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THE UNIVERSITY OF PUERTO RICO AT MAYAGÜEZ
INSECT COLLECTION – THEN AND NOW

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ABSTRACT. The origin, historical trajectory, and present status of the insect collection of the University of Puerto Rico at Mayagüez (collection coden: UPRM) are reviewed. The collection initiated in the mid 1920s and has grown relatively continuously thanks to efforts by several outstanding entomologists working at UPRM. As of 2007 the collection includes more than 130,000 objects (individual specimens, slides, or vials) pertaining to 25 hexapod orders. The numbers of collection objects per order are listed. The geographic emphasis is on Puerto Rico and surrounding islands. The auchenorrhynchous Hemiptera, Collembola, and Coleoptera are particularly well represented. The collection is in a process of reorganization and is available for specimen loans and related collaborative activities.

KEY WORDS: Caribbean, Hexapoda, Insecta, inventory, research collection

Puerto Rico is the smallest and most densely populated island of the Greater Antilles. Many of its diverse natural habitats have been strongly diminished by intensive agriculture practiced until the 1940s. A shift to manufacturing has since facilitated a partial recovery of forested areas via secondary succession (Grau et al., 2003). Nevertheless, Puerto Rico constitutes a key element of the immense biological heritage of the Caribbean region (Myers et al., 2000).

The scientific study of the insect fauna of Puerto Rico and surrounding islands began with Linnaeus (1758) who described *inter alia* the infamous sugarcane weevil *Diaprepes abbreviatus* (Linnaeus). The tradition of European specialists leading the entomological exploration of Puerto Rico carried on for well over a century thereafter (Chardon, 1949). Juan Gundlach (1878, 1883) and Augustín Ståhl (1882) were among the earliest "local" specialists (Gundlach was Cuban) to publish on insects. In the period of 1913-1934, the American Museum of Natural History in New York co-organized a series of expeditions aimed at documenting the Puerto Rican insect fauna (see Maldonado Capriles, 1996). At that time, the University of Puerto Rico had already established itself with campuses in Río Piedras and Mayagüez, respectively, where pioneering entomologists would plant the seeds for the two most recognized research collections on the Island.

The history of the collection located at Río Piedras was profoundly shaped by George Norton Wolcott (Lawrence, 2000) and is adequately summarized in Franqui et al. (1997). With holdings of nearly 220,000 specimens (~ 60% in liquid preservatives), the "Museo de Entomología y Biodiversidad Tropical" (coden: MEBT)¹ remains as the largest and historically most significant insect collection in Puerto Rico (del Valle, 2007). Above all, the MEBT collection has served as the primary repository for voucher specimens associated with Wolcott's (1948) "Insects of Puerto Rico", which is still the primary reference for most of the Island's insect groups. The collection is incorporated with the Agricultural Experiment Station and continues to provide valuable outreach and extension services in relation to insects (see also <http://museo.cca.uprm.edu/>).

¹ Although it is physically located in Río Piedras, on the outskirts of San Juan, the MEBT is academically (and somewhat confusingly) integrated with the University of Puerto Rico at Mayagüez.

This paper examines the history and present conditions of second largest Puerto Rican insect collection, located on the main campus of the University of Puerto Rico at Mayagüez (coden: UPRM). The UPRM insect collection was previously also referred to as EPRL (Entomological Pioneering Research Laboratory; see Arnett et al., 1993). We review the collection's origins and contributions of its primary caretakers until present time. Results from a specimen- or object-level inventory are presented along with an update on current events and outlook.

ORIGINS OF THE UPRM INSECT COLLECTION

The University of Puerto Rico at Mayagüez was established in 1911 and originally named the Colegio de Agricultura y Artes Mecánicas (abbreviated CAAM). In 1921, Ralph Emerson Danforth, formerly a Professor of Zoology at Rutgers University in New Jersey, accepted a position as head of the Department of Biology at UPRM. His son, Stuart Taylor Danforth (Fig. 1A), was born in 1900 and had become fascinated by nature at an early age (see Wetmore, 1939; Wolcott, 1939). After completing his undergraduate education he also moved to Mayagüez, where he began to teach at the high school and at the same time studied the birds of the Cartagena Lagoon in southwestern Puerto Rico, collecting specimens and information towards his doctoral degree at Cornell University (Danforth, 1926). Stuart Danforth was an exceptionally gifted naturalist. Beyond his focal studies on birds he maintained a passion for entomology and established a well organized personal collection of insects (particularly Coleoptera) as his field work intensified in the years 1923-1924. The earliest specimens preserved in the UPRM insect collection stem from this period and constitute many first records of insect species in western Puerto Rico (Wolcott, 1948). In 1926 Stuart Danforth became professor of zoology and entomology at UPRM. He traveled extensively throughout the Caribbean region until his untimely passing in 1938. At that time he had published 65 scholarly articles (Wetmore, 1939) and accumulated an authoritative collection of Puerto Rican insects still partially preserved at UPRM.

In the early 1930s Stuart Danforth mentored José Andrés Ramos Alemar (1915-1989; Fig. 1B), who graduated in 1936 and subsequently worked as an Instructor of entomology (Chardon, 1949). Upon his mentor's death, he became the official successor and the first formally recognized entomologist at UPRM. José Ramos was an outstanding insect taxonomist and collector who traveled extensively throughout the Neotropical region and South America from the 1930s to the 1970s. He officially established the collection in 1946 and is responsible for acquiring, either personally or through exchange and purchase, more than 60% of all UPRM housed insect specimens. Among his earliest contributions is a review of the insects of Mona Island (Ramos, 1946). Later in his career, he would specialize in the taxonomy of auchenorrhynchous hemipterans, in particular members of the Cicadellidae, Cicadidae, Membracidae, and related families (e.g. Ramos, 1957, 1979, 1983, 1988; Wolda and Ramos, 1992). José Ramos acted as the primary curator of the UPRM insect collection until the late 1980s.

SECOND HALF OF THE 20TH CENTURY

Jenaro Maldonado Capriles (1919-1995; Fig. 1C) was trained at UPRM in the late 1930s and joined the Biology Department in 1948 to begin the most prolific career of any native Puerto Rican entomologist to date (see Berríos-Ortiz, 1996; Santiago-Blay et al., 1997). His primary interests were the systematics of heteropterous hemipterans, in particular Miridae and Reduviidae (e.g. Maldonado Capriles 1969, 1990). However, his nearly 160 scholarly publications include valuable contributions to the taxonomy and ecology of many other insect groups mainly of the greater Neotropical region, as well as numerous applied medical and agricultural papers (for a complete list of publications, see Santiago-Blay et al., 1997). In addition to collecting for and curating the general UPRM collection, Jenaro Maldonado Capriles maintained a personal collection with more than 18,000 specimens, including primary types, which was posthumously sold to the National Museum of Natural History (Washington, D.C.).

The period of roughly 1950 to 1990 was the "golden age" for systematic entomology at UPRM. The collection grew rather continuously, thanks in no small part to contributions of entomologists who were trained as undergraduate students in Mayagüez and subsequently employed at the Agricultural Experiment Station in Río Piedras, including Luis Felipe Martorell (e.g. Martorell, 1976) and Silverio Medina Gaud (e.g. Medina Gaud, 1961).

The latest generation of UPRM insect specialists includes Stuart José Ramos Biaggi (Fig. 1D), an expert on the taxonomy, biogeography, and ecology of Puerto Rican butterflies (Ramos, 1996) who has contributed nearly 6000 specimens to the collection. José Antonio Mari Mutt (Fig. 1E) has published approximately 70 papers on the taxonomy of springtails (e.g. Mari Mutt, 1976; Mari Mutt and Bellinger, 1990; see also <http://www.uprm.edu/biology/profs/marimutt/>). His collection of nearly 3500 slides of primarily Neotropical Collembola remains at UPRM.

The period of 1990 to 2005 saw a steady decline of specimen-based systematic research on insects at UPRM, and the collection became increasingly dormant. During this phase the administrative support was minimal. The collection was preserved through individual efforts of the now retired entomologists Stuart Ramos and Angel Berríos-Ortiz (Fig. 1F).

INVENTORY OF THE UPRM INSECT COLLECTION

The senior author (NMF) was hired by UPRM in 2006 and was named curator of entomology shortly thereafter. In preparation for a collection grant proposal, we carried out an object-level inventory of the UPRM insect collection during the first half of 2007. Nearly 131,000 objects (individual specimens, slides, or vials) were captured in a computer spreadsheet. Their taxonomic names and related information are available for future reference. The main results are shown in Table 1, listed by order and family (in select cases), following the higher-level system of Grimaldi and Engel (2005).

Not surprisingly for a small and primarily regional collection such as UPRM, the taxonomic composition is strongly influenced by a select group of past contributors. Nearly 65% of the specimens are hemipterans, and almost 33% are cicadellids, the great majority of which were

acquired by José Ramos. These specimens are well preserved in more than 500 numbered Schmitt boxes; however their arrangement is partly chronological and partly regional instead of taxonomic, making it difficult to locate all specimens for particular taxa. Other groups with strong representation include the Collembola, Coleoptera (particularly leaf and snout beetles), Diptera (more in taxonomic coverage than absolute numbers), and Lepidoptera. Many of the less diverse hexapod orders are underrepresented. Arguably the greatest weakness of the collection are the Hymenoptera holdings; in part because of a loan that was never returned to UPRM and also due to an abandoned project by a UPRM faculty member during which many specimens deteriorated. In all, 25 out of 26 orders of Puerto Rican insects are represented (see Wolcott, 1948; Maldonado Capriles, 1996); the only missing order is the Strepsiptera.

Holotype specimens of at least 15 species of Collembola and of 35 species of Hemiptera are presently housed in the UPRM insect collection. An annotated list of these taxa is in preparation. Some holotype specimens in the collection have not yet been returned to their legitimate repositories.

CURRENT ACTIVITIES AND OUTLOOK

Thanks to a three-year grant from the National Science Foundation – Biological Research Collections program (DEB-0749434), the future of the UPRM insect collection looks brighter now than it has for numerous years. Starting in 2008 all specimens will be moved into a single collection room, reorganized according to a contemporary reference classification, and accommodated within a new collection infrastructure. As the reorganization proceeds, specimens of select Puerto Rican species will be georeferenced, databased, barcoded, and photographed. The digitized information will be presented on-line using the Specify collections software (see <http://www.specifysoftware.org/>). The stated goal for this project is to transform the UPRM insect collection into the first node in the Caribbean region that contributes entomological specimen information to the Global Biodiversity Information Facility network (see <http://www.gbif.org/>).

Meanwhile, regular activities such as acquisitions of newly collected specimens, publication of systematic papers (e.g. Franz, 2008; Franz and Skelley, 2008; Genaro and Franz, 2008), loans to experts, and identifications have resumed and are increasing in volume. In recognition of recent developments and to facilitate a more stable future, the Biology Department has established a position "director of the UPRM invertebrate collection". Nevertheless the institutional commitment remains limited – too often the responsibility for moving the collection activities forward rests almost entirely upon the shoulders of individual faculty members who understand its legacy and unique potential for research, training, and outreach within the region.

Although the Puerto Rican fauna is only moderately diverse, much taxonomic research remains to be done in order to properly document its insect species (see also Maldonado Capriles, 1996). For example, a week-long effort to collect insects on Mona Island produced 25 species of weevils (Coleoptera: Curculionidae), up from 8 species listed in Ramos (1946; NMF, personal observation). The UPRM insect collection contains thousands of valuable historical and new specimens from Puerto Rico and surrounding islands that require taxonomic study. At present, a

relatively generous loan policy is in place, and we encourage specialists to either visit UPRM to conduct curatorial research on site, or to contact us and inquire about the availability of particular taxa and specimens for loan. We are strongly motivated to establish collaborations at the regional and international level to expand the usage of the collection and thereby strengthen its status.

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Table 1. Approximate specimen holdings of the UPRM insect collection, including entognathous hexapods, according to an inventory undertaken during the first half of 2007. Numbers of 20 or more are rounded to the nearest ten.

Taxon	Specimens	Taxon	Specimens
1. Protura	5 ^a	18. Hemiptera	85,210 ^c
2. Collembola	3730 ^{a,b}	a. Cicadellidae	42,710 ^c
3. Diplura	2 ^a	b. Cicadidae	2820 ^c
4. Zygentoma	15 ^a	c. Membracidae	13,710 ^c
5. Ephemeroptera	20	19. Neuropterida	130
6. Odonata	840	20. Coleoptera	20,360
7. Phasmatodea	80	a. Chrysomelidae	2950
8. Orthoptera	690	b. Curculionidae	6230 ^d
9. Dermaptera	70	c. Scarabaeidae	1410
10. Embioptera	5	21. Siphonaptera	40 ^a
11. Zoraptera	3	22. Diptera	5070
12. Blattodea	300	23. Hymenoptera	3020
13. Mantodea	80	24. Trichoptera	100
14. Isoptera	150	25. Lepidoptera	10,840 ^e
15. Psocoptera	20	a. Noctuidae	2020
16. Phthiraptera	50 ^a	b. Nymphalidae	780 ^c
17. Thysanoptera	70 ^a	c. Pieridae	1310 ^e
		Total	130,900

^a Numbers correspond to microscope slides; each slide may contain multiple specimens.

^b Primarily José Mari Mutt collection.

^c Primarily José Ramos Almenar collection.

^d Including approximately 4000 specimens collected by the senior author (NMF).

^e Primarily Stuart Ramos Biaggi collection.

Fig 1. Notable specialists associated with the UPRM insect collection. (A) Stuart Danforth; (B) José Ramos Alemar; (C) Jenaro Maldonado Capriles; (D) Stuart Ramos Biaggi; (E) José Mari Mutt; (F) Angel Berríos-Ortiz. Photographs A-D and F were obtained courtesy of the Archive of the University of Puerto Rico at Mayagüez; photograph E was taken by the senior author.

Fig. 1

