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C. ESTUARINE SURVEYS

2. THE ST LUCIA ESTUARY

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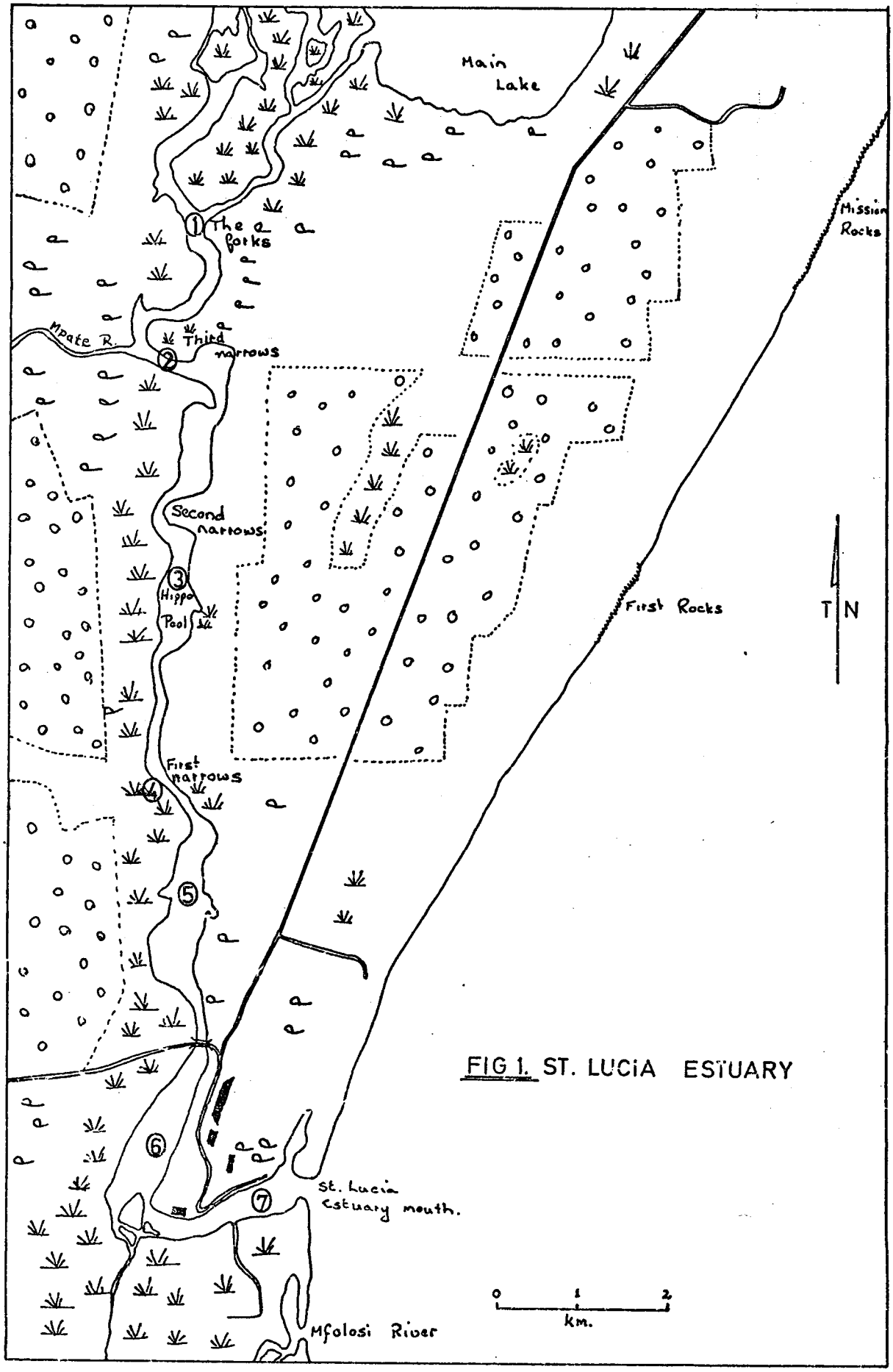

FIG 1. ST. LUCIA ESTUARY

THE ST LUCIA ESTUARY

INTRODUCTION

The topography of the St Lucia system was described by Day *et al* (1954). At that time the Umfolosi River opened into the mouth of the St Lucia system, but since then has been diverted so that it now opens separately into the sea, at a point about 2 km south of the St Lucia estuary mouth (Fig. 1). In addition extensive dredging above and below the road bridge across the estuary between stations 5 and 6, has resulted in improved tidal exchange. At the time of this study, dredging was also in progress above station 1 (Fig. 1), cutting a new channel between "The forks" and the main lake.

The present study was confined to the estuarine end of the lake only, to cut down on the number of samples that would otherwise have been necessary to adequately sample the main lakes and False Bay. It was felt that pollutants entering the system would in any event be detected in the lower part of the estuary. Prior to the study the system had become well flushed, as a result of good rains, and salinities were very low in the main lakes. Our visit was thus delayed until late April 1978, when salinities in the main lakes had risen to 4 - 6 °/oo, and about 30 °/oo in the narrows. Details of Natal Parks Board salinity readings for April and May 1978 are given in Table 1.

The estuary was visited from 24 - 28 April 1978, following a full-moon springtide on 23rd. Full tide data are presented in Table 2.

TABLE 2

Tide timetable for St Lucia estuary during late April 1978

Date	High	Low
25.4.78	04h56 17h18	11h06 23h21
26.4.78	05h34 17h58	11h44 24h00
27.4.78	06h16 18h42	12h25 -

The survey was conducted in the usual manner as described in previous annual reports. Water, mud and animal tissue samples were collected for heavy metal analyses, muds and animal tissues for pesticide analysis and zooplankton and zoobenthos samples for species analysis. A movement of large prawns (*Penaeus indicus*) was detected during the survey, and some of these were collected for insecticide and heavy metal analysis. A reasonable sample of fish was collected in the gill net at Station 4 (First narrows) before the net was completely ruined by a large crocodile.

ACKNOWLEDGEMENTS

We are grateful to the Natal Parks Board for allowing us to camp in a convenient area on the banks of the estuary, for use of their jetty facilities and for the salinity data listed in Table 1.

PHYSICAL CHEMICAL DATA

The Kjeldahl nitrogen and OA analyses of muds from each station are included in the meiofauna table (Table 4) since interpretation of the data in Table 4 relates to these parameters. While these samples were being collected, samples were also taken for dissolved oxygen, together with temperature and salinity data (Table 3).

TABLE 3

Temperature, salinity and dissolved oxygen data St Lucia estuary 25.4.78

Station	Temperature °C	Salinity °/oo	D.O. mg/l
1 Surface	23,4	27,3	6,49
1 Bottom	-	-	6,70
2 Surface	23,4	28,5	6,32
3 Surface	23,7	28,5	6,66
4 Surface	23,4	28,5	6,56
4 Bottom	-	-	6,63
5 Surface	24,0	29,8	6,63
6 Surface	25,1	32,6	6,76
7 Surface	25,4	34,0	7,04

The Kjeldahl nitrogen and O.A. data for the muds are discussed in the section of meiofauna.

THE BENTHIC FAUNA

Due to the presence of crocodiles and hippopotami in the system our normal method of scuba diving to obtain accurate cores was considered inadvisable. Use was therefore made of a remote corer and a dredge in obtaining samples.

At each station a one litre sample of sediment was obtained by means of a cone dredge. After fixing in 5% formalin, the macrofauna was extracted by stirring, decanting and sieving through a 230 µm sieve, and analysed qualitatively and quantitatively. In addition, two cores of sediment were collected at stations 1 to 6. The cores covered a surface area of 50 cm^2 and extended to a depth of 10 cm, thus yielding samples comparable to those normally obtained by scuba diving. At Station 7, situated near the mouth of the estuary, a strong current prevented the taking of sediment cores. The meiofauna was extracted from the sediment using the techniques of Oostenbrink (1960) and Heip *et al* (1974), and analysed qualitatively and quantitatively. Subsamples of sediment from all stations were analysed for oxygen absorbed from alkaline permanganate (O.A.) and Kjeldahl nitrogen.

The Kjeldahl nitrogen and O.A. values (Table 4) indicate the presence of high levels of nitrogenous and easily oxidisable organic material in the sediments throughout most of the survey area. Only at Station 7, where the sediments consisted of clean, well-washed sand were relatively low values recorded. Considering the high organic content, the meiofauna (Table 4) was surprisingly poorly developed. This can be attributed to the high percentage of silt present in the sediments. Silt is restrictive to meiofauna in that it tends to smother organisms and interfere with the through flow of oxygen bearing water by blocking the interstices. At Station 1 there was evidence of an anaerobic layer. The benthic macrofauna (Table 5) was also surprisingly poorly developed in terms of total numbers and diversity. At Station1, for example, where anaerobic conditions were evident, the fauna was restricted to relatively few nematodes. The presence of organically rich silt and the associated potential for smothering and anaerobic conditions again appears to be the reason for the paucity of macrofauna. The impoverished macrofauna at Station 7, where silt was absent, can be attributed to physical instability resulting from strong tidal flows.

ZOOPLANKTON

The zooplankton was sampled in the usual way, using a sled-net hauled 50 m across the bed of the estuary. The results are shown in Table 6. The zooplankton was dominated throughout the narrows by crab zoeae. The calanoid copepod *Pseudodiaptomus stuhlmanni* was encountered only in small numbers, but is probably more common than these samples suggest, since they were collected in good afternoon light to avoid having to navigate past hippo herds in the dark. *Pseudodiaptomus* is always more evident in night-collected samples. The settled volume of the samples was consistently below 5 cc, indicating a relatively low zooplankton biomass.

CHLORINATED PESTICIDES

Types of samples analysed were sediments taken at the stations shown, prawns caught by cast net and various fish.

The method of preparation, extraction and analysis was similar to that previously reported.

No pesticides were detected in the sediments. Some DDT and its decomposition products DDE and TDE were detected in the fish tissues, the highest level being in the liver of the *Acanthopagrus berda* (see Table 7). The levels were about an order lower than the higher levels found at Kosi Bay and about similar to those found in the commercial areas such as Port Elizabeth and East London, but generally higher than in similar species from remote areas such as Bashee estuary.

In addition to the above, some bird-eggs were analysed. Two species of birds' eggs were collected for us by Mr Aldo Berrutti, with the permission of the Natal Parks Board. The results are given in Table 8. Neither the gull nor spoonbill eggs showed DDT levels comparable with those found in the Black-backed Gull from St Croix Island in Algoa Bay. In the latter between 1 000 and 2 000 µg/kg was detected, but the highest total DDT detected in the eggs from St Lucia was about 150 µg. Of further interest is the presence of both DDT and TDE in all eggs from St Lucia, suggesting a fairly local source of the contamination. The gulls' eggs from St Croix Island, on the other hand, contained only DDE. Dieldrin levels were low in

the grey-headed gull eggs from St Lucia, but in the spoonbill eggs, ranged from 70 - 80 µg/kg, similar to levels found in seabird eggs from St Croix (Second Annual Report 1976).

TRACE METAL RESIDUES

Water, sediment and animal tissue samples were taken for metal analyses in the usual way.

Sediments

The data, presented in Table 9, reveals little of any consequence apart from the high levels of iron. These were even higher, on average, than those found in the sediments of Durban Bay. The origin is presumably geological and may be aggravated by dredging operations. The low result from Station 7 is directly related to the sandy nature of that sample, taken near the mouth of the estuary. Nickel is another element which was relatively high in the sediments, with as much as 83 µg/gm recorded for Station 1. The highest recorded level in Durban Bay sediments was only 25 µg/gm.

Water

Apart from iron which was again high (Table 10) the results were typical of unpolluted estuaries. Nickel was unfortunately not analysed in the water samples.

Animal Tissues

Table 11 lists the results from animals collected from the estuary. An unusual concentration of large *Penaeus indicus* was detected in the region of Station 4 and the opportunity was taken to collect and analyse a series of these. In addition a number of fish were collected in the gill net and on rod and line.

Neither iron nor nickel show up markedly in these tissue analyses with nickel consistently lower in animal tissue than it was in the sediments.

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TABLE 1

Natal Parks Board salinity data for St Lucia estuary and lakes during April and May 1978. Salinity in °/oo

	LOCATION	1.4.78	3.5.78
1.	NPB Jetty, St Lucia mouth	15,5	34,8
2.	Bridge, NPA water level recorder	15,0	24,6
3.	Narrows, NPA water level recorder	14,7	34,3
4.	Esssengeni, NPA water level recorder	14,4	34,0
5.	Potter's Channel, NPA water level recorder	14,3	27,5
6.	Mitchell Island, NPA water level recorder 300 ms	12,6	15,6
7.	Old Jetty, 3122600:51200	14,9	15,4
8.	Charter's Creek, W3M05 water level recorder	11,3	14,6
9.	Dead Tree Bay, 3113600:553000	8,3	9,0
10.	Fanies Island, W3M06 water level recorder	7,5	6,2
11.	Tewati, 3106000:49000	6,0	7,2
12.	Hell's Gates	4,7	5,0
13.	Nyalazi river mouth, 3108700:60800	1,2	6,4
14.	Hluhluwe river mouth, 310300:6200	3,6	4,6
15.	Lister's Point, W3M03 water level recorder	5,2	6,6
16.	Sengwane, 3096300:47600	4,2	4,7
17.	Selly's Lakes upstream, 30962000:42000	4,1	4,6
18.	Selly's Lakes upstream, 309662000:42000	-	-
19.	Bird Island, NOA water level recorder	3,0	5,2
20.	Mkuzi river mouth, 30862000:50800	0,4	1,4
21.	Mkuzi river upstream, 309400:5100	0,4	0,4
22.	False Bay North	5,5	5,3
23.	Vincent Island	10,6	10,0
24.	Imbisityeni	6,7	5,3
25.	Lane Island	6,0	5,0

TABLE 4

The meiofauna (numbers per 100 cm^2 to a depth of 10 cm) and sediment chemistry of St Lucia estuary - April 1978

Station number	1	2	3	4	5	6	7
NEMATODA	89	48	892	189	605	733	
HARPACTICOIDA	97	4	2	2		2	
ACARINA	2		2				
TURBELLARIA	2		2				
POLYCHAETA			4	2	14	32	
TOTAL NO.	190	52	902	193	619	767	
NO. OF TAXA	4	2	5	3	2	3	
O.A. ($mgO_2\ g^{-1}$)	34,9	25,4	13,0	14,9	20,1	21,9	1,44
Kjel. N ($\mu g\ g^{-1}$)	2 334	1 858	592	868	1 170	866	30,9

TABLE 5

The benthic macrofauna (numbers per litre of sediment) of St Lucia estuary - April 1978

Station number	1	2	3	4	5	6	7
NEMATODA	32	318	28	77	194	224	12
NEMERTEA							3
TURBELLARIA							10
OLIGOCHAETA							
POLYCHAETA							1
Capitellidae		171		34	24	102	1
Glyceridae							
Glycera sp.			2	1			
Nereidae							
Dendronereis sp.			2	1			
ARCHIANNELIDA							1
Protodrilus sp.							1
Saccocirrus sp.							1
CYCLOPOIDA		2				2	
HARPACTICOIDA			3	3			
PELECYPODA				2			
Solen sp.				1			
BRACHYURA							
Tylodiplax blephariskios					2	5	
ISOPODA							
Anthuridae					4		
Grathiidae						1	
TOTAL NO.	32	491	35	119	224	334	30
NO. OF TAXA	1	3	4	7	4	5	8

TABLE 6

Zooplankton per 50 m haul using a sled net. St Lucia Estuary
26-27 April 1978

Station number	1	2	3	4	5	6	7
CNIDARIA							
Medusae		1			20	20	
POLYCHAETA							
Sabellid larvae					1		20
CHAETOGNATHA		2			20	10	10
OSTRACODA					10		
COPEPODA CALANOID							
Nauplii	10				20		60
Juveniles	10						50
Calocalanus sp.					20		10
Nannocalanus minor					10		
Acrocalanus gibber					1	1	40
A. similis		50	30			10	60
A. monochus							10
Paracalanus aculeatus	20		20		110	20	90
P. crassirostris		10			10	10	
Neocalanus gracilis							10
Eucalanus pileatus					1		
Calanopia simplex					1		
Temora turbinata	10				50	30	30
Centropages elongatus					10		
Labidocera minutum							10
Pseudodiaptomus stuhlmanni	100	220	170		2		
P. nudus		10			30	2	60
Acartia natalensis	10	460			10		10
A. negligens							10
COPEPODA CYCLOPOID							
Oithona brevicarnis			10	100			
Oithona sp. (marine)					10	20	40
Corycaeus sp.					10	20	40
Oncaea sp.		1	10				30
Halicyclops sp.		10			60		10
COPEPODA HARPACTICOID							
Euterpina acutifrons	10				20	10	
Clytemestra						10	10
Others		10				10	20
CIRRIPEDIA							
Nauplii	60	70	150	1 400	250	310	270
Cypri						1	10
DECAPODA							
Crab zoeae	26 580	40 990	28 990	89 600	50 120	30 970	7 380
Crab megalopae		3					
Caridian larvae			2		10	1	
Penaeid juveniles	4	1		2	10	10	40
ECHINODERMATA							
Brittle-star larva						10	
GASTROPODA							
Larvae		30					10
Pelecypod larvae			30			10	
UROCHORDATA							
Oikopleura		20					
CHORDATA							
Fish eggs	40	40	180	100	30	60	140
Fish larvae	120	80	120		20	40	130
Total numbers	26 974	42 018	29 712	91 202	50 866	31 585	8 650
Number of taxa	12	18	11	5	27	22	29
Settled volume (cc)	-	2,7	-	3,9	3,5	2,6	-
Time of sampling 26.4.78	16h00	16h20	16h40	17h00			
27.4.78					16h30	17h00	17h20
Temperature (°C)	22,6	22,4	22,4	22,4	22,2	22,6	23,8
Salinity (°/oo)	30,0	30,0	30,8	30,8	31,0	33,0	34,0
Depth (m)	1,5	1,5	1,6	1,5	1,5	1,3	2,1

TABLE 7

Location: St Lucia Estuary
Sample: Animal Tissue and Sediments
Units: µg/kg

Date: April 1978
ND = Not detected

Species	Tissue	Length mm	DDE	DDT	TDE	Dieldrin
Sediments (7 samples)	-	-	ND	ND	ND	ND
Mugil cephalus	Muscle	490	2	2	0,5	1
" "	Liver	"	15	38	10	8
Pomadasys commersoni	Muscle	300	4	4	1	1
" "	Liver	"	9	8	2	2
Acanthopagrus berda	Muscle	220	0,5	1,8	ND	0,5
" "	Liver	"	16	8	ND	ND
" "	Muscle	280	2	4	1	ND
" "	Liver	"	79	13	ND	ND
Argyrosomus hololepidotus	Muscle	530	2	1,8	0,2	ND
" "	Liver	"	34	26	4	4
Elops machnata	Muscle	730	1,1	0,8	ND	0,7
" "	Liver	"	22	21	7	4
Penaeus indicus	Whole Animal	-	1	1	ND	1

TABLE 8

Location: St Lucia Lakes
Sample: Bird Eggs
Units: ug/kg

Date: June 1978
ND = Not detected

Species	DDE	DDT	TDE	Dieldrin
Larus cirrocephalus (Grey-headed Gull)	42	ND	140	3
" " " "	58	20	54	3
Platalea alba (Spoonbill)	110	31	17	5
" " "	55	32	9	86
" " "	58	25	17	84
" " "	52	23	21	86
" " "	56	22	19	76
" " "	51	23	20	73

TABLE 9

Location: St Lucia
Sample: Sediment
Units: µg/g dry weight

Date: 25-26.4.78

Stn No.	Hg	Cu	Cd	Pb	Zn	Fe	Cr	Co	Ni
1	0,037	61,1	0,396	18,7	71,9	60236	154	26,7	83,6
2	0,031	46,0	0,280	15,7	50,9	43756	113	20,4	55,4
3	0,015	25,3	0,244	5,59	30,5	24680	66,9	10,8	33,2
4	0,010	36,8	0,082	4,32	43,7	27530	95,5	15,4	46,7
5	0,024	39,4	0,236	11,4	38,7	35890	96,0	21,3	50,4
6	0,020	38,6	0,195	9,63	46,6	35017	89,2	19,7	51,7
7	0,007	2,00	0,150	0,754	3,42	2954	7,05	1,06	2,87

TABLE 10

Location: St Lucia
Sample: Water
Units: µg/ℓ

Date: 25-26.4.78

Stn No.	Hg	Cu	Cd	Pb	Zn	Fe	Co
1	0,095	2,69	0,031	2,47	4,47	887	0,557
2	0,085	3,58	0,250	2,11	7,03	986	0,398
3	0,080	1,23	0,081	1,16	2,87	465	0,080
4	0,047	1,68	0,069	2,6	2,40	803	1,39
5	0,128	1,23	0,025	1,4	1,44	727	2,39
6	0,024	17,2	0,038	6,06	11,7	1 971	1,11
7	0,033	1,57	0,056	1,77	2,23	1 222	2,03

TABLE 11

Location: St Lucia
Sample: Biological Tissues
Units: ug/g dry weight

Date: 25-26.4.78

NOTE: S = Section across the middle

Sample	Species	Hg	Cu	Cd	Pb	Zn	Fe	Cr	Co	Ni	Type	Size mm
T1	*Penaeus indicus*	0,074	97,7	0,325	2,15	68,8	575	6,44	0,950	3,40	S	70
T2	" "	0,084	88,6	0,447	2,94	60,3	513	7,51	0,668	2,25	S	80
T3	" "	0,071	40,8	0,159	0,571	45,2	100	5,55	0,202	1,19	S	100
T4	" "	0,066	78,9	0,390	1,48	49,8	294	3,60	0,278	2,01	S	75
T5	" "	0,130	63,3	0,370	2,36	53,7	633	3,35	0,560	4,29	S	70
T6	" "	0,050	55,2	0,269	1,92	47,0	246	0,450	0,192	2,22	S	110
T7	" "	0,107	53,6	0,456	1,83	44,8	120	1,72	0,313	1,41	S	60
T8	" "	0,055	38,3	0,366	0,480	44,3	1135	0,552	0,136	1,28	S	90
T9	" "	0,058	84,9	0,551	2,70	59,5	648	1,13	0,322	2,33	S	65
T10	" "	0,062	175	0,852	0,353	61,9	340	6,75	0,743	1,72	S	75
T11	*Acanthopagrus berda*	0,329	1,74	0,132	0,760	27,3	61,9	11,9	0,311	1,57	Muscle	320
T12	" "	0,363	216	3,89	0,843	951,0	3076	19,1	3,41	2,38	Liver	320
T13	*Argyrosomus hololepidotus*	0,158	1,99	0,315	0,178	20,8	47,1	13,6	0,236	2,46	Muscle	520
T14	" "	0,047	12,0	0,669	0,201	84,9	809	14,6	0,416	1,70	Liver	520
T15	" "	0,078	2,88	0,114	ND	19,5	31,3	6,59	0,086	1,59	Muscle	390
T16	" "	0,111	7,67	0,664	ND	64,0	930	13,6	0,400	0,867	Liver	390
T17	*Mugil cephalus*	0,017	2,15	0,195	ND	30,4	67,9	4,83	0,128	0,302	Muscle	490
T18	" "	0,159	739	1,11	ND	132	2170	7,65	2,75	1,20	Liver	490
T19	*Liza macrolepis*	0,038	1,34	0,407	ND	11,4	15,9	6,90	0,080	2,90	Muscle	360
T20	" "	0,044	151	0,604	0,540	26,1	227	3,56	0,866	8,42	Liver	360
T21	*Pomadasys commersoni*	0,026	0,984	0,112	ND	12,2	23,3	2,17	0,029	1,80	Muscle	420
T22	" "	0,003	2,87	0,150	0,096	19,1	382	1,17	0,028	1,58	Liver	420