A Comparative Study of the First and Final Zoeal Stages of Four Species of *Thalamita* (Crustacea: Portunidae)

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Abstract.—The zoeal morphologies of four species of swimming crab, *Thalamita admete, T. crenata, T. danae* and *T. sima* are compared in the first and final zoeal stages. Differences are few, but these are tabulated and discussed. The most useful features are: In the first zoea: *T. danae* has the largest zoeae and the lowest dorsal-spine to rostrum length ratio. Both *T. danae* and *T. crenata* have two lateral telson setae (one minute); the other species have only one, that in *T. admete* being stout whereas that in *T. sima* is hair-like. In the final zoea: *T. danae* zoeae are as small or smaller than those of the other species, but again have a relatively short dorsal spine; *T. crenata* is distinguished by having two rather than one cluster of aesthetes distally on antenna I; *T. sima* is difficult to separate other than by body proportions and dimensions, or by differences in numbers and type of setae on the maxilla, scaphognathite and maxilliped II exopod. The final zoeae of *T. admete* are not known.

In a recent paper describing the larval development of *Thalamita danae* (Fielder and Greenwood, 1979), we commented on the difficulty of establishing species-specific features for those larvae. At this time the first zoeal stage of *T. crenata* (Prasad and Tampi, 1953), *T. poissonii* (Al-Kholy, 1963), *T. prymna* (Kurata, 1975), and all zoeal stages of *T. sima* (Kurata 1975), had been described. However, these descriptions are generally superficial and do not give details of setation comparable with those given for *T. danae*.

Subsequently, we have reared in the laboratory both *T. sima* H. Milne-Edwards, 1834 and *T. crenata* H. Milne-Edwards, 1834 to the megalopa, and *T. admete* (Herbst, 1893) to the first zoeal stage. Detailed examinations of all available zoeal stages reared by us have been made and compared in an attempt to determine distinguishing features. The previously published descriptions cited above have only been used to complement this comparison, because of their lack of detail.

In the larval-histories of three *Thalamita* which are now fully known, there are differing numbers of zoeal stages, with three in *T. danae*, six in *T. sima* (five according to Kurata, 1975) and seven in *T. crenata*. Although it is necessary to describe each larval history fully in order to determine intermoult stages and to allow comparison of rates of development, valid interspecific comparison between life histories having differing numbers of zoeal larvae can most meaningfully be made only between the initial and/or final zoeal stages. It is the purpose of this note to present the results of such an analysis for the four species we have examined.

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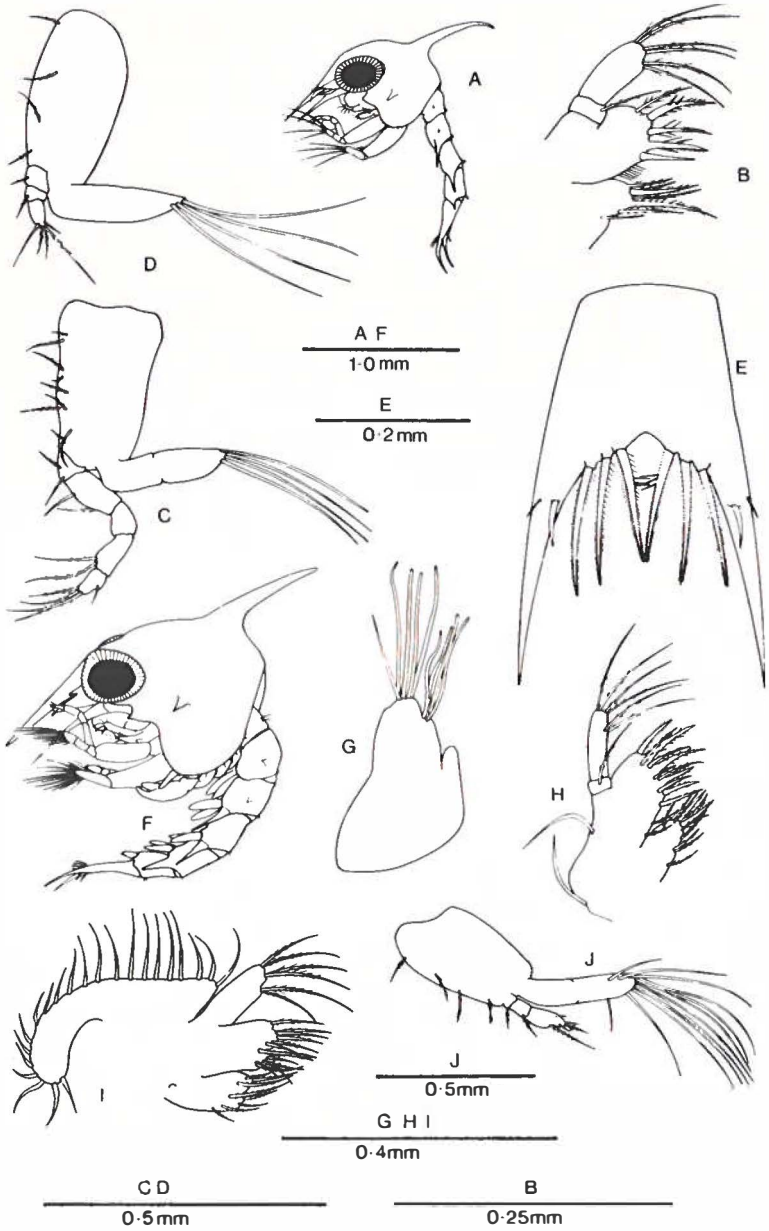

Fig. 1. Examples of tabulated structures, as in *T. danae*. A–E, first zoea: A, lateral view; B, maxilla I, C, maxilliped I; D, maxilliped II; E, telson. F–J, final zoea: F, lateral view; G, antenna I; H, maxilla I; I, maxilla II; J, maxilliped II.

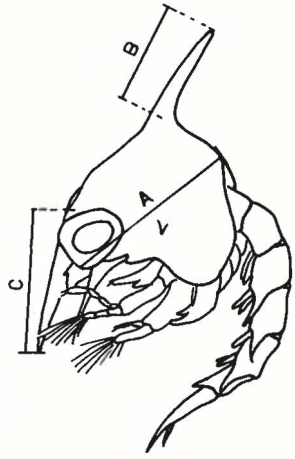

Fig. 2. Zoeal larva showing limits for length measurements of carapace (A), dorsal spine (B) and rostrum (C).

Because of the close similarity in larval morphology of all species of *Thalamita*, all are generally similar to those published for *T. danae* (Fielder and Greenwood, 1979). Differences which have been consistently found concern dimensions, ratios and numbers of setae. These are presented in Table 1, and examples of the tabulated appendages are illustrated in Fig. 1. Dimensions of the larvae given in the Table were measured from the fixed points as indicated in Fig. 2.

Table 1 shows that many of the features listed are minor, or perhaps open to subjective interpretation. For example, in setation of the endopodal segments of maxilliped 2 in the first zoea, setal numbers are the same in all four species, the only differences being in the nature of secondary setation. Although an individual worker may acquire the expertise to readily recognise such differences, there is limited value in such features for broader use. While recognising the truth of this, we have nevertheless included in Table 1 all those features where differences were found. If nothing else, they do indicate the degree of similarity between the species and emphasise the problem of locating interspecific diagnostic characters within the larvae of *Thalamita*. Some of the features given in Table 1 are of a more positive nature and at least serve to distinguish the present four species. These features are discussed below.

Size and proportions of *T. danae* first zoea are clearly distinct from the other three species. The former has the largest zoeae and, on averages, a lower dorsal spine: rostrum length ratio. Final stage zoeae of *T. danae* are the smallest, though with ranges overlapping the other two species, and again (on averages) having notably lower dorsal spine: carapace and dorsal spine: rostrum length ratios. It should be noted, however, that at the extremes of their ranges these ratios in both first and last zoeal stages approach those for the other species. While proportions do thus help to distinguish *T. danae* from those of congenitors, natural variation within a brood

Table 1. Contrasting features in four species of *Thalamita*. All measurements in mm. The numbers of individuals measured are given in brackets. A = aesthetasc, S = simple, SP = sparsely plumose, P = plumose, HP = highly plumose, PD = plumodenticulate.

Feature	*T. danae*	*T. sima*	*T. crenata*	*T. admete*
First Zoea				
Length carapace (A)	0.71(3)	0.39(10)	0.48(8)	0.44(5)
" range	0.7–0.72	0.36–0.44	0.4 –0.54	0.42–0.46
Length dorsal spine (B)	0.46	0.27	0.34	0.29
" range	0.42–0.5	0.22–0.3	0.3–0.38	0.28–0.62
Length rostrum (C)	0.54	0.28	0.35	0.31
" range	0.52–0.56	0.26–0.3	0.32–0.36	0.3–0.34
Ratio B/A	0.65	0.69	0.71	0.66
Ratio B/C	0.85	0.96	0.97	0.96
Carapace post-lat. margin, denticles	7–15	8–10	6	9
% abd. segt 4 overlapped by abb. 3 post-lat. spine	100	50	50	<30
Telson, lat. spine 1 (prox)	minute	absent	minute	absent
" lat. spine 2 (dist)	hair-like	hair-like	hair-like	rel. stout, spine 3
Maxilla I, coxal endite	1S, 3SP, 3PD	3SP, 3PD	1S, 5SP	1S, 5PD
Maxilliped I, basis	9SP	9SP	10SP	10SP
Maxilliped II endop.				
prox. segt	1PD	1PD	1SP	1SP
mid. segt	1PD	1PD	1SP	1SP
dist. segt	2S, 3SP	1S, 4SP	1S, 4SP	1S, 4SP
Final Zoea				
Length carapace (A)	1.09(10)	1.14(3)	1.19(8)	—
" range	1.02–1.2	1.08–1.22	1.16–1.24	—
Length dorsal spine (B)	0.7	0.9	1.05	—
range	0.58–0.84	0.88–0.92	0.92–1.16	
Length rostrum (C)	0.97	0.91	1.0	—
" range	0.9–1.02	0.8–1.02	0.92–1.1	
Ratio B/A	0.64	0.81	0.88	—
Ratio B/C	0.72	0.99	1.05	—
Carapace margin:				
setae	12	14	13–15	—
denticles	16	16	20–28*	—
Antenna I				
terminally	4–5A, 1S	4A, 1S	4A, 1S	—
subterm.	4–6A	6A	6A + 4A	—
Maxilla I, basal endite	1SP, 14PD	4SP, 11PD	9SP, 9PD	—
Scaphognathite	22–27HP	30HP	33–35HP	—
Maxilliped II exoped.	12P	14P	14P	—

* molariform

restricts the utility of these features alone, and there is reasonable presumption that differing environmental conditions during development could yield different means and variance in dimensions.

The percentage of abdominal segment 4 which is overlapped by the posterolateral spines from segment 3 readily allows separation of *T. danae* and *T. admete* zoeae from each other and from those of the other species as known.

Armature of the lateral telson margins is sufficiently distinctive in the first zoeae to be of value. In *T. danae* and *T. crenata* there are two lateral setae, the more proximal being minute but clearly visible under close examination. In the other two species only the more distal seta remains. In *T. admete* this is quite stout, whereas in *T. sima* it is fine and hair-like. These telson differences no longer apply in the final stage zoeae.

In the final stage zoea, *T. crenata* is clearly distinguished by having two distinct subterminal clusters of aesthetascs on antenna I, and by the large number of denticles around the carapace margin. Separation of *T. danae* and *T. sima* is more difficult and (apart from dimension differences mentioned above) at present can only be based on minor differences in setation and secondary adornment of setae, particularly that of the scaphognathite as indicated in Table 1.

Whilst in some decapods larval characters are sufficiently distinctive to be of value in establishing specific distinctness of adult populations previously regarded as conspecific (e.g., Gore, 1972), the reverse seems almost the case in *Thalamita*. This is not surprising for it is well recognised that identification of larval Portuninae is particularly difficult (Lebour, 1928; Roberts, 1969; Bookhout and Costlow, 1974, 1977; Kurata, 1975; Rice and Ingle, 1975). Some authors have been unable to distinguish between zoeae of different genera (Yatsuzuka, 1957 in Kurata, 1975). Others have stated that "larvae are so similar that it is very difficult to tell species apart other than by examination of minute characteristics" (Bookhout and Costlow, 1974: 20) and "identification of species is almost impossible without referring to every available minor difference" (Kurata, 1975: 39).

While agreeing with these sentiments, we have been able to find larval features of value in distinguishing at least between the present four species of *Thalamita*. In most cases however these are minutae of setation which may be difficult for routine identifications.

In addition to the features reported here, we have also made stereoscan E.M. examinations of zoeae, and studied stained cuticles for integumental organs of taxonomic use. Neither of these two lines of approach have so far yielded valuable information.

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