J. mar. biol. Ass. India, **46** (2) : 141 - 145, July - Dec., 2004

Reproductive strategy of gammarid amphipods in Vellar Estuary and Killai Backwaters

P. S. Lyla, S. Velvizhi, P. J. Antony and S. Ajmal Khan

Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai – 608 502, Tamil Nadu, India

Abstract

Reproductive strategy of six species of gammarid amphipods namely *Maera othonides, Photis digitata, Corophium triaenonyx, Orchestia platensis, Quadrevisio bengalensis* and *Gandidierella gilesi* covering aspects like sex ratio, fecundity, reproductive cycle and brood mortality were studied during October 1997 to September 1998. There was a preponderance of females over males all through the year and the sex ratio in all the species deviated significantly from the expected 1:1 ratio. Breeding activity was continuous in *M. othonides* and *P. digitata.* While *C. triaenonyx* was found to breed twice in an year, *O. platensis, Q. bengalensis* and *G. gilesi* were found to breed only once in a year. Brood mortality was found to be high during the monsoon months. The study pertained to the amphipods from Vellar Estuary and Killai Backwaters.

Key words: Reproductive strategy, amphipods

Introduction

Of the four suborders in amphipoda, maximum number of biological studies has been made on gammarids, perhaps due to their numerical abundance and wide distribution. But studies on tropical gammarids are very few except some observations (Shyamasundari, 1973; Steele, 1973) in particular on the reproductive aspects of tropical gammarids. Therefore, an attempt has been made to study the reproductive biology of six species of amphipods namely *Maera othonides, Photis digitata, Corophium triaenonyx, Orchestia platensis, Quadrevisio bengalensis* and *Gandidierella gilesi,* occurring in the brackish waters of Parangipettai covering various aspects as sex ratio, fecundity, reproductive cycle and brood mortality.

The authors are thankful to Dr. T. Balasubramaniam, Professor and Director, CAS in Marine Biology for his encouragement and support and the authorities of Annamalai University for the facilities provided.

Material and methods

Collections were made fortnightly for an year from October 2002 to September 2003 during low tide from the Vellar Estuary and Killai Backwaters (Lat. 11^0 29′ N and Long. 79^0 49′ E).

Specimens were collected, separated and preserved in 70% alcohol and the ovigerous females were preserved individually. Length of each specimen was measured from the tip of the rostrum to that of telson to the nearest 0.1 mm, along the median dorsal side. Sex was distinguished based on secondary sexual characters. Females with bristles on oostigites were further classified as ovigerous (with egg/embryo in the brood pouch) and non-ovigerous. The contents of the brood pouch of ovigerous females were removed, counted and then grouped under 6 categories. Homogeneity in sex ratio was tested with Chi square test. Simple Pearson Correlation coefficient (r) values were calculated between body length and freshly laid eggs (fecundity). Percentage of brood mortality was obtained by dividing the number of embryos at later stages (4 to 6) with average number of eggs at early stages (1 to 3) and multiplied by 100. Information on physicochemical parameters such as temperature, salinity, *p*H and dissolved oxygen was also collected.

Results

Physicochemical parameters

Monthly averages of physicochemical parameters observed during the study period are given in Figure 1. Temperature was found to vary from 28.5°C (November) to 34°C (May), salinity from 8ppt (November) to 34ppt (May), dissolved oxygen from 3 ml/l (March) to 6ml/l (January) and *p*H from 7.4 (November) to 8.5 (June).

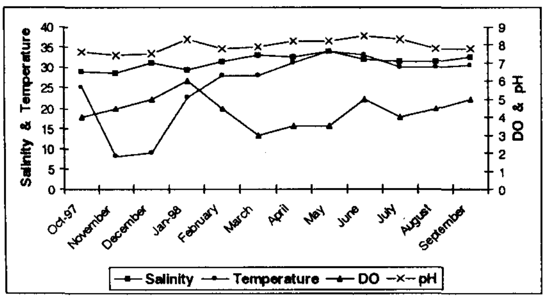

Fig. 1. *Monthly variation of physicochemical parameters of Vellar Estuary during the study period Oct. 2002 – Sep. 2003.*

Sex ratio

The sex ratio (F:M) varied from 1:1 to 2.08:1 in *P. digitata,* during different months; 1.05:1 to 1.66:1 in *M. othonides;* 1.25:1 to 2.2:1 in *C. triaenonyx;* 1.04:1 to 1.58:1 in *O. platensis.,* 1.25:1 to 1.6:1 in *Q. bengalensis;* and 1.16:1 to 1.7:1 in *G. gilesi.* In all the species, females dominated over the males throughout the year In *P. digitata,* the sex ratio was exactly 1:1 during August. In all the species, the chi-square analysis showed the sex ratio (F: M) to deviate significantly from the expected 1:1 ratio as a whole. But month-wise, it conformed to the expected 1:1 ratio.

Fecundity

The maximum fecundity was observed in *C. triaenonyx* where it varied from 4 to 42 eggs in specimens of 2 mm to 3.9 mm in length respectively. In *O. platensis,* it varied from 4 (1.5 mm) to 41 (5.5 mm), 11 (3 mm) to 35 (5 mm) in *M. othonides,* 5 (2.3 mm) to 32 (4 mm) in *Q. bengalensis* and 5 (1.8 mm) to 22 (4 mm) in *P. digitata.* The minimum fecundity 4 (2.5 mm) - 11 (4.3mm) was observed in *G. gilesi.* Correlation between fecundity and length of females was significant ($P<0.001$) in all the species. The 'r' value between body length and number of eggs in *O. platensis* was 0.969 followed by 0.899 in *G. gilesi,* 0.812 in *M. othonides,* 0.792 in *C. triaenonyx,* 0.736 in *Q. bengalensis* and 0.726 in *P. digitata.*

Brood mortality

The maximum brood mortality was observed during the monsoon season in all the 6 species (Table 1). It was in the range of 30-35% in *Q. bengalensis* and 50-55% in *G. gilesi*. The minimum brood mortality was observed during the postmonsoon season and it was in the range of 21-27% in *M. othonides* and 35-40% in *P. digitata*. The brood mortality was more or less equal during the summer and premonsoon seasons. The seasonal variation in brood mortality can be summarized this way: the mortality, which was low during postmonsoon season increased through summer and premonsoon to reach the maximum in summer.

Reproductive cycle

Females of *P. digitata* and *M. othonides* either with brood or with fully developed bristles on oostigites could be collected throughout the year, indicating their continuous breeding nature (Table 2). Two peak breeding periods were observed in the former species (March – April and July – September), whereas it was restricted to only one peak in the latter (March – April). Brooding females of *O. platensis* were noticed only during the summer season (April-June), *C. triaenonyx* showed two breeding periods, one extending from January to March and another from July to September with peak breeding during March and September. In *Q. bengalensis* brooding females were noticed only dur-

Table 1. *Percentage of brood mortality in six species of amphipods during different seasons.*

Species name	Monsoon	Post-monsoon	Summer	Pre-monsoon
M. digitata	40 – 45	35 – 40	30 – 35	30 – 35
M. othonides	22 – 45	21 – 27	42 – 47	42 – 47
C. triaenonyx	40 – 45	30 – 40	35 – 45	35 – 45
O. platensis	40 – 42	22 – 31	22 – 31	22 – 31
Q. bengalensis	30 – 35	22 – 25	22 – 25	23 – 29
G. gilesi	50 – 55	25 – 30	33 – 45	33 – 45

Table 2. *Breeding periods of six species of amphipods.*

Species	Breeding period	Peak breeding
M. digitata	Throughout the year	March – April & July – Sept.
M. othonides	Throughout the year	March – April
C. triaenonyx	Jan. – March & July – Sept.	March – Sept.
O. platensis	April – June	April
Q. bengalensis	Jan. – March	Jan. – March
G. gilesi	Jan. – Sep.	March and August – Sept.

ing the post-monsoon season (January – March) while, in *G. gilesi* it extended from January to September with quiescent period during the monsoon season.

Discussion

The present study on the reproductive aspects of amphipods gave interesting results. In the 6 species studied presently, the females dominated over males as a whole. However monthwise it conformed to 1:1 ratio. Sameota (1969, 1969a) also found the same phenomenon in *Protohaustorium longimerus* and *Haustorius canadensis*, and Greeze (1977) in the Black Sea gammarids. Surtikanti *et al.* (1998) reported a varied sex ratio from 1:3 to 2:3 in *Corophium* sp. Fish and Preece (1970) also reported the above fact in *Bathyporeia pelagica* and *B. pilosa*. The probability of both sexes inhabiting different habitats and errors in sampling techniques has been cited as possible reasons. Amphipods do occur abundantly among the seaweeds. It is necessary to collect samples of amphipods from seaweeds as well to get a clear picture of their sex ratio.

The relationship between body length and freshly laid eggs was found to be linear in the present study. Similar observation was recorded by several workers (Kinne, 1961; Fish, 1975; Sheader, 1978; Peethambaran Asari, 1983). Kunha *et al.* (2000) developed a model to predict the variation in fecundity of brackish water amphipods and mentioned that the fecundity will decline with decrease in salinity. Larger females always carried larger broods. Similar observations were made by Sameoto (1969 and 1969a) in few haustoriids of Northern Canada.

Brood mortality is common in amphipods and isopods (Fish, 1975). The brood mortality was found to be especially high during monsoon months in *P. digitata, M. othonides* and *C. triaenonyx*. Weak bristles of the brood plates were attributed as possible reason for this mortality. Increase in the size of the eggs during development is also considered as major reason (Fish, 1975). The studies of Steele and Steele (1975) showed that brood mortality decreased in the higher latitude under low temperatures. Higher temperature, continuous breeding and instability of the environment may be attributed as possible reasons for a comparatively higher percentage of brood mortality in tropical gammarids.

The factors, which induce breeding in marine invertebrates, may be endogenous or various exogenous factors like temperature, salinity, food availability, etc. or a combination of all could influence it. Two species studied presently (*M. othonides* and *M. digitata*) were found to be continuous breeders with one or two peaks corresponding to the postmonsoon and premonsoon seasons when the environmental conditions were more or less stable with better availability of food. This is in conformity with the data available for the tropical gammarids such as *Parhyalella pietschmani* (Steele, 1973) and *M. zeylanica* (Krishnan and John, 1975). It is probable that high ambient temperature might help continuous breeding as observed presently and also reported earlier by several authors (Giece, 1959; Steele and Steele, 1975; Morino, 1978). However, in the brackishwater habitats, it is the salinity, which fluctuates more widely than temperature. Associated with changes in salinity, the availability of food also varies. Therefore, these organisms reproduce more during the stable months to ensure maximum survival of their young ones. However, to understand fully the reproductive strategy of each species, experimental study on the role of salinity on the fecundity, brood mortality has to be carried out. In culture systems, amphipods are widely used as an important feed for various developmental stages of the commercially important marine organism. They are also used in environmental monitoring. Hence a detailed study on all the amphipods should be undertaken to perfect a technology for their mass production.

References

Fish, J.D. 1975. Development, hatching and brood size in *Bathyporeia pilosa* and *Bathyporeia pelagica* (Crustacea: Amphipoda). *J. Mar. Biol. Assoc. U.K.*, **55**: 471-488.

Fish, J.D. and G S Preece. 1970. The annual reproductive patterns of *Bathyporeia pelagica* and *Bathyporeia pilosa*. ibid.**50**: 425-488.

Giece, A.C. 1959. Comparative physiology: Annual reproductive cycle of marine invertebrates. A review. *Physiol.*, **21**: 547-576.

Greeze, I.I. 1977. Life cycle of *Gammarus acquicaudata* (Martynov, 1931) in the Black Sea. *Crustaceana*. **4**: 88-90.

Kinne, O. 1961. Growth, moulting frequency, heart beat, number of eggs and incubation time in *Gammarus zaddachi*, exposed to different environs. ibid. **2**: 26-36.

Krishnan, L. and P.A.John. 1975. Breeding biology of amphipod, *Melita zeylanica* Stebbing in a troical monsoon lake. *Zool. Anz.*, **194**: 328 – 334.

Kunha M. R., M. H. Moreira and J.C. Sorbe. 2000. Predicting amphipods brood size variation in brackish environment: an empirical model for *Corophium multisetosum* Stock, 1952 (Corophiidae) in Ria de Aveiro (N W Portugal). *J.Exp.Mar.Biol.Eco.*, **248** (2): 207-223.

Morino, H. 1978. Studies on the Talitridae (Amphipoda, Crustacea) in Japan III. Life history and breeding activity of *Orchestia platensis Kroyer. Soto. Mar. Biol. Lab.*, **24**: 416pp.

Peethambaran Asari, K. 1983. Biology of Brackish water gammarid amphipods, *Eriopisa chilkensis* (Chilton) and *Idunella chilkensis* Chilton in Pitchavaram mangroves. *Indian J. Mar. Sci.*, **12**: 52-54.

Sameoto, P. P. 1969. Some aspects of ecology and life cycle of three species of subtidal and burrowing amphipods (Crustacea: Haustoriidae). *J. Fish. Res. Bd. Canada*, **26**: 1321-1345.

________1969a. Comparative ecology, life histories and behavior of intertidal and sand burrowing amphipods (Crustacea: Haustoriidae) at Cape Cod. ibid. **26**: 361-388.

Sheader, M. 1978. Distribution and reproductive biology of *Corophium insidiosum* (Amphipoda) on the north east coast of England. ibid. **58** 585-596.

Shyamasundari, K. 1973. Studies on the tube dwelling amphipod, *Corophium triaenonyx* Stebbing from Vishakhapatnam. *Biol. Bull.*, **144**: 503-510.

Steele, D. H. 1973. The biology of *Parhyalella pietschmani* Schellenberg, 1938 (Amphipoda). *Crustaceana*, **25**: 276 – 280.

______ and V.J. Steele. 1975. The biology of gammarus in the north western Atlantic XI. Comparison and discussion. *Can. J. Zool.*, **53**: 1116-1126.

Surtikanti., H. K, R.V Hyne, D. A. Everett and R.P.Lim. 1998. Population density and breeding periodicity of the amphipod, *Corophium* sp., in the Hawkesbury River. *Australas. J. Ecotoxicol*, **4** (2): 85-91.