

Salinity and Survival of *Martesia striata* (Linn) in Cochin Harbour

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The effects of salinity variations on the survival of *Martesia striata* from Cochin Harbour are presented. It is observed that at least a few of the animals survive the low saline conditions during monsoon. Laboratory experiments showed the lethal salinity as 6‰ when animals acclimatised in 34‰ were subjected to abrupt changes in salinity. But acclimatisation to 17‰ salinity showed a downward shift in the lethal salinity to 4‰. The present observations indicate that *M. striata* is euryhaline and the extent of tolerance to lower salinities depends on the degree of acclimatisation.

Martesia striata (Linn) is one of the most common molluscan wood-borers of the Cochin Harbour which cause serious damage to underwater timber structures. Some aspects of the biology and ecology of this bivalve from the Cochin Harbour have been studied by Erlanson (1936), Balasubramanyan and Menon (1963), Cheriyan (1964), Balasubramanyan (1965, 1967), Nair (1965, 1966), Cheriyan & Cherian (1971, 1974). Nagabhushanam (1955) have studied the salinity tolerance of *M. striata* from the Waltair coast by conducting laboratory experiments on animals acclimatised to normal sea water. The effects of acclimatisation to different salinities are not covered in his studies. The present paper reports the effects of salinity on the survival of *M. striata* from the Cochin Harbour, acclimated to different salinities. Laboratory experiments were supplemented by field observations, as evaluation of the tolerance limits to salinity variations requires both information obtained in the field and under controlled conditions in the laboratory as pointed out by Kinne (1971).

Materials and Methods

Field observations were carried out in Cochin Harbour using short term and long term test panels of mango wood (*Mangifera indica*) as described by Cheriyan

and Cherian (1971). Per cent mortality in the field during different periods was calculated after removing live and dead animals from the test panels. The specimens required for laboratory experiments were collected from the test panels as well as from other underwater timber structures during the post-monsoon period when the salinity was about 17‰ and during the pre-monsoon period when the salinity was about 34‰. The specimens collected during post-monsoon were acclimated in the laboratory in 17‰ salinity and those collected during the pre-monsoon in 34‰ salinity, for 10 days along with the timber in laboratory aquaria. The water in the aquaria was rich in phyto and zooplanktons and continuously filtered and aerated for one to two hours twice a day as described by Cheriyan (1967a). Two series of salinity tolerance experiments on the lines described by Nagabhushanam (1955) were carried out with animals acclimated at 17‰ and 34‰ salinities. Various dilutions of sea water for tests were prepared by adding adequate quantities of re-aerated distilled water. The animals were carefully removed from the timber and healthy ones of 10-25 mm length were selected. They were thoroughly washed with water of the same salinity to which they were later to be transferred. In the first series, the animals acclimated in 34‰ salinity were subjected to 12 lower salinities ranging from distilled water to 34‰ (control). In the second series animals acclimated in 17‰ salinity were tested in 9 lower salinities including distilled water

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and 17‰ (control). For each test 200 ml of filtered sea water was taken in 500 ml beakers and 3-5 animals were transferred. 40-50 animals were tested in each salinity, the water changed and aerated every day. The animals were checked at short intervals during the experimental period of 14 days and no food was provided during this period. The animals survived in the laboratory without food for 5 weeks. The temperature was maintained at $28.5 \pm 1^\circ\text{C}$. The animal was considered to be dead when the tip of the siphon no longer responded to mechanical stimulation. This was further checked by transferring it to the acclimatised salinity. Salinities where 50% mortality observed was considered as lethal.

Results and Discussion

Table 1 shows that during 1974 and 1975 about 30 and 21% of the animals, respectively, survived the very low salinity period of June-September (monsoon). During this period the surface water became almost fresh and at least 25% of the animals survived.

Animals acclimated in 17‰ salinity were directly placed in salinities 0, 1, 2, 4, 5, 6, 8, 10 and 17‰ (control). The results are presented in Table 2. When the animals were transferred to different test media,

they closed their shell valves tightly. But gradually they opened the shell valves and extended the siphons. The time taken for the protrusion of the siphons in the different media varied from 5 to 30 min. the minimum in 17‰. 100% survival was noticed in 6-17‰ salinities. No survival noticed in 0‰ and 1‰ salinities at the end of the experiment. The lethal salinity noticed was 4‰.

M. striata acclimated in 34‰ were directly placed in salinities 0, 1, 2, 4, 5, 6, 8, 10, 15, 20, 30 and 34‰ (control). The results are presented in Table 3. As in first series, the tightly closed shell valves opened gradually within about 30 min. The animals took minimum time to protrude the siphons in 34‰ and the maximum in 1‰. Survival was 100% in 20-34‰ and no survival in 0.5‰ at the end of the experiment. The lethal salinity was 6‰.

The hydrographical conditions in Cochin Harbour region are largely influenced by the monsoon and fresh water influx from a number of rivers. Studies in and around Cochin have shown that the temperature varies between $24-32^\circ\text{C}$ while the salinity from fresh water condition to 34‰ (Cherian 1967b; Sankaranarayanan & Qasim, 1969; Cherian, 1978). Based on the salinity variations in the Cochin Harbour, three

Table 1. Survival of *M. striata* on test panels immersed in Cochin Harbour during low salinity period (June to September)

	Period	Average salinity ‰	Total Martesia	Number of live Martesia	Percentage of live Martesia
1974	June	25.5	13	8	61.5
	July	1.9			
	August	0.9			
1974	June	25.5	20	2	10.0
	July	1.9			
	August	0.9			
	September	13.9			
1975	May	30.2	24	5	20.8
	June	20.7			
	July	0.3			
1975	June	20.7	10	2	20.0
	July	0.3			
	August	2.6			
	September	5.0			

Table 2. *Per cent survival of of M. striata transferred to various salinities after acclimation in 17‰.*

Days	Salinity ‰					
	17-6	5	4	2	1	0
1	100	100	100	100	35	25
2	100	100	90	50	10	5
3	100	90	90	20	5	0
4	100	90	50	10	0	0
5	100	90	50	10	0	0
6	100	90	50	10	0	0
7	100	90	50	10	0	0
8	100	90	50	10	0	0
9	100	90	50	10	0	0
10	100	90	40	10	0	0
11	100	90	40	10	0	0
12	100	90	40	10	0	0
13	100	90	40	10	0	0
14	100	90	40	10	0	0

periods can be distinguished namely, the monsoon (June–August), the post-monsoon (September–December) and summer (January–May). Owing to freshwater influx the monsoon is characterised by salinity often below 1‰. During the post-monsoon the salinity gradually rises and the area attains typical marine conditions in summer.

Cheriyān (1964) and Nair (1965) have observed that in Cochin Harbour the settlement of *M. striata* is seasonal, restricted to the summer months January–May. Cheriyān & Cherian (1971) reported that the attack of *M. striata* begins as early as December and continues till May with maximum intensity in March–April, when salinity is maximum. Since the temperature variations of this region are not much, it is presumed that the settlement of *M. striata* is largely dependent on salinity. *Martesia* being marine, may not breed in the low saline period of June–November. Moreover in these conditions even if some larvae from the adjoining sea enter the harbour, they may not survive. The salinity is usually above 20‰ from December onwards and this period is tolerable to the young ones.

Field observations have revealed that most of the stenohaline sedentary organisms that settle during the high saline period perish during monsoon. But an average of 25% of the population survive the low saline period of June–September (Table 1) and propagate when the salinity becomes favourable. The fresh settlement of *M. striata* in the harbour region from December onwards may not be entirely by larvae entering the estuary from the adjoining sea.

Table 3. *Per cent survival of M. striata transferred to various salinities after acclimation in 34‰.*

Days	Salinity ‰									
	34-20	15	10	8	6	5	4	2	1	0
1	100	100	100	100	100	100	80	80	30	20
2	100	100	100	100	100	80	80	0	0	0
3	100	100	100	90	80	50	0	0	0	0
4	100	100	100	90	80	50	0	0	0	0
5	100	100	100	80	70	50	0	0	0	0
6	100	100	100	80	70	30	0	0	0	0
7	100	100	90	80	70	30	0	0	0	0
8	100	90	90	80	60	20	0	0	0	0
9	100	90	90	80	60	10	0	0	0	0
10	100	80	70	70	60	0	0	0	0	0
11	100	80	70	70	60	0	0	0	0	0
12	100	80	70	70	40	0	0	0	0	0
13	100	80	70	60	40	0	0	0	0	0
14	100	80	70	60	30	0	0	0	0	0

Kinne (1971) observed that acclimation to low salinities tends to shift the lower lethal limit further downward. Laboratory experiments on *M. striata* acclimated in 34‰ showed the lethal salinity to be 6‰, when subjected to abrupt changes in salinity (Table 3). Nagabhushanam (1955) has also reported 6‰ as the lethal salinity. Field observations showed that at least a few withstand even near freshwater conditions (Table 1). This may be due to the fact that the area attains fresh water conditions only within the course of a few days of heavy rains which may be sufficient for the animals to slowly acclimatise. The present observations indicate that *M. striata* can tolerate low salinities depending on the degree of acclimation and since Remane (1958) has included those animals which tolerate salinities below 15‰ in the euryhaline group, this species can be also called euryhaline, if not truly estuarine.

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