

Notes on the life history of *Labia minor* (L.) (Dermaptera), a potential predator of housefly eggs and larvae (Diptera, *Musca domestica* L.)

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The little earwig, *Labia minor*, is common in Danish dung heaps. It inhabits the older parts of the manure and prefers temperature zones between 18° and 25° C. The little earwig develops and oviposits throughout the year. The generations overlap and the different developmental stages can be found together throughout the year. The average life span in the laboratory was 80 days at 25° C. In the laboratory the females laid an average of 43 eggs in 2 – 3 batches. The life history of the species is described, and observations on mating, oviposition and feeding habits are presented.

Labia minor prefers animal food, but owing to its distribution in the dung, it has no influence on the regulation of housefly populations.

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Introduction

In 1968 a program was initiated to evaluate the importance of predators and parasitoids in the regulation of housefly populations in Denmark (Mourier & ben Hannine 1969).

Housefly production in this country mainly takes place in stockpiled manure and interest was therefore focused on this habitat.

Mites of the family Macrochelidae, beetles of the families Staphylinidae, Hydrophilidae and Ptilidae, and the little earwig, *Labia minor* (L.), are common in most dung heaps. As *Labia minor* proved to be a voracious predator on eggs and larvae of houseflies in the laboratory, and as information on the biology of this species is scarce, it was decided to make a preliminary study of its life history.

Methods and materials

During 1968 samples of dung were taken from dung heaps of three farms located in Freerslev in NE Zealand (about 4 km west of Hillerød) to follow the seasonal variation

of the fauna. Two four-litre samples of manure were taken each week, one from the upper parts of the heap, the other from the bottom. Each sample was thoroughly mixed and half-litre subsamples drawn from it and extracted using Berlese funnels.

The dung heap of farm 219 (Fig. 1) was chosen for a study of the distribution of the small earwigs in the different zones of the pile. The manure was removed in April 1969, and the heap was then gradually built up, exclusively of pig manure.

The dung was never treated with chemicals, but insecticides were used in the stable during the summer to control adult flies.

Additional earwigs for laboratory observations were collected from dung heaps and maintained in Petri dishes, 16 cm in diameter, into which plaster of Paris had been poured, this provided a base that could be kept moist and in which an open system of chambers and pathways was carved. The chambers could be covered with small pieces of plaster of Paris or other material and were accepted by the earwigs for egg laying. Individuals were marked with dots of paint



Fig. 1. The dung heap of farm 219.

Fig. 1. Møddingen ved gård 219.

on the elytra and their position in the rearing units was recorded three times a day. Earwigs were fed frozen housefly eggs. They never had access to free water.

Temperature in the rearing room was maintained at 25° C and the RH at about

60%, but the actual RH in the rearing units was from 90% to 100%. A number of rearing units were kept at temperatures from 15° C to 35° C so that the duration of the incubation period of the eggs and of the nymphal period could be observed.

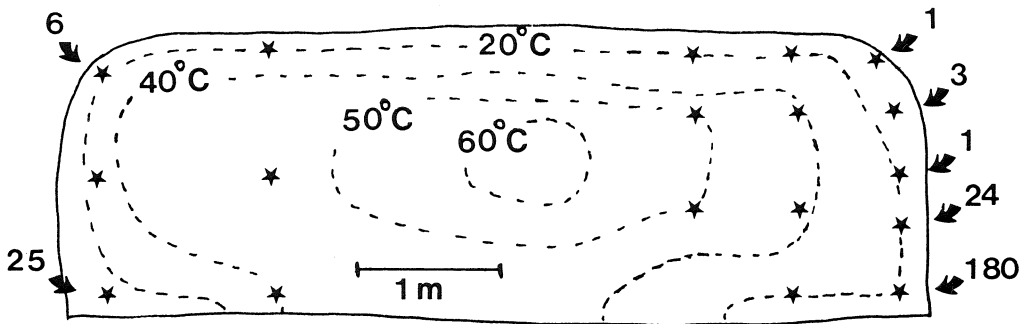


Fig. 2. Semi-schematic cross section of a dung heap (farm 219) showing temperature zones and the distribution of the little earwig, *Labia minor*. The stars indicate places where 1 dm³ samples have been taken. The figures show the number of *Labia minor* found in the samples.

Fig. 2. Halvskematisk lodret snit gennem en mødding (gård 219) visende temperaturzoner og fordelingen af *Labia minor*. Stjerneerne angiver, hvor der blev taget 1 dm³ prøver. Tallene angiver antallet af fundne *Labia minor*.

For observations on the consumption capacity, 200 newly laid housefly eggs in 400 cm³ rearing medium (see Keiding & Arevad 1964) in 500 cm³ plastic vials were exposed to 2-16 earwigs per vial, and the survival of the fly larvae was observed. This method of exposure forced the predators to seek out the eggs and forage for the larvae as they would do under natural conditions. The predators were given no food during a 24-hour period preceding the test.

The eggs were taken from laboratory-reared flies (*Musca domestica* L.) and were 0-2 hours old when exposed. The tests were run in an incubator at 28° C and 60% RH. Temperatures from 26° - 32° C were maintained in the media. This is close to the temperature at which housefly eggs and larvae are found in the manure piles. The exposure period was five days, which at 28° C covers the egg stage and the larval period up to the prepupal stage.

Results

The habitat

Fig. 2 shows a cross section of the manure compost pile in July 1970. The little earwig inhabits places with temperatures between 18° C and 25° C, the species prefers the lowest and oldest part of the pile. As many as 180 individuals were observed in a 1 dm³ sample which had been composting for about 15 months.

The same observations were carried out the following December. The number and distribution of earwigs in the manure pile was essentially the same during the winter as in the summer, but they were found deeper in the dung heap, as the temperature of its surface was lower.

Laboratory observations

The eggs

Eighteen females which were followed during their adult life laid an average of 43 eggs each over a period of 55 days from their 40th, to their looth day of life. There were from 11 to 30 eggs in each batch (an average of 22), and the females laid an average of 2.7 batches each.

Newly deposited eggs of *Labia minor* are opaque white, typically ovoid, and measure

an average of 0.8 long and 0.6 mm in diameter. During development moisture is absorbed from the environment, the volume of the eggs increases, and just before hatching the average length is approximately 1.0 mm, the diameter 0.8 mm.

The eggs are covered with a thin, gelatinous coating which makes them sticky. To remain viable they require an environment with a relative humidity approaching 100%. Under normal conditions in dung, the eggs depend on the care of the mother without which they get mouldy or are eaten by other earwigs.

Kept isolated in clean vials they survive, however, and hatch, even if the mother is removed just after egg laying.

During our study the eggs did not hatch at 15° C. At 20° C the incubation period lasted twelve days, at 25° C seven days, and at 32° C five days. At temperatures above 35° C no hatching occurred.

The nymphs

At eclosion the nymphs weigh 0.23 mg and measure 2.1 mm on an average. They go through four instars, and fed only housefly eggs they complete their development in 43 days at 21° C. At 25° C development from eclosion to adult stage lasts 25 days, and at 28° C it lasts 20 days.

During the study ten »families« of *Labia minor* nymphs were observed several times daily during the first weeks of their life. Each grup (»family«) was comprised of 15 to 25 nymphs.

The mother stays with the nymphs in the brooding chamber during the first days of their life. The nymphs gather around the adult female when they are disturbed, and the adult may move the nymphs, carrying them in her mandibles, in search of a hiding place when the chamber is opened. The mother leaves the family for good after four days (3-6 days in the observed cases), but the nymphs stay together for an additional period (6-22 days). They leave the chamber but return to their family group. The family is considered as dispersed when less than half the original number of nymphs are observed in the brooding chamber in three successive observations.

In eight cases the mothers were removed

before the nymphs hatched. This did not alter the behaviour of the young. Under these conditions they stayed together for an average of 15 (9-24) days.

The adults

Labia minor adults are yellowish brown and the average length is 5 mm, the female being a little larger than the males, females and males weighing 4 mg and 3.5 mg, respectively. Adults have functional wings, and the small earwigs were often observed flying, both in the field and in the laboratory.

In the male the tongs are curved and furnished with denticles as shown in Fig. 3 B, C, while they are straight and smooth in the female (Fig. 3 A). As in other species of Dermaptera, *Forficula auricularia* L. for instance, there is a considerable variation in the length of the tongs, which is apparently due to the quality of the food available.

Observations of the cages in the laboratory showed that the little earwigs are mutually aggressive and territorial. When they meet they often fight with one another. During fighting the pair of tongs is used as a club, as described for *Forficula auricularia* by Verhoef (1909), but the earwigs often bite as well. Cannibalism occurs, but apparently only weakened individuals are devoured.

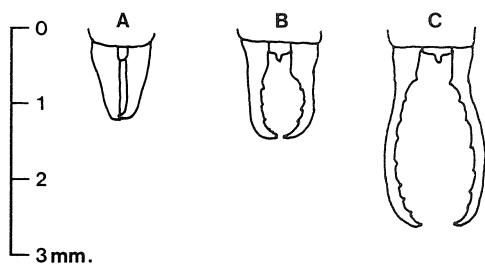


Fig. 3. Tongs of adult *Labia minor*. A, female. B and C males. B is one of the smallest tongs from an individual collected in a dung heap. C is one of the largest from a laboratory-reared specimen.

Fig. 3. Tænger af voksne *Labia minor*. A, hun. B og C hanner. B viser de mindste tænger fra et eksemplar fra en mødding. C. viser de største tænger fra et eksemplar klækket i laboratoriet.

Mating behaviour

Egg fertilization is essential to reproduction, and specimens in the Petri dishes were observed to copulate. Males were seen running around, often with the tip of the abdomen bent over the back. When meeting a female they become excited, dance around her, finally approach, seeking contact and biting with their tongs. If contact is obtained the two sexes assume the same posture as described for *Forficula auricularia* during copulation (Kuhl 1928), the heads in opposite directions and the abdomens turned toward one another. A copulation takes about 30 minutes.

Egg laying

At 25° C the females began oviposition about two weeks after the last molt. The duration of the total period from egg to egg is thus 40-50 days at this temperature.

Before ovipositing the female finds or builds a small chamber. As a rule a male can be found together with her in the breeding chamber for a period of about two days. During this period the male takes part in the defence of the place. After this short period of cooperation the male leaves the chamber and the female starts to close the entrance, remaining inside the chamber herself. In the experimental units the chamber was normally closed with small pieces of plaster of Paris taken from the walls of the chamber. The eggs are frequently licked and turned and they are defended against other earwigs.

Feeding habits

The little earwig appears to be omnivorous. It has been observed to take small prey, small housefly larvae, for instance, and it eats dead insects and takes vegetable matter as well.

A measure of the consumption capacity of *Labia minor* was obtained by serving known numbers of housefly eggs to known numbers of earwigs kept in plastic vials. The results of these observations are shown in Fig. 4.

It has been demonstrated that the length of the tongs of male earwigs depends on the quality and quantity of the food available

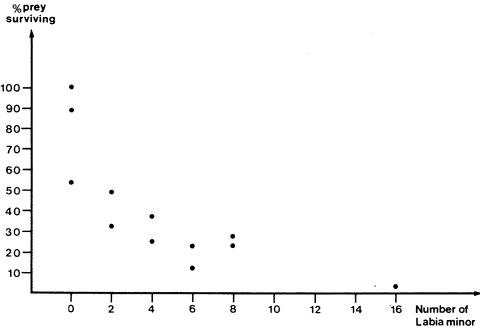


Fig 4. Percent of housefly larvae surviving when 200 newly laid eggs were exposed to different numbers of *Labia minor* for five days in plastic vials containing 400 cm³ rearing medium (see text). Each dot represents one observation.

Fig. 4. Den procentvise andel af overlevende stuefluelarver når 200 nylagte æg blev præsenteret for forskellige antal *Labia minor* i fem dage. Prædationen foregik i plastikbægre med 400 cm³ flue-dyrkningsmedium. Hver prik angiver en observation.

during the nymphal period (Djekanov 1925 and Kühl 1928).

The average length of the tongs of 50 laboratory-reared male *Labia minor* was 1.9 mm (range 1.6-2.2 mm), whereas the average length of the tongs of 50 male little earwigs caught in the dung during the summer period was 1.4 mm (range 1.1-1.9 mm).

This indicates that the fly eggs eaten in the laboratory are a better diet for this species than the food they can find in the dung heaps.

Life cycle

In the laboratory and at the temperatures found in the dung heaps the little earwig develops throughout the year. The generations overlap and the different developmental stages can be found together throughout the year. The average life span in the laboratory was 80 days at 25° C. From the observations in the rearing unit it is evident that the adult life of a female *Labia minor* is divided in well defined phases in which the female exhibits a characteristic behaviour. The succession and length of these phases are summarized in Fig. 5.

About five days prior to the first egg-laying the female occupies a potential breeding chamber.

During the first two days of this period she is normally found together with a male in the chamber. Then the female becomes aggressive to the male, which leaves the chamber, and for about three days the female stays alone in the chamber, the entrance of which she has closed.

Oviposition is followed by a period of egg nursing, which lasts seven days at 25° C. After eclosion the nymphs are nursed by the female for about four days. The female then leaves the chamber and the nymphs, and for the next three days can be observed at different places in the cage. After this short period of roaming about the female eventually settles down in a potential breeding chamber, and the same succession of events recurs two or three times.

In the laboratory the males live as long as the females.

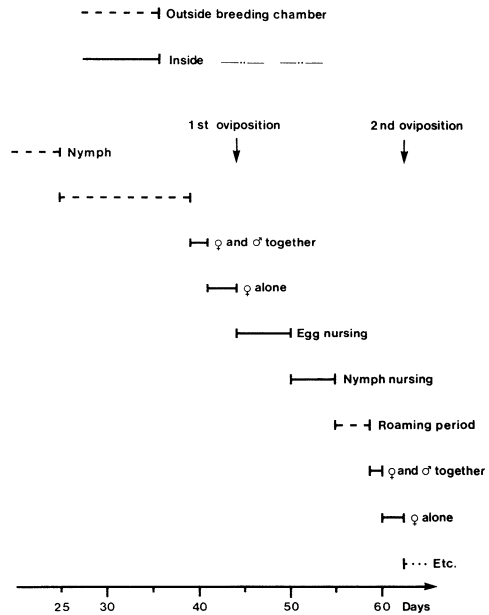


Fig. 5. Duration of the different phases of the life of female adult *Labia minor* kept in the laboratory at 25° C.

Fig. 5. Varigheden af de enkelte livsfaser hos *Labia minor* - ♀ holdt i laboratoriet ved 25° C.

Discussion

Labia minor occurs mainly in depots of composting vegetable matter, and our obser-

vations indicate that dung heaps are probably the most important habitat for this species in Denmark. In the laboratory it was shown that the preferred food of this species apparently is dung-inhabiting insects, among these small housefly larvae and housefly eggs. This indicated that the species might play a role in the natural control of houseflies. A study of the little earwig in its natural habitat, however, showed that its distribution, in the older parts of the dung, at temperatures between 18° C and 25° C, excludes the possibility that the species should eat housefly eggs and larvae in any considerable amount. A comparison between the length of the tongs of the male earwigs reared in the laboratory and those collected in the dung heaps showed that the tongs are longer in the laboratory-reared individuals. This indicates that the fly eggs eaten in the laboratory comprise a bitter diet for the little earwigs than the food they can find in the parts of the dung heaps in which they live, a diet that probably chiefly consists of vegetable matter. In the cages in the laboratory the little earwigs are mutually aggressive and territorial during most of their life, and the high density observed in certain areas of the piles is apparently only possible due to the complexity of this habitat, furnishing the earwigs with many cracks and crevices in which they can avoid continual confrontations.

It is difficult to distinguish ordinary aggressive behaviour from precopulatory behaviour. If contact is obtained the two sexes assume the same posture as described for *Forficula auricularia* during copulation (Kuhl 1928).

The characteristic habit of the Dermaptera of taking good care of the eggs (Weyrauch 1929) is displayed by *Labia minor*.

Sammendrag

Bemærkninger til biologien hos Den lille Ørentvist (*Labia minor* (L.)) – en potentiel predator på stuefluen (*Musca domestica* L.). Ved en undersøgelse af faunaen i danske møddinger, med henblik på at bedømme mulighederne for at regulere stuefluebestande ved hjælp af naturlige fjender, viste det sig at den lille ørentvist *Labia minor* var almindelig i mange møddinger.

I laboratoriet æder den lille ørentvist mange flueæg og larver, men prøvetagninger i møddinger

viste, at den her holder til i de ældre dele af møddingen ved temperaturen mellem 18° og 25° C, noget som udelukker, at den kan spille en rolle som fjende for stueflueyngel. En sammenligning af tanglængden hos individer indsamlet i møddinger og dyrket i laboratoriet på en kost af stueflueæg alene viste, at tængerne er længst hos de laboratoriedyrkede. Det peger på, at flueæg er en bedre diæt for denne art, end den kost den normalt finder i møddingerne.

I laboratoriet lægger hunnerne i gennemsnit 43 æg over en periode på 55 dage, fordelt på 2 eller 3 æglægninger. Ved 25° C er æggene syv dage om at klække og udviklingen fra klækning til voksen tager 25 dage.

I møddingerne og i laboratoriet lægger den lille ørentvist æg året rundt, og generationerne overlapper hinanden. I laboratoriet ved 25° C lever den lille ørentvist i gennemsnit 80 dage.

En hun gennemlever en serie faser, i hver af hvilke hun viser en karakteristisk adfærd. Før hver æglægning finder og indretter hun et kammer. I de første par dage deler hun redekammeret med en han, men på et tidspunkt bliver hun aggressiv, jager hannen ud og lukker kammeret. Et par dage senere lægger hun æg og derefter følger en periode med ægpasning som ved 25° C varer 7 dage. Efter at nymferne er klækket passer hunnen dem, i gennemsnit 4 dage, derefter forlader hun redekammeret og i et par dage færdes hun forskellige steder i omgivelserne. Hun kan gentage dette forløb ialt 2 eller 3 gange.

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