Difference in the Sex Ratio of the Pine Bark Weevil Parasite,
Dolichomitus sp. (Hymenoptera : Ichneumonidae),
Emerging from Different Host Species

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Two experiments were conducted to study difference in the sex ratio of the pine bark weevil parasite, *Dolichomitus* sp., emerging from different host species. The first experiment was to ascertain whether the host weight influenced the sex of the emerging adult. The adults emerging from *Pissodes nitidus*, which was lightest, were all males, those from *Shirahoshizo* spp., which were light, were 8 females to 82 males, those from *Niphades variegatus*, which was heavier, were 54 females to 39 males. Obviously, the female adults of *Dolichomitus* sp. tended to emerge from heavier host species. Hence, the second experiment was conducted to clarify whether the parasite progenies changed sex in the course of their development, by transferring the eggs deposited on lighter host weevils to heavier ones and those on heavier ones to lighter ones. It was noted that the parasite sex could be determined at the time of oviposition. Hence, it is considered most possible that difference in the sex ratio of the parasite is due to difference in host species and that the females of *Dolichomitus* sp. control oviposition of fertilized eggs and deposit them selectively on heavier host weevils.

INTRODUCTION

While studying the biology of *Dolichomitus* sp., a parasite on the pupae and the prepupae of the pine bark weevils, in Chiba Prefecture near Tokyo during 1966-1967, the author found that the female parasites emerging from *Shirahoshizo* spp. were few in number, and those from *Niphades variegatus* ROELOFS, which was heavier than *Shirahoshizo* spp., were larger in number than the male ones. And, it was observed that most of the female parasites emerged largely from heavier host weevils.

There have been many reports on variations in the sex ratio of hymenopterous parasites which are affected by host size and environmental conditions, and most of these reports are on difference in the sex ratio of monophagous parasites. However, there are only few reports on polyphagous parasites emerging from different host species. Hence, experiments were conducted during 1968-1969 to know whether the difference in the sex ratio of the parasite was due to differential host size (weight) of the weevil species, and if so, whether the parasite sex can be determined at the time of oviposition.

Specimens of *Dolichomitus* sp. have been sent to Dr. S. MOMOI, Kobe University, for identification.

MATERIAL

Dolichomitus sp. dealt in this paper is a hymenopterous parasite of the pine bark weevil. It attacks only the pupae and the prepupae in the pupal cell. It overwinters during the larval stage in the pupal cell of the host weevil, and, after pupating, develops into an adult in April. The adult, however, does not attack host weevils during April-June, although there are many pupae and prepupae of *Pissodes obscurus*. Oviposition on the host is noted from the beginning of July to the end of September.

The parasite deposits only one egg on each host through the exit hole excavated by the weevil larva before pupating. The parasite larva feeds on the host to exhaust it completely, except the cuticula and the head. The emergence is noted from the end of July to the middle of October. The period from an egg to an adult is 14-21 days under laboratory conditions (20-32°C).

EXPERIMENT-I

This experiment was conducted in order to find an answer to the question whether the host weight (size) influenced the development of the parasite progeny and the sex of the emerging adult parasite.

Methods: Host weevils with the parasite eggs were collected in the field, weighed in a precision balance and introduced singly into small chambers (20mm in length $\times$ 5-8 mm in width $\times$ 4-7 mm in depth) made in the stem of *Pinus densiflora* (80-120 mm in diameter) by cutting out a bit of the bark into a square.

The stem was kept in laboratory conditions (20-32°C). At the time when the parasite larvae had fully grown and began to make their cocoons, they were weighed. Then, the sexes of the emerging adults were recorded. In this manner, 49 eggs deposited on *P. nitidus*, 100 eggs on *Shirahoshizo* spp. and 100 eggs on *N. variegatus* were introduced into small chambers made in the pine stem and their development was examined.

Results: The results are shown in Fig. 1. Out of the 49 parasite progenies on *P. nitidus*, 8 died in the egg or larval stage, and 41 developed into male adults. The female adults emerging from *P. nitidus* was 0, the ratio of female to male being 0 to 41.

Out of the 100 parasite progenies on *Shirahoshizo* spp., 10 died in the egg or larval stage, 82 developed into male adults and 8 into female adults. The ratio of female adults to male ones emerging from *Shirahoshizo* spp. was 8 to 82.

Out of the 100 parasite progenies on *N. variegatus*, 7 died in the egg or larval stage, 39 developed into male adults and 54 into female adults. The ratio of female adults to male ones emerging from *N. variegatus* was 54 to 39.

From these, it is clear that the sex ratio of *Dolichomitus* sp. emerging from different host species was apparently different. And, the female adults tended to emerge from heavier host weevils. Especially, the adults emerging from heavier host weevils (more than 68 mg) were all females. On the contrary, those from lighter ones (less than 39 mg) were all males. Above all, the adults from *P. nitidus*, which was lightest, were all males.

Fig. 1. The growth and the adults of the pine bark weevil parasite, *Dolichomitius* sp., emerging from different host species.

Weights of the parasite larvae at the time when they began to make their cocoons were dependent on the sexes. Especially, the adults developing from the parasite larvae heavier than 55 mg were all females. On the contrary, those from ones less than 23 mg were all males.

EXPERIMENT-II

From the results of Exp. I, it is obvious that the female adults of *Dolichomitius* sp. tend to emerge from heavier host weevils. Hence, the next experiment was carried out to clarify whether the parasite progenies changed sex in the course of their development or the parasite sex was determinable at the time of oviposition.

Fig. 2. The growth and the adults of *Dolichomitius* sp., transferred to heavier host weevils at egg stage.

Methods: The eggs deposited on lighter host weevils were transferred to heavier ones (more than 68 mg), and the eggs on heavier ones transferred to lighter ones (less than 30 mg in the case of *Shirahoshizo* spp. and 50 mg in the case of *N. variegatus*). The same experiment as Exp. I was conducted with the transferred eggs.

Results: The results of this experiment are shown in Fig. 2 and Fig. 3. In both *Shirahoshizo* spp. and *N. variegatus*, the tendency of the female emergence was similar to that shown in Exp. I.

Most of the parasite progenies transferred to heavier host weevils developed into male adults, and grew out of the usual proportion. Several males reached weights of over 55 mg.

On the other hand, many of the parasite progenies transferred to lighter host weevils died in the course of development. It appeared that the parasite progenies which might be females could not develop into adults due to lack of food.

DISCUSSION

As mentioned above, the adults of *Dolichomitius* sp. emerging from *P. nitidus*

Fig. 3. The growth and the adults of *Dolichomitius* sp., transferred to lighter host weevils at egg stage.

were all males, those from *Shirahoshizo* spp. were 8 females to 82 males and those from *N. variegatus* were 54 females to 39 males. And the females of *Dolichomitius* sp. tended to emerge from heavier host weevils. From the experiments, it is considered that difference in the sex ratio of *Dolichomitius* sp. due to difference in host species is related to host weevil weight.

There have been many reports on variations in the sex ratio of monophagous hymenopterous parasites caused by the effect of host size or environmental conditions. It is known that variations in the sex ratio of parasites are caused by the difference in mortalities between sexes (JACKSON, 1937; GROSCH, 1945; IYATOMI, 1950; WILKES, 1963; WYLIE, 1966), and also caused by controlled oviposition of fertilized eggs (BRUNSON, 1937, 1938; WYLIE, 1966; SHIGA and NAKANISHI, 1969).

On the contrary, there are few reports on variations in the sex ratio of polyphagous hymenopterous parasites emerging from different host species. Only NOZATO (1969 a) reported the effect of host species on the sex ratio of *Itopectis cristatae* MOMOI which is a parasite on the pine shoot moths, but he made no mention of the mechanism.

On hymenopterous parasites of the bark and wood borers, RYAN and RUDINSKY (1962) reported that the females of *Coeloides brunneri* VIERECK, a parasite of *Dendroctonus pseudotsugae*, tended to emerge from heavier hosts, but they too did not mention the mechanism.

Three causes are considered to be possible for the difference in the sex ratio of a polyphagous parasite, *Dolichomitius* sp., due to difference in the host species:

(1) difference in mortalities of the parasite progenies between males and females, (2) sex change of the parasite progenies in the course of development as known in *Lampyrus noctiluca* (NAISSE, 1966), (3) controlled oviposition of fertilized eggs.

The first cause is not considered to be possible because few parasite progenies died in Exp. I and in the field. The second cause also is not considered from the results of Exp. II. So, the third cause is considered most possible for the difference in the sex ratio of the parasite due to difference in host species, that is, the females of *Dolichomitus* sp. control oviposition of fertilized eggs and deposit them on heavier host weevils.

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