.**

The sponges *Mycale euplectellioides* and *Echinoclathria gibbosa* were collected by hands using Scuba at depths between 10 and 20 m of Egyptian Red Sea coast. Specimens belonging to the genus *Mycale* have been the subject of extensive research leading to the isolation and identification of a wide variety of novel structures. Some of these *Mycale* metabolites display interesting biological properties such as the anti-viral and anti-tumor activities. The genus *Echinoclathria* has been subject of extensive research leading to the isolation and identification of biologically active metabolites. The present study contains three phases. The first phase focused on chemical investigation of the sponge *Mycale euplectellioides* including isolation, identification and structural elucidation of four compounds (1-4). Compound 1 is hexacos-6,10-dienoic acid methyl ester (new compound); Compound 2 is icos-8,11-dienoic acid methyl ester; compound 3 is hexacos-6,10-dienoic acid (new compound); and compound 4 is B-sitosterol. The second phase focused on chemical investigation of the sponge *Echinoclathria gibbosa* including isolation, identification and structural elucidation of six compounds (5-10). Compound 5 is B-sitosterol-3-O-(E)-pentacos-3-enoyl (new compound); compound 6 is mixture of cholesterol, dihydrocholesterol, dihydroergosterol and  $\beta$ -sitosterol; compound 7 is thymine (5-methyluracil); compound 8 is uracil; compound 9 is 2-hydroxyheptadecanoylamino-19-methyl-icosan-1,3,4-triol (Echinoclathriamide, new compound); and compound 10 is 5-



pregna-3-acetoxy-12,16-diol-20-one (new compound). The third phase focused on biological studies for the different extractives and some pure isolated compounds of the two sponges such as: 1- preliminary antimicrobial study of the different fractions and total alcoholic extracts of the two sponges; and 2- preliminary pharmacological investigations of the different fractions and total alcoholic extracts (including anti-inflammatory, antipyretic and hepatoprotective activities and cytotoxicity assay for some isolated compounds).

**2011. Seha, M. M. Phytochemical and Biological Studies of *Heteroxenia fuscescens* Soft Coral from Red Sea. M. Sc. Thesis, University of Beni Suef, Faculty of Science, Department of Pharmacognosy.**

The search for novel compounds from marine organisms has been intensified since 1970. The collection of organisms from the oceans provided us with a largely untapped resource of a range of unique structure classes and novel compounds. The Red sea represents one of the most promising areas as a source of medicinal natural products as it considered a virgin area that full of secrets. The soft coral *Heteroxenia fuscescens* collected from the Red Sea, Egypt was investigated for its chemical constituents and biological activity. Fresh organism was extracted using 70% ethanol. The ethanol extract was partitioned between hexane, chloroform and ethyl acetate. GLC analysis of the unsaponifiable part of the lipid content of the hexane fraction revealed the presence of two sterols ( $\beta$ -Sitosterol and Sigmasterol) in addition to a series of normal hydrocarbons ranging from C10- C28. The ethyl acetate fraction was repeatedly chromatographed over silica gel and Sephadex LH-20 columns. The isolation process yielded five compounds 6-hydroxy- $\alpha$ -muurolene, gorgosten-5(E)-3  $\beta$ -ol, 1-nonadecyloxy-2,3-propanediol, (2S,3R,4E,8E)-N-hexadecanoyl-2-amino 4, 8-octadecadiene-1,3-diol and Sarcoaldosterol A. The structures of the isolated compounds were established based on NMR measurements and mass spectrometric data. The pharmacological screening of the alcoholic extract showed significant anti-inflammatory, anti-pyretic, analgesic and anti-oxidant activity. In addition, the alcoholic extract has showed promising cytotoxic activity against several cancer cell lines. The alcoholic extract showed anti-microbial activity against gram-positive, gram-negative bacteria and fungi. The isolated compounds showed anti-microbial activity against tested bacterial and fungal strains. On the other hand, the coral distribution and diversity at Hurghada (the sample collection site) have been studied in order to obtain the hard and soft coral coverage in the area. The cover percentage of the coral reef community was estimated at the locality using the line intercept transect. The morphological and histological studies have been performed to follow the general external and internal structure of soft coral *Heteroxenia fuscescens*.

### 19. 3- Microbiological Studies.

**2017. Elnaggar, M. S. Isolation and structure elucidation of bioactive metabolites from marine organisms and associated endosymbionts. M. Sc. Thesis, Ain Shams University, Faculty of Pharmacy, Department of Pharmacognosy.**

Marine microorganisms, especially fungi have a crucial impact in the pharmaceutical and the agricultural industries as a result of their tendency to produce a large array of natural products with a unique diversity of chemical structure that proves their potential for specific medicinal and agrochemical applications. Furthermore, most of these fungal-derived secondary metabolites show biological activities in pharmaceutically relevant bioassays which furnish potential lead candidates that could be optimized to yield effective therapeutic and bioactive agents. The aim of this dissertation was to investigate the natural products from fungi isolated out from marine sources. Three marine-derived, fungal strains, *Scopulariopsis*, *Alternaria* and *Gliomastix* spp. were selected as biological sources. The fungi were grown mainly on solid rice medium, as well as in some cases, solid beans medium for a period of four to six weeks. Chemical investigations of the obtained extracts were then carried out through different chromatographic separation techniques in order to isolate the secondary metabolites. Moreover, structure elucidation was performed using different spectroscopic techniques, including mass spectrometry and nuclear magnetic resonance experiments. The stereochemistry of chiral compounds was determined by comparison of their optical rotation with the literature or by ECD calculations. Finally, the isolated compounds were subjected to bioactivity assays, including antibacterial and cytotoxicity assays. Furthermore, in order to activate silent biosynthetic gene clusters, different methods were employed to culture selected fungal strains. Fermentation on different culture media as well as co-cultivation with bacteria successfully induced the production of some secondary metabolites that were not isolated from the axenic culture. In conclusion, a total of seventy-eight compounds were isolated and identified from three different marine-derived fungal strains, in which, eighteen were identified as new natural products. Both known and new compounds were tested for their biological activities using different bioassay systems. Different culture approaches successfully triggered the accumulation of distinct metabolites compared with axenic controls. Furthermore, two of the major fungal metabolites isolated here in this work were also obtained from the host coral crude extract through analysis of this extract, which illustrated the possible relationship existing between the host organism, Red Sea hard coral *Stylophora* sp., and the isolated fungal strains.

**2012. Mohamed, M. S. Bioactive secondary metabolites from marine and terrestrial microorganisms with expected antitumor activity. M. Sc. Thesis, Cairo University, Faculty of Pharmacy, Department of Pharmacology.**

Natural products have always been the most successful source of drug leads. They maintain to supply greater structural diversity than standard combinatorial chemistry

and thus propose major opportunities for finding new and novel low molecular weight leading structure that are biologically active against a wide range of assay targets.

**2012. Youssef, S. M. Isolation and Purification of Natural Compounds from Cyanobacteria for Pharmaceutical Uses. M. Sc Thesis, Alexandria University, Institute of Graduate Studies and Researches, Department of Biotechnology.**

There is a significant recent interest in the commercial utilisation of algae based on their chemical constituents, many of which exhibit multiple bioactivities with food, cosmetic, agricultural and horticultural sectors and in human health. Commercial interest includes pigments, lipids, fatty acids, proteins and phenolics which all display considerable diversity between and within taxa. Composition of natural algal populations is further influenced by spatial environmental parameters including light, temperature and nutrients. Cyanobacterial microorganism was screened for antioxidant and intracellular bioactive potential metabolites. They were extracted using chloroform and methanol organic solvents: chloroform/acetone, and methanol/acetone organic mixtures against *Grammccus aureus*, Gram negative *Kiebsiella pneumonia* and *Escherichia coli* indicators; and against *Candida albicans* fungal pathogenic indicator. Screening of algal methanol extract using HPLC identified vitamin C antioxidant and carotenoids at high concentrations (activity against cancer and cardiovascular disease). Vitamin 12 was rr HPLC which is essential to avoid pernicious anemia. Structure elucidated shi znapund's molecular weight was 220 and it was identified as butylated hvdrox both antimicrobial and antioxidant activities.

**2010. El-Sayed, M. M. Studies on endophytic microorganisms of some medicinal plants. M. Sc. Thesis, Sohag University, Faculty of Science, Department of Botany.**

The present investigation aimed to study the diversity of endophytic micro-organisms of healthy looking leaves of six medicinal plants (*Morus rubra*, *Lantana camara*, *Ocimum basilium*, *Psidium guajava*, *Citrus limon* and *Allium sativum*) in Sohag Governorate.

**2010. Mansour, K. A. Biologically Active Metabolites from Microorganisms. Ph. D. Thesis, Suez Canal Universty, Faculty of Pharmacy, Department of Pharmacolognosy.**

The projects described in this dissertation are mainly focused on exploration of microorganisms as a source of interesting pharmacologically active natural products. The principal objective of this study has been directed to the isolation and structure elucidation of biologically active secondary metabolites from marine fungi and terrestrial bacteria. The first project aimed to isolate fungi associated with the marine sponge *Gellius bubastens* collected from Suez Canal. Several fungal symbionts were identified by the use of DNA sequencing combined with World Wide Web (WWW) searchable databases. Bioassay guided fractionation of the extract of saline czapek's dox yeast culture of marine-derived *Aspergillus flavus* led to the isolation of eight

known compounds; kojic acid, aflatoxin B1, maculosin 1, hexahydro-3-(4-hydroxybenzyl) pyrrolo[1,2-a] pyrazine-1,4-dione, alpha-cyclopiazonic acid, cyclopiazonic acid imine, aspergillic acid and hydroxy aspergillic acid. Structure elucidation of isolated compounds was based on dereplication using one dimensional and/or two dimensional NMR and MS data. The lipid content of the crude extract of *A. flavus* was studied using GC/MS and led to the identification of more than fifty compounds with reported diverse bioactivities. A cultivation-based approach was employed to compare the secondary metabolites diversity associated with *A. flavus* in eight different sea water culture media. The type of medium exhibited a significant difference of the yield and the type of compounds responsible for biological activities of the corresponding extract. The anti-fungal activities exhibited by bacteria such as *Burkholderia* have led to a strong interest in exploiting these properties as biological agents to control fungal infections. Bioassay guided purification of the active principles of *Burkholderia ambifaria* 2.2N using a panel of pathogenic fungi led to the discovery of a complex mixture of lipopeptides, the burkholdines. In this study, we report the structure elucidation of the new and potent anti-fungal octapeptides; burkholdine 1229 (Bk-1229) and burkholdines 1097 (Bk-1097). Bk-1229 and Bk-1097 are octapeptides comprised of nonproteinogenic amino acids, including beta-hydroxytyrosine, beta-hydroxyasparagine, and a new fatty amino acid (FAA). Burkholines also are comprised of proteinogenic amino acids, two serine, two asparagines and glycine residues. Bk-1229 is a glycopeptide that contains a xylose moiety. Bk-1229 and Bk-1097 possess fungicidal against a panel of fungi with potencies 2-60-fold better than amphotericin B activity.

**2010. Tawfik, K. et al. Natural Compounds from Sponge-Derived Fungi. Agricultural Research Journal, Suez Canal University 10 (1).**

Fungi associated with the marine sponge *Gellius bubastens* from El-Temsah Lake were isolated. All isolated sponge-derived fungi were screened for the presence of biologically active secondary metabolites in their cultures. Fungi that organic extracts of their cultures showed bioactivities were identified. The lipid content of hexane extracts of saline cultures of three fungal isolates was analyzed with GC/MS and led to identification of compounds with reported diverse bioactivities. Identification of marine fungi was based on DNA sequencing combined with searchable databases. The diversity of the microbial communities associated with *G. bubastens* collected from El-Temsah Lake may attract chemists to explore such area as a source of new, diverse and interesting secondary metabolites due to symbiosis. This work represents the first report of a study of the secondary metabolites diversity of marine-derived fungi isolated from its sponge host collected from El-Temsah Lake.

## 20- Natural Protectorates

**2018. Gabr, A. M. Fine and aesthetic values of the elements of natural reserves and benefit from them in the formation of metal pendants. Master of Specific Education, Faculty of Specific Education, Tanta University, Tanta, pp. 211.**

This research aims to benefit from the aesthetic values of the elements of the Egyptian nature reserves and to benefit from them in the formation of metal pendants through a series of chapters. The first chapter deals with the background of research, objectives, hypothesis, importance, methodology, research terminology, and related studies. The second chapter deals with the definition and types of nature reserves and short description of the protected areas in Egypt including the elements which distinguish each of them. The third chapter deals with the explanation of the metal pendants during the Jahali and Islamic periods as well as the traditional arts, definition of the aesthetic values and constitution of the design foundations. The fourth chapter deals with the applied framework for research and presentation of the most important methods of metal formation and finishing. The fifth chapter explains the used metallic materials and the self-experience of the researcher.

**2018. Shaltout, K. H. and Galal, T. M. Ecosystem of Manzala Wetland: Ecological, Biological and Conservational Aspects. Lap Lambert Academic Publishing, Deutschland, Germany, 125 pp.**

This Book deals the abiotic and biotic components of the ecosystem of Lake Manzala, the largest lake along the Mediterranean coast at the north-eastern corner of Nile Delta. It comprises the geography, morphometry, climatology and water characteristics of the lake; and introduces its biota including flora and vegetation, phytoplankton, zooplankton, benthic fauna, mammals, amphibians and reptiles, birds and fishes. It is forwarded by an executive summary and introduction and ended by the main threats upon the ecosystem, some conservation measures and recommendations, list of references, and an Arabic summary. Lake Manzala has a maximum length of 65 km and a maximum width of 49 km with a total area of 1200 km<sup>2</sup> by 1980 (the original area was more than 1700 km<sup>2</sup> in 1900). There is an increasing eutrophication in the water body of the Lake as a result of excessive wastewater discharge through the southern drains. Phosphate and nitrate levels in the water have increased approximately three to four times, while Oxygen concentrations have decreased by about 1/3 in the southern part of the Lake. A total of 144 species of vascular plants (62 annuals and 82 perennials) belonging to 107 genera 47 families were recorded in the Lake; 2 of which are endangered (*Nymphaea lotus* and *Nymphaea caerulea*), one is indeterminate (*Lobularia Arabica*) and another one is rare (*Juncus bufonius*). On the other hand, some 170 species of phytoplankton were recorded in the water body of the Lake. A total of 24 zooplankton taxa represented by genera, species or development stage were identified in Lake Manzala. Of these, 3 genera comprised 75 % of the total number of zooplankton (*Cladoceros-Diaphanosoma*, *Bosmina* and *Moina dubia*). In addition, 23 species were recorded in the benthic fauna: of which 15 species were

represented by bivalves and gastropod mollusks, 2 species of annelids and 6 species of arthropods. Twelve species of mammals, 3 of amphibians and 17 of reptiles were also recorded. Although there no checklist for the avifauna of Lake Manzala, but one expected that it would be a figure between the 112 species recorded in Lake Burullus and the 242 species recorded in Lake Bardawil. In general, Lake Manzala is an important breeding site for large numbers of Little Tern, Pied Kingfisher, Kentish Plover, Spur-winged Plover, Graceful Warbler, Egyptian Nightjar, Little Bittern, Purple Gallinule, Collared Pratincole, and Clamorous Reed Warbler. Lake Manzala belonged entirely to the moderate enrichment category, where the estimated fish production was about 190 kg/ha. The southern sector of this Lake (ca. 23 % of its total area) is considered to be an excellent example of ultra-enrichment category, where the estimated potential yield was about 2000 kg/ha. Increased nutrient loading from drain water sources to the Lake elevated its total yield to 74000 ton/yr (census of 2000), thus it is considered the most productive Lake in Egypt. Contribution of Tilapias to the Lake fisheries was increased in the last few years, while the valuable marine fishes were decreased. Population in the wetland of Lake Manzala inhabits different settlements varying from 10000 people to single family plots. The increasing population pressure is in the settlements of areas reclaimed from the Lake or along the drainage canals (e.g. Bahr El Baqar). Fishing activities cover about 70% of the area, agriculture accounts for only 5%, while almost one quarter is essentially unexploited. Hosha, as a form of closed fishing, yields the highest output and net economic return per unit area. Population living in Lake Manzala is suffering from the same health problems of most Egyptians. Health hazards are primarily due to: contamination with chemicals (including heavy metals) from industrial wastes, pesticides from agricultural drains, sewage disposal, gases from organic and chemical decomposition, insect outbreaks and bad sanitary habits. The main recent threats upon the ecosystem of Lake Manzala include the construction of El-Salam Canal which has led to some lands use changes along the shores of the lake, fragmentation of the water body into a number of semi-closed sub-basins, and severe impact upon the vulnerable sand bar.

**2017. Fouda, M. M. National monitoring program for biodiversity and non-indigenous species in Egypt. United Nations Environment Program, Mediterranean Action Plan, Regional Activity Centre for Specially Protected Areas, Tunis. pp. 202.**

The Ecosystem Approach (EA) is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way, as stated by the Convention of Biological Diversity. This process aims to achieve the Good Environmental Status (GES) through the elaborated 11 Ecological Objectives and their respective common indicators. Since 2008, Contracting Parties to the Barcelona Convention have adopted the EA and agreed on a roadmap for its implementation. First phases of the EA process led to the accomplishment of 5 steps of the scheduled 7-steps process such as: 1) Definition of an Ecological Vision for the Mediterranean; 2) Setting common Mediterranean strategic goals; 3) Identification of

an important ecosystem properties and assessment of ecological status and pressures; 4) Development of a set of ecological objectives corresponding to the Vision and strategic goals; and 5) Derivation of operational objectives with indicators and target levels. The remaining 2 steps will include: 6) Revision of existing monitoring programs for ongoing assessment and regular updating of targets; and 7) Development and review of relevant action plans and programs.

**2017. Shaltout, K. H and Eid, E. M. National Progress towards Targets of the Global Strategy for Plant Conservation. Lap Lambert Academic Publishing, Deutschland, Germany 67 pp.**

The Conference of the Parties of the Convention on Biological Diversity (CBD), held in The Hague (April 2002), adopted the Global Strategy for Plant Conservation (GSPC): a strategy that aims at halting the current and continuing loss of plant diversity, as a contribution to poverty alleviation and sustainable development. This strategy was also an innovative advance for the convention as it incorporated for the first time a framework of 16 targets for biodiversity conservation aimed at achieving measurable plant conservation outcomes by 2010. These targets are addressing the five themes of the GSPC: 1- understanding and documenting plant diversity (3 targets), 2- conserving plant diversity (7 targets), 3- using plant diversity sustainably (3 targets), 4- promoting education and awareness about plant diversity (one target), and 5- building capacity for the conservation of plant diversity (2 targets). This book presents the substantial progress that has been made towards reaching the 16 GSPC targets in Egypt.

**2016. Kaky, E. and Gilbert, F. Using species distribution models to assess the importance of Egypt's protected areas for the conservation of medicinal plants. Journal of Arid Environments 135: 140-146.**

Human activities affect the distribution and abundance of plants, with impacts on ecosystem services and human well-being; it is thus vital that a network of Protected Areas is capable of conserving plants that are useful. Using the species distribution (SDM) model algorithm MaxEnt, we tested whether Egypt's network of Protected Areas performs well in conserving the region's important medicinal plant species. We constructed individual SDMs for each species, and then combined the models into a single 'species-richness' layer, which we then compared to the distribution of the existing Protected Areas. Temperature was the most important of eleven predictor variables used to build the SDMs. Assuming the SDM's prediction of suitable habitat was accurate and corresponded to the occurrence of the medicinal plant species, then on average, species richness was significantly higher within than outside the Protected Areas. Based on our findings, Egypt's Protected Areas are effective at conserving its medicinal plants.

**2016. Salem, A. H. Assessing the role of Wadi Allaqi Biosphere Reserve in the vegetation conservation. Ph. D. Thesis, Faculty of Science, Tanta University.**

The present study deals with the analysis of the populations and vegetation communities in Wadi Allaqi Biosphere Reserve, it aims to study the long term vegetation dynamics in terms of survival and mortality of plant populations, and evaluating the role of the core areas as conservational tool in Wadi Allaqi Biosphere Reserve. Ninety-seven species were recorded in the present, which contribute about 76.4% of the 127 species recorded in the same region by Springuel *et al.* (1991- 1994). This investigation demonstrated that 30 species (23.6%) were lost or may be extremely rare within 16 to 19 years. The present study indicated also that 67.8 % of the larger individuals mapped in 2008-2010 were present in 1960s. The study indicated that 94.3% of the population mapped was already present in 1960s and trees grow slowly and are older than expected. This is confirmed by results based on the marginal parenchyma bands of *Acacia tortilis* subsp. *raddiana* woody samples. Annual radial increment growth varied between 0.2 to 2.2 mm yr<sup>-1</sup> and longevity close to 200-649 years. Pollarded trees were detected in the imagery, and the resultant reduction in canopy cover area (CCA) may lead to mis-interpretations in change analyses. Land cover classification indicated that the upstream part vegetation decrease of approximately 18.7%, midstream part decreased by 20.8% and the downstream by 20.9% in the period 1960s-2010. The vegetation cover of some sites at downstream part of Wadi Allaqi expanded from approximately nil to 1774.2 ha (5.1%). In approx. 46 years, the total mortality was 24.6% based on the total detected trees of 1960s imagery. On the other hand, this number was raised to 26.1% based on the total survived individuals. Scenarios used to estimate the age of trees in downstream part suggested an establishment date back to 1885. Domestic and wild animals, can graze and browse on 57 species in Wadi Allaqi (58.8% of the total). In addition to the high palatable species, camels can graze over 20 species that are usually avoided by other animals. Sheep-herding, charcoal production and small-scale cultivation, camel-herding and medicinal plant collections are the main economic activities carried out by the Bedouins of Wadi Allaqi.

**2013. Leach, K., Zalut, S. and Gilbert, F. Egypt's Protected Area network under future climate change. Biological Conservation 159: 490–500.**

Concerns about the impacts of climate change loom large among biodiversity scientists. A pressing issue is the role of Protected Area networks under future climate change, because of the shifting of species distributions polewards due to climate warming. In this study we use two techniques in conservation science: 1- to estimate the likely impacts on the distributions of mammals and butterflies in Egypt (MaxEnt), and 2- to measure the effectiveness of Egypt's Protected Area network (Zonation). We predict that future climate will have significant effects on species richness and the relative value for conservation of sites in Egypt: some areas will increase in species richness, whilst others will decrease significantly. Currently, the sites of highest relative conservation value are found in the Nile Delta, southeastern and Sinai regions of Egypt and along the Mediterranean and Red Sea coastlines, with Protected Areas



having a higher conservation value than unprotected areas. Under future climate scenarios, the relative conservation value of Protected Areas are predicted initially to decline and then gradually increase by the 2080s. It is predicted that many areas, especially the Nile Delta and the southeast, will require extra protection in the future; areas that are currently not protected, but have high species richness and conservation value, may need to be protected to prevent loss of biodiversity.

**2013. Roupael, T., Abdulla, A., Attum, O., Marshall, N. and Ghazali, U. Do Marine Protected Areas in the Red Sea Afford Protection to Dugongs and Sea Turtles? *J Biodivers Endanger Species*, 1: 1.**

Dugongs (*Dugong dugon*) and most sea turtles are threatened by gill nets and other human activities worldwide. In the Red Sea, these animals are potentially isolated from populations in other areas of the world. This isolation would make recovery following major population decline in the Red Sea unlikely. Protected areas are promoted as a management tool to safeguard these animals from human activities. Elba National Park, Egypt, supports populations of dugongs and sea turtles, as well as a growing fishing industry. We undertook a survey of fishers to determine if dugongs and sea turtles formed by catch in Elba National Park. Specifically, we quantified the proportion of fishers operating in Elba National Park who had caught these animals as by catch in fishing nets and the proportion of fishers who perceived that sea turtle eggs were still collected. This study indicates that at least one protected area in the Red Sea is not achieving conservation objectives relating to these animals. Nine and eighty percent of fishers reported having caught dugongs and sea turtles in nets, respectively. Seven percent of fishers perceived that people still collected turtle eggs. Elba National Park is failing to protect these animals for reasons including: it is managed solely as an IUCN Category VI Protected Area; fishers lack awareness of laws pertaining to these animals; and fishers are highly resource dependent. Potential management strategies to reduce by catch include the establishment of IUCN Category 1a Protected Areas in important dugong and sea turtle habitat, encouraging fishers to adopt fishing gear that poses less risk to mega-fauna and raising awareness among fishers of the protected status of dugongs and sea turtles.

**2012. Fouda, M. Our Natural Protectorates. General Organization of Cultural Palaces, Cairo, pp. 503 (in Arabic).**

This book is a summary of the intensive and extensive experience of the author in field of wildlife conservation in general and the Egyptian natural protectorates (ENPs) in particular. It includes 3 parts; the first is an overview on the natural protectorates and their relations with biological diversity, sustainable development, climate change, international conventions, goods and services, human rights and strategic planning, among others. The second part deals with the wildlife conservation in the ENPs including the history of their declaration and short descriptions of the 30 ENPs (they represent 15 % of the total area of Egypt). The third part deals with the future of ENPs

with regard to Data Base, Knowledge Bank, Training Center, Museum of Natural History, and role of ENPs in Scientific research, among others.

**2012. Ibraheem, M. Natural Protectorates in Egypt: Related Laws, Leigisaltions and Conventions. Printshop of Akhbar Alyoum, Cairo (in Arabic).**

This book includes the geographical position of Egypt and River Nile and the importance of the wetlands, biodiversity and climate change, and the reasons for construction of protected areas, as well as examples of the natural resources and the old and recent classification schemes of the natural reserves. It includes also the economic values and management of natural protectorates (with focusing on the bisphere reseves) and their role in the development of ecotourism, as well as the related laws, leigisaltions and conventions. It contains also an overview about the 30 natural protectorates that were initiated according to the law of natural protectorates in Egypt, as well as 14 proposed future protectorates (6 in western desert, 5 in eastern desert and 3 in North Sinai).

**2011. Samy, M., Sánchez Lizaso, J. and Forcada, A. Status of marine protected areas in Egypt. Animal Biodiversity and Conservation 34 (1).**

Egypt has sought to protect its natural resources and marine biodiversity by establishing a network of six MPAs that are generally located in the Gulf of Aqaba and the Red Sea; most of them include interconnected marine and terrestrial sectors based on conserving coral reefs and accompanying systems. We assessed the present status of MPA networks that showed a set of important results manifested in some strengths (*i.e.* proper selection according to specific criteria, management plans, etc.), and also some weaknesses (*i.e.* a relatively small protected proportion of the Egyptian marine territorial waters, significant pressures mainly by tourism activities, etc.). Finally, some recommendations are proposed from this work (*i.e.* incorporate more habitats that are not well represented in the network, especially on the Mediterranean Sea; establishing a touristic carrying capacity of each area; etc.) to improve the current situation.

**2010. Mahmoud, T. Desert Plants of Egypt's Wadi El Gemal National Park. The American University in Cairo Press, Cairo-NewYork.**

This book is a comprehensive illustrated guide to the botanical resources of an Egyptian National Park. The vegetation in Wadi El Gemal National Park in Egypt's Eastern Desert is more diverse than might first be expected, but even more surprising is the relationship that the desert dwellers continue to have with the plant life in their habitat, despite the increasing modernization of their world. As a ranger in the park, Tamer Mahmoud quickly realized the importance of surveying, identifying, and documenting the indigenous plants, and recording the information he compiled from interviews with the local community about how they use the plants for food, healing, animal fodder, and fuel. The result is this detailed and colorful guide, which includes

photographs of each plant, the scientific and local names in Arabic and English, and information on location, distribution, uses, and ecology.

**2010. Shaltout, K. H. Towards Mainstreaming Lake Burullus Biodiversity, North Egypt. Ass. Univ. Bull. Environ. Res. 13 (1): 71-87.**

Lake Burullus is situated in a middle locus between the two branches of the Nile that form the Delta. It is one of a network of Protected Areas throughout Egypt, designated and managed by the Egyptian Environmental Affairs Agency. It is registered as a Ramsar site and the BirdLife International has identified it as an Important Bird Area (IBA). Recent surveys showed rich biodiversity of planktons, higher plants and fauna; including numbers of rare, endemic and threatened species. Fisheries provide the principal life-support system for the inhabitants. Other resource uses include: agriculture, livestock farming, fish farming, reed harvesting, bird hunting, tourism and recreation. This Lake and its surroundings are subjected to ecological and administrative constraints that lead to threaten its biodiversity and to excessive use of resources. To mitigate the impacts of these constraints for conserving its biodiversity, a management plan of five major programs that respond to five principal objectives was suggested: 1- restore ecological and landscape values, 2-maintain and enhance the ecological and landscape values, 3- conserve resources through sustainable management, 4-improve socio-economic opportunities for local people and 5- develop public awareness for nature conservation; projects have been devised for each of these headings. Eight governmental institutions are involved in the management plan: 1- Kafr El-Sheikh Governorate, 2- Nature Conservation Sector, 3- General Authority for the Development of Fisheries Resources, 4- Ministry of Irrigation and Water Resources, 5- Coast Guard, 6- Water and Environment Police, 7- Ministry of Housing and New Communities and 8-Directorate of Public Health. A number of non-governmental associations (NGOs) also play a key role affecting land and resource use in the area. An Advisory Committee comprising all relevant stakeholders, including representatives of relevant ministries, NGOs, local communities and fishermen associations, was designated. The role of this committee should be re-formulated from being merely consultative to themore effective function of decision-making. A further Executive Committee headed by the Manager of the Protectorate will assist the Advisory Committee.

**2010. Zalat, S. S. Perceptions of the environment and wildlife by school students in Egypt. Egyptian Journal of Biology 12: 90-98.**

This paper explores the perceptions of school children and adolescents concerning their current environment, and how they would like it to be. Respondents were asked to do two drawings of their environment, one for the present and another for their desired environment. The results revealed a keen awareness of environmental problems, but little concern about wildlife. Differences between current and desired visions showed remarkable results. Artifacts, pollution and population formed their main concerns: few showed wildlife. The drawings showed clear causes to the various

environmental problems, and some even suggested solutions. It is essential that a curriculum for schools students be established to introduce children to biodiversity and the interdependence between organisms.

**2006. Khalil, M. T. and Shaltout, K. H. Lake Bardawil: Zaranik Protected Area. Publication of National Biodiversity Unit No. 15, Egyptian Environmental Affairs Agency (EEAA), Cairo, 599 pp.**

Lake Bardawil is a part of the Mediterranean coastal lands of Egypt. Its prevalent climate belongs to the dry lands of the southern Mediterranean (low winter rainfall: less than 200 mm/year). For the landform set-up, it is a coastal lagoon with access to the sea through (three) natural and man-made inlets. The lagoon is hypersaline, seawater prevails, it receives little seepage of underground fresh water and limited rainfall and no agricultural drainage (compared to other Delta coastal lakes that receive considerable volumes of semi-fresh water debouched by agricultural drains). The hydrological balance of all these lakes, including Lake Bardawil, is a key ecological factor. Chapter 1 of this book provides a multidisciplinary assessment, sets the scene of the ecological background of Lake Bardawil and its outskirts. Quantitative analyses of water balance of coastal wetlands were among the pioneering studies of this series. Subsequent chapters (2011) are a series of thematic studies, each surveying the ecological significance of one feature or one taxon of the biota recorded in the area. Here data are collected and analysed to uncover their ecological, biogeographical and historical significance. Two aspects of ecology are underlined: biodiversity richness and its significance, and impacts of development (use of natural resources at present and envisaged in future development programmes). Two aspects of biogeography are noted: the palearctic-tropical bird voyages and the Red Sea - Mediterranean biotic exchange via the Suez Canal. Chapter 12 addresses a particularly significant group of rich and diverse avifauna of the regions: c. 242 species including numerous migratory bird species. Because the voyage of the latter group between the temperate north and the warm south, they are of international concern. Their likely role in carrying pathogenic elements was monitored during episodes of avian flu endemic. Lake Bardawil is a site that is valued and hence qualified to the Ramsar list of wetlands of international importance. To these ecological surveys, chapter 14 describes socio-economic features prevalent in the area. These include the processes operative within the communities (socio-cultural) and the relationships of societies and their life-support systems of natural resources in terrestrial (farming, grazing, etc.) and aquatic (fishing, etc.) ecosystems. The understanding of these processes provides bases for assessing the community abilities to contribute to, and participate in, the ecologically sound management of the area. The final chapter outlines elements of the management plan set for the Zaranik Protected Area (PA). It also implies consideration of prospects of expanding the PA to cover the whole area of Lake Bardawil and keeping Zaranik as its core. Because Lake Bardawil and its outskirts provide the life-support systems of associated human communities (fishermen,

farmers, graziers, bird-hunters, etc.), its management needs to be on bases of environment-integrity and not just protection.

**2006. EEAA-NCS. Protected Areas of Egypt: Towards the Future. Ministry of State for Environmental Affairs. Egyptian Environmental Affairs Agency, Nature Conservation Sector, Cairo.**

Since prehistoric times Egypt has relied upon its wealth of natural resources to sustain its civilization. In the 21<sup>st</sup> century, biodiversity has come to be recognized as integral to the health, well-being and prosperity of the country. The challenge facing Egypt is how to balance the needs of a populous developing nation with protection of its biodiversity. Like the rest of the world Egypt faces new and difficult environmental challenges which will likely be exacerbated by the uncertainties of climate change. The increasing loss of biodiversity combined with ongoing desertification contribute to the reduction of the nation's natural productivity. Egypt has made great strides in Protected Area Management in the past twenty years - a relatively short period of time to establish a system that is entirely new to the country. This report looks at the history of Protected Areas in Egypt, the Egyptian experience, and the outlook for the future. There are many success stories, and many things yet to be done to enhance the management of these areas. We have learned that well-managed protected areas are one of the basis of sustainable development. They generate significant investment and rural employment opportunities, contribute to the alleviation of poverty, and thereby constitute a vital element in our strategy to meet Egypt's Millennium Development Goals. We appreciate the assistance of individuals and organizations, national and international, who have contributed over the years to build an effective national network of Protected Areas. Protected Areas are an investment in our future. By maintaining ecological processes in these areas of land and water we are preserving the natural resilience of the resource base, thus retaining options for remedial action as well as economic development that otherwise would be lost.

**2005. Shaltout, K. H. and Khalil, M. T. Lake Burullus: Burullus Protected Area. Publication of National Biodiversity Unit No. 13, Egyptian Environmental Affairs Agency (EEAA), Cairo, 578 pp.**

This book includes an introduction, historical review and 13 chapters in addition to an executive Arabic summary. The first chapter includes the general properties of the Burullus Wetland such as the location, geology, morphometry, habitat types, hydrology, biotic community and climatology. The spacial and temporal variations of twenty water properties were analyzed in chapter 2. The nature of bottom sediments and sedimentation rates were reviewed at the beginning of chapter 3. In chapter 4, the flora and vegetation of the lake proper, its islets as well as the sand bar that separates between the lake and the Mediterranean Sea was presented. An annotated checklist of the recorded species and their distribution among habitats are presented. The flora were analyzed in terms of life form, species diversity, phytogeography and abundance. In addition, an emphasis on the endemic, rare and noteworthy species was done. The

economic importance of the recorded species was assessed in terms of grazing, fuel, medicinal, human food, timber and other uses. This chapter deals also with the problem of common reed (*Phragmites australis*) in the lake taking into account its spacial and temporal variations, water characteristics, nutritive values, economic uses and control techniques. In chapter 5, the phytoplankton was analyzed in terms of species diversity, density and biomass of the three major algal divisions (Bacillariophyta, Chlorophyta and Cyanophyta). The epiphytic algal species on the common submerged hydrophyte *Potamogeton pectinatus* were listed. At the end, this chapter presents a comparison between the phytoplankton of Lake Burullus and that of some North African lakes. Chapter 6 includes a review on the saprotrophism and the oxidized microzones of the bottom sediments in the water bodies, in addition to the actinomycetes and zoosporic fungi in Lake Burullus. Zooplankton and zoobenthos were the subject of chapter 7, which evaluates the present status of the zooplankton and benthos biota (common, rare, disappeared and endemic species, as well as the new records). The seasonal variations of the common species were assessed as well as their population dynamics with emphasis on the eutrophication-indicator species and salinity indicator species. Chapter 8 includes valuable information about the fishes and fisheries of this wetland. This includes the present status of fish species in terms of common, rare, very rare and disappeared species. It includes also, a brief description of 22 fish species including the Latin names, synonyms, common names, status, local and world distribution, biology ecology and economic importance. At the end, the main threats to fisheries of Lake Burullus were diagnosed and recommendations for fisheries management were reported. Chapter 9 deals with the amphibian and reptilian fauna, it contains systematic list for the recorded species taking into account the systematic position, common name, local and world distribution, preferable habitat, ecology and status of each species. Chapter 10 includes the habitat types supporting important water birds in Lake Burullus, breeding birds, and bird surveys. An annotated checklist of the birds which recorded during several bird surveys are presented, in addition to tables include the status, abundance, national and world distribution of the recorded bird species. An emphasis was done on economic importance of bird species such as waterfowl hunting and capturing of the birds of prey. Chapter 11 includes a list of the recorded mammalian fauna with focusing on the acceptable Latin names, common names, observation localities in Burullus, national and world distributions, brief morphological descriptions, comparisons with the nearest species, types of habitat and ecology, with remarks from the previous literature. Chapter 12 deals with the socioeconomic development including glimpses about the history and importance of Burullus Wetland, environmental setting, demographic development, economic activities such as tourism, agriculture and fisheries (economics of fishing, livestock, reeds and bird catching). It includes also the results of a survey about education status and fishing activities. The management plan for Burullus Protectorate was the subject of chapter 13, the document of this plan was prepared by the MedWetCoast Project; includes 5 main parts: background, site description, evaluation and objectives, implementation and plan of action.

**2003. Khalil, R. and Ali, D. Egypt's Natural Heritage. SNP SPrint Pte Ltd, Singapore.**

This book presents a photographic documentation of the beauty and diversity of the nature of Egypt and its wildlife. It should help its readers to identify many of the species they encounter on their Egyptian travels. Through the photographs and text, we are taken from the west of the country in a meandering easterly direction, pausing at characteristic areas of Egypt's diverse and remarkable habitats. The authors point out that a few of their photographs record natural sites that no longer exist, reminding us that we are the trustees of Egypt's natural heritage.

**2003. Grainger, J. People are living in the park. Linking biodiversity conservation to community development in the Middle East region: a case study from the Saint Katherine Protectorate, Southern Sinai. Journal of Arid Environments 54: 29–38.**

The Saint Katherine Protectorate is one of Egypt's largest protected areas and includes the country's highest mountains. This arid, mountain ecosystem supports a surprising biodiversity and a high proportion of plant endemics. The protectorate contains religious and culturally significant sites, including Mount Sinai and the Monastery of Saint Katherine. Seven thousand Bedouin from six tribes live in or around the protectorate. Recent development pressure, catalysed by tourism, has resulted in the natural resource base of this fragile region being over-exploited. An integrated management plan is under development to conserve the area's natural and cultural heritage, and ensure community participation while expanding opportunities for sustainable tourism. Local community guards now enforce a conservation ethic in one of Egypt's most spectacular and fragile regions.

**2002. WRPA. Wadi el Rayan, Gateway to the Western Desert. Wadi el Rayan Protected Area (WRPA), EEAA, Egypt.**

Wadi el Rayan protected area represents the ecological complex combining man-made lakes with an extremely arid natural background and landforms showing the interaction of environment and history. The area is a sub-depression forming part of the Fayoum depression, one of the largest in Egypt's Western Desert. The ancient history of the depression included phases of connection with the River Nile and a large lake (Moeris). At present, Bahir Yousef channel connects the main Fayoum depression with the Nile and provides irrigation water for its farmland. Wadi el Rayan part of the depression was at one time considered for a flood storage project, but this scheme was shelved when the Aswan High Dam was built. Wadi el Rayan was later developed to receive excess drainage water from the Fayoum depression, leading to the formation of its two man-made lakes. Wadi el Rayan area now combines the original desert habitat and a number of fresh water springs (micro-oases) with the man-made wetland habitat of the newly formed lakes. These lakes have attracted a variety of birds and other wildlife, and allowed a range of resource uses, including fish farming, agriculture and recreation. The inventories and ecological surveys of Wadi el Rayan

Protected Area summarized in the present volume, as well as the management schemes implemented in this important nature reserve, are the outcome of a collaborative endeavor between Italy's General Directorate for Development Cooperation and the Egyptian Environmental Affairs Agency.

**2002. Mikhail, G. Egypt's Biodiversity and the Quest for Conservation. Ministry of State for Environmental Affairs - Egyptian Environmental Affairs Agency, Image House, Cairo.**

This book contains information about significance of biodiversity in Egypt, diversity of species, eco- zones of Egypt, indigenous people, medicinal plants, the nature conservation sector, objectives of conservation, strategy and action plan, achievements in implementation of the CBD from Rio to Johannesburg, protected areas, laws and regulations, conservation programs, eco- tourism, cooperation with the international community, visitor centers, research and monitoring, training centers and Egypt's future conservation agenda.

**2002. Sabry, H. Y. Towards A Categorization of Protected Areas in Egypt. M. Sc. Thesis, Cairo University, Faculty of Engineering, Department of Architecture.**

Egypt's biodiversity is being lost at an accelerated rate. Unless mitigation measures are taken, Egypt will stand to lose most of its natural heritage. Protected area is one way to control biodiversity deterioration. Under Law No.102/83 concerning nature protectorates, 21 Protected Areas have been declared. There is no provision in the law concerning protected area categorization. Therefore, this study was undertaken to propose a new categorization framework for Egypt's protected areas. This research is based on examining and analyzing the literature on Natural Protected Areas Management System through review of the IUCN Management Category System and assessment of previous experience in Nature Protected Area Management System in 4 selected countries. Based on the review and the assessment, a Management Category System is proposed which is based on identifying clear management objective, promotes values, relationship between man and nature, and hierarchy. This category system can be used as a base for developing the regulation system, the management system and for planning the Protected Area.

**2000. Bishai, H. M., Abdel- Malek, S. A. and Khalil, M. T. Lake Nasser. Egyptian Environmental Affairs Agency (EEAA). Nature Conservation Sector (NCS). Publication of National Biodiversity Unit- No. 11.**

This volume does two principle things: (1) collects basic ecological data and renders it available to research workers, managers and decision markers; (2) clarifies the significance of these data and information contained therein and analyses the ecological processes and their significance, whether scientific or applied, as they related to the water body or its adjoining territories. The scheme of this remarkable treatise organizes the presentation and analyses of information in 13 chapters. Chapters 1-4 address the physical, hydrological and chemical attributes of the water



body of Lake Nasser and its environs. Chapters 5-8 deal with the biota, its diversity and ecology, including the fish fauna and its history. Chapters 9-11 deal with fisheries: assessment, development and management, including the farming. Chapter 12 reviews information on reptilian and avian fauna. The final chapter (13) compares the features and ecological attributes of this lake with other man-made lakes (reservoirs).

## Chronology of the Listed Publications

**(2018)**

- Abdelmeneam, B. E., Ahmed, M. I., Madkour F. F. and Hanafy M. H (2018). Phylogenetic relationships and taxonomy of three species of family Lethrinidae in the Red Sea, Egypt. *Egyptian Journal of Aquatic Biology & Fisheries Zoology* 6131, 22(1): 15-22.
- Abdelsalam, K and Mona, M (2018). First record of Brachyuran crab *Eurycarcinus integrifrons* de Man, 1879 from the Egyptian Mediterranean Sea. *Cahiers de Biologie Marine* 3 (59).
- Abbass S; Madkour F and Abu-Elregal M (2018). Checklist of phytoplankton species in the Egyptian Red Sea Coast of Hurghada. *Egyptian Journal of Aquatic Biology & Fisheries* 22 (2): 93- 101.
- Abomohra, A., El-Naggar, A. H. and Baeshen, A (2018). A. Potential of macroalgae for biodiesel production: Screening and evaluation studies. *Journal of Bioscience and Bioengineering*, 125 (2): 231-237.
- Alsherif, E (2018). Exploration of unconventional fodder for arid land Rehabilitation. *Arid Land Research and Management* 32 (3): 337-350.
- El-Khalafy, M (2018). The red list of endemic and near-endemic species in Egypt. M. Sc. Thesis, Faculty of Science, Tanta University.
- El-Sheekh, M., Abomohra, A., Eladel, H., Battah, M. and Mohammed, S (2018). Screening of different species of *Scenedesmus* isolated from Egyptian freshwater habitats for biodiesel production. *Renewable Energy* xxx:xxx-xxx.
- El-Ziletny H. A (2018). Ecological and phytochemical studies on the arable weed *Malva parviflora* L. in its different habitats. Ph.D. Thesis, Faculty of Girl, -Ain Shams University.
- Farahat E.A. and Galal T.M (2018). Trace metal accumulation by *Ranunculus sceleratus*: implications for phyto-stabilization. *Environmental Science and Pollution Research*. 25(5): 4214–4222.
- Farghaly, M (2018). Diversity of seaweeds and seagrasses in the Egyptian Mediterranean coastal eco-zones. *J Coast Zone Manag*, 21.
- Gabr, A. M. (2018). Fine and aesthetic values of the elements of natural reserves and benefit from them in the formation of metal pendants. Master of Specific Education, Faculty of Specific Education, Tanta University, Tanta, pp. 211.
- Habib, M. (2018). Sandwich Terns breeding at Port Fouad, Egypt, in June 2017. *Dutch Birding* 40: 168-171.
- Habib, M. I. (2018). Breeding Status of Ospreys in Egypt (Red Sea) from 2012 to 2018. *Proceedings of Conferences, Raptors Conservation*, Suppl. 1.
- Habib, M. I., Megally, M and Pröhl, T. (2018). Breeding behaviour of Desert Owl in Egypt. *Dutch Birding* 40: 82-89.
- Mansour K.H (2018). Evaluation of some aquatic macrophytes for their capacity to remove water pollutants from the main water courses in Greater Cairo, Egypt. M.Sc. Thesis, Helwan University.

- Ng P, Abosalem K, Mona M and Nour El-Deen M (2018). A synopsis of *Eurycarcinus* A. Milne-Edwards, 1867 (Decapoda, Brachyura, Pilumnidae). *Crustaceana* 91 (4): 471-487.
- Nour El-Deen S and Thomas R (2018). First record of fossil Trachycarpeae in Africa: three new species of *Palmoxylon* from the Oligocene (Rupelian) Gebel Qatrani Formation, Fayum, Egypt. *Journal of Systematic Palaeontology*, 16 (9): 741-766.
- Sadek, M. A., Madkour, F. F, Ismail, A. and Hanafy, M. H (2018). Comparative morphology on some sclerectanian corals in Arabian Gulf and the Egyptian Coast of the Red Sea.
- Sanderman J, Hengl T, Fiske G, Solvik K, Adame M, Benson L, Bukoski J, Carnell P, Cifuentes-Jara M, Donato D, Duncan C, Eid E, Ermgassen P, Lewis C, Macreadie P, Glass L, Gress S, Jardine S, Jones T, Sanders E, Spalding M and Landis E (2018). A global map of mangrove forest soil carbon at 30 m spatial resolution. *Environ. Res. Lett.* 13.
- Shalaby, A. I (2018). Environmental assessment of the artificial forests in the western desert of Egypt. M. Sc. Thesis, Faculty of Science, Tanta University.
- Shaltout K. H (2018). Reed Products from Lake Burullus, Egypt. Finlayson CM et al. (eds.), the Wetland Book. Springer Science & Business Media B.V.
- Shaltout, K. H. and Galal, T. M. (2018). Ecosystem of Manzala Wetland: Ecological, Biological and Conservational Aspects. Lap Lambert Academic Publishing, Deutschland, Germany, 125 pp.
- Shaltout, K. H., El-Bana, M. I. and Eid, E. M (2018). Ecology of the Mangrove Forests along the Egyptian Red Sea Coast. LAP Lambert Academic Publishing.
- Shao, W., Ebaid, R., Abomohra, A. and Shahen, M (2018). Enhancement of *Spirulina* biomass production and cadmium biosorption using combined static magnetic field. *Bioresource Technology*, 265: 163–169.
- Wang, S., Uzoejinwa, B. B., Abomohra, A., Wang, Q., He, Z., Feng, Y., Zhang, B. and Hui, C (2018). Characterization and pyrolysis behavior of the green microalga *Micractinium conductrix* grown in lab-scale tubular photobioreactor using Py-GC/MS and TGA/MS. *Journal of Analytical and Applied Pyrolysis* 135:340–349.
- Youssef M and El-Sorogy A. (2018). Agglutinated foraminifera from the Campanian-Maastrichtian Kiseiba Formation in the Kurkur area, Egypt. *Arabian Journal of Geosciences* 11: 171.

### (2017)

- Abdelaal, M (2017). Current status of the floristic composition in Wadi Hagul, Northwest Suez Gulf, Egypt. *Rend. Fis. Acc. Lincei* 28: 81–92.
- Abd El-Ghani, M., Huerta-Martínez, F., Hongyan, L. and Qureshi, R (2017). Plant Responses to Hyperarid Desert Environments. Springer.
- Abd-Elhamid, W. S (2017). Ecological Studies on Some Marine Gelatinous Zooplankton in the Egyptian Coasts. M. Sc. Thesis, Port Said University, Faculty of Science, Department of Zoology.

- Abdelnaby, F (2017). First record of family Pisionidae (Polychaeta) from Gulf of Aqaba Egypt. *Egypt. J. Exp. Biol. (Zool.)*, 13(1): 109 – 114.
- Abomohra, A., El-Sheekh, M. and Hanelt, D (2017). Screening of marine microalgae isolated from the hypersaline Bardawil lagoon for biodiesel feedstock. *Renewable Energy* 101: 1266-1272.
- Abo-Shady, A. M., Khairy, H. M., Abomohra, A., Elshobary, M. E. and Essa, D (2017). Influence of algal bio- treated industrial wastewater of two companies at Kafr El-Zayat city on some growth parameters of *Vicia faba*. *Egypt. J. Exp. Biol. (Bot.)*, 13(2): 209 – 217.
- ASRT – NRC (2017). *Egyptian Encyclopedia of Wild Medicinal Plants: Volume 1 (Acacia - Alternanthera)*. Academy of Scientific Research and Technology, Printshop of Al-Ahram, Cairo.
- Badawy, A. A (2017). Ecological studies on *Origanum syriacum* subsp. *sinaicum* plant in south Sinai, Egypt. M. Sc. Thesis in Agricultural Sciences (Environment and Bio-Agriculture). Faculty of Agriculture, Al-Azhar University, Cairo.
- Ebaid, E., Elhussainy, E., El-Shourbagy, S., Ali, S. and Abomohra, A (2017). Protective effect of *Arthrospira platensis* against liver injury induced by copper nanoparticles. *Orient Pharm Exp Med*, 17: 203–210.
- Eid E, Shaltout K and Al-Sodany Y (2017). *Population Ecology of Ipomoea carnea*. Lap Lambert Academic Publishing, Saarbrücken, Germany, 119 pp.
- Eid, E. M, Moghanm, F. S and Shaltout, K. H (2017). Effect of the different types of land-use on the distribution of soil organic carbon in north Nile Delta, Egypt. *Rend. Fis. Acc. Lincei* 28: 481–495.
- Eid, E.M, Keshta, A. E, Shaltout, K.H, Baldwin, A. H and Sharaf El-Din, A. A (2017). Carbon sequestration potential of the five Mediterranean lakes of Egypt. *Fundam. Appl. Limnol.* 190/2: 87–96.
- Eid EM and Shaltout KH (2017). Growth dynamics of water hyacinth (*Eichhornia crassipes*): a modeling approach. *Rend. Fis. Acc. Lincei* 28: 169–181
- El-Barougy R. F (2017). *Phylogenetic Diversity and Performance of the Invasive Species Ipomoea carnea Jacq. in the Nile Delta*. Ph. D. Thesis, Faculty of Science, Damietta University.
- El-Barougy R, Cadotte M, Khedr, Nada R and Maclvor J (2017). Heterogeneity in patterns of survival of the invasive species *Ipomoea carnea* in urban habitats along the Egyptian Nile Delta. *NeoBiota* 33: 1–17.
- El-Gayar S, El-Nsaf E, El-Naggar H and Mona M (2017). Intertidal Macro-benthos diversity and their relation with tourism activities at Blue Hole Diving Site, Dahab, South Sinai, Egypt. *SYLWAN* 161 (11).
- Elnaggar, M. S (2017). Isolation and structure elucidation of bioactive metabolites from marine organisms and associated endosymbionts. M. Sc. Thesis, Ain Shams University, Faculty of Pharmacy, Department of Pharmacognosy.
- El-Kahawy RM and Abd El-Wahab M. (2017). Environmental factors controlling benthic foraminiferal distribution in Hurghada area, Red Sea coast, Egypt. *Geophysical Research Abstracts* 19.

- El-Saadawi, W., Ziada, N., El-Faramawi, M., Kamal El-Din, M. and Loutfy, M (2017). The Cairo Petrified Forest revisited. *Review of Palaeobotany and Palynology* 238: 34–42.
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## Conclusion

Based on the available data, Egyptian biodiversity contributes 1.7 % of the world biota, although the area of Egypt contributes only 0.7 % of the world area. The most represented groups are fungi (8.5 % of the world figure), followed by algae (5.6 %), fishes (5.5 %) and birds (5.2 %). On the other hand, the less represented groups are flora (1.0 % of the world figure), bryophytes (1.2 %), insects (1.3 %), lichens (1.4 %) and reptiles and amphibians (1.4 %).

1- The first chapter of this bibliography includes the essential references that cover the

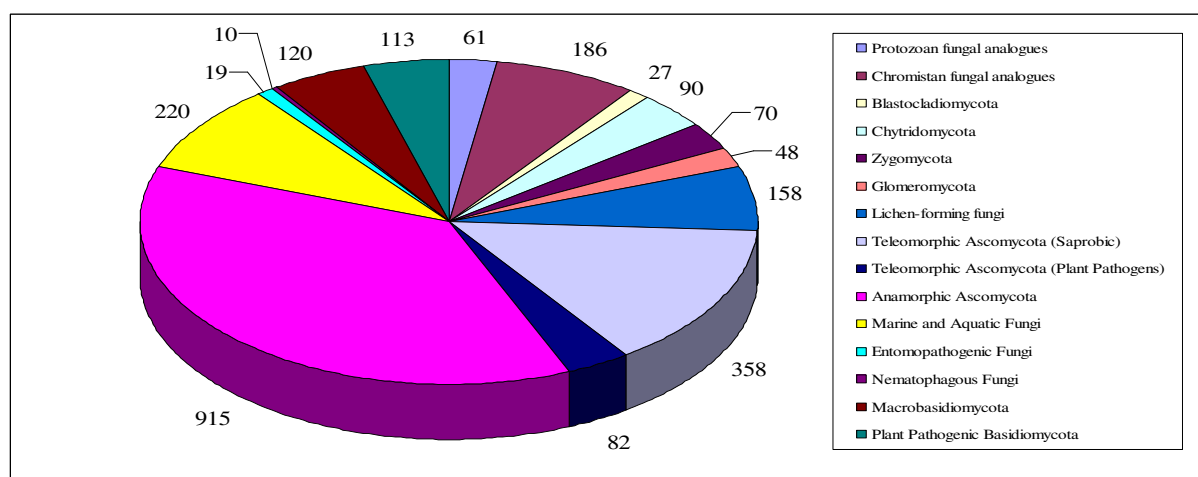
<b>Taxonomic group</b>	<b>Biodiversity in Egypt</b>	<b>Biodiversity in the world</b>	<b>Egypt's contribution (%)</b>
Flora	2365 taxa	248,428 taxa	1.0 %
Bryophytes	194 taxa	16,600 taxa	1.2 %
Algae	1500 taxa	26,900 taxa	5.6 %
Fungi	2477 taxa	28,983 taxa	8.5 %
Bacteria	157 taxa	4,000 taxa	3.9 %
Lichens	250 taxa	18,000 taxa	1.4 %
Arachnida	1565 taxa	92,343 taxa	1.7 %
Insects	10,000 taxa	751,000 taxa	1.3 %
Fishes	1050 taxa	18,993 taxa	5.5 %
Reptiles and amphibians	119 taxa	10,484 taxa	1.4 %
Mammals	125 taxa	4000 taxa	3.1 %
Birds	470 taxa	9040 taxa	5.2 %
<b>Total</b>	<b>20115</b>	<b>1,197,871</b>	<b>1.7 %</b>

whole flora and vegetation of Egypt (Boulos 1999-2005); encyclopedia of a certain topic such as the wild medical plants in the Egyptian flora (ASRT-NRC 2017); or the checklists of certain animal groups such as reptiles and amphibians of Egypt (Baha El-Din 2006) and spiders of Egypt (El-Hennawy 2016).

2-The second chapter deals with the publications on the vascular flora and vegetation which are classified, according to the phytogeographical regions, into four groups: 1- Nile region and wetland, 2- eastern desert and sinai, 3- western desert and oases and 4- publications in more than one region. In general, the vascular plants in Egypt include 2365 taxa (2145 species and 220 infra-specific taxa) of native and naturalized vascular plants, belonged to 755 genera and 129 families (Boulos 2009). This figure approximates 1.0% of the world figure of 248,428 taxa.

3- Chapter 3 deals with the publications on the alien vascular plants in the Egyptian flora. These publications include an evaluation of the total aliens which approximates 136 species categorized as follows: 49 casuals, 81 naturalized and 6 invasive species (Shaltout 2014). Other publications deal with evaluation of only one alien such as *Ipomoea carnea* (Eid et.al. 2017). In a reassessment study under finalization (Salma Shaltout 2018, personal communication), the number of alien flora in Egypt reached 250 species (114 casuals, 129 naturalizers and 7 invasive).

- 4- Chapter 4 includes the publications on the Egyptian bryophytes which approximate 194 species and subspecies: 181 mosses and 13 hepatics (El-Saadawi et. al. 2003, 2007 and 2015). The Egyptian figure approximates 1.2 % of the world figure of 16,600 taxa of Bryophyta.
- 5- Chapter 5 includes the publications dealt with the Egyptian agro-biodiversity, which is very rich and exceeds that of the Egyptian natural flora. In a recent study by Ammar (2015), the ornamental flora in Nile Delta only, including Cairo and Alexandria, was 2392 species and infra-species belonged to 940 genera and 176 families.
- 6- Chapter 6 includes the publications on the phytoplankton in the Egyptian wetlands of fresh and brackish water, other than in the marine ecosystems that included the chapter of Marine Biology. Unfortunately, no checklist for the algae in Egypt (Phytoplankton and macro-algae) is available, but the rough estimate is approximately 1500 taxa which approximates 5.6% of the world algal flora of 26, 900 taxa, but it is thought to be under-estimating the actual number of this biotic group in Egypt. For example, the study of Essa (2012) on the northern lakes of Egypt reported 867 taxa of phytoplankton related to 9 algal divisions, 102 families and 203 genera. In addition, Shabaka (2018) recorded 187 species of sea weeds from the Egyptian Mediterranean water. We think that the available publications are suitable and sufficient to prepare a recent checklist for the algae of Egypt as a whole.
- 7- Chapter 7 deals with the publications on fungi and lichens. Fungi approximate 2477 taxa (Abdel-Azeem 2018), which represent 8.5 % of the world fungal taxa of 28,983. Fortunately, a study by Seaward and Simpson (2006) is available about the lichens of Egypt which approximate 250 species with a remarkably poor representation of many common groups such as Parmeliaceae; this represents 1.4 % of the world lichen tax taxa of 18,000. It must be a priority to concentrate our studies on the lichen biodiversity in order to prepare acceptable verified checklist for this biotic group.



(Abdel-Azeem 2018)

- 8- Unfortunately, there is no available recent figure for the bacteria and viruses in Egypt; but the rough estimate is approximately 44 viruses and 157 bacteria (excluding cyanobacteria). The Egyptian bacterial figure approximates 3.9 % of the world figure of 4000 taxa, but it is thought to under-estimate the actual number of this microbiological group in Egypt.
- 9- Chapter 9 includes the publications on Arachnida which approximate 1565 taxa that represent 1.7 % out of the world Arachnida of 92,343 taxa (El-Hennawy 2016). A private Arachnida collection is available at Hesham El-Hennawy, the Initiator of the Egyptian Arachnida Collection.
- 10- Chapter 10 deals with the publications on insects. A rough estimate of 10,000 insect taxa was recorded from Egypt out of the world figure of 751,000 taxa (1.3 %). It is recommended to prepare a recent checklist for insects in Egypt. Fortunately, a book on the butterflies of Egypt was published by Gilbert and Zalat (2007).
- 11- Chapter 11 deals with the publications on the fishes in the fresh and brackish water, other than the fishes of the marine ecosystems which included in chapter of Marine Biology (Zoological Studies). Overall, 956 fish species (71 Elasmobranchii, 2 Holocephali and 883 Actinopteri) have been recorded to date from the Egyptian marine waters: of those, 592 species are present only in the Red Sea, 263 species are present only in the Mediterranean Sea, and the remaining 101 species are reported from both seas (Haroun et al 2017). In addition, 94 species were recorded from the fresh water of the Nile and its connected canals and drains (85 natives and 9 introduced; of the natives 22 are common, 49 are rare and 14 are extinct). Thus, the estimate of fish species in Egypt, including those of the marine ecosystems, is 1050 taxa out of 18,993 taxa as a world figure (5.5 %).
- 12- Chapter 12 includes the published studies on the reptiles, amphibians and mammals in Egypt. Egyptian reptiles are 109 taxa, while amphibians are 9 taxa (Baha El-Din 2006) out of 10,484 as a world figure (1.4 %). In addition, Egyptian mammals approximate 125 taxa (Hoath 2003) out of a world figure of 4000 (3.1 %).
- 13- Chapter 13 deals with the publications on the alien fauna in Egypt. Unfortunately, there no collective study deals with the total alien fauna in Egypt, such as that of the Egyptian flora. Studies are available on some alien fauna in Egypt such as that of

Ibrahim and Khalil (2009) on the fast spreading of fresh water invasive crustacean (i.e. red swamp crayfish). Extensive work should be done to collect the alien fauna of Egypt based on the taxonomical hierarchy of the animal kingdom.

14- Chapter 14 includes the publication on the birds. The Egyptian figure is around 470 taxa (Porter and Cottridge 2001) out of 9040 taxa as a world figure (5.2 %). It is worth to mention that the available publications on the Egyptian birds are too limited, thus further efforts should be done for enriching our knowledge on the Egyptian avifauna.

15- Chapter 15 includes the publications on the zooplankton in fresh and brackish water, other than those in the marine ecosystems which included in chapter 16 (Marine Biology). In the view of the available literature, we recommend to start the preparing of a complete checklist for the Egyptian zooplankton in the fresh, brackish and marine aquatic bodies.

16- Chapter 16 deals with the studies published on the marine biology in the Mediterranean and Red Seas. This chapter was divided into three groups of studies: 1- botanical studies (i.e. seaweeds and sea grasses), 2- zoological studies and 3- phytoplankton – zooplankton studies.

17- Chapter 17 deals with the publications on paleobiology including the macro-fossils of higher plants (Nour El-Din 2015) and nano-fossils of phytoplankton and other related biota (Mohamed and Shabaan 2017). Based on the present knowledge, Egypt is the richest African country in the number of recorded macrofossil palm remains (Kamal El-Din et al 2013).

18- Chapter 18 included the publications on the goods and services offered by the Egyptian plants, animals and microorganisms. Goods are defined as the organisms and their parts and products that grow in the wild and are used directly for human benefits such as grazing and browsing (e.g. Heneidy and Waseem 2007). On the other hand, services are those valuable ongoing streams of benefits provided by thriving ecosystem. One of the most important services is the role of the Egyptian wetlands and their biota in carbon sequestration process which plays a valuable role in mitigation of global warming (e.g. Eid et. al. 2017). Some studies on the use of plants as phytoremediators and for production of biofuel are also included.

19- Chapter 19 deals with the publications on the chemistry and pharmacology of the plants (e.g. Abdou 2015), animals (e. g. El-Saify 2015) and microorganisms (e. g. Mohamed 2012) in Egypt. Such studies aim for searching of new and bioactive natural products, studying the chemical diversity and biochemical activity of the secondary metabolites, explaining the substances which play roles in the medical use of different biota as well as assessing their pharmacological activities.

20- Chapter 20 includes the publications dealt with the Egyptian net of natural protectorates such as the study of the components of their whole ecosystems including their management plans (e.g. Shaltout and Khalil 2005, Khalil and Shaltout 2006); their role in the application of the global strategy for plant conservation (e.g. Shaltout and Eid 2017); or their characterization, related laws, legislations and conventions (e.g. Ibraheem 2012). An overview on the Egyptian natural protectorates (ENPs) and their relations with biological diversity, sustainable development, climate change, international conventions, goods and services, human rights and strategic planning is presented by Fouda (2012). His book deals also with the wildlife conservation in the ENPs including their history, declaration as well as short descriptions of the 30 ENPs that represent 15 % of the total area of Egypt.



## Suggested Recommendations

- 1- According to the available publications, the Egyptian bryologists are invited to prepare a book that collects all the previous studies on the Egyptian bryophytes including brief descriptions for the recorded species together with line drawings and identification keys as well as distribution maps for all species or the critical endemic ones.
- 2- Regarding the agro-biodiversity in Egypt, further studies should be widening to cover the all the Nile Region (a recent study by Esraa Ammar has been carrying out in Botany Department, Faculty of Science, Tanta University), as well as the Eastern Desert (including Sinai) and Western Desert (including the Oases).
- 3- Unfortunately, no checklist for the phytoplankton in Egypt is available, although there are numerous published data that are suitable to prepare such checklist. Thus an initiative should be taken to prepare a complete checklist for this biotic group in the fresh, brackish and marine aquatic bodies.
- 4- It must be a priority to concentrate our studies on the lichen biodiversity in order to prepare acceptable verified checklist for this biotic group.
- 5- As the 10000 insect species known from Egypt underestimate the insect diversity in our country, thus further studies need to be carried out to verify the 5 volumes prepared by Prof. Ali Morsy and his students during the nineties of the last century. After this analysis, a checklist for the insect species in Egypt could be prepared.
- 6- Extensive work should be done to collect the alien fauna of Egypt based on the taxonomical hierarchy of the animal kingdom, and classify them according to their alien status (e.g. casual, naturalized and invasive species).
- 7- Unfortunately, there is no available list for the zooplankton at the national level, thus it is urgent to prepare an Egyptian checklist for this important group in the fresh, brackish and marine aquatic bodies, based on the recent publications under these topics.
- 8- The Egyptian paleo-biologists in Botany, Zoology and Geology Departments should work together to publish a book dealing with the Egyptian paleobiology. Such type of studies will lead to high ranking the Egyptian biodiversity at the international scale (based on the present knowledge, Egypt is the richest African country in the number of recorded macrofossil palm remains).