

## CHAPTER 5

## 5. Distribution Of Fish

## 5.1 Introduction

In Malaysia, mangroves traditionally provide two main biological resources, timber and fish (Khoo,1989). Jothy (1984) found that 40% of the fish landings in Malaysia are associated with mangroves. Studies of fish community show a large number of species utilize the habitat i.e 119 species in Selangor (Malaysia) mangroves including its creeks and inlets (Chong *et al.*, 1990 and Sasekumar *et al.*, 1992). Murdy (1987) recorded 37 species in the Muar mangrove estuary on the west coast of Peninsular Malaysia.

Mangroves are the feeding and breeding grounds and a habitat for juvenile fish (Chong, 1980; Bell *et al.*, 1984; Little *et al.*, 1988; Odum and Heald,1972; Pinto, 1987 ). The macrofauna on the mangrove floor and pelagic resources in the waterways provide the main food resources for fish (Leh and Sasekumar,1989). The animals of the benthic community are probably sustained by benthic flora, dead phyto- and zooplankton, allochthonous mangrove detritus, faecal deposits and other dead organic material (Chong *et al.*, 1989).

In mudflats of the subtidal zone, Selangor, the fish

population are co-dominated by the Sciaenidae, Clupeidae, Leiognathidae and Engraulididae (Chong *et al.*, 1989). Martosewojo and Soedibjo (1989) found 82 species of fish with Ambassidae as a dominant family at Grajagan mangroves in Java. Ambassidae, Engraulididae and Clupeidae occurred in high numbers in the mangrove estuary at Sungai Sementa Kecil, Selangor (Sasekumar *et al.*, 1989).

Few studies have been carried out on the fish associated with mangrove inlets or estuaries (Blaber, 1980; Chong *et al.*, 1989; Leh and Sasekumar, 1984; Little *et al.*, 1988 ). Only a few of these studies were carried out in mangrove creeks (Chong *et al.*, 1989; Leh and Sasekumar, 1989 Little *et al.*, 1988). The aim of this study is to identify the common species that occur in mangrove creeks during high tide. Their distribution in terms of wet weight, density, number of specimens and species composition was studied. Diversity and similarity of species between sites were also examined.

## **5.2 Results And Discussion**

### **5.2.1 Abundance**

#### **5.2.1.1 Total Wet Weight Of Fish**

The monthly observation for the total wet weight for Site I recorded all the samples with more than 400g. The

highest total wet weight was recorded on 5 April/with 3686.1g in the sample. Site II recorded the highest total wet weight of 2159.0g in 29 September. Site III recorded the highest total wet weight of 5002.1g in November (Table 4.0).

The lowest catch for Site I was recorded in May with 423.1g sample. Site II recorded the lowest catch in weight in October. Site III recorded the lowest total wet weight of 438.6g in 22 April. The monthly average of the total wet weight for three sites recorded catches with more than 1000g samples (Table 4.0).

#### 5.2.1.2 Fish Biomass

The biomasses of fish in creeks was calculated based on the catch in the bagnets. The highest biomass for Site I was found on 5 April with  $111.7\text{g/m}^2$ . Whereas the lowest biomass at this site was recorded in May with  $12.8\text{g/m}^2$ . The lowest and highest biomasses for Site II were recorded in 29 Sept. and <sup>28</sup>October with values of  $54.9\text{g/m}^2$  and  $21.4\text{g/m}^2$  respectively. Site III had the highest biomass of  $262.6\text{g/m}^2$  in January and the lowest of  $17.0\text{g/m}^2$  in 22 April 1993.

The monthly average of biomasses for three sites were also recorded. Site III had the highest monthly biomass

Table 4.0 : The total number of specimens, species, wet weight and biomass of fish captured in bagnets at three sites (I, II and III) in Sungai Sementa Kecil.

Month/Date/ 1992	Site	Total number of specimens	Total number of species	Total wet weight (g)	Fish Biomass (g/m <sup>2</sup> )
Sept, 2	I	732	10	1622.1	49.2
	II	346	6	1531.4	39.0
Sept, 29	I	716	15	2087.1	63.2
	II	1099	15	2159.0	54.9
Oct, 28	I	983	15	2249.3	68.2
	II	231	15	840.6	21.4
Nov, 25	I	607	14	1570.9	47.6
	III	1945	25	5002.1	193.9
Dec, 28	I	154	15	1430.0	43.3
	III	393	18	1697.5	65.8
Month/Date/ 1993	Site	Total number of specimens	Total number of species	Total wet weight (g)	Fish Biomass (g/m <sup>2</sup> )
Jan, 21	I	465	16	1998.4	60.6
	III	904	23	6775.7	262.6
Feb, 22	I	236	12	491.6	14.9
	III	453	9	869.2	33.7
Apr, 5	I	536	17	3686.1	111.7
	III	311	16	752.2	29.2
Apr, 22	I	133	11	463.5	14.0
	III	158	11	438.6	17.0
May, 21	I	161	9	423.1	12.8
	III	194	16	1652.0	64.0
Jun, 26	I	263	15	688.1	20.9
	III	801	17	569.6	22.1
Jul, 26	I	672	15	1012.5	30.7
	III	652	15	1228.4	47.6
Aug, 21	I	684	14	1435.2	43.5
	III	460	15	821.8	31.9
Sept, 18	I	600	15	1270.3	38.5
	III	1047	18	2354.5	91.3
Average	I	496	14	1459.2	44.2
	II	559	12	1510.3	38.4
	III	665	17	2014.7	78.1



whereas Site II had the lowest monthly biomass (Table 4.0).

#### **5.2.1.3 Number Of Fish Species And Specimens**

Twenty-three families with thirty-eight species of fish were found in this study. Site I, II and III collected twenty-nine, nineteen and thirty-six species respectively (Table 4.0). The monthly number of species showed that Site III collected the highest monthly number of species in November 1992 and Site II collected the lowest monthly number of species on 2 Sept. 1992. The monthly average for number of species indicated that Site III had the highest number of species whereas Site II had the lowest number of species (Table 4.0).

The total number of specimens were measured on each sampling occasion. Site I recorded the highest number of specimens in October 1992 with 983 specimens. This site collected the lowest monthly number of specimens among the three sites with only 133 specimens (22 April 1993). Site II recorded the highest number on 29 September with 1099 specimens. Site III recorded the highest number of specimens in November with 1945 specimens. This site recorded the highest monthly number of specimens among the three sites (Table 4.0). The monthly average for the total number of specimens indicated that Site III had the highest

monthly number of specimens, while Site I had the lowest monthly number of specimens (Table 4.0).

#### 5.2.2 Total Wet Weight Of Catches In Bagnet Against Tidal Heights.

Results at Site I showed that the total wet weight of catches were more than 1000g when the tide levels were 4.5m to 5.8m except for tide levels at 4.9m. This site collected the highest weight at 4.5m tide level. The weight of catches were below 1000g at 4.9m tide level. Site II recorded the highest weight at 5.3m tide level. Most of the total wet weights at Site III were more than 1000g at every tide level of sampling (Figure 4.0).

The correlation of wet weights on tide levels was calculated for Sites I and III. Both Sites I and III showed no significant correlation ( $p > 0.05$ ) between total fish weight and tide level (Table 4.1).

#### 5.2.3 Abundance Of Fish Families

The percentage abundance of fish families were taken for monthly observations (Table 4.2). Bagnet samples collected at Site I showed that the fish species were

Table 4.2 : Percentage abundance of fish families captured in three small creeks (Sites I, II and III) in Sungai Semena Kecil, Selangor during 1992 and 1993.

Families	Site	1992										1993						
		Sep.2	Sep.29	Oct.28	Nov.25	Dec.28	Jan.21	Feb.22	Apr.5	Apr.22	May.21	Jun.26	Jul.26	Aug.21	Sep.18	Oct.16	Nov.13	Dec.10
Ambassidae	I	96.0	78.5	85.8	71.3	8.4	32.5	58.3	36.8	23.3	40.4	19.0	87.1	30.3	39.5	-	-	-
	II	88.2	85.1	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	38.4	21.6	21.8	77.0	35.7	25.3	57.4	16.5	76.5	34.7	25.1	-	-	-
Ariidae	I	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	II	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Belontiidae	I	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	II	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Centropomidae	I	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	II	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Clupeidae	I	0.0	8.6	3.5	1.6	0.6	5.0	14.4	3.9	23.3	16.1	8.0	3.9	5.8	6.3	-	-	-
	II	0.0	4.7	10.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	23.3	5.6	5.0	19.0	11.3	20.3	5.8	10.3	5.2	14.6	6.1	-	-	-
Cynoglossidae	I	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	II	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eleotridae	I	0.3	0.0	1.0	2.5	5.2	1.0	1.7	4.7	6.0	6.2	7.6	-	3.5	1.8	-	-	-
	II	0.9	0.6	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0.2	4.8	2.0	1.8	2.6	3.2	0.0	17.5	0.6	0.0	1.0	-	-	-
Engraulidae	I	0.3	1.3	2.5	12.7	3.9	2.0	10.2	16.0	5.3	4.3	34.2	2.7	50.7	40.8	-	-	-
	II	1.7	4.9	12.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	19.5	40.5	23.1	0.0	22.5	29.7	21.0	0.0	7.8	25.6	27.3	-	-	-
Gerreidae	I	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.8	0.3	0.0	0.3	-	-	-
	II	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0.0	0.0	0.0	0.0	7.7	0.0	0.0	1.5	0.0	0.0	8.9	-	-	-
Gobiidae	I	1.0	2.8	1.0	3.8	23.4	2.0	4.2	2.8	4.5	6.2	11.0	1.2	1.5	2.3	-	-	-
	II	0.0	0.8	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0.9	2.3	2.0	-	3.2	6.3	0.9	17.0	1.7	2.0	2.5	-	-	-
Hemirhamphidae	I	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	II	0.0	0.0	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	3.2	6.6	8.4	0.0	0.0	3.8	9.3	0.0	0.0	0.0	6.0	-	-	-
Leiognathidae	I	0.8	0.0	3.0	0.8	-	2.0	3.0	3.7	5.3	0.0	1.5	1.8	2.5	1.0	-	-	-
	II	5.2	1.7	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	3.2	2.5	0.0	1.5	6.1	7.6	1.6	6.2	2.2	15.9	4.3	-	-	-
Lutjanidae	I	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0
	II	0.0	0.1	12.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0.6	1.5	0.3	0.7	0.0	0.0	0.0	0.0	0.3	0.0	0.0	-	-	-
Mugilidae	I	1.6	7.4	2.7	6.8	51.3	51.9	8.1	28.2	18.8	14.3	17.5	2.4	3.7	4.3	-	-	-
	II	2.9	1.7	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	5.7	3.1	8.4	0.0	2.9	0.0	2.9	17.5	4.2	4.6	11.6	-	-	-
Platycephalidae	I	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	II	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0.1	0.5	0.2	0.0	0.6	0.0	0.3	0.0	0.2	0.0	0.0	-	-	-
Plotosidae	I	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.6	0.0	0.0	0.4	0.0	0.0	0.3	-	-	-
	II	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0.0	0.3	0.2	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-
Pomadasyidae	I	0.0	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.0	-	-	-
	II	1.2	0.1	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	1.6	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	1.2	-	-	-

Continued from Table 4.2 :

Scatophagidae	I	0.0	0.1	0.2	0.5	3.2	1.6	0.0	2.1	4.5	5.0	0.0	0.0	1.6	1.0
	II	0.0	0.1	0.0	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	1.0	3.6	1.1	0.0	2.3	3.8	0.9	3.6	1.4	2.4	2.9
Sciaenidae	I	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	II	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Serranidae	I	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	II	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Siganidae	I	0.0	0.1	0.0	0.0	0.6	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	2.0
	II	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0.0	1.8	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.2	0.2
Syngnathidae	I	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	II	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tetraodontidae	I	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.7	6.8	5.6	0.0	0.1	0.0	0.2
	II	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	2.3	5.3	25.6	0.0	2.3	0.0	0.1	7.7	0.0	0.0	2.9

\* - sampling was not done

dominated by members of the families Ambassidae, Mugilidae and Engraulididae. Ambassidae made up to 96% of the catch in the 2 September 1992 catch. The lowest percentage of Ambassidae was in 26 June 1993 with 19.0%. The mean percentage abundance of Ambassidae, Mugilidae and Engraulididae were 50.5%, 15.6% and 13.4% respectively (Table 4.2).

Site II was also dominated by the family of Ambassidae with monthly <sup>percentage</sup> abundance of not less than 50.0%. However, Engraulididae and Clupeidae were also co-dominant at this site with mean percentages of 6.3% and 5.0% respectively. Fish samples at Site III showed that Ambassidae, Engraulididae and Clupeidae were the dominant families. Ambassidae was again dominant in all the catches. The mean percentages of these three families were 39.1%, 19.7% and 11.5% respectively (Table 4.2).

#### 5.2.4 Species Composition

A total of 38 species were found in this study (Table 4.3). The Ambassidae was represented by *Ambassis gymnocephalus* as the dominant species in Sites I, II and III. Site I was co-dominated by *Liza melinoptera*, *Thryssa kamalensis* and *Ilisha megaloptera* based on the number of specimens. Site II was also represented by *Stolephorus tri*,

Table 4.3 : The occurrence of fish collected using bagnet placed across creeks at three sites (I, II and III) in Sungai Sementa Kecil based on the number of specimens.

Families/Species	Site	1992					1993							
		Sep,2	Sep,29	Oct,28	Nov,25	Dec,28	Jan,21	Feb,22	Apr,5	Apr,22	May,21	Jun,26	Jul,26	Aug,21
<b>Ambassidae</b>														
<i>Ambassis gymnocephalus</i>	I	+++	+++	+++	+++	+	+++	+++	+++	+	++	++	+++	+++
	II	+++	+++	+++	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	+++	++	+++	+++	+++	+	+++	+	+++	+++
<b>Ariidae</b>														
<i>Arius sagor</i>	I	0	0	0	0	0	0	0	0	0	0	0	0	0
	II	0	0	0	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0	0	+	0	0	0	0	0	0	0
<b>Belontiidae</b>														
<i>Tylosurus strongylurus</i>	I	0	0	0	0	0	0	0	0	0	0	0	0	0
	II	0	0	0	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	+	0	+	0	0	0	0	0	0	0
<b>Centropomidae</b>														
<i>Lates calcarifer</i>	I	0	0	0	0	0	0	0	0	0	0	0	0	0
	II	0	0	0	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0	0	+	0	0	0	0	0	0	0
<b>Clupeidae</b>														
<i>Anodontostoma chacunda</i>	I	0	0	0	0	0	0	0	0	0	0	0	0	0
	II	0	0	0	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0	0	0	0	0	0	+	0	0	0
<i>Hilsa</i> sp.	I	0	0	+	+	0	+	0	0	0	0	+	0	+
	II	0	0	+	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0	+	0	0	+	+	+	+	+	+
<i>Hilsa megaloptera</i>	I	0	++	+	+	+	+	+	+	+	+	+	+	+
	II	0	++	+	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	+++	+	+	0	+	+	+	+	+	++
<b>Cynoglossidae</b>														
<i>Cynoglossus lingua</i>	I	0	0	0	0	0	0	0	0	0	0	0	0	0
	II	0	0	0	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0	0	+	0	0	0	0	0	0	0
<b>Eleotridae</b>														
<i>Butis butis</i>	I	+	0	+	+	+	+	+	+	+	+	+	0	+
	II	+	+	+	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	+	+	+	+	+	+	0	0	+	+
<i>Ophiocara porocephala</i>	I	0	0	0	0	+	0	0	0	0	0	0	0	0
	II	0	0	0	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0	0	0	0	0	0	0	0	0	0
<b>Engraulidae</b>														
<i>Stolephorus tri</i>	I	+	+	+	+	+	+	+	+	+	+	+	+	+
	II	+	++	+	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	+++	+++	+	++	0	+	++	+	+	++
<i>Thryssa kamalensis</i>	I	+	+	0	0	0	+	+	+	0	0	+	+	+++
	II	0	0	0	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	+	0	0	+	+	+	++	+	+	+
<i>Thryssa mystax</i>	I	0	+	+	++	+	0	+	++	+	0	+	+	+
	II	0	+	+	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	+	+	+++	+	+	+	+	+	+	+
<b>Gerreidae</b>														
<i>Gerres abbreviatus</i>	I	0	0	0	0	0	0	0	+	0	0	+	+	0
	II	0	0	0	-	-	-	-	-	-	-	-	-	-
	III	-	-	-	0	0	0	0	+	0	0	+	0	0

continued Table 4.3 :

Families/Species	Site	1992					1993								
		Sep,2	Sep,29	Oct,28	Nov,29	Dec,28	Jan,21	Feb,22	Apr,5	Apr,22	May,21	Jun,26	Jul,26	Aug,21	S
Gobiidae															
<i>Acentrogobius caninus</i>	I	+	0	+	+	+	+	+	0	0	0	+	+	0	
	II	0	0	+	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	0	0	0	0	0	0	0	0	0	
<i>Boleophthalmus boddarti</i>	I	0	0	0	+	+	+	+	0	0	0	0	0	0	
	II	0	0	+	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	0	+	0	0	0	0	+	0	+	
<i>Glossogobius giuris</i>	I	+	+	+	+	+	+	+	+	+	+	+	+	+	
	II	0	+	+	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	+	+	0	+	+	+	+	+	+	
Gobiidae sp.	I	0	0	0	0	0	0	0	+	0	0	+	+	0	
	II	0	0	0	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	0	0	+	0	0	0	0	+	0	0	
<i>Periophthalmodon schlosseri</i>	I	+	0	0	+	+	0	0	0	0	0	+	0	0	
	II	0	+	0	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	+	0	0	0	0	+	+	+	0	
Hemirhamphidae															
<i>Hyporhamphus unifasciatus</i>	I	0	0	0	0	0	0	0	0	0	0	0	0	0	
	II	0	0	0	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	+	++	0	0	0	0	0	0	0	
<i>Zenarchopterus dispar</i>	I	0	0	0	0	+	0	0	0	0	0	0	0	0	
	II	0	0	+	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	++	+	+	0	0	+	++	0	0	0	
Leiognathidae															
<i>Leiognathus brevirostris</i>	I	+	+	+	+	0	+	+	+	+	0	+	+	+	
	II	0	+	+	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	+	0	+	+	+	+	+	+	+	
<i>Leiognathus equulus</i>	I	+	+	+	+	0	0	0	+	0	0	0	0	+	
	II	+	+	+	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	0	0	+	0	0	0	0	0	+	
<i>Secutor insidiator</i>	I	0	+	+	0	0	+	+	+	0	0	0	0	+	
	II	0	+	+	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	0	0	+	+	0	+	+	+	+	
Lutjanidae															
<i>Lutjanus johni</i>	I	0	+	0	0	0	0	0	0	0	0	0	0	0	
	II	0	+	+	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	+	+	+	0	0	0	0	0	0	
<i>Lutjanus russelli</i>	I	0	0	0	0	0	0	0	0	+	0	0	+	0	
	II	0	0	0	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	0	+	0	0	0	0	0	+	0	
Mugilidae															
<i>Liza melanopectera</i>	I	+	++	+	+	++	+++	+	+++	+	+	+	+	+	
	II	+	+	+	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+++	+	++	0	+	0	+	+	+	+	
<i>Liza subviridis</i>	I	0	+	+	0	0	+	0	+	0	0	0	+	0	
	II	0	+	0	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	0	0	0	0	0	0	0	0	0	
Platycephalidae															
<i>Platycephalus indicus</i>	I	0	0	0	0	0	0	0	0	0	0	0	0	0	
	II	0	0	0	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	+	+	0	+	0	+	0	+	0	

Continued Table 4.3 :

Families/Species	Site	1992					1993									
		Sep,2	Sep,29	Oct,28	Nov,25	Dec,28	Jan,21	Feb,22	Apr,5	Apr,22	May,21	Jun,26	Jul,26	Aug,21	Sep,18	
<b>Plotosidae</b>																
<i>Plotosus canius</i>	I	0	0	0	0	0	+	0	+	0	0	+	0	0	+	
	II	0	0	0	-	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	0	+	+	0	+	0	0	0	0	0	0	
<b>Pomadasyidae</b>																
<i>Pomadasyys hasta</i>	I	0	+	+	0	0	0	0	0	0	0	0	+	+	0	
	II	+	+	0	-	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	0	0	0	+	0	0	0	0	0	+	
<b>Scotophagidae</b>																
<i>Scotophagus argus</i>	I	0	+	+	+	+	+	0	+	+	+	0	0	+	+	
	II	0	+	0	-	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	+	+	0	+	+	+	+	+	+	+	
<b>Sciaenidae</b>																
<i>Dendrophysa russelli</i>	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	II	0	0	0	-	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	0	0	+	0	0	0	0	0	0	0	0	
<b>Serranidae</b>																
<i>Epinephelus bleekeri</i>	I	0	0	0	0	+	0	0	0	0	0	0	0	0	0	
	II	0	0	0	-	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	0	0	0	0	0	0	0	0	0	0	0	
<b>Siganidae</b>																
<i>Siganus canaliculatus</i>	I	0	+	0	0	0	0	0	0	0	0	0	0	0	0	
	II	0	0	0	-	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	0	0	0	0	0	0	0	+	0	0	0	
<i>Siganus javus</i>	I	0	0	0	0	+	0	0	0	0	+	0	0	0	+	
	II	0	0	0	-	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	0	+	0	0	0	0	0	0	0	+	+	
<b>Syngnathidae</b>																
<i>Dorichthys cunculus</i>	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	II	0	0	0	-	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	0	+	0	0	0	0	0	0	0	0	
<b>Tetraodontidae</b>																
<i>Chelonodon fluviatilis</i>	I	0	0	0	0	0	+	0	+	+	+	0	+	0	+	
	II	0	0	0	-	-	-	-	-	-	-	-	-	-	-	
	III	-	-	-	+	+	+++	0	+	0	+	+	0	0	+	

\* + - numbers less than 49.

++ - numbers from 50 to 99.

+++ - numbers above 100.

- : sampling was not done

0 : no specimen was found.

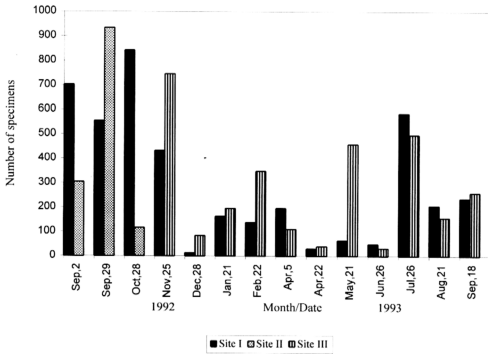


*Ilisha megaloptera* and *Liza melinoptera*. Site III was co-dominated by *Stolephorus tri*, *Ilisha megaloptera* and *Thryssa mystax* (Table 4.3).

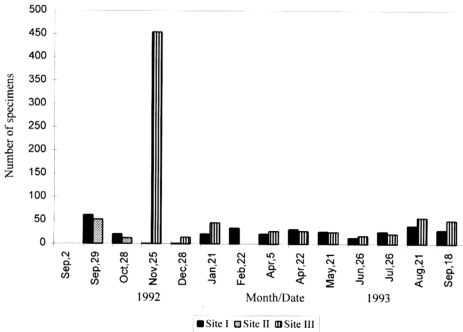
The abundance of *Ambassis gymnocephalus* at Sites I, II and III during the study period did not show any pattern. The highest number of specimens at Site I was collected in October 1992 and the lowest number in December 1992. Site II collected more than 100 specimens during the study period. Site III collected the highest number of specimens in July 1993, whereas the lowest number was in June 1993 (Fig. 4.1).

*Ilisha megaloptera* was found through out the study period at Site III. This species did not occur at Sites I and II in 2 September 1992. Site III recorded the highest number of specimens in November 1992 with more than 400 specimens. This was the highest number of specimens recorded among the three sites during the course of this study (Fig. 4.1).

The abundance of *Stolephorus tri* at Site I throughout the study period did not showed any pattern. Not more than 80 specimens were found at each monthly collection in Site II. The highest number of specimens of this species was found in Site III in November 1992 (Fig. 4.2). The abundance of *Thryssa kamalensis* at Sites I, II and III is

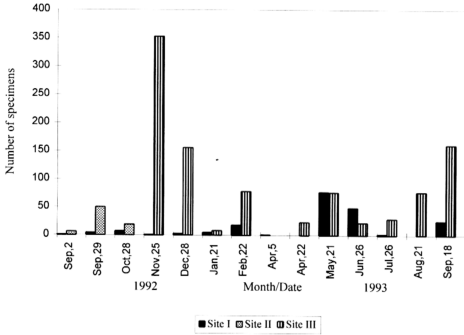


(a)

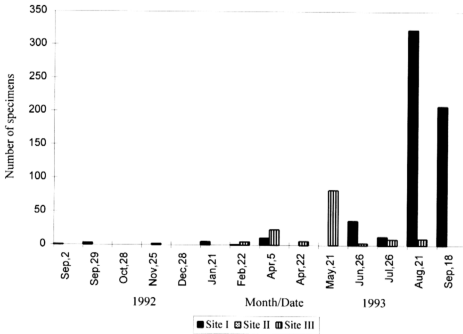


(b)

Figure 4.1 : The number of fish specimens (a) *Ambassis gymnocephalus* and (b) *Ilisha megaloptera* captured in three study sites (I, II and III) in Sungai Sementa Kecil during 1992 and 1993.



(a)



(b)

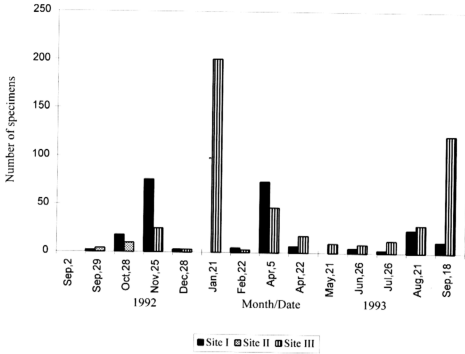
Figure 4.2 : The number of fish specimens (a) *Stolephorus tri* and (b) *Thryssa kamalensis* captured in three study sites (I, II and III) in Sungai Sementa Kecil during 1992 and 1993.

shown in figure 4.2. Thryssa mystax was found on every sampling occasion in Site III with the highest number of specimens collected in January 1993. Not more than 75 specimens were found at each monthly collection in Sites I and II (Fig. 4.3). Number of Liza melinoptera at Site II showed a linear pattern through the study period. The highest number of specimens collected in Site I was in January 1993 whereas for Site III it was in September 1993 (Fig. 4.3).

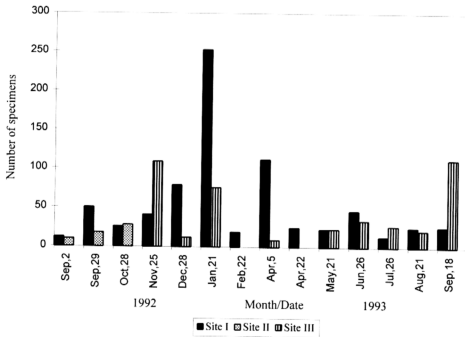
#### 5.2.5 Species Richness (D), Diversity (H') and Evenness (J')

The species richness, diversity and evenness between Sites I and II were calculated from pooled data from 2 September until 28 October 1992. Site II was more species rich and diverse compared to Site I. The difference of evenness value between these two sites showed that Site I and II had their own unique fish residents (Table 4.4).

The comparison for species richness, diversity and evenness between Site I and III was calculated for pooled data from 25 November 1992 until 18 September 1993. The higher value of species richness and diversity for Site III indicated that this site recorded more numbers of species compared to Site I. Although the value of species richness



(a)



(b)

Figure 4.3 : The number of fish specimens (a) *Thyrrsa mystax* and (b) *Liza melinoptera* captured in three study sites (I, II and III) in Sungai Sementa Kecil during 1992 and 1993.

and diversity was higher in Site III, the evenness of species was nearly similar. This indicates that Sites I and III had nearly the same residents (Table 4.4).

#### 5.2.6 Species Similarity (D)

The monthly similarity of species between Sites I and II was calculated using three collections (2 and 29 September and 28 October 1992). More specimens with the same species were captured on 2 September 1992. Comparing the monthly similarity of species between Sites I and III (samples from 25 November 1992 until 18 September 1993) showed that the highest value was obtained in July 1993. This indicates that more catches with the more similar species occurred in this month (Table 4.5).

The monthly average for similarity of species showed that more catches with the same species were found between Sites I and II (Table 4.5). However, the similarity value of species was higher between Sites I and II using all samples from 2 September 1992 until 28 October 1993. This shows that these two sites catch almost the same species of fish compared to Sites I and III (Table 4.6).

Table 4.4 : The comparison of diversity, evenness and richness of fish species captured in creeks between Sites I and II for the first three times of sampling and between Sites I and III for the rest of sampling during year 1992 and 1993.

	Site I	Site II	Site I	Site III
No of samplings	3	3	11	11
H'	0.70	0.91	1.92	2.19
H max	2.94	3.00	3.33	3.61
Evenness (J')	0.24	0.30	0.58	0.61
Species richness	5.31	5.88	7.38	9.33

Table 4.6 : The comparison of similarity of fish species captured in creeks between Sites I and II for the first three times of sampling and between Sites I and III for the rest of sampling during year 1992 and 1993.

Sites	Schoener Index (D)
I and II	0.93
I and III	0.70

Table 4.5 : Comparing the monthly similarity of fish species between Sites I and II and between Sites I and III using similarity index Schoener (D).

Month/Date/1992		Sites I and II
Sept, 2		0.91
Sept, 29		0.87
Oct, 28		0.64
		Sites I and III
Nov, 25		0.48
Dec, 28		0.24
Month/Date/1993		Sites I and III
Jan, 21		0.4
Feb, 22		0.7
Apr, 5		0.71
Apr, 22		0.62
May, 21		0.45
June, 26		0.67
July, 26		0.86
Aug, 21		0.52
Sept, 18		0.47
Average	Sites I and II	0.81
	Sites I and III	0.56
S.D	Sites I and II	0.15
	Sites I and III	0.17