

Zooplankton standing stock and diversity in the Gulf of Kachchh with special reference to larvae of decapoda and pisces

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Zooplankton characteristics of the Gulf of Kachchh including the major creek systems of Nakti, Kandla and Hansthal were studied for monsoon, postmonsoon and pre-monsoon periods. Zooplankton collections were made at 7 locations. The area was very rich in zooplankton standing stock showing a variation of 0.59 to 185.50 ml/100m³. The maximum biomass was at st 5-112.6 ml/100m³ in monsoon; st 2 - 109.91 ml/100m³ in postmonsoon and at st 1 - 88.01ml/100m³ in premonsoon. Similarly, the population maxima were 942 no/100m³ during monsoon, 196 no/100m³ in postmonsoon and 8027 no/100m³ during premonsoon. *Metapenaeus affinis*, *M. dobsoni*, *Penaeus indicus*, *Parapenaeopsis stylifera* and *P. hardwickii* were the species of penaeid prawns present in the samples. Larvae of *M. affinis* were dominant in the creek and gulf during monsoon, whereas *Acetes indicus* dominated in the collections during premonsoon and postmonsoon. Among the fish larvae, majority of them were in the early stages of development and the size varied from 1 mm to 5 mm. *Boleophthalmus glaucus*, *Engraulis mystax*, and *Clupeids* were the most common fish larvae present in this area. The major species of larvae of prawns and fishes occurring in the gulf were compared with the adults caught from the area. The environmental parameters like salinity, temperature, oxygen and nutrients were taken to study the zooplankton population, its intensity and diversity.

Eventhough many reports on the zooplankton studies are available for the Bombay coast¹, reports on the Gulf of Kachchh are scarce, except, that of Ramamurthy & Dhavan². Dhavan³ studied the zooplankton giving importance to the hydrological factors at Kandla region. The distribution of the benthic fauna in the gulf was studied by Kasinathan *et al.*⁴. The environmental parameters of the Gulf with some details on plankton and benthos were reported by Zingde *et al.*⁵, while the fishery resources of the Gulf of Kachchh was studied by Nair *et al.*⁶. Since there is no elaborate study in the larval stages of the prawn and fishes from the gulf of Kachchh, the present study is significant in providing baseline data.

Materials and Methods

The Gulf of Kachchh is an extensive area of about 170 km long and 75 km wide subject to appreciable tidal fluctuations. The mouth covers an area of nearly 7300 km². The depth varies from about 60 m at the mouth to less than 20 m at the head of the gulf. The gulf comprising a network of

creeks and alluvial marshy tidal flats in the interior regions which will be covered only during high tidal influx. The southern shore has numerous islands and inlets covered with brush wood and surrounded by coral reefs. The northern shore is predominantly sandy or muddy infringed by numerous shoals.

The investigations were undertaken during three phases covering three seasons i.e. August, 1986 (Monsoon); November-December 1986 (postmonsoon), and February 1987 (premonsoon). Stations 1-4 are located in the interior Gulf and 5-7 in the creek area (Fig.1). Zooplankton collections were made using a Heron tranter Net with a mesh size of 0.3 mm having a mouth area of 0.25 m², with an attached flow meter. An oblique haul of 5 minutes duration was taken from all the stations. Biomass of the sample was determined by displacement method and the entire sample was studied for evaluating the community structure of zooplankton. The larvae of prawns and fishes were subsorted and identified up to genus or species level, as and where identification was possible. Fish

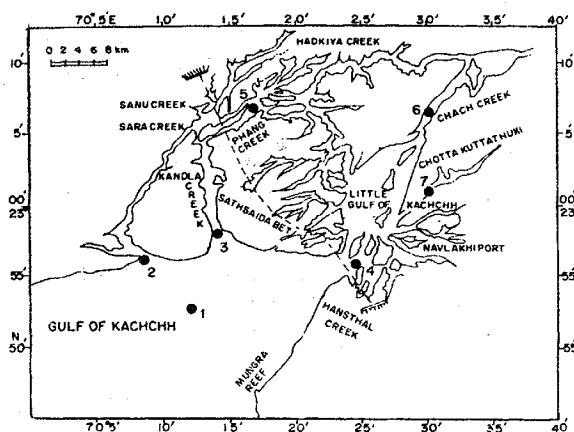


Fig. 1—Station positions.

trawl catch data were taken into account for comparison with the larvae found in the zooplankton collections.

Results and Discussion

Water temperature in the creek and Gulf varies at a range of 19-29°C during the period of study. The creek sustained very high salinity (av. 46×10^{-3}) during premonsoon period. A gradual reduction in salinity from the creek towards the outer Gulf was evident. The freshwater influx during occasional monsoon spell considerably diluted the seawater in the major creeks (av. 24×10^{-3}). Very high suspended load was observed at the creeks (av. < 700 mg/l) than the inner Gulf (av. 350 mg/l). The mean DO level was above 5.5 mg/l during the three seasons. The BOD level was low (av. 2 mg/l) indicating the water free of any organic pollution. The pattern of variations of nitrate and phosphate indicated that the creeks served as important source of nutrients.

The Gulf of Kachchh region, in general, has a very high standing crop of zooplankton. The zooplankton biomass varied from 0.59 to 185.50 ml/100 m³. The average values of biomass and population density are given in Table 1. Considering the seasonal average the variation in biomass was not very significant, as the lowest biomass was of 31.40 ml/100 m³ in November and the highest in February i.e. 41.45 ml/100 m³ (Fig. 2). But when different stations and seasons were studied the lowest biomass was found in st. 7 during the monsoon (22.2-23.03%) and postmonsoon (45.6-

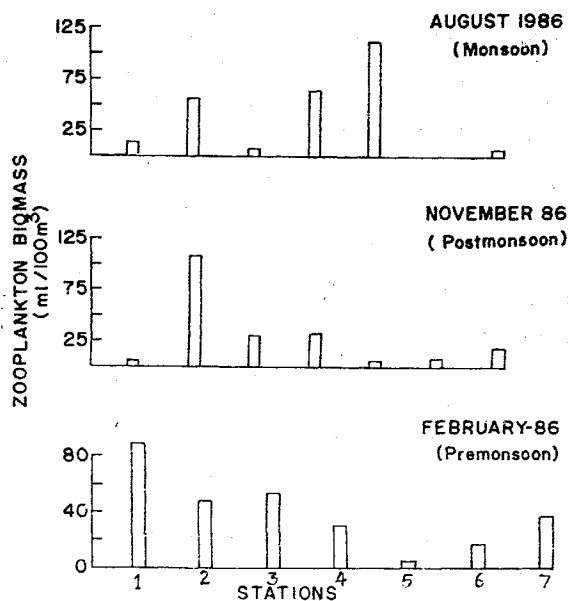


Fig. 2—Zooplankton biomass (ml/100m³) (av. volume).

Table 1—Average zooplankton biomass and population density

Season	Biomass (ml/100m ³)	Population (no/m ³)
Monsoon	40.67	342.37
Postmonsoon	31.40	72.26
Premonsoon	41.45	351.35

46.3%) and in st. 6 during premonsoon (47.5-50.4%) period, the respective values being 0.59, 2.16 and 1.96 ml/100 m³. Similarly, the highest biomass values were 185.50 ml/100 m³ in st. 6 during monsoon (8.5- 21.6%), 149.5 ml/100 m³ in st. 3 during postmonsoon (40.5- 41.5%) and 130.79ml/100 m³ at st. 2 during premonsoon period (40.6-41.3%). Though high salinity was typical of the inner gulf region and creek areas when it exceeds 45‰ it appeared to affect the standing stock of zooplankton. As a result, relatively low production was observed when salinity was very high. The average biomass during August was 112.70 ml/100 m³, in November it was 85.2 ml/100 m³ and in February 118ml/100 m³. Similarly, the average number of organisms present in any single station during August was 942/m³, in November it was 196/m³ and in February 1147/m³. This showed that the maximum number of organisms were pre-

sent during the premonsoon period. Generally, the Gulf of Kachchh contributed more organisms than the creeks. However, the creeks had a seasonal abundance, during monsoon particularly at st. 6.

Effect of tide on the distribution of zooplankton did not indicate a definite pattern. During the monsoon period numerical abundance of zooplankton in the creek was more for ebb than flood. The tidal variability indicated higher standing stock of zooplankton during flood in the inner creek while a reverse pattern was observed at the Gulf locations. The premonsoon period showed a comparable trend like that of postmonsoon period with higher standing stock of zooplankton during flood period in the creek than ebb period (Table 1). It would appear that as the creek is less productive during the postmonsoon and premonsoon period the influx of population into the creek from the Gulf led to relatively higher standing stock of zooplankton during the flood period. However, maximum biomass of zooplankton was recorded for the ebb period at the creek as well as inner Gulf except during the premonsoon period (Table 2).

In monsoon and postmonsoon seasons the population intensity was noticed during the ebb tides, both in the gulf area and creeks, indicating that the abundance is due to the local population whereas in the premonsoon season, it was seen during February, both in the gulf and creek, which indicated recruitment of larval population to the creek was through the gulf. So larval migration seems to be during the premonsoon period, which in turn, points out the spawning seasons of the fish and prawns. In August the inner creeks sustained relatively higher biomass (av. 59.17 ml/100 m³) as compared to the Gulf (av. 22.58 ml/100 m³).

The composition of zooplankton in the gulf was quite diverse and was contributed mainly by copepods and decapods. In the inner creek the contribution of decapods was more with a decrease in group diversity. Medusae and chaetognaths were absent in the inner creek while fish eggs and larvae were common in all stations. At st. 6 (Chach creek) during the monsoon period unusual abundance of the crustaceans, *Streptocephalus*, *Dischotomus*, *Caenestheriella indica* and cladocerans were observed and these during low tide formed over 90% of the total population of zooplankton. Fresh water influx during the monsoon period lowered the sa-

Table 2—Range in biomass (ml/100m³) of zooplankton during flood (Fl) and ebb (Eb) at the creek and inner Gulf for different seasons

Season	Inner Gulf	Gulf
Monsoon	3.1-163.7	0.6-185.5
	(Fl) (Eb)	(Eb) (Eb)
Postmonsoon	3.1-149.5	2.2-58.3
	(Fl) (Eb)	(Eb) (Eb)
Premonsoon	17.0-130.8	2.0-78.7
	(Fl) (Fl)	(Eb) (Fl)

Flood = Fl, Ebb = Eb

linity from 45-50% to 8.5 to 26.6%. *Caenestheriella indica* was also present at sts 2, 3 and 7, though at a lower density. Swarming of these crustaceans led to maximum standing stock of zooplankton providing a congenial feeding ground for prawns and fishes.

The inner creek became less productive (av. 15.78 ml/100 m³) than the gulf (av. 42.75 ml/100 m³) in November. The overall average biomass decreased from 39.04 ml/100 m³ in August to 33.14 ml/100m³ in November. The faunal composition became more diverse during this period. In the gulf, the copepods dominated with a fair representation of decapods, chaetognaths and amphipods. The inner creek was also dominated by copepods, followed by mysids, decapods and amphipods.

The average zooplankton biomass (41.45 ml/100 m³) during February was comparable with that of August. The zooplankton standing stock was more in the gulf (av. 56.70 ml/100 m³) than the inner creek (av. 18.59 ml/100 m³). The faunal diversity was quite high during this period. In the inner creek, eventhough the copepods were predominant, decapods also contributed significantly to the total population. The other common groups were mysids and fish larvae.

The standing stock of zooplankton was 2.7 to 3 times more in the gulf than in the inner creek. This coincides with the major fishing season from July to September, in the Surajbari area. The rich crustacean fauna, particularly the high population of *Streptocephalus* provided a congenial feeding ground for the prawns and fishes.

The fish catch from experimental trawlings carried out at various stations off Kandala during

three seasons showed the occurrence of *Penaeus semisulcatus*, *P. indicus*, *Metapenaeus kutchensis* and *Parapenaeopsis stylifera* and non-penaeid prawns like, *Nematopalaemon*, *Exopalaemon styliferus* and *Exhippolysmata ensirostris*. *Acetes indicus* was another common species present in all the seasons and in almost all stations. Some of the common brachyuran crabs and stomatopods were

also present in the trawl catch.

The larvae of decapods and fishes were studied in detail considering their significance in the fishery resources of the region. Larval identification of the prawns in the gulf of Kachchh was done depending upon the presence of the adults in the area. A season-wise study of concentration of the prawn larvae indicated that maximum density of larvae

Table 3—Showing density and diversity (no/100 m³) of prawn larvae at different stations during monsoon, postmonsoon and premonsoon

Species	Season	Stations						
		1	2	3	4	5	6	7
<i>Metapenaeus affinis</i>	M	14	100	7	36	39	152	518
	PM	—	—	—	—	—	5	—
	PRM	—	—	—	—	—	—	—
<i>M. kutchensis</i>	M	—	3	4	1	9	—	23
	PM	—	—	—	—	—	—	—
	PRM	—	—	—	—	—	—	—
<i>M. dobsoni</i>	M	—	—	—	—	11	—	—
	PM	—	—	—	—	—	—	—
	PRM	—	—	—	—	—	—	—
<i>P. indicus</i>	M	2	—	—	—	—	—	—
	PM	5	—	—	—	3	—	—
	PRM	—	—	—	—	—	—	—
<i>Acetes indicus</i>	M	2	33	—	6	—	—	4
	PM	13	—	9	—	21	21	11
	PRM	—	2	4	9	3	3	24
<i>Exopalaemon styliferus</i>	M	—	18	—	2	2	233	3
	PM	1	—	9	—	—	—	2
	PRM	—	—	—	—	—	—	—
<i>Exhippolysmata ensirostris</i>	M	4	28	—	1	—	11	—
	PM	4	—	—	—	3	—	—
	PRM	—	6	3	—	—	—	—
<i>Nematopalaemon</i>	M	—	—	—	—	—	—	—
	PM	—	—	—	1	—	—	—
	PRM	—	—	—	—	—	—	—

M = Monsoon, PM = Postmonsoon, PRM = Premonsoon

Table 4—Percentage incidence of different larvae of prawns and total counts (no/100m³) in the creek (C) and interior gulf (G) areas during different months

Species	Total count					
	August		November		February	
	C	G	C	G	C	G
Total count (av.)	306	65	14	10	10	24
<i>Metapenaeus affinis</i>	60.1	73.2	—	7.9	—	—
<i>M. kutchensis</i>	3.7	2.8	—	—	—	—
<i>M. dobsoni</i>	—	1.0	—	—	—	—
<i>Penaeus indicus</i>	0.7	—	26.32	—	—	9.09
<i>Acetes indicus</i>	15.6	0.3	68.42	84.42	62.5	90.90
<i>Exopalaemon styliferus</i>	7.5	21.5	5.26	3.1	—	—
<i>Nematopalaemon</i> sp.	—	—	—	0.6	—	—
<i>Exhippolysmata ensirostris</i>	12.5	1.0	—	4.7	37.5	—

was found during the monsoon period. The low saline conditions must have triggered high phytoplankton production along with aggregations of crustaceans in the inner creek providing a congenial feeding ground for the shrimp larvae. The details of larval form of prawns obtained from different stations during three seasons - monsoon, postmonsoon and premonsoon are given (Table 3). Most of the larvae and the post larvae of the different species of prawns present in the gulf area were also found in the inner creek (Table 4). Larvae of *M. affinis* was most abundant at st. 7 (518) during August although they were present in all the stations. Larvae of *M. kutchensis* were obtained from 5 stations during August and were not found during November and February and also the maximum was at st 7 as in the case of *M. affinis*, in the central part of the gulf of Kachchh. Though *M. dobsoni* is a common species, larvae of this species was obtained only from a single station (st. 4) and that too only in August. Larvae of *P. indicus*

was poorly represented during all the three seasons. During August and November they were present in st. 1 in the gulf region whereas in February they were present in the creek at st. 5. Thus in the gulf of Kachchh region which included sts 1 - 3 an assemblage of 5 species of prawns was encountered (Table 4).

Metapenaeus affinis forms the most abundant species and was found at all the stations during August, and only in st. 6 during November (Table 3). This shows the salinity tolerance of the species. *Nematopalaemon* is the least abundant genus present, only at st. 4 during November. *Exopalaemon styliferus* was seen in abundance, found at st. 5 during August and at st. 3 during November. The maximum number (233) was observed at st. 6 during monsoon season. Eventhough *E. styliferus* is a fresh water form it enters brackish water area as well.

Acetes indicus was invariably present in all the seasons and the maximum density (33/100m³) occurred at st. 2 during August. However, they were found more in the premonsoon and postmonsoon seasons. The presence of other species are given in Table 3.

The fish larvae of the gulf of Kachchh region were studied considering the most common adult species found in the trawl catches. Fish landing for the past 7 years (1980- 86) indicated a sharp increase at New Kandla while old Kandla shows a fluctuating trend (Table 5). Most common species were *Harpodon nehereus* (21.5%), *Coilia* (15.6%), *Hilsa* (8.3%), Clupeid (7.9%), *Polynemus tetrada-*

Table 5—Total fish landing (in tonnes) at New and Old Kandla and Kachchh District.

Year	New Kandla	Old Kandla	Kachchh District
1979-80	53	—	5658
1980-81	358	—	4109
1981-82	793	92	6334
1982-83	1346	287	13785
1983-84	1394	1240	23314
1984-85	1644	247	34288
1985-86	1910	643	35477

Source: State Fisheries Department, Gujarat

Table 6—Percentage incidence of different fish larvae and total count (no/100m³) in the creek (C) and interior gulf (G) during different seasons.

Species	Total					
	Monsoon		Postmonsoon		Premonsoon	
	C	G	C	G	C	G
Total count (av.)	205	127	3	15	826	6
<i>Paraplagusia blochii</i>	—	1.62	—	—	—	—
<i>Cynoglossus</i> sp.	—	—	—	1.15	—	—
<i>Engraulis mystax</i>	4.76	59.29	11.11	9.41	—	34.62
<i>Otolithoides</i> sp.	1.26	5.25	—	—	—	—
<i>Synaptura commersoniana</i>	—	9.29	—	—	0.51	—
<i>Tetradon</i> sp.	—	—	—	—	—	7.69
<i>Boleophthalmus glaucus</i>	68.85	9.50	88.89	41.81	95.62	30.77
Clupeid sp.	27.13	10.3	—	37.65	3.86	26.92
<i>Bregmaceros</i> sp.	—	4.44	3.53	—	—	—
Labridae	—	—	—	7.06	—	—

cytlus (5.5%), *Pampus argenteus* (4.6%) and *Cybbium* sp. (4.4%). The detailed analysis shows that gulf sustained three times more fishing potential than the inner creek.

Larvae of species of fish present in the samples taken from both Gulf and creek (Table 6) were very much less when compared to the adults present in the region. In variety and abundance, majority of larvae caught from this region were in the early stages of development, ranging from 1 to 5 mm in length. The species diversity were more in the gulf and larvae of *Paraplagusia*, *Cynoglossus* and Labridae were restricted, whereas *Boleopthalmus*, *Engraulis* and Clupeids were the most common species in this region (Table 6). A proportion of 79:1:239 of fish larvae was present in the inner creek during monsoon, postmonsoon and premonsoon and 19:3:1 from the gulf area during the above seasons. The higher abundance of fish larvae in the inner creek region was contributed mainly by a concentration of *Boleopthalmus glaucus* (Table 6) which is not economically important.

Creek region gives a permanent habitat for this group may be because of their mud dwelling habit. In general, creek sustained 4.7 times more of larval production than those of the gulf which may be due to the natural protection of this region with less predators, and a clear and calm environment.

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