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NOTE

Effect of initial starvation on the larval survival and development of the inshore water crab, *Philyra corallicola* Alcock

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Abstract

Effect of early starvation on larval survival and developmental duration in the inshore water crab *Philyra corallicola* was studied. Six different feeding regimes were tested. Point of Reserve Saturation (PRS_{50}) for 50% individuals were 2.4 days and Point of –No-Return for 50% individuals was 0.7 days. Early starvation resulted in delayed development and reduced survival.

Food quality and quantity are key factors influencing not only the survival and metamorphosis in meroplanktonic larvae, but also the duration of development (Sulkin, 1975; Sulkin and Norman, 1976). Starvation is expected in a natural variable environment (Anger *et al.*, 1981). Most pelagic larvae living under natural conditions would starve. In brachyuran larvae, reserves are usually not sufficient to allow development under starvation conditions (Anger and Dawris, 1981). Such studies are very much limited in tropical forms (Krishnan and Kannupandi, 1987; Farrelly and Sulkin, 1988; Kannupandi *et al.*, 2000). Hence, the present work has been attempted to study the effect of initial starvation on the larval survival and development of inshore water crab, *Philyra corallicola*.

Material and methods

"Sponge" bearing female crabs, *Philyra corallicola*, were collected from inshore waters of the Vellar Estuary (Lat. 11° 29' N; Long. 79° 46' E). They were maintained individually in the laboratory in round fiberglass tanks (salinity 25 ± 1‰, temperature 27±1°C and photoperiod of 12:12 L: D). The crabs were fed with shrimps and clam meat and the water was changed daily until the eggs hatched into zoea.

Immediately after hatching, only active swimming larvae from same brood were transferred to separate bowls (diameter 10 cm, depth 3.5 cm) containing 25 ml of seawater of salinity 30±1‰, temperature 27±1°C. The larvae were fed with freshly hatched San Francisco Bay Brand of *Artemia* nauplii. Water and food were changed and moults or mortality were noted every day. Experiment was terminated when all the larvae either died or metamorphosed to first crab stage. The life history of *P. corallicola* comprised of three zoeal and one megalopa stages. Twelve days were taken to reach megalopa stage.

Experimental design followed was that

of Kannupandi *et al.* (2000) and consisted of six sub experiments of 100 larvae each. Each sub experiment has a different feeding regime. Point of Reserve Saturation (PRS) and Point of-No-Return (PNR) were calculated following the method of Anger and Dawris (1981).

Results

Feeding regime 1- Food was offered only during the first day following hatching. Only 25 nos. of zoea I molted into zoea II after 4.00 ± 0.0days. None of the zoea II molted into next instar. The results are presented in Table 1 and Figures 1,2 and 3.

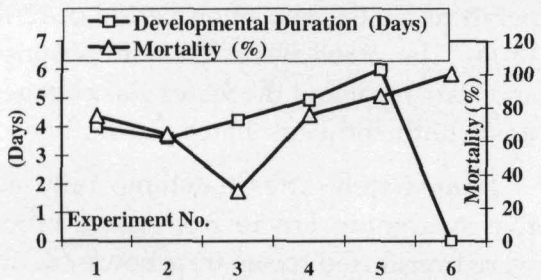

Fig. 1. *Development duration (days ± Standard deviation) and mortality (%) in the Z – I stage in relation to the feeding regime tested*

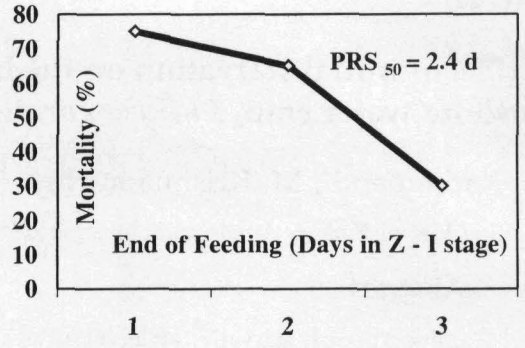

Fig.2. *Point of Reserve Saturation of 50% of Z – I stage (PRS_{50}) in days*

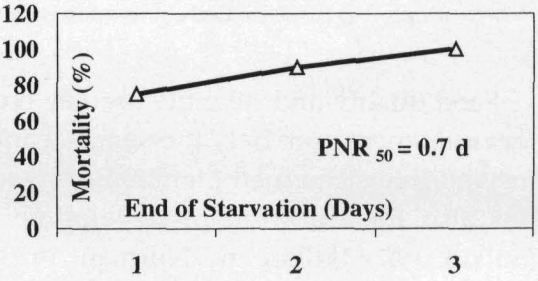

Fig. 3. *Point-of-No Return of 50% of Z – I stage (PNR_{50}) in days*

Feeding regime 2 – Same as in feeding regime 1, but initial feeding period was for two days. Here, 36 nos. of zoea I molted to zoea II in 3.6 ± 0.48 days. Out of which only 13 metamorphosed into zoea III in 1.00 ± 0.00 days and megalopa stage was not reached. PRS_{50} value obtained was 2.4 days.

Feeding regime 3 – Control (no starvation) – 70 of I

Table 1. P.corallicola – *duration of zoeal stages and cumulative development in days (mean ± standard deviation) mortality (%), given different feeding regimes*

Feeding regime	Stages					
	Zoea I		Zoea II		Zoea III	
	Days	%	Days	%	Days	%
1	4.0 ± 0.00	75	-	25	-	-
2	3.6 ± 0.48	64	1.0 ± 0.00	23	-	13
3	4.24 ± 0.75	30	1.93 ± 0.70	10	2.33 ± 0.47	0
4	4.95 ± 0.91	76	2.0 ± 0.00	4	2.35 ± 0.67	0
5	6.0 ± 0.91	87	3.0 ± 0.00	0	2.8 ± 0.87	2
6	-	100	-	-	-	-

zoea molted into II zoea in 4.24 ± 0.75 days. 60 of II zoea metamorphosed to III zoea in 1.93 ± 0.70 days and all the 60 III zoea reached megalopa in 2.33 ± 0.47 days. Interestingly there was no mortality in the III zoea.

Feeding regime 4 – 1-day initial starvation. 24 of zoea I molted into zoea II which lasted for 4.95 ± 0.91 days. 20 of zoea II molted into zoea III in 2.00 ± 0.00 days period. All the 20 zoea III molted into megalopa in 2.35 ± 0.67 days.

Feeding regime 5 – Two days initial starvation. 13 of I zoea reached zoea II in 6.00 ± 0.91 days. All the 13 zoea II molted into megalopa and development took within 2.8 ± 0.87 days. PNR_{50} is 0.7 days.

Feeding regime 6 – Starved control – no feeding. No zoea I reached to zoea II and all the larvae died after 4 days.

Discussion

In *P. corallicola*, after initial feeding, short starvation for 1 day in zoea I shortended the instar, but it was found prolonged in *Metaplex distincta* (Krishnan and Kannupandi, 1987). On the contrary, studies on the larvae of temperate crabs, viz., *Hyas araneus* (Anger and Dawris, 1981), *Menippa mercinaria, Neopanope sayi, Panopeus herbstii* and *Sesarma cinereum* (Anger *et al.*, 1981) showed that starvation at the end of zoea I has no effect or shortens the stage I.

The PRS_{50} in *P. corallicola* is Ca. 2.4 days, as against 1.3 days observed in *M. distincta* (Krishnan and Kannupandi, 1987); 1 day in *Libinia emerginata*, between 1 and 2 days in *M. mercenaria, P. herbstii, N. sayi, S. cinereum* (Anger *et al.*, 1981); 3 days in *H. araneus* (Anger and Dawris, 1981); and 1.6 days in *T. crenata* (Kannupandi *et al.*, 2000).

None of the larvae of the 2 days fed group molted to megalopa. But starvation delayed II zoea and following stages and total zoeal development appeared to be prolonged in tropical waters (Krishnan and Kannupandi, 1987) and temperate waters (Anger and Dawris, 1981; Anger *et al.*, 1981).

Starvation period at the beginning of zoea I of *P. corallicola* prolonged this stage (Anger and Dawris, 1981; Krishnan and Kannupandi, 1987; Anger *et al.*, 1981). They have shown that the delay in moulting was approximately equivalent to the duration of the starvation period in zoea I, and same holds good only for the 2 days starved I zoea of *P. corallicola*, similar to *M. distincta* (Krishnan and Kannupandi, 1987).

PNR_{50} of *P. corallicola* is Ca. 0.7 days and that of *M. distincta* is 1.2 days. In five other species of crab larvae, viz., *L. emerginata, M. mercenaria, P. herbstii, N. sayi* and *S. cinereum* it was found to be 1.2 days (Anger *et al.*, 1981), <8 days in *H. araneus* (Anger and Dawris, 1981) and 1.6 days in *T. crenata* (Kannupandi *et al.*, 2000). The influence of starvation immediately following hatching in *P. corallicola* is stronger than when a feeding period

precedes starvation as suggested by Anger *et al.* (1981).

Owing to initial starvation in *P. corallicola*, II zoea and III zoea are prolonged unlike in *M. distincta* where the total zoeal development is delayed. Initial lack of prey lengthened development of II zoea in *P. herbstii*, *S. cinereum* and *L. emarginata* and shortened in *M. mercenaria*, *N. sayi* (Anger *et al.*, 1981) and *Hyas araneus* (Anger and Dawris, 1981). The subsequent zoeal stages are prolonged in all species except in *H. araneus*.

In the light of these observations, it appeared that there is a critical period in the beginning of larval development of *P. corallicola* as reported by Kon (1979), Anger and Dowris (1981), Anger *et al.* (1981); Krishnan and Kannupandi (1987) and Kannupandi *et al.* (2000). Except for chitin synthesis, development process awaits the starting signal given by first feeding (Anger and Nair, 1979). When prey is available during intermoult, tissue growth and accumulation of organic reserves take place (Yamoka and Scheer, 1970). If starvation precedes or interrupts the phase C, (intermoult stage) it will last longer, because protein losses have to be compensated for (Anger and Dawris, 1981). Sterols present in the first feed are the precursors of β-ecdysone, which initiates premoult and ecdysis independent of further food availability (Anger and Dawris, 1981). Lipid pools formed during the PRS are necessary precursors for chitin synthesis in zoea II.

The delay in I zoea which are starved initially and their inability to moult to II zoea, may be due to an irreversible damage to some hormonal or enzymatic systems controlling moulting, catabolism of proteins (Anger and Nair, 1979), lipid degradation during final premoult (Anger and Dawris, 1981) and amino acid catabolism (Munday and Poat, 1971). Further studies on biochemical, histological and physiological changes during starvation of tropical crab larvae will through more light on probable causative factor. Perhaps the larvae may have maximum starvation resistance as an ecological adaptation.

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