

Pimpla processioneae and *P. rufipes*: specialist versus generalist (Hymenoptera: Ichneumonidae, Pimplinae)

The differences between *Pimpla processioneae* and *P. rufipes* are discussed, based on reared and collected specimens in The Netherlands. It is argued that *P. processioneae* is a distinct species and a specialist pupal parasitoid of *Thaumetopoea processionea* (Linnaeus) (Lepidoptera: Notodontidae). *Pimpla processioneae* is recorded here for the first time from The Netherlands.

Entomologische Berichten 65(1): 14-16

Key words: oak processionary caterpillar, *Thaumetopoea processionea*, parasitoid

Introduction

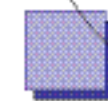
Ratzeburg (1849) described a pimpline species that had been reared from *Thaumetopoea processionea* (Linnaeus) (Lepidoptera: Notodontidae) on oak: *Pimpla processioneae* (figure 1). In the description Ratzeburg emphasised the yellowish-white marked scutellum. Due to its close resemblance to the very common polyphagous pupal parasitoid *P. rufipes* (Miller) (synonyms: *P. hypochondriaca* (Retzius), *P. instigator* (Fabricius)) subsequent authors have treated this taxon in various ways. Schmiedeknecht (1934) considers it to be a variety of *P. rufipes*. Using the white marked scutellum as distinguishing character Aubert (1959) explains *P. processioneae* to be a form of *P. rufipes* on the basis of specimens reared from pupae of the Lepidoptera *Malacosoma neustria* (Linnaeus) and *Aglais urticae* (Linnaeus). Oehlke (1967) treats *P. processioneae* as a synonym of *P. rufipes*. The first author who treated *P. processioneae* in an identification key as a distinct species seems to have been Kasparyan (1974). His view has been adopted by Yu & Horstmann (1997). Kasparyan presents in his key the white pubescence on face and propodeum as the main character for the separation of *P. processioneae* and *P. rufipes*. The lectotype of *P. processioneae*, a male specimen, is present in the collection of the Deutsches Entomologisches Institut (DEI), Müncheberg (previously in Eberswalde), Germany (Fitton 1978). I had the opportunity to study the specimen and it shows indeed a striking white pubescence on face and propodeum.

Biology

In The Netherlands the host species *Thaumetopoea processionea* reappeared in 1987 after an absence of more than a century. This univoltine species lives on oak and hibernates

C.J. Zwakhals

Dr. Dreeslaan 204
4241 CM Arkel
keeszwakhals@hetnet.nl



as egg. The processionary caterpillars live in colonies and rest at daytime in 'nests', mainly consisting of empty caterpillar skins. At night they walk in procession over the branches to the leaves. When they are fully grown they pupate together in the nest.

The species can be absent for long periods and then within a few years develop into a plague. From 1987 on it steadily increased in range and numbers until in 1997 it became a real plague in the southern provinces Noord-Brabant and Limburg (Stigter *et al.* 1997). It then defoliated many oak trees and the wind-blown urticating hairs caused serious trouble to people living in the infected area.

The occurrence of this species in great numbers offered the opportunity to collect parasitoids. In 1996 some speci-



Figure 1. *Pimpla processioneae* ♀, habitus. Foto: Kees van Achterberg
Pimpla processioneae ♀, habitus.

mens of *P. rufipes* and *P. processioneae* were caught on or nearby *T. processionea*-nests. A few nests were collected and from them six *P. processioneae* males emerged in 1996. The next year in April, after hibernation in the nests, again some *Pimpla*'s emerged: 26 *P. processioneae* (8 females and 18 males) and twelve *P. rufipes* (five females and seven males).

In 1997, the peak of the outbreak, 25 *T. processionea*-nests were collected between 12 July and 2 August from six locations in Eindhoven, Bergeyk, Lierop and Luyksgestel, Noord-Brabant. From these nests emerged, besides many moths, the following numbers of *Pimpla*-species (and a lot of tachinids (Diptera)): *P. turionellae*: 32 females and nine males, *P. rufipes*: nine females and fourteen males, *P. processioneae*: 46 females and 46 males, all between 5 and 23 August 1997. No parasitoids emerged the next year. So *P. processioneae* greatly outnumbered the common polyphagous species *P. rufipes*.

Identification

The reared specimens allow for the separation of *P. rufipes* and *P. processioneae* based on the following characters:

| character | <i>processioneae</i> | <i>rufipes</i> |
|--------------------------|------------------------|---------------------|
| pubescence | whitish | fuscous |
| trochantelli | red | mainly black |
| punctuation on tergite 4 | weak, with weak striae | deep and dense |
| punctuation on tergite 5 | absent | dense in basal half |
| width/length femur 3 ♀ | 0.32 - 0.37 | 0.26 - 0.28 |
| width/length femur 3 ♂ | 0.31 - 0.33 | 0.27 - 0.30 |

In *P. processioneae* the punctuation on mesopleura and abdomen is generally less deep and less dense than in *P. rufipes* but this cannot be easily appreciated without direct comparison of both species (figures 2-3). The two humps on the postpetiolus are also less developed, giving the postpetiolus a more evenly rounded appearance. The hind femur is



Figure 2. *Pimpla processioneae* ♀, mesopleuron. Foto: Kees van Achterberg
Pimpla processioneae ♀, mesopleuron.

generally broader in *P. processioneae* and more slender in *P. rufipes*.

Occasionally in both species, specimens with an ivory marked scutellum appear, so that character cannot be used to separate the two species.

Association with *Thaumetopoea processionea*

After the experience gained with the reared specimens the following Dutch ichneumonid collections were checked for *P. processioneae* and *P. rufipes*: Zoological Museum Amsterdam; National Museum of Natural History Naturalis, Leiden; Laboratory of Entomology, Wageningen University; Natural History Museum Rotterdam; Natural History Museum Tilburg; Natural History Museum Maastricht. Examination of the collections revealed 1000 *P. rufipes* but no *P. processioneae* over the last century. This suggests a close association between *P. processioneae* and *T. processionea*, as *P. processioneae* was obviously absent in the period that *T. processionea* was absent in The Netherlands.

In addition to the collecting of nests and rearing parasitoids from them, an attempt was made to further breed *P. processioneae*. To this purpose a male and a female specimen were brought together in a cage with some *Galleria mellonella* (Linnaeus) (Lepidoptera: Pyralidae) cocoons. These cocoons came from a laboratory strain of *Galleria* and were free of parasitoids. This experiment was repeated several times with different males and females. Only once a short copulation was observed, but the female died before producing eggs. In the end, only two male specimens emerged from the *Galleria* pupae and they were clearly *P. processioneae*, as was their mother. So obviously, only unfertilized eggs had been laid. Afterwards it became clear that unfortunately many *Galleria* cocoons had been too old and only produced a moth or contained an empty pupal case. Pupal parasitoids can only attack young pupae successfully.

All this leads to the conclusion that *P. processioneae* is a



Figure 3. *Pimpla rufipes* ♀, mesopleuron. Foto: Kees van Achterberg
Pimpla rufipes ♀, mesopleuron..

distinct univoltine species and a specialist pupal parasitoid of *T. processionea*, usually emerging together with its host. As a consequence, *P. processionae* has to overwinter as an adult. Only very few pimplines are known to overwinter as an adult. Cole (1967) reports *Itopectis maculator* (Fabricius) to do so in England. Overwintering as an adult is also known from *Scambus pomorum* (Ratzeburg) (Zijp & Blommers 2002). *Scambus pomorum* is a specialist parasitoid of the univoltine curculionid beetle *Anthonomus pomorum* (Linnaeus), living in apple blossom buds. In the research project on *A. pomorum*, 300 specimens of *S. pomorum* were reared from infested apple buds, 180 females and 120 males. In the same project 30 *Scambus annulatus* (Kiss) (sixteen females and fourteen males) were reared from those buds. *Scambus annulatus* is known to be a very polyphagous parasitoid (Fitton *et al.* 1988). So, in this case, also the specialist *S. pomorum* greatly outnumbered the generalist *S. annulatus*. As in the case of *T. processionea*, the host species was present in great numbers. At first sight one would expect a generalist parasitoid would strongly benefit from such a situation. Apparently this is not the case. Obviously a specialist is better adapted to a strong increase in host specimens of one species, whereas a generalist always disperses its eggs over several host species even if one host is very numerous. Usually a parasitoid can only successfully attack a host in a specific stage of its development. If the host is too young there is a great chance the host will die, while if the host is too old it can often successfully encapsulate the parasitoid egg. For a pupal parasitoid the right stage is the young pupa. For a given species such pupae are present only in a rather short period, so the parasitoid has to produce a lot of eggs in a short time as well. Probably specialists can do so better than generalists.

Acknowledgements

Dr. A. Taeger (DEI) kindly made it possible to study the lectotype of *P. processionae*. Prof. Dr. C. van Achterberg kindly provided the figures (using an Olympus motorized stereozoom microscope SZX12 with Analysis Extended Focal Imaging Software). F. Groenen, H.W. van der Wolf and B. van Aartsen collected ichneumonids, assisted in collecting the nests and shared the annoying encounters with the urticating hairs. Y. Jongema (Wageningen University) kindly provided the *Galleria* pupae. H.W. van der Wolf corrected the English text.

References

- Aubert JF 1959. Validité et formes individuelles de quelques *Pimpla* F., *Apechtis* Först. et *Itopectis* Först. françaises et nordafricaines. Bulletin Mensuel de la Société Linnéenne de Lyon 28: 53-63.
- Cole LR 1967. A study of the life-cycles and hosts of some Ichneumonidae attacking pupae of the green oak-leaf roller moth, *Tortrix viridana* (L.) (Lepidoptera: Tortricidae) in England. Transactions of the Royal Entomological Society of London 119: 267-281.
- Fitton M 1978. The types of *Pimpla reissigii* Ratzeburg and *Pimpla processionae* Ratzeburg (Hym., Ichneumonidae). Entomologist's Monthly Magazine 113: 147.
- Fitton MG, Shaw MR & Gauld ID 1988. Pimpline Ichneumon-flies. Hymenoptera, Ichneumonidae (Pimplinae). Handbooks for the identification of British insects 7(1): 1-110.
- Kasparyan DR 1974. Review of the palearctic species of the tribe Pimplini. The genus *Pimpla* Fabricius. Entomological Review 53: 102-117.
- Oehlke J 1967. Westpaläarktische Ichneumonidae I: Ephialtinae. In: Hymenopterorum Catalogus Pars 2 (Ferriere C & van der Vecht J eds): 1-45, Junk.
- Ratzeburg [JTC] 1849. Parasitologische Beiträge. Entomologische Zeitung Stettin 10: 133.
- Schmiedeknecht O 1934. Opuscula Ichneumonologica Supplement Fasc. 19: 37-116.
- Stigter H, Geraedts WHJM & Spijkers HCP 1997. *Thaumetopoea processionea* in the Netherlands; present status and management perspectives (Lepidoptera: Notodontidae). Proceedings Experimental & Applied Entomology, N.E.V. Amsterdam 8: 3-16.
- Yu DS & Horstmann K 1997. A catalogue of world Ichneumonidae (Hymenoptera). Memoirs of the American Entomological Institute 58: I-VI, 1-1558.
- Zijp J-P & Blommers LHM 2002. Survival mode between the yearly reproduction periods and reproductive biology of *Scambus pomorum*, a parasitoid of the Apple Blossom Weevil *Anthonomus pomorum* (Coleoptera: Curculionidae). Entomologia Generalis 26: 29-46.

Received 25 April 2004, accepted 15 September 2004.

Samenvatting

Pimpla processionae en *P. rufipes*: specialist versus generalist (Hymenoptera: Ichneumonidae, Pimplinae)

Na een eeuw afwezig te zijn geweest verscheen de eikenprocessievlinder *Thaumetopoea processionea* (Linnaeus) (Lepidoptera: Notodontidae) in 1987 weer in Nederland en ontwikkelde zich in tien jaar tot een plaag in delen van Brabant en Limburg. Dit bood de gelegenheid een onderzoek te doen naar parasitoiden; in dit geval naar popparasitoiden behorende tot de familie Ichneumonidae. Daarbij werd naast de zeer algemene polyfage soort *Pimpla rufipes* (Miller) in grotere aantallen een andere *Pimpla*-soort uitgekweekt. Over de status van die andere soort, *P. processionae* Ratzeburg, bestaat in de literatuur veel onduidelijkheid. Uit collectie-onderzoek bleek dat deze laatste nog niet uit Nederland bekend was. In de periode dat *T. processionea* afwezig was in Nederland ontbrak dus *P. processionae* ook en dit duidt op een sterke binding van de parasiet aan de gastheer. Nu werd *P. processionae* uitsluitend op of bij *T. processionea*-nesten gezien en uit *T. processionea*-poppen gekweekt. Hierbij was *P. processionae* veel talrijker dan de polyfage *P. rufipes*. Het bleek mogelijk de soort met behoud van zijn kenmerken door te kweken met *Galleria*-poppen. De conclusie luidt dan ook dat *P. processionae* een zelfstandige soort is, die gezien kan worden als een sterk gespecialiseerde, aan de eikenprocessievlinder gebonden popparasiet. In tegenstelling tot zijn polyfage zustersoort, die in de gastheerpop overwintert, overwintert *P. processionae* waarschijnlijk als imago, aangezien hij tegelijkertijd met de vlinders in augustus tevoorschijn komt maar de jonge pop parasiteert. Omdat *T. processionea* een generatie per jaar produceert zijn die poppen eerst weer het volgende jaar in juli aanwezig. Een soortgelijke situatie doet zich voor bij de parasitering van de appelbloesemkever *Anthonomus pomorum* door de *Scambus*-soorten *S. pomorum* en *S. annulatus*. Bij eerder onderzoek bleek eveneens de gespecialiseerde soort *S. pomorum* veel talrijker dan de polyfage *S. annulatus*. *Scambus pomorum* is eveneens een van de weinige Pimplinae die als adult overwintert. De specialist profiteert dus wel van een groot aanbod aan gastheren van één soort, de generalist niet of in veel mindere mate. Dit kan er op duiden dat de specialist beter in staat is in een korte tijd veel eieren te produceren; het juiste gastheerstadium is immers slechts gedurende een korte periode aanwezig.