MAHASAGAR
Vol.21, No.1 (March), 1988, pp.61-65.

EFFECT OF SALINITY ON THE DEVELOPMENT OF LARVAE AND JUVENILE INSTARS OF *HETEROPANOPE INDICA* DE MAN (DECAPODA: BRACHYURA)

S. SELVAKUMAR, S. AJMALKHAN AND R. NATARAJAN
Centre of Advanced Study in Marine Biology, Annamalai University
Parangipettai-608502

ABSTRACT

There are 3 zoeal stages and a megalopa in the larval life history of *Heteropanope indica* De Man. The effect of salinity on the larval life history and juvenile development was studied in the present work in 7 test salinities (5, 10, 15, 20, 25, 30 and 35‰). The larval development was completed in a salinity range of 10-30‰, and that of juvenile development in 5-30‰. In the above salinity ranges, survival was 100% in both. As the intermoult period of zoea larvae was shorter in 25‰, this appears to be the optimum salinity for the development of zoeal larval stages. Development of megalopa and further development through juvenile instars was faster in 15‰. The larval stages of this crab were found to be hardy compared to the larvae of other crab species, as 100% survival was observed in a wide range of salinity.

Key-words: Salinity effect, *Heteropanope indica*, decapoda, larvae.

Salinity is the most widely fluctuating environmental parameter in the estuary and the organisms inhabiting this dynamic environment are admirably adapted to it. The brachyuran xanthid crab *Heteropanope indica* occurs in the intertidal region of the Vellar estuary (lat.11°28'N; long. 79°49'E) where the salinity drops to zero during monsoon months. Salinity tolerance experiments on both adults and larvae were conducted to throw light on the successful colonisation of this crab and its reproductive capacity. The results elucidate the role of salinity on larval development comprising 3 zoeal stages and a megalopa (data unpublished) and the development of first three juvenile instars of this crab.

Ovigerous females (minimum carapace width 11 mm) were collected from the intertidal oyster bed community in the estuary and kept in finger bowls containing the locality water (30‰). After hatching, larvae were gradually transferred to different salinities after proper acclimatisation. Larvae were reared in 7 test salinities (5, 10, 15, 20, 25, 30 and 35‰). Total of 30 larvae were reared in each salinity, with 10 larvae in each finger

bowl containing 150 ml of water. Freshly hatched *Artemia* nauplii were used as food. Water was changed daily after carefully examining for the presence of moults and dead larvae. Megalopa and juvenile instars were reared individually in the test salinities and small pieces of leaves and oyster shells were provided as substrate to them.

In 5% and 35% salinity all the zoeal stages died the very next day and development could be completed only in the remaining 5 test salinities wherein the larvae and juvenile survival was 100%. When the juvenile instars were reared in 5 and 35‰, there was 100% survival in the former and 100% mortality in the latter.

Table I — Mean intermoult duration (in days) of larval stages and the first three juvenile instars of *Heteropaneope indica* reared in different salinities.

Stages		5‰	10‰	15‰	20‰	25‰	30‰
I Zoea	Mean	-	3.87	3.27	3.17	3.07	3.17
	SD	-	0.5713	0.4498	0.3790	0.2537	0.3790
	Variance	-	0.3264	0.2023	0.1437	0.0644	0.1437
	Number	-	30	30	30	30	30
II Zoea	Mean	-	3.96	3.30	3.13	3.00	3.10
	SD	-	0.7649	0.5960	0.3457	0	0.3051
	Variance	-	0.3851	0.3552	0.1195	0	0.0931
	Number	-	30	30	30	30	30
III Zoea	Mean	-	4.27	3.50	3.17	3.00	3.07
	SD	-	0.6915	0.7768	0.3790	0	0.2537
	Variance	-	0.4782	0.6034	0.1437	0	0.0644
	Number	-	30	30	30	30	30
Megalopa	Mean	-	5.40	4.60	4.90	5.70	7.20
	SD	-	1.0463	0.5026	0.7182	0.8013	0.6156
	Variance	-	1.0947	0.2526	0.5158	0.6421	0.3790
	Number	-	20	20	20	20	20
I juvenile instar	Mean	6.40	6.13	5.60	6.10	6.40	6.80
	SD	1.3139	1.0878	0.5026	0.9679	1.0463	1.1965
	Variance	1.7263	1.1833	0.2526	0.9368	1.0947	1.4316
	Number	20	20	20	20	20	20
II juvenile instar	Mean	6.40	6.40	6.13	6.50	7.30	8.30
	SD	2.0105	1.0878	1.2312	1.5252	1.0513	1.5927
	Variance	4.0421	1.1833	1.5159	2.3262	1.1052	2.5367
	Number	20	20	20	20	20	20
III juvenile instar	Mean	8.13	7.60	7.30	7.50	8.20	8.50
	SD	1.1425	0.9155	0.9234	1.1050	1.0513	1.0513
	Variance	1.3053	0.8381	0.8526	1.2210	1.0520	1.1052
	Number	20	20	20	20	20	20

Total period of larval development in each salinity grade was 12.10, 10.07, 9.47, 9.07 and 9.34 days respectively in 10, 15, 20, 25 and 30‰ salinity. Intermoult period for the three zoeal stages was shortest in 25‰ suggesting that this salinity is optimum for the development of zoeal stages (Table I). Above and below this salinity, mean duration increased being longest in 10‰. Intermoult period of zoeal stages I, II and III in 10% differed significantly from those of other test salinities. 't' values for the differences in intermoult period between other salinities are presented in Table II. Shortest intermoult period for the megalopa was observed in 15‰, above and below which it increased. As in megalopa, 15‰ appears to be the optimum for rapid development of first three juvenile instars as the intermoult period was short. The 't' values for the differences in intermoult period between different salinities are given in Table III.

Table II – t values for the differences in mean intermoult duration of different larval stages of *Heteropanope indica* in different salinities.

Larval stage	Salinity	Salinity (‰)				
		10	15	20	25	30
Zoea I	10	-	4.51^{d}	5.59^{d}	6.02^{d}	5.59^{d}
Zoea II		-	3.71^{d}	5.40^{d}	6.85^{d}	5.71^{d}
Zoea III		-	4.06^{d}	7.65^{d}	10.04^{d}	8.94^{d}
Megalopa		-	3.09^{c}	1.76	1.02	6.64^{d}
	15	-		0.94	2.15	0.80
				1.34	2.74^{c}	1.63
				2.10^{a}	3.54^{d}	2.90^{c}
				1.53	5.21^{d}	14.65^{d}
	20	-	-	-	1.22	-
					2.06^{a}	0.36
					2.49^{b}	1.22
					3.32^{c}	10.84^{d}
	25	-	-	-	-	1.32
						1.83
						1.57
						6.64^{d}
	30	-	-	-	-	-

a, b, c & d represent significance at 5, 2, 1 & 0.1 percent respectively.

Shelford (1915) commented on the influence of abiotic factors on the larval stages. Among the different abiotic factors that influence the larvae, salinity is the master factor in tropical waters especially in the estuarine environments playing a key role in the development of larvae. Among brachyurans, blue crab *Callinectes sapidus* is the best documented example (Sandoz and Rogers, 1944; Costlow and Bookhout, 1959; Costlow, 1967). The adults of this crab have the ability to live in fresh to oceanic waters, but the females have to return to water with a salinity of more than 15‰ to hatch off their eggs. The complete development of the larvae was possible only at 20‰ and above. Costlow and Bookhout (1962) studied the influence of salinity on larval development of *Hapatus epheliticus*

Table III – t values for the differences in the mean intermoult duration of different juvenile stages of *Heteropanope indica* in different salinities

Juvenile stages	Salinity (‰)						
	Salinity	5	10	15	20	25	30
Juvenile I	5	-	1.58	-	1.37	2.13[a]	3.09[c]
Juvenile II			0.48	-	1.59	0.20	3.31[c]
Juvenile III			2.78[c]	0.91	1.69	0.29	2.59[b]
	10	-	-	3.67[c]	0.09	0.76	1.83
				0.69	2.58[b]	1.04	4.64[d]
				2.64[b]	0.20	1.89	1.09
	15	-	-	-	2.05[a]	3.09[c]	4.14[d]
					2.05[a]	0.28	4.22[d]
					2.80[c]	0.65	3.83[c]
	20	-	-	-	-	0.94	2.03[a]
						2.51[b]	2.03[d]
						2.08[a]	0.88
	25	-	-	-	-	-	1.13
							4.21[d]
							2.04[c]
	30	-	-	-	-	-	-

a, b, c & d represent, significance at 5, 2, 1 & 0.1 percent respectively.

and stated that the development took place over a narrow range of 30-35‰. Costlow, Bookhout and Monroe (1966) also reported that larval development of *Rhithropanopeus harrisii* was completed between 15 and 30‰. In the case of the terrestrial brachyuran crab *Cardisoma guanhumi*, complete larval development was observed between a range of 15-45‰ (Costlow and Bookhout, 1968). The osmoregulatory mechanism is not well developed in the larvae and they are not able to withstand low salinities. Therefore, complete larval development takes place in 15‰ and above. Thus the larvae of different species of crabs, terrestrial, estuarine or marine require a specified salinity range for the completion of larval development within this range, the survival rate and rate of development are maximum at an optimum salinity. Above and below this salinity, survival rate decreased and the overall time required for the completion of larval development increased (opp. cited), while the adults of estuarine crab species *H. indica* has the ability to withstand salinity variations from fresh to seawater, the larvae require a specified salinity range of 10-30‰. The results of the present study are interesting in that in the whole salinity range the survival rate was 100%. The optimum salinity for rapid development also varied between larval and juvenile instars. While 25‰ was found to be optimum for the zoeal stages (Short development period and 100% survival rate), 15‰ was found to be optimum for megalopa and first three juvenile instars.

ACKNOWLEDGEMENTS

The authors are thankful to Prof. V.K. Venugopalan, Director, C.A.S. in Marine Biology, Parangipettai; DST, New Delhi and the authorities of Annamalai University for the support and facilities.

REFERENCES

Costlow, J.D., C.G. Bookhout, 1959. The larval development of *Callinectes sapidus* Rathbun reared in the laboratory. *Biological Bulletin*, **116:** 373-396.

Costlow, J.D., C.G. Bookhout, 1962. The larval development of *Hepatus epheliticus* (L.) under laboratory conditions. *Journal of the Elisha Mitchell Scientific Society*, **78:** 113.

Costlow, J.D., C.G. Bookhout and R. Monroe, 1966. Studies on the larval development of the crab *Rhithropanopeus harrisii* (Gould) 1. The effect of salinity and temperature on larval development. *Physiological Zoology*, **35:** 79-93.

Costlow, J.D., 1967. The effect of salinity and temperature on survival and metamorphosis of megalops of the blue crab *Callinectes sapidus* Rathbun. *Helgolander Wiss Meeresunters*, **15:** 84-97.

Costlow, J.D., 1968. The effect of environmental factors on the development of the land crab, *Cardisoma guanhumi* Laterille. *American Zoology*, **8:**397-410.

Sandoz, M. and R. Rogers, 1944. The effect of environmental factors on hatching, moulting and survival of the zoea larvae of the blue crab *Callinectes sapidus* Rathbun. *Ecology*, **25:** 216-228.

Shelford, V.E., 1915. Principles and problems of ecology as illustrated by animals. *Journal of Ecology*, **3:** 1-23.