EXPERIMENTAL CULTURE OF CHANOS IN FISH PENS IN A COASTAL LAGOON AT MANDAPAM

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ABSTRACT

Chanos was experimentally cultured in three fish pens, fabricated with palmyra poles and enclosed with 20-mm-mesh nylon webbing, of area 2500 m^2 each. The methods of construction of the pens,, the hydrological conditions and general topography of the lagoon are described.

Chanos fingerlings of length 80-146 mm were stocked in the pens, respectively at a rate of 4000, 6000 and 8000 per ha, and their rate of growth was observed. The chanos fiingerlings belonging to the secondary spawning, during October-November, were also stocked in a pen at a rate of 3460|ha. The stock attained a length of 260 mm, weighing 137 g, during 132 days. Constraints met with the pen culture are also discussed briefly.

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India has about 2 million ha of backwater areas, coastal lagoons and low-lying areas. But at present only obout 30000 ha are used for culturing fishes and prawns. The average production rate from these culture areas is about 150 to 1200 kg|ha|yr. There are different methods for improving the production and bringing more areas under fish culture by rearing fast-growing euplastic fishes by employing the recent technological developments. Culture of fishes in pens, being an important and viable one, is suitable for our conditions.

Culture of fishes in pens has its origin in Japan, where yellow tails (*Seriola quinqueradiata*) are cultured extensively. Later, this method spread to other countries like Philippines, Taiwan, and Indonesia. In Philippines, due to the high production achieved initially, the pen culture practice extended from a few ha to 7000 ha. However, in India, in spite of the vast potentials, the pen culture has not yet developed as a culture system.

The present study is the first large-scale attempt to culture fishes in pens in a saltwater lagoon and this paper deals with its preliminary results.

Pen Culture Site

The fish pens are erected in a coastal lagoon adjacent to Palk Bay, which has an area of 850 ha, extending about 5.2 km along the coast (09 17° N and 79 06° E). The depth of the lagoon ranges from 40 to 120 cm. It had two natural bar-mouths, one of which was closed during the cyclone in 1964. How ever, a new bar mouth is made recently to control the salinity and keep the water at an optimum level. The freshwater inlet is at the southwest portion of the lagoon.

The bed of the lagoon is muddy. The bottom profile consists of 5 to 40 cm loose mud. Coarse sand forms the layer below the mud. The mud consists of 3.5% of coarse sand (600-1200 μ), 40% of fine sand (300-600 μ), 11% of very fine sand (150-300 μ) and 2% silt (75-150 μ.)

The openings of the bar-mouths, which control the vital parameters of the lagoon, are so placed that they function by the direction and the velocity of the wind. During the North East wind, from October to January, the Palk Bay swells, flushing the seawater into the lagoon through the bar-mouths. During this period also rain water flows into the lagoon through the freshwater inlet. But during the South West wind, from May to September, the water level in the sea recedes closing the barmouth. The water level in the lagoon then becomes low due to seepage and evaporation, raising the salinity of the lagoon. Certain parts of the lagoon even dry up during this period, and the salinity of the lagoon goes as high as 132 ppt. However, the barmouth can be kept open manually to facilitate flushing of sea water at least during full moon and new moon days, to reduce salinity.

Hydrological Condition

Temperature and Salinity

Temperature of the lagoon fluctuated between 23 and 38°C. Low temperature of 23° C to 26° C was recorded from November to January. During summer months, the temperature was as high as 38° C. During the hypersaline periods the lagoon experiences temperature stratification, especially when the less-saline seawater flows into the lagoon. The dense lower layer of water becomes very hot with the rise in temperature, to 40° C, depleting the oxygen to 1.2 ppt. It was observed that the bottom salinity was 76 to 88 ppt during this period, while the surface salinity was 57 to 67 ppt.

Salinity of the lagoon was subjected to a wide range of variation, influenced by rain fall, wind, evaporation and the tidal amplitude. The average monthly salinity ranged from 15 to 89 ppt, though the individual values were observed to be as high as 133 ppt during the month of September. During November, as

the Northeast Monsoon sets in, the salinity dropped to 14 ppt rendering the lagoon hyposaline. This condition prevailed from November to January and salinity of the lagoon was found to be between 14 to 25 ppt. The lagoon became mesosaline during February to April with the salinity values ranging from 26 to 40 ppt. The salinity increased during the succeeding month, making the lagoon hypersaline from May to October. The salinity was found to be in the range of 40 to 152 ppt during this period. The salinity could, however, be controlled to an extent by opening the barmouth and letting the seawater enter the lagoon, during full moon and new moon periods. The opening of the bar mouth facilitates entry of fish and prawn seed into the lagoon.

Dissolved-oxygen content

The dissolved oxygen of the lagoon was influenced by temperature, salinity, rain fall and the influx of sea water. The dissolved oxygen ranged between 0.20 and 6.9 ml|1. During the hypersaline period from August to September the dissolved-oxygen content of the lagoon was observed to be low, from 0.2 to 3.9 ml|1, whereas during the hyposaline period, October to January, the oxygen level was high, ranging from 5.0 to 6.9 ml/1. Water temperatur also had a bearing on the dissolved-oxygen content of the lagoon. During the colder months of the year, when the temperature ranged from 23° C to 26 C, the average dissolved oxygen content was 3.5 ml|1. During the thermal stratification, when the bottom temperature rose to 38° C to 40° C, the dissolved oxygen further dropped to 1.2 ml/1. Diurnal changes were also observed in the oxygen content. During the same day the oxygen content was as low as 1.2 ml|1 at 7 a.m. and 3.1 ml|1 at 8 p.m.

Fish Pens

Fish pens were fabricated using the locally-available palmyra poles (*Musica indica*), measuring 3 m long, 15 cm wide and 10 cm thick. The poles, pointed at one end, were driven 50 cm deep in the mud, 2 metres apart. A nylon webbing 3 m wide, with 20 mm mesh, was used to enclose the pens. The upper and lower ends of the webbing were reinforced with 3 mm polythene rope. The webbing, along with the upper rope, was securely tied to nails which were driven on the top of the poles. Laterite stones of 1 kg weight were tied to the lower rope at 2 m interval in such a way that they were equidistantly placed in the middle of two consecutive poles. The stones along with the rope and webbing were anchored 50 cm deep in the mud. Care was taken while anchoring so that no fish could escape. The webbing was so arranged that the poles offered support to it against heavy winds. As it was the Northeast wind which is usually strong, the webbing on the northern side was kept outside the poles and the webbing on the southern side placed inside.

Seed

As the mesh size of the webbing was 20 mm, chanos seed measuring only about 80 mm or more were stocked. The seed of chanos was collected from

the lagoon itself, where they occur during April to July and October to November. The seeds were collected with the aid of a scareline made of coir rope, to which split palmyra leaves were attached. The scareline was operated along with a rectangular bagnet. Both the net and the scarelines were dragged in unison, knowing the behaviour of the chanos fiingerlings. The fiingerlings, when disturbed, jumped over the scareline, and were collected in the bagnet. They were immediately transferred to rectangular plastic tanks lined with ½"-thick rubber foam and covered over with net. The foam lining reduced the impact of the fingerlings stiking against the walls of the tank and thus mortality was reduced.

STOCKING

The pens were stocked with chanos fingerlings of length 80 to 150 mm at the rate of 4000, 6000 and 8000/ha, respectively, in three 0.25 ha pens.

In an experiment, with a stocking rate of 4000|ha, the fingerlings of length 146 mm grew to 200 mm in 30 days, the increment in weight being 25.5 g to 63 g. When the fiingerlings of length 108 mm were stocked at rate of 6000|ha, the fishes attained a length of 195 mm in 30 days. The weight increment for the period was 62 g. At the end of the next 36 days the length reached was 242 mm, attaining a weight of 103 g. With the stocking rate of 8000/ha, the fingerlings of length 107 mm attained 166 mm, weighing 40 g in 30 days. Their length increased to 210 mm, weighing 74 g, during the next 30 days. The salinity was 56.6 to 70.5 ppt during the first 30 days, followed by a range of 76.5 to 83 ppt during the next 30 days (Table 1).

TABLE 1. *Growth of chanos in the fish pens.*

Expt. No	Date	Rate of Stocking (No/ha)	Length (mm)	Wt. (g)	Duration (days)	Growth Length (mm)	Growth Wt. (g)	Increment/day Length (mm)	Increment/day Wt. (g)	Salinity (ppt) Monthly average
I	15-07-82	4000	146	25.5						GF.R
	14-08-82		200	63.0	30	54	38	1.8	1.2	75.3
II	22-06-82	6000	108	9.5						56.6
	27-07-82		195	61.6	30	87	52	2.9	1.7	76.6
	31-08-82		242	103	36	56	41.7	1.5	1.1	83.4
III	22-06-82	8000	107	10						56.6
	22-07-82		166	40	30	59	30	1.9	1.0	76
	21-08-82		210	74	30	44	34	1.4	1.1	83
IV	18-11-82	3460	75	2						26.5
	13-12-82		125	16	25	50	14	2.0	0.5	13.9
	18-01-83		144	23	36	19	17	0.5	0.47	24.1
	1-03-83		221	100	41	77	77	1.8	1.8	31.9
	31-03-83		260	137	30	39	37	1.2	1.3	

In a 0.06 ha pen, when the fingerlings of length 139 mm, weighing 20 g, were stocked at a rate of 3600/ha, the fish attained a length of 236 mm weighing 96 g in 101 days. After 262 days they attained a length of 435 mm, weighing 520 g. Here the daily increment of length was 1 mm and that of weight was 1 g for the first 3 months, in a salinity of 40 to 70 ppt, whereas when the salinity was lowered to 25 ppt the growth rate increased to 2.1 mm/day and 4 g/day. (Fig. 1 and 2).

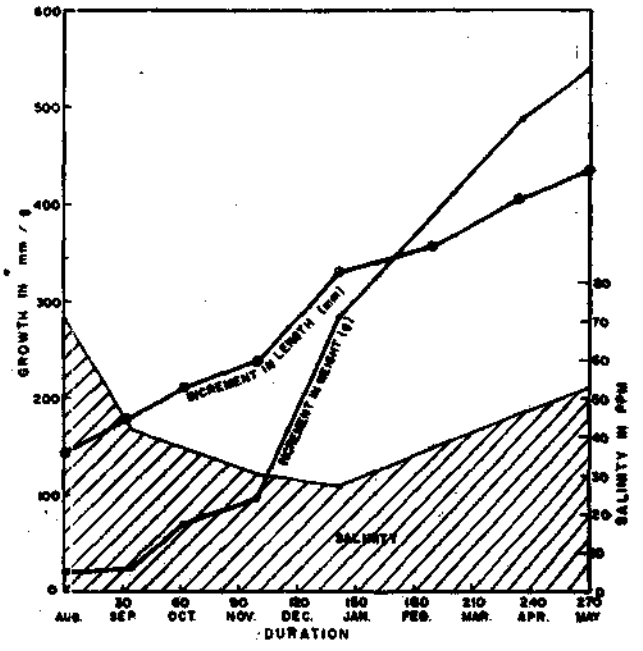

FIG. 1. Growth of chanos in relation to salinity in a fish pen at Pillaimadam lagoon.

Fingerlings of length 70-89 mm, collected from the second spawning of the chanos in the area, were stocked in a 0.25 ha pen at the rate of 3460/ha during November. The stock attained an average length of 260 mm weighing 137 g after a period of 132 days. Salinity of the lagoon during the period of culture varied between 6.1 and 68 ppt. A better growth of 2 mm/day was observed when the salinity was in the range of 6.1 to 14.0 ppt.

Owing to the low water level in the lagoon, the survival in the experiments were very low, mainly due to predation by birds.

Discussion

The potential of chanos culture was recognised as early as 1920, when efforts were made to culture chanos in Krusadi Island and adjacent areas, (Chacko and Mahadevan 1956; Tampi 1973). Recently revived attention was given to

chanos culture (Tampi and Bensam 1976) when experiments were conducted to culture them in various systems. Chacko and Mahadevan (1959), Tampi (1960), Ramamurthy et al (1978) and Marichamy and Rajapakiam (1982) cultured chanos in conventional ponds; Mohan and Nandakumaran (1980. 1980a and 1981) reared chanos in the polythene-fiilm-lined ponds, and Mohan (1983) conducted experiments culturing chanos in net enclosures in a coastal lagoon.

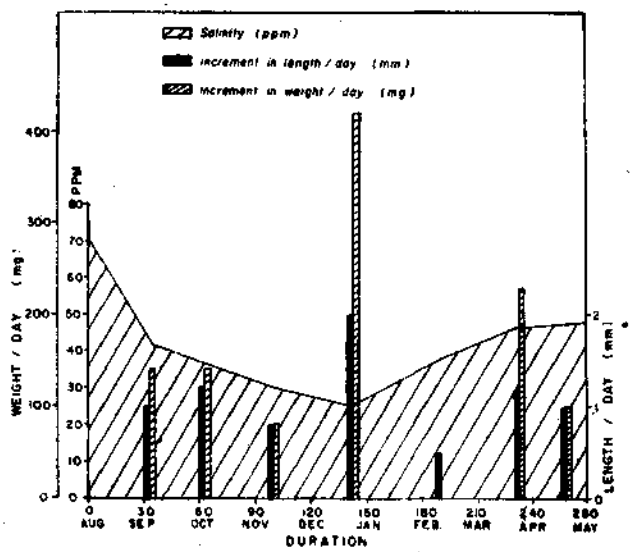

FIG. 2. Relative length and weight increment of chanos in relation to salinity in a fish pen at Pillaimadam lagoon.

Growth of chanos has been found to vary. Chacko and Mahadevan (1956) and Tampi (1960) observed that the chanos fingerlings of length 50-85 mm grew to 240 mm and 300 mm in one year in the seawater ponds. Ramamurthy et al (1978) reported faster growth, 37 mm to 249 mm during a period of 111 days, in a brackishwater pond; Marichamy and Rajapackiam (1982) found that they grew to a length of 277 mm and 346 mm from 50 mm and 42 mm during a period of 210 and 365 days, respectively, in a saltwater pond. In the polythene-film-lined ponds, Mohan and Nandakumaran (1981) found that the chanos grew to a length of 310 mm during a period of 7 months.

TABLE 2. *Hydrological parameters of the Pillaimadam lagoon during* 1982 (*Monthly Average*).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Salinity (ppt)	25.5	37.1	41.2	46.3	46.9	56.7	81.8	86.2	89.2	43.0	20.0	15.0
Diss. Oxygen (ml/l)	4.4	4.8	3.8	2.2	4.8	4.0	3.0	2.5	2.9	3.8	6.2	6.9
Temp. (C)°	24.4	30.0	29.4	32.0	31.5	29.6	27.6	29.0	29.0	29.0	26.0	23.0
Depth (mm)	105	47	56	56	50	42	25	15	10	10	40	52

Though Shanmugham and Bensam (1982) observed a poor growth, 155-255 mm from 23-26 mm during 6 months, in the fish pens in the Tuticorin backwaters, better growth was observed in the present experiments, wherein, with no artificial feeding, chanos fingerlings of length 107 mm were found to grow to 210-242 mm, weighing 75-103 g, in a period of 2 months. This growth rate is well comparable with the growth recorded in other systems.

One of the important factors which influences the growth of chanos is the salinity. Chidambaram and Unni (1946), Pannikkar et al (1952), Canagaratnam and Davis (1960) and Kinne (1969) found that the salinity above 55 ppt adversely affects the growth of chanos. During the present observation also it was found that the growth increment was 2.1 mm per day in the salinity range of 14-37 ppt. The growth rate was only 1 mm|day, and the weight increment 1 g|day, when the salinity was in the range of 40-80 ppt. However, when the salinity was more than 120 ppt the fishes were found coming to the surface often, falling easy prey to birds. Mortality of fiingerlings was also observed when the salinity of the lagoon was above 120 ppt. At this high salinity dissolved oxygen was found to be below 1 ml|1 especially during mornings.

Milne (1982) reported that boring and fouling organism may weaken the supporting poles of the pens. Though boring organisms were not found to infest the palmyra poles in the present study, the fouling organisms like *Balanus amphitrite* was found heavily attached to the poles. From one pole as much as 1250 g of balanus was collected after one year. The webbing also was damaged when it rubbed against the balanus during windy days. However, they can be removed periodically by scarping.

Other fouling organisms, like sponges, bryozoans, oysters, and algae, had also been reported to clog the meshes of the webbing and making it vulnerable in heavy winds and currents and obstruct free exchange of water (Horbund and Freiberger, 1970); Milne 1972; Shanmugham and Bensam 1982); the clogging in turn resulting in the deposition of organic debris inside the pen increasing the carbon dioxide and hydrogen sulphide production. However, this problem can be considerably be tackled by using 20-mm mesh webbing.

The meshes of the webbing getting obliterated with the scum and the algae, like *Chorococcus, Phormidium, Lyngbya, Osbcilliteria,* is another problem, if the webbing is not cleaned periodically. This problem was found pronounced when 10-mm mesh was used for the webbing.

Birds like kites (*Milvus migrans and Haliastar indus*), pelicans, brown headed gull (*Larus brunnicephalus*), *L. ridibundus,* Indian whiskered terns (*Chlidonias hybrida*) and the Caspian tern (*Hydroprogne caspia*), cranes, *Egretta garzetta*), all were found to prey on the fingerlings when the water level in the lagoon was law. Bird menance can be reduced if the pens are smaller, by covering them over by coir nets of large mesh.

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