

# THE STATUS OF INSECT ALPHA TAXONOMY IN PUERTO RICO AFTER THE SCIENTIFIC SURVEY

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**T**HE PURPOSE of this paper is to summarize the status of alpha taxonomy in Puerto Rico. The approximate number of species now known in each Order is given in TABLE 1. These figures are compared with Wolcott's in *The Insects of Puerto Rico*<sup>1</sup> as his information includes that given in the entomological volumes of the *Scientific Survey of Porto Rico and the Virgin Islands* (SS). The Virgin Islands were not included in this study.

For the small Orders most of the papers cited are those that can be of help, even to the non-specialist, with the identification of local species. These are monographs, revision of local, Caribbean or even North American taxa, in which keys, lists, etc., can be of assistance to the researcher. Unfortunately there are not many such papers and of these most lack keys. For large Orders, such as Hymenoptera, Diptera and Coleoptera, because of the large number of publications, mostly with a few local records and new species, comparative notes about all the listed species are not provided. A brief but incomplete summary of the present status of the large Orders is included.

## INTRODUCTION

During the first years of this century the study of insect taxonomy in Puerto Rico went hand in hand with the development of economic entomology. Ledru, Stahl, A., Gundlach and other naturalists catalogued the flora and fauna of the Island during the late years of the nineteenth century. The establishment in 1901 of the Federal Agricultural Experiment Station at Mayagüez gave an impetus to insect taxonomy because its staff included several entomologists. Their interest in biological control resulted in the introduction of several parasites of the most important agricultural pests. The Insular Experiment Station was established in 1910 in Río Piedras. The staff included, throughout the years, several entomologists, among them G. N. Wolcott.

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TABLE 1 Number of Insects by Orders in Puerto Rico, as Recorded in Wolcott 1948, and Approximate Numbers as of 1993

Orders	Wolcott	1993
Protura	—	3
Entotrophii (Diplura)	—	2
Thysanura	4	4
Collembola	17	68
Dermaptera	10	10
Orthoptera	91	109
Isoptera	16	18
Embioptera	1	1
Psocoptera	14	17
Mallophaga	35	39
Ephemeroptera	18	20
Odonata	43	46
Neuroptera	23	24
Trichoptera	21	34
Thysanoptera	77	99
Anoplura	8	9
Homoptera	458	580
Heteroptera	228	336
Coleoptera	934	1,098
Strepsiptera	1	1
Diptera	669	901
Siphonaptera	7	7
Lepidoptera	939	1,045
Hymenoptera	421	595
Zoraptera	—	1
Totals	3,675	5,066

Alexander Wetmore, an ornithologist, also participated. His publication, *The Birds of Puerto Rico*<sup>2</sup> (1916) includes abundant entomological information.

Wolcott, on horse back, by train or foot, traveled over most of the island. His patience, excellent record keeping and devotion to his work, resulted in his *Insectae Portoricensis*<sup>3</sup> (1923). This was later expanded and corrected to *Insectae Borinquensis*<sup>4</sup> (1936), and finally to the useful *The Insects of Puerto Rico*<sup>1</sup> (1948). The first journal covering entomological matters was *Revista de Agricultura* published by the Insular Department of Agriculture. The *Journal of Agriculture of the University of Puerto Rico* was first published in 1917 as *Journal of the Board of Commissioners of Agriculture of Porto Rico* and as the *Journal of the Department of Agriculture of Porto Rico*, with the current name coming into use in 1934. Barber, Fisher, Forbes, Jones, Osborn, Oman, Smith, Travers, Tulloch and other specialists published taxonomic papers during the early years of the Journal.

The teaching of entomology, with emphasis on taxonomy and agricultural pests, was offered in the early 1930s by Danforth, an ornithologist, at the then

"College of Agriculture and Mechanical Arts," of the University of Puerto Rico at Mayagüez. J. A. Ramos, a specialist in Homoptera, replaced Danforth as a lecturer in entomology in the late 1930s. Agricultural entomology is presently taught by the staff of the Crop Protection Department in the College of Agricultural Sciences. A graduate course in insect taxonomy is taught occasionally in the Department of Biology at the College of Arts and Sciences, also at Mayagüez.

The insect fauna of Puerto Rico is much better known than that of the other Antillean islands. For this reason, comparison of the local fauna with that of other circumcaribbean areas cannot be significant. Only Cuban authors have recently monographed some insect groups (e.g., Pastor Alayo—Lygaeidae,<sup>5</sup> Grillo y Alayo—Emesinae,<sup>6</sup> Grillo—Aradidae: Carventinae.<sup>7</sup> Ramos<sup>8</sup> monographed the Membracidae of the Dominican Republic. Miskimen and Bond<sup>9</sup> (1970) published *The Insect Fauna of St. Croix, U.S. Virgin Islands*. This annotated list records 1,220 species in 18 orders and 233 families. Such a relatively high number of species from a small island suggests that the number of species from Puerto Rico should at least be close to twice the number known. These and other papers indicate that intensive collecting remains to be done in the circumcaribbean area.

### *The Scientific Survey*

In chronological order, the year of publication of the entomological volumes of the Scientific Survey of Puerto Rico and the Virgin Islands and the group of insects covered are: 1928 Curran,<sup>10</sup> Diptera; 1930 Folsom,<sup>11</sup> Heterocera part; 1930 Forbes, moths in part and supplement<sup>12</sup> (1931); Folsom<sup>13</sup> (1931), supplement, Heterocera; 1932 Klots,<sup>14</sup> Odonata; 1935 Osborn,<sup>15</sup> Homoptera (except Sternorhyncha); 1939 Barber,<sup>16</sup> Hemiptera; 1940 Schaus,<sup>17,18</sup> Noctuidae Part 2, Geometridae and Pyralididae (sic) Part 3; 1944 Comstock,<sup>19</sup> Lepidoptera (Papilionoidea and Hesperioidea). Barber considered his contribution as his best paper ever (personal communication!).

### *Taxonomy—The Present Status*

Titles of papers discussing different kinds of medical and agricultural entomological matters, such as biology, taxonomy, records, damage to crops, check lists, monographs, etc., from the last years of last century to the present, add up to over 3,000 (S. Medina Gaud, personal communication). The notes that follow come from the revision of most of these publications.

## APTERYGOTA

### *Protura*

This primitive order as well as two of its species were recorded for the first time from Puerto Rico by Nosek.<sup>20</sup> These same species were again mentioned together with the first records for Cuba, Jamaica, and Haiti by Nosek and Mari Mutt.<sup>21</sup> One species each occurs in the latter three localities. Of these, *Bolivardia perissochaeta* Bonet occurs in Mexico, Cuba, Dominican Republic, and Haiti. *Eosentomon puertoricoense* also occurs in the Dominican

Republic. *Delamarentulus tristani* (Silvestri) occurs in Jamaica and High Volta, Africa.

#### *Entotrophi (Diplura)*

Fox<sup>22</sup> recorded *Parajapyx* sp. and *Neojapyx insulans* as thysanurans from Culebra.

#### *Thysanura*

Wygodzinsky<sup>23</sup> revised the thysanurans of United States and the Antilles, reporting 13 species for each area. He recorded *Lepisma saccharina* L. and *Ctenolepisma diversisquamis* Silvestri from Puerto Rico.

#### *Collembola*

The study of Collembola in Puerto Rico really started with Mari Mutt's<sup>24</sup> paper on the genera. He adopted the classical five-family classification, provided a key to these and keys to genera by family. Wolcott<sup>1</sup> had recorded seven genera, two other authors added two more and Mari Mutt's paper added eleven new generic records. This paper is conveniently designed for the non-specialist and is profusely illustrated. Mari Mutt listed the Puerto Rican collembolan fauna in 1980.<sup>25</sup> He recorded 59 species distributed in 39 genera and 6 families. Analysis of about half of these species indicate that the local fauna is tropical primarily and with close Antillean and Central American affinities. Minor affinities occur with the Ethiopian, Oriental, Nearctic, Palearctic, and Australian faunas. His catalog of the neotropical Collembola—done with P. K. Bellinger—was published in 1990.<sup>26</sup> This last account of the local fauna includes 12 families, 66 species and 32 genera.

### PTERYGOTA

#### *Ephemeroptera*

Travers's "The Mayflies of Puerto Rico"<sup>27</sup> (1938) is still the only comprehensive paper on this group of insects. He collected 20 species representing six genera in three subfamilies. These included three new genera and nine new species. This order is probably the most affected of all by present environmental contamination and changes. Most rivulets have been dammed or tapped to supply water to large reservoirs. In many mountain areas, although they are provided with running and treated water, streams are still used for some daily chores. Fords of small streams and rivulets are favorite shaded places for washing vehicles. Deforestation has dried up watersheds and consequently many streams are dry most of the year. Residues from the intensive use of fertilizers and pesticides have but one place to go: downstream. Pollution has been, unfortunately, unavoidable.

#### *Odonata*

Maldonado and Navarro<sup>28</sup> reported the only additional record of Odonata since Klots's<sup>14</sup> monograph. Intensive collecting by Prof. S. Ramos and his students produced no new records for the island. Klots's monograph covered 38 species. Of the three genera endemic to the Antilles only *Scapanea* is known

from the island. Except for Klots' notes, very little is known about the aquatic stages of this order. Garcia Diaz,<sup>29</sup> in his paper on the ecology of fresh water insects of Puerto Rico, described many nyads. As aquatic species he listed 31 Coleoptera, 26 Diptera, mostly tipulids; 13 Ephemeroptera, 6 Lepidoptera, and 12 Trichoptera.

### *Orthoptera*

Guernsey and Maldonado Capriles<sup>30</sup> reported *Hygronemobius alleni* (Morse) collected in semisubmerged pans on the muck of red mangrove stands in La Parguera. They pointed out the importance of collecting in specialized habitats such as this. This species also occurs in a few similar areas around Miami, Florida and in Moraine Cay, Bahamas.

The caribbean *Oecanthus allardi* Walker and Guernsey<sup>31</sup> was confused with *O. niveous* for many years. Walker and Guernsey<sup>32</sup> described three new species of the endemic genus *Borinquenula* from the mountain forests, where they hide during the daytime inside curled dead leaves. They also studied the acoustic behavior of these crickets.

Only one species of mole cricket was known from the island. Castner and Fowler<sup>33</sup> found that actually three species had been confused as one. Rehn<sup>34</sup> described *Aspiduchus cavernicola* and *A. borinquensis*, two apterous roaches from caves. Moxey<sup>35</sup> described *Agamenon iphimedia* and *Lamponius clytemnestra* new species, 6 new combinations and *A. thomae* as new record. These walking-sticks live in the mountain regions. Nicholas's<sup>36,37</sup> studies of the orthopteran fauna of the cave-spring system of Rio Camuy record *Amphiacusta cavernicola*, *A. annulipes*, and *Propotomaphagus puertoricensis*.

### *Isoptera*

Snyder's<sup>38</sup> monographic work on the Antillean termites is the source of taxonomic information for the local termite fauna. Wolcott provided biological information for most of them. Martorell<sup>39</sup> added *Glyptotermes liberatus* (Snyder) to the local species.

The drywood termite or "polilla" is quite common and does great damage to household effects. Of the five species in Rhinotermitidae (subterranean termites) two, *Heterotermes convexicollis* (Snyder) and *H. tenuis* (Hagen), can be extremely destructive and relatively difficult to control. A species of *Anoplotermes* (Termitidae) was found living underground, but it seems not to invade houses.

### *Dermaptera*

Three families of this Order have been recorded from Puerto Rico, namely, Labiduridae, Forficulidae and Labiidae, with five, two and four species, respectively. Maldonado and Navarro<sup>28</sup> added *Euboriella plebeja* (Dohrn) to Wolcott's records. Wolcott gave notes on the life histories of several species.

### *Embioptera*

The cosmopolitan *Oligotoma saundersi* (Westwood) is the only embiopteran recorded from the island. Although probably found all over the island

it is not a common species. The winged males are attracted to light. Medina Gaud and myself, from different localities, have collected a second, as yet unidentified, species. Wolcott recorded the Order as Embidiina.

### *Psocoptera*

Wolcott listed nine species and five others identified to genus only. *Liposcellis divinatorius* (Muller) is a minor pest of stored food products and sometimes requires control. Owners of small stores keep flours of different kinds in refrigerators to avoid the attack of this species. Insects collections are destroyed by this species and fungi unless protected with insecticides and fungicides.

### *Zoraptera*

*Zorotypus barberi* Guerny is the only zorapteran known from the island. The first record came from El Yunque. It can be collected from rotting logs and sometimes from forest litter.

### *Mallophaga*

Wolcott<sup>1</sup> listed 24 species and seven species identified to genera only but not all species were assigned to their corresponding family. Maldonado and Navarro<sup>28</sup> added one species, identified to genus only, in Menoponidae and two in Philopterae. It is evident that this Order has been studied poorly in the island.

### *Anoplura*

Six species, including the cosmopolitan head and pubic lice (Pediculidae), were recorded by Wolcott. Among these, one comes from rhesus monkeys in captivity. Maldonado and Medina Gaud<sup>40</sup> reported the tail louse as *Haematopinus quadripertusus* collected from tail and eyelids. They indicated that the records given by Wolcott as *H. eurysternus* Nitsch and *H. tuberculatus* Burmeister could be misidentifications. Fox<sup>41</sup> (1955) reported *Hopopleura oenomydis* Ferris from rats.

### *Thysanoptera*

Medina Gaud<sup>42</sup> monographed the Order. He recorded 66 species of which 46 were previously known from the island and 15 of these described as new endemics. The species were distributed in 43 genera and 4 families. He treated 11 genera and 7 new species. These were collected from 182 host plants. The paper includes keys to all taxa mentioned. In 1963<sup>43</sup> he described a new species of *Heterothrips* and in 1989, as principal author of another paper,<sup>44</sup> recorded the introduction of *Fulmektiola serrata* (Kobus) a pest of sugar cane. Two other species were listed in anonymous USDA pest reports.<sup>45,46</sup> Sakimura<sup>47-48</sup> described *Chaetisothrips striatus caribeanus* and *C. medinali* and added two more records to the thrips of Puerto Rico (see also Medina Gaud et al. 1991<sup>50</sup> & 1973<sup>111</sup>).

### Heteroptera

Barber's<sup>16</sup> paper in the *Scientific Survey* is quite useful for the identification of most local heteroptera.

Drake and Maldonado<sup>51</sup> listed the Puerto Rican water-striders. These include one Hebridae, two (one to genus only) Hydrometridae, eight Gerridae, and ten Veliidae in addition to the new *Microvelia angusta*. Nomenclatural changes were made to Wolcott's records. *Gerris remigis* and *Trochopus plumbea* Uhler are not included among these 21 names. *Mesovelia mulsanti caraiba* Jaczewski is well distributed throughout the island. Two Pleidae, *Plea puella* and *P. punctifer* Barber, four Notonectidae, four Saldidae, one Naucoridae and the nepid *Ranatra* are known from the island. These last families and genera can be identified with Barber's keys. Spangler et al.<sup>52</sup> in the check list of the species in *Rheumatobates*, keyed three species from Puerto Rico, adding *R. vegatus* Drake and Harris to Drake and Maldonado's list of water-striders.

Wolcott<sup>1</sup> listed three Aradidae and one as *Aneuris* species. Drake and Maldonado<sup>53</sup> described the apterous *Eretmocoris disparis* and *Aglaocoris natalii* new genus and species. Kormilev<sup>54</sup> described the winged *Aneuris айонитенсис*.

Maldonado<sup>55</sup> monographed the Miridae. This includes 65 species distributed in 37 genera, including a new one and 21 new species. Keys are given for the subfamilies, tribes, and genera. Keys were given for either the local species or neotropical species in genera with a small number of species. In 1991<sup>56</sup> (he revised the monograph including the description of two new species, addition of new records, some nomenclatural changes and keyed the species in *Rhinacloa* reducing to 7 the local species. Both papers have abundant habitus and detailed anatomical drawings.

Maldonado<sup>57</sup> listed 31 local reduviid species, two of these to genus only. Maldonado,<sup>58</sup> in the monographic paper on the neotropical reduviid genus *Heza*, included two species from Puerto Rico, one of these as new. Hart<sup>59</sup> described *Zelus puertoricensis* and recorded *Z. longipes* (L.) from Mona Island.

The important local chinch-bug had been treated mistakenly as *Blissus leucopterus insularis*, a species not found locally. Leonard<sup>60</sup> raised *insularis* to species rank and in 1968<sup>61</sup> described it as one of the two new species from the island.

Froeschner, R. C. and Maldonado<sup>62</sup> (1992) published a synopsis of the burrowing bugs or Cydnidae of Puerto Rico. Eleven species, including a new one, in six genera were discussed. The paper includes a key to the two subfamilies present in the island, and the genera and species in each.

Kritsky<sup>63</sup> published a key to the Enicocephalidae genera and species in the Western Hemisphere. In 1979<sup>64</sup> he revised the genus *Enicocephalus* including the two species known from Puerto Rico, namely, *E. semirufus* Barber (1939) and *E. usingeri* Maldonado (1948),<sup>65</sup> both endemic species. These are brightly colored with reddish orange and live in bromeliads at high altitudes.

Drake and Ruhoff's catalog<sup>66</sup> of the Tingidae and Slater's catalog<sup>67</sup> of the Lygaeidae provide quite complete lists of species for the island and complete bibliographical information (for Tingidae see also Medina Gaud<sup>68</sup>).

### *Homoptera*

Caldwell and Martorell,<sup>69,70</sup> in two parts, revised the Homoptera, excepting Cicadidae, Kinnaridae and Membracidae. Part I, *The Cicadellidae*, provides keys to subfamilies, genera, and species. All species were illustrated and notes on their biology provided. Taxonomic and nomenclatural matters were authored by Caldwell, biological details by Martorell. The *Fulgoroidea*, Part II, records 141 forms 70 of which are new species and 13 new records for the island. The species are distributed in 9 families and 28 previous records based on misidentifications were deleted. Keys to families, genera and species are provided. Both papers are profusely illustrated. Mead and Kramer<sup>71</sup> included the three local species in a key to the species in *Olarius*.

Ramos<sup>72</sup> treated the Membracidae, Cicadidae, Cercopidae, and Kinariidae, not discussed in Caldwell and Martorell's papers. The paper discussed 37 species. The membracids includes 15 species in 12 genera, three of which are endemic. Two species of cicadids occur in the island of which *Borencona aguadilla* (Davis) is endemic. The Kinnaridae includes 12 species all of which are endemic and one endemic genus (*Oreopenes*). The Cercopidae includes 8 species, five of which are new, and two endemic genera (*Asprocranites* and *Gaetopsis*). Keys are provided for the identification of families, genera and species. The paper is well illustrated.

Smith, Martorell and Perez<sup>73</sup> recorded 45 species of aphids, gave the principal hosts, illustrated relevant anatomical details and provided keys to the species. Smith et al.<sup>74</sup> made nomenclatural corrections and added new records. In two subsequent papers Smith added new records, made nomenclatural corrections, and added new hosts and in 1970<sup>76</sup> described *Picturaphis puertoricensis*. In Smith and Cermeli's annotated list<sup>75</sup> the number was raised to 62.

Nakahara and Miller<sup>77</sup> listed 129 species of Coccoidea, representing 72 genera and 10 families, from Puerto Rico. The hosts of most of them were given. Ferris' atlases<sup>78-80</sup> help to identify most of the local scale insects (see also Medina Gaud et al., 1977<sup>110</sup>).

The only monographic publication on the Psyllidae is Caldwell and Martorell's<sup>81</sup> preliminary survey. They keyed 7 genera and the species in each, for a total of 18 forms including 9 new species. Medina et al.<sup>109</sup> added five new records of white flies (Aleyrodidae) to the local fauna.

### *Trichoptera*

Flint<sup>107</sup> recorded 35 species in his monograph of the Order, of which 9 were previously known from the Island, 22 of these were described as new. The paper includes keys to all taxa mentioned. In 1968<sup>108</sup> he described a new species of *Ochrotrichia* from Puerto Rico.

### *Neuroptera*

Order Neuroptera is represented in the island by 5 families. These include 24 species according to Wolcott. The genera including the greatest number of species is *Chrysopa*, with 12 species. The cone-shaped traps of the two species of myrmeleonids are common in sandy areas and larvae, mostly of *Chrysopa*, are commonly seen feeding on aphids on corn and other plants. There are no keys to these taxa.



### *Coleoptera*

Including Wolcott's records about 1,100 species have been informed from Puerto Rico. A summary of this Order was not attempted.

Doris Blake, in about 25 papers, described over 34 new species of chrysomelids from Puerto Rico. Fisher (1918–1950) published 17 papers describing over 30 species in Eucnemidae, Buprestidae, Cerambycidae and other small families. Both sets of publications are without comprehensive keys.

E. G. Smyth, E. A. Chapin and L. Saylor, in a 40-year period, described new species and studied the biology of the scarabaeid genera of agricultural importance. Chapin<sup>82</sup> included 15 species from Puerto Rico in his revision of the Antillean Aphodinae. Outside of this paper, no other taxonomic paper discusses the important agricultural pest beetles (*Phyllophaga*, *Ataenius*, *Strategus*, etc.). Maldonado<sup>83</sup> listed 15 species of *Ataenius*, including four new records and made, under the guidance of O.L. Cartwright, a few nomenclatural changes on old species records. Mathews<sup>84</sup> published on the biology and taxonomy of the local canthonines (Coleoptera: Scarabaeidae: Canthoninae) and a key to the few local species.

Wolcott listed 14 species of Bruchiidae. Kingsolver<sup>85</sup> pointed out that *Amblycerus martorelli* Bridwell is a junior synonym of *A. sallei* (Jekel, 1855), a species reported by Wolcott as nr. *sallaei* [sic]. In 1969 Kingsolver<sup>86</sup> added *Acanthoscelis zeteki*, a new species with type from Panama, to the other seven species of the genus occurring in the island and in 1972<sup>87</sup> three species in *Sator*, a bruchid genus not previously recorded from the island (see also Kingsolver 1970<sup>88</sup>).

Fischer's publications<sup>89</sup> (1925, etc.) continue to be the best source of information about the buprestids in the Antilles. This family contains 18 species in the island.

### *Strepsiptera*

*Stenocranophilus quadratus* Dwight is the only species recorded from Puerto Rico. It was reared from the fulgorid *Delphax saccharivora* Westwood. Wolcott included it under Stylopodidae. I have noticed some specimens of this order in almost every light-trap collection examined.

### *Lepidoptera*

S. Ramos<sup>90</sup> publication is an up-to-date list of the Puerto Rican butterflies. He dropped a few names as he found that from one clutch of eggs of *Ascia monuste aubotea*, he recovered what had been called several subspecies. The list includes 106 species, including three new records. Since then, Johnson and Descimon<sup>91</sup> assigned *Prepona* to *Archeoprepona* and described the local subspecies as *ramosorum*. Smith et al.<sup>92</sup> described *Strymon monensis* from Mona.

Hodges<sup>93</sup> described *Batrachedra comosae* (Cosmopterygidae) the important minute moth causing gomosis in pineapples. The most abundant and useful information for the moths is that given in the Scientific Survey. As for the other major Orders information is scattered in many publications. The well known microlepidopterologist V. Becker three years ago collected

thousands of specimens from different parts in the island. His forthcoming papers will add quite a few records to the local fauna.

### *Diptera*

Telford<sup>94</sup> included a key to the 11 genera and 58 species of syrphids known from the island at the time of the study. Among these, four species were described as new. About 40 of these species are considered aphidophagous. A few species live on plant food, but the benefits far outweigh the possible (minor) damage. Telford called attention to the importance of collecting syrphids by means of Malaise traps. Thompson<sup>95</sup> revised the syrphids of the West Indies. After making nomenclatural corrections he reduced the number of species from Puerto Rico to 46, excluding species doubtfully recorded. He points that the West Indian fauna has a high number of endemic elements and that its affinity is mostly neotropical (57%) with small (9%) Ethiopian-Neotropical elements. The paper includes abundant keys and illustrations.

Pritchard and Pratt<sup>96</sup> published a list of the mosquitoes of Puerto Rico. Belkin and Heinemann<sup>97</sup> listed the species of Culicidae and Dixiidae they examined. According to them, what was recorded in the literature as *Aedes nubilis* was probably *A. tortilis*, *Deinocerites magnus* was previously recorded as *D. cancer* and *Uranotaenia socialis* as *U. sapphirina*. Four different *Wyeomyia* (*W.*) are known from bromeliads at high elevations. These have not been identified to species. Fox<sup>98</sup> described *Culex inamolae*.

James<sup>99</sup> in his paper on the Stratiomyidae from the West Indies listed eight species including the new species *Merosargus telfordii* from Puerto Rico.

Fairchild<sup>106</sup> listed five species of tabanids from Puerto Rico in his paper "The Tabanid Fauna of the West Indies."

Wirth, between 1953 and 1974, alone or with coauthors, in 14 publications, described and recorded 15 species in Heleidae, Ephyridae and Ceratopogonidae from Puerto Rico. Excepting Wirth's paper with Blanton<sup>100</sup> and Fox's<sup>101</sup> about *Culicoides*, there are no comprehensive or partial keys for the species in these families.

### *Siphonaptera*

Maldonado<sup>102</sup> published a key to 8 species of fleas known at the time to occur in Puerto Rico. All of them were cosmopolitan species. Brief notes on their biology and medical importance and simple sketches of their heads, spermathecae or hind coxae were given.

### *Hymenoptera*

The local superfamilies in this Order, as recorded by Wolcott are: Tenthredinoidea, with Argidae only, Cynipoidea, Ichneumonoidea, Chalcidoidea, Proctotrupoidea, Sphecoidea, Vespoidea, and Apoidea. Forty-eight families are distributed among these. No local key to these taxa is available.

Heydon<sup>103</sup> keyed the species in the genus *Notoglyptus* and described *N. nesiotus* from Puerto Rico. The latter species is also known from Georgia. This is the eleventh species of Pteromalidae in the island.

The local Formicidae includes the subfamilies Ponerinae, a single record

of Cerapachyinae, Pseudomyrminae, Myrmicinae, Dolichoderinae, and Formicidae. Wolcott listed 62 forms of ants. Smith's<sup>104</sup> paper on the ants of Puerto Rico was the work of reference for many years. Dr. J. Torres and his collaborators have increased the number of species to over 80. These will be treated by him in a future publication.

### THE FUTURE

Slater's paper<sup>105</sup> on the future of systematics in United States is worth re-reading as now, the present, is part of the future he explored. He predicted that better identification manuals were inevitable and pointed out the need of faunal studies. Slater's dream has not been exactly realized.

The short summaries given above on the taxonomic status of the insect Orders in Puerto Rico show a dearth of comprehensive works or monographs. Many are needed. These should be clear enough, with keys and illustrations, to attract newcomers.

A complete faunal study of the insects of Puerto Rico should be the goal of what was started as the Scientific Survey. Paraphrasing Slater, the glamour of such fields as cladistics, biosystematics, phenetics, numerical taxonomy and environmental studies should not deviate us from such endeavor. Is not a cladogram just a horizontal key or horizontal systematic arrangement of species? Is not the selection of characters for cladistic studies another form of systematics? That phylogenetic relationships result from some of these studies so much the better.

Keys to the families and genera of the insect Orders in Puerto Rico should be the first step towards a total faunistic study. Then, the genera, with the corresponding species, should be taken in groups or one at a time if too large. First steps have already been taken. Specialists are still (!) available. The ecological notes given above under Ephemeroptera should be considered as a warning.

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