A Study of Stylopization in the Bee Genus *Dufourea*

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Strepsipteran parasites of the bee genus *Dufourea* Lepeletier have been known from very few reported cases. Bohart (1941) described *Eurystylops desertorum* from a small series of females extracted from *Dufourea boregoensis* (Michener) collected near Indio, California. Bohart (1943) described *E. tetonensis* from a small series of females extracted from *Dufourea maura* (Cresson) collected in Grand Teton National Park, Wyoming. The third species known was described by Hofeneder (1949) as *E. oenipontana* based on two females taken from *Dufourea inermis* (Nylander) collected in Innsbruck, Austria. A fourth *Eurystylops* was extracted from two species of *Conanthalictus* collected in Andreas Canyon, Riverside County, California. It was named *conanthalicti* by Kinzelback (1971).

The writers in June and July, 1962, located two areas at about 6,300 feet elevation in the central Sierra Nevada Mountains of California where *Dufourea trochantera* G. Bohart was plentiful and showed abundant evidence of stylopization by a new species described herein as *Eurystylops sierrensis* by the senior author. The two areas in question were a semi-arid edge of a meadow at the University of California Sagehen Creek Project, 12 miles north of Truckee in Nevada County (Station I) and a similar meadow margin 2.3 miles west of Highway 89 on the Independence Lake Road some 30 miles north of Truckee in Sierra County (Station II). No nesting sites of the bee hosts were found at the Sagehen locality, but a large nesting colony was observed at Station II. Bees at both sites were visiting dense low-growing masses of *Phacelia humilis* T. and G.

Parasitized *D. trochantera* are not readily detected by the casual observer because the exserted cephalothorax of the *Eurystylops* is obscured by abdominal hair bands on the dorsum of the bee. However, stylopized specimens have the pygidium mostly hidden and dull, the general color browner, and the abdomen somewhat bloated.

Parasitized female *D. trochantera* do not regularly collect pollen. In the 1962 study, tabulations were made on the number of females carrying pollen on the legs. At Station 1, 284 females were examined

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and 12.7 percent of them were unstylopized and without pollen, 59.5 percent were unstylopized and bore pollen, 27.4 percent were stylopized and without pollen, and 0.4 percent (one stylopized bee with a light amount of pollen on the abdomen) bore a trace of pollen. Similarly, in 1962 at Station II, 289 female bees were examined and 15.5 percent were unstylopized and without pollen, 39.1 percent were unstylopized and bore pollen, and 45.4 percent were stylopized and without pollen.

Collecting at Station I encompassed four days from June 29 through July 2, 1962 and eight days from June 19 through July 10, 1964. Bees were netted at random near midday, on or about the patches of *Phacelia.* Out of a total of 681 bees, 307 were males and 374 were females. Of the males 4.9 percent were parasitized, 4.3 percent of these being monostylopized (13 bees), 0.3 percent were distylopized (1 bee), and 0.3 percent were tristylopized (1 bee). Of the females 29.8 percent were parasitized, with a percentage breakdown of 24.9 with one parasite (93 bees), 4.1 with two (15 bees), and 0.8 with three (3 bees).

At Station II collecting encompassed two days, July 6 and 7, 1962, and two days, July 8 and 10, 1964. A total of 632 bees were netted, of which eight were males and 624 were females. The female bees were 41.8 percent parasitized (261 bees) probably the highest rate ever reported for bees of any sort. The percentage of females bearing one, two, three or four *Eurystylops* were 31.7 (198 bees), 8.8 (55 bees), 1.1 (seven bees), and 0.2 (one bee) respectively.

When comparing the two years it is apparent that we collected later in the season in 1962 than in 1964. The numbers of male bees collected at Station I dropped sharply after June 29, 1964, and that was our starting reference for 1962. By the first of July, 1964, the females were being collected in greater quantity than were the males, whereas before that date, the reverse was true. Although several males were collected after July 1, 1964, none were parasitized, whereas many of the females were. Perhaps the males bearing parasites die sooner, leaving by July 1 a predominantly parasite-free male population; but the females with their extra stores of food are able to survive for longer periods even though parasitized.

During two days of collecting at Station II in 1962 a phenomenal 45.4 percent parasitization of female bees was recorded (290 total female bees). Two years later, with a considerably larger sample (334 female bees) a somewhat lower percentage was noted: 38.6. In both years males were very scarce at Station II, correlating well with time of year.

Altogether, 1,313 *D. trochantera* were examined at the two stations. Of these, 388 bore parasites and multiple parasitism occurred in 83 of the bees giving a total of 483 *Eurystylops.* This was an excellent opportunity to observe the position of the parasites as indicated by

the location of the exserted cephalothorax of the female *Eurystylops.* As in other stylopids on bees the female parasite rides upside down and backwards with its head protruding through the intersegmental membrane between abdominal terga of the host. In 305 monostylopized bees the parasite was always under apparent tergum IV. The position was lateral but with no obvious choice between right or left side. The 71 distylopized bees had parasites nearly always under apparent tergum IV, one on each side. One bee had a parasite under tergum IV and another under III but on opposite sides. In 11 tristylopized bees, seven had two parasites under IV and one under III, two had all three parasites under IV, and two had one parasite under IV and two under III. In the only quadristylopized specimen captured there were two parasites under IV and two under III. These data show a clear preference for a position under apparent tergum IV with a second choice under III.

It seems likely that parthenogenesis occurs in *E. sierrensis* and possibly within the entire genus. In the five described species only females are known. This is quite unlike the situation in *Stylops* which parasitize *Andrena.* An example of the latter is *Stylops pacifica* Bohart, studied by Linsley and MacSwain (1957). The bee hosts of this species bear male pupae or empty pupal cases (exuviae). In the two year period of their study, 1954 and 1956, the total number of *Andrena caerulea Smith (=A. complexa* Viereck) examined was 4,473 of which 476 were stylopized. Female *Stylops* constituted 60.5 percent and males 39.5 percent. They stated that "the sex ratio of *S. pacifica* is probably one to one" (Linsley and MacSwain, 1957:408). In our study 1,313 *Dufourea trochantera* were examined and 388 of these bore 483 parasites, all female *Eurystylops.*

In the halictid, *Lasioglossum zephyrum*, male parasites of *Halictoxenos jonesi* Pierce occur throughout the summer according to Batra (1965). However, male parasites are most common in August and September. Since the populations of *Dufourea trochantera* which we studied are one-brooded, the presence of male parasites in a second brood can be discounted. Also, there is a possibility that males may occur but kill the host bee as it emerges. No evidence of this sort has been reported for any strepsipteran. There is also the outside chance that male parasites may attack some other insect host, perhaps not even a bee. Although this is not known in Stylopidae, it does occur in the strepsipteran family Myrmecolacidae. Males of this tropical group parasitize ants while females attack Orthoptera.

Linsley and MacSwain, (1957) stated that the aedeagus of the male *Stylops* penetrates and broadly ruptures the membrane of the entrance to the median brood canal. Several specimens of *Stylops* spp. from *Andrena* spp. were examined and compared with specimens of *Eurystylops sierrensis* in *Dufourea trochantera.* No rupturing could be

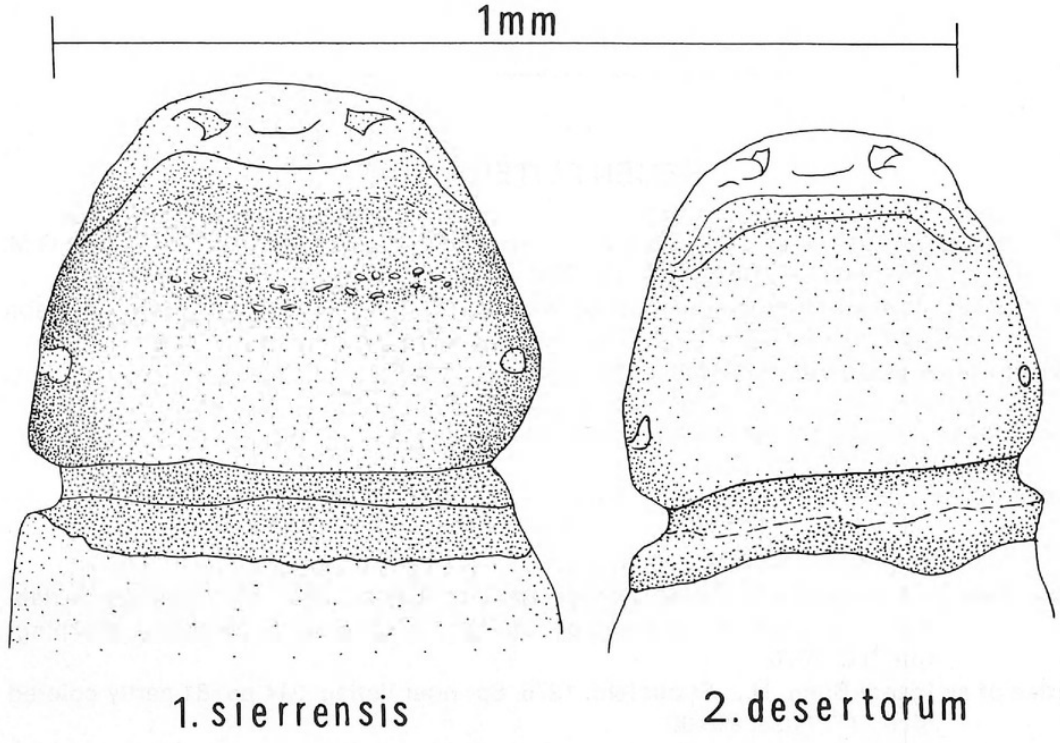
seen in the membrane of *E. sierrensis* where the outer lip of the brood canal was smooth and continuous. On the contrary, the *Stylops* had the outer lip somewhat jagged and there was evidence of punctures in more than one place. These observations point toward parthenogenesis in *Eurystylops.*

Eurystylops sierrensis Bohart, new species (Fig. 1)

Female holotype (Univ. Calif. Davis): Head and spiracular areas light, remainder of cephalothorax testaceous, basal band fuscotestaceous. Shape of head and thorax as in Fig. 1; mandible approximately triangular, apical tooth nearly straight; apex of head broad, convex. Thorax with transverse band of about 70 transparent spots just posterior to laterobasal angles of head; with an irregular line of 16 pigmented spots between spiracles; cephalothorax widest just behind spiracles. Cephalothorax in mm:width 0.555, width at base of head 0.465, length 0.380, length to collar 0.340, length to front edge of spiracles 0.295.

Holotype female, Sagehen Creek, Nevada County, California, June 29, 1962, ex *Dufourea trochantera* G. Bohart, on *Phacelia humilis* T. and G. (R. Bohart and M. Irwin). Paratypes, 32 females, same data as holotype but collected from June 24 to July 1; 14 females, Independence Lake Road, Sierra County, California, July 7, 1962, same host and collectors as holotype. Paratypes in collections of U.S. National Museum, California Academy of Sciences, and U.C. Davis.

E. sierrensis is about a fourth larger than *desertorum* (Fig. 2) but is different also in the presence of a transverse band of clear spots just behind the head, and in being more angled behind the spiracles. In



Figs. 1-2. Cephalothoraces of female *Eurystylops,* ventral.

the last two characters it agrees with *tetonensis*. However, it is about a fourth smaller than the latter, and the ratio of head width to cephalothorax width is greater (0.865:0.758). Therefore, the cephalothorax appears to be more compact.

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Literature Cited

Batra, S.W.T. 1965. Organisms associated with *Lasioglossum zephyrum*. J. Kansas Entomol. Soc. 38:367-389.

Bohart, R.M. 1941. A revision of the Strepsiptera with special reference to the species of North America. Univ. Calif. Pub. Entomol. 7:91-160.

Bohart, R.M. 1943. A new generic name in Strepsiptera and description of a new species. Bull. Brooklyn Entomol. Soc. 38:12-13.

Hofeneder, K. 1949. Über einige Strepsipteren. Brotéria (sér. Ciênc. Nat.). 18:109-162.

Kinzelback, R.K. 1971. Morphologische Befunde an Fächerfluglern and ihre phylogenetische Bedeutung. Zoologica, 41 Band, 5 Lieferung, Heft 119(2):129-256.

Linsley, E.G. and J.W. MacSwain. 1957. Observations on the habits of *Stylops pacifica* Bohart. Univ. Calif. Pub. Entomol. 11:395-430.

RECENT LITERATURE

Diagnostic Manual for the Identification of Insect Pathogens. G.O. Poinar, Jr. and G.M. Thomas. 1978. Plenum Publ. Corp. 210 pp. $19.50

Biological Control by Augmentation of Natural Enemies. R.L. Ridgway, S.B. Vinson Eds. 1977. Plenum Publ. Corp. 480 pp. $39.50

Biochemical intervention Between Plants and Insects. J.W. Wallace, R.L. Mansell Eds. 1976. Plenum Publ. Corp. 425 pp. $35.00

Evolutionary Strategies of Parasitic Insects and Mites. P.W. Price Ed. 1975. Plenum Publ. Corp. 224 pp. $25.00

Evolution of Insect Migration and Diapause. H. Dingle. Ed. 1978. Springer-Verlag. 350 pp., 103 illus. $22.80. Based upon Symposium "Evolution of Escape in Space and Time", 15th Int. Congress of Entomology, Washington, D.C. 1976.

The Role of Arthropods in Forest Ecosystems. J. Mattson. Ed. 1977. Springer-Verlag. 104 p., 28 illus. Proceedings of 15th Int. Congress of Entomology, Washington, D.C. 1076.

Atlas of an Insect Brain. N.J. Strausfeld. 1976. Springer-Verlag. 214 pp. 81 partly colored illus., 71 plates. $98.00

An Introduction to the Aquatic Insects of North America. R.W. Merritt, K.W. Cummins Eds. 1978. Kendall/Hunt. Publ. Co. 512 pp. $18.95 tentative.