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PLANNING FOR TOMORROW: THE FUTURE OF ENTOMOLOGICAL INVESTMENTS

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The Florida Entomological Society Pioneer Lecture honored William and Nadine McGuire during the Annual FES Meetings, Jul 16-19, 2007 for their accomplishments and contributions to science, culture, and the world at large. It is indeed fitting that we recognize them for their remarkable detailed scientific research contributions on the life histories and taxonomic relationships of the poorly known skipper butterflies (Hesperioidea), especially the genus *Hesperia* and the subfamily Megathyminae, which are exceedingly difficult groups. In addition, the McGuires have provided a leadership role in emphasizing the need for entomological and other collections of organisms as biological research resources for scientific investigation and for educating the general public at large about natural history. The McGuires (Fig. 1) have a keen interest in endangered species, biodiversity, conservation and the environment, and the major role that entomological collections, especially Lepidoptera as bioindicator species can play in documenting species diversity over time. Finally and not in the least, we wish to honor and recognize them for their extraordinary philanthropy in founding the McGuire Center for Lepidoptera and Biodiversity at the Florida Museum of Natural History, University of Florida, and their continued support for training of graduate and undergraduate students at the University of Florida and elsewhere throughout the U.S.A.

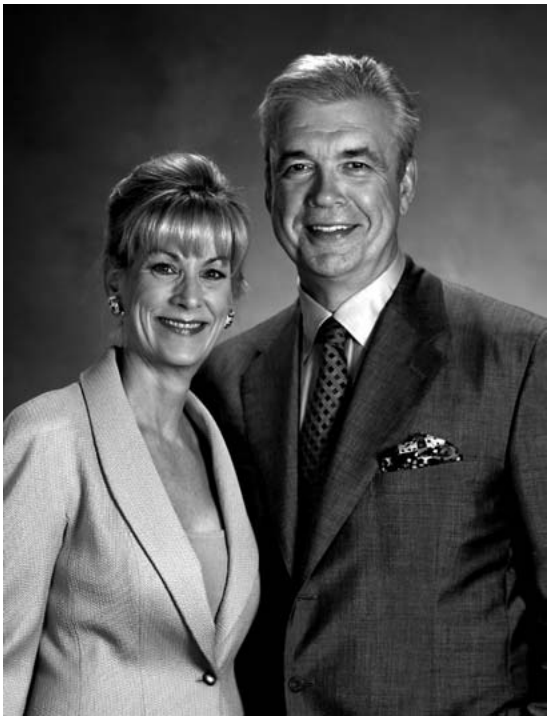

Fig. 1. Nadine and William McGuire.

HISTORICAL PERSPECTIVE

William McGuire is an accomplished physician. He received a B.A. from the University of Texas, Austin, in 1970, and his medical degree from the University of Texas Medical Branch at Galveston, Texas in 1974. His talents in cardiopulmonary and trauma care medicine were honed at the University of Texas, the Scripps Institute in California, and the Penrose/Broadmoor Hospital complex in Colorado Springs, Colorado. By 1984, his extraordinary medical and management skills attracted the attention of the president of a small, nascent HMO in Colorado Springs: Peak Healthcare Systems. Starting as Vice President, he soon became President and CEO. In 1988 he became Executive Vice-President of United Healthcare, and the President in 1989. During the next 2 decades, until his retirement in Dec 2006, his talents, insights, and vision built United Health into a $30-billion corporation and the leading health maintenance organization in the world.

As we recognize the McGuires' entomological contributions, it is serendipitous that the Florida Entomological Society Meetings have convened in Sarasota, Florida, this year. One of Bill McGuire's major mentors, Arthur C. Allyn, lived here for many years. An owner of the Chicago White Sox, in addition to a wide variety of national and international businesses, including aviation interests and the Sarasota Jungle Gardens, Allyn was a well known philanthropist in Chicago and also in Sarasota. He was also the Director and founder of the Allyn Museum of Entomology, based in a small building adjacent to the Sarasota Jungle Gardens where Drs. Jacqueline and Lee Miller served as the curatorial staff. Bill McGuire became well acquainted with Arthur Allyn during occasional visits to the Museum collections during the mid-80s. When Dr. Allyn also became Director of the San Diego Natural History Museum in 1979-1980, the friendship between Allyn and the McGuires was rekindled as they interacted on a regular basis. For the record, Arthur Allyn do-

nated the facilities, research collections of more than 900,000 specimens, equipment and other assets of the Allyn Museum to the University of Florida Foundation, Inc. and the Florida Museum of Natural History in 1981. The extensive collections of the Allyn collections and its phylogenetic arrangement became the foundation of the extraordinary comprehensive McGuire Center butterfly holdings.

Research

Like his mentor, Arthur Allyn, Bill McGuire is an exceptional, self-taught amateur taxonomist, and Lepidoptera is his foremost avocation. During his meteoric rise in the medical business world, Bill did not forget his roots in the natural sciences. As a medical student, he and Nadine were already building the world's finest collection of the Giant Skipper butterfly subfamily, Megathyminae, as well as the *Hesperia* skippers. Often Bill would find different *Hesperia* populations or an unusual set of Agave or Yucca plants (the hosts for *Agathymus* and *Megathymus*) growing in a distinctive habitat. Later while Bill was confined by coursework, the medical practice, or business, he would send Nadine out to revisit these field sites, to make observations, obtain eggs and larvae with the proper foodplant, and bring live material back home to complete the life history. Thus, with her assistance and some help from others on the life history studies, he described a number of new taxa from California, Texas, and elsewhere in the western United States. These were in-depth research studies, and prior to 1982, they had examined and made observations on 64 populations of *Hesperia* representing 31 species and subspecies. All of these taxa were reared completely or in part from ova with detailed notes and preserved immature stages. While all *Hesperia* generally deposit eggs directly on grasses, some species deposit eggs on adjacent plants. McGuire (1982a) predicted great diversity in oviposition substrates and foodplants, and noted that basic field observations and field and laboratory rearings will be the cornerstones of this search and must be actively encouraged.

In another paper published in 1982, McGuire focused on documenting the significance of temporal and spatial relationships in the genus *Hesperia* and their associated foodplants in Texas based on data derived from private and public collections. He visited private and museum collections and began to note the differences in terms of temporal distributions of various species. Some species, for example *Hesperia viridis*, are bivoltine, but the emergence period is spread out over 2 to 3 months, while others such as *H. metea licinius*, a more common species, are multivoltine throughout the flight period. Although Don MacNeil had noted some temporal differences, Bill and Nadine took the opportunity to investigate and detail this aspect of *Hesperia* biology. Again, the McGuires noted the importance of well documented specimens in collections with field observations and life history information. Their research on *Hesperia* set the standard for life history studies on this genus and encouraged others to look beyond morphological examination and include life history, spatial and temporal, and behavior studies as well.

To date, McGuire has authored or co-authored 5 papers with additional research to be published. His first 3 papers were published in the Bulletin of the Allyn Museum (1975, 1982a, 1982b), with two others published in a major volume, Systematics of Western Butterflies (1998). His interest in the Hesperioidea has continued, and these publications are still widely acclaimed for their accuracy and detail. Thus far, there have been 2 taxa named in his honor, *Euphyes macguirei* Freeman 1975 (Hesperioidea) from Texas (this is not a misspelling but was defined by the requirements of the zoological code at that time) and *Clanis mcguirei* Eitchberger, 2004 (Sphingoidea) from North Thailand. Other new taxa, including a remarkable new fossil butterfly species from Colombia, are currently under description.

The McGuire Center for Lepidoptera and Biodiversity

When the McGuire's oldest daughter, Marissa, expressed an interest in completing a summer environmental internship working at the Endangered Species Laboratory at the University of Florida, the McGuire family visited the University of Florida campus for the first time. They were astounded at the productivity of the staff and students working on numerous endangered species and the systematic and ecological research completed in the very limited facilities. Noting this situation along with the promise of many talented faculty, curators, and students working with the University's research collections of Lepidoptera which were then scattered in 7 different buildings across the home campus and south to Sarasota, Bill and Nadine McGuire took the initiative in Jun 2000 to request a proposal that would unite all these academic units and activities into one great world-class new Center that could address biodiversity and environmental problems, focusing on Lepidoptera as a flagship group, but including other organisms as well. Dr. Thomas C. Emmel in conjunction with Dr. Douglas S. Jones, Director of the Florida Museum of Natural History, developed this proposal along with input from discussions with several UF departmental chairs, especially Dr. John L. Capinera, Chair of the Department of Entomology and Nematology. Upon review of this proposal and through a subsequent series of extraordinary gifts totaling over $7.5 million from the McGuire

Family Foundation to UF plus 4.2 million in state matches, the McGuire Center for Lepidoptera and Biodiversity was brought to reality by mid 2004 with the completion of a new 50,000 square foot building complex. This facility represents a $12 million private and matching public investment—one of the largest entomological investments ever made!

The University of Florida held the official dedication ceremony for the McGuire Center for Lepidoptera and Biodiversity on Oct 8, 2004. During the proceedings, Dr. McGuire gave an impassioned speech alluding to the global importance of this unique facility. He stated that "the Center will bring together the great human and collection resources already located at the University of Florida into one unit that will focus on and foster a wide range of research and educational opportunities with biodiversity and environmental concerns." He further exclaimed that "it (the Center) will help bring to the forefront of human concern the great need to preserve the Earth's biodiversity, and address the environmental and human population issues that are adversely impacting the world around us in the 21st century." From these ideas, and the many previous conversations with Dr. Thomas C. Emmel, evolved the Center's elegantly simple mission statement: *dedicated to understanding, preserving and interpreting the world's Lepidoptera, biodiversity and environment*. The McGuires understood that successfully addressing this broad goal represents a significant challenge—and one that requires effective, charismatic messengers. For them, Lepidoptera fit the bill perfectly. These colorful insects represent powerful and highly effective tools for scientific discovery, biodiversity conservation, and environmental education.

The extensive Lepidoptera collections are the foundation of the Center, and there are collection rooms totaling more than 12,000 sq. ft. with modern mechanical storage units on each of 3 floors. These are exceptional resources that are used to help document and inventory global biodiversity. The Lepidoptera collections from the Florida State Collection of Arthropods, Div. of Plant Industry, were also moved into the McGuire Center in 2005, and along with these came the immature collections, especially those of Dale Habeck. These, coupled with the John Downey collection from the Allyn Museum, make these special collections exceedingly significant.

These collections offer multiple avenues for scientific research focusing on taxonomy, systematics, distribution, evolution, diversity, mimicry, and conservation. In an era when many major museums across the country are scaling down and placing less emphasis on collections and curatorial staff, the McGuire Center has planned for the future. The 3 floors of collections space can accommodate expansion to some 23 million specimens. Consequently, new acquisitions targeting geographic or taxonomic gaps continue on a regular basis.

Adjacent to the collection rooms on the second and third floors, there are research laboratories and office spaces for curatorial staff and graduate students. There is a working research and reference library on the third floor which has expanded markedly since 2004. In addition, there is a spacious conference room on the third floor where society meetings and national and international workshops are hosted on numerous occasions each year since the Center opened. There are biweekly seminars held in the conference room and during the past year alone, 20 visiting national and international research scientists made presentations here during the fall and winter terms of 2006.

The full time staff includes 12 curators and 2 collection managers. There are currently 17 grants in progress and 21 research papers were published in peer-reviewed journals during 2006, with others in press. There are presently 9 graduate students, not including 2 visiting students from Venezuela and Brasil, and 2 postdoctoral fellows in residence at the McGuire Center. Within the last year, 3 Ph.D. candidates and 3 M.S. students completed their degrees. Thus, we successfully have developed the academic side and brought the McGuires' vision to reality in providing opportunities for students.

Their vision and generosity is longstanding as during the past 20 years, Bill and Nadine McGuire have quietly made numerous personal financial gifts to support graduate student fellowships and endangered species research on Lepidoptera. In addition to the other gifts listed, Bill and Nadine have continued to obtain exceptional, well documented collections and libraries and plan to donate these to the University of Florida in the future.

Conservation

Conservation is central to the Center's mission, and is reflected in broad faunal inventories as well as individual imperiled-species recovery projects. One such program has focused on the Miami blue butterfly (*Cyclargus thomasi bethunebakeri*) (Comstock & Huntington) (Lycaenidae). Once widespread and locally abundant, the Miami blue has been eliminated from much of its former range due to ever-expanding urbanization and the associated loss of coastal habitat. In the years following Hurricane Andrew, it was feared that the butterfly may have become extinct as no verified sightings were recorded. Fortunately, the butterfly was rediscovered on 29 Nov 1999 as part of a small population of less than 100 individuals within the boundaries of Bahia Honda State Park in the Lower Florida Keys. The resulting low

numbers and population vulnerability make the Miami blue one of the most critically imperiled insects in the nation and prompted the Florida Fish and Wildlife Conservation Commission to list the taxon as state-endangered in 2003. The resulting recovery effort rapidly evolved into a large-scale, model cooperative program to help conserve the butterfly through captive propagation, organism reintroduction, public education, and scientific research. Paramount to the effort was the development of a stakeholder group composed of representatives from numerous interested Florida agencies and organizations. Collectively, this group (known as the Miami Blue Working Group) was charged with helping to direct current and future recovery actions, identifying priority areas of research, and most importantly providing an open forum for dispute resolution. The Miami Blue Working Group has proven particularly effective at fostering a suitable venue for open member dialogue, addressing potential areas of stakeholder conflict in a preemptive manner, identifying critical regulatory issues, and facilitating cooperative and timely problem resolution. With assistance from the Florida Department of Agriculture and Consumer Services and the Florida Coordinating Council on Mosquito Control, the Miami Blue Working Group resulted in direct stakeholder research partnership development and participation—channeling previous discordant associations into productive cooperative conservation efforts. This positive outcome supports the notion that an increase in the diversity of stakeholder contributors and scientific participation benefits the overall implementation and acceptance of recovery plans and their implementation.

Additional conservation partnerships and programs were catalyzed with the arrival of the Butterfly Conservation Initiative (BFCI) to the McGuire Center this past May. The Butterfly Conservation Initiative (BFCI) was established in 2001 as a result of conversations between the Association of Zoos and Aquariums (AZA) and U.S. Fish and Wildlife Service's Office of Partnerships and Outreach. At that time, it was recognized that many AZA zoos and aquariums, particularly smaller facilities, were actively seeking opportunities to contribute to North American conservation efforts. By demonstrating their commitment to local wildlife, these institutions could position themselves as community conservation leaders. Similarly, as leaders in conservation education, zoos and aquariums provide a powerful venue for connecting millions of people with nature. Butterfly conservation and recovery offer a unique opportunity for zoos and aquariums of all sizes to participate in field conservation in a meaningful way. Hands-on efforts, including habitat restoration and creation, native plant propagation, captive rearing, education and outreach, and population monitoring, offer participants a chance to connect directly with species and habitats in need while helping to inform their visitor base.

BFCI is a national coalition of 43 accredited zoos and aquariums and 7 partner organizations: the Association of Zoos and Aquariums, U.S. Fish and Wildlife Service, National Wildlife Federation, Environmental Defense, McGuire Center for Lepidoptera and Biodiversity, Xerces Society and the North American Pollinator Protection Campaign. Together, BFCI is dedicated to the conservation of threatened, endangered, and vulnerable North American butterflies and the habitats that sustain them, with a focus on recovery, research, and education. It works closely with the McGuire Center for Lepidoptera and Biodiversity, the Florida Museum of Natural History and the University of Florida, striving to empower its members and partners to work individually and collaboratively to affect butterfly conservation and offer opportunities for engagement suitable to diverse interests and strengths.

ECOTOURISM

In cooperation with the Department of Entomology and Nematology (IFAS, UF), the Center is striving to become a leader in the emerging field of ecotourism. The Butterfly Rainforest, a 6,400-square-foot, 65-foot tall, steel and screen exhibit featuring some 2000 free-flying butterflies, is a key visual element of the center and the main public attendance draw. But the Butterfly Rainforest is much more than a typical exhibit—it is a true living outdoor laboratory and campus resource that has been utilized by students and researchers alike for classes such as ornamental horticulture, insect conservation, animal behavior, ecology, animal physiology, zoology, sociology, architecture, and education. Two M.S. students working on butterfly behavior have even completed the majority of their thesis research within the Butterfly Rainforest facility. The Center is additionally working with several butterfly farming operations to assist with habitat restoration, land acquisition, organism research, and research station development in Florida, Costa Rica, and Ecuador.

PUBLIC AND OUTREACH PROGRAMS

Public understanding of science and engagement in science-oriented activities in general is critical to conservation and quite essential to an institution of higher education. To accommodate broad entry levels and engagement opportunities, educational programs at the McGuire Center are extensive and diverse. They range from docent-led tours and faculty seminars to interactive exhibits and hands-on discovery carts showcasing living organisms. The Center's main exhibit hall offers numerous opportunities for visitors to learn the basics about Lepidoptera and witness first-

hand the tremendous worldwide diversity of this popular insect order. Visitors can also view the collection spaces and research laboratories through large glass windows in the public galleries (Fig. 2a-c). This unique perspective highlights the diversity of the Center's faculty and students, and helps make science fun and accessible to the public. Outside the Center, visitors can enjoy the Florida Wildflower and Butterfly Garden, a landscape dedicated to Florida butterflies and the native plants that attract and support them. Exhibit panels provide information on life cycles, host and nectar plants, and resources for visitors to create their own backyard butterfly habitat.

Several outreach education projects provide innovative, hands-on opportunities for youth to learn about and actively participate in scientific research. *Project Butterfly WINGS: Winning Investigative Network for Great Science* fosters adolescent interest, understanding, and long-term involvement in science through authentic, hands-on, collaborative research with McGuire and other UF scientists investigating butterfly biodiversity, distribution, and host-plant preferences. *WINGS* is a field- and web-based Student and Scientist Partnership (SSP) that targets adolescents in grades 4-8, especially females. *WINGS* participants monitor butterflies in gardens and natural areas, and conduct regular surveys of the species visiting them. They enter this information into an online database linked to an interactive web site where other participants, the public, and UF scientists can access the information. Scientists use the database to obtain quantitative and qualitative information to answer basic research questions. Likewise, *WINGS* participants are encouraged to use the information to formulate their own questions about butterfly biodiversity, and carry out additional experiments to answer those questions.

Adult science programs are highlighted by the Florida Butterfly Monitoring Network (FBMN). The FBMN (www.flbutterflies.net) is a field- and web-based citizen science initiative developed by the University of Florida and Disney's Animal Programs. It has led to synergistic partnerships with several American Zoo and Aquarium Associ-

Fig. 2. Visitors to the McGuire Center have an intimate view into research laboratories and collections. (a) A University of Florida student discusses her research; (b) Collections Manager Dr. Andrei Sourakov actively pins new material in the Specimen Preparation Area; (c) Butterfly Conservation Initiative coordinator Stephanie Sanchez explains endangered species propagation in the Special Projects Lab.

ation (AZA) member institutions in Florida, including Disney's Animal Kingdom, Miami Metro-Zoo/Zoological Society of Florida, Lowry Park Zoo, Brevard Zoo, Jacksonville Zoo, and Central Florida Zoological Gardens, as well as the Florida Natural Areas Inventory, Florida Fish and Wildlife Conservation Commission's Office of Recreational Services, the Butterfly Conservation Initiative (www.butterflyrecovey.org) and various conservation land area units (Florida DEP, Division of Parks and Recreation). The primary field research initiative involves the regular monitoring of butterflies using Pollard transect methods on select conservation land areas throughout Florida to generate accurate and current distribution information and population trend data for both common and imperiled species. Regular monitoring is carried out by citizen scientists in cooperation with AZA-member institution or conservation land area staff members and University of Florida researchers. The program involves classroom and field training of citizen scientists (adult volunteers, age 18 and older), zoological institutions staff members, and state and federal land managers and biologists. The data generated on common and imperiled species' distribution and population trends are intended to be a resource for scientists, private or government wildlife conservation agencies, and land managers that can be utilized to better inform recovery or management actions. Additionally, participating institutions/land areas will have the opportunity to use the information gathered for public education programs and interpretive exhibits thereby further enhancing the public's awareness of both the participating zoo's existing commitment to butterfly conservation efforts and the overall conservation issues themselves. From 2005 to Jul 15, 2006, participation in training and field monitoring included more than 126 AZA staff, 314 public participant volunteers, 46 training events, and some 21 sites surveys (116 individual surveys or training surveys).

To better support the above-mentioned programs, the Center is in the process of developing a series of printed and web-based educational materials. These include informative brochures and booklets on Florida butterflies, with an emphasis on wildlife viewing, gardening and conservation.

Professional Development

Professional development and student training is a critical area of need as well. The first international planning meeting of the Tropical Andean Butterfly Diversity Project (TABDP) was held at the McGuire Center in Apr 2006. It is a three-year project funded by the United Kingdom's Darwin Initiative. The project's goals are to establish a foundation for future research on butterflies in the region. The project will provide resources, such as specimen databases, species lists and images, conduct training courses for students in Andean countries, and develop and publish a strategy for butterfly research and conservation in the tropical Andean region.

In addition to science and education, the McGuires have an equally strong devotion to culture and the arts. This is an especially passionate pursuit for Nadine McGuire, who has served on many national and regional museum and theatrical boards, including the Kennedy Center in Washington, D.C. Their joint interest in the promise of UF's Theatre and Dance program in the College of Fine Arts resulted in a $2.5 million gift to that college to establish the new Nadine M. McGuire Pavilion of Theatre and Dance, and to also completely renovate the Constans Theater facility as part of that $10 million project in 2004. In her capacity as President of the McGuire Family Foundation and as Bill's close partner, she has had equal responsibility for the major influence that their Foundation has already generated, dispersing over $50 million in 2005 alone to carefully selected philanthropic causes across the U.S.

The McGuire Center for Lepidoptera and Biodiversity is a world-class research and education facility. It showcases the tremendous vision of Dr. William and Nadine McGuire, and demonstrates convincingly how philanthropy, avocation, and science can seamlessly blend to create great benefit for nature and humankind alike. With the pioneering work of the McGuires in so many areas and especially entomology, it is fitting that this distinguished and accomplished couple be recognized by the 2007 Pioneer Award.

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