

Laboratory Maturation and Spawning of the Penaeid Prawn *Metapenaeus dobsoni* in Brackishwater Salinities

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Abstract

Experiments on maturation and spawning of the penaeid prawn *M. dobsoni* in different brackishwater salinities ranging from 15 to 30 ppt were carried out in the laboratory. The results indicated that immature impregnated females collected from perennial brackishwater prawn culture fields readily matured in salinities above 26 ppt. Prawns were maturation process had initiated, when further maintained in 20, 22 and 26 ppt salinities, indicating possibility of breeding this prawn in salinities as low as 22 ppt. Prawn maturation and spawning was observed to be size and salinity dependent. The details regarding initiation of maturation, time taken to attain different maturity stages, time of spawning and fecundity are also described.

Introduction

In India, using mature specimens collected from sea, penaeid prawn species such as *M. monoceros*, *M. affinis*, *P. merguensis* have been successfully bred and their larval stages studied in the laboratory (Raje and Ranade, 1972; Thomas *et al.*, 1974 a,b; Muthu *et al.*, 1974 and 1978; Silas *et al.*, 1978). Through the natural breeding ground of *M. dobsoni* is considered to be the inshore sea (Menon, 1952), instances of occurrence of mature females in brackishwater systems during high salinity period have been reported by few workers (George, 1974; Rao and Kathirvel, 1973; Silas *et al.*, 1982). Stray instances of occurrence of mature females in estuarine environment have also been reported for *M. burkenroadi*, *P. indicus* and *P. japonicus* (Muthu and Manickam, 1973; Krishna murthy and Ganapathi, 1985; Kathrivel and Selvaraj 1989).

Though penaeid prawn *M. dobsoni* is reported to attain maturation and spawn in brackishwater culture systems during summer months when the salinity is high (George 1974; Vasudevappa and Suseelan 1994), the details regarding precise salinity requirements for maturation and spawning are still not known. The present communication deals with influence of salinity on maturation and spawning of *M. dobsoni* in captivity.

Materials and Methods

The experiments on prawn maturation in the laboratory were conducted during the period July and August 1990 and April to August 1991 as impregnated females were available in considerable numbers during this period in brackishwater prawn culture systems (salinity 2.65 - 18.20 ppt). The prawns were collected during night and transported to the laboratory in wide mouthed plastic seed transportation bins and gradually acclimated over 24 hours to the experimental salinities. The experiments were carried out in 15, 20, 22, 24, 26, 28 and 30 ppt salinities on different occasions. Immature impregnated female prawns larger than 70 mm were generally used for the

experiment. In some instances early maturing prawns (stage II) were also tried for further maturation and spawning. The prawns were fed *ad libitum* with frozen clam meat in two rations, one in the morning and the other in the evening. After siphoning out the faecal matter and the left over food every morning, one-third of the water was replenished with freshly prepared experimental media. The maturation experiments were always carried out in duplicate and some times greater number of replicates were also maintained. The tubs used were covered with corrugated paper sheets to reduce the light intensity and continuous round the clock aeration was provided. The pH of the experimental media was maintained above 8.0 using sodium carbonate.

Any prawn showing sign of maturation was left alone and undisturbed. The process of maturation was observed under diffused light using torch. Once the prawn attained late-maturing stage (stage III), 0.1 g of EDTA per 100 litres of water was added. The time taken for initiation of maturation, attainment of successive stages of maturation and spawning were noted. The total number of eggs released by the prawn was estimated based on average number of eggs in three 100 ml samples.

Prawns which failed to mature were reared until they moulted and subsequently discontinued. The water quality parameters, such as temperature, pH, oxygen, ammonia and nitrite were monitored.

Results and Discussion

The results are presented in Table 1 and 2. In all, 18 immature impregnated females and three early maturing prawns showed initiation and progression of maturation which finally spawned and in few instances the ovaries reabsorbed. Out of 15 experiments tried in 26 ppt salinity only four showed initiation of maturation and of which only two spawned and the remaining reabsorbed the gonads after attaining III stage (late maturing). The time taken for initiation of maturation varied

from 3 to 5 days, less than a day to reach III stage and about 10-12 hours, to reach ripe stage. The number of eggs spawned varied from 26450-28500.

In 28 ppt, out of 15 experiments tried, 9 prawns attained maturation and all spawned successfully excepting one which reabsorbed after reaching stage III, indicating a high proportion of spawning (87.5%) in the salinity as compared to 26 ppt salinity. The time required for initiation of maturation varied from 3-8 days. The gonad took about less than a day to 3 days time to attain stage III (late maturing stage) which finally reached mature stage (IV) in about 10-18 hours of time. The prawn of size 71 mm though responded positively, the fecundity was only 3850, reflecting the effect of size on fecundity.

In 30 ppt salinity 5 prawns (84-88mm) responded positively, maturing and spawning successfully with 100% spawning success. It took 2-8 days for the prawn to show initiation of maturation, 1-3 days to attain stage III which finally spawned in about 9-22 hours with a fecundity of 19,850 - 30,600 eggs.

Three prawns where advancement of maturation had already set in (stage II) while collecting the prawns, were acclimated to 20,22 and 26 ppt salinities to study the maturation and spawning. The prawns maintained in 20 ppt reabsorbed the gonad while in 22 and 26 ppt salinity both the prawns reached fully mature stage in about 8 hours and spawned successfully. The fecundity varied between 17,200 and 18,460 eggs.

The maturation and spawning experiments were conducted in higher salinities (15-30 ppt) as compared to that existed in the prawn culture fields and coconut grove canal

system (2.65 - 18.20 ppt). The fact that even prawn collected from very low salinity conditions that prevailed during monsoon months (June - September), matured and spawned successfully in the laboratory at higher salinity levels, indicating the salinity of environment from which the animals were drawn does not have any significance on maturation. Water quality parameters such as temperature, oxygen nitrite and ammonia fluctuated within the normal range in all the experiments (Chen *et al.*, 1986). The pH of the maturation media was maintained above 8.0 using sodium carbonate, as pH below 8.0 is reported to have adverse effect on prawn maturation (Muthu and Laxminarayana 1977).

Contrary to published information (Rao and Kathrivel, 1973; Silas *et al.*, 1982) the present investigation reveals that the species has potentiality to mature in considerably low saline conditions (22-30 ppt). When early maturing prawns were gradually acclimated to 20, 22 and 26 ppt, prawn in 22 and 26 ppt spawned successfully while that in 20 ppt reabsorbed the gonad. Immature prawns when tried in 26 ppt salinity, a spawning success of 50% was recorded among the prawns where maturation was initiated. In 28 ppt where induction of maturation was noticed in 9 prawns, 8 prawns spawned successfully indicating 89 percent spawning success. In 30 ppt, 5 prawns matured and spawned successfully indicating 100% spawning success. These results clearly indicate that *M. dobsoni* matures and spawns successfully in salinities as low as 22 ppt. Silas *et al.*, (1987) encountered fully mature females of *M. dobsoni* in 28 ppt and got it successfully spawned in the laboratory at 28.72 ppt. From the above, it is clear that 22 ppt salinity is the minimum salinity required for spawning this prawn in captivity.

Table 1. Results of successful maturation and spawning of *M.dobsoni* in brackishwater salinity conditions in the laboratory

Sl. No.	Particulars	26±0.30	Salinity % 28±0.38	30±0.41
1)	No. of experiments conducted	15	15	10
2)	No. of prawns used	30	30	20
3)	No. of prawns which showed sign of maturation	4	9*	5
4)	Total length (range) in mm	74-90	71-94	84-88
5)	Stage of maturity	1	1	1
6)	Time taken for initiation of maturation (in days)	3 - 5	3 - 8	2 - 8
7)	Progress of maturation; Time taken to reach the successive stage (in hrs):		12-72	
	i) II to III Stage	14 - 24	12-72	24-72
	ii) III to IV Stage	10 - 12	10 - 18	9 - 22
8)	End result	2 spawned 2 reabsorbed	8 spawned 1 reabsorbed	5 spawned -
9)	No. of eggs spawned	26,450-28,500	21,650-35,700	19,850-30,600
10)	Physico-chemical conditions			
	i) Temperature (Oc)	26.10-29.10	25.4-29.20	25.30-29.2
	ii) pH	8.02-8.31	7.95-9.22	8.01-8.28
	iii) Oxygen (mg/l)	4.30-6.40	4.86-6.30	4.68-6.50
	iv) Nitrite (µg at/l)	2 - 40	2 - 44	2 - 18
	v) Ammonia (µg at/l)	4 - 80	4 - 58	4 - 42

* Only one prawn of size 71 mm spawned with a fecundity of 3850 eggs.

Table 2: Advancement in maturation and spawning of early maturing *M.dobsoni* in brackishwater salinity conditions in the laboratory

Sl. No.	Particulars	20±0.10	Salinity % 22±0.15	26±0.2
1)	No. of prawns which showed sign of maturation	1	1	1
2)	Total length in mm	83	78	76
3)	Stage of maturity	II	II	II
4)	Time taken for initiation of maturation (in days)	Continued	Continued	Continued
5)	Progress of maturation-Time taken to reach the successive stage (in hrs.):			
	i) II to III Stage	24	24	24
	ii) III to IV Stage	-	8	8
6)	End Result	reabsorbed	spawned	spawned
7)	No. of eggs spawned	-	18,460	17,200
8)	Physico-chemical condition			
	i) Temperature (Oc)	27.0-27.3	27.0-27.3	25.1-26.7
	ii) pH	8.122-8.16	8.12-8.15	8.04-8.17
	iii) Oxygen (mg/l)	5.68-5.90	5.68-5.90	5.64-6.12
	iv) Nitrite (µgat/l)	8-16	2-14	4-16
	v) Ammonia (µg at/l)	4-68	4-80	4-44

Only prawns above 71 mm could attain maturation. When tried with still smaller sizes, on many occasions the prawns did not show any sign of gonadal change, indicating that 71 mm could be the lower limit of size for maturation.

The present studies have also revealed that considerable variations exist for the time taken to complete the maturation process, spawning time and number of eggs produced during each spawning in the laboratory. Once the maturation is initiated (Stage II), the time taken for attainment of full maturation (Stage IV) varied from one to four days (22-94 hrs). In 10 out of 17 prawns spawned, the time required for full maturation ranged from 32-36 hours, indicating that the maturation process is very fast in this species.

In all the 17 cases, the spawning took place only at night and majority of the spawnings took place between 2330 and 0130 hours in the midnight, similar to the observations of Silas *et al.*, (1972) and Muthu and Laxminarayana (1977).

The number of eggs released by prawns matured in the laboratory also showed considerable variation (3850-35700). In most cases (13), the total number of eggs varied between 18,000 and 30,000 for sizes ranging from 76-90 mm. The fecundity of prawns matured in perennial prawn culture systems varied between 38,400 to 80,600 for size ranging from 80-95 mm respectively. This shows that the fecundity is comparatively higher for prawns matured in the field than those induced to mature in the laboratory. Rao (1968) observed a fecundity ranging from 34,500 at 70 mm size to 1,60,000 at 120 mm size for the species in the sea and according to him the fecundity of *M. dobsoni* increases approximately as the cube of the total length, while Rao (1968) reports that the fecundity in the related species *M. monoceros* increases in direct proportion to total length.

It is also interesting to note that there was absolutely no gonadal change in prawns less than 71 mm size even when

they were experimented in higher salinities ranging from 22-32 ppt. These observations clearly show that the maturation of *M. dobsoni* in less saline water is size dependent. Out of 22 prawns that matured during the experimentation, 10 were in the size group 86-90 mm, 5 in 81-85 mm, 4 in 76-80 mm and one each in 71-75 mm, and 91-95 respectively. Thus it is clear that prawns in the size range 86-90 mm, mature readily in the brackishwater salinities. The results further indicate that prawns above 76 mm can be induced to mature and spawn in the laboratory by providing higher salinities preferably above 26 ppt. The size of the prawn observed in maturing or mature stage in the prawn culture systems was always above 71 mm (Vasudevappa and Suseelan, 1994), which corroborates with the findings from the laboratory experiments. Rao and Kathirvel (1973) collected mature specimens of size 69 mm and above from the brackishwater environment (estuarine mouth) where the salinity was relatively high (30.2 ppt) and marine conditions prevailed during summer months. Silas, *et al.*, (1982) observed maturation of *M. dobsoni* taking place in the size range 74 to 104 mm in the brackishwater ponds at a minimum salinity of 28 ppt.

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