

Parasitism of *Stylops* (Strepsiptera, Stylopidae) in poly- and oligolectic *Andrena* hosts (Hymenoptera, Apoidea)

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The taxonomic status of many *Stylops* species described often on the basis of poor female characters is problematic and host specificity of these dubious species is largely unsettled. In Germany and Finland, oligolectic *Andrena* species were not observed to be parasitized more frequently by *Stylops* than polylectic ones. The result does not support several coexisting *Stylops* species with strict host specificity.

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1. Introduction

Strepsiptera are endoparasites of other insects. The males are free living and winged, while females are wingless and, except in one family, also legless and do not leave the host. *Stylops* species are parasites of many species of *Andrena*. Species delimitation of parasites is problematic when populations on different hosts are slightly different (Mayr & Ashlock 1991), and a great number of *Stylops* species have been described on the basis of poor characters in female cephalothorax (e.g. Luna de Carvalho 1974, Kifune & Hirashima 1985, Kifune & Maeta 1990). The morphology of males is much more suitable for taxonomic comparisons than the few structures visible on the females. However, males have been found quite rarely and males of most described species are unknown.

Kinzelbach (1978) listed 55 described species of *Stylops* and 161 species of *Andrena* as hosts of *Stylops* from the western Palearctic area, but he preliminarily regarded all the described species as synonyms of *Stylops melittae* Kirby, 1802. How-

ever, Kinzelbach (1978) stressed that western Palearctic *Stylops* populations are in no way a homogeneous group and that great variation exists in the structures of female cephalothorax, and in the form of aedeagi in the males. Furthermore, Kinzelbach (1978) noted some kind of similarity in the morphology of *Stylops* parasitizing species of the same subgenus of *Andrena*, but he left the taxonomic value of this variation unsettled.

Host specificity of *Stylops* species is suggested to vary from one to several species of hosts. Bohart (1941) noted 21 "distinctive" species of *Stylops* from North America, about half of them having only one host species. In California, Linsley and MacSwain (1957) reported that *S. pacifica* Bohart is a common parasite of two *Andrena* species, but is unable to complete its life cycle on other host bees. In Germany, Borchert (1963) found that 1st instar larvae (triungulins) of *Stylops* parasitizing *A. vaga* differed in their morphology from the larvae parasitizing three other vernal *Andrena* species. This led him to suggest that there were two different species of *Stylops* in question.

As is generally the case in Strepsiptera, the life cycle of *Stylops* involves hypermetamorphosis. A female produces even several thousand free-living 1st instar larvae (Linsley & MacSwain 1957), which the parasitised host bee leaves on food flowers of other bees. If a *Stylops* species is host specific, then a critical point during its life cycle would be to find the right host among several bee species visiting flowers with the 1st instar larvae. The degree of flower specialization, especially in pollen collecting, varies among bees. Oligolectic bee species collect pollen within a few species of a genus or a family of plants, whereas polylectic species collect pollen from plants belonging to two or several families. Even though oligolectic bees usually forage for nectar from various kinds of flowers, the number of all food flowers is for oligolectes apparently much lower than for polylectes. For instance, Elfving (1968) recorded from Finland on an average (\pm SD) 14.9 ± 10.4 and 31.7 ± 21.8 food plants for 13 oligo- and 12 polylectic and widely distributed *Andrena* species, respectively. Presumably, the successful completion of the life cycle of host specific *Stylops* is better in species parasitizing oligolectic hosts than in those parasitizing polylectic hosts. The aim of this report is to find if oligolectic *Andrena* species are more often infested by *Stylops* (stylopized) than polylectic ones, and by this means elucidate the host specificity of this group which has been problematic.

2. Results and conclusions

About half of all *Andrena* species in Finland and Germany are oligolectic, and among the species in which stylopization has been observed the proportions are 54 and 40 percent, respectively (Table 1). In Finland, stylopids have been recorded on about one third of the polylectic as well on the oligolectic species. The same proportions are higher in Germany, especially in polylectic species. However, the higher proportion may be simply caused by the larger material of *Andrena* from Germany, and the smaller material from Finland possibly does not include all rarely stylopized species.

Local proportions of stylopization may be highly variable, and Jensen (1971) noted even 18% stylopized specimens in a large colony of oligo-

lectic *Andrena vaga* Panzer in North Zealand in Denmark. In Finland, stylopids have been recorded on polylectic and oligolectic *Andrena* species (in collection materials) as follows (Pekkarinen & Raatikainen 1973):

| | Species | Specimens studied | Specimens stylopized | Percentage stylopized |
|-------------|---------|-------------------|----------------------|-----------------------|
| Polylectic | 5 | 2247 | 97 | 4.3 |
| Oligolectic | 6 | 2713 | 50 | 1.8 |

The frequency of stylopized specimens is significantly smaller on oligolectic species ($X^2 = 25.4$, $P < 0.001$). This result indicates that oligolectic *Andrena* species are not stylopized more frequently than polylectic ones, and thus do not support several coexisting *Stylops* species with strict host specificity. If the same *Stylops* species parasitizes both oligo- and polylectic hosts, the large flower spectrum of polylectes possibly favours the dispersal of the 1st instars and the whole life cycle of *Stylops* better, than the lower spectrum of oligolectes.

Table 1. Numbers non-stylopized and stylopized (*Stylops* infested) on polylectic (Pol.) and oligolectic (Ol.) species of *Andrena* recorded in Finland and the former Western Germany. The material according to Pekkarinen and Raatikainen (1973), Kinzellbach (1978), Westrich (1990), Pekkarinen (1997) and unpublished notes by the late E. Valkeila.

| | Finland | | | | Germany | | | |
|-----------|---------|-----|----------|-------|---------|-----|----------|-------|
| | Pol. | Ol. | Σ | % ol. | Pol. | Ol. | Σ | % ol. |
| Non-styl. | 12 | 11 | 23 | 48 | 25 | 29 | 54 | 54 |
| Styl. | 6 | 7 | 13 | 54 | 32 | 21 | 53 | 40 |
| Σ | 18 | 18 | 36 | 50 | 57 | 50 | 107 | 47 |
| % styl. | 33 | 39 | 36 | — | 54 | 42 | 49 | — |

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