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# Unusual Sex Allocation in a Solitary Parasitoid Wasp, *Sphaeropthalma Pensylvanica* (Hymenoptera: Mutillidae)

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# UNUSUAL SEX ALLOCATION IN A SOLITARY PARASITOID WASP, *SPHAEROPTHALMA PENSYLVANICA* (HYMENOPTERA: MUTILLIDAE)

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## ABSTRACT

*Sphaeropthalma pensylvanica* reared from cocoons of the organ pipe mud dauber, *Trypoxylon politum* from Georgia over several years yielded only adult males. Possible explanations for this sex-biased emergence from this host are (1) obligatory heteronomous heterotrophy, in which the two sexes develop on entirely different hosts; (2) differential mortality in the immature stage, with female larvae dying during development; and (3) facultative size-dependent sex allocation, with female eggs laid only on hosts smaller than *T. politum*.

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Mutillid wasps are parasites of a diverse group of bees and wasps. Most mutillid females oviposit on the resting larvae of other insects, either in cocoons or in puparia. Adults are strongly sexually dimorphic. Females are wingless and covered with a dense pile of setae, forming the basis for their common name, "velvet ant". Males have wings and in general appearance are rather typical wasps (see Deyrup 1988).

*Sphaeropthalma pensylvanica* (Lepeletier), ranges throughout southeastern United States west to Texas and north to Missouri (Krombein 1979). Comparatively little is known of its biology. Rau and Rau (1916) and Rau (1928) reported it to be a parasite of the common Missouri mud daubers, *Sceliphron caementarium* Drury and *Trypoxylon politum* Say, and Rau and Rau (1918) also reared it from mud nests of *Auplopus* (probably *architectus*) (Pompilidae). The numbers and sexes reared were not indicated, except for a brief remark in reference to *T. politum* (1928, p.426) ". . . on several occasions the mutillid parasite has been bred from the cocoons, but here too, like those of this species bred from *Sceliphron* nests, all were males".

Krombein (1967) provided the most biological detail for *S. pensylvanica*, including photographs of the larva and host cocoon. Three twig-nesting species of *Trypoxylon* (*Trypargilum*) taken in trap nests were recorded as hosts of this species. The outermost cell of each of six nests was parasitized after a female *S. pensylvanica* gained access by chewing through the outer mud plug. Two males and one female were reared from three of these cells; the other three cells were subsequently parasitized by *Melittobia* sp. (Eulophidae). Krombein (1967) concluded that this mutillid species parasitizes a wide range of mud dauber hosts, but confines its attacks to those which store paralyzed spiders.

More recently, Molumby (1995) extensively sampled *T. politum* nests from nine sites in Missouri and Louisiana. He reared a very low incidence

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(< 1%) of *Sphaeropthalma* (misidentified as *Scolia*) from three of the Missouri sites. Because he identified them as a species in which both sexes are winged, we can infer that his reared specimens also had wings and therefore were all males. Curiously, in the most thorough study of *T. politum*, Cross et al. (1975) report no mutillid parasites from several populations sampled in Alabama.

I have sampled *T. politum* nests from several localities in the vicinity of Athens, Georgia over the past several years. During this time I have sporadically encountered *S. pensylvanica*-parasitized cocoons, and have reared over two dozen individuals (vouchers deposited in the University of Georgia's P. W. Fattig Entomology Collection). Consistent with Krombein's (1967) finding, female *S. pensylvanica* invariably cover the oviposition opening in the host cocoon with a distinctive mud plug, and the parasite's cocoon is spun within the host cocoon (Fig. 1). The presence of the mud plug is a reliable external clue indicating parasitism by *S. pensylvanica* and in combination with a woven mesh tan cocoon inside the host cocoon, is absolutely diagnostic for this species.

Consistent with Rau's (1928) observation, all 28 *T. politum* cocoons parasitized by *S. pensylvanica* that I collected yielded only adult male *S. pensylvanica*. In the largest sample from a single site (Sandy Creek Park, Athens, GA, February 1989), 16 mutillid-parasitized cocoons from several nests each produced a male *S. pensylvanica*. This absolute male bias seems unlikely to be due to chance, and several possible alternative explanations exist.

One possibility is that the two sexes obligatorily develop on entirely different hosts as in the chalcidoid family Aphelinidae, a phenomenon termed heteronomous heterotrophy (Walter 1983). In one documented case, males develop in lepidopteran eggs, while females develop in scale insects in different microhabitats (Walter 1983). It might be that females of *S. pensylvanica* also hunt in different microhabitats, and that female offspring are produced from mud wasps that nest in more cryptic locations, such as those preferred by *Auplopus* or twig-nesting *Trypoxylon*.

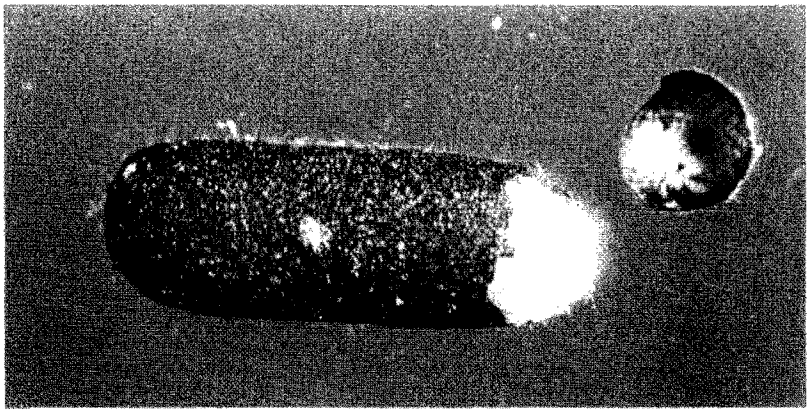

Figure 1. *Trypoxylon politum* cocoon (ca. 2 cm. long), opened to show the cocoon of the parasite *Sphaeropthalma pensylvanica* within. The central pale spot on the cocoon is a mud plug characteristically made by the parasite to fill her oviposition hole.

Another possible explanation might involve some sort of differential mortality occurring during the immature stage of development. In this scenario, female larvae would fail to thrive on *T. politum* hosts and die before maturity. Grosch (1948) has described an analogous situation for a braconid wasp.

A third possible explanation is provided by the host size hypothesis. The offspring of many solitary parasitoid wasps develop on hosts that, like *T. politum*, will not continue to grow in size after the attack. Often, eggs producing (smaller) males tend to be laid in small hosts and eggs producing (larger) females are laid in large hosts (Charnov et al. 1981). Host size phenomenon may apply in reverse for mutillids, in which the winged males typically are the larger sex. For a different mutillid species that attacks *Microbembix* sand wasps, Mickel (1928) has shown that smaller host cocoons give rise to females, whereas larger cocoons of the same species produce males. Sex-biased size variation in mutillid wasps has been discussed by Deyrup and Manley (1986).

An additional 58 males and 6 females of *S. pensylvanica* (none reared) are preserved in the University of Georgia Fattig Insect Collection. To the extent that this collection represents a natural situation, these male-biased data could be explained in at least three ways. One is that *S. pensylvanica* sex ratios may truly be strongly male-biased. Alternatively, the sex ratio is at parity, but the sexes may occur in strikingly different habitats that have not been equally well collected. Because females are all much smaller than the smallest male (being typically about half as long), the combination of small size and cryptic habits probably make females more difficult to see and harder to collect, relative to the more conspicuous flying males.

The *T. politum* cocoon is enclosed inside a mud cell and the mother mutillid wasp chews in from the outside without actually entering the cell compartment, raising a question as to how the ovipositing female might assess relative host size. Furthermore, even within a given nest, the cocoon sizes of *T. politum* can be quite variable (Cross et al. 1975), so that one might expect to rear females from small cocoons and males from larger cocoons. However, for *S. pensylvanica* this decision could be made by a fixed "rule of thumb" in which hosts larger than some threshold size always receive unfertilized (male) eggs. Perhaps all sizes of *T. politum* cocoons exceed this threshold. The twig-nesting *Trypoxylon* from which Krombein (1967) reared a female of this parasite has much smaller cocoons than those of *T. politum*.

Obviously much more information and experimentation is needed in order to understand this male-biased sex ratio in *S. pensylvanica* reared from mud daubers. Data on population sex ratios, host location behavior, and responses to experimental manipulation of host size and relative abundance would help to reveal the basis for this apparent sex ratio bias in *S. pensylvanica*.

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