Observations on the Fish and Prawn Seed Resources of the Gulf of Kutch and their Utilization in Aquaculture

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The characteristics of the fish and prawn seed resources of the Gulf of Kutch are described. Results of experiments conducted in a primary low saline reservoir of a solar salt works to study their utility for aquaculture are reported. The prospective role of aquaculture in augmenting fish production along the coast is also discussed.

Gopalakrishnan *et al.* (1975) and Trivedi *et al.* (1982) have studied the characteristics of the fish and prawn seed potential of the Gulf of Cambay region. Dave *et al.* (1982) conducted preliminary seed surveys along the south east coast of the Gulf of Kutch.In the present paper, a comprehensive account of the potential and seasonal abundance of the seed along the south west coast of the Gulf of Kutch and the cultivability of different species in a large seawater reservoir of a salt works is given. The scope of aquaculture along the coast is also discussed.

Materials and Methods

Fish seed was collected from creeks and mangrove channels using drag nets of 5 m length and 10 mm mesh and cast nets of 2.5 m dia and 10 mm mesh during both low and high tides between 0600–1800 h during 1977 and 1978. Altogether 600 samples were studied.

Prawn seed was collected by funnel shaped monofilament 1 mm mesh shooting net in the seawater channels and creeks for 60 – 90 min during high and low tides between 0600-1800 h, during 1979 and 1980. Altogether 400 samples were analysed. The influence of tide and lunar periodicity was worked out by pooling together collections separately for respective high tide, low tide, full moon and newmoon periods.

Experiments on the salinity tolerance and growth rate were conducted by stocking the seed of prawns in small ponds as well as the reservoirs and sampling periodically.

Fishing in the reservoirs was done by 210/1/3, 210/2/3, 210/3/3 nylon gillnets of units having 350 m length, 3 m hung depth and mesh sizes ot 65 to 90 mm. The data on the species composition is based on 600 fishes collected throughout 1980–84.

Prawns were harvested from the reservoir using nylon cast nets of 2.5 m dia. having 10 mm mesh size, for 8 days around each full moon and newmoon from 12th phase of the ascent to 4th phase of the descent. Data on the species composition and lunar periodicity was recorded from 192 samples during 1980–84.

Hydrological data of salinity and temperature were recorded regularly and data on rainfall obtained from the records of the factory.

Topography and locality

The area of study was a 29 km landstrip along the mouth of the Gulf of Kutch near Port Okha (Lat 22° 28' N Long 69° 05' E). The land is arid with no rivers flowing into the Gulf. The tidal range is 4.94 m, exposing vast intertidal areas during ebb tides. Rich faunal and floral growth occur in the intertidal and subtidal areas (Gopalakrishnan, 1970).

Sparse population of dwarf mangroves of species *Avicinnia* provide litter, forming

detritus along the bottom. The sea has also abundant phyto and zoo plankton production (Bhaskaran & Gopalakrishnan, 1971).

Layout of the reservoir

The reservoir is constructed by bundhing up the intertidal rann area of a mangrove mudflat. The water depth is 25–60 cm with 20–40 cm thick silt along the bottom. Tidal water was pumped into the reservoir by vertical pumps from a seawater channel for onward flow to connected series of reservoirs. All reservoirs were non-drainable. Fresh seawater was pumped into the first reservoir for 8–12 h daily, round the year except for the monsoon months of August–September. The inlet of the reservoir was screened with 20 mm mesh monofilament webbing to restrict entry of large predators.

Results and Discussion

Hydrology

The seawater temperature ranged from 18.5°C in January to 35.3°C in June. The salinity varied from 30‰ in August to 39.8‰ in June in the seawater channel; however, the range was 15 to 44‰ in the reservoir. The annual rainfall was 400 mm. However in 1979 and 1980 unprecedented rainfall of 800 mm and 1000 mm were recorded due to cyclonic conditions. Dissolved oxygen in the reservoir ranged from 4.1 to 6.8 p p.m. and the pH ranged from 7.6 to 8.2.

Fish seed

An annual seed potential of 2.2 million fries and fingerlings of mullets (74.5%), milk fish (4.1%), seabreams (18.4%) and grunters (3.0%) was estimated. The catch/net/h (number) ranged from 1636 in August to 11,415 in January (Table 1). Mullets were represented by *Mugil cephalus, Mugil parsia, Mugil macrolepis, Mugil cunnesius, Mugil tade, Mugil seheli, Mugil carinatus* and *Mugil waigiensis*. The seabreams consisted of non-predatory *Gerres setifer* and *Gerres filamentosus* and the predatory grunters were *Pomadasys* spp and *Chrysophrys* spp. The collections made during the early phase of ebb tides were richer. The average size observed was 15–90 mm for mullets, 70–160 mm for milk fish and 50–75 mm for seabreams and grunters.

Salinity, growth and production trend

The fishes were abundant upto 40‰ salinity and beyond that, predatory perches were more common. An average growth of 300 mm (330g) in respect of *Chanos chanos*, 240 mm (300 g) in respect of *M. ceplalus* and 160 mm (125 g) in respect of lesser mullets was observed. The non-predatory seabream, *Gerres* spp recorded 120 mm (60–70 g) growth in one year. Largest *Mugil cephalus* (2.5 kg), *M. tade* (2.0 kg), *M. parsia* (350 g), *M. macrolepis* (200 g), *Lates calcarifer* (7.0 kg), *Chanos chanos* (13 kg), *Chrysophrys* sp (1.0 kg), *Pomadasys* spp (1.4 kg) and *Gerres* spp (350 g) were also recorded during the study.

The production from daily fishing, showed an annual average catch of 8470 kg from 436 hectare area with a catch/hectare/yr of 19.4 kg and 4.8 kg/h. Monthly fluctuations of the landings are given in Table 2. The production showed two peaks, in January and June. The catch comprised of 21 species of fish contributing 94% and the crabs 6%.

It was observed that the mullets of all species carried ripening ovaries in maturity stages III and IV during January–February and July–August period. Experiments to mature them fully and spawn in controlled laboratory conditions with mullet pitutary hormones showed encouraging results in *Mugil parsia* in 34 days. However fertilisation could not take place as male spawner was not available during the final stages of experiment.

Prawn seed

An annual potential of 47.6 million prawn seed, of which 69.6% penaeids, was estimated. *Penaeus merguensis* (54%), *Metapenaeus kutchensis* (27.5%), *Metapenaeus brevicornis* (18.5%), and occasionally *Metapenaeus monoceros* were represented. The catch/net/h (number) of total seed observed was 159.5 in January to 20876.5 in August. Their monthly fluctuations are given in Table 1.

Dave et al. (1982) noted a penaeid prawn seed abundance in the south east coast of Gulf

Table 1. *Monthly fluctuations of major fish and prawn seed during* 1977–1980, *catch/net/h (nos)*

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Fish seed	nos	11415	6890	4735	5762	4798	1499	2103	1636	4865	5600	7297	7231
Mugil cephalus	%	12.0	15.0	39.0	20.0	27.5	25.1	—	—	—	—	1.0	1.5
Other mullets	%	51.0	63.4	61.0	80.0	72.5	60.2	77.8	60.0	80.0	21.2	53.1	72.3
Perches	%	37.0	21.6	—	—	—	14.7	10.0	15.0	10.3	76.3	45.9	26.2
Chanos chanos	%	—	—	—	—	—	—	12.2	25.0	9.7	2.5	—	—
Prawn seed	nos	159.5	372.0	760.0	476.5	849.0	525.0	4005.0	20876.5	5460.5	4325.0	1003.5	303.0
Penaeus merguensis	%	43.7	41.0	17.0	26.0	31.0	42.0	48.5	29.0	22.0	24.0	56.0	66.0
Metapenaeus kutchensis	%	49.0	37.0	59.0	28.0	47.0	37.0	27.5	37.0	45.0	39.0	24.0	20.0
Metapenaeus brevicornis	%	3.0	8.0	19.0	21.0	4.0	5.0	8.0	25.0	14.0	16.0	9.0	11.0
Palaemon spp.	%	4.3	14.0	5.0	25.0	18.0	16.0	16.0	9.0	19.0	21.0	11.0	3.0

of Kutch from May to July during high tide periods. Whereas, the present investigations showed that this peak extended upto November and that 56.3% of the penaeid seed were collected during low tides indicating a tendency of the juveniles to stay longer in the mangrove areas. The lunar periodicity in relation to juvenile abundance was 52.13% for new moon to 47.87% for full moon. A size range of 05–120 mm for *P. merguensis*, 06–105 mm in respect of *M. kutchensis* and 06–75 mm for *M. brevicornis* was noted. The average model size of the seed was however 37 mm, 35 mm and 28 mm respectively.

Salinity tolerance, growth and production trend

The overall tolerance to varying salinities of the reservoir for different seasons, was 34% for *M. kutchensis*, 0.5% for *P. merguensis* and 0.02% for *M. brevicornis*. *P. merguensis* showed 38% survival upto 36‰ salinity and beyond it only 2% survived upto 40‰ salinity. In case of *M. kutchensis* the survival was 36–40% and *M. brevicornis* showed survival trend similar to *P. merguensis* upto 38% and thereafter succumbed to increasing salinities quickly. A growth rate of 22–24 mm/month upto 33‰ salinity 14–15 mm upto 36‰ salinity, and 5–6 mm/month upto 38‰ salinity was observed in case of *P. merguensis*. *M. kutchensis* showed 14–15 mm/month, 6–8 mm/month and 3–4 mm/month and *M. brevicornis* showed 7 mm/month and 3 mm/month (upto 38‰ salinity) for respective salinity gradients.

Batch harvests during 1980–84 yielded an average annual catch of 5670 kg prawns from the reservoir area of 336 hectare with a catch/hectare of 16.9 kg and catch/h effort value of 3.4 kg. The fluctuations of landings showed two distinct peacks, in February–May and August–November (Table 2).

The catch was more during the newmoon fortnights (55.25%). It was seen that during February – May, 79.5% catch was during new moon fortnights, whereas during August – November, the fullmoon fortnights, accounted for 64.5% prawns. The species composition was *M. kutchensis* (96.2%) followed by *P. merguensis* (2.7%) and rest comprised of *M. brevicornis* and *M. monoceros*. The size range observed was 90–150 mm in respect of *P. merguensis*, 80–120 mm in respect of *M. kutchensis* and 70–90 mm in respect of *M. brevicornis* and *M. monoceros*. Another interesting observation was the availability of maturing females of *P. merguensis*, *M. kutchensis* and *M. brevicornis* in stage 3 and 4 during the peak harvests. Successful spawning of *P. merguensis*, *M. kutchensis* and *M. brevicornis* was carried out in laboratory.

Prospects for aquaculture development

The estimate of 35.2 million quality fish and prawn seed for the small strip of coastal area, suggests massive seed potential along the Gulf of Kutch and Saurashtra coast as similar ecological and topographic features exist. Extensive surveys to assess the massive realistic seed resource potential for the whole area is however essential. It is estimated that 42200 hectares of coastal area in Gujarat state is covered under salt works and most of them are in the Saurashtra – Kutch belt. About 4000 hectares of primary reservoir areas can be suitably harnessed for fish and prawn production. Autostocking would reduce the seeding expenditure though the productivity of prime fish and prawns would be reduced due to predation and competition. Since most of the predators and competitors are also good edible varieties, daily fishing for their removal would ensure steady supply of material to consumers. Despite the shallowness of reservoir and heavy silting which tends to create anaerobic conditions during summer in the too shallow areas, and the avain predation by migratory birds like herons, pelicans etc. conspecous in the salt works, the fish and prawn stock was free from diseases like 'soft shell' and parasitic infections and the production was fairly economic (Table 3) to suggest application of similar activity in other areas.

Natural maturation of prawns and prospects of induced maturation of mullets promise opportunities to utilise them for artificial seed production programme to substantially supplement the natural resources of prime varieties. Besides the programme

Table 2. *Monthly fish and prawn production and composition of species*

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Fish	kg	1437.5	906.9	421.0	627.0	489.1	1076.4	312.0	152.0	342.4	570.0	986.4	1200.0
Mugil cephalus	%	2.6	8.5	5.1	3.4	22.6	17.2	25.6	5.3	10.1	40.0	11.8	11.2
Mugil tade	%	4.7	1.2	7.6	—	0.5	—	—	2.0	6.1	1.8	2.6	1.1
Mugil parsia	%	2.8	3.9	0.9	0.7	16.4	3.3	17.1	—	—	2.0	0.7	1.2
Mugil macrolepis	%	20.8	45.9	20.3	7.2	2.6	8.6	3.4	8.9	7.6	1.6	2.1	22.9
Chanos chanos	%	4.3	0.7	0.8	4.6	9.2	1.2	—	1.0	3.6	2.7	3.9	2.6
Lates calcarifer	%	0.5	1.7	4.1	3.3	0.7	1.4	0.5	2.3	1.1	1.9	7.7	5.2
Chrysophrys cuvieri	%	1.0	—	0.7	0.8	2.0	3.3	—	—	—	6.5	0.9	1.6
Chrysophrys berda	%	2.4	2.7	1.4	—	2.7	6.4	1.0	2.6	13.9	16.2	25.3	15.6
Argyrops spinifer	%	—	—	—	—	—	—	—	—	2.7	0.3	2.9	2.0
Pomadasys maculatus	%	2.3	2.7	7.2	11.3	8.8	24.1	0.7	0.8	2.3	5.4	11.3	1.4
Gerres setifer	%	47.6	15.6	27.7	5.0	14.5	5.0	21.4	1.0	18.4	1.3	0.7	22.0
Gerres filamentosus	%	—	—	—	—	—	—	—	—	—	—	1.2	—
Sillago sihama	%	—	—	—	—	—	—	—	1.8	—	—	—	—
Elops sawrus	%	7.8	9.2	16.4	34.8	10.2	12.1	9.3	9.0	18.8	12.8	12.7	7.0
Platycephalus insidator	%	2.2	2.0	—	—	—	0.8	—	—	—	—	0.8	1.2
Pseudorhombus arsius	%	—	1.8	1.0	7.7	3.5	2.0	—	—	—	—	11.6	1.0
Muraenosax cinereus	%	—	—	—	—	—	—	—	—	—	1.0	1.0	—
Eleutheronema tetradactylum	%	—	1.3	2.0	—	—	—	—	—	10.5	—	—	—
Scatephagus arsius	%	—	—	1.2	0.7	—	—	—	—	3.8	—	—	—

Table 2. (Contd.)

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Nematalosa nasus	%	0.6	—	—	—	0.9	2.3	—	55.9	—	2.5	—	—
Epinephelus merra	%	—	—	—	—	—	2.9	1.3	—	—	—	—	1.5
Miscellaneous	%	0.4	2.8	1.9	1.5	0.4	0.9	1.7	1.4	0.5	1.0	0.8	2.0
Crab	kg	2.7	1.2	7.2	119.2	23.5	91.2	55.2	12.0	5.5	17.7	29.9	22.9
Scylla serrata	%	—	—	1.7	19.0	5.0	8.5	18.0	8.0	1.6	3.0	3.0	0.5
Prawns	kg	107.0	257.5	764.9	877.3	601.3	38.9	21.3	202.7	861.8	1340.0	670.9	212.2
Penaeus merguensis	%	3.0	2.0	1.6	3.0	8.5	2.3	—	1.0	4.0	2.3	1.2	4.0
Metapenaeus kutchensis	%	96.0	97.1	98.0	96.3	90.5	95.1	100.0	98.7	96.0	96.3	96.3	94.0
Metapenaeus brevicornis	%	1.0	0.4	0.4	0.5	0.7	2.6	—	—	—	1.4	2.5	1.0
Metapenaeus monoceros	%	—	0.5	—	0.2	0.3	—	—	0.3	—	—	—	1.0

Table 3. *Fish and prawn production pattern of salt works reservoir*

Item	1980	1981	1982	1983	1984
Fish (kg)	5600	7450	11500	7400	10400
Market value (Rs.)	18800	27600	31800	46400	81430
Prawn (kg)	4209	4644	7591	4343	7566
Market value (Rs.)	52186	58821	65427	44756	78806

of aquaculture also would generate rural employment in this traditionally drought prone area. The most significant contribution from the programme would be production of massive quantities of good fish of price within the reach of the economically weaker sections of the society.

At present there is a wide gap between the production and demand of seafood in the Saurashtra-Kutch region. The coastal fishing limited for a period from August to May, produced 1144 t at an average of 2.5 kg/h catch rate in 1981 compared to 1590 t at 4.4 kg/h of 1980. Except during May and October months, the catch was below 100 t/month (George *et al.*, 1982). In this declining trend, the prawn, *Metapenaeus kutchensis,* the main contributor in the present aquaculture study, contributed 7.8 to 10.0%. Iyer *et al.* (1981) estimated the idle capacity of freezing plants in this zone at an alarming 84.6%, due to shortfall in raw material supply, among other reasons, accounting for 89.6%. It is thereafore obvious that concerted efforts by Government and private agencies to develop aquaculture utilising the vast expanse of tidal waste lands available, adopting suitable technology would be greatly helpful to combat this deficit of raw material for export industry and indigenous consumption by masses.

The authors express their deep gratitude to Mr. D.S. Seth, Chairman of Tata Chemicals Limited and the Management of the company for their keen interest and generous encouragement during the course of the study.

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