

PARTURITION IN ONYCHOPHORANS: NEW RECORD AND A REVIEW

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ABSTRACT

Parturition in a Costa Rican species of *Epiperipatus* has the following sequence: the mother shows peristalsis and a swollen gonopore, the terminal lobopods are raised and the neonate walks out, a drop of white material is expelled by the gonopore. The young may crawl to the mother's back. Four young measured 1.2-1.8 mm in length and weighed 0.010-0.017 g (mean, 5.9% of mother's weight). During the first six weeks young are more lightly coloured than adults. In onychophorans, the parturition sequence is relatively constant throughout the taxa, requires 10-30 min and its frequency appears to be influenced by environmental conditions. The systematic distribution of modes of reproduction suggests an increasing tendency towards greater parental investment.

The onychophorans, commonly known as "peripatus", are a group of arthropod-like species presently found in terrestrial environments of tropical (fam. Peripatidae) and subtropical (fam. Peripatopsidae) areas. Most accounts of their biology are generalizations based on scanty data (mainly from South African species, see Buchsbaun, 1948; DeBeer, 1970; Barnes, 1984; Meglitsch, 1978).

Little is known of their behaviour in the field because of their rarity and secretive habitats (Sedgwick, 1895; Lavallard *et al.*, 1975; Meglitsch, 1978; Peck, 1982; Read, 1985). In addition, some species do not thrive well in captivity (Ruhberg, in preparation), the condition in which all parturitions have been observed.

These animals have three modes of reproduction: oviparity, ovoviviparity, and viviparity (Cuenot, 1949). Viviparity is one of their most outstanding characteristics, which makes it a particularly interesting subject (Morrison, 1946). While researching the literature after recording two births in a neotropical onychophoran, we became aware of the difficulty of gathering the disperse reports—some unpublished—and felt that a review would also be of value.

This is a report of a double parturition in a species of *Epiperipatus* to be described as *Epiperipatus hilkae*. Other species where parturition has been recorded are, in the family Peripatidae (Neotropics): *Macroperipatus insularis clarki* or *Plicatoperipatus jamaicensis*—identification doubtful, only a film available (Ealing Corporation, 1969), *M. acacioi* (Lavallard & Campiglia, 1975), *M. torquatus* (Read, 1985), *Epiperipatus brasiliensis vagans* and *Oroperipatus corradoi* (Morrison, 1946) and in the family Peripatopsidae (Old World): *Peripatopsis moseleyi* in South Africa (Holliday, 1944; Ruhberg, 1981) and *Euperipatoides leukarti* in Australia (Steel, 1896).

Material and methods

A female *E. hilkae*, collected in Barra Honda National Park, Guanacaste, Costa Rica (6-IV-1985), was kept in a plastic terrarium (8 cm in diameter and 10 cm in height) stuffed with moist rotten wood. Live termite nymphs were added as food. The adult and the neonates were deposited in the Museo de Zoología, Universidad de Costa Rica (Nº. 11-19).

Observations

Twenty-eight days after capture, one of us (R.S.) was holding the female in his hand for examination. She moved around for a while and then gave birth to twins in the following sequence: 1) weak peristaltic contraction waves progressed backward along her body, her gonopore became swollen, and the two terminal pairs of lobopods were raised, 2) the neonate emerged, head first, freeing itself from the female and apparently with the help of the maternal peristalsis (Fig. 1 a,b), 3) she expelled a drop of white cloudy material by the gonopore, 4) the young crawled on to the mother's back (Fig. 1 c). The second birth, 30 min later, followed steps 1-3.

Both young measured, at birth, 1.8 mm in length and weighed 0.0178 and 0.0155 g. They left the mother the next day. Two posterior births (in terrarium) were not witnessed (8-VI-1985, 1-VII-1985). The young measured 1.2 and 1.4 mm and weighed 0.0130 and 0.0108 g respectively. On 10-VII-1985 the female died with a young—also dead—partially emerging from the gonopore (Fig. 1 a,b). The weight of the four young was in average $5.95\% \pm 1.20$ the mother's weight, which was 0.2404 g before parturitions. All young were more lightly coloured than the mother (Fig. 2 a), and their pigmentation changed to normal about six weeks later.

Discussion

Like most Peripatidae, *Epiperipatus* presents a highly derived form of viviparity that can be considered analogous to that of some mammals (Kaye *et al.*, 1972; Ghiselin, 1985). Parturition behaviour is similar in viviparous and ovoviviparous species. There is peristalsis in *Oroperipatus corradoi*, *Peripatopsis moseleyi* and this species of *Epiperipatus* (Morrison, 1946; Ruhberg, 1985a; this paper). Peristalsis was not seen in *E. brasiliensis vagans* (Morrison, 1946).

In Neotropical peripatids the young is able to move the anterior pairs of legs when the posterior part of its body has not yet emerged from the genital orifice and walk out (Read, 1985; Lavallard and Campiglia, 1975). This also occurs in *P. moseleyi* when the head emerges first (Ruhberg, 1985a). Embryo and placenta are initially anchored to the mother by a pedicule (Cuenot, 1949). In a later stage, both disappear and the embryo moves free in the maternal duct; perhaps for this reason all are born head first (Fig. 2 a). In *P. moseleyi* the embryos are curled up hookwise and can be born either head or tail first, a probable cause for simultaneous parturition (Ruhberg, 1985 b).

Manton (1938) stated in peripatopsids that the white drop that followed the young contains the egg membrane, the peritrophic membrane and the integument. Obviously, Morrison (1946) was unable to see them because the small peripatid egg (40-50 μ m) disappears when the embryo attaches to the placenta (Cuenot, 1949).

The young of *M. torquatus* also move to the back of the mother, according to photographs in Bates (1964) and Read (1985), perhaps a result of gregarism, typical of the group (see Ruhberg, 1985b). Nevertheless, Reed (1986, pers. com.) believes that this behavior is accidental.

In general, parturition requires 10-30 min and the young are born singly or in pairs (Ruhberg, in preparation). The breeding season seems to be influenced by environmental conditions, since there is no phylogenetic pattern. *Opisthopatus cinctipes* in South Africa and the Central American *Epiperipatus* reproduce year round (Ruhberg, 1985a), while *P. moseleyi* and *M. acacioi* breed in March-April and December-July, respectively (Holliday, 1944; Lavallard and Campiglia, 1975).

Buchsbaum and Milne (1961) believed that manipulation induces parturition, and this could be the case of this report. Nevertheless, there seem to be no remarkable differences in parturition between these species of Peripatidae and Peripatopsidae, which suggests that the sequence here reported is normal.

The taxonomic distribution of modes of reproduction (Bouvier, 1905; Sedgwick, 1908; Ruhberg, 1985 a) may indicate that there has been a strong selection to increase parental investment in the "progression" from the less derived oviparous species of Australia to the viviparous—and derived—Neotropical Peripatinae.

Resumen

El parto en una especie costarricense de *Epiperipatus* tiene la siguiente secuencia: la madre presenta peristalsis y un hinchamiento del gonoporo, los lobopodios terminales se levantan y el neonato empieza a salir, a lo que ayuda caminando, una gota de material blanco se expelle por el gonoporo. El neonato puede trepar al dorso de la madre. Cuatro juveniles midieron entre 1.2 y 1.8 mm, y pesaron entre 0.010 y 0.017 g, lo que representa en promedio el 5.9% del peso de la madre. Durante las primeras seis semanas los juveniles tienen un color más claro que los adultos. El parto en los onicóforos presenta una secuencia de eventos relativamente constante en el taxón, requiere entre 10 y 30 minutos y su frecuencia parece estar regulada por las condiciones ambientales. La distribución sistemática de los tipos de reproducción sugiere una creciente tendencia hacia el aumento de la inversión paterna.

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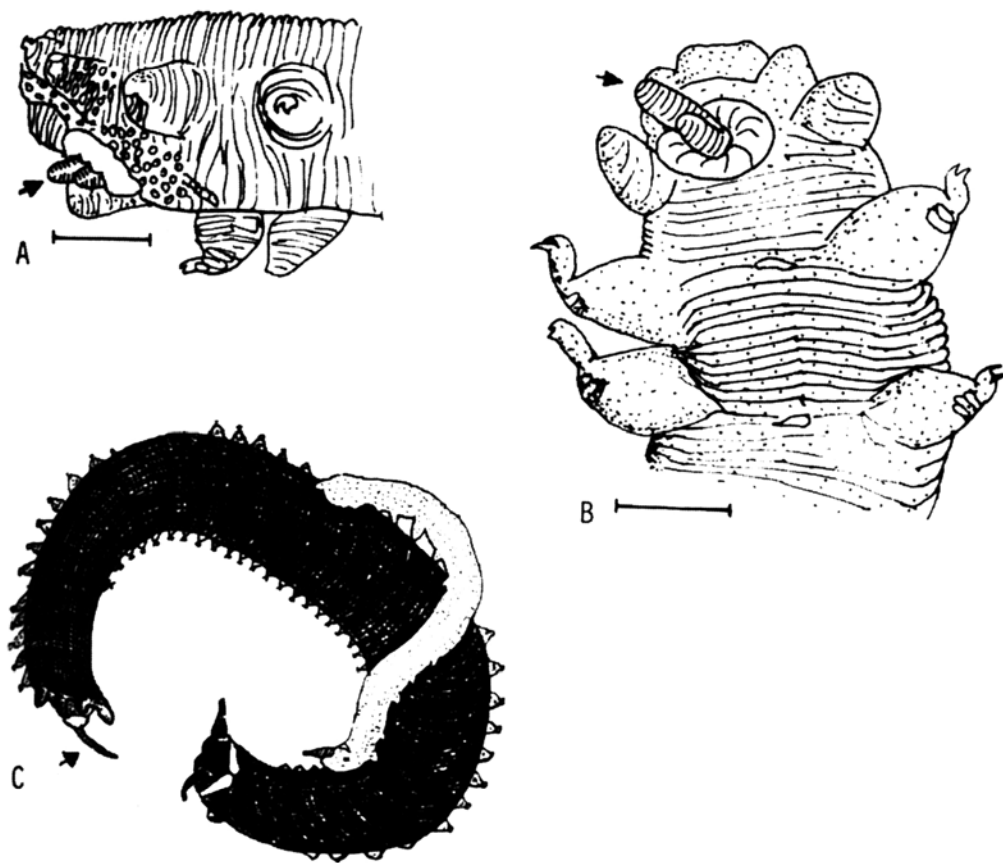


Fig. 1. Birth begins as the antennae (arrows) emerge from the gonopore (bar = 1 mm), a: lateral view. b: ventral view. c: The young may crawl on the mother's back (after a photograph in Bates, 1964).

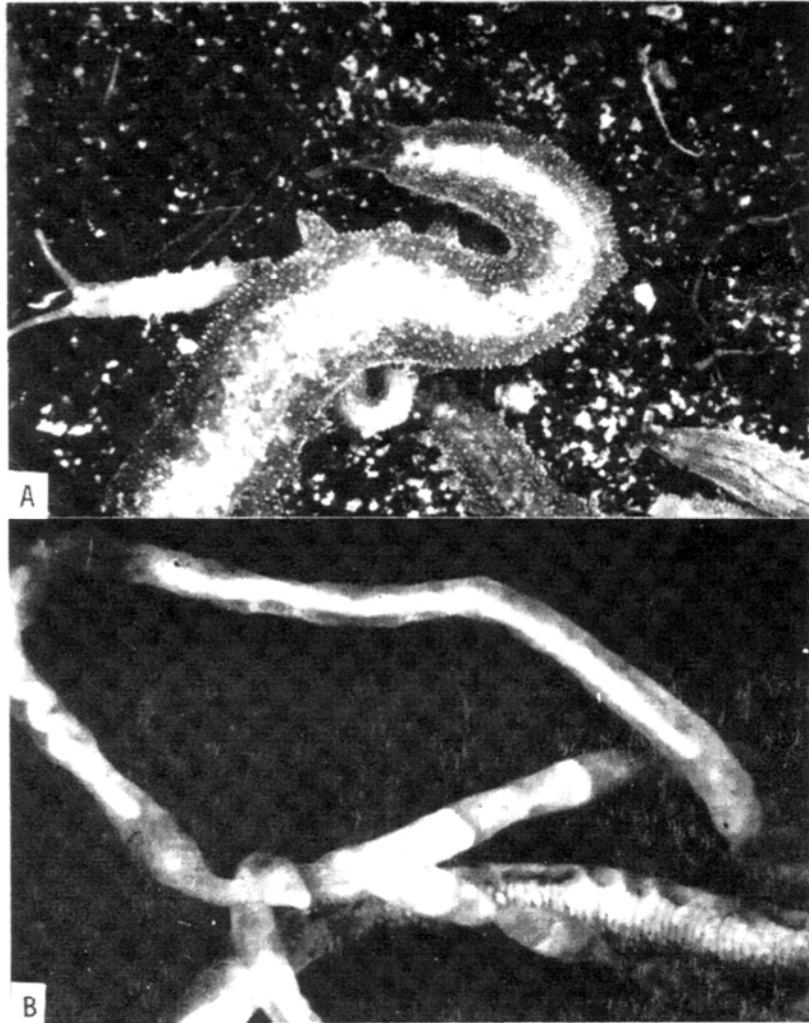


Fig. 2. a: All young are more lightly coloured than the mother. b: The embryos line up as they move on the maternal duct, forming a chain of developmental statages.