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Effect of photoperiod on the post-overwinter development of a crab spider, *Xysticus croceus* Fox (Araneae, Thomisidae)

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Summary

In order to investigate the effect of photoperiod on the post-overwinter development of *Xysticus croceus* Fox, nymphs collected on 15 March 1988 in the field were reared under natural, long (LD 16:8) and short (LD 10:14) photoperiods. Under natural and long photoperiods, the nymphs developed normally to adults, and the mean developmental period was 70-94 days. Under short photoperiod, however, their mean developmental period was prolonged 1.5-2.3 times as compared with that under natural and long photoperiods.

Introduction

According to Schaefer (1977), spiders can be divided into two different groups as regards their responses to photoperiod. In one group development is not affected by differences in photoperiod, while in the other, development is retarded under a short photoperiod. In this context, I have investigated the effect of photoperiod on the post-overwinter development of a crab spider, *Xysticus croceus* Fox.

Materials and methods

Nymphs collected on 15 March 1988 in Abiko City (140°02′ E, 35°52′ N), Chiba Prefecture, Japan, were reared under 3 different photoperiods: natural, long (LD 16:8) and short (LD 10:14). Natural conditions are defined as a semi-outdoor situation protected from direct sunshine, rain and wind. Day length at the start (16 March), middle (4 May) and end of the experiment (30 June) was 13h 02m, 14h 56m and 15h 49m respectively; the day length at the summer solstice (21 June) was 15h 51m. Long and short photoperiods were prepared by switching on and off a 6-W fluorescent tube in a wooden box, 60 cm wide, 45 cm high and 45 cm deep, the tube providing 250-300 lux. The boxes were placed in a corridor of our school building. As the temperature was not controlled, that under natural photoperiod was somewhat lower than that under long and short photoperiods, because the wooden box containing rearing vials was placed in semi-outdoor conditions. Humidity was supplied by a 1.0-1.5 cm layer of wet soil at the bottom of each rearing vial. The rearing vials were 3.8 cm in diameter by 7.3 cm in height and had cotton plugs. Twelve spiders for each experiment were kept individually in such vials placed under pre-set conditions and provided with food at intervals of 3-4 days until they became adult; individuals that died during rearing were omitted from the subsequent graphs. The prey consisted of *Sinella cuspidatus* (Collembola) nymphs and adults, *Drosophila melanogaster* (Drosophilidae) adults, and *Saccharosyden procerus* (Delphacidae) nymphs and adults. These were provided in rotation. The number of prey given each time was increased from 3-4 of small body size to 4-5 of large size as the development of the experimental animals proceeded. This feeding regime was considered to be sufficient for the development of the experimental animals, since one or two prey often remained alive at the time of the next feeding.

Results

Figure 1 shows the results obtained under natural conditions. Males required 79-110 days for development to adults, the mean being 93.7 ± 10.10 days; females did so in 78-102 days, the mean being 89.2 ± 7.89 days. The difference between these means was not significant in *t*-test ($p > 0.5$). It is suggested from these results that, in the field, the overwintering juveniles of *X. croceus* complete their development and appear as adults from late May to early July. Field observations made in the area around Tokyo agree with this, since the adults are found most frequently in June-July.

Figure 2 shows the results obtained under a long photoperiod. The developmental period in males was

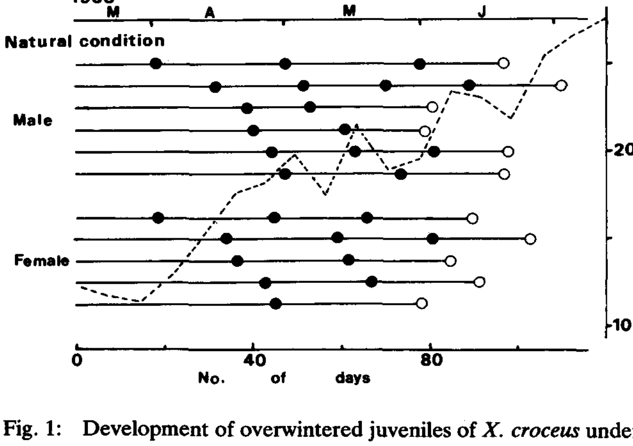

Fig. 1: Development of overwintered juveniles of *X. croceus* under natural conditions. Solid circles indicate moults, and clear circles final moults. Dotted line is weekly mean temperature (°C).

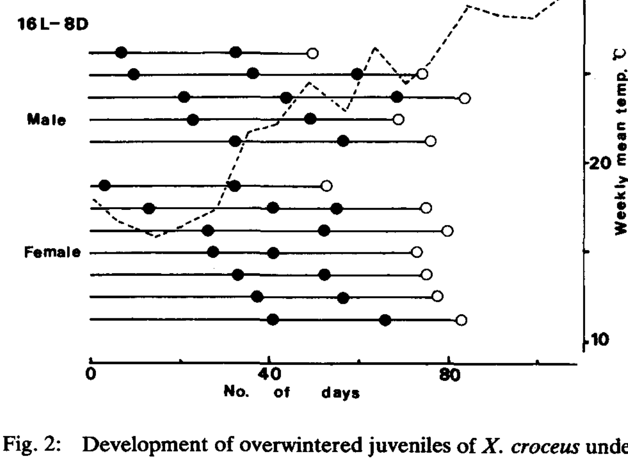

Fig. 2: Development of overwintered juveniles of *X. croceus* under a long photoperiod (LD 16-8). Symbols as in Fig. 1.

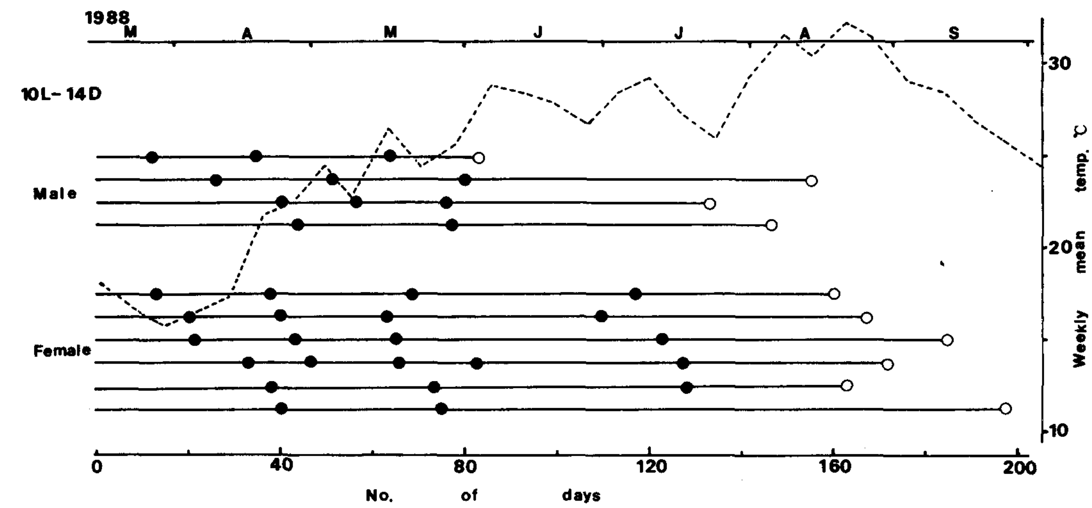

Fig. 3: Development of overwintered juveniles of *X. croceus* under a short photoperiod (LD 10:14). Symbols as in Fig. 1.

50-84 days with a mean of 70.6 ± 11.37, and in females 53-83 days with a mean of 73.9 ± 9.08. These periods were somewhat shorter than those under natural conditions. This is probably due to the difference in temperatures between the two conditions. As indicated by dotted lines in each graph, the temperature was always higher during rearing under a long photoperiod than during a natural one, since the former was conducted indoors and the latter in semi-outdoor conditions.

Figure 3 shows the results obtained under a short photoperiod. Among the males, one individual emerged as an adult 84 days after the start of the experiment, but the others remained as juveniles for 130 days or more. The mean developmental period required was 145.0 ± 8.60 days, if the result from the one individual which emerged early is excluded. Among the females no individual emerged as an adult in less than 160 days, in spite of a sharp rise in temperature during the experimental period after 30 days. The mean developmental period was 173.3 ± 12.35 days.

Discussion

These results indicate that this spider belongs to Schaefer's second group. Similar developmental retardation under a short photoperiod has already been reported for *Philodromus subaureolus* Boes. et Str. by Hamamura (1982) and for *Dolomedes sulfureus* L. Koch by Miyashita (1986). In contrast, there are species which show no or only a weak reaction to short photoperiod, for example *Achaearanea tepidariorum* (C. L. Koch) and *Pholcus phalangioides* (Fuesslin) (Miyashita, 1987, 1988).

Under both natural and long photoperiods, the number of moults necessary for development to adulthood ranged from 2 to 5 (see Figs. 1, 2). This indicates that the overwintering population consisted of individuals in various instars, although the exact number of moults needed during their life is unknown. Under the short photoperiod, however, the number of moults was 3-6. In addition, intense prolongation of either the last instar or the last and penultimate instars occurred. These results suggest that the juveniles developing under the short photoperiod must have passed through one or two extra moults. This is also supported by the carapace measurements shown in Table 1. The carapace width of adults, especially of females, was significantly larger in individuals reared under a short photoperiod than in those reared under a natural or long photoperiod. Schaefer (1987) stated that, in species maturing in spring or summer, a prolongation of intervals between moults, especially towards the end of development, and an increase in number of moults are liable to be brought about by short photoperiod. This is true of the post-overwinter development in *X. croceus* juveniles. However, further investigation is needed to understand the ecological meaning of such a reaction to photoperiod. Especially, it is necessary to examine the response to intermediate photoperiods. In the present experiment, unfortunately I could not examine this point, because the collection of many experimental animals at once was quite difficult.

	Mean carapace width (mm)	
Conditions	**Male**	**Female**
Natural	2.54 ± 0.173 (n=6)	2.82 ± 0.166 (n=5)
LD 16:8	2.41 ± 0.168 (n=5)	2.75 ± 0.182 (n=7)
LD 10:14	2.62 ± 0.101 (n=3)	3.14 ± 0.201* (n=6)

Table 1: Carapace widths of adults of *Xysticus croceus* obtained from rearing under natural, long and short photoperiods. *Significant in t-test ($p < 0.05$).

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Compass orientation of *Lycosa tarentula fasciiventris* nests in central Spain

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Introduction

Spiders of the species *Lycosa tarentula fasciiventris* Dufour build tubular nests in the soil with a certain slope in relation to the surface, and with an opening to the exterior. This opening may sometimes be surrounded by a cylindrical structure built in the upper part of the nest using fine material such as silk and grass (Fig. 1; Ortega, 1986).

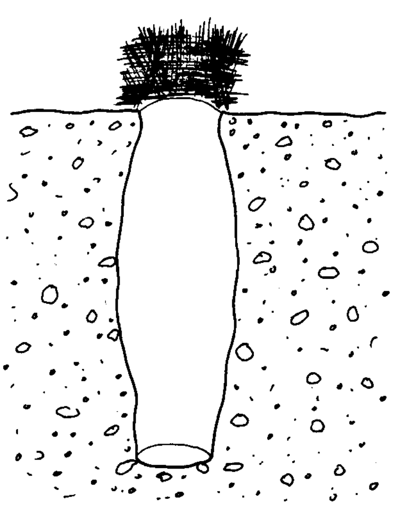

Fig. 1: Schematic drawing of a *Lycosa tarentula fasciiventris* nest.

The depth and diameter of these nests have been described by Ortega (1986), calculating the correlation coefficients between the product of the width and length of the prosoma as a body parameter of the spider and the depth and diameter of the nest. However, in this previous study compass orientation was not considered. This parameter could be important in the biology of the spider. Humphreys (1987b) has shown that *L. tarentula* (Linn.), studied in northern Greece, modifies its position within the nest according to the ambient temperature. The compass orientation of the nest could modify the amount of insolation that the nest (and the spider) receives during the day and therefore, the temperature range found inside it.

In this paper we present the results of a study of the compass orientation of a population of 34 nests of adult individuals of *L. tarentula fasciiventris* in the central region of Spain.

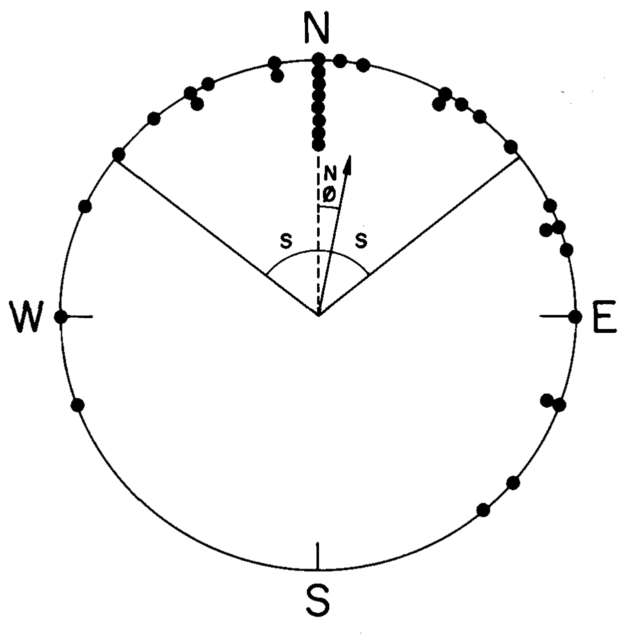

Fig. 2: Orientation of nests with a deviation (s) of 52.71° from the azimuth to the left and the right. Each dot corresponds to one nest. The arrow indicates the mean vector being the length (r) = 0.57 and the mean angle from the azimuth (θ) = 13.00°.