

**A CASE STUDY ON THE IMPACT OF INDUSTRIAL EFFLUENT  
DISPOSAL ON THE FISHERY OF AMBA RIVER ESTUARY,  
MAHARASHTRA**

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**ABSTRACT**

The impact of waste discharge on fishery resources is a matter of great concern. The accepted norm in all environmental impact assessment studies is to avoid areas of high fishery potential while locating a marine outfall. Contemplating on this aspect a case study was conducted in the Amba River estuary before and after the establishment of a petrochemical complex at Nagothane. The treated wastewater from this complex is released through a subsurface outfall after adopting effective control measures for marine disposal of waste. Experimental trawling was done at five locations covering a distance of 30 km during 1990 to 1991. The catch rate within the estuary varied from 0.6 to 255 kg/h (av 24 kg/h). The trend indicated considerable decrease in fishery potential from the mouth of the estuary (av 64 kg/h) to the upstream location (av 11 kg/h). A total of 49 species of fishes, 16 species of prawns, 7 species of crabs and 1 species of lobster were identified from the collections. Number of species gradually increased from the interior segment at Dharamtar (8) to the outer area near Revas (18). A comparison of the quantitative and qualitative nature of the post outfall and preoutfall data revealed only marginal difference. The study indicates that if necessary precautions are taken to render the waste harmless the marine ecology will hardly be affected.

**INTRODUCTION**

A petrochemical complex established at Nagothane on the western bank of the Amba River estuary has gone into commercial production during March, 1990. The wastewater generated in the process plants and domestic sewage are adequately treated and is being released in the estuarine region of

Amba River about 25 km downstream from the factory site. The location of release of wastewater was selected on the basis of detailed oceanographic studies during 1986 (NIO, 1987). Through these studies it was assessed that the treated wastewater when released at the recommended location would not influence the then existing marine environmental quality to any

significant extent (Dineshkumar and Sarma, 1989 and 1991; Zingde, 1994).

Subsequently the investigations were further extended during 1989 to evaluate biological production potential of the estuary to evolve a reliable database against which future comparisons could be made and also to ensure that the proposed wastewater release would not adversely affect the ecosystem including fisheries (NIO, 1990).

Even with the most careful and comprehensive study for selection of best site for disposal of wastewater, there remain uncertainties because of which the predicted assessment of

impact on the aquatic environment may not conform to actual situations. Hence it is most important to evaluate the changes if any from the predicted assessment through periodic post-wastewater disposal monitoring. The present investigation evaluates the quantitative and qualitative nature of the fishery of the area for the pre and post outfall conditions.

### MATERIAL AND METHODS

Amba River which originates in Western ghats, follows a narrow and meandering course along her length of

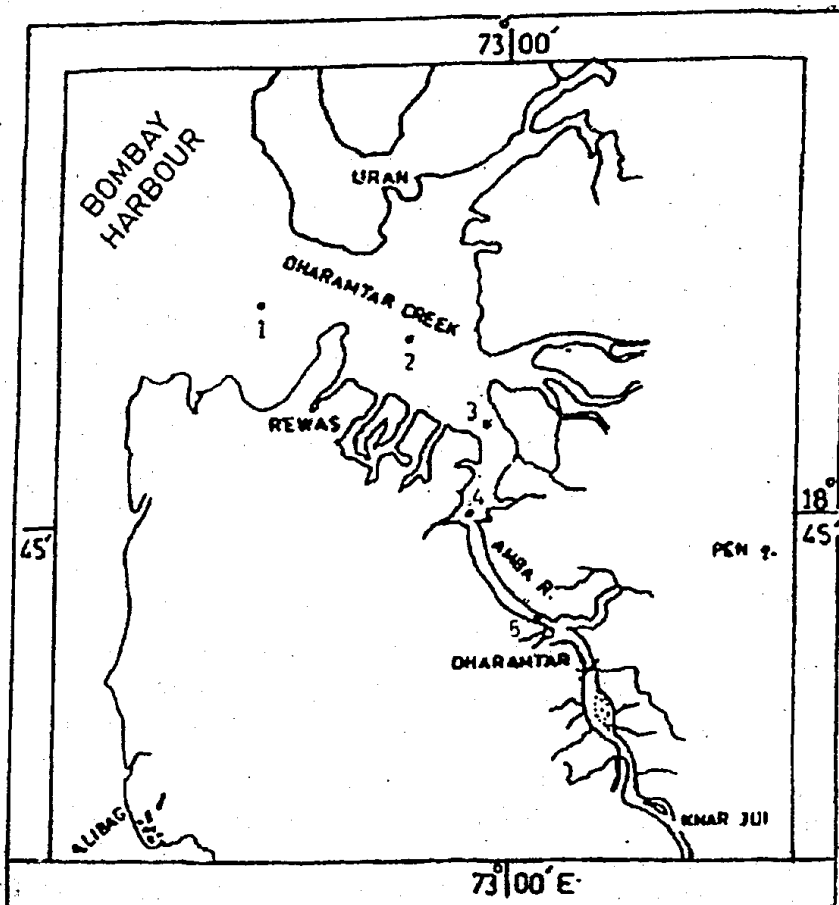


Fig 1 : Station locations in Amba estuary

over 140 km before opening into the Bombay Harbour (Fig.1). The catchment area of the river basin receives on an average 2100 mm annual rainfall 95% of which occurs during south-west monsoon. The lower reaches of the river often referred to as Dharamtar creek is navigable upto Dharamtar jetty for medium size crafts under all tidal conditions. Both the banks of the river are covered with dense mangroves which act as the breeding and nursery ground for fishes.

Five stations were fixed in the estuarine area between Dharamtar and the estuary mouth (Fig.1). The station 4 is the disposal point and is located near Mankule.

Bottom trawling was undertaken during October 1990, December 1990, February 1991 and May 1991 using a mechanised trawler. A high opening bottom trawl net of 20.7 m (636 meshes of 50 mm when stretched) was used for trawling. Total fish catch and groups composition were estimated immediately. A part of the catch was preserved in the 5% formalin for identification.

#### **Environmental characteristics**

The estuary is seawater dominated during the dry season and salinities as high as 27‰ were observed at Nagothane (Zingde, 1994). The high riverine discharge during monsoon however, completely flushed out even the traces of seawater in the inner estuary with salinity remaining unaltered around 0.05‰ even during flood tides. The surface and bottom

salinities were comparable and the estuary was well mixed vertically during the dry season. However, occasional stratification was observed at the month during monsoon (NIO, 1990).

Detailed environmental characteristics of Amba river were reported by NIO (1987), Tiwari and Nair (1991) and Zingde (1994). The results were compared with the baseline water quality criteria for the estuary evolved on the basis of studies undertaken prior to the commencement of release of wastewater in the estuary. These studies revealed that the water quality and sediment quality were closely comparable to the baseline criteria within the natural variability expected for the estuarine environment. Variations in phytoplankton pigments, zooplankton biomass and macrobenthic biomass compared well with the results of the earlier studies.

## **RESULTS AND DISCUSSION**

The data on catch rate, tidal variation, percentage composition and species distribution at different stations are given in Tables 1 to 4 and in Fig. 2.

### **Station 1**

A total of eighteen trawling operations were conducted during the period of study. The catch rate varied between 9-255 kg/h (av 63 kg/h) with maximum catch during ebb tide in October. This catch consisted of fourteen species of fish, four species of prawn and four other

species. *Coilia dussumieri* was the most dominant (82%) species. The other most common species in the order of abundance were *Johnius glaucus*, *Otolithoides biauritus*, *Arius caelatus*, *Harpodon nehereus*, *Scoliodon laticaudus*, *Lepturacanthus savala* and *Metapenaeus brevicornis*. The minimum catch was also obtained during ebb tide in February and composed by *C.dussumieri* (34%), *J. glaucus* (23%), *L. savala* (9%), *Ilisha megaloptera* (11%) and prawns (7%).

*C. dussumieri* and *J. glaucus* were often the most common species followed by *L.savala*, *H. nehereus*, *Trypauchen vagina*, *Thryssa mystax* and *Polynemus heptadactylus*. Among the prawns, the most common species were *Metapenaeus brevicornis*, *M. affinis*, *M.dobsoni*, *M. monoceros*, *Parapenaeopsis stylifera* and *Nematopalaemon sp.* The other crustaceans like squilla, lobster

(*Panulirus polyphagus*) and crabs alongwith cephalopods were occasionally found in the area.

Irrespective of the tidal condition, the catch rate was maximum in October (av 183 kg/h) followed by May-June (66 kg/h). Comparatively low catch rate was obtained during December (24 kg/h) and February (18 kg/h). The average percentage composition for the entire period indicated that the anchovy (54%) and croaker (17%) formed the major constituent of the fish catch. The other groups were prawns (7%), squilla (4%), shark (3%), *Thryssa* (3%), crabs (3%), ribbon fish (2%) and Bombay duck (2%). Anchovy, croaker, ribbon fish, cat fish, gobies, prawns, squilla, crabs and *Thryssa* were recorded throughout the period of observation, whereas Bombay duck was present only in October and

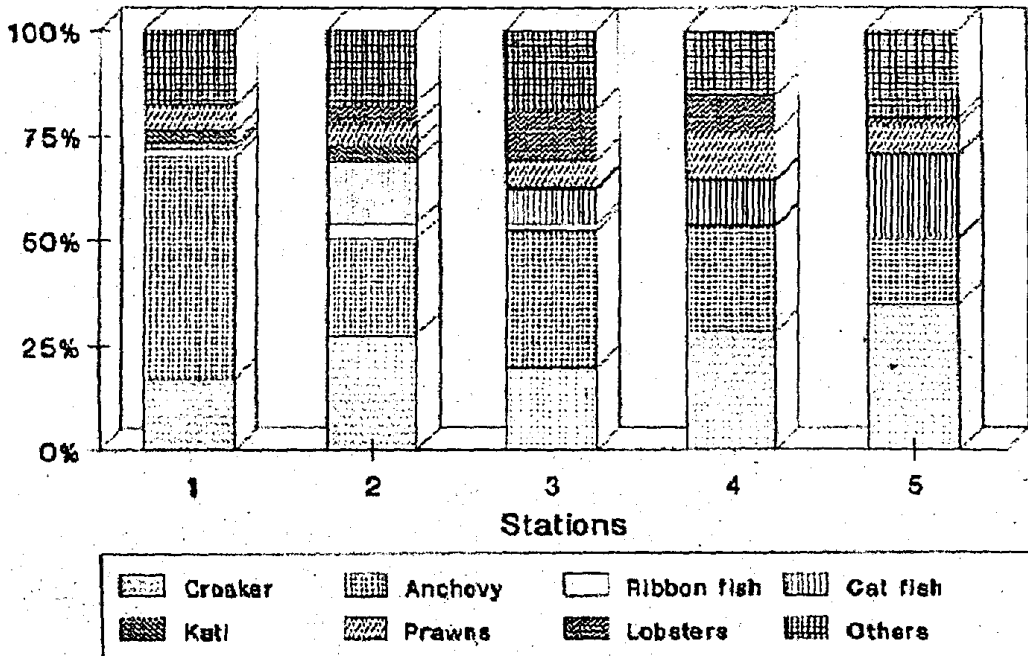


Fig. 2 : Percentage contribution of major groups at various stations in Amba river estuary.

Table 1 : Trawl catch rate (kg/h), species diversity (no) at different stations during I - October 1990, II - December 1990, III - February 1991 and IV - May to June 1991, Mean values given in parenthesis

Period	Tide	Station 1			Station 2			Station 3			Station 4			Station 5							
		Catch	Species	F P O	Catch	Species	F P O	Catch	Species	F P O	Catch	Species	F P O	Catch	Species	F P O					
I	F1	112	12	4	4	*	50	10	2	1	19	8	3	1	30	6	1	1			
	Eb	255	14	4	4	*	9	8	5	1	21	8	5	1	8	6	4	1			
		(159)	(13)	(4)	(4)		(30)	(9)	(4)	(1)	(20)	(8)	(4)	(1)	(19)	(6)	(3)	(1)			
II	F1	18	8	4	3	12	8	6	3	3	9	5	1	2	6	4	2	1			
	Eb	31	7	4	2	22	7	1	3	9	5	2	3	7	1	7	10	3	2		
		(25)	(8)	(4)	(3)	(17)	(8)	(4)	(3)	(6)	(5)	(3)	(4)	(2)	(7)	(7)	(3)	(2)			
III	F1	25	10	4	3	18	7	5	4	11	5	2	3	7	5	1	2	16	7	3	2
	Eb	9	11	3	2	1	4	2	4	9	9	1	3	1	5	5	3	6	3	1	1
		(17)	(11)	(4)	(3)	(10)	(6)	(4)	(4)	(10)	(7)	(2)	(3)	(4)	(5)	(3)	(3)	(11)	(5)	(2)	(2)
IV	F1	40	9	4	4	27	9	3	4	17	8	3	3	16	10	4	2	13	5	3	3
	Eb	36	15	4	3	19	12	1	2	15	6	4	2	3	5	5	2	16	41	1	2
		(38)	(12)	(4)	(4)	(23)	(11)	(2)	(3)	(16)	(7)	(4)	(3)	(10)	(8)	(5)	(2)	(15)	(5)	(2)	(3)

\* - No sample

F - Fishes

P - Prawns

O - Other species

Table 2 : Species composition of fishes at various stations during different periods I - October 1990, II - December 1990, III - February 1991 and IV - May-June 1991.

Name of species	Station 1				Station 2				Station 3				Station 4				Station 5			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
<i>Arius caelatus</i>	+	-	-	-	+	+	-	-	-	-	-	+	+	+	-	-	-	-	-	-
<i>A. maculatus</i>	+	+	-	-	+	-	-	+	+	+	+	+	+	-	+	+	-	-	+	+
<i>A. arius</i>	-	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Coilia dussumieri</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Johnius glaucus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Lepturacanthus savala</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>L. haumela</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Harpodon nehereus</i>	+	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>Scoliodon laticaudus</i>	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Ilisha megaloptera</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Thryssa mystax</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>T. vitrostris</i>	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pampus argenteus</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. chinensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Trypauchen vagina</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Otolithes cuvieri</i>	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Otolithoides biauritus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Polynemus heptadactylus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Megalaspsis cordyla</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Name of species	Station 1				Station 2				Station 3				Station 4				Station 5			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
<i>Protonibea dicanthus</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sillago sihama</i>	+	-	+	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	+
<i>Cynoglossus macrolepidotus</i>	+	+	+	-	+	+	-	+	+	-	+	-	-	+	-	-	-	-	-	-
<i>Sillago chondropus</i>	-	+	+	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-
<i>Terapon jarbua</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
<i>Opisthopterus tardoore</i>	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Kathala axillaris</i>	-	+	+	-	-	-	+	-	+	-	+	-	-	-	-	+	-	-	-	+
<i>Mugil cephalus</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Labeo rohita</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Tetrodon chaelondon</i>	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
<i>Anodontostoma chacunda</i>	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Nebrius ferrugineus</i>	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Paranibea semiluctuosa</i>	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Euryglossa orientalis</i>	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Carangoides equula</i>	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Platycephalus sp.</i>	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
<i>Plotosus lineatus</i>	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	+	-	+

Name of species	Station 1				Station 2				Station 3				Station 4				Station 5			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
<i>Lutjanus johni</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cynoglossus puncticeps</i>	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Scatophagus argus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Tetrodon</i> sp.	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>Bempros</i> sp.	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Scorpionidae	-	-	+	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	+
<i>Dendrophysa russelli</i>	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Upeneus sulphureus</i>	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Muraenesox talabonoides</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Leiognathus splendens</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Boleophthalmus</i> sp.	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Hemiramphidae	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Bregmaceros</i> sp.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

\* No sample

+ Present

- Absent



Table 3 : Species composition of prawns at various stations during different periods I - October 1990, II - December 1990, III - February 1991 and IV - May-June 1991.

Name of species	Station 1				Station 2				Station 3				Station 4				Station 5			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
<i>Metapenaeus brevicornis</i>	+	+	+	+	*	+	-	+	+	-	-	+	+	+	+	+	+	-	+	+
<i>M.affinis</i>	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	-	-	+
<i>M.dobsoni</i>	+	+	+	+	+	+	+	+	+	+	-	+	-	-	-	-	+	-	-	-
<i>M.monoceros</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Metapenaeus sp.</i>	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Parapenaeopsis stylifera</i>	+	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>P. hardwickii</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>P. sculptilis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Palemon sp.</i>	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Nematopalemon sp.</i>	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Penaeus indicus</i>	-	-	-	-	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>Fenneropenaeus merguensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Acetes sp.</i>	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-

\* No sample

+ Present

- Absent

Table 4 : Species composition of crabs at various stations during different periods I - October 1990, II - December 1990, III - February 1991 and IV - May-June 1991.

Name of species	Station 1				Station 2				Station 3				Station 4				Station 5			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
<i>Charybdis annulata</i>	+	+	+	+	*	-	+	-	+	-	-	-	+	-	+	-	-	-	+	+
<i>Neptunus</i> sp.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Matuta lunaris</i>	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-
<i>M. planipes</i>	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-
<i>Scylla serrata</i>	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Charybdis cruciata</i>	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Unidentified sp.	+	+	+	+	+	+	-	-	+	+	+	-	+	+	+	+	+	+	-	+

\* No sample

+ Present

- Absent

May catches. Fish like dori, cat fish, Ray, Rawas and shark were absent in May, 1991.

An increase in species diversity of fish (33) and prawns (10) was observed during flood period as compared to ebb tide (fish-24, prawn-9).

### Station 2

A total of six trawl operations were conducted during December-February and May-June during different tidal conditions. The catch rate varied from 0.6-27 kg/h (av 17 kg/h). The maximum catch was dominated by *C.dussumieri* (51%) and *J.glaucus* (18%). The other common species were *H. nehereus*, *A. caelatus*, *Trypauchen vagina*, *Sillago sihama* and *Kathala axillaris*. Prawns were represented by *M.brevicornis*, *M.affinis*, *Nematopalaemon* sp. The minimum catch obtained chiefly consisted of four species of fish and two species of prawns and four other species. The major species in the minimum catch were *Trichiurus haumela* (27%), *Ilisha megaloptera* and *Thryssa mystax* (18%) and *Plotosus lineatus* (18%). The species of prawns were *P.hardwickii* and *P.indicus*.

On an average, the maximum catch was obtained during October (23 kg/h) as compared to December (17 kg/h) and February (9kg/h). The results indicated that the trawl catches were mainly composed of croaker (26%), anchovy (23%), cat fish (14%), dori (6%), lobster (5%), ribbon fish (5%) and prawns (4%). In all, about twenty six species were recorded at this station. The occurrence

of *A. arius*, *Polynemus heptadactylus*, *Cynoglossus macrolepidotus*, *Mugil cephalus*, *Euryglossa orientalis*, *Carangoides* sp., *M. brevicornis*, *M. affinis*, *M. dobsoni*, *Metapenaeus* sp., *P. hardwickii* were restricted during the flood tide, whereas *A. maculatus*, *L. savala*, *Otolithoides biauritus*, *Terapon jarbua*, *P. lineatus*, scorpionids, *Boleophthalmus* sp. *Squilla* sp. were observed only in ebb tide.

### Station 3

A total of ten trawling operations were conducted during October, December, February and May. The catch varied from 3 to 50 kg/h (av 14 kg/h). Maximum and minimum catch were recorded during October and December respectively. The maximum fish catch was dominated by *C.dussumieri* (70%) followed by *J.glaucus* (10%), *H.nehereus* (3%), gobies (3%) and prawns (5%). The minimum fish catch was represented by *J.glaucus* (33.3%) and cat fish (33.3%). The other fishes were *C.dussumieri* (7%), prawn (7%) and lobster (13%).

*C.dussumieri* (33%), *J.glaucus* (17%) and lobster (12%) were the major constituent forming 62% of total fish catch. The other important group were cat fish, koth, prawns, crabs and cephalopods. Overall, twenty species of fishes, fourteen species of prawns and three species of crabs were identified during the study period. Marginal increase in species diversity was noticed during flood tide. However, species diversity of prawn was more during ebb tide.

#### Station 4 (wastewater release point)

Eight trawling operations were carried out around this location. The fish catch varied from 1 to 21 kg/h (av 10 kg/h) with maximum and minimum values recorded during October and February respectively. The minimum as well as maximum catch were observed in ebb tide. The maximum catch was represented by prawns (41%), *J. glaucus* (24%), cat fish (16%) and *C. dussumieri* (8%). The minimum catch was dominated by lobster (57%), *J. glaucus* (9.5%), and *C. dussumieri* (4.8%).

In all collections *J. glaucus* (28%), *C. dussumieri* (28%), cat fish (10%), prawns (10%) and lobster (9%) dominated the samples. The other major species were *H. nehereus*, cephalopods and dori. Total eighteen species of fish, fifteen, species of prawns and other three species were encountered in the collection.

#### Station 5

Trawling operations were conducted nine times. The fish catch varied between 6 and 30 kg/h (av 12 kg/h). The maximum catch was obtained during October (flood tide) and minimum catch during February (ebb tide). The maximum fish catch was contributed mostly by *J. glaucus* (52%), cat fish (39%) and *C. dussumieri* (3%).

Overall the fishery was composed of *Johnius* (35%), cat fish (19%), *Coilia* (15%), dori (10%) and crabs (4%). A

total of twenty two species of fishes, twelve species of prawns and two species of crabs were identified. Maximum number of fish and prawn were caught during ebb tide.

The overall assessment suggested that the area sustained a moderate fishery potential. The catch rate varied from 0.6-255 kg/h (av 24 kg/h) for the estuary. Which is three and half times higher than earlier reported values for Dharamtar creek (NIO, 1987) and comparable to that of Thana creek system (Jyoti and Nair, 1990).

The postmonsoon months (October-November) sustained higher catch (63 kg/h) which decreased gradually in December (12 kg/h) to February (10 kg/h). A second peak in the fish catch was observed during May-June with an average catch rate of 26 kg/h. The rates were 63, 17, 16, 10 and 12 kg/h for stations 1, 2, 3, 4 and 5 respectively. The trend indicated considerable decline in fishery potential towards the interior zone. Station 1 was the most productive showing five times more potential as compared to station 5.

A total of forty nine species of fishes, sixteen species of prawns, seven species of crabs and one species of lobster were identified in the area. The species diversity of fish increased appreciably from Dharamtar to Revas. The total number of species of fish recorded at stations 5, 4, 3, 2 and 1 were respectively 22, 18, 23, 26 and 33. However, the species diversity of prawns showed a reverse trend.

The catch composition for the study area indicated that anchovy (31%), croaker (25%), cat fish (11%), prawns (7%), lobster (6%) and dori (5%) were the most abundant groups contributing more than 70% of the catch. The other important fishes were Bombay duck (1%), ribbon fish (2%), crabs (3%), cephalopods (1%) and *Thryssa* (2%). The crustaceans were mainly composed of prawn (7%), lobster (6%), *Squilla* (1%) and crabs (3%). The lobster formed one of the major components in the catch at station 3 (12%) and station 4 (9%).

Eventhough seasonal variation in species composition was evident on most of the occasions, *J.glaucus* and *C.dussumieri* were present at all the stations. *L.savala* was present throughout the season but more at station 1 and 2. *T.vagina*, *A.maculatus*, *P.heptadactylus*, *I.megaloptera*, *T.mystax*, *O.biauritus*, *Kathala axillaris*, *M.brevicornis*, *M.affinis*, *M.dobsoni*, *M.monoceros*, *P.hardwickii* and *Palemon* sp. were present throughout but in less quantity. Species like *Protonibea diacanthus* was restricted only to station 1. *Megalaspis cordyla*, *P. argenteus*, *Opisthopterus tardoore*, *Anodontostoma chacunda*, *Nehrius ferrugineus*, *Paranibea semiluctuosa*, *Dendrophysa russelli*, Hemiramphidae, *Leiognathus splendens*, *Arius caelatus* and *A.arius* were absent during February and May. *Scoliodon laticaudus* was present only in October at station 1. *M.cordyla*, *P.argenteus* were only present in October and *Lutjanus johni*, *Scatophagus argus* were recorded in December. Hamiramphidae, *Upeneus sulphureus*,

*P.maculatum* were observed only in February. *L.splenden*, *Boleophthalmus* sp. and *Muraenesox talabonoides* occurred only in May. The occurrence of juveniles of croaker, anchovy, *Acetes*, Rawas and cat fish indicated the possibility of breeding/nursery grounds of these species in the estuary.

As compared to earlier studies of 1989 (NIO, 1990) the catch rate showed an enhancement, possibly due to more intensive trawling covering a wider area and increase in fishing efforts. However, the groupwise composition was comparable with the predominance of *Coilia* and croaker. The species diversity was also high during the present study. During a later study (NIO, 1990) the catch rate varied between 1 and 20 kg/h (av 9 kg/h) at station 4, while the present study, the rate was between 3 and 50 kg/h (av 16 kg/h). At station 2, the catch rate was five times higher during the present observation as compared to the earlier report.

The study did not reveal any change in the fish catch over the years due to release of treated wastewater in to the river. This suggests that with the required precautions, it is possible to maintain the ecosystem in healthy condition even after discharge of waste. As the present study is the first report on the species composition of Amba river estuarine system, it is difficult to assess the change, if any, in species composition on account of pollution stress. However, the present data will serve as baseline for all future comparison and ecological assessment.

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## REFERENCES

- Dineshkumar, P.K. and Sarma, R.V.,** 1989. A study of the probable movement and mixing of contaminants in a tidal estuary. *Indian J. Environmental Protection.* **9** (11) : 834-838.
- Dineshkumar, P.K. and Sarma, R.V.** 1990. Flushing characteristics of Amba river estuary, west coast of India. *Indian J. Mar. Sci.* **20** : 212-215.
- Jyoti, E. A. and Nair, V. R.** 1990. Fishery potential of the Thana-Bassein creek system. *J. Indian Fish. Ass.* **20** : 1-5.
- NIO.** 1987. Hydrographic studies in Amba River estuary for wastewater disposal from a Petrochemical Complex (Part 1). Technical Report, NIO Regional Centre, Bombay.
- NIO.** 1990. Release of wastewater from a petrochemical complex in Amba river estuary - probable impact on marine life. Technical Report, NIO Regional Centre, Bombay.
- Tiwari, L.R. and Nair, V. R.** 1991. Contribution of zooplankton to the fishery of Dharamtar creek, adjoining Bombay Harbour. *J. Indian Fish. Ass.* **21** : 15-19.
- Zingde, M.D.** 1994. Environmental impact assessment of disposal of liquid waste through marine outfall - a case study. *Environment and Applied Biology*: 41-66.