CULTURE STUDIES WITH MALAYSIAN PRAWN IN UNFED BRACKISH WATER PONDS

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Abstract: This study describes culture of Malaysian prawn *(Macrobrachium rosenbergii)* without feeding in brackish water ponds in Louisiana. Survival and average size increased with decreasing stocking densities. After 163 days, average production in kg/ha for stocking rates of $1.25/m^2$, $2.5/m^2$ and $3.75/m^2$ was 159, 191 and 218, respectively. Orbit length-total length relationships were determined to be expressed by the linear equation: Orbit length = 1.498 + 0.736 (total length) with both sexes combined. Total length-weight measurements at harvest of both sexes resulted in the curvalinear equation Log Weight = -5.867 + 3.410(Log Length). Measurements were in millimeters and grams.

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Over a hundred species of *Macrobrachium* prawns occur in the world. Aquaculture of prawns has been practiced, at least in some primitive form, for hundreds of years. In some tropical countries, juvenile prawns are captured and raised in ponds at varying levels of intensity using such nutrient materials as manure, table scraps and poultry feed.

Researchers have investigated the culture of prawns indigenous to the United States (Dugan and Frakes 1972, Dobkin et al. 1977); however, *M. rosenbergii,* a species not native to the United States, appears to have the best culture potential (Aquaculture Planning Program 1978). For years this species has been highly esteemed as food by people of the tropical countries of Asia and the Far East (Ling 1969). It is a large prawn, attaining a body length of 30 cm (Dobkin et al. 1974).

Research of controlled reproduction of the prawn began in 1959 in Penang, Malaysia by Dr. Shao-wen Ling (Ling 1977). News of his success in controlling the life cycle of the prawn and raising prawns in ponds and irrigated paddy fields spread around the world. In the United States, development of prawn culture began in 1965. Dr. Takuji Fujimura, Chief Biologist of the Anuenue Fisheries Research Center, Hawaii, imported prawns from Dr. Ling and was instrumental in developing practical mass larval-rearing techniques.

Presently, continuous prawn production systems in Hawaii are producing up to 3,115 kg of market-sized prawns per ha per year (Aquaculture Planning Program 1978). The prawn is being reared in several tropical and semi-tropical countries throughout the world. Some of these include Panama, Honduras, Puerto Rico, and Costa Rica. Here in the United States, most of the research is being conducted in Hawaii, followed by South Carolina, Florida, Texas, Arkansas, and Louisiana.

In contrast to tropical countries, prawn culture in the temperate regions of the United States is restricted since winter water temperatures are usually lethal. The growing period ranges from 5 to 6 mo in South Carolina (Smith et al. 1978) to 9 to 10 mo. in central Florida (Willis and Berrigan 1977). In the continental United States, prawns must be harvested after a relatively short growing season and total production in fed ponds has ranged up to 1,300 kg/ha (Sandifer and Smith 1976, Smith et al. 1978, Willis and Berrigan 1977). Another problem has been the bull-runt phenomenom as described by Smith et al. (1978). A few males become quite large while others remain small and less valuable.

Prawn culture has been attempted by private citizens in Louisiana (Martin, personal communication 1979) and Arkansas (Finch, personal communication 1979). These were not closely monitored. However, they did demonstrate a definite need for research for practicality of *Macrobrachium* sp. culture in Louisiana.

In 1979, experiments on the pond culture of prawn were initiated in Louisiana. The objectives were: (1) to obtain basic production data at various stocking densities without feeding, to develop a data base for future studies, and (2) to calculate total length-orbit length and length-weight relationships for prawns grown in these studies for future comparisons.

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METHODS

April 25, 1979, *M. rosenbergii* post-larvae were transported from the Weyerhaeuser Prawn Hatchery in Homestead, Florida to the Rockefeller Wildlife Refuge in Grand Chenier, Louisiana. The post-larvae were approximately 50 days old and averaged 0.02 g. Upon arrival the prawns were stocked into nine 0.04 ha earthen ponds at rates of $1.25/m^2$, $2.5/m^2$ and $3.75/m^2$ (12,350/ha, 24,690/ha and 37,040/ha). There were 3 replications (ponds) per treatment. The ponds were not fed. Water temperature in the shipping boxes was 27.2°C and 27.5°C in ponds at stocking.

Research ponds at Rockefeller are rectangular and arranged in rows of 10. The first 2 rows on the east side of the complex contain ponds which are slightly deeper and have basins inside them. The other ponds do not contain basins as such. In order to lessen effects of pond depth and design only 1 replication of each stocking density was randomly assigned to a particular row. Growth was monitored monthly beginning in June by seining. Prawns were measured from tip of the rostrum to the tip of the telson.

The ponds were harvested on October 4 and 5, 1979. A random sample of at least 10 percent of prawns was taken from each pond for specific measurements. Total lengths (tip of rostrum to tip of telson) and orbit lengths (posterior margin of orbit to tip of telson) were recorded in millimeters and prawns weighed to the nearest 0.1 gram. The remainder were counted and weighed as a group.

RESULTS AND DISCUSSION

Water salinity in these studies was low (averaging 1.4 to 3.2 ppt) and did not influence any treatment over the other. This species normally inhabits fresh and brackish water (Perdue and Nakamura 1976), and it is in waters of salinities ranging from 10 to 14 ppt that the eggs hatch. After metamorphosis the young begin migrating to less saline waters. Research in plastic containers demonstrated prawns to grow in salinities up to 15 ppt, but optimum growth is at 2 ppt (Perdue and Nakamura 1976). Pond studies in South Carolina (Smith et al. 1976) report excellent growth and survival in brackish water (mean salinity 7.2 ppt).

Monthly samples indicated average total lengths of prawns at the 3 stocking densities to be equal through July (Fig. 1). After this, mean total lengths and standard deviations illustrated an inverse relationship with stocking densities. It was particularly noticeable between the low stocking density of $1.25/m^2$ and the others. Rapid growth and a bull-runt

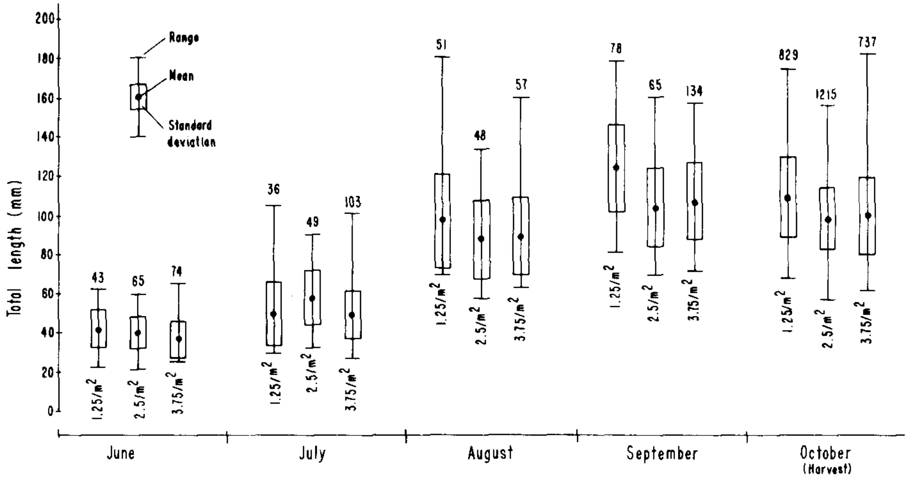

Fig. 1. Mean, standard deviation and extremes of *Macrobrachium rosenbergii* total length at each stocking density for months sampled and at harvest in October, Rockefeller Wildlife Refuge, 1979.

relationship was obvious in the June samples when prawns in the treatments ranged from 22 to 65 mm total length. By July, this range increased from 27 to 105 mm and at harvest on October 5, 1979, a size range of 58 to 182 mm was recorded.

A few females with eggs were collected during the September sample. At harvest in October, females ranging from 115 to 160 mm were found in berry. Stocking densities did not seem to have any effects.

Survival in the individual ponds ranged from 53 percent to 88 percent (Table 1). As the stocking densities increased, survival decreased. The 3 ponds stocked at 1.25/m^2 had the highest average survival, 82 percent. Those stocked with 3.75/m^2 averaged 61 percent survival.

Prawn production after 163 days ranged from 117 kg/ha to 315 kg/ha. Weight harvested increased as the stocking densities increased. Average harvest for ponds stocked with 1.25/m^2 was 159 kg/ha. An average of 191 kg/ha was obtained when stocking 2.5/m^2 and 218 kg/ha when 3.75/m^2 were stocked. Average individual prawn size (15 g, 112 mm) was largest at the lowest stocking density of 1.25/m^2. The 2 higher stocking densities differed slightly. They averaged 11 g, 98 mm and 12 g, 100 mm.

When monthly total length data and length at harvest data were subjected to an analysis of variance, a highly significant ($P < 0.01$) difference was demonstrated. There was a tremendous size variation found within all ponds. Fig. 2 illustrates the lower stocking rate of 1.25/m^2 resulted in a harvest with 65 percent of the prawns exceeding 100 mm. Pond B-7, the deepest of the 3, resulted in 87 percent prawns exceeding 100 mm. Higher stocking rates of 2.5/m^2 and 3.75/m^2 resulted in 41 percent and 49 percent prawns exceeding 100 mm. The results were influenced by the production in the deeper ponds B-8 and B-9 which had 66 percent and 75 percent prawns exceeding 100 mm. Pond B-9 was stocked at 3.75/m^2 but experienced 53 percent survival which resulted in almost the same concentration of prawns as B-8 which was stocked with 2.5/m^2.

Individual prawn weight also varied considerably in the ponds regardless of the stocking densities. Experimental pond B-7, originally stocked with 1.25/m^2, yielded prawns of 2.8 to 58 g each. Harvest of B-8, which was stocked with 2.5/m^2, yielded similar results of 2.8 to 62.8 g. Pond B-9, stocked with 3.75/m^2, had a weight range of 4 to 69 g.

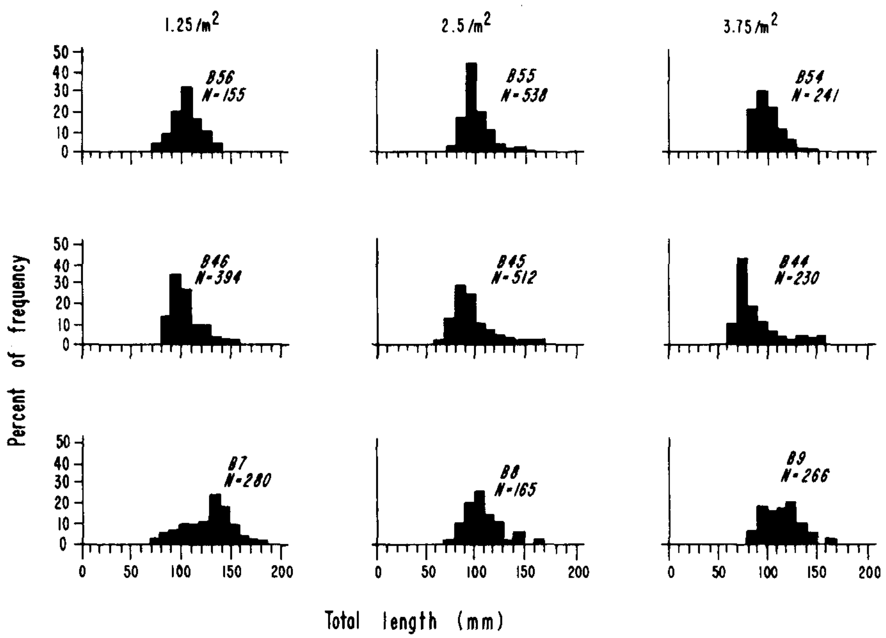

Fig. 2. Total length-frequency of occurrence of *Macrobrachium rosenbergii* harvested from each of the ponds and their stocking densities, Rockefeller Wildlife Refuge, 1979.

Orbit length-total length relationships and length-weight relationships were computed from 693 prawns upon harvest. Both sexes were combined and a random sample was taken from at least 10 percent of the harvest of each pond. The orbit length-total length relation was calculated and resulted in the equation: $OL = 1.498 + 0.736(TL)$, $R^2 = 0.95$ when OL = orbit length in millimeters and TL = total length in millimeters (Fig. 3). The length-weight data were subjected to analysis and the following equation resulted: $\text{Log } W = -5.867 + 3.410(\text{Log } L)$, $R^2 = 0.98$; where W = weight in grams and L equals total length in millimeters (Fig. 4).

Total length to orbit length relationship is illustrated in the literature (Dobkin et al. 1977). However, since no equation was given, a visual comparison with the curve computed from these results reveals a close relationship.

The wide size distribution in fed grow-out ponds stocked at higher densities of 8.4 to $20.1/m^2$ have been described by others (Sandifer, personal communication 1979, Smith et al. 1978). Stocking less than $1.25/m^2$ used in this study in unfed ponds might lessen this bull-runt phenomenon, but it is doubtful if final production would be enough to warrant it. Also, if stocking densities used in this study were used in ponds with vegetation, yield might be higher because of increased natural foods. However, too much vegetation would restrict harvest.

A private pond in Louisiana is reported as producing approximately 400 kg/ha of prawns (Martin, personal communication 1979). The pond was stocked with post larvae ($2.5/m^2$) in May 1978 and harvested in November 1978. Huner et al. (1980) also reported 400 kg/ha of prawns in an unfed pond at Louisiana State University in Baton Rouge. This production is approximately twice that obtained in the pond studies at Rockefeller.

Table 1. Growth and survival for *Macrobrachium rosenbergii* cultured for 163 days in unfed brackish water ponds, Rockefeller Wildlife Refuge, 1979.

Pond number	Stocking density/m^2	Number recovered	Percent survival	Harvest (kg/ha)	Average weight (g)	Range weight (g)	Average length (mm)	Range length (mm)
B-7	1.25	370	74	244	24	3-58	132	85-175
B-46	1.25	438	88	117	10	4-44	99	73-153
B-56	1.25	420	84	117	10	3-23	104	68-148
Avg.	1.25	409	82	159	15	3-58	112	68-175
B-8	2.50	795	80	218	16	3-63	105	71-156
B-45	2.50	662	66	139	9	3-42	91	58-153
B-55	2.50	851	85	211	9	3-37	99	71-152
Avg.	2.50	769	77	191	11	3-63	98	58-156
B-9	3.75	802	53	315	16	4-69	117	84-182
B-44	3.75	1,062	71	153	10	2-58	83	62-158
B-54	3.75	885	59	186	9	3-38	99	75-150
Avg.	3.75	916	61	218	12	2-69	100	62-182

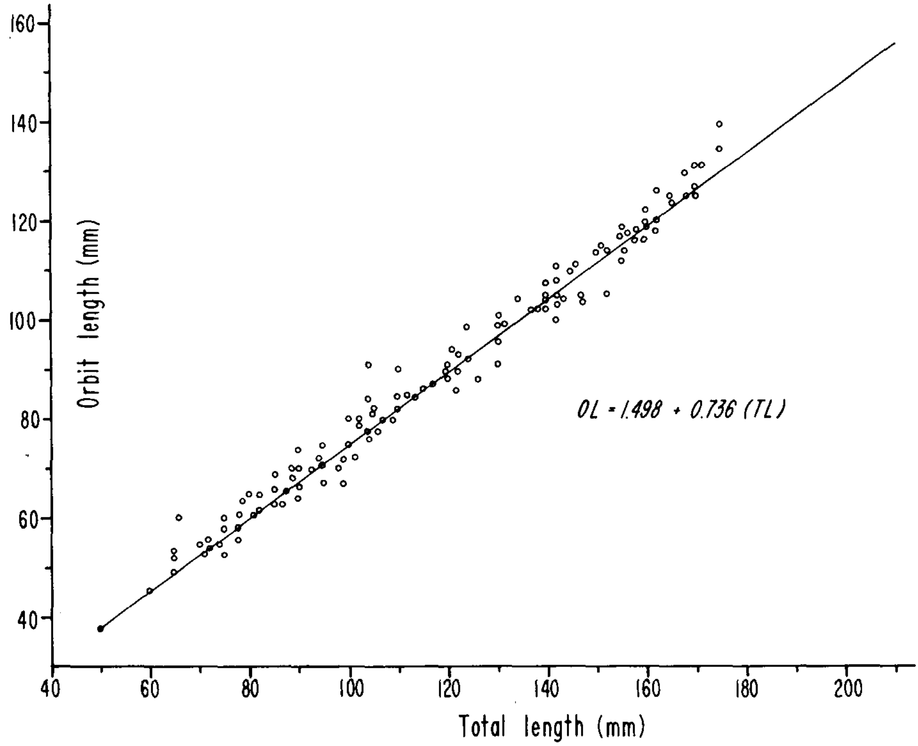

Fig. 3. Comparison of total length (tip of rostrum to tip of telson) with orbit length (posterior margin of orbit to tip of telson) in *Macrobrachium rosenbergii* reared at Rockefeller Wildlife Refuge, 1979.

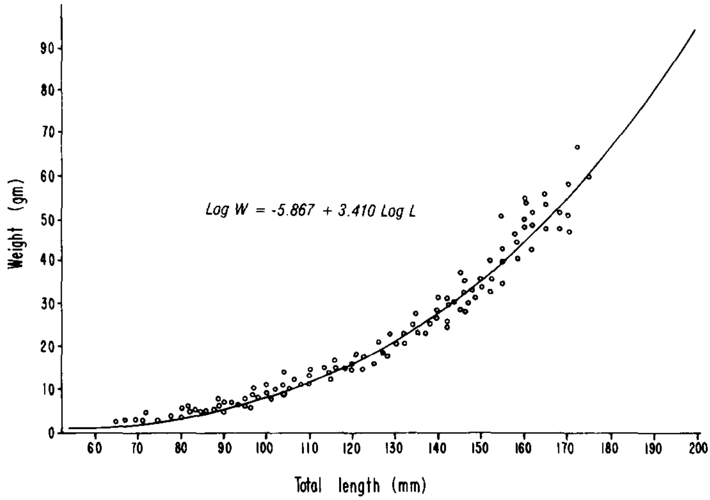

Fig. 4. Total length-total weight relationship of *Macrobrachium rosenbergii* reared at Rockefeller Wildlife Refuge, 1979.

Relatively large numbers of crawfish, *Procambarus clarki,* were in the Rockefeller ponds in June and July. They reached maturity at a small size (60-80 mm versus 90-110 mm) supporting the fact that the carrying capacity of the ponds was taxed due to limited natural food. After July, crawfish virtually disappeared. Predation as well as burrowing seem to account for this phenomenon.

When fed, prawn production is considerably better. Sandifer (personal communication 1979) reports stocking post larvae at 69,000/ha appears to be best for South Carolina. In a 5 month growing period approximately 840 kg/ha may be produced with an average weight of about 18 g. The most attractive yields from discontinuous, temperate ponds result when juvenile prawns are stocked at low densities. Juveniles will cost more and Sandifer's studies suggest stocking mixed populations of post larvae and juveniles may result in approximately 1,100 kg/ha (Florio 1979).

In summary, prawn culture studies clearly indicate its potential in Louisiana. It has recreational value to individuals which may be far from the coast and wish to raise shrimp with no profit motive in mind. If Louisiana culturist could duplicate production reported from continuous production ponds in Hawaii a lucrative industry could develop. However, it is doubtful if prawn culture in Louisiana could be a primary crop. If future studies reveal increased production of larger prawns as reported in Florida and South Carolina (Sandifer and Smith 1976, Smith et al. 1978, Willis and Berrigan 1977) landowners may be able to use this as a secondary source of income.

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