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BROOD POUCH MORTALITY IN TRICHONISCUS PUSILLUS

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INTRODUCTION

Woodlice have proved to be ideal organisms for modelling population dynamics for two main reasons, namely the close relationships between growth rate and temperature, and the number of embryos carried in the brood pouch of a female and her size. In any set of equations used to model population growth, mortality factors acting at particular times in the life cycle are bound to be included. Brood pouch mortality (BPM), whereby a proportion of eggs in the marsupium fail to develop into well-developed embryos subsequently capable of independent existence, is one such factor.

BPM in terrestrial isopods has been recorded by a number of authors. Brereton (1956) estimated 18% BPM in Porcellio scaber, basing this value on the difference between the mean numbers of well-developed embryos and mean numbers of early stage embryos carried by females of the same size. More direct measures have been carried out by a number of workers by counting the number of undeveloped embryos in brood pouches carrying well-developed embryos (Table 1).

Table 1 : Previous estimates of Brood Pouch Mortality (BPM) in terrestrial isopods.

Species	Estimate of BPM	Authors
Philoscia muscorum	3.6% to 4.6%	Sunderland et al. (1976)
Philoscia muscorum	0.8%	Sutton (1968)
Porcellio scaber	2.8% to 5.7%	Davis (1978)
Armadillidium vulgare	7.4%	Paris & Pitelka (1962)
Armadillidium vulgare	6.0%	Al-Dabbagh & Block (1981)
Armadillidium vulgare	2.4% to 3.3%	Lawlor (1976)

As Sunderland & Hassall (1976) commented, "it would seem that brood pouch mortality can vary both between species and between populations of the same species". These authors found that late breeding groups in Philoscia muscorum had higher BPM than early breeding groups, a finding repeated by Davis (1978) for Porcellio scaber. Sunderland et al. (1976) stated that BPM was independent of brood size in Philoscia muscorum, but Lawlor (1976) working with Armadillidium vulgare came to the conclusion that "BPM is more closely related to fecundity than to either female size or age".

In Trichoniscus pusillus, the situation regarding BPM has been less well-defined. Standen (1963) found no difference between numbers of embryos in well-developed broods compared to numbers in early stage broods when plotted against female size (measured, as in many isopod studies, by head width). She stated that "examination of brood pouches revealed larvae only or eggs only all of which appeared to be similar". Later, Sutton (1968) stated that BPM was "very low" and Standen (1973) assumed it to be "negligible".

The present study analyses BPM in a field population of Trichoniscus pusillus and examines the levels of BPM in ovigerous females transferred from the field to gestate in a laboratory incubator.

METHOD AND RESULTS

Trichoniscus pusillus were collected from a mixed deciduous woodland at Parlington Hollins, W. Yorks. (Ordnance Survey grid reference SE 415 353) by pooter during 1979-80. The population was wholly composed of the parthenogenetic form (Trichoniscus pusillus f. pusillus) as indicated by the fact that of 940 animals collected, only one was male (which was identified by the shape of the pleopods to be one of the rare parthenogenetic males).

In the laboratory, the head width of females carrying well-developed embryos (showing elongation and segmentation) was measured (one head width unit = 0.0056 mm) and the number of embryos per female counted. The numbers of undeveloped embryos (i.e. showing BPM) were scored for these females and are shown in Table 2. Females carrying embryos at an early stage of development were placed in pots for two weeks in incubators with a 9 hour dark/15 hour light regime at 15 ^{o}C. The head width of females surviving this treatment which had not released their broods was determined, numbers of embryos were counted and BPM was measured as described above. Results of this study are given in Table 3.

Table 2 : Brood pouch mortality in a field population of *Trichoniscus pusillus*

	Date			
	6.6.79	26.6.79	6.6.80	TOTAL
No. of ovigerous females with well-developed embryos	51	38	14	103
No. of females showing BPM	15	2	2	19
% females showing BPM	29.4%	5.3%	14.3%	18.4%
Total no. of embryos	471	266	104	841
No. of undeveloped embryos	25	2	4	31
% embryo mortality	5.3%	0.8%	3.8%	3.7%
% embryo mortality in affected females	17.7%	13.3%	22.2%	17.8%

Table 3 : Brood pouch mortality in *Trichoniscus pusillus* in the laboratory

	Date			
	6.6.79	26.6.79	6.6.80	TOTAL
No. of females at start of experiment	33	38	45	116
No. of females at end of experiment retaining brood	29	24	34	87
No. of females showing BPM	13	5	22	40
% females showing BPM	44.8%	20.8%	64.7%	46.0%
Total no. of embryos	253	161	280	694
No. of undeveloped embryos	18	8	51	77
% embryo mortality	7.1%	5.0%	18.2%	11.1%
% BPM for affected females	21.1%	22.9%	28.8%	25.6%

A composite plot of embryo number against female head width for all three groups of incubated females is shown in Fig. 1. A least squares regession line was fitted to the data which gave the equation:

No. of embryos = 0.198 x headwidth - 12.81

Points which lie above and to the left of this line represent females with above average numbers of embryos for their size. By chi squared analysis of the contingency (Table 4), it is clear that "over-endowed" females are not more liable to BPM than the "less well-endowed" females (chi squared = 0.087, with one degree of freedom, not significant at 5% level).

Table 4 : Chi squared contingency table for female Trichoniscus pusillus (see text for explanation)

	No. of females showing BPM	No. of females not showing BPM
Females with above average numbers of embryos for their size	25	21
Females with below average numbers of embryos for their size	18	19

Similar findings were obtained from an analysis of data from those animals collected in the field with well-developed embryos.

DISCUSSION

The finding that BPM in Trichoniscus pusillus collected in the field occurs at a level of 3.7% (range 0.8% to 5.3%) is in accord with results for other terrestrial isopods. However, because of the much smaller brood sizes in Trichoniscus pusillus, the effect of BPM on individual mothers is much more marked (an average 17.8% loss of embryos to those affected). The treatment of ovigerous females in incubators increases BPM to 11.1% (range 5.0% to 18.2%) with a 25.6% loss of embryos to those females affected. The percentage of females suffering some BPM rose from 18.4% in the field to 46.0%, providing convincing evidence that environmental factors can affect BPM. This is also suggested by the variability in the levels of BPM shown in the three field samples.

Figure 1

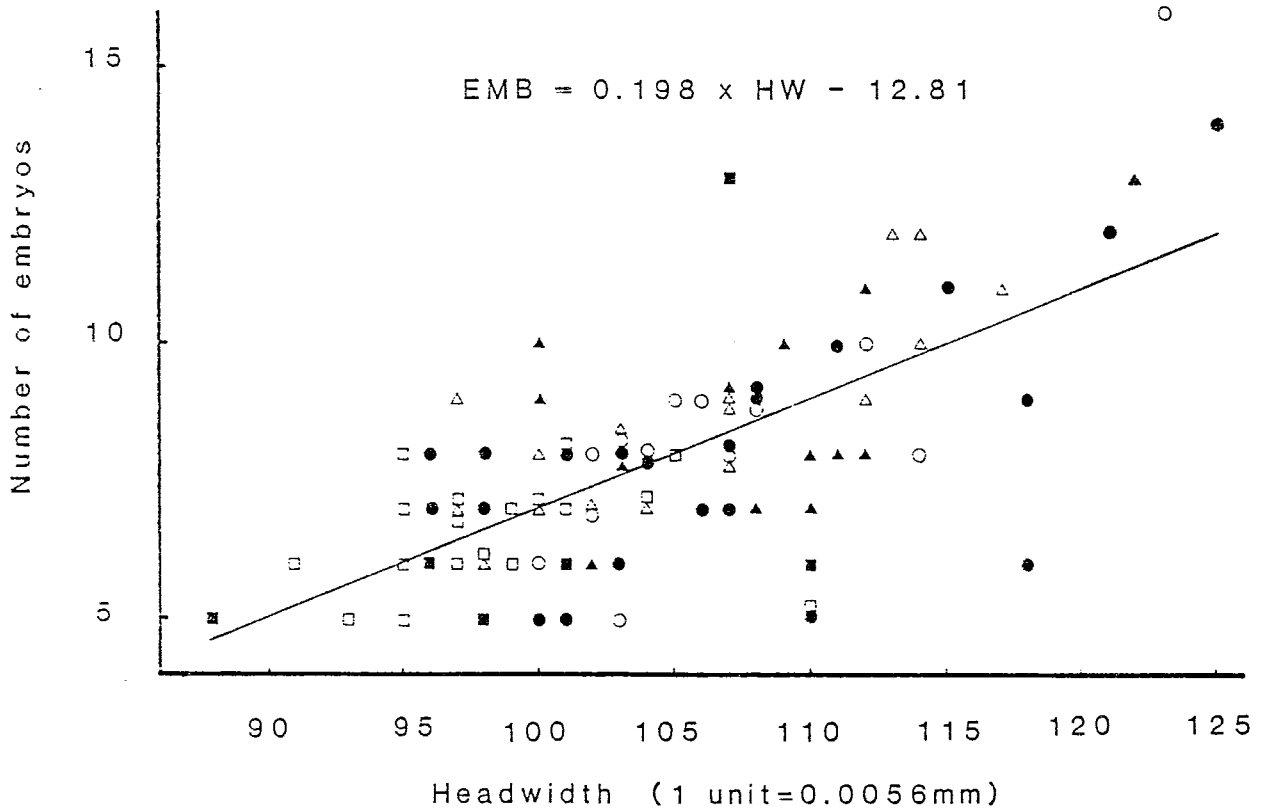

Fig. 1 : Composite plot of embryo number against head width of incubated females of Trichoniscus pusillus (triangles, 5.6.79; squares, 26.6.79; circles, 6.6.80). Isopods which suffered BPM are indicated by solid symbols and isopods unaffected by BPM by open symbols.

Perhaps more important is the fact that the animals used in the present study are parthenogenetic. Since all the embryos in a female's brood pouch are, therefore, almost certain to be genetically identical, we can look elsewhere for explanations of the variable viability shown within broods. Observations made by the author suggested that embryos were much more likely to show BPM at the anterior end of the brood pouch and this might repay further investigation.

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