

THE RECOGNITION AND BIOLOGY
OF *PHALACROTOPHORA QUADRIMACULATA* (DIPTERA: PHORIDAE)
PARASITISING *OLLA V-NIGRUM* (COLEOPTERA: COCCINELLIDAE)
USED IN ATTEMPTS
TO CONTROL THE *LEUCAENA PSYLLID*

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SUMMARY

The Neotropical psyllid *Heteropsylla cubana* Crawford (Homoptera: Psyllidae), having become a major pest of *Leucaena leucocephala* (Lam.) De Wit (Leguminosae: Mimosaceae) in New Caledonia, is being subjected to attempted control by the ladybird

beetle *Olla v-nigrum* (Mulsant). The latter, however, is being heavily parasitised by the phorid *Phalacrotophora quadrimaculata* Schmitz. The recognition of this fly is assisted by provision of figures and biological data are reported for the first time.

RÉSUMÉ : Identification et biologie de *Phalacrotophora quadrimaculata* (Diptera : Phoridae), parasite de *Olla v-nigrum* (Coleoptera : Coccinellidae), utilisé dans la lutte contre le psylle du *Leucaena*.

Le psylle néotropical *Heteropsylla cubana* Crawford (Homoptera : Psyllidae) est devenu l'un des plus grands ravageurs du *Leucaena leucocephala* (Lam.) de Wit (Leguminosae : Mimosaceae) en Nouvelle-Calédonie. Les tentatives de lutte biologique utilisent

certaines coccinelles qui sont fortement parasitées par le Diptère Phoridae *Phalacrotophora quadrimaculata* Schmitz. Des données morphologiques et biologiques sont fournies sur la mouche.

Since 1984 the Neotropical plant louse *Heteropsylla cubana* Crawford (Homoptera: Psyllidae) invaded tropical Pacific islands, Australia and South-East Asia. A lack of effective natural enemies in these areas has allowed it to become a significant pest of the important fodder plant *Leucaena leucocephala* (Lam.) de Wit (Leguminosae: Mimosaceae). In New Caledonia attempts to control the psyllid have been made using a ladybird beetle imported from Tahiti, *Olla v-nigrum* Mulsant (Coleoptera: Coccinellidae). The latter, however, has suffered significant levels of parasitisation by a scuttle fly (Diptera: Phoridae) (Chazeau *et al.*, 1989). The purpose of the present paper is to report that the phorid in question is *Phalacrotophora quadrimaculata* Schmitz, and to provide figures to facilitate its recognition along with the first biological data for the species.

This species was described from a male and female from Taiwan (Formosa). In 1985, numbers were collected from agricultural land near the edge of the Toraut Forest, Dumoga-Bone National Park, in Sulawesi-Utara, Indonesia (Disney, unpublished data). The numerous specimens from New Caledonia provide a third locality.

Recognition

The series of specimens now available indicates more variation in the costal index than Borgmeier (1967) allows for in his key, that an occasional specimen has 3 or 4 supra-antennal bristles, and that the frons may be (in part at least) darker than usual. Certain recognition, therefore, should be supported by matching the male hypopygium or female ovipositor segments with *figs. 1-4*. The form of the ovipositor resembles that of *P. berolinensis* Schmitz (e. g. see *fig. 99* in Disney, 1983).

Biology

The eggs are laid on the prepupa or on the very young pupa of *Olla v-nigrum*. Oviposition occurs rapidly, and the fly does not seem deterred by jerky movements of its victim. The translucent cylindrical eggs (up to eight on a single pupa) are stuck on the host's cuticle, most often laterally or ventrally.

Phalacrotophora quadrimaculata, Schmitz

Phalacrotophora quadrimaculata Schmitz, 1926, p. 49
(♂, ♀) : Borgmeier, 1967, p. 257 (*in key*).

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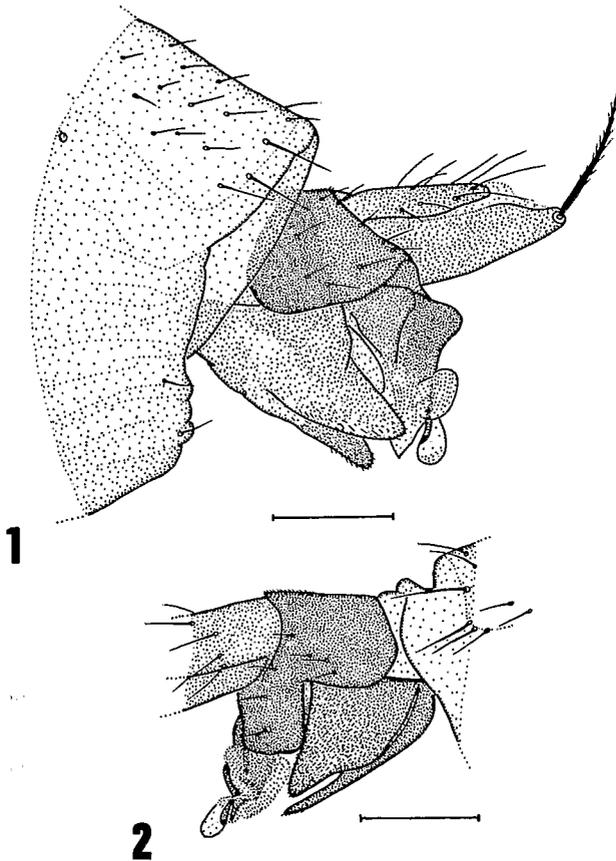


FIG. 1 and 2. — *Phalacrotophora quadrimaculata* Schmitz, male hypopygium. 1. — From left side. 2. — From right side (Scale bars = 0.1 mm).

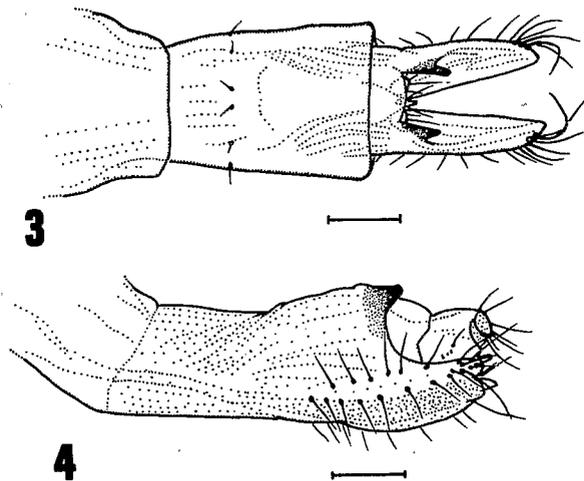


FIG. 3 and 4. — *Phalacrotophora quadrimaculata*, female ovipositor segments. 3. — From above. 4. — From left side (Scale bars = 0.1 mm).

At an average temperature of 23.6° C (max. 25.5, min. 21.5) egg hatching occurs within 24 hours and the newly hatched larva penetrates the host immediately. Larval

development was observed on two parasitised pupae. Nine fully grown larvae emerged from the hosts between the second and third day. They usually emerged through a large, conspicuous, irregular hole on the ventral side of the host. The larva pupates on or in the ground, within eighteen hours of leaving its host. Pupal development is much longer, with a mean duration of 17.4 days (range 16-19 days for 98 pupae).

The total duration of development of the fly from egg to adult is estimated to be 21-22 days at 23.5° C. The average number of mature larvae leaving one host is 4.3 (range 2-7). The rate of hatching from the pupae in the laboratory was very high (table I).

TABLE I. — Parasitisation of *Olla v-nigrum* by *Phalacrotophora quadrimaculata* in New Caledonia.

	<i>Olla</i> <i>pupae</i>	<i>Phorid</i> <i>pupae</i>	<i>Phorid</i> <i>adults</i>	<i>Phorid</i> <i>pupae</i> <i>per Olla</i>	<i>Hatching</i> <i>rate</i> <i>of phorids</i> <i>per pupa</i>
May 1988	16	59	46	3.7	0.78
May 1989	23	108	87	4.7	0.81
March 1989	23	100	79	4.3	0.79
<i>Totals</i>	62	267	212	4.3	0.79

Phalacrotophora quadrimaculata was reared from *O. v-nigrum* pupae collected on the West coast of Noumea, Bouloupari, Bourail, Pouembout, Ouaco and on the east side of the Central Range at Col de Nassirah. Rearing was done from March to June. The fly may occur at all seasons.

The rate of parasitism was high in March 1989, averaging 0.39 (no. of pupae + pupal exuviae observed being 233). The rate was 0.42 in Noumea, 0.15 in Paita, 0.79 in Ouaco. These high rates correlate with high population densities of the ladybird host and of its prey species, *H. cubana*. Also the end of 1988 and first few months of 1989 experienced higher rainfall than usual. Perhaps high humidities favour *P. quadrimaculata*, which was found to be the major natural enemy of *O. v-nigrum* in New Caledonia during the *Olla/Heteropsylla* survey (Chazeau *et al.*, 1989).

DISCUSSION

It is well known that some species of *Phalacrotophora* parasitise pupae of Coccinellidae (e. g. Delage and Laureire, 1974). Iperiti (1964) provided data on the development of *Phalacrotophora fasciata* (Fallén), which parasitises ladybirds in Europe. The total duration of development, from egg to adult, was 25 days for larvae parasitising *Coccinella septempunctata* L. and about 20 days for larvae utilising *Adonia variegata* (Goeze), in June in

south eastern France. In *P. fasciata* the pupal stage represents only about half the total developmental period, in contrast to *P. quadrimaculata*, in which the pupal period represents about 0.8 of the total developmental period.

The most detailed information available on a phorid's developmental period is that for *Megaselia scalaris* (Loew). In most studies of this cosmopolitan, warm-climate, species the pupal period represents 0.5-0.6 of the total developmental period, despite the latter varying inversely with temperature from 14-37 days (El-Miniawi and Moustafa, 1965; Prawirodisastro and Benjamin, 1979; Trumble and Pienkowski, 1979). However, in a population studied in Thailand the pupal period represented only 0.4-0.5 of the total developmental period (Tumrasvin *et al.*, 1977). In *Megaselia halterata* (Wood) the pupal period (of 14 days at 24° C) represents about 0.6 of the total developmental period (Hussey, 1959). The total development period varies from 14 days at 24° C to 102 days at 10° C (Hussey and Wyatt, 1962). These data serve to emphasise the relative brevity of the pre-pupal stages in *P. quadrimaculata*, as the pupal period of *M. scalaris* at 20° C is 17-18 days (Prawirodisastro and Benjamin, 1979), which is comparable to the 17.4 days at an average temperature of 23.6° C for *P. quadrimaculata*.

The known biology of the genus *Phalacrotophora* indicates that parasitoid habits are the norm, the known hosts being Coccinellidae, spider eggs and Aculeata (Borgmeier, 1963). The data suggest that each species is restricted to a particular type of host, but is not very host specific. Thus the species known to parasitize the pupae of Coccinellidae have not been reared from other hosts, but each tends to attack a range of ladybird species (Van Emden, 1950; Richerson, 1970). Despite this catholicity there is some evidence of host preferences. For example *P. berlinensis* and *P. fasciata* both parasitize a range of species including *Adalia bipunctata* (L.) and *Coccinella septempunctata* (L.), but observations of a mixed population of both species of fly and ladybird indicated there was a preference of *P. berlinensis* for *A. bipunctata* and *P. fasciata* for *C. septempunctata* (Disney, 1979).

The observations reported above are the first records of a phorid parasitizing *Olla v-nigrum* and the first biological observations for *P. quadrimaculata*. It is probable that

the fly parasitizes at least one native species of ladybird in New Caledonia.

REFERENCES

- Borgmeier T. : Revision of the North American phorid flies. Part I. The Phorinae, Aenigmatiinae and Metopininae, except *Megaselia* (Diptera, Phoridae). *Studia Ent., Petrópolis*, 1963, 6, 1-256.
- Borgmeier T. : Studies on Indo-Australian phorid flies, based mainly on material of the Museum of Comparative Zoology and the United States National Museum. Part II. (Diptera, Phoridae). *Studia ent., Petrópolis*, 1967, 10, 81-276.
- Chazeau J., Bouye E., Bonnet de Larbogne L. : Lutte biologique contre le psylle *Heteropsylla cubana*, ravageur du faux-mimosa *Leucaena leucocephala* en Nouvelle-Calédonie. *ORSTOM Centre de Nouméa, Conventions Sciences de la vie, Zoologie appliquée*, 1989, 82 p.
- Delage A., Lauraire M.-Cl. : Mise au point sur le genre *Phalacrotophora* (Dipt. Phoridae) et description de l'ovipositor d'une femelle parasite. *Ann. Parasitol. Hum. Comp.*, 1974, 49, 495-500.
- Disney R. H. L. : Natural history notes on some British Phoridae (Diptera) with comments on a changing picture. *Entomologist's Gaz.*, 1979, 30, 141-150.
- Disney R. H. L. : Scuttle flies Diptera, Phoridae (except *Megaselia*). *Handbk. Ident. Br. Insects*, 1983, 10, 1-81.
- El-Miniawi S. F., Moustafa M. A. : On the biology of *Megaselia scalaris* (Loew) (Diptera: Phoridae). *Bull. Soc. Ent. Egypte*, 1965, 49, 81-91.
- Hussey N. W. : Biology of mushroom phorids. *Mushroom Sci.*, 1959, 4, 260-269.
- Hussey N. W., Wyatt I. J. : The interaction between mushroom mycelium and insect pest populations. *Mushroom Sci.*, 1962, 5, 509-517.
- Iperti G. : Les parasites des Coccinelles aphidiphages dans les Alpes-Maritimes et les Basses-Alpes. *Entomophaga*, 1964, 9, 153-180.
- Prawirodisastro M., Benjamin D. M. : Laboratory study on the biology and ecology of *Megaselia scalaris* (Diptera: Phoridae). *J. Med. Ent.*, 1979, 16, 317-320.
- Richerson J. V. : A world list of parasites of Coccinellidae. *J. Entomol. Soc. Br. Columb.*, 1970, 67, 33-48.
- Schmitz H. : H. Sauter's Formosa-Ausbeute: Phoriden (Dipt.). *Ent. Mitt.*, 1926, 15, 46-57.
- Trumble J. T., Pienkowski R. L. : Development and survival of *Megaselia scalaris* (Diptera: Phoridae) at selected temperatures and photoperiods. *Proc. Ent. Soc. Wash.*, 1979, 81, 207-210.
- Tumrasvin W. S., Sucharit S., Vutikes S. : Studies on the life history of *Megaselia scalaris* (Loew) in Thailand. *S. E. Asian J. Trop. Med. Publ. Hlth*, 1977, 8, 74-76.
- Van Emden F. I. : Dipterous parasites of Coleoptera. *Entomologist's Mon. Mag.*, 1950, 86, 182-206.