

SANDRA ABEDRABBO\*, JEYARANEY KATHIRITHAMBY\*\*, MASSIMO OLMI\*\*\*

\* Charles Darwin Research Station, Puerto Ayora, Santa Cruz, Galapagos.

\*\* Department of Zoology, University of Oxford, South Parks Road, Oxford, OX1 3PS, England.

\*\*\* Dipartimento di Protezione delle Piante, Università della Tuscia, Viterbo, Italy.

## Contribution to the Knowledge of the Elenchidae (Strepsiptera) and Dryinidae (Hymenoptera: Chrysidoidea) of the Galapagos Islands<sup>(1)</sup>.

### INTRODUCTION

Elenchidae (Strepsiptera) and Dryinidae (Hymenoptera: Chrysidoidea) are parasitoids of leafhoppers and planthoppers (Homoptera: Auchenorrhyncha). The Strepsiptera and Dryinidae fauna of the Galapagos is little known. Peck and Peck (1989) mention the presence of *Elenchus koebeli* Pierce in the islands of Santa Cruz (Media Luna, 4 km N Bellavista, m 620) and Isabela (Sierra Negra) but no host records are given.

The papers on Dryinidae (Olmí 1984, 1986, 1987a, 1987b) describe six new species of Gonatopodinae:

- 1) *Apterodryinus arnaudi* Olmi 1984, known from Academy Bay (Santa Cruz).
- 2) *Apterodryinus rabidanus* Olmi 1986, known from Rabida and S. Salvador (Los Guayabillos).
- 3) *Pseudogonatopus invictus* Olmi 1986, known from S. Salvador (El Mirador) and Santa Cruz (Pelican Bay).
- 4) *Haplogonatopus crucianus* Olmi 1986, known from Santa Cruz (Puerto Ayora-Baltra Road).
- 5) *Gonatopus fernandinae* Olmi 1984, known from Fernandina and Santa Cruz.
- 6) *Gonatopus santiaganus* Olmi 1986, known from S. Salvador (El Mirador).

Only females of the above species of Dryinidae are known from the Galapagos Islands except for *G. fernandinae* for which a male is also known (Olmí 1984). Another male specimen was described later (Olmí 1987a), but it is uncertain whether it is a male of *A. arnaudi* or *A. rabidanus*.

---

<sup>(1)</sup> Contribution no. 463 of the Charles Darwin Research Foundation.

The hosts and biology of Strepsiptera and Dryinidae as well as data of the possible method of colonization of the archipelago were not previously known. In January 1989 one of us (Olm) spent two weeks in the Galapagos Islands for filling some gaps in the knowledge of the Galapagos Dryinidae and Strepsiptera.

During the stay the research was done with the collaboration of Mrs. Lic. Sandra Abedrabbo. On return to Italy the study on Strepsiptera was done by Jeyaraney Kathirithamby and those on Dryinidae by Massimo Olmi.

#### MATERIAL AND METHODS

The collecting in the Galapagos was done in Santa Cruz (Cerro Mesa, Bellavista and El Puntudo, m 800) and in Isabela (El Cura-El Mirador path, on Sierra Negra, m 800).

The parasitized hoppers were collected by sweeping, they were then reared in glass tubes. After some days the males of Strepsiptera and the larvae of Dryinidae emerged from the hosts. The larvae of Dryinidae spun their cocoons and after some days the adults emerged.

Unparasitized hosts were also collected in order to identify the host species. The presence of endoparasites (particularly Strepsiptera) causes morphological changes to the external genitalia of Auchenorrhyncha (Kathirithamby 1989), hence host species cannot reliably be identified solely by the parasitized host.

#### RESULTS

##### Dryinidae

Two species of Dryinidae were reared in the Galapagos Islands, one identified as *H. crucianus* and another doubtfully identified as *G. fernandinae*.

*Gonotopus fernandinae* Olmi 1984?

Material examined: One male specimen labelled «Galapagos Is., Isabela I., El Cura-El Mirador (Sierra Negra), m 800, 16-1-89, M. Olmi leg.». The data on the label refers to the day of collection of the parasitized hopper.

Hosts: This male specimen was reared from *Cicadulina tortilla* Cadwell (Cicadellidae) (M. Webb det.). In the same locality a large number of parasitized Delphacidae were collected and *H. crucianus* was reared from them. One male specimen was obtained from the single cicadellid collected. In the same area 7 ♂♂ and 2 ♀♀ unparasitized Cicadellidae were collected for identification.

Identification: This male specimen was identified doubtfully as perhaps *G. fernandinae*. Comparison with the male paratype of *G. fernandinae* showed only one difference: the colour of the body is black in the male that was reared, whereas it is reddish-brown in the paratype. The genital armature as well as other morphological characters are similar. As there is only one male specimen (that of the paratype) it is difficult to identify the importance of the difference. In El Salvador there is another species *G. santiaganus* and there is a possibility

that it might be that species. The other dryinids in the Galapagos parasitize Delphacidae.

**Conclusion:** The identification is doubtful and further research is necessary to solve the identity of this male specimen.

*Haplogonatopus crucianus* Olmi 1986.

**Material examined:** 4 ♂♂ and 1 ♀ labelled «Galapagos Is., Isabela I., El Cura-El Mirador (Sierra Negra), m 800, 15-1-89, M. Olmi leg.»; 1 ♂ and 1 ♀ labelled «Galapagos Is., Isabela I., El Cura-El Mirador (Sierra Negra), m 800, 16-1-89, M. Olmi»; 10 ♀♀ and 2 ♂♂ labelled «Galapagos Is., Santa Cruz I., El Puntudo, m 800, 19-1-89, M. Olmi leg.»; 2 ♀♀ labelled «Galapagos Is., Santa Cruz I., El Puntudo, m 800, 20-1-89, M. Olmi leg.». The dates of the labels refer to the collection of parasitized hoppers.

**Notes:** The above specimens were reared in Isabela from *Nesosydne alcmaeon* Fennah (J. Kathirithamby det.) and in Santa Cruz from *N. olipor* Fennah, *N. iphis* Fennah and *N. alcmaeon* Fennah (J. Kathirithamby det.). The Dryinidae were not widely distributed in the islands and were found on *Panicum glutinosum* (particularly in Isabela) (S. Abedrabbo det.).

This species was known only from Santa Cruz: but the presence of this species in Isabela is now ascertained. A description of the male is given below as only females were known previously.

**Male:** Fully winged; length 1,81-2,50 mm; black; antennae brown; legs testaceous, antennae not distally thickened, antennal segments: 5:4:7:8:8:8:7:7,5:7:9; head shiny, swollen, finely punctate, without sculpture among punctures; frontal line absent; occipital carina absent; POL (distance between the posterior ocelli) = 6; OL (distance between posterior and anterior ocelli) = 3; OOL (distance between posterior ocelli and eyes) = 2; temples distinct; scutum dull, granulated; notaulices complete, posteriorly separated in large specimens, joint in small specimens; scutellum and metanotum shiny, without sculpture; propodeum reticulate rugose, without transversal or longitudinal keels; forewing hyaline, without dark transversal bands; distal part of radial vein longer than proximal part (15:7); dorsal process of gonoforceps (Fig. 1) long, with apical region broadened and with serrated margin; maxillary palpi with 2 segments; labial palpi with 1 segment; tibial spurs 1,1,2.

For further information on the terminology used in the above description see Olmi (1984).

The male of *H. crucianus* is the only male specimen of the genus known from the Neotropic region. The other species of this genus known from South America are *H. insularis* Ogloblin (1953) (from the J. Fernandez Islands), *H. hernandezae* Olmi (1986) (known from Costa Rica, Panama and Colombia) and *H. bonairensis* Olmi (1987) (from Bonaire Island, Dutch Antilles). In the islands of the Pacific Ocean the nearer species *H. vitiensis* Perkins (1906) is known from Fiji and Hawaiian Islands. This species is different from the species in Australia (*H. apicalis* Perkins 1905) and in the further Mariana Islands (*H. oratorius* (Westwood 1833)). The main differences in the males are in the shape of the genitalia (Fig. 1).

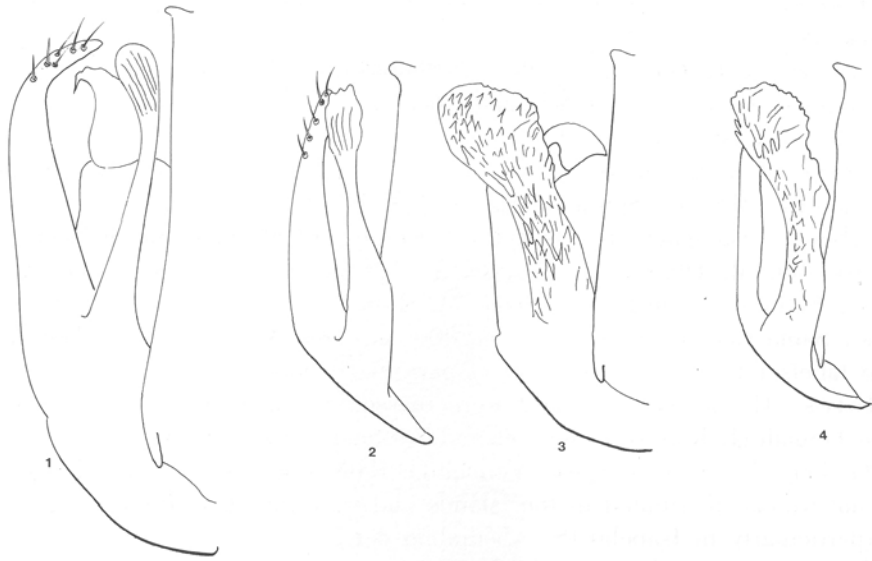


Fig. 1 - Male genital armatures of *Haplogonatopus vitiensis* Perkins from Fiji (1), *oratorius* (Westwood) from Guam (2), *apicalis* Perkins from Sri Lanka (3), *crucianus* Olmi from Sierra Negra (Galapagos) (4), right half removed.

The dorsal processes of the gonoforceps in the genitalia of *H. crucianus* (Fig. I, 4) are less slender than in *H. vitiensis* (Fig. I, 1).

The females of *Haplogonatopus* have small differences: the uniformity of the morphology is hindering a study of the affinities among the species. For this reason it is difficult to decide if *H. crucianus* is near to the Neotropical species of *Haplogonatopus* or to *H. vitiensis* or *H. apicalis*. Other dryinids of the Galapagos Islands seem to have more affinity with the Neotropical species. *A. rabidanus* and *A. arnaudi* belong to genus not known from the islands of the Pacific ocean; in the Australian region the nearer species are found in Australia. In South America on the contrary ten species of *Apterodryinus* are known. Of the genus *Gonatopus* the two species of the Galapagos Islands, *G. fernandinae* and *G. santiaganus*, have more affinity with the Neotropical species; in fact the only two species of *Gonatopus* found in the islands of the Pacific Ocean are *G. melanias* (Perkins 1905) and *G. zealandicus* Olmi 1984. The earlier in Fiji and the latter in New Zealand. The nearer species *G. melanias* has very different morphological characters to those of *G. fernandinae* and *G. santiaganus*, and there is more affinity with the Neotropical species. *G. fernandinae* shows morphological affinity (colour, sculpture) with *G. antilleanus* Olmi (from Curaçao Island, Dutch Antilles); *G. santiaganus* shows morphological affinity (meso-metapleural suture obsolete, shape of the enlarged claw, sculpture) with a great number of Neotropical *Gonatopus* (chiefly *G. autumnalis* Olmi 1984, *G. tuxtlanus* Olmi 1987 and *G. silvestrii* Kieffer 1912).

Of the genus *Pseudogonatopus* the only species in the Galapagos Islands is *P. invictus* Olmi. It shows greater affinity to the Neotropical fauna. The single species of *Pseudogonatopus* found in the islands of the Pacific Ocean is *P. nigricans* (Perkins 1905) (known from Fiji). This species however shows an obsolete meso-metapleural suture and rounded sides of the metanotum, whereas *P. invictus* has a distinct meso-metapleural suture and sides of the metanotum forming a lateral point, as in *P. morenoi* Olmi 1984 found in Colombia.

In conclusion the six species of Dryinidae in the Galapagos show a greater affinity with the Neotropical fauna with *H. crucianus* being the only exception. This is partly because it is impossible to ascertain if it is nearer to the species of *Haplogonatopus* found in the islands of the Pacific Ocean, or in the Neotropical region.

During the rearing of *H. crucianus* interesting hyperparasitoids were obtained. They were identified by Dr. J.S. Noyes (British Museum of Natural History) as *Helegonatopus pseudophanes* Perkins 1906 and *Cheiloneurus* sp. near *gonatopodis* Perkins 1906 (*Encyrtidae*).

*Cheiloneurus* sp. near *gonatopodis* is doubtful because the specimens show a slightly different colour (orange) from the colour of the specimens in the British Museum.

*Encyrtids* were obtained in Santa Cruz (El Puntudo). Other *Encyrtids* were reared in Isabela (El Cura-El Mirador path, Sierra Negra), but no adults emerged from the cocoons of the Dryinidae. It was possible to see the larvae of *Encyrtids* through the transparent cocoons.

One of us (Olmi) reared the same species of *Encyrtids* in continental Ecuador, from *Pseudogonatopus flavus* Olmi 1984 in different localities: Cornejo Astorga (S.to Domingo) and Las Pampas (S.to Domingo).

#### Strepsiptera

One species of Strepsiptera *Elenchus koebeli* Pierce 1909 (Elenchidae) was reared from *Nesosydne olipor* Fennah and *N. alcmaeon* Fennah (Delphacidae: Homoptera). The stylopised Delphacidae were obtained from Santa Cruz: Cerro Mesa (430 m) and El Puntudo (800 m). There were 4 cases of superparasitism and only one of these had a combination of one male and one female Strepsiptera in one host, the others were parasitized by males. The male *Elenchus* emerged from both 5th instar nymphs and adults. The females, as in other Strepsiptera except the Mengenillidae, extrude only in adult hosts.

Modifications in the external genitalia were observed in stylopised hosts (Fig. II). Stylopisation in Delphacidae causes gross modifications in the external genitalia (Kathirithamby 1989a, 1989b), and this has often led to misidentification of the species.

Four species of *Elenchus* have been recorded from the Neotropics, and three of these are from Mexico (Kathirithamby, in press). Further study is required to verify whether these three are valid species.

Material examined: 1 5th instar with ♂ cephalotheca labelled «Gala-

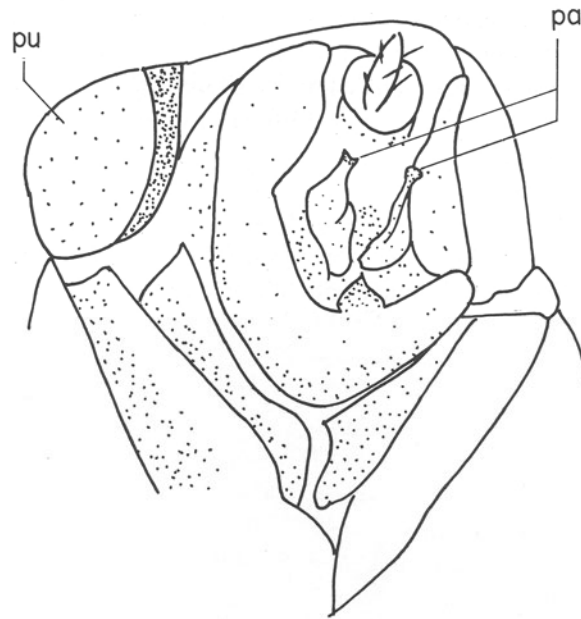


Fig. 11 - Stylipised male Delphacidae with reduced genitalia. pa - parameres; pu - male puparia of *Elechus*. Scale line = 0.2 mm.

pagos Is., Santa Cruz, Cerro Mesa, m 430, 13-1-89, M. Olmi leg.»; *N. olipor* with ♂ cephalotheca labelled «Galapagos Is., Santa Cruz, Cerro Mesa, m 430, 13-1-89, M. Olmi leg.»; 1 adult ♂ (reared from *N. alcmaeon*) labelled «Galapagos Is., Santa Cruz, Cerro Mesa, m 430, 13-1-89, M. Olmi leg.»; 1 adult ♂ (reared from ♀) labelled «Galapagos Is., Santa Cruz, Cerro Mesa, m 430, 13-1-89, M. Olmi leg.»; 3 ♂♂ cephalothecae (in ♀♀) labelled «Galapagos Is., Santa Cruz, El Puntudo, m 800, 20-1-89, M. Olmi leg.»; 1 adult ♂ (reared from *N. alcmaeon*) labelled «Galapagos Is., Santa Cruz, El Puntudo, m 800, 19-1-89, M. Olmi leg.»; 2 adult ♂♂ (reared from 5th instar nymph), labelled «Galapagos Is., Santa Cruz, El Puntudo, m 800, 19-1-89, M. Olmi leg.»; 1 ♂ cephalotheca (in ♀) labelled «Galapagos Is., Santa Cruz, Cerro Mesa, m 430, 13-1-89, M. Olmi leg.»; 2 adult ♂♂ (reared from *N. olipor* males) labelled «Galapagos Is., Santa Cruz, Cerro Mesa, m 430, 13-1-89, M. Olmi leg.»; 2 adult ♂♂ (reared from 5th instar nymphs) labelled «Galapagos Is., Santa Cruz, Cerro Mesa, m 430, 13-1-89, M. Olmi leg.»; 1 ♂ cephalotheca and 1 ♀ cephalothorax (in abnormal male adult) labelled «Galapagos Is., Santa Cruz, Cerro Mesa, m 430, 13-1-89, M. Olmi leg.»; 2 adult ♂♂ labelled «Galapagos Is., Santa Cruz, Cerro Mesa, m 430, 13-1-89, M. Olmi leg.»; 3 adult ♂♂ (reared from ♀♀) labelled «Galapagos Is., Santa Cruz, El Puntudo, m 800, 19-1-89, M. Olmi leg.»; 2 ♂♂ cephalotheca (in 5th instar nymphs) labelled «Galapagos Is., Santa Cruz, El Puntudo, m 800, 19-1-89, M. Olmi leg.»; 1 ♀ and 1 empty ♂ pupa (in ♀) labelled «Galapagos Is., Santa Cruz, Cerro Mesa, m 430, 13-1-89,

M. Olmi leg.»; 1 ♂ cephalotheca (in *N. alcmaeon*) labelled «Galapagos Is., Santa Cruz, El Puntudo, m 800, 20-1-89, M. Olmi leg.»; 1 ♀, and 1 adult ♂ (in ♀) labelled «Galapagos Is., Santa Cruz, El Puntudo, m 800, 19-1-89, M. Olmi leg.».

#### CONCLUSION

Five of the species of Dryinidae of the Galapagos have more affinity with the Neotropical fauna for reasons given above. As for *H. crucianus* it is difficult to give an explanation. Hence a Neotropical origin of the Dryinidae of the Galapagos is a reasonable conclusion.

The females of all Dryinidae of the Galapagos are apterous with winged males. The females of *E. koebelei* are neotenic and permanently endoparasitic in the host whereas the males are free-living.

The possible ways in which the species reached the islands may be as follows:

- 1) On floating vegetation from the South America.
- 2) By wind currents from South America.
- 3) On imported cultivated plants, which is a fairly recent introduction.
- 4) As parasitoids in macropterous hosts.

The third possibility seems less probable as the six species of Dryinidae seem endemic. The most likely way in which both the parasitoids would have reached the islands would have been the fourth, although the hosts of *H. crucianus* and *G. fernandinae* also seem endemic to the islands. *Peregrinus maidis* (Ashmead) and *Sogatella kolophon* (Kirk.) are the two most widely distributed hoppers in the islands but none of these two hosts were found to be parasitized by either Strepsiptera or Dryinidae during the collection in January 1989. The hosts of the Dryinidae *Gonatopus* which are Cicadellidae are also endemic to the islands.

#### ACKNOWLEDGMENTS

We wish to thank Dr. J.S. Noyes and Dr. M. Webb (London) for the identification of the hyperparasites and Cicadellidae, to the Charles Darwin Research Station, the Galapagos Park Service and the Ecuadorian Government for their facilities, and to the British Council and the Leverhulme Trust for the travel grant and the Research Fellowship to J.K. We wish to thank also Prof. Giovanni Onore (Quinto) for his valuable help during the organization of the stay in the Galapagos.

#### SUMMARY

In this paper the authors discuss about the Dryinidae (Hymenoptera: Chrysidoidea) and Elenchidae (Strepsiptera) of the Galapagos Islands. List of the species living in the islands are given,

together with information on the hosts. The following species were reared: *Haplogonatopus crucianus* Olmi 1986 (Dryinidae); a male specimen doubtfully identified as *Gonatopus fernandinae* Olmi 1984 (Dryinidae); *Elenchus koebeli* Pierce 1909 (Elenchidae). The male of *H. crucianus* Olmi is described for the first time. Information on hopper hosts, together with data on the origin of the fauna of Dryinidae and Elenchidae of the Galapagos and on the ways of colonization are discussed.

Contributo alla conoscenza di Elenchidae (Strepsiptera) e Dryinidae (Hymenoptera: Chrysidoidea) delle Isole Galapagos

RIASSUNTO

In questo lavoro gli autori elencano le specie di Dryinidae (Hymenoptera: Chrysidoidea) e di Elenchidae (Strepsiptera) che vivono nelle Isole Galapagos fornendo al contempo informazioni relative ai loro ospiti (Homoptera: Auchenorrhyncha). *Haplogonatopus crucianus* Olmi 1986 (Dryinidae), un maschio probabilmente di *Gonatopus fernandinae* Olmi 1984 (Dryinidae) ed *Elenchus koebeli* Pierce 1909 (Elenchidae) sono stati ottenuti dall'allevamento di ospiti. Inoltre è descritto per la prima volta il maschio di *H. crucianus* Olmi. Infine sono forniti dati relativi all'origine di Dryinidae ed Elenchidae delle Galapagos ed alle loro modalità di colonizzazione.

REFERENCES

- KATHIRITHAMBY J., 1989a - A review of the Strepsiptera. *Systematic Entomology* 14(1): 41-92.  
KATHIRITHAMBY J., 1989b - Descriptions and biological notes of the Australian Elenchidae (Strepsiptera). *Invertebrate Taxonomy* 3(2): 175-195.  
KATHIRITHAMBY J. - Strepsiptera. In: *Insects of the Neotropics and Mesoamerica*. Oxford University Press (in press).  
LINSEY E.G., 1977 - Insects of the Galapagos (Supplement). *Occasional papers of the Californian Academy of Sciences* 125: 1-50.  
OLMI M., 1984 - A revision of the Dryinidae (Hymenoptera). *Memoirs of the American Entomological Institute* 37: XXXI + 1913 pp.  
OLMI M., 1986 - New species and genera of Dryinidae (Hymenoptera Chrysidoidea). *Frustula Entomologica* (Nuova Serie) 7-8: 63-105.  
OLMI M., 1987a - New species of Dryinidae (Hymenoptera Chrysidoidea). *Fragmenta Entomologica* 19: 371-456.  
OLMI M., 1987b - New species of Dryinidae, with description of a new family from Florida and a new species from the Dominica amber (Hymenoptera Chrysidoidea). *Bollettino del Museo Regionale di Scienze Naturali Torino* 5: 211-238.  
PECK S.B. AND PECK J., 1989 - *Elenchus koebeli* (Pierce) (Elenchidae): first record of Strepsiptera from the Galapagos Islands, Ecuador. *Coleopterist* 43 (2): 203-204.