View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Research Papers in Economics

Analysis of Demersal Assemblages off the North Coast of Central Java, Indonesia

Subhat Nurhakim
Research Center for Capture Fisheries, Agency for Marine and Fisheries Research
Jl. Pasir Putih I, Ancol Timur Jakarta
14430 Jakarta, Indonesia

Nurhakim S. 2003. Analysis of demersal assemblages off the north coast of Central Java, Indonesia, p. 187 - 206. *In* G. Silvestre, L. Garces, I. Stobutzki, M. Ahmed, R.A. Valmonte-Santos, C. Luna, L. Lachica-Aliño, P. Munro, V. Christensen and D. Pauly (eds.) Assessment, Management and Future Directions for Coastal Fisheries in Asian Countries. WorldFish Center Conference Proceedings 67, 1 120 p.

Abstract

Trawl survey data collected by the RV Mutiara 4 in 1979 off the north coast of Central Java (Indonesia) were used to examine the composition and distribution of species assemblages in the area. Classification (TWINSPAN) and ordination (DCA) techniques commonly used in community structure analysis were utilized during the study. The results indicate the existence of "shallow" and "deep" assemblages with a boundary at around 20 - 30 m depth (varying with the monsoon season). There is some consistency in the assemblages between the seasons.

Introduction

The waters off the north coast of Central Java (Fig. 1) are exploited not only by traditional fishers but also by commercial shrimp trawlers. Trawling started to increase in 1970 when shrimp trawlers expanded their fishing grounds from the Malacca Straits and Southern Java. In 1980, a Presidential Decree banned the operation of trawlers. Most of the trawlers converted to purse seining which developed rapidly in the Java Sea. Traditional fishers, with operations limited to near the coast (< 80 km), continued to exploit the demersal and shrimp species using traditional fishing gear. The presence of a fishing port and other facilities along the north coast of central Java are conducive to the concentration of traditional fishers in this area.

Intensive trawl surveys were conducted from 1974 to 1979 by the Indonesian-German Demersal Fisheries Project. After the ban on trawl operations in 1980, irregular surveys were done by the Research Institute for Marine Fisheries. (Bianchi et al. 1996) examined the demersal fish assemblages of the Java Sea using the 1974 - 76 survey data. Their results show that the Java Sea has at least three demersal assemblages: one assemblage in the central and one in the deep part of the basin (> 30 m), and the shallow coastal assemblage.

This paper analyzes data from trawl surveys conducted off the north coast of central Java Sea in 1979 using methods commonly used in community structure analysis. It aims to investigate the distribution of demersal assemblages and their species composition.

Materials and Methods

This study focused on waters off the north coast of central Java Sea (Fig. 1). Data were collected using the wooden stern trawler RV Mutiara 4 (24.52 m LOA, 100 GT, 286 HP). The trawl used was the "Thailand trawl" with headline and footrope length of 35 m and 42.2 m respectively. The cod-end mesh size was 40 mm with a 22 mm cod-end insert net. Average trawling speed was 5.4 km·hr^{-1} and the vertical net opening was estimated at 2 m. Most

of the hauls lasted one hour and were made during daylight hours (from 0500 H to 1800 H).

A total of 144 hauls were made during the 6 cruises conducted in the area in 1979 (Table 1). Catches were sorted up to species level for "food" fish (economically important) species and to families for "trash" fish. Environmental data (i.e. sea temperature, turbidity, depth) were collected for each haul.

The data from the 144 stations were grouped into seasons based on current understanding of monsoon seasonality in the study area. This process resulted in 3 temporal station groupings, namely: (1) West Monsoon (18 stations sampled in January and February); (2) Intermonsoon I (71 stations in April and May); and (3) Intermonsoon II (55 stations in September and October). No data are available for the East Monsoon season given the absence of cruises during June to August 1979. Each monsoon season is characterized by different environmental conditions, thus analysis was done separately by season.

The station-species/group matrices for each of the three temporal groups were analyzed using Two-Way Indicators Species Analysis, or TWINSPAN (Hill 1979), and Detrended Correspondence Analysis (DCA) using the CANOCO software (Ter Braak 1988). There was no data transformation done prior to analysis using TWINSPAN and CANOCO.

Table 1. RV Mutiara 4 cruises in waters off the north coast of Central Java in 1979.

Cruise No.	Date	No. of Stations
01/79	12 - 13 January	7
03/79	19 - 20 February	11
04/79	26 - 30 April	27
05/79	10 - 24 May	44
09/79	9 - 10 September	11
11/79	12 - 18 October	44
TOTAL	12 Jan - 18 Oct	144

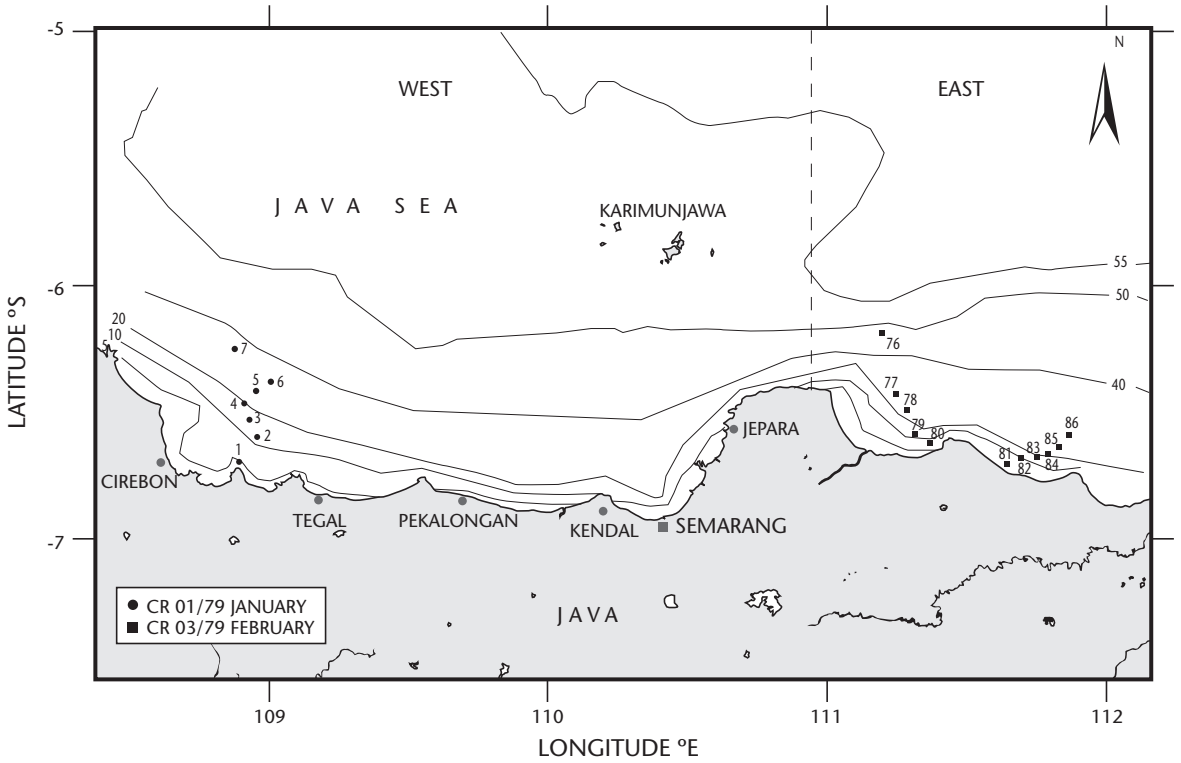

Fig. 1. Map of waters off the north coast of Central Java.

Results and Discussion

The two-way table generated from TWINSPAN and the ordination plot from DCA for the January and February (west monsoon period) trawl stations is given in Table 2 and Fig. 2 respectively. Two groups of stations were evident, each with a characteristic species composition. The first group (Table 2, Group A) consists of eleven stations, characterized by areas with depths of more than 20 m while the second group (Table 2, Group B) consists of seven stations associated with the shallow/coastal waters (< 20 m) (Fig. 3).

There are notable differences in species composition between the shallow and deep-water stations (Table 2). The taxa in species cluster 1a include, among others, of *Lutjanus sanguineus*, *Pomadasys argyreus*, *Pomadasys hasta*, *Scolopsis* spp. and *Abalistes stelaris*. These were observed to be absent in shallow water stations. Taxa in species cluster 2d consisting of Sciaenidae, Muraenidae and *Anodontostoma* spp. which were absent in deep water stations. Some taxa (e.g. species cluster 1d) species cluster such as *Priacanthus* spp., *Pentaprion longimanus,* Sphyraenidae, *Arius thalassinus* and *Nemipterus japonicus* were relatively more abundant in deep compared to shallow water stations.

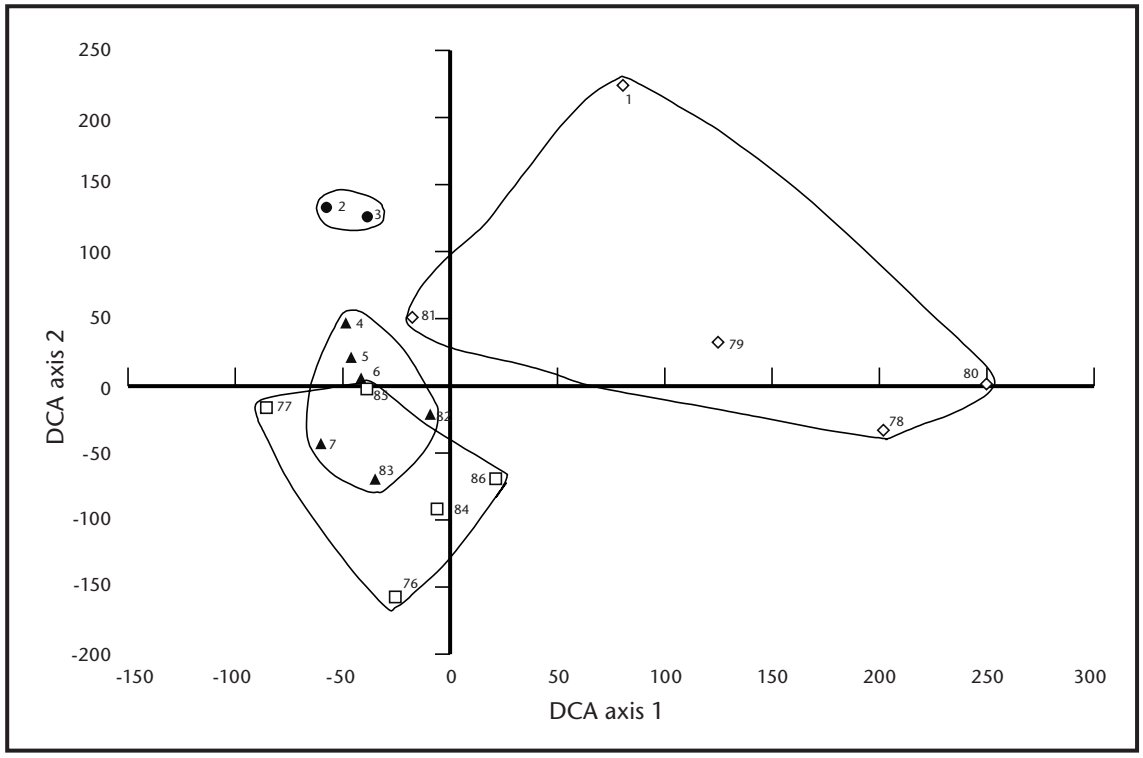

Fig. 2. Ordination plot from DCA of the stations fished during the west monsoon period (January - February 1979).

Table 2. Two-way table of stations versus species/groups generated from TWINSPAN for data collected during the west monsoon period (January - February 1979).

	Group A (20 - 30m)											Group B (< 20m)									
	76	77	84	85	86	4	5	6	7	82	83	78	79	80	1	81	2	3			
34 Other Lutjanidae	–	1	–	–	–	–	–	–	3	2	2	–	–	–	–	–	–	–	0	0	0	0	0	
36 *Pomadasys hasta*	–	–	1	–	–	–	1	–	–	2	2	–	–	–	–	–	–	–	0	0	0	0	0	
49 Drepaneidae	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	0	0	
41 Snakes	2	–	1	–	–	2	–	–	–	1	1	–	–	–	–	–	–	–	0	0	0	0	1	Spp cluster 1a
44 *Abalistes stellaris*	1	–	–	–	1	–	–	2	2	–	–	–	–	–	–	–	–	–	0	0	0	0	1	
60 Serranidae	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	1	0	0
48 Other sharks	2	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	1	0	1
58 Pentaponidae	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	1	0	1
59 *Nemipterus marginatus*	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	1	0	1
64 *Upeneus bensasi**	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	1	0	1
20 *Lutjanus sanguineus*	2	4	1	1	–	2	–	–	2	1	2	–	–	–	–	–	–	–	0	0	0	1	1	0
42 *Pomadasys argyreus*	1	2	1	–	–	–	1	2	1	–	–	–	–	–	–	–	–	–	0	0	0	1	1	0
53 Other Pomadasyidae	1	2	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	0	0	0	1	1	0
54 *Carcharhinus sealei*	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	0	0	0	1	1	1
57 *Scolopsis* spp.	1	–	1	1	–	–	–	–	1	–	1	–	–	–	–	–	–	–	0	0	0	1	1	1
4 *Priacanthus* spp.	5	5	5	5	4	1	1	3	3	2	4	2	1	–	–	–	–	1	0	0	1	0		
26 Other Nemipteridae	2	3	1	–	1	1	1	1	1	–	2	–	–	–	–	1	–	1	0	0	1	0		
29 *Atule* spp.	1	–	3	1	2	–	1	–	–	1	1	–	–	–	–	1	–	–	0	0	1	0		
37 Other invertebrates	1	1	1	1	1	1	1	–	–	–	1	–	–	–	–	–	–	1	0	0	1	0		
14 *Pentaprion longimanus*	5	3	1	1	1	1	3	3	4	1	–	1	1	–	–	–	–	–	0	0	1	1	0	Spp cluster 1b
45 Heterosomata	1	1	1	1	1	1	1	1	1	1	–	–	–	1	–	–	–	–	0	0	1	1	0	
11 Sphyraenidae	1	2	3	2	2	2	1	4	4	4	4	1	–	–	–	2	–	–	0	0	1	1	1	
25 *Arius thalassinus*	1	1	1	1	–	1	2	1	1	2	2	2	–	–	–	–	–	–	0	0	1	1	1	
33 *Nemipterus japonicus*	1	1	1	1	1	1	1	2	2	1	2	1	1	–	–	–	–	1	0	0	1	1	1	
7 *Upeneus sulphareus*	4	5	5	3	4	1	3	3	4	–	1	1	1	3	–	2	1	1	0	1	0	0		
16 *Selar spp.*	–	3	3	2	1	–	1	–	4	–	1	3	–	–	–	1	–	1	0	1	0	0		
22 Synodontidae	2	3	1	1	2	–	1	1	2	–	1	1	–	1	–	2	–	1	0	1	0	0		
43 *Rachycentridae canadus*	–	–	2	–	–	–	1	–	–	–	1	–	–	–	–	1	–	–	0	1	0	1	0	
47 Lobster	1	–	–	2	–	–	–	–	–	–	1	–	–	1	–	1	–	–	0	1	0	1	1	Spp cluster 1c
50 Other rays	–	–	2	–	–	–	–	–	–	1	–	–	–	1	–	–	–	–	0	1	0	1	1	
55 *Leiognathus equulus*	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	1	–	–	0	1	0	1	1	
56 Polynemidae	–	1	–	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	0	1	0	1	1	

Table 2. Two-way table of stations versus species/groups generated from TWINSPAN for data collected during the west monsoon period (January-February 1979). (continued)

	Group A (20 - 30m)											Group B (< 20m)										
	76	77	84	85	86	4	5	6	7	82	83	78	79	80	1	81	2	3				
10 Trichiuridae	1	3	3	5	2	1	2	2	2	2	1	2	4	1	3	2	–	–	0	1	1	0	0	0	
30 Other food fish	1	2	1	1	1	–	–	–	3	1	–	1	1	1	1	1	–	–	0	1	1	0	0	0	
51 *Leiognathus bindus*	1	1	1	1	–	–	–	–	1	1	–	1	1	–	–	1	–	–	0	1	1	0	0	0	
6 Other Carangidae	2	4	5	3	2	3	3	3	2	4	4	2	3	3	1	3	1	2	0	1	1	0	0	1	Spp cluster 1d
19 *Selaroides leptolepis*	1	–	3	1	1	–	–	–	1	4	2	1	1	1	–	3	–	1	0	1	1	0	0	1	
39 Cuttles	1	2	–	–	1	–	1	1	1	1	1	–	1	1	1	–	–	1	0	1	1	0	0	1	
1 *Leiognathus splendens*	–	5	4	5	1	5	5	5	5	5	4	–	1	2	–	5	5	5	0	1	1	0	1		
27 Theraponidae	1	1	–	–	3	1	1	1	–	1	–	–	1	–	–	1	1	2	0	1	1	0	1		
32 Chirocentridae	–	–	–	2	–	–	1	1	–	3	1	–	1	1	–	–	1	–	0	1	1	1			
17 *Scomberomorus* spp.	2	–	–	–	1	3	2	2	2	3	1	2	1	1	1	1	1	2	1	0	0				
23 Dasyatidae	1	–	3	–	1	–	1	1	–	1	1	–	–	4	–	–	–	–	1	0	0				Spp cluster 2a
31 Formionidae	1	–	1	1	1	3	2	1	–	–	–	1	1	1	1	1	–	–	1	0	0				
9 Squids	3	3	2	3	2	1	2	2	1	2	–	2	4	5	1	2	1	2	1	0	1	0			
28 Stromatidae	–	–	2	1	1	1	2	–	–	1	–	–	–	1	2	1	1	–	1	0	1	0			
3 Other Leiognathidae	2	3	1	2	1	4	5	5	5	1	1	2	3	1	2	3	5	4	1	0	1	1	0		
5 Trash fish	2	3	3	3	1	1	2	2	2	5	4	1	3	3	1	5	3	2	1	0	1	1	0		Spp cluster 2b
35 Lactaridae	–	2	–	1	1	1	1	1	1	1	–	1	1	1	–	1	1	1	1	0	1	1	0		
18 *Dussumieria acuta*	–	–	1	1	–	1	5	1	1	–	–	2	2	1	1	–	1	1	1	0	1	1	1		
63 Shrimps	1	–	–	–	–	1	–	–	1	1	–	1	–	1	1	–	–	–	1	0	1	1	1		
8 *Alectis indicus*	2	1	1	4	3	1	1	3	1	2	1	4	3	5	1	3	1	1	1	1	0	0			
46 Crabs	–	1	–	1	1	–	–	–	–	–	–	1	1	1	1	–	–	–	1	1	0	0			
2 *Rastrelliger* spp.	1	–	2	2	2	1	1	1	1	2	1	3	4	5	–	2	2	4	1	1	0	1	0		
12 *Sardinella* spp.	–	–	1	3	1	1	1	1	1	1	1	5	2	4	1	1	1	–	1	1	0	1	0		Spp cluster 2c
38 *Illisha* spp.	–	–	–	1	–	1	–	–	–	–	–	–	–	–	3	–	1	1	1	1	0	1	0		
13 Other Ariidae	1	–	–	–	–	4	1	2	2	1	1	–	–	4	4	3	2	–	1	1	0	1	1		
21 *Stolephorus* spp.	–	–	–	1	1	–	1	4	1	1	–	1	1	3	2	1	1	1	1	1	0	1	1		
61 Other Mullidae	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1	–	1	1	0	1	1		
24 Sciaenidae	–	1	–	–	–	–	–	–	–	–	–	1	1	1	2	4	–	–	1	1	1	0			
40 Other Engraulidae	–	–	–	–	–	–	–	–	–	–	–	–	–	1	2	2	–	–	1	1	1	0			
52 Muraenesocidae	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	1	1	1	0			Spp cluster 2d
65 Other Gerreidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	1	1	0			
15 *Anadonstoma* spp.	–	–	–	–	–	1	–	–	1	–	–	–	–	–	1	1	5	5	1	1	1	1			
62 *Decapterus* spp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	1	1	1			
	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1							
	0	0	0	0	0	1	1	1	1	1	0	1	0	0	0	0	1	1							
	0	0	1	1	1	0	0	0	0	1	1	0	0	0	1	1									

(*U. japonicus)**

***valid name in FishBase 2000**

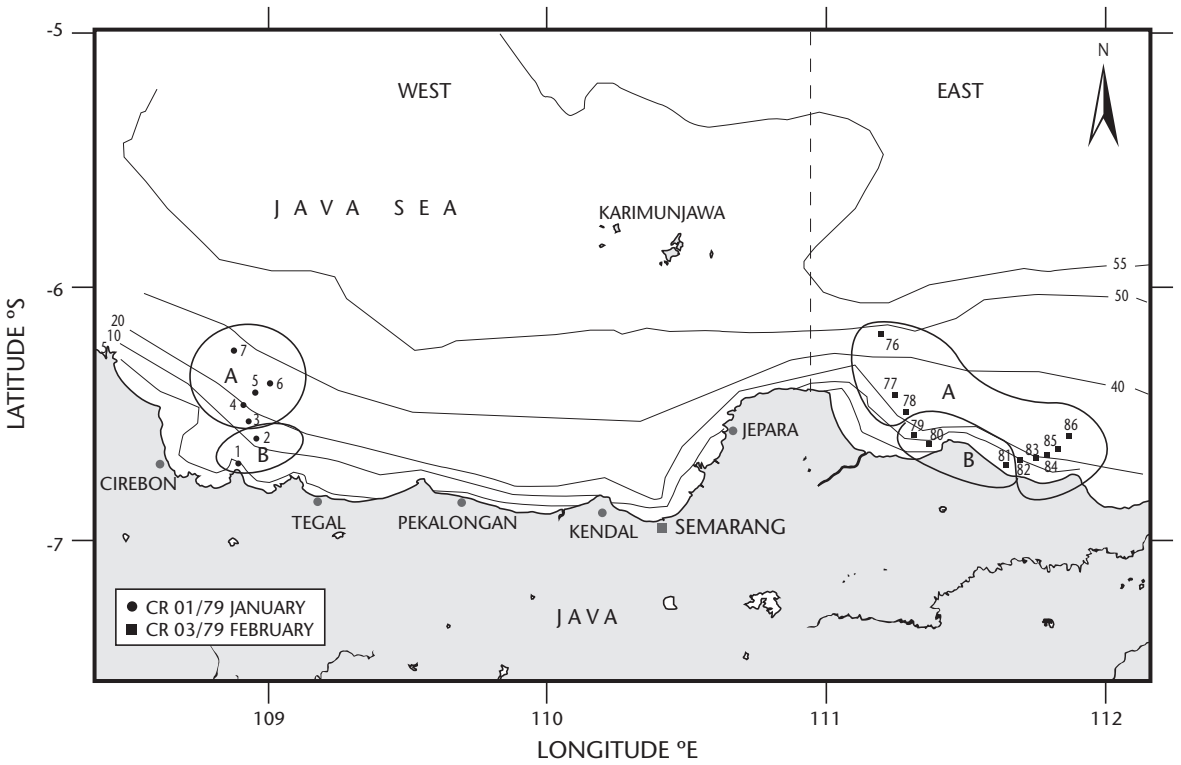

Fig. 3. Trawl stations off the north coast of Central Java in January and February 1979 showing station clusters derived using TWINSPAN and DCA.

In contrast, taxa belonging to species cluster 2c were more abundant in the shallower stations than the deeper ones. Its appears that taxa in species cluster 1c, 1d, 2a and 2b have almost the same abundance in both shallow and deep water stations. However, abundance of taxa in species cluster 1d and 2b was higher than those in species cluster 1c and 2a (e.g. *Leiognathus splendens* and squid) (Table 2).

During the intermonsoon I period (April and May 1979), 65 stations were included in the analysis. Two main station clusters were formed. The first cluster included stations with depth of less than 25 m, and the second cluster included stations in depths of 25 to 45 m (see Table 3, Figs. 4 and 5).

The species/groups in species cluster 1a, 1b and 1c preferred shallow waters below 25 m. Species/groups in species cluster 1a were abundant at depths < 20 m, but rare at stations with depths greater than 20 m. Species/groups in species cluster 2 preferred the deep stations (Table 3). Lactaridae, *Scomberomorus* spp., *Rastrelliger* spp., squid and *Leiognathus splendens* which belong to species cluster 1d were abundant both in shallow and deep stations; they are ubiquitous species/groups.

In species cluster 2, *Upeneus sulphureus*, *Stolephorus* spp. and *Pentaprion longimanus* were more abundant at 35 to 45 m deep stations. Serranidae, *Charcharinus sealea*, Pentapodidae, *Abalistes stelaris* and *Nemipterus margiatus* were observed to be absent at shallow water stations (< 25 m depth).

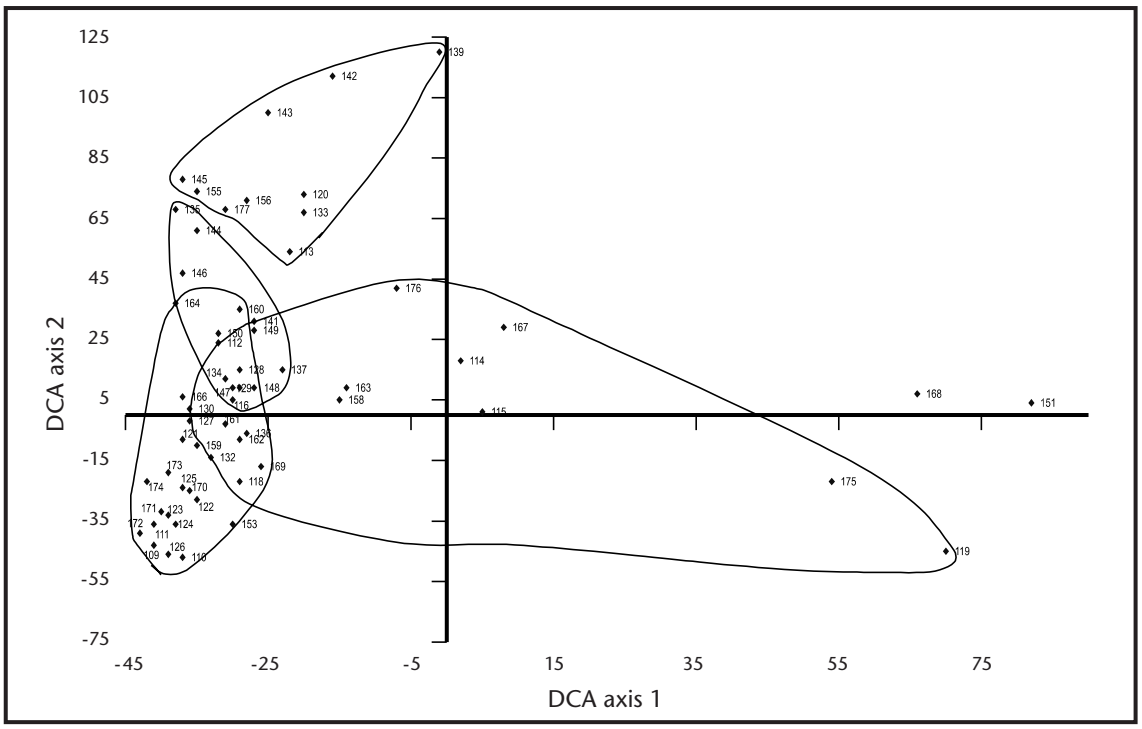

Fig. 4. Ordination plot from DCA of the stations fished during the intermonsoon I period (April - May 1979).

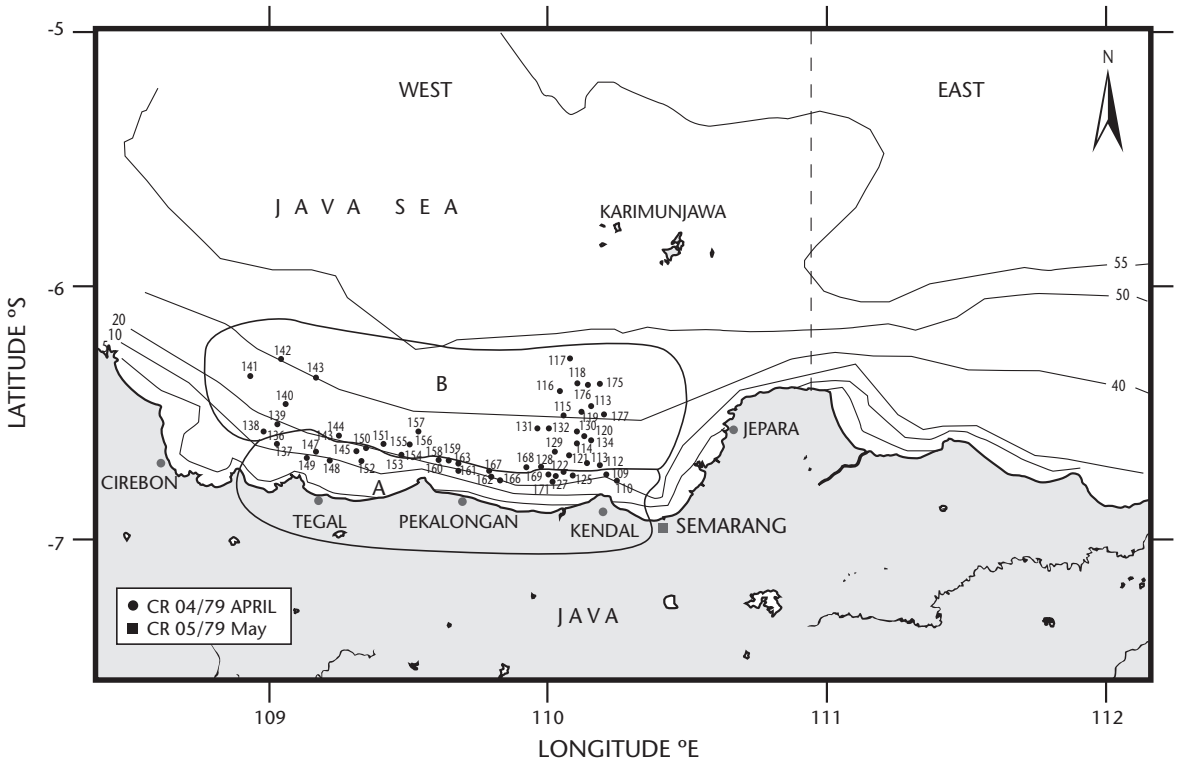

Fig. 5. Location of the trawl stations off the north coast of Central Java in April and May 1979 showing station derived using TWINSPAN and DCA.

Table 3. Two-way table of stations versus species/groups generated from TWINSPAN for data collected during the intermonsoon I period (April-May 1979).

	Group A		Group B			
	20<25m	<20m	25<35m	35-45m		
	147 150 135 137 146 148 149 153	110 111 124 125 126 109 121 122 123 168 169 170 173 163 164 171 159 172 174 160 161 162	131 138 152 144 145 177 120 139 142 143 140 141 151 113 127 128 134 155 156 167 168 136	112 116 114 129 130 132 115 118 133 175 176 119 158		
14 *Leiognathus equulus*	– – 2 – – 1 – 1	5 3 1 1 5 4 2 4 4 1 4 3 3 4 5 5 1 3 1 1 3 4	– – 2 1 – – – – – – – – – 1 2 – – – 1 1 1 –	– – – 1 – – – – – – – – –	0 0 0	
20 Polynemidae	– – – – – – – –	3 4 1 1 – 1 1 – – – 1 – 2 2 – 3 1 – – 5 1 –	– – 1 – – – – – – – – – – – – – – – – – – –	1 – – – – – – – – – – – –	0 0 0	Spp cluster 1a
8 Drepaneidae	– – – – – – – –	– 1 – – 1 – – – – – – 1 – 1 – – 1 – – – – – –	– – – – – – – – – – – – 1 – – – – – – – – –	– – – – – – – – – – – – –	0 0 0	
7 Other Clupidae	– – – – – – – –	– – – – – – – – – – – – 1 – – – – 1 – 1 1 –	– –	– – – – – – – – – – – – –	0 0 0	
7 *Anadonstoma* spp.	3 4 2 1 3 3 1 1	3 5 4 5 4 5 5 2 3 5 4 2 5 3 3 5 4 5 5 5 3 4	– – 1 3 1 1 2 1 1 1 1 1 3 1 1 1 2 1 1 2 4 1	– 1 2 3 3 1 1 1 1 1 1 1 1	0 0 1	
28 Stromatidae	– – 2 2 – 1 – 5	3 3 1 2 5 1 2 3 2 – 4 2 3 4 5 5 5 6 4 2 5 5	2 – 2 1 – 1 1 – – – – 1 – 1 1 1 2 2 – 1 – –	– 2 2 2 2 2 2 2 1 – 1 2 3	0 0 1	Spp cluster 1b
21 *Pomadasys hasta*	1 1 – – – – – –	3 2 1 2 1 – – 1 – – – 1 – 1 – – 1 1 1 5 1 1	– – 1 – 1 – 1 1 – – – – – 1 1 – – – – 1 2 –	1 – – – – – – – – – – – –	0 0 1	
9 Other Engraulidae	1 1 – 1 1 1 1 1	3 1 1 – 1 1 – 1 1 1 1 1 1 3 3 2 3 1 4 2 2 1	– – – – – 1 1 1 – – – 1 – – 1 – – 1 1 1 – –	1 – – – – – – – – – – 1 1	0 0 1	
7 *Illisha spp.*	1 1 1 – – – 1 –	– – – – – 1 – – – – 1 – 1 – 1 1 – 1 1 – – –	– – – – – – – – 1 1 – 1 – – – – – 1 – – – 1	– – – – – – – – – – – – –	0 1 0 0 0	
5 *Alectis indicus*	3 4 4 5 3 5 4 5	5 3 4 5 4 4 1 2 4 3 5 3 5 3 3 5 3 3 1 5 4 4	1 5 1 4 4 1 1 2 1 1 1 2 2 1 1 3 – 3 3 4 1 2	2 2 2 1 3 1 2 2 1 2 4 2 4	0 1 0 0 1 0	
7 *Sardinella* spp.	2 1 3 4 1 3 3 1	2 2 3 4 4 3 1 1 3 2 3 1 1 2 4 2 1 2 1 3 2 1	1 3 1 1 1 1 1 2 1 1 1 1 1 1 1 1 – 1 1 1 1 1	4 1 1 1 1 1 1 – – – 1 – 1	0 1 0 0 1 0	Spp cluster 1c
33 Trash fish	1 1 4 1 – – – 1	2 2 1 2 1 2 3 2 3 4 3 4 2 2 2 1 2 2 2 4 3 5	– 1 1 1 1 1 1 1 1 1 1 1 1 2 1 1 1 2 2 2 3 –	1 2 1 1 1 1 1 2 1 1 1 1 1	0 1 0 0 1 1	
2 Dasyatidae	5 – – – – – – –	1 – – – 3 3 – – – 4 – 5 4 – – – 3 – 4 5 1 –	– 1 4 1 1 4 – 1 1 1 1 1 – – – 1 – – – – – –	– 1 1 – – – 1 – – 1 1 1 –	0 1 0 0 1 1	
32 Other food fish	– 1 1 2 1 – – 1	3 3 – 2 1 2 1 1 1 – – 1 2 – – 1 2 2 1 2 – 1	1 1 – – – 1 1 1 – – 1 1 – 1 1 1 – 1 1 1 1 1	2 1 – 1 1 1 – – – 1 – 1 –	0 1 0 0 1 1	
14 Other Leiognathidae	– – 1 – – – – –	3 5 1 2 5 4 3 1 1 1 2 3 1 3 2 3 2 1 2 4 4 4	– 1 1 1 – 1 – 1 – 1 1 1 1 1 2 1 – 1 2 1 3 –	1 1 1 1 1 1 – 1 – 1 1 1 2	0 1 0 1	
2 Other rays	– – – – – – – –	3 4 3 – – – – – – – – – – – – – – – – – – 4	– – – – – 3 – – – – – – – – – – – – – – – –	– – – – – – – – – 5 – – –	0 1 0 1	
13 Lactaridae	1 1 1 1 1 1 1 –	1 3 1 1 3 4 1 2 1 1 2 1 1 2 2 2 4 1 1 4 2 2	1 – 1 1 – 1 1 1 – – 1 1 1 1 1 1 1 1 2 1 1 –	1 1 1 1 1 1 1 2 1 1 1 2 3	0 1 1 0	
21 Other Pomadasyidae	– – – – – – – –	3 3 1 – 1 2 – – – – – – – 1 – – – – – – – –	– – – – – – – – – 1 – – – – – – 1 – – 1 – –	– – – – 1 – – – – 2 2 – –	0 1 1 0	Spp cluster 1d
11 Other Gerreidae	– – – – – – – –	– 2 1 – – – – – – – – – – 1 – – – 1 1 – – –	– – – – – – – – – – – – – 1 1 – – – – – – –	– – – – – – 1 – – – – – 1	0 1 1 0	
25 *Scomberomorus* spp.	4 4 3 2 1 1 1 2	– 1 2 2 1 1 3 2 2 2 4 2 1 4 3 2 3 1 1 1 2 3	2 1 2 3 1 2 2 – – – 1 3 2 1 – 2 2 2 2 2 2 1	– 3 2 2 3 2 1 2 1 1 1 2 4	0 1 1 1 0 0	
40 Snakes	1 1 – – – 1 – –	1 – – – 1 1 1 1 2 1 – 2 – – 1 3 – – – – –1	– – – – 1 – 2 – – 2 – – 1 – – – – – – – – –	– 1 – – 1 – 1 1 – – – 2 –	0 1 1 1 0 0	
25 *Rastrelliger spp*	2 5 5 1 5 1 2 4	3 4 5 3 2 3 4 2 4 1 5 3 5 5 5 5 5 – 2 5 2 2	1 1 2 5 5 5 3 1 2 3 1 2 – 3 1 3 3 5 4 1 5 1	4 3 4 3 5 2 6 – 1 4 5 2 –	0 1 1 1 0 1	
5 Other Carangidae	1 1 1 4 1 1 1 1	2 2 3 2 5 2 4 3 4 3 3 3 1 4 3 4 3 3 1 5 5 5	1 3 3 1 1 3 2 1 1 2 1 1 1 4 1 3 2 3 2 3 3 1	3 4 3 3 3 2 5 2 2 4 3 2 2	0 1 1 1 0 1	
34 Squids	1 1 2 2 1 1 1 1	1 1 2 3 3 1 2 2 3 2 1 2 2 4 4 3 3 3 2 4 4 3	2 2 1 2 1 1 3 4 1 3 4 2 1 3 2 2 2 4 5 3 – –	1 2 3 2 2 4 2 2 2 2 2 2 2	0 1 1 1 0 1	

Table 3. Two-way table of stations versus species/groups generated from TWINSPAN for data collected during the intermonsoon I period (April-May 1979). (continued)

	Group A				Group B			
	20<25m	<20m	25<35m	35-45m				
	147 150 135 137 146 148 149 153	110 111 124 125 126 109 121 122 123 168 169 170 173 163 164 171 159 172 174 160 161 162	131 138 152 144 145 177 120 139 142 143 140 141 151 113 127 128 134 155 156 167 168 136	112 116 114 129 130 132 115 118 133 175 176 119 158				
3 Other Ariidae	3 3 1 2 1 1 1 2	5 4 – – 1 3 4 4 2 – 3 5 2 2 – 3 3 – – 4 1 3	1 1 1 1 – – 1 – – – 1 1 1 4 – 3 2 1 1 1 3 4	1 3 1 2 4 – – 2 1 2 2 4 5	0 1 1 1 0 1			
27 Sphyraenidae	1 – 1 – – – – –	4 4 1 – 1 1 2 2 – 1 1 2 – 3 3 1 2 – 1 4 5 4	– 3 1 1 – 1 2 1 – – – – – 2 1 1 1 1 1 1 2 –	2 1 1 2 2 1 1 1 1 1 2 1 3	0 1 1 1 0 1			
30 Theraponidae	– – – – 1 – – 1	2 – 1 2 4 1 2 1 2 2 1 1 – 1 1 1 1 – 1 4 2 4	– 1 1 1 1 – 1 – 1 – 1 – 1 1 1 1 1 1 1 1 2 1 –	1 1 1 1 – 1 1 1 1 – 1 1 2	0 1 1 1 0 1			
5 *Megalaspis cordyla*	– – – – – – – –	– – 1 1 1 1 1 3 1 – – – – – – – – – – – –	– – – – – – 1 – – – – – – – 2 1 1 1 – – – – –	1 1 – 2 1 – – – – – – – –	0 1 1 1 0 1			
24 Sciaenidae	– – – – – 1 – –	2 1 – – 3 1 – – – – 1 1 1 1 2 1 1 1 1 1 1 1	– – – – – 1 – – – – – – 1 1 1 – 1 1 1 – 1 – 1	1 – 1 – 1 1 – – 1 1 1 – –	0 1 1 1 0 1	Spp cluster 1d		
14 *Leioguathus splendens*	– – 2 – – – – –	5 5 5 5 5 5 5 5 5 – 5 5 5 5 4 5 5 5 4 – 4 3	1 – 3 – – 2 1 – 1 – 1 3 – 1 2 3 4 1 4 1 3 –	4 5 5 3 4 4 5 5 2 5 4 5 4	0 1 1 1 1 0			
31 Trichiuridae	3 2 – 1 1 1 – 5	– 1 5 5 5 – 1 4 5 – 5 5 1 1 1 5 2 1 – 2 1 2	2 – 3 1 1 1 1 1 1 1 – 1 1 1 1 3 1 1 1 1 1 1	1 3 3 5 5 3 2 1 1 1 3 2	0 1 1 1 1 0			
7 *Dusssumieria acuta*	1 1 1 1 1 1 – 1	1 2 – 1 1 1 1 2 – – 3 2 2 3 3 3 – 2 1 1 4 2	1 – 1 1 – 1 – – – – – 1 1 1 1 1 1 1 – – 1 –	2 4 2 2 1 – 2 2 1 1 2 1 1	0 1 1 1 1 0			
14 *Leiognathus bindus*	– – 1 – – – – –	1 – – – 1 1 – 1 1 – 1 1 1 1 1 1 1 1 1 1 1 1	– 1 – – – – – – – 1 – – – – 2 1 – – 1 – 1 –	– 1 1 1 – 1 – 1 1 1 1 1 1	0 1 1 1 1 0			
6 Chirocentridae	– – – – – – – –	– – 1 – 1 1 – 1 – – – – 1 1 – 1 1 1 1 – 1 2	– – – – – – – – – – – – – – 1 – 1 – 1 – – – 1	– 1 – – – – 1 1 1 – 2 1 –	0 1 1 1 1 1			
9 *Stolephorus* spp.	– 1 – – – – – –	– 1 1 1 1 1 1 1 1 1 1 1 1 2 3 1 2 1 1 1 3 1	– 1 – – – 1 1 – – 1 – 1 – 1 1 1 1 1 1 1 1 –	3 4 4 4 4 2 1 2 1 1 1 1 1 2	1 0 0	Spp cluster 2a		
23 *Rachvcentridae canadus*	– – – – – – – –	– – – – – – – – – – – – – – 3 – – – – – – –	– – – 1 – 1 – – – – – – – – – – – – 1 2 – –	– – – – – – – – – – – – –	1 0 0			
16 *Upeneus sulphureus*	– – – 1 1 1 1 –	– 1 – – – 1 1 1 – 1 1 1 1 1 2 1 3 1 1 5 2 3	1 1 1 1 – 1 1 – 1 – 1 1 1 1 1 1 1 1 1 2 1 2 –	3 4 1 1 1 1 2 2 1 2 3 1 3	1 0 1			
11 *Pentaprion longimauus*	– 1 – – – – – –	1 – 1 1 2 1 1 1 1 – 1 1 1 1 – 1 3 1 1 4 2 3	1 – – – – 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3 1 1 –	2 4 2 1 1 2 2 3 2 4 2 2 2	1 0 1	Spp cluster 2b		
3 *Arius thalassinus*	– – – – – – – –	2 – 1 – – 2 1 – – – – 1 – – – – – 1 – 1 – 4	– – – 1 – – 1 1 – – – – – 1 – – 1 – – – 2 –	2 1 1 1 – 1 1 2 – 2 1 – –	1 0 1			
29 Synodontidae	– 1 – 1 1 1 1 1	– – – – – 1 2 1 – – 1 – – 1 – – 1 – 1 2 1 1	– – 1 1 1 1 1 – – 1 – – 1 1 1 1 1 1 1 1 1 –	1 1 1 1 1 1 – – – 1 1 1 1	1 0 1			
37 Crabs	1 1 – – 1 – 1 –	– 1 – – 1 – 1 – 1 – 1 1 1 – – – – – – 1 – –	– – – – 1 1 3 1 – – – – – 1 – 1 1 – – 1 1 –	– 1 – – – 1 – – – – – – – 1	1 1 0			
1 Other sharks	– – 1 – – – – –	– –	– – – – – 4 – – – – – – – – – – – – – – – –	– – – – – – – – – – – – –	1 1 0	Spp cluster 2c		
5 *Atule* spp.	– – – – 1 – – –	– – – – 1 – – 1 – – – – – – – – – – – – –	– 1 – 1 1 – – 1 – 1 – – – 1 1 – – – – – – –	– – 1 – – – – – – – – – –	1 1 0			
10 Formionidae	1 1 1 – 1 1 – –	– 1 – 1 – 1 1 – – – – 2 – – 1 – – – – –	1 1 1 1 1 – 1 1 2 2 1 – 1 1 – 1 2 1 3 1 – –	1 2 1 – – – 1 1 – 1 1 – 1	1 1 1 0 0			
35 Cuttles	– – 1 1 1 – – –	1 – 1 – 1 – 2 – – – 2 – – 1 – – – – – – –	– – 1 – – – 1 – 1 – 1 – 1 1 – 1 1 1 1 – 1 –	– – 1 – – – – – 1 – – – –	1 1 1 0 0			
18 *Nemipterus japonicus*	– – – – – – – –	– – – – 1 1 1 – 1 1 1 1 – 1 – – – – – 1 1 –	1 – – – – – 1 1 1 – 1 1 – 1 – 1 – 1 1 – 1 –	– 1 2 – – – 2 – – 3 1 4 1	1 1 1 0 0	Spp cluster 2d		
38 Lobster	– – – – – – – –	– – – – – – – – 1 – – – – – – – – – – – –	– –	2 – 3 2 2 2 2 3 2 3 2 3 3	1 1 1 0 0			
15 *Lutjanus sanguineus*	– – – – – – – –	– – – – – – – – 1 – – 2 1 – – – – 1 – – 1 – 1	5 – – – – – – – – – 1 – – – – 1 – – – 2 1 –	– 1 – 1 1 – 1 – – 3 2 1 2	1 1 1 0 1			

Table 3. Two-way table of stations versus species/groups generated from TWINSPAN for data collected during the intermonsoon I period (April-May 1979). (continued)

	Group A		Group B			
	20<25m	<20m	25<35m	35-45m		
	147 150 135 137 146 148 149 153	110 111 124 125 126 109 121 122 123 168 169 170 173 163 164 171 159 172 174 160 161 162	131 138 152 144 145 177 120 139 142 143 140 141 151 113 127 128 134 155 156 167 168 136	112 116 114 129 130 132 115 118 133 175 176 119 158		
5 *Selar* spp.	– 1 – 1 – – – –	– – – 1 – 1 1 2 – – 1 1 – – – – – – – 4 2 –	1 1 1 – – 1 3 1 5 3 1 1 1 4 – 1 1 – 3 2 3 –	2 – 3 2 2 2 2 3 2 3 2 3 3	1 1 1 0 1	
5 *Selaroides leptolepis*	– – – 1 – – – –	– – – – – 1 – – 1 – – – – – – – 1 – – 3 1 1	2 1 1 1 1 1 – 1 – 1 1 1 1 1 1 – – – 1 – – –	– 1 – 1 1 – 1 – – 3 2 1 2	1 1 1 0 1	
21 *Pomadasys argyreus*	– – 2 – – – – –	– – – – – – – – – – – 1 – – – – – – – – – –	– – – – – – – – – – – – – – – – – – – 1 1 –	– 1 – – – 1 1 1 1 1 1 1 –	1 1 1 0 1	
15 Other Lutjanidae	– – – – – – – 2	– – – – 1 – – – – – – – – 3 – – – – – – – –	5 5 5 – – – 1 1 – – – – 2 1 – – – – 1 – 4 –	1 1 1 1 – – – – – 2 1 1 1	1 1 1 1 0 0	
26 Serranidae	– – – – – – – –	– –	– – – – – 1 1 1 1 – 4 – – – – – – – – – – –	– 1 – – 1 – – – 1 – 1 – –	1 1 1 1 0 0	
39 Other invertebrates	– – – – – – – –	– –	– – – – – 1 1 1 1 1 1 1 1 1 – – 1 – – – 1 –	– – 1 – 1 1 – – 1 1 1 – –	1 1 1 1 0 0	
18 Other Nemipteridae	– – – – – – – –	– – – – – – 1 – – – – – – – – – – – – 1 – –	1 1 1 1 – – 1 1 1 1 1 1 1 1 – – – – – 1 1 –	1 1 1 1 1 1 1 1 1 1 1 1 –	1 1 1 1 0 1	Spp cluster 2d
1 *Carcharbinus sealei*	– – – – – – – –	– –	– – – – – 3 – – – – – – – – – – – – – – – –	– 2 – – – – – – – – – – –	1 1 1 1 0 1	
16 Other Mullidae	– – – – – – – –	– –	– – – – – – – 1 – – – – – – – – – – – – – –	– – – – – – 1 – – – – – –	1 1 1 1 0 1	
22 *Priancanthus* spp.	– – – – – – – –	– – – – – 1 1 1 – – – – – – – – – – – 1 1 –	1 1 – – – – 1 1 1 – 1 1 – 1 – 1 1 – 1 – 1 –	1 2 2 2 1 3 1 2 1 1 2 2 1	1 1 1 1 1 0	
19 Pentapodidae	– – – – – – – –	– –	2 – – – – 1 – 1 – – – – – – – – – – – – – –	– – – – – – – 1 – 1 1 – –	1 1 1 1 1 0	
4 *Abalistes stellaris*	– – – – – – – –	– –	– – – – – – – – – – – 1 – – – – – – – – 1 –	– – – – 1 – – – 1 1 – – –	1 1 1 1 1 0	
36 Shrimps	– – – – – – – –	– –	– – – – – – – – – – – – – – – – – 1 – – – –	– – – – – 1 – – – – 1 – –	1 1 1 1 1 0	
18 *Scolopsis spp*	– – – – – – – –	– –	– – – – – – – 1 – – – – – – – – – – – – – –	– 1 – – – – 1 1 1 1 1 – –	1 1 1 1 1 1	
12 Heterosomata	– – – – – – – –	– –	– 1 –	– 1 1 – – 1 – – 1 – 1 – –	1 1 1 1 1 1	
42 Sponges	– – – – – – – –	– –	– –	– – – – – – 2 1 – – – – –	1 1 1 1 1 1	
18 *Nemipterus marginatus*	– – – – – – – –	– –	– –	– – – – – – – – – 1 – – –	1 1 1 1 1 1	
	0 0 0 0 0 0 0 0	0000000000000000000000	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1		
	0 0 0 0 0 0 0 0	1111111111111111111111	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 1 1 1 1		
	0 0 1 1 1 1 1 1	0000000000000000000111	0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 1 1 1 1 1 1 1		
	0 1 1 1 1 1	0011111111111111111	0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 1 1 1 1 1 0 0 0 0 0 1 1		
	0 0 0 0 1	0000000000111111	0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1	0 1 1 1 1 0 0 0 1 1		
		0001111111000111	0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 1			

A total of 49 stations were finally included in the analysis for the intermonsoon II period (September and October 1979). Two major groups of stations were observed (Table 4, Figs. 6 and 7). One group was associated with shallow water stations (0 - 30 m) and the other group was associated with stations of more than 30 m depth. Some species in species cluster 1a, such as *Gazza minuta, Arius maculatus, Leiognathus equulus, Ilisha* spp., *Arius caelatus, Pomadasys hasta,* Drepanidae, and Polynemidae were abundant in shallow stations. Some species in species cluster 2d such as *Abalistes stelaris, Atule* spp. *Lutjanus sanguineus, Scolopsis* spp. and *Nemipterus nemurus* were found mainly in deep stations.

Taxa which belong to species cluster 1d, 2a and 2b were found to have the same abundance in shallow and deep water stations (e.g., *Leiognathus splendens, Priacantus* spp., *Sphyraena* spp.). These ubiquitous species/groups dominate catches in the study area. Species/groups that were abundant in shallow water stations (and rare in deep waters) include Dasyatidae, *Alectis indicus,* Sciaenidae, *Sardinella* spp., *Anadontostoma* spp. *Stolephorus* spp. Lactaridae, Stromatidae, *Thryssa* spp. and *Leiognathus brevirostris* (species cluster 1b). Species/groups which belong to species cluster 2c, such as *Priacanthus tayenus, Nemipterus mesoprion, Atropus atropus, Upeneus sulphureus, Pentaprion longimanus, Selaroides leptolepis, Selar* spp. and *Leiognathus bindus* were more abundant in deep than in shallow stations. A summary of the most important species/groups comprising the shallow and deep assemblages during the three time periods considered here is given in Table 5 and 6. The species clusters were observed to be similar across seasons (i.e. there is consistency in taxa associated with the shallow versus deep stations).

The scope of the present study was limited by data constraints. These include the design of the trawl survey in 1979, the sorting and identification of catches, and availability of relevant environmental data. Best use of the data was attempted despite these constraints and has produced some insight into the species assemblages in the region. The results indicate the existence of shallow and deep and shallow assemblages with a boundary at around 20 - 30 m depth. This is consistent with the findings of (Bianchi et al. 1996).

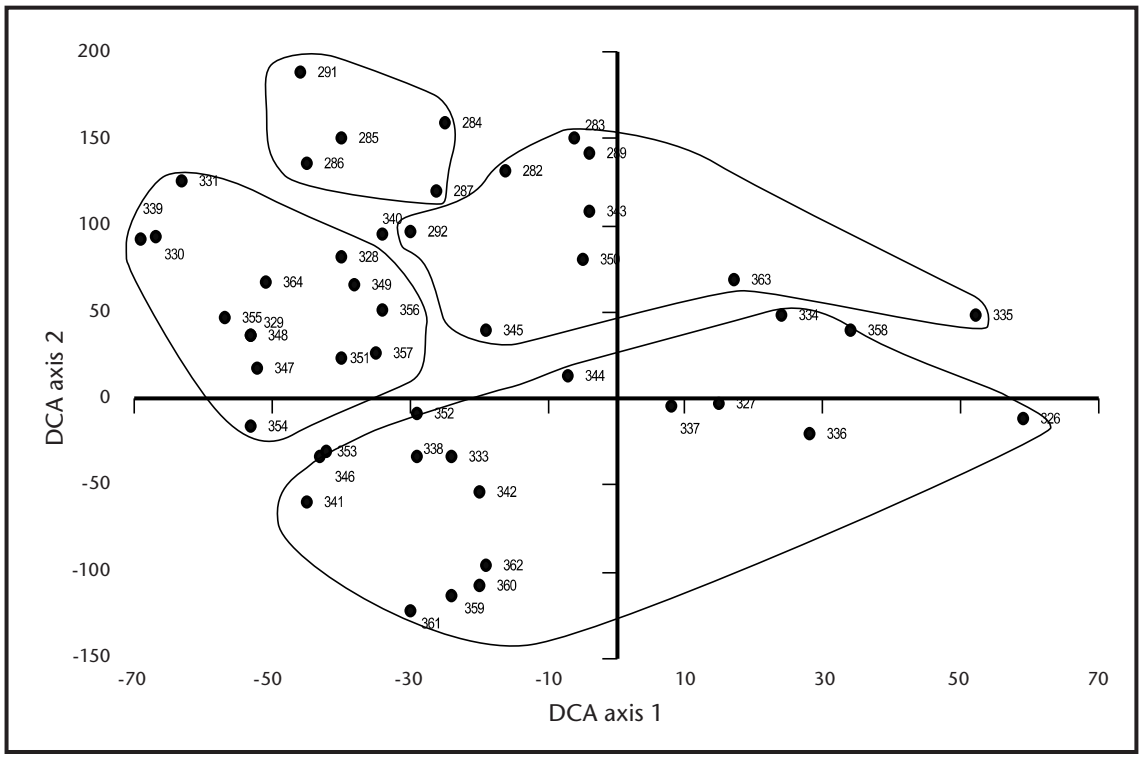

Fig. 6. Ordination plot from DCA of the stations fished during the intermonsoon II period (September - October 1979).

Table 4. Two-way table of stations versus species/groups generated from TWINSPAN for data collected during the intermonsoon II period (September-October 1979).

	Group A (< 30m)	Group B (> 30m)		
	346 360 361 362 334 336 337 359 343 326 327 333 336 341 347 354 353 344 346 351 352 290 336 383 364 282 283 288 289 292	328 357 350 358 365 339 340 348 349 355 356 329 330 331 284 287 285 286 291		
14 *Gazza minuta*	– 4 1 – – 1 – 1 1 1 – 1 1 1 – 1 – – 1 – – – – – – – – – – –	– – – – – – – – 1 – – – – – – – – – – –	0 0 0 0	
3 *Arius maculatus*	– – 1 – – – – – 2 1 – 2 1 – – – – – – – – – – – – – – – – –	– – – – – – – – – – – – – – – – – – –	0 0 0 0	
3 Other Ariidae	– – – – – – – – 1 – – – 1 1 – – – 1 – – – – – – – – – – – –	– – – – – – – – – – – – – – – – – – –	0 0 0 0	
7 Other Clupidae	– 2 –	– – – – – – – – – – – – – – – – – – –	0 0 0 0	Spp cluster 1a
8 Drepanidae	1 – – – 2 – – 2 – – – 1 – – – – – – 1 1 – 5 2 1 1 – 1 – – –	– – – – – – – – – – – – – – – – – – –	0 0 0 1 0	
14 *Leiognathus equulus*	1 – 2 – 2 2 2 3 4 4 – 1 – – – – 1 1 1 1 1 1 – – 2 – – – – –	– – – – – – – – – – – – – – – 1 – – – –	0 0 0 1 1 0	
20 Polynemidae	– – – 1 – – 1 – 1 4 2 – 1 – – – – 1 – 1 – – 2 – – – – – – –	– – – – – – – – – – – – – – – – – – –	0 0 0 1 1 0	
7 *Illisha* spp.	– 2 – 1 1 – – – – – 1 1 – – – – – – – 1 – – 1 – – – – – – –	– – – – – – – – – – – – – – – – – – –	0 0 0 1 1 0	
3 *Arius caelatus*	1 1 2 1 – 4 2 2 – 5 4 – 1 – – – 1 – – 1 – 5 2 1 1 – – 4 1 –	– – – – – – – – – – – – – – – – – – –	0 0 0 1 1 1	
21 *Pomadasys hasta*	2 4 4 3 4 2 1 3 3 3 3 1 1 1 1 – 1 4 1 2 1 – 5 2 3 – 2 – – 3	– – – – – – – – – – – – – – – – – – –	0 0 0 1 1 1	
2 Other Rays	– – – – – – – – – – 5 – – – – – – 4 – – – – – – – – – – – –	– – – – – – – – – – – – – – – – – – –	0 0 0 1 1 1	
2 Dasyatidae	4 1 4 4 2 4 1 1 4 1 – 2 2 1 – – 2 5 5 5 – 2 4 4 4 2 4 5 2 –	– – – – 1 1 1 2 – – – 2 2 1 1 – 5 – 4	0 0 1 0	
5 *Alectis indicus*	– – – – 1 1 1 3 – 1 1 – – – – – – 1 – – – 1 – – 1 4 3 2 4 3	– – 1 – – 1 – – – – – – – – 2 1 – – 1	0 0 1 0	
23 *Rachycentridae canadus*	– – – – – 1 1 – 1 1 – – – – – – – – – – – – – – – 1 – 1 1 – 1	– – – – – 1 – – – – – 1 – – – – – – –	0 0 1 0	
6 Chirocentridae	– – 1 – – 1 – – – – – – – – – – – – – 1 1 – – – – – – – – –	1 – – – – – – – – – – – – – – – – – –	0 0 1 0	
14 Other Leiognathidae	5 4 2 4 2 1 3 2 2 4 5 1 2 2 1 3 3 1 1 1 1 2 2 4 2 4 1 2 2 3	– 1 1 1 1 1 1 1 1 1 1 2 – – 1 1 2 1 1	0 0 1 1 0	
24 Sciaenidae	3 2 3 1 2 3 4 2 3 1 3 1 – – 1 1 6 1 1 1 1 1 1 3 3 1 1 1 2 1 2	– 3 1 1 – 1 – – 1 – – – 1 1 1 3 – – –	0 0 1 1 0	Spp cluster 1b
7 *Sardinella* spp.	2 – 2 2 2 2 1 1 3 3 2 1 1 1 4 2 1 1 1 2 1 1 1 – 1 1 1 1 3 1	1 1 1 1 1 – 1 1 1 1 – – – – 1 1 – – 1	0 0 1 1 0	
11 Other Gerreidae	1 – 2 2 2 2 – 1 1 1 – – – – – – – – 2 1 – – – 1 1 1 1 1 – – –	– – 1 – – – – – – – – – – – 1 – – – –	0 0 1 1 0	
7 *Anadonstoma* spp.	1 – 1 2 1 1 1 2 3 3 2 2 2 4 3 4 1 – – – – 1 2 3 1 2 – 1 1 –	1 1 1 1 1 – – 1 3 1 – – – – – – – – –	0 0 1 1 1 0	
9 *Stolephorus* spp.	– 2 1 5 1 1 1 1 1 2 4 2 2 1 1 3 2 – – – – 1 1 – 1 – 1 – 1 3	1 – – – – – – 1 1 1 1 1 – 1 – 1 1 – –	0 0 1 1 1 0	
13 Lactaridae	– 1 1 2 1 1 2 1 1 2 2 1 1 1 1 2 1 – 1 1 1 – 1 – – 1 1 – 1 1	1 – – – 1 – – – – 1 1 – – – – 1 1 – –	0 0 1 1 1 0	
28 Stromateidae	2 1 2 2 3 3 1 2 4 5 2 3 4 1 – 3 1 – 1 1 1 – 2 3 1 – 1 1 2 –	– 2 – – – – 1 2 – – 2 1 – – 1 1 1 – –	0 0 1 1 1 1	
9 *Thryssa* spp.	– 2 1 2 – 1 3 – 3 2 2 – 1 1 1 – 4 1 – 1 – – 1 1 1 – – – 1 –	– – – – 1 – 1 – – – – 1 – – – 1 – – –	0 0 1 1 1 1	
4 *Leiognathus bevirostris*	– 4 3 3 1 2 2 2 1 1 – 1 1 1 1 1 1 1 1 1 1 – 3 1 1 – – – – –	– – 1 1 1 1 – – – – – – – – – – – – –	0 0 1 1 1 1	
21 *Nemipterus* spp.	1 – – – 1 1 – 1 4 2 – – – 1 – – – 1 1 – – – – – 1 – 1 – – –	– – – – – – 1 – – – – – – – 1 – – – –	0 0 1 1 1 1	
5 *Alepes* spp.	3 2 2 2 2 2 2 1 4 1 2 1 3 5 5 5 5 2 1 2 3 – 1 1 1 – – – – –	2 1 1 1 1 1 – 1 2 3 2 2 1 – – – – – –	0 1 0	
3 *Osteogeneosis milit*	1 – – – 3 1 2 – 2 4 1 2 3 1 – – 2 – 1 – – – 1 – 1 – 1 – 1 –	3 3 – 1 – – – – – – – – – – 1 – – – –	0 1 0	Spp cluster 1c
14 *Secutor insidiator*	1 3 2 – 1 1 1 1 – 1 2 – – 1 1 3 – 1 – – 1 – 1 – – – – – – –	1 – – – – – – 1 1 1 2 1 – – – – – – –	0 1 0	
5 *Carangoides* spp.	– – – – – – – 1 2 1 1 1 – – – – – – – – – – – – – – – – – –	2 – – – – – – – – – – – – – – – – – –	0 1 0	
14 *Leiognathus splendens*	5 5 5 5 – 5 5 4 5 5 5 5 5 5 4 1 5 4 1 5 1 1 – 1 5 2 1 – 1 1 –	1 2 1 2 1 1 2 5 4 5 4 5 – – 1 – 1 1 –	0 1 1 0	

Table 4. Two-way table of stations versus species/groups generated from TWINSPAN for data collected during the intermonsoon II period (September - October 1979). (continued)

	Group A (< 30m)	Group B (> 30m)		
	346 360 361 362 334 336 337 359 343 326 327 333 336 341 347 354 353 344 346 351 352 290 336 383 364 282 283 288 289 292	328 357 350 358 365 339 340 348 349 355 356 329 330 331 284 287 285 286 291		
7 *Dussumieria acuta*	4 3 2 1 2 3 3 2 3 2 3 3 2 2 4 3 1 1 1 1 – 1 1 1 1 – 1 1 3 4	2 1 – – – – 1 2 4 1 5 1 – – – 2 – – –	0 1 1 0	
5 *Megalaspis cordyla*	1 2 1 – – 2 4 1 1 – – – 2 2 2 2 3 – 1 1 1 1 1 – 1 1 1 1 1 3	1 1 1 – – – – 1 1 – – 1 1 – 5 – – – –	0 1 1 0	
30 Theraponidae	2 2 1 – 1 2 2 2 2 1 1 1 1 2 3 1 1 1 2 1 1 1 1– 1 – 1 3 1 1	1 1 1 1 1 1 1 1 1 1 – 1 1 1 2 – 2 – –	0 1 1 0	
33 Trash fish	4 5 3 3 4 3 3 4 3 – 1 2 3 3 2 2 4 2 3 3 2 3 4 – 2 3 4 3 3 3	2 2 2 2 2 2 2 1 2 2 1 3 3 1 5 3 3 5 3	0 1 1 1 0 0	Spp cluster 1d
22 *Priacanthus* spp.	3 5 5 5 3 3 3 2 4 1 3 1 3 5 5 5 5 3 2 3 3 1 2 1 2 1 1 1 1 3	2 1 2 1 1 1 1 3 3 4 2 3 2 1 2 1 2 3 4	0 1 1 1 0 0	
27 Sphyraenidae	1 – 1 1 1 4 1 1 4 1 – 2 – 2 2 – 3 1 2 1 1 1 1 – 1 2 2 1 1 1	1 2 1 1 1 1 2 2 3 1 – 2 1 – 2 1 1 3 –	0 1 1 1 0 0	
32 Other food fish	1 5 5 5 2 2 2 1 1 1 2 1 1 – 1 – – 2 2 1 1 1 2 – 1 1 1 1 1 –	– – 1 – 1 1 1 3 2 3 – 3 2 1 1 1 1 1 1	0 1 1 1 0 1	
25 *Scoberomorus* spp.	2 2 1 – 2 2 2 1 1 – – 2 1 2 2 1 3 1 2 1 1 1 2 1 – – – – 2 2	1 2 1 1 1 1 2 2 1 1 3 2 – 1 1 – 2 – –	0 1 1 1 0 1	
16 *Nemipterus lolu*	– – – – – – – – – – – – – – – – – 1 – – – – – – 1 – – – – –	– – – – – – – 1 – – – – – – – – – – –	0 1 1 1 1 1	
5 Other Carangidae	– – – – – 1 1 – 1 – 3 1 1 1 1 – 1 2 1 1 – 1 – – – 3 3 2 3 2	2 – – 1 1 1 – – – – – – – – 5 3 2 1 3	1 0 0 0	
37 Crabs	– – – 1 – 1 1 – – – – – – 2 1 – – 1 1 1 – – – – – 1 1 1 1 1	– 1 1 – 1 – – – – – – – 1 – 1 1 –1 1	1 0 0 0	
25 *Rastrelliger* spp.	– – – 1 – 2 1 – – 5 4 – – 2 4 3 4 – – 2 2 1 1 3 1 5 2 1 3 2	1 2 3 – 1 1 1 1 3 3 3 2 2 1 5 3 1 – –	1 0 0 1	Spp cluster 2a
34 Squids	2 – 1 – 2 1 1 1 – 1 2 1 2 1 1 – 1 1 1 1 1 1 1 2 1 1 1 1 2 4	1 1 1 1 1 1 2 1 1 1 1 – 1 1 – 2 – 1 3	1 0 0 1	
5 *Caranx* spp.	– – – – 1 1 1 2 2 – – 3 3 1 2 1 – 1 2 1 – – – 2 1 – – – – –	– 1 1 1 1 3 1 2 2 1 1 2 – 1 – – – – –	1 0 0 1	
39 Other invertebrates	– – – – – 1 1 1 1 1 – 1 2 1 2 – 1 1 1 1 1 – – – – – – – 1 –	1 1 1 1 1 1 1 1 – 1 – 1 – 1 1 1 – 1	1 0 1 0	
10 Formionidae	– 2 3 – – 1– – – – – – 1 1 – 1 – – – 1 1 – – – – – 1 – 1 1	1 1 – – – – 1 1 – 1 2 1 1 – 2 1 1 – –	1 0 1 1 0 0	
3 *Arius thalassinus*	– – 2 – 1 – – 2 1 2 4 3 1 1 3 – – – – 1 – – 2 – – 1 2 1 3 2	2 2 1 – – 1 1 2 1 – – 4 1 – 4 1 1 1 2	1 0 1 1 0 1	
35 Cuttles	– – – – 1 1 – – 1 – – 1 2 1 2 1 1 1 1 1 1 1 1 – 1 2 2 1 1 1	1 – 1 1 1 – 1 1 1 – 1 1 1 1 2 1 1 1 2	1 0 1 1 0 1	
12 Heterosomata	1 1 – – – 1 – 1 – – 1 1 1 1 1 3 – – 1 1 – – 1 1 1 2 1 1 1 1	1 – 1 1 1 1 1 1 1 – 1 1 1 1 1 1 1 2 1	1 0 1 1 0 1	Spp cluster 2b
31 Trichiuridae	– – – 1 – – 1 – 1 1 1 1 1 1 1 – – 1 – 1 1 – – – – – 1 1 1 3	1 1 – – – 1 1 – – 1 1 1 1 1 1 1 2 1 –	1 0 1 1 0 1	
36 Shrimps	– – – – – – – – – – – – – 1 1 – 1 – 1 1 1 – – – – 1 – 1 1 1	1 1 1 – 1 – – – – – 1 1 1 – – 2 1 1 –	1 0 1 1 0 1	
18 *Nemipterus japonicus*	– – – – 1 1 1 2 1 1 3 1 1 1 1 1 – 1 1 1 1 – – – 1 1 1 – 1 –	1 1 1 1 1 1 1 1 1 1 1 2 2 1 1 1 3 4 –	1 0 1 1 1	
29 Synodontidae	1 – – – 1 1 1 1 2 1 1 1 1 1 1 1 – 1 1 1 – – 1 1 1 3 1 1 2 2	1 1 – 1 1 1 1 1 1 1 1 1 1 – 2 2 2 2 2	1 0 1 1 1	
3 *Arius* spp.	– 2 –	– – – – – – – – – – – – – – – – 2 – –	1 0 1 1 1	
3 *Arius venosus*	– – – – – – – – – 4 – – 3 3 – 3 – – – – – – – – – – – – – –	– 1 – 1 3 1 – 2 1 – 2 – 2 – – – – – –	1 1 0 0 0	
5 *Seriolina nigrofasciata*	– – – – – – – – – – – 1 – 1 1 2 – – 1 1 – – – – – – – – – –	– 1 1 1 1 – – 1 – – – – 1 – – – – – –	1 1 0 0 0	
18 *Nemipterus hexodon*	– – – – – 1 1 – 1 1 – – 1 1 – 1 – – 1 1 – – – – 1 – – – – –	1 1 1 1 1 1 – 1 – – 1 1 1 – – – – – –	1 1 0 0 0	
1 *Carcharhinus scalei*	– – – – 1 – – – – – – 1 – – – 1 – – – – – – – – – – – – – –	3 – – – – – – – – – – – – – – – – – 2	1 1 0 0 1 0	
22 Other Pomadasyidae	– – – – – – – – 1 – – 1 2 1 2 2 1 – 1 1 1 – – – – – – – – –	2 2 1 1 1 5 3 3 3 4 5 4 5 2 – – – – –	1 1 0 0 1 1	
22 *Priacanthus layenus*	– – – – – – – – – – – 2 2 1 1 1 – – 1 – – – – – – – – – – –	2 1 1 1 2 1 2 2 2 – – 3 3 1 – – – – –	1 1 0 0 1 1	
18 *Nemipterus mesoprion*	– – – – – 1 – – 1 – – – 1 1 – 1 – – 1 1 – – – – – – – – – –	1 1 1 1 1 1 1 1 1 1 1 2 1 1 – – – – –	1 1 0 0 1 1	
14 *Leiognathus elongatus*	– – – – 1 –	1 – – – – – – – – – – – 1 – – – – – –	1 1 0 0 1 1	Spp cluster 2c
40 Snakes	– – – 2 – – – 1 – – – – – – 2 – – – 2 – 3 – – – – – – – – –	1 2 2 – – 2 – 1 – – – 2 2 – – – – 2 –	1 1 0 1 0 0	
5 *Atropus atropus*	– – – – – – – – – – – – 1 1 – 1 – 1 1 1 1 – 1 – 1 – – – – –	1 1 – 1 1 2 1 1 3 1 1 – 1 1 – – – – –	1 1 0 1 0 0	

Table 4. Two-way table of stations versus species/groups generated from TWINSPAN for data collected during the intermonsoon II period (September-October 1979). (continued)

	Group A (< 30m)	Group B (> 30m)	
	346 360 361 362 334 336 337 359 343 326 327 333 336 341 347 354 353 344 346 351 352 290 336 383 364 282 283 288 289 292	328 357 350 358 365 339 340 348 349 355 356 329 330 331 284 287 285 286 291	
16 Other Mullidae	– – – – – – – – – – – – – – – – – – 1 1 1 1 – – – – – – 1 – –	– – 1 – – 1 – 1 1 – – 1 1 – 1 – – 1 –	1 1 0 1 0 0
16 *Upeneus sulphureus*	1 1 1 – – – – – 1 1 – 1 3 1 2 4 – – 1 1 – – – – – 1 – 1 1 4	1 2 1 – 4 4 4 4 4 2 2 5 4 – 1 1 5 2 –	1 1 0 1 0 1
11 *Pentaprion longimanus*	– 1 – – – 1 1 1 – – – 1 3 – 1 4 – – 1 1 – – – – – – 1 – 1 1	1 1 1 1 1 4 3 4 4 2 2 5 4 2 1 1 3 3 3	1 1 0 1 0 1
5 *Decapterus spp.*	– – – 1 –	– – – – – – – – – 1 – – 1 – – – – – –	1 1 0 1 0 1
5 *Selaroides leptolepis*	1 – – – – – – – – – – – 1 2 1 1 – 1 1 1 1 – – – 1 – 2 1 – – 2	– 1 1 1 1 – 1 1 1 1 2 3 1 2 4 1 3 1 4	1 1 0 1 1
5 *Selar spp.*	– – – – – – – – – – – – 1 1 – 2 – 4 1 1 – – – – – 1 1 – – – –	2 – – 1 – – 3 2 1 2 1 1 1 1 2 2 4 1 1	1 1 0 1 1
14 *Leiognathus bindus*	1 – – – – – – 1 – – – 1 1 – – 5 – – – – – – – – 1 – – – – –	2 1 1 – 2 1 – 1 1 1 1 2 1 – 1 – 4 1 –	1 1 0 1 1
21 *Pomadasys argyreus*	1 – – – – – 1 1 – – 1 – 1 1 1 – – – 1 1 – – – – – – 1 – 1 1 –	– – – 1 – 1 – 1 1 1 1 2 2 – – 1 1 2 –	1 1 0 1 1
4 *Abalistes stellaris*	– 1 – – 1	– – – – 1 1 1 1 1 – – – – – 1 – 1 1 1	1 1 1 0 0
5 *Atule spp.*	– – – – – – – – – – – – – – – 1 – – – – – – – – – – – – – –	– – – 1 – 1 1 – 1 – – – – – 2 – – – –	1 1 1 0 0
17 Muraenesocidae	– –	– – – 1 – – – – – – – – – – – – – – –	1 1 1 0 0
16 *Upeneus bensasi*	– –	– – – – – – – – – – – – – – – – – – 3	1 1 1 0 1 0
16 *Nemipterus marginatus*	– –	– – – – – 1 – – – – – – 1 1 – – 1 – 2	1 1 1 0 1 0
42 Sponges	– –	– – – – – 1 – – – – – 1 2 – – – – – –	1 1 1 0 1 0
18 *Nemipterus peronii*	– –	– – – – – – – – – – – – – – – – – – 1	1 1 1 0 1 0 Spp cluster 2d
15 *Lutjanus sanguineus*	– – – – – 1 – 1 1 – – – – – – – – – 1 – – – – – – – – – – –	– – – – – 1 1 5 3 3 3 2 – 2 – – 4 4 –	1 1 1 0 1 1
18 *Scolopsis spp.*	– – – – – – – – – – – – – – – – – 1 1 – – – – – – – – – – –	– – 1 – – 1 – 1 1 – 1 1 1 1 1 – 1 1 1	1 1 1 0 1 1
15 Other Lutjanidae	– – – – – 1 – – – – – – – – – – – – – – – – – – – 1 – 1 –	– – – – – – – 1 – 1 – – – 1 1 – 1 1 1	1 1 1 1 0
38 Lobster	– – – – – – – – 1 – – – – – – – – – – – – – – – 1 1 – 1	– – – – – 1 1 – – – – – – – 1 1 1 1 1	1 1 1 1 0
18 Other Nemipteridae	– 1 – – 1 –	– – – – – – – – – – – – 1 1 1 – 3 3 4	1 1 1 1 1
18 *Nemipterus nemurus*	– 1 –	– – – – – – – – – – – – – – 1 1 1 1 1	1 1 1 1 1
19 Pentapodidac	– 1 – – –	– – – – – – – – – – – – 1 1 – – 1 – 1	1 1 1 1 1
	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	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1	
	0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 0 0 0 0 0 0 0 0 1 1 1 1	0 0 0 0 0 00 1 1 1 1 1 1 1 00 1 1 1	
	0 0 0 0 1 1 1 1 1 1 1 0 0 0 0 0 1 0 0 0 0 1 1 1 1 0 0 0 0 1	0 0 1 1 1 1 1 0 0 0 0 1 1 1	
	0 0 0 0 0 1 1 0 0 0 0 1	0 0 0 1 1	
	0 0 0 0 1		

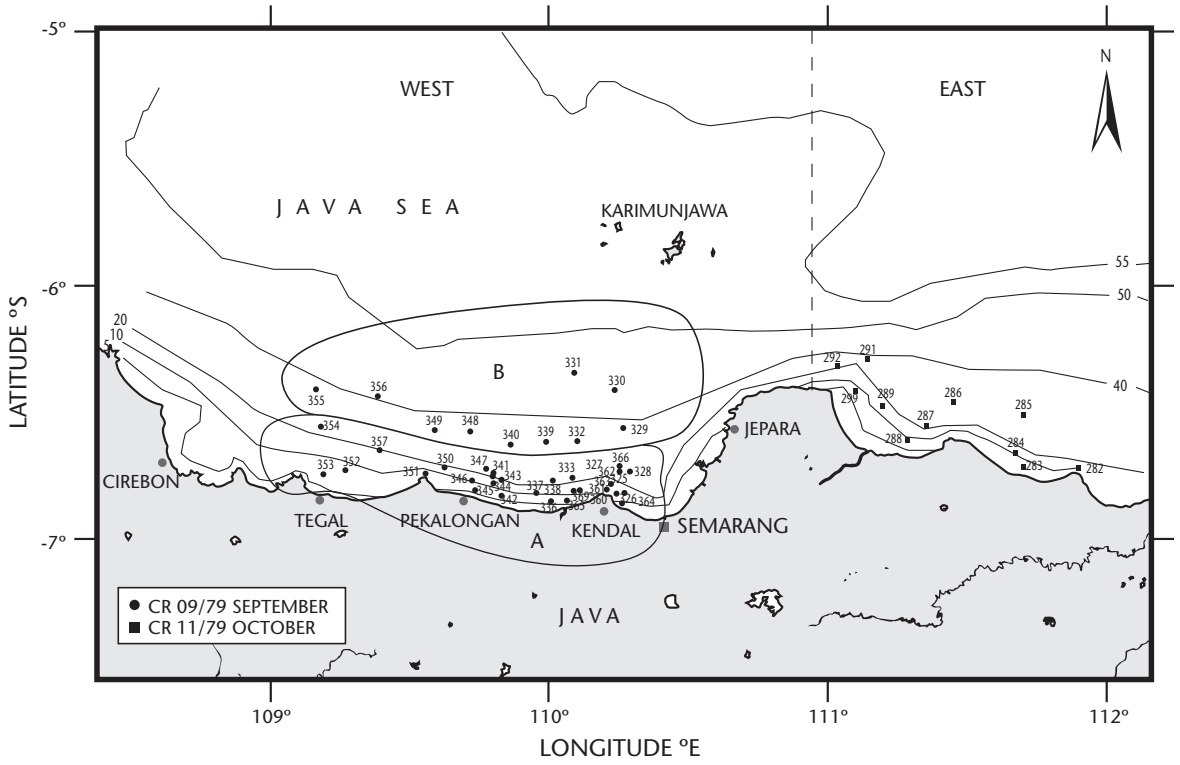

Fig. 7. Trawl stations off the north coast of Central Java in September and November 1979 showing station clusters derived using TWINSPAN and DCA.

Table 5. Catch rate and relative abundance of the 30 most important taxa comprising the shallow and deep assemblages during the west monsoon and intermonsoon I period.

West Monsoon					
Shallow			**Deep**		
Taxa	**kg·h^{-1}**	**%**	**Taxa**	**kg·h^{-1}**	**%**
Leiognathus splendens	29.8	20.2	*Leiognathus splendens*	80.0	39.0
Rastrelliger spp.	25.1	17.1	*Priacanthus* spp.	15.2	7.4
Alectis indicus	11.0	7.5	Other Leiognathidae	10.7	5.2
Sardinella spp.	10.0	6.8	*Upeneus sulphureus*	10.3	5.0
Anadontostoma spp.	9.2	6.2	Other carangidae	9.7	4.7
Other Leiognathidae	8.9	6.1	Trash Fish	9.1	4.4
Squids	7.8	533	Sphyraenidae	7.4	3.6
Trash Fish	7.5	5.1	*Pentrapion longimanus*	6.2	3.0
Other Ariidae	6.2	4.2	Trichiuridae	4.7	2.3
Trichiuridae	5.0	3.4	*Alectis indicus*	4.1	2.0
Other Carangidae	4.0	2.7	Squids	3.7	1.8
Scianidae	2.5	1.7	*Selar* spp.	3.0	1.4
Stolephorus spp.	2.3	1.6	*Lutjanus sanguineus*	2.6	1.3
Upeneus sulphureus	1.6	1.1	*Dussumieria acuta*	2.6	1.3
Scomberomorus spp.	1.6	1.1	*Scomberomorus* spp.	2.5	1.2
Dasyatidae	1.4	1.0	Other Ariidae	2.4	1.2
Selaroides leptolepsis	1.2	0.8	*Selaroides leptolepsis*	2.4	1.2
Selar spp.	1.1	0.8	Synodontidae	1.9	0.9
Dussumieria acuta	1.1	0.7	*Rastrelliger* spp.	1.8	0.9
Other Engraulidae	1.0	0.7	Other Nemipteridae	1.5	0.7
Ilisha spp.	1.0	0.7	*Atule* spp.	1.4	0.7
Theraponidae	0.9	0.6	*Arius thalassinus*	1.3	0.6
Stromateidae	0.8	0.5	Dasyatidae	1.3	0.6
Lactaridae	0.6	0.4	Other Food Fish	1.2	0.6
Priacanthus spp.	0.6	0.4	*Stolephorus* spp.	1.1	0.6
Formionidae	0.5	0.4	Other Lutjanidae	1.1	0.5
Arius thalassinus	0.5	0.3	*Nemipterus japonicus*	1.1	0.5
Muraenesocidae	0.5	0.3	Chirocentridae	1.0	0.5
Sphyraenidae	0.5	0.3	*Pomadasys hasta*	1.0	0.5
Others	2.3	1.6	*Sardinella* spp.	1.0	0.5
			Others	11.3	6.1

Table 5. Catch rate and relative abundance of the 30 most important taxa comprising the shallow and deep assemblages during the west monsoon and intermonsoon I period. (continued)

Intermonsoon II					
Shallow			Deep		
Taxa	**kg·h^{-1}**	**%**	**Taxa**	**kg·h^{-1}**	**%**
Leiognathus splendens	59.8	21.7	*Rastrelliger* spp.	15.7	15.9
Trichiuridae	27.3	9.9	*Leiognathus splendens*	10.3	10.4
Anadontostoma spp.	26.2	9.5	*Alectis indicus*	8.5	8.6
Rastrelliger spp.	21.9	7.9	Trichiuridae	6.8	6.8
Stromateidae	16.5	6.0	Other Lutjanidae	4.7	4.7
Alectis indicus	15.4	5.6	Other Carangidae	4.6	4.7
Leiognathus equulus	11.2	4.0	Squids	4.4	4.4
Other Carangidae	10.1	3.7	*Lutjanus sanguineus*	4.3	4.4
Other Leiognathidae	8.7	3.1	Stromateidae	3.4	3.4
Other Ariidae	6.8	2.5	Other Ariidae	3.4	3.4
Trash Fish	6.2	2.3	*Scomberomorus* spp.	3.2	3.3
Squids	5.8	2.1	*Selar* spp.	3.1	3.2
Dasyatidae	5.8	2.1	*Anadontostoma* spp.	2.4	2.4
Sphyraenidae	5.3	1.9	*Sardinella* spp.	1.9	2.0
Sardinella spp.	5.2	1.9	Other Rays	1.9	1.9
Scomberomorus spp.	4.0	1.5	*Pentrapion longimanus*	1.8	1.8
Lactaridae	3.9	1.4	*Stolephorus* spp.	1.5	1.5
Theraponidae	3.6	1.3	*Upeneus sulphureus*	1.5	1.5
Polynemidae	3.2	1.1	Formionidae	1.4	1.5
Dussumieria acuta	3.1	1.1	Trash Fish	1.3	1.3
Upeneus sulphureus	2.9	1.1	Dasyatidae	1.2	1.2
Pomadasys hasta	2.8	1.0	Sphyraenidae	1.1	1.1
Other Food Fish	2.5	0.9	*Priacanthus* spp.	1.0	1.0
Other Engraulidae	2.4	0.9	*Dussumieria acuta*	0.9	0.9
Pentrapion longimanus	1.8	0.7	Lactaridae	0.8	0.8
Other Rays	1.8	0.6	Cuttles	0.7	0.7
Stolephorus spp.	1.4	0.5	other Leiognathidae	0.6	0.6
Selar spp.	1.3	0.5	*Arius thalassinus*	0.5	0.5
Snakes	1.0	0.4	Theraponidae	0.5	0.5
Arius thalassinus	1.0	0.4	*Selaroides leptolepsis*	0.4	0.4
Others	6.5	2.3	Others	5.1	5.1

Table 6. Catch rate and relative abundance of the 30 most important species/groups comprising the shallow and deep assemblages during the intermonsoon II period.

Deep			Shallow		
Species/Group	**kg·h^{-1}**	**%**	**Species/Group**	**kg·h^{-1}**	**%**
Leiognathus splendens	12.88	10.53	*Leiognathus splendens*	55.84	30.98
Priacanthus spp.	11.47	9.38	Dasyatidae	9.67	5.36
Priacanthus macracanthus	8.45	6.91	*Alepes* spp.	9.36	5.19
Upeneus sulphureus	8.26	6.75	*Arius caelatus*	8.30	4.60
Pentrapion longimanus	7.11	5.81	Other Food Fish	8.07	4.48
Trash Fish	6.52	5.33	Trash Fish	7.86	4.36
Rastrelliger spp.	4.30	3.51	Sciaenidae	7.39	4.10
Lutjanus sanguineus	4.23	3.46	Other Leiognathidae	6.04	3.35
Dasyatidae	3.91	3.19	*Pomadasys hasta*	4.91	2.72
Other Leiognathidae	3.42	2.80	*Rastrelliger* spp.	4.82	2.68
Arius thalassinus	3.38	2.76	Stromateidae	3.94	2.19
Dussumieria acuta	3.30	2.69	*Dussumieria acuta*	3.61	2.00
Other Carangidae	2.54	2.07	*Anadontostoma* spp.	3.14	1.74
Selaroides leptolepis	2.32	1.90	*Sardinella* spp.	2.58	1.43
Nemipterus japonicus	2.32	1.90	Sphyraenidae	2.19	1.22
Megalaspis cordyla	1.95	1.59	*Scomberomorus* spp.	1.96	1.09
Selar spp.	1.94	1.58	*Megalaspis cordyla*	1.94	1.08
Other Food Fish	1.84	1.50	*Stolephorus* spp.	1.89	1.05
Sphyraenidae	1.79	1.46	*Leiognathus equulus*	1.80	1.00
Priacanthus tayenus	1.41	1.15	*Alectis indicus*	1.75	0.97
Squids	1.39	1.13	*Leiognathus brevirostris*	1.72	0.95
Other Nemipteridae	1.36	1.11	*Thryssa* spp.	1.66	0.92
Leiognathus bindus	1.27	1.04	Theraponidae	1.61	0.89
Scomberomorus spp.	1.27	1.04	*Upeneus sulphureus*	1.58	0.87
Alepes spp.	1.26	1.03	Drepanidae	1.46	0.81
Synodontidae	1.19	0.97	*Arius thalassinus*	1.45	0.80
Scianidae	1.17	0.96	*Osteogeneosis milit*	1.42	0.79
Other Rays	1.10	0.90	Squids	1.42	0.79
Arius venosus	1.06	0.87	Other Carangidae	1.27	0.70
Snakes	0.90	0.74	*Priacanthus* spp.	1.19	0.66
Others	16.72	13.60	Others	18.07	10.03

References

Bianchi, G., M. Badrudin and S. Budiharjo. 1996. Demersal assemblages of the Java Sea: a study based on the trawl survey of the R/V Mutiara 4, p. 55 - 61. *In* D. Pauly and P. Martosubroto (eds.) Baseline studies of biodiversity: the fish resources of Western Indonesia. ICLARM Studies and Reviews 23, 7 312 p.

Hill, M.O. 1979. TWINSPAN-a FORTRAN program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes. Section of Ecology and Systematics, Cornell University, Ithaca, New York.

Ter Braak, C.J.F. 1988. CANOCO-A FORTRAN program for canonical community ordination by partial detrended canonical correspondence analysis, principal components analysis and redundancy analysis (Version 2.1). Agricultural Mathematics Group, Wageningen, The Netherlands.