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Life cycle of *Porcellio laevis* (Latreille) (Isopoda, porcellionidae)

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ABSTRACT

Sexes could be distinguished in *P. laevis* on the basis of secondary sexual characters. Copulation occurred during spring and monsoon seasons. Fertilization was internal and the female carried the brood in a ventral brood pouch. Early period of life following emergence until completion of the third moult was most vulnerable and humidity played a critical role. During the life span of about 12–18 months, nine to ten moults occurred and with each moult there was an increase in body length.

1. INTRODUCTION

As part of an investigation of the population ecology of the terrestrial isopod, *Porcellio laevis* (Latreille) in Delhi region, laboratory observations were made to know the life cycle of the species. These animals form a major section of the macro-invertebrate community in the soil and play a considerable role in the breakdown of litter and wood residues. A good deal of information is available about the various aspects of life cycle of isopods.[1–9]

2. METHODS

To study the various aspects of life and reproductive cycles of *Porcellio laevis* (Latreille), it was felt necessary to culture these animals in the laboratory. In the present study, culture method described by Heeley[4] with slight modification was found to be most suitable for rearing *P. laevis* in the laboratory. These animals thrived well between one to one and a half years under constant care. The main attention necessary to maintain these animals in the laboratory conditions was to keep the degree of humidity at the optimum level. Relative humidity inside the dishes

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was maintained between 70% and 80%. Insufficient moisture conditions led to high mortality of these animals just as excessive moisture killed them by clogging the pleopods. To prevent these, the conditions of humidity within the dishes were maintained and controlled by the filter-papers, which were periodically remoistened by introducing upon them 0·5 to 1·0 cm of water from a small pipette, to replace that lost by evaporation. Water was very carefully dropped on the sides of the petri dishes away from the specimens so that the moisture gradually soaked through the paper. The room temperature ranged between 20–25° C in winter while in summer and monsoon seasons the temperature range was 28–35° C.

3. OBSERVATIONS

(i) DESCRIPTION OF ADULT MALE AND FEMALE WITH REFERENCE TO SECONDARY SEXUAL CHARACTERS

The sexes are distinct in *Porcellio laevis*. Sexually mature females are slightly larger than mature males. The male can be distinguished by the presence of modified pleopods (first and second) on the abdominal region on the ventral side. During the peak breeding seasons, the female can be distinguished by the presence of a ventral brood pouch containing developing eggs or young.

MALE

The first two pairs of pleopods on the ventral surface of the abdominal region in male differ from the other pairs of pleopods (figure 1 A, B, C). The first pair has a protopodite, a small epipodite and a flat lobe known as the exopodite. The second pleopod of male is characterised by the presence of a large flat exopodite and an epipodite like those of the first pair of pleopods and in addition, a long elbowed endopodite which presumably has some copulatory function. Internally three tubular lobes of the testis are seen on either side of the male which unites to form a dialated seminal vesicle. This leads to the vas deferens which terminates in a single papilliform penis located medially on the last thoracic segment.

FEMALE

The first and second pairs of pleopods of female are much simpler compared to that of the male and bear two small appendages like that of the endopodite of the male (figure 2 A, B, C). Internally a single tubular ovary is situated on each side which continues downwards as the oviduct. The two oviducts join and open on the middle line of the abdominal region beneath the seventh thoracic segment. The external openings of the

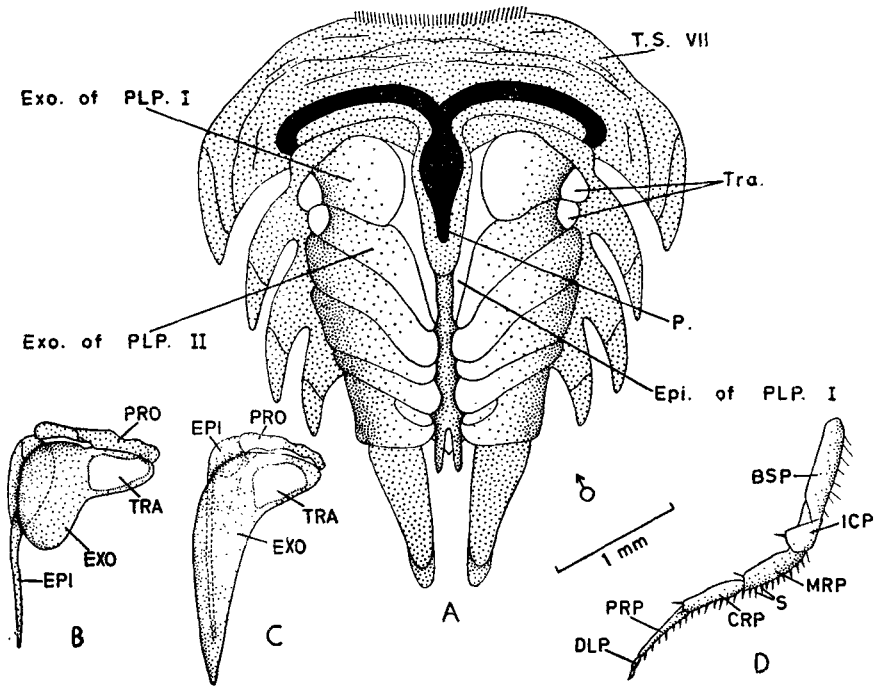

Figure 1. *Porcellio laevis.* Diagrams showing secondary sexual characters in adult male.

1 A — Ventral view of the seventh thoracic segment and abdominal segments showing the position of pleopods and copulatory organ.

1 B — First pleopod of the right side.

1 C — Second pleopod of the right side.

1 D — Second thoracic appendage showing the arrangement of setae.

For explanation of abbreviated terms in the figure, please see p. 171.

oviducts become very clear in sexually mature females during the breeding seasons and in these females, there arises close to the base of the basipodite of the appendages, four plate-like structures known as the oostegites which are attached with the second to the fifth pairs of legs. Each oostegite (figure 3 *b*) is a large free oval plate overlapping its neighbours and its fellow of the other side to form a very compact brood pouch for carrying the brood. In the immature female, oostegites are represented by small club like processes. They become more prominent in the fifth instar when the body length is 5 mm or more.

The arrangement of the setae on the seven pairs of thoracic appendages also show some variations in the two sexes (figures 1 D, 2 D). In the male, the setae are short and uniformly arranged, whereas the arrangement of the setae in females is not uniform, and some setae are long and prominent

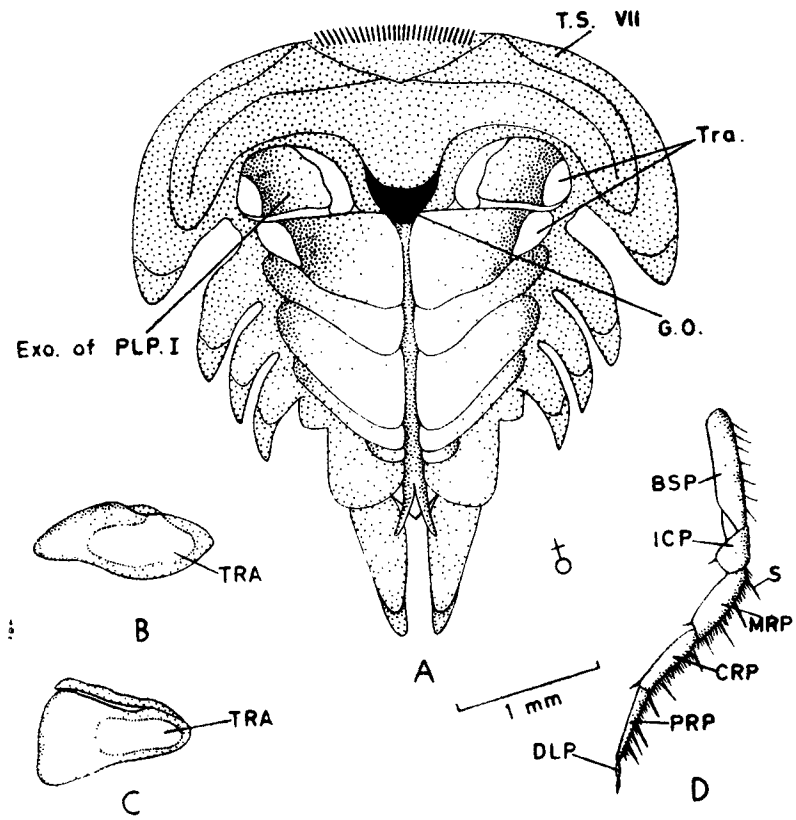

Figure 2. *Porcellio laevis.* Diagrams showing secondary sexual characters in adult female.

2 A — Ventral side of the seventh thoracic segment and abdominal segments showing the position of pleopods and genital opening.

2 B — First pleopod of the right side.

2 C — Second pleopod of the right side.

2 D — Second thoracic appendage showing the arrangement of setae.

For explanation of abbreviated terms in the figure please see p. 171.

while others are very short. This difference in arrangement of setae may be associated with the copulatory behaviour. It was reported by Unwin[10] that there exists a body colour differentiation between the sexes among terrestrial isopods. Such colour differentiation was not observed in the present study.

(ii) COPULATION AND THE FORMATION OF BROOD POUCH

Copulation in *P. laevis* occurred commonly during the spring and monsoon seasons. The specimens collected from the field when kept in petri dishes in the laboratory were seen to copulate during these seasons.

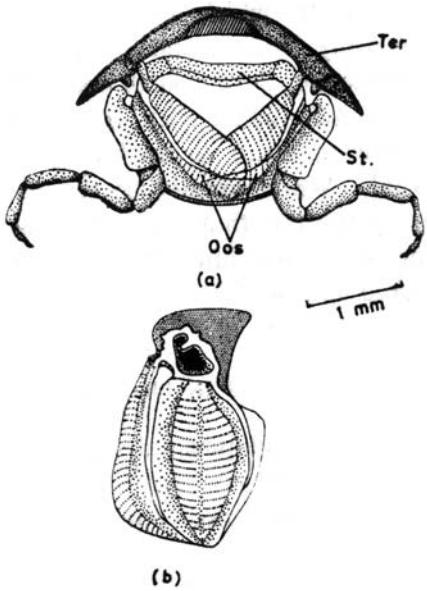

Figure 3. (*a*) 2nd thoracic segment showing the arrangement of oostegites forming the brood pouch. (*b*) Flat view of fully developed oostegite. OOS, Oostegites; ST, Sternum; Ter., Tergum.

The male seized the female after a chase and he exerted a firm hold on her with the help of the first pair of legs. After catching the female, the male tried to turn her around until he could hook his fourth pair of legs over the edges of her thorax. Then the male slowly slided towards one side of the abdominal region corresponding to the position of the abdominal region of the female and copulation took place. On one or two occasions the sliding of the male towards one side before copulation was noted. Kaulbersz[11] also noticed in *Asellus aquaticus* a similar sliding of the male towards the right side before copulation. The length of the period of association varied. In one case, it was observed for nearly half an hr and in another instance it lasted for 45–60 min. During the period of copulation, if the pair was disturbed even slightly, they moved apart immediately. If a male seized a female which was impregnated already or had the brood pouch developed, he released her at once.

After the copulation, the female sought some convenient hiding place under a leaf or stone, if they were available nearby, and awaited the completion of her ecdysis and with it the release of the oostegites. There was an intimate relationship between the process of reproduction and the change of cuticle. The same observation was made by Unwin[10] also while studying the reproduction of *Asellus aquaticus*. After copulation, the ecdysis was completed within 24 hr.

After ecdysis, the oostegites which were till now represented by small club-like processes were fully formed and released. The four pairs of oostegites attached to the second, third, fourth and fifth pairs of legs formed the characteristic brood pouch (figure 3 *a*). Eggs were deposited into this brood pouch through the aperture at the base of the fifth pair of legs. Fertilization was internal. While examining the contents of the brood pouch it was occasionally noticed that some eggs did not develop at all while the remaining ones developed into embryos. This may be due to the fact that some eggs were not fertilized.

(iii) RELEASE OF BROOD AND STAGES IN LIFE CYCLE

The embryonic and early developmental stages were passed off within the brood pouch. The overlapped oostegites allowed the pouch to expand as the developing brood required more room when the young ones had developed from the embryonic stage and were ready to leave the female. At this time, the oostegites barely touched each other. Young ones became rather active and moved around in the brood pouch prior to their release and escaped through the gaps between the oostegites. The female remained quite still during the release of the young. The young ones leaving the brood pouch were inactive for some time and remained together in a group. They were pale white with a soft and delicate integument. After the first moult, which occurred within one day of liberation, the integument was hardened.

After the first moult, the animal was pale yellow except for a deeply pigmented black eye spots and the chitinous jaws which were now employed for feeding. The gut became increasingly opaque with solid food materials swallowed, and when fed on carrot in the laboratory a conspicuous red band running from the mouth to the anus was visible. The absence of the seventh thoracic segment and the seventh pair of legs at this early free living stage is a characteristic feature of *Porcellio* and other common isopods.

The period between the emergence from the brood pouch and the first moult and also the period between the first and second moult which took place after 5–6 days from emergence were a vulnerable period in the life history of this species when humidity played a critical role. If the humidity on the soil surface was below 50%, the animals invariably died. This, according to Heeley[4] is due to the fact that the integument containing little or no calcium carbonate at this early stage is more liable to desiccation than at later stages. Furthermore, the moist integuments were particularly

liable to fungal attack. Consequently the death rate was very high at this period. No maternal care was exercised over the young after liberation, whereas instances of cannibalism had been observed where the mother devoured some of her brood. Once the second moult had been accomplished, the animal became more resistant to variations in humidity and temperature. After the third moult, the sexes could be distinguished on the basis of secondary sexual characters and after the fifth moult they became sexually mature. Usually during their complete life span nine to ten moults occurred. With each moult there was an increase in body length. After the fifth moult, which took place after 7–8 months of their liberation from the brood pouch, the females were seen to bear their first brood pouch and thereafter the moulting intervals were irregular both in males and females.

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Abbreviations used in figures **1** and 2

BSP	.. Basipodite
CRP	.. Carpopodite
DLP	.. Dactylopodite
EPI	.. Epipodite
EPI of PLP I	.. Epipodite of first pleopod
EXO	.. Exopodite

EXO of PLP I	.. Exopodite of first pleopod
EXO of PLP II	.. Exopodite of second pleopod
ICP	.. Ischiopodite
MRP	.. Meropodite
P	.. Penis
PRO	.. Protopodite
PRP	.. Propodite
S	.. Setae
Tra.	.. Tracheal respiratory organ
T.S. VII	.. Seventh thoracic segment.