

Notes on the host-feeding and hyperparasitic behaviours of *Itopectis* species (Hymenoptera: Ichneumonidae, Pimplinae)

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Synopsis

Dissections of campoplegine ichneumonid prepupae in cocoons parasitised by *Itopectis maculator* and *I. aterrima* revealed that both are truly endoparasitic in this context, and that campoplegine prepupae remain capable of movement for a time following parasitisation by these *Itopectis* species. Oviposition and host-feeding behaviours by the two *Itopectis* species are briefly described. It is speculated that the mobility of *Phobocampe* and *Scirtetes* cocoons may deter attack from many potential pseudohyperparasitoids, though possibly promoting specialisation on them by others.

Key words: *Itopectis maculator*, *Itopectis aterrima*, *Itopectis clavicornis*, pseudohyperparasitism, host-feeding, Campopleginae cocoons, *Phobocampe*, *Scirtetes*, mobile cocoons.

Introduction

Itopectis species can be parasitoids of both Lepidoptera pupae and Ichneumonoidea cocoons – in the latter role acting as pseudohyperparasitoids with respect to the original host (usually Lepidoptera). For several *Itopectis* species, ichneumonoid cocoons are a major part of the host range (e.g. Fitton, Shaw & Gauld, 1988). In attacking Lepidoptera pupae it is well known that *Itopectis* species are fully endoparasitic, whether or not the pupa is cocooned, but there seems to be no published information regarding egg placement when the host is a frail ichneumonoid pupa or prepupa in a relatively tough cocoon. To investigate this, females of two species of *Itopectis* were offered cocoons of Campopleginae (Ichneumonidae) in 7.5 cm × 2.5 cm, corked glass tubes.

Destructive host-feeding (cf. Jervis & Kidd, 1986) is widely practised by *Itopectis* species, and indeed in some cases the resulting host mortality appears to be an overwhelmingly more important source of host mortality than actual parasitisation (Campbell, 1963). Some cases of destructive host-feeding took place in the trials recorded here, but ovipositions into un-mutilated hosts were also obtained from females of both species. Both behaviours are briefly described.

Itopectis maculator (Fabricius)

A female was collected on 5.v.1987 in S. Edinburgh (U.K.), and fed on a mixture of honey and water (1 : 3) *ad libitum*. When given a cocoon (spun onto

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a firm substrate) of a campoplegine ichneumonid (*Hyposoter* or *Campoletis* sp.) from an unidentified noctuid larva on 23.v.1987, the parasitoid repeatedly inserted her ovipositor deeply into the cocoon, making violent circular churning movements that were clearly designed to mutilate the contents, then withdrew it in order to feed on the substance oozing from the insertion site at the cocoon's exterior. This host-feeding activity continued for 45 minutes, involving several fresh insertions into the cocoon and subsequent mutilating movements, with one short break in the activity when the female left the host for under a minute. The campoplegine cocoon was opened after 2 days, to reveal the dead occupant in a badly mutilated and more or less dried-up state, with no *Itopectis* egg or young larva present.

The female *I. maculator* was returned to the honey/water mixture until a further suitably fresh cocoon of an ichneumonoid became available. On 11.vi.1987, a cocoon of another campoplegine ichneumonid, a *Casinaria* sp. (from the geometrid *Hylaea fasciaria* (Linnaeus), spun firmly onto the substrate 9.vi.1987), was offered. This time the female *Itopectis* inserted her ovipositor deeply but cleanly into the cocoon for *ca* 25 seconds, with no violent movements, then withdrew the ovipositor and immediately left the host (and groomed herself). After 72 hours the cocoon was opened, to reveal the living *Casinaria* late-stage prepupa (eyes well-coloured), which was capable of strong wriggling movement, with an oviposition scar visible on its dorsum approximately centrally. On dissection it was found to contain a well-developed parasitoid egg, clearly that of the *Itopectis*, loose in the haemocoel. This demonstrated that the egg is placed internally within the ichneumonoid host. It is also of interest that the host seems unimpaired before the egg hatches, and this corroborates the observation (cited in Fitton, Shaw & Gauld, 1988) that the 'jumping cocoons' of the campoplegine ichneumonid *Scirtetes robusta* (Woldstedt) remain active when parasitised by *Itopectis clavicornis* (Thomson).

In a different trial with *I. maculator* (which is well-known to be univoltine, overwintering as an adult (Cole, 1967; Fitton, Shaw & Gauld, 1988)), a female collected in S. Edinburgh on 9.viii.1993 was fed on the honey/water mixture as before and over-wintered in an unheated, detached garden shed. The following spring the female continued to feed sparingly on honey/water but remained rather emaciated and appeared incapable of developing eggs on this food source alone (N.B. pollen was not added to the feed). On 5.vi.1994 she was given a tortricid larva which (unobserved) was evidently killed, mutilated and fed upon to some extent, though the parasitoid still appeared undernourished and not to be developing eggs. On 6.vi.1994, a cocoon of a *Phobocampe* sp. (ex the geometrid *Opeophtera brumata* (Linnaeus), formed 5.vi.1994) was offered. The cocoons of most *Phobocampe* species (including this one) are ovoid and spun unattached to any substrate, therefore being loose and mobile. The female *I. maculator* tried hard to insert her ovipositor, but was unable to do so because she was unable to hold the cocoon in place and it always rolled away. After about 10 minutes she gave up, but the cocoon was left with her continuously until 25.vi.1994 when an adult *Phobocampe* emerged, showing that if she had tried to attack it again, then she had still

been unsuccessful. From 6–14.vi.1994 several Campopleginae cocoons (*Phobocampe* sp. ex *O. brumata*, *Hyposoter* sp. ex *Agriopsis marginaria* (Fabricius), and *Hyposoter* sp. ex *Theria primaria* (Haworth) – the latter two being attached to substrates) were offered but always rejected, with the female showing no interest in the easy opportunity to host-feed provided by the *Hyposoter* cocoons. The female *I. maculator* lived, feeding very sparingly on honey/water and remaining thin, until 18.ix.1994. It appears from this that the window for post-hibernation reproductive activity in this species is short (perhaps reflecting the aestivation period undergone by first-year adults described by Cole, 1967) and that, having failed to become reproductive early in the summer, the female had no capacity to do so later.

Further, it seems from the above observations (together with a general impression that in the field parasitism of mobile *Phobocampe* cocoons is usually not severe) that the loose, easily rolled cocoons of most *Phobocampe* species may accord some protection to the inhabitant from attack by at least some pseudohyperparasitoids. However, the possibly specialist pseudohyperparasitoid *Itopectis clavicornis* seems adept at attacking large mobile *Phobocampe* cocoons (Stelfox, 1929) and the similar cocoons of the related *Scirtetes robusta* (Fitton, Shaw & Gauld, 1988) and, as these constitute most of the known host records for this species, it seems possible that their relative security from attack by at least some others has promoted a degree of specialisation on them by *I. clavicornis*.

Itopectis aterrima Jussila

A female was collected on 6.vi.1994 in S. Edinburgh, and fed *ad libitum* on honey/water (1 : 3). Immediately after her first (extensive) feed she was offered cocoons of *Hyposoter* sp. (ex *Theria primaria*) and *Phobocampe* sp. (ex *Operophtera brumata*), but both were treated with indifference. Several attempts up to 14.vi.1994 were made to interest her in cocoons of *Hyposoter* sp. ex *Agriopsis marginaria* and *Phobocampe* sp. ex *O. brumata*, but without success. On 14.vi.1994 she was offered in succession two three-day-old *Hyposoter* cocoons ex *T. primaria*, and both were accepted for smooth oviposition (as described for *I. maculator* above). After one hour, both cocoons were opened to reveal early stage campoplegine prepupae (eyes undeveloped), which were wriggling actively. On dissection both proved to contain a single egg loose in the haemocoel, clearly that of the *Itopectis*.

The female *I. aterrima* was then immediately offered a *Hyposoter* cocoon ex *A. marginaria* (age not noted), which she immediately attacked with the same mutilating activity recorded above for *I. maculator*, and extensively host-fed on it. It is difficult to be sure why this was accepted for host-feeding in view of the previous repeated rejections, but it seems possible that the egg availability of this female had been adequately maintained for the week or so in which she had been captive by the *ad libitum* access to honey, and that no additional feeding activity was triggered until eggs had been laid. It is also possible that no egg was laid before 14.vi.1994 because the female had no mature eggs until this date, which would imply that she was able to mature her eggs on honey

alone, without needing to host-feed. Better-controlled experiments would be needed to test these notions.

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