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Note

Effect of salinity on the growth and survival of spat of *Marcia opima* (Gmelin)

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Abstract

The objective of the study was to find out the optimum salinity for the spat of the clam *Marcia opima* (Gmelin) to attain maximum growth with 100% survival. Among the salinities tested (10-40 ‰), 100% survival of spats and the maximum growth rate of 0.13mm/day were observed at 25‰ salinity. By comparing the growth rate and survival percentage, it was concluded that 25 ‰ is the best salinity condition for the spat of this species.

Salinity is one of the factors that affect the distribution of a species in marine and brackishwater ecosystems. Knowledge of salinity tolerance of commercially important bivalves is of prime importance for taking up culture on a large scale. With the development of hatchery technology for the production of the clam seed, nursery management assumes importance. Salinity plays a prominent role affecting growth and survival in the sea ranching of the post-set clams to stocking size. For the nursery management of any species, practical knowledge on the optimum salinity requirements is very much significant.

Turner and George (1955) observed changes in the early larvae of *Venus mercenaria* when introduced to diminishing salinities. Davis (1958) studied the survival and growth of clam *V. mercenaria* and oyster *Crassostrea virginica* larvae at different salinities. The response and survival of blood cockle *Anadara granosa* at different salinities were studied by Davenport and Wong (1986). Namaguchi and Tanaka (1987) studied the effect of temperature and salinity on the growth of early young clams of *Meretrix lusoria*.

Although the information on molluscan resources along the Indian coast is available (Abraham, 1953; Ranade and Kulkarni, 1972; Rao, 1951 a), investigations on salinity tolerance are very few. Salinity tolerance of the venerid clam *Paphia malabarica* was studied by Ram Mohan and Velayudhan (1998). Sundaram and Shafee (1994) investigated the salinity tolerance of the clam *Meretrix meretrix*, the green mussel *Perna viridis* and the oyster *C. madrasensis* of Ennore Estuary. Muthiah *et al.* ((*pers. comm.*) studied the effect of salinity on growth and survival of hatchery produced juvenile clams of *M. meretrix* and *A. granosa.* The clam *Marcia opima* was successfully bred in captivity by Muthiah *et al.*(2002). The present investigation was taken up to determine optimum salinity requirements for the spat of *M. opima.*

Materials and methods

The clam, *Marcia opima*, (length: 30.7 - 50.8 mm) were collected from Ashtamudi Lake in Kerala, India. An estuarine condition prevails in the sampling site throughout the year. The salinity of the collection site, on the sampling date was 27 ‰ and the temperature 27°C. The clams were brought to the shellfish hatchery at Tuticorin Research Centre of Central Marine Fisheries Research Institute, Tuticorin, Tamilnadu. They were induced to spawn in the hatchery and larval rearing was done. The larvae settled on 11[th] day. Thirty-four day old, spat from the same brood (mean length: 2.09 mm) were divided into six groups of 20 each and were exposed to salinity ranging from 10 to 40 ‰. Each of the six groups was duplicated, thus exposing a total of 240 spat in the experiment. The salinity of each treatment was checked by using an Atago salinity refractometer, which was reconfirmed by titration using silver nitrate titration method (Strickland and Parsons, 1972).

The lower salinities (10 to 25 ‰) were obtained by addition of sufficient quantity of freshwater to seawater of known salinity and the higher salinity of 40 ‰ was made up by addition of required quantity of common salt to seawater. The salinity treatments selected for the study were 10, 15, 20, 25, 36 ± 1 (normal seawater) and 40 ‰. The spat were transferred directly to 20 l plastic containers and to the respective salinity. Water exchange was done daily and the dead spat, if any, were removed. The phytoplankton *Isochrysis galbana* was given at the rate of 500 ml per day. Gentle aeration was provided in each container. The duration of the experiment was 30 days.

On 15th and 30th day, the seed clams from each basin were counted for survival and measured for their length, nearest to 0.01 mm with ocular micrometer. The mean length was used for statistical analysis.

Statistical analysis of the Arc sine transformed percentage survival data of *M. opima* spat at different salinities was done through one-way Analysis of Variance (ANOVA). Two - way ANOVA was done to analyse the actual growth rate of spat in different salinity treatments. In all the cases, when the F-value of the treatments was significantly different, the best treatment was found out through pair-wise comparison (Students t-test at P < 0.05) of treatment means.

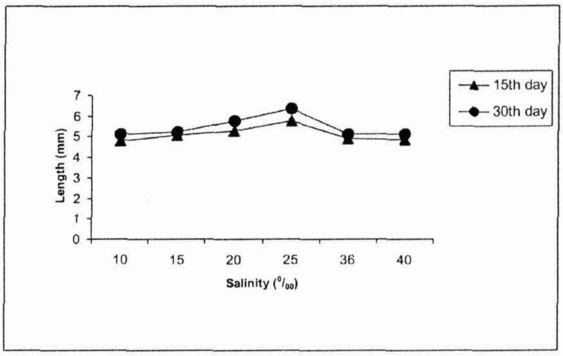

Fig. 1. Effect of salinity on the growth of *M. opima* spat

Results

The initial average length of seed clams used for experimental trials was 2.09 mm. The spats attained highest growth rate at 25 ‰, followed by 20 ‰ (Fig.1). On 15th day, the seed clams had a maximum size of 6.36 mm and a minimum size of 5.06 mm with an average size of 5.80 mm in 25 ‰. On 30th day the spat attained a maximum size of 7.00 mm and a minimum of 5.27 mm with an average of 6.08 mm. At 20 ‰ salinity, the spats attained a mean size of 5.58 mm within thirty days. The slowest growth rate was recorded at 10 ‰ and 40 ‰, where the average size was 4.97 mm after thirty days. At 15 ‰ and in normal seawater salinity (36 ± 1 ‰) the growth rate was moderate, where the juvenile clams attained an average growth of 5.21 mm within thirty days.

On 15th day the survival rate was 100% at 10,15,20,25 and 40 ‰ salinities. But it was 95% at normal seawater salinity (36 ± 1 ‰). The observation on 30th day showed that, at 20 ‰ salinity the survival rate was 95%. In the other treatments survival rate remained at 100% (Table 1).

Single factor Analysis of Variance on the effect of salinity on the survival of *M. opima* spat revealed no significance between the treatments (Table 2). Whereas significant difference between the treatments was observed on the effect of salinity on the growth rate of spat (Table 3). When pair comparison of growth rate means were done by way of Students t-test, significant difference was noticed between the salinity treatments 10 and 20 ‰, 10 and 25 ‰, 20 and 25 ‰, 20 and 40 ‰, 25 and 36 ‰, and 25 and 40 ‰ at the end of the study period. The best treatment selected was 25 ‰ with a growth rate of 0.13 mm / day.

Discussion

In the present study, it is observed that the spat of clam *M. opima*, achieved highest growth at 25 ‰. Namaguchi and Tanaka (1987) observed that for juvenile growth, a salinity range of 19.3 - 32.2 ‰ is favourable for *Meretrix lusoria*. Muthiah *et al.* (*pers. comm.*) noted that the optimum salinity for growth of juvenile *M. meretrix* is 21 ‰ and this species prefers a slightly lower salinity than its congener. Davis (1958) reported that the optimum salinity for the development of straight - hinge larvae from eggs of *V. mercenaria* from Long Island Sound is about 27.5 ‰. Turner and George (1955) observed that the larvae of *V. mercenaria* suffered high

Table 1. *Percentage survival of* M. opima *spat at different salinity treatments*

	Salinity (‰)					
Day	10	15	20	25	36±1	40
15	100	100	100	100	95	100
30	100	100	95	100	95	100

Table 2. *Single factor ANOVA on the effect of salinity on the survival of* M. opima *spat*

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	326.67	5.00	65.33	0.02	1.00	4.39
Within Groups	16828	6	2804.67			

Table 3. *Two-way ANOVA on the effect of different salinity treatments on growth of* M. opima *spat*

Source of Variation	SS	df	MS	P-value	F
Between days	0.05	1.00	0.05	0.00 *	304.62
Between salinity	0.01	5.00	0.00	0.00 *	8.79
Interaction	0.00	5.00	0.00	0.62	0.73
Within	0.00	12.00	0.00		

* Significant at $P < 0.05$

mortality either prior to setting stage (15 ‰) or during metamorphosis (17.5 ‰).

In the present study, 100% survival rate was observed at 10, 15, 25 and 40 ‰. Survival rate was 95% at 20 ‰ and normal seawater salinity. This shows that *M. opima* is a euryhaline species, which can tolerate a wide range of salinity. Davenport and Wong (1986) observed total mortality within 7 days for *Anadara granosa* at 9.6 ‰ and there was no mortality at 22.4 ‰ and above. Muthiah *et al.* (*pers. comm.*) observed high mortality of *A. granosa* at about 6.5 ‰. Ranade and Kulkarni (1972) found that *A. granosa* survived in salinity as low as 10.5 ‰. Maximum survival rates for large size groups of *P. malabarica* was recorded between salinities 17 ‰ and 34 ‰, while for the small size groups maximum survival rates were recorded between 20 ‰ and 30 ‰ (Ram Mohan and Velayudhan, 1993). Since the experimental juvenile clams were produced from the brood stock of Ashtamudi Lake, where salinity fluctuates widely due to the freshwater influx during monsoons, it is evident that they are always affected by wide range of salinity fluctuations and is tolerant to such changes. The results on optimal growth and survival rates brought out by this study could be helpful in developing nursery systems for commercial rearing of the seed of *M. opima*.

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