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DIFFERENCES IN EMERGENCE DATE AND SIZE BETWEEN THE SEXES OF *MALACOSOMA AMERICANUM* THE EASTERN TENT CATERPILLAR (LEPIDOPTERA: LASIOCAMPIDAE)

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ABSTRACT

Malacosoma americanum males were smaller and began to pupate earlier than females. Since the sexes spent the same amount of time as pupae, males also emerged earlier. The adaptive significance of these results is discussed. Emergence data revealed an interesting sidelight; no moths emerged from cocoons inside tents.

Stehr and Cook (1968) reported that laboratory reared North American *Malacosoma* males developed in an average of 36.7 days compared to 37.3 days for females, and that "nearly always more males than females emerged the first few days and more females emerged the last few days that emergence took place." They also reported "that the males tend to emerge slightly earlier than females" for adults reared from field-collected caterpillars and pupae, and that males were smaller than females. Thus, the shorter development time for males corresponds with earlier emergence, and possibly there is a relationship between size and emergence date of the sexes. We report the pupation and emergence dates for *M. americanum* (Fabricius) in the field, the first such observations recorded for *Malacosoma*. In addition, possible relationships between size, development rate, and emergence date of the sexes are examined and discussed.

METHODS

A 20 × 30 m plot was located on a hill near the Leslie Park Golf Course in Ann Arbor, Michigan. The hill was grass-covered with scattered trees less than 5 m tall. The majority of trees were host species (apple, *Malus* spp.; black cherry, *Prunus serotina* Ehrh.; and hawthorn, *Crataegus* spp.). The caterpillars built most of their tents on apple, the predominant host on the hill.

We looked for pupae in concealed locations (on grass stems and under debris) and inside tents. Eight and 45 were found in concealed locations and inside tents, respectively. All were put in 0.3 litre covered paper cups. Once in cups, the cocoons found in concealed locations were replaced at that location, and the cocoons collected from inside tents were placed below their tents.

In order to observe the start of pupation and to guarantee finding a large sample of cocoons and moths, 883 ultimate larval instars were collected and placed in cups approximately where they were found. Caterpillars were only collected if they were in the grass, where they were assumed to be searching for pupation sites and not food, since leaves remained on the trees containing tents. The caterpillars and cocoons found in the grass were collected between 25 May and 3 June and the cocoons were collected from inside the tents on 5 June 1976.

The beginning of pupation, recognized by the shortening of the larval body, was noted.

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The diameter and length of cocoons were measured with calipers to 0.1 mm. Cups were inspected daily after pupation began; emergence date and sex were noted.

RESULTS

Eighty-three males and 141 females emerged between 15 June and 1 July 1976. We have no way of knowing how the 24% (224/931) survival for individuals in cups compares with the survival of free-living individuals. All but three of the 224 moths developed from the 883 individuals collected as larvae. Those three emerged from cocoons collected in the grass. This leads to an interesting sidelight; no moths emerged from the 45 cocoons collected from inside tents, though free-living moths were seen in the area indicating emergence from cocoons in concealed sites. We suspect the caterpillars which pupated in tents had been weakened by starvation, disease, and/or parasites and were unable to search for more concealed sites. Unfortunately, mortality factors were not monitored. However, cocoons collected inside tents were smaller (mean ± standard error, 1.50 ± 0.09 cm^3) than cocoons of individuals collected in the grass which did not mature (1.85 ± 0.09 cm^3) and also smaller than those cocoons collected in the grass from which adults did emerge (2.04 ± 0.04 cm^3) (t-test, $P < 0.001$ for both comparisons). The smaller size of cocoons inside tents may imply a weakened condition, but it also may indicate a larger proportion of males in this sample than the others. Males were smaller than females (1.59 ± 0.05 cm^3 for males and 2.30 ± 0.04 cm^3 for females; t-test, $P < 0.0001$). The sex of pupae was determined only for those from which adults emerged.

Males began pupating an average of a day earlier than females (3 June compared to 4 June; t-test, $P < 0.01$). Males and females spent the same amount of time as pupae (19.6 ± 0.2 and 19.7 ± 0.2 days for males and females, respectively, t-test, $P = 0.866$). Thus, males emerged an average of one day earlier than females (22 June compared to 23 June) (Fig. 1). Stehr and Cook (1968) observed the same pattern for all North American *Malacosoma* under laboratory conditions. We did not see free-living moths until moths began to emerge in the cups. Therefore, confinement in the cups probably did not affect emergence time.

DISCUSSION

Leonard (1970) argued that males emerged earlier than females in order to search for mates before their sisters emerged and thus promote outbreeding. However, in numerous species in which inbreeding occurs, males also emerge earlier than their sisters (Hamilton 1967, Moser et al. 1971, Werren 1980). Therefore early male emergence clearly does not preclude the possibility of inbreeding. It, in fact, appears to be frequently associated with inbreeding. Two alternative theories to the outbreeding advantage are presented:

(1) Early emergence in males would be favored as early males would find a large number of available mates. Darwin (1871) suggested that when male insects were smaller than females it was because males gained a mating advantage from earlier emergence. He argued that natural selection would pick smaller males because they develop more quickly and emerge earlier. However, the advantage of early emergence would have to surpass the possibility of predation before the first females emerged.

(2) It is also possible that larger females may be selected for because larger females can carry more eggs. In *M. disstria* Hübner and *M. neustria* L. fecundity was positively correlated with size (Lorimer 1979, Shiga 1977). Thus females would take more time to develop than males and would emerge later.

Therefore, the difference in emergence dates of the sexes may be due to selection on males for earlier emergence because of the mating advantage or to selection on females for later emergence because of the size advantage. These two theories are not mutually exclusive.

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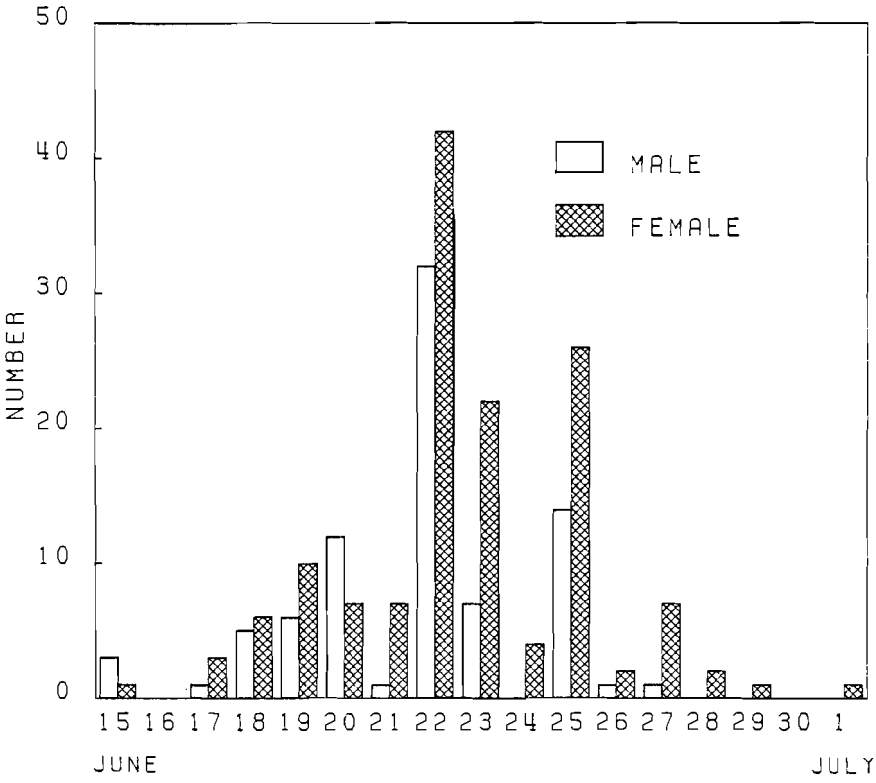

Fig. 1. The number of male and female *Malacosoma americanum* emerging per day.

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