Demersal Fish Resources Stock Assessment of East Coast Sabah-The Sulu Sulawesi Seas Economic Exclusive Zone of Malaysia

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Abstract: This was the very first demersal survey carried out in east coast Sabah. A total of 4 cruises, covering 40 stations were completed utilizing the trawl net of research vessel, KK MANCHONG from the 15th to 31st July 2009. The survey area was divided into three depth strata [1: 10-30 fathoms (18-55 m), 2: 20-50 fathoms (56-91 m) and 3: 50-100 fathoms (92-185 m)] and into three Sulu-Sulawesi marine ecoregions: SSME 1, SSME 2 and SSME 3. A total of 213 species with an overall average catch rate of 59.74 kghr^{-1} were recorded during the survey. Of this, demersal fish contributed 25.29 kghr^{-1} or 42%, pelagic fish contributed 11.89 kghr^{-1} or 20%, while 22.56 kghr^{-1} or 38% was attributed to trash fish. Biomass estimates of demersal and trash fish resource was calculated using Swept Area Method. The biomass distribution in the three surveyed strata and 3 SSMEs was roughly in percentage ratios of 32: 9: 59 and 44: 28: 28 for strata 1, 2 and 3 and SSME 1, SSME 2 and SSME 3 respectively. In the estimation of Maximum Sustainable Yield (MSY) of demersal fish, the acceptable figure was a summation of the 3 SSMEs' potential yield that was 44,718 tons with the demersal fish productivity at 5.295 tonsNM^{-2}yr^{-1}. The exploitation rate for the combination of catchability coefficient, q=0.6 and mortality rate, M=1.66 per year at yield, Y=45,450.6 tons was at 0.58 per year, indicating over exploitation of the demersal resource in the surveyed area. Taking the precautionary approach to fisheries management, it was suggested that the present level of demersal fish resource exploitation be reduced.

Keywords: Demersal, fish, stock assessment, EEZ, Sabah

Abstrak: Ini merupakan survei yang julung kali dibuat bagi pantai timur Sabah. Dari 15 hingga 31 Julai 2009, KK MANCHONG, kapal pukat tunda penyelidikan telah menjalankan penundaan di 40 stesen. Perairan survei dibahagi kepada tiga kedalaman air [kedalaman1: 10-30 (18-55 m), kedalaman 2: 20-50 (56-91 m) dan kedalaman 3: 50-100 (92-185 m)] dan tiga kawasan marin Sulu-Sulawesi: SSME 1, SSME 2 dan SSME 3. Sebanyak 213 spesis ikan telah dikenalpasti semasa survei ini dengan keseluruhan purata tangkapan sebanyak 59.74 kgjam^{-1}. Dari purata kadar tangkapan tersebut ikan demersal, ikan pelagik dan ikan baja masing-masing menyumbangkan 25.29 kgjam^{-1} atau 42%, 11.89 kgjam^{-1} atau 20% dan 22.56 kgjam^{-1} atau 38%. Kaedah anggaran biomas bagi ikan demersal dan ikan baja adalah menggunakan kaedah penyapuan kawasan. Taburan biomas bagi tiga kedalaman air dan 3 kawasan marin yang disurvei mempunyai anggaran nisbah peratusan 32: 9: 59 dan 44: 28: 28 bagi kedalaman air 1, 2 dan 3 dan kawasan marin, SSME 1, SSME 2 dam SSME 3 masing-masing. Anggaran tahap tuaian mampan maksima bagi ikan demersal adalah 44,718 tan hasil dari gabungan potensi kesemua 3 SSME dengan produktiviti ikan demersal sebanyak 5.295 tan BN^{-2}tahun^{-1}. Kadar eksploitasi bagi kombinasi koeffisien tangkapan, q = 0.6 dan kadar kematian, M = 1.66 tahun^{-1} dengan pendaratan, Y = 45,450.6 tan adalah 0.58 tahun^{-1}, menunjukkan bahawa terdapat lebihan eksploitasi sumber ikan demersal di kawasan survei. Dengan mengambil langkah berwaspada dalam pengurusan perikanan, adalah dicadangkan tahap eksploitasi semasa sumber ikan demersal dikurangkan.

Introduction

The Malaysian fisheries industry plays an important role in the economic development of the country. Besides providing cheap protein (per capita fish consumption: 55.9 kgyear^{-1} (Food and Agriculture Organization (FAO), 2006) or 38.2% of the total animal protein intake), it also provides various socio-economic opportunities including employment for some 99,617 full-time fishermen (Anon., 2007) in the country.

During the last decade, the value of fisheries exports from Sabah had increased many folds. These products, mainly from the coastal capture fisheries sector, were exported as raw materials or semi-processed

products with only minimum value added. Some of the fisheries resources for example shrimps within the 12-nautical mile coastal zone had already shown some probable signs of over-exploitation. At present, there is a paucity of comprehensive information on the distribution, biology, potential yield and exploitation status of fisheries resources in both coastal and offshore waters of Sabah. These were more critical for the east coast of Sabah, the Sulu-Sulawesi seas knowing the fact that piracy was the main treat.

The first fisheries resource survey in the Economic Exclusive Zone (EEZ) of Malaysia was conducted from 1985-1987 (Anon., 1988) and the second survey was carried out from 1996-1997 (Anon., 2000). These surveys estimated the demersal and semi-pelagic/pelagic fish biomass and potential yield in the waters of the Malaysian EEZ, covering the west and east coasts of Peninsular Malaysia as well as the South China Sea area off Sarawak and Sabah. Due to security reason, fish resource survey was not carried out in the Sulu and Sulawesi seas east coast of Sabah. The results from the surveys provided the Department of Fisheries Malaysia with baseline resource information for the formulation of plans for the development of the fisheries. The systematic development of the fisheries industry is expected to increase fish production to meet the demand for food.

This present survey is part of the inaugural Malaysian Sulu-Sulawesi scientific expedition organized by the National Oceanography Directorate (NOD), Ministry of Science, Technology and Innovation, MOSTI. It was the first ever carried out in this water and its aims to assess the status of the demersal fish resource of east coast Sabah. In this survey, the demersal fish biomass and potential yield will be determined. The detailed programme of this east coast Sabah demersal survey was prepared by the Fisheries Research Institute (FRI) Bintawa, Kuching. The Swept Area Method was used to estimate demersal fish density and biomass (Hadil *et al.*, 2008). This survey was carried out using the research vessel K.K. MANCHONG from FRI-Bintawa. Results of this survey also give catch rates, density distribution and species composition of fish.

Materials and Methods

The area surveyed extended seawards beyond the coastline to about 100 fathom depth contour from 8°N to 4°N on the east coast of Sabah. This area was divided into three depth strata i.e. stratum 1 from 10-30 fathoms (18-55 m), stratum 2 from 30-50 fathoms (56-91 m) and stratum 3 from 50-100 fathoms (92-185 m). The division of the survey area into depth strata followed the standard procedure used by FRI in earlier, EEZ fish resource survey using RV RASTRELLIGER (Anon., 1988). The area was also divided into 3 Sulu-Sulawesi Marine Ecoregion, SSME (figure 1) as mentioned by Biusing (2001). The three SSME comprised three zones: SSME 1 (Kudat, Kota Marudu, Pitas) on the northern part of Sabah; SSME 2 (Sandakan, Kinabatangan, Beluran) on the northeast; and SSME 3 (Tawau, Lahad Datu, Semporna, Kunak) on the southeast.

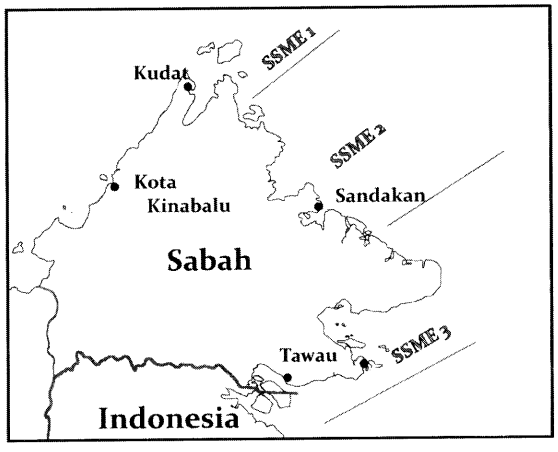

Figure 1: Sulu-Sulawesi Marine Ecoregions, SSME of East Coast Sabah (adapted from Biusing, 2001)

K.K. MANCHONG is a research trawler based at FRI-Bintawa. Some of the principal details of the vessel and her equipment are given in Hadil *et al.* (2008) and Anon. (2000). The design of the trawl net and otter boards used and some of its principal features were illustrated in Hadil and Richard (1991). The net was made of polyethylene with a cod-end mesh size of 38 mm. The polyvalent otter-boards used weighed 350 kg each.

The survey methodology used was adopted from Hadil *et al.* (2008) that closely followed the standard methodology outlined in Mackett (1973) and Sparre and Venema (1992). Sampling was conducted using the stratified random sampling technique. Within each stratum, trawl stations were selected randomly such that at least one trawl station will be covered in each grid of 15 x 15 square nautical miles. Table 1 shows the distribution of the stations after been randomly selected with SSME 1 having only shallow water trawl stations and only SSME 3 having deep water trawl stations. The Malaysian EEZ in the east coast of Sabah is very narrow and with rugged sea bottom (untrawable), the furthest being <30NM and only SSME 3 is having bigger area and deeper water.

Table 1: Possible trawl stations planned for 3 depth strata under respective Sulawesi Marine Ecoregion (SSME)

Depth strata\SSME	SSME 1	SSME 2	SSME 3
10-30 fathoms (18-55)	5 stations (1-5)	10 stations (6-13,15,20)	7 stations (30-36)
30-50 fathoms (56-91m)		5 stations (14,16-19)	8 stations (21-26, 28, 29)
50-100 fathoms (92-185m)			5 stations (27, 37-40)

The total area covered in this survey was calculated from maps digitized using the software Explorer. The cruise track was fixed after considering the port at the beginning and the end of each cruise. A total of 4 cruises, covering 40 stations were completed from 15th July to 31st July 2009. The distribution of stations by depth is shown in Figure 2 and Appendix 1. The names of personnel involved were listed in Appendix 3. Treatment of samples and catch analysis followed methods stipulated by Hadil *et al.* (2008).

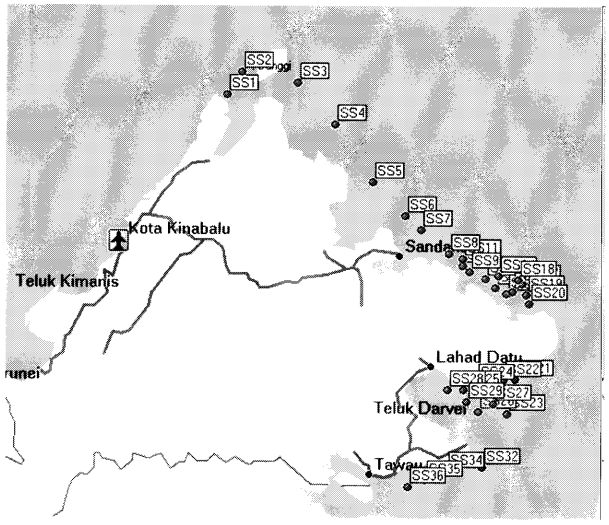

Figure 2: Thirty-three trawling stations successfully carried out by KK MANCHONG in the Sulu-Sulawesi seas EEZ Malaysia East Coast Sabah from 15th to 31st July 2009

Results

Four cruises were completed from 15th July to 31st July 2009. A total of 33 hauls were successfully conducted at an average of three hauls per day. Seven trawl operations were aborted due to rough grounds, very deep water or very strong water current. Details on each haul are given in Appendix 1. Fig. 2 shows the distribution of the trawl stations in the surveyed area.

The catch rates for the first few hauls were high at > 100 kghr^{-1} (Table 2 and Fig. 3). The rest of the hauls were in the region of 50 kghr^{-1} more or less. The highest catch rate at 228.51 kghr^{-1} was obtained from trawl station 1. The next 4 high catch rates were obtained from station 5 at 195.79 kghr^{-1}; station 26 at 133.50 kghr^{-1}; station 3 at 124.52 kghr^{-1} and station 2 at 102.04 kghr^{-1}.

Table 2: The commercial and trash fish percentage composition for all the successful trawls hauls conducted by KK MANCHONG in East Coast Sabah

Station No.	Catch rate (kghr^{-1})	Commercial species (%)	Fish (%)	Total No. of species	No. of commercial species	No. of trash species	Depth range (m)	SSME
Stratum 18-55m								
1	228.51	93	7	31	29	2	22	1
2	102.04	13	87	22	16	6	32-39	
3	124.52	61	39	35	21	14	32	
4	28.40	79	21	32	17	5	21-24	
5	195.79	22	78	45	34	11	27	
6	41.78	29	71	31	25	6	15-27	2
7	7.08	66	34	15	11	4	36-40	
8	18.52	90	10	32	23	9	34	
9	22.55	32	68	16	12	4	10-21	
10	47.25	41	59	28	23	5	27-32	
11	65.14	46	54	44	30	11	40-44	
12	65.83	74	26	8	33	41	29-32	
13	53.17	66	34	12	33	45	39-51	
15	30.91	85	15	20	18	2	41-63	
20	45.48	53	47	24	20	4	34-43	3
32	21.96	35	65	13	7	6	21-23	
34	34.60		39.1	35	25	10	20-21	
35	50.89	90	10	59	49	10	20-29	
36	30.51	82	18	34	25	9	27-36	
Average	63.94		41.16	28	24	11		
Stratum 56-91m								
14	35.78	91	9	33	29	4	55-62	
16	32.03	99	1	27	23	4	60-67	2
17	48.7	67	33	47	28	19	66-69	
18	61.52	96	4	46	27	19	73-76	
19	76.65	66	34	40	24	16	66-67	
21	71.7	61	39	34	15	19	71-76	3
22	59.41	94	6	40	20	20	64-68	
23	16.6	78	22	14	8	6	78-95	
24	67.86	89	11	32	23	9	53-70	
25	35.98	95	5	32	21	11	69-71	
26	133.5	17	83	23	14	9	76-78	
28	33.45	77	23	37	26	11	51-61	
29	43.44	69	31	23	12	11	75-78	
	55.12	76.85	23.15	33	21	12	100-118	
Stratum 92-185m								
27	39.71	93.1	9.6	31	17	14		3
Overall Average	59.74	76.26	24.64	30.71	20.50	12.30		

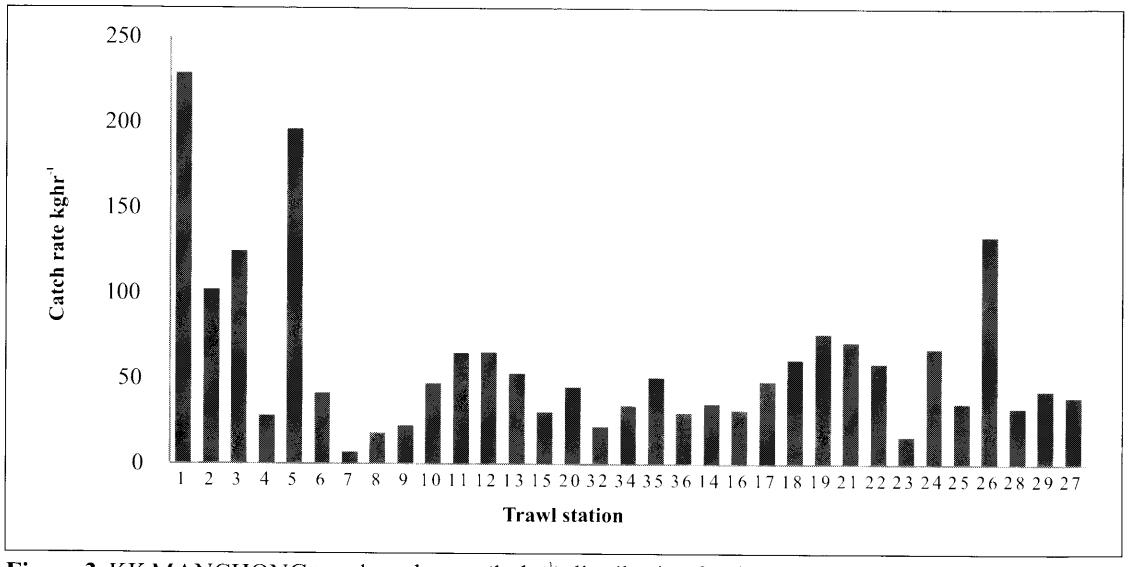

Figure 3: KK MANCHONG trawl catch rates ($kghr^{-1}$) distribution for the East Coast Sabah 2009

Overall an average catch rate of 59.74 $kghr^{-1}$ was recorded from the 33 trawl hauls conducted (Table 3). Of this, demersal fish species contributed 21.95 $kghr^{-1}$ or 36.75%, pelagic fish contributed 11.89 $kghr^{-1}$ or 19.90%, while trash fish contributed 22.56 $kghr^{-1}$ or 37.77% (Fig. 4 and 5). The rest of the catch contributing 5.58% comprised elasmobranchs, crabs, shrimps, mollusc, lobsters and cephalopods.

Table 4 shows the distribution of average catch rates and their percentage contribution to the respective SSME under different stratum. Under stratum 1 (18-55 m), SSME 1 was the most productive having the highest average catch rate of 140.3 $kghr^{-1}$ compared to SSME 2 (43.8 $kghr^{-1}$) and SSME (35.8 $kghr^{-1}$). The contribution of trash fish in the catch of SSME 1 under stratum 1 was very high at 44.5%. But, under stratum 1 significant contribution of demersal and pelagic fish was observed in the average catch rates of SSME 2 (66.9%) and SSME 3 (53.8%) as compared to SSME 1 (51%). Significantly high contribution of demersal and pelagic fish was also observed in the average catch rates of SSME 2 (70.4%) and SSME 3 (49.3%) under stratum 2. The high average catch rate of SSME 3 (58.7 $kghr^{-1}$) was attributed to the high percentage (46.7%) of trash fish in the catch. At stratum 3 only one haul (station 27) can be managed by KK MANCHONG and this might not represent the average catch rate of the stratum. But it's obvious to note that since station 27 was in deeper water, a very high (86.8%) contribution of demersal fish to the trawl catch was understandable. Throughout the surveyed area, the contribution by invertebrates was rather low ranging from 1.3 to 9.2% of the average catch rate.

Table 3: KK MANCHONG trawl total catch and average catch rate composition for East Coast Sabah

Fish group	Total catch (kg)	(%)	Average catch Rate (kg/hr^{-1})	Std (+/-)
Demersal fish	724.46	36.75	21.95	66.99
Pelagic fish	392.32	19.90	11.89	41.94
Elasmobranchs	12.91	0.65	0.39	2.12
Crabs	23.78	1.21	0.72	2.42
Shrimps	8.12	0.41	0.25	1.12
Mollusc	3.96	0.20	0.12	0.43
Lobsters	2.68	0.14	0.08	0.29
Cephalopods	58.58	2.97	1.78	3.00
Trash fish	744.45	37.77	22.56	85.52
Total	**1,971.26**	**100**	**59.74**	**203.86**

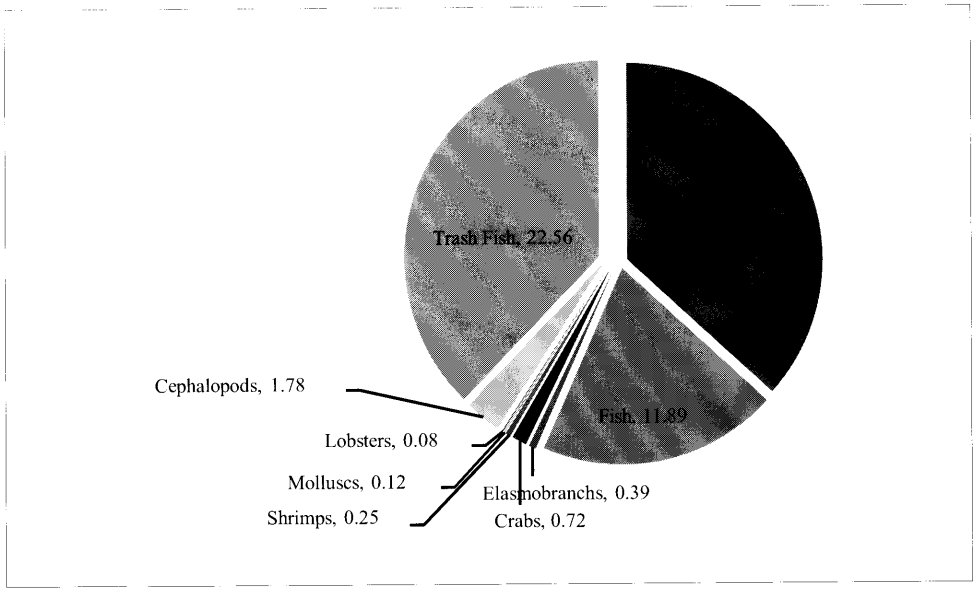

Figure 4: KK Manchong trawl total catch (in $kghr^{-1}$) composition for East Coast Sabah 2009

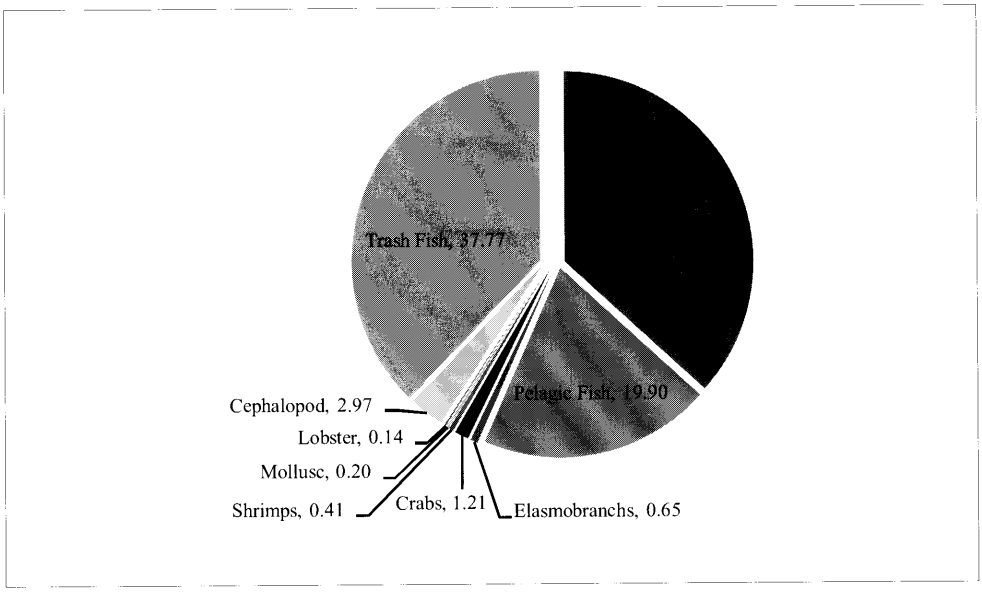

Figure 5: KK Manchong trawl total catch (in percentage) composition for East Coast Sabah 2009

Table 4: KK MANCHONG average catch rate and percentage composition for the three depth strata under different SSME of East Coast Sabah 2009

Stratum	1						2				3	
SSME	1		2		3		2		3		3	
	Average Weight	%	Average Weight	%	Average Weight	%	Average Weight	%	Average Weight	%	Average Weight	%
Demersals	38.4	27.4	9.4	21.4	17.1	47.8	21.3	44.3	20.8	35.4	34.5	86.8
Pelagics	33.1	23.6	14.2	32.4	6.9	19.1	12.6	26.1	8.2	13.9	0.1	0.3
Elasmobranchs	0.5	0.3	0.0	0.0	1.0	2.8	0.4	0.8	0.5	0.9	1.9	4.8
Crabs	1.0	0.7	0.7	1.7	1.5	4.2	1.8	3.7	0.0	0.0	0.0	0.0
Shrimps	0.1	0.1	0.2	0.4	0.3	0.9	0.0	0.1	0.6	1.0	0.0	0.0
Molluscs	0.5	0.4	0.0	0.1	0.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0
Lobsters	0.2	0.1	0.2	0.5	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Cephalopods	4.0	2.9	1.3	3.0	0.7	1.9	2.6	5.4	1.1	1.9	0.5	1.3
T.Invertebrates	5.8	4.2	2.5	5.7	2.9	8.2	4.4	9.2	1.7	2.9	0.5	1.3
Trash Fish	62.5	44.5	17.7	40.5	7.9	22.1	9.5	19.7	27.5	46.9	2.8	6.9
Total	140.3	100.0	43.8	100.0	35.8	100.0	48.2	100.0	58.7	100.0	39.7	100.0

In term of stratum by stratum observation, the overall average catch rate of Stratum 1 were higher (63.94 $kghr^{-1}$) than the overall catch rate of the whole survey area. But this was contributed in large by the higher average catch rate of trash fish (Table 5) at 27.24 $kghr^{-1}$ (42.61%). The average catch rate increased as trawling get deeper; from 19.12 $kghr^{-1}$ at stratum 1; 25.13 $kghr^{-1}$ at stratum 2 and 34.45 $kghr^{-1}$ at stratum 3 (Fig. 6, 8 and 10). The opposite holds true for pelagic and trash fish catch. This phenomenon was in tandem with the percentage contribution to the total catch rate (Fig. 7, 9 and 11).

Table 5: KK MANCHONG average catch rate and percentage composition for the three depth strata of East Coast Sabah 2009

Stratum	18-55m		56-91m		92-185m	
Fish Group	Catch rate ($kghr^{-1}$)	Percentage (%)	Catch rate ($kghr^{-1}$)	Percentage (%)	Catch rate ($kghr^{-1}$)	Percentage (%)
Demersal Fishes	19.12	29.91	25.13	45.59	34.45	86.75
Pelagic Fishes	14.10	22.06	9.56	17.34	0.11	0.28
Elasmobranchs	0.33	0.52	0.36	0.66	1.90	4.78
Crabs	0.79	1.23	0.68	1.23	-	-
Shrimps	0.15	0.23	0.41	0.74	-	-
Molluscs	0.21	0.33	-	-	-	-
Lobsters	0.14	0.22	-	-	-	-
Cephalopods	1.85	2.90	1.76	3.19	0.50	1.26
Trash Fishes	27.24	42.61	17.23	31.25	2.75	6.93
Total	63.94	100	55.12	100	39.71	100
No of trawl station	19	19	13	13	1	1

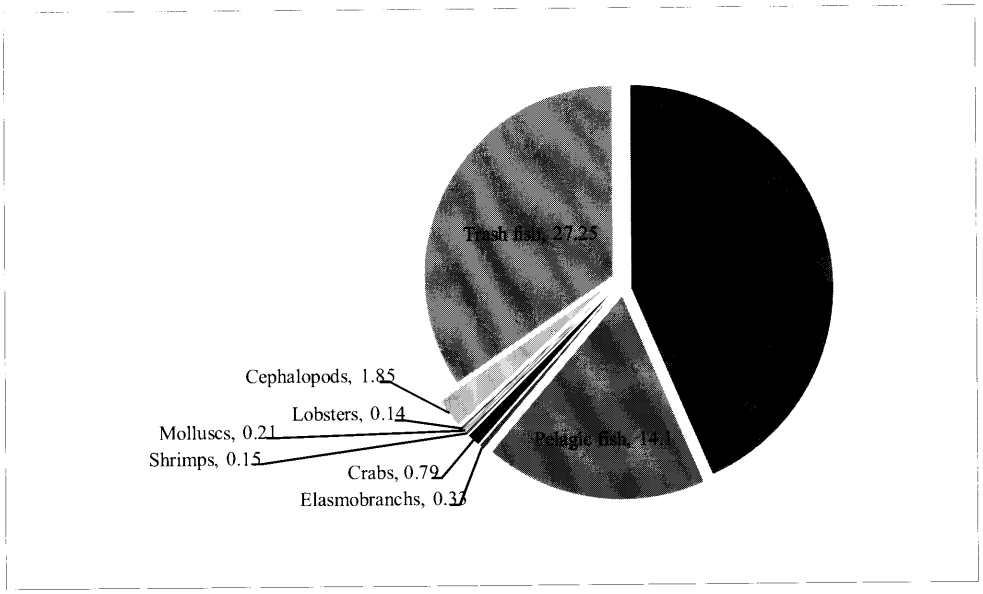

Figure 6: KK MANCHONG trawl average catch rate (in $kghr^{-1}$) composition for stratum 18-55 m East Coast Sabah 2009

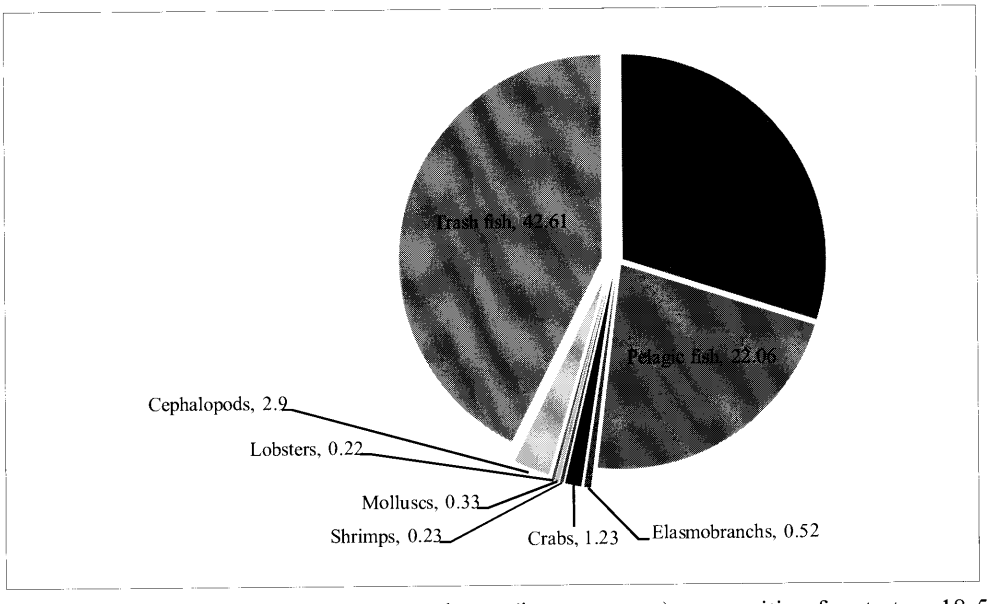

Figure 7: KK MANCHONG trawl average catch rate (in percentage) composition for stratum 18-55 m East Coast Sabah 2009

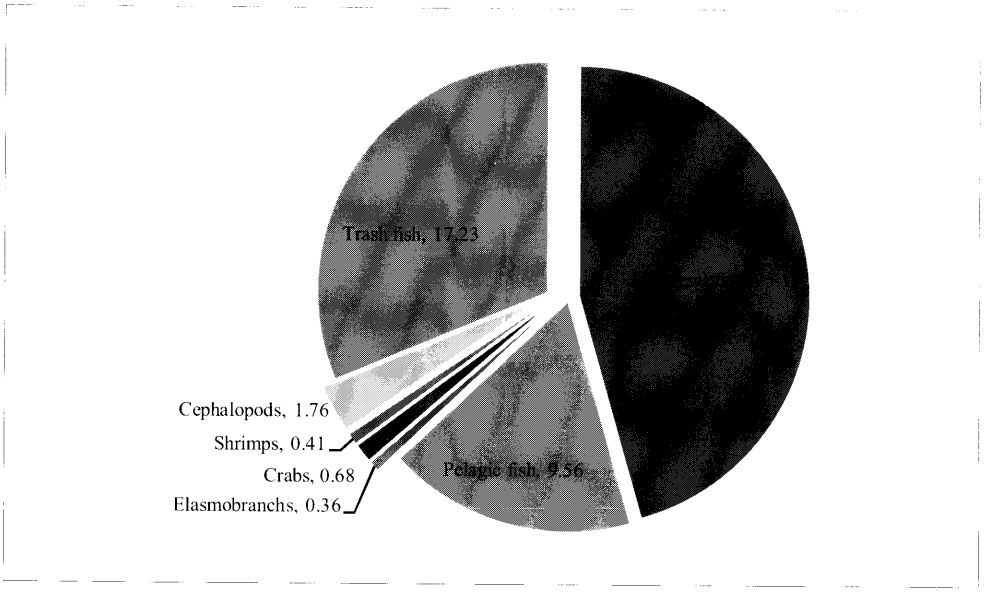

Figure 8: KK MANCHONG trawl average catch rate (in $kghr^{-1}$) composition for stratum 56-91 m EastCoast Sabah 2009

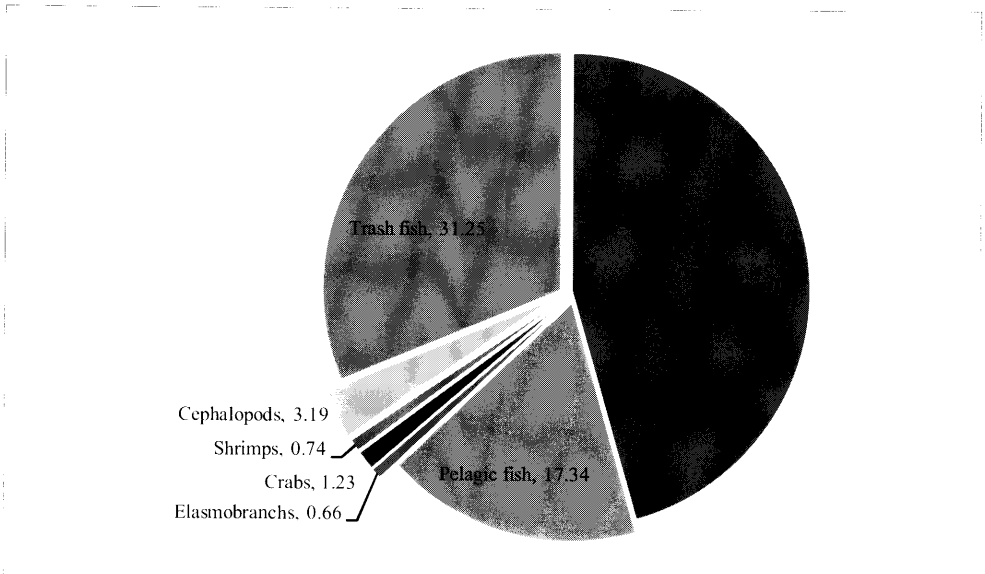

Figure 9: KK MANCHONG trawl average catch rate (in percentage) composition for stratum 56-91 m East Coast Sabah 2009

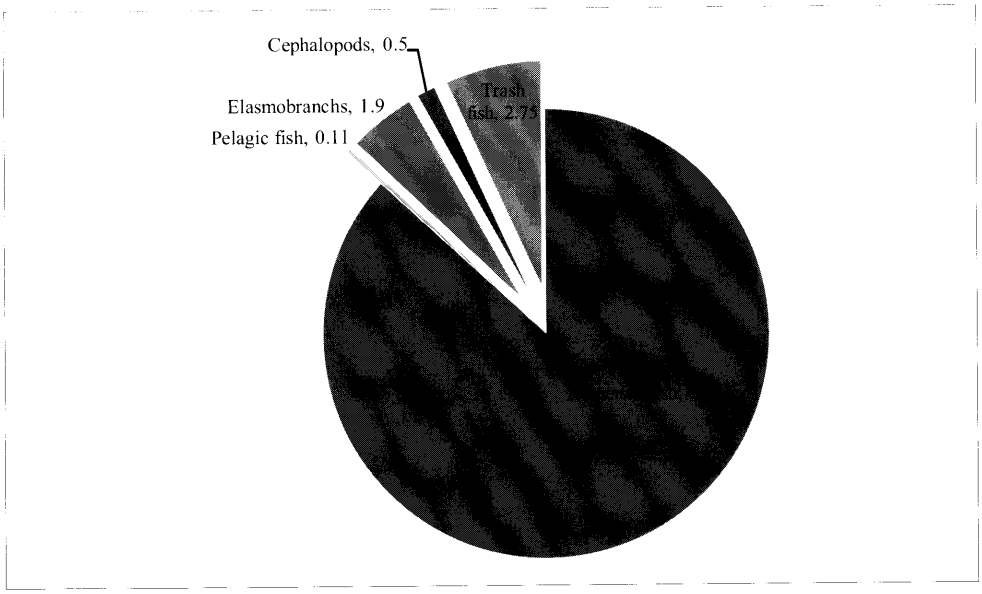

Figure 10: KK MANCHONG trawl average catch rate (in $kghr^{-1}$) composition for stratum 92-185 m East Coast Sabah 2009

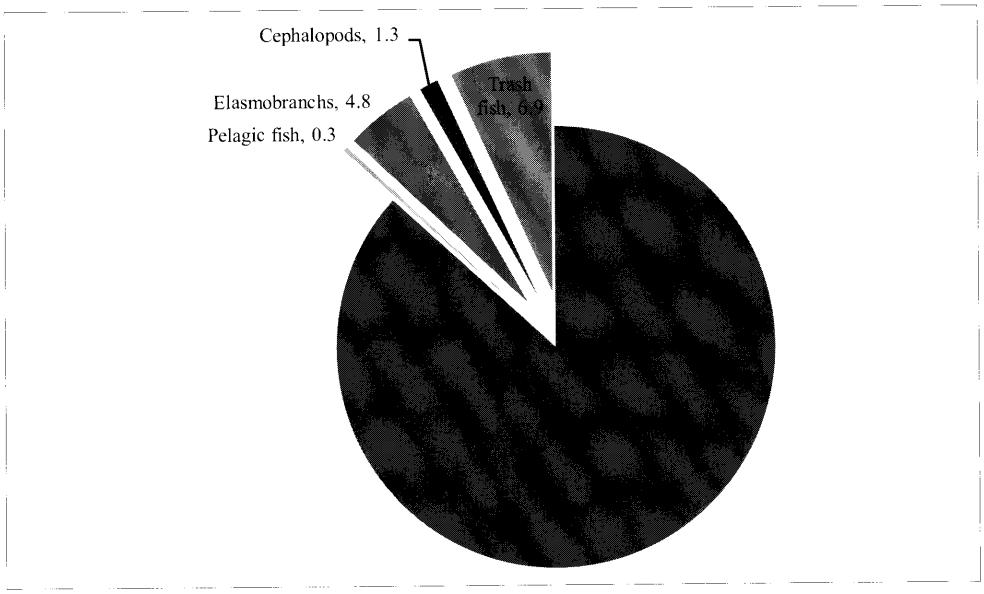

Figure 11: KK MANCHONG trawl average catch rate (in $kghr^{-1}$) composition for stratum 56-91 m East Coast Sabah 2009

Among the SSMEs, there was a big different in the average catch rates recorded for SSME 1 (135.85 kghr^{-1}) compared with SSME 2 (43.49 kghr^{-1}) and 3 (49.20 kghr^{-1}). Table 6 shows that this observation was largely attributed to the high catch of both demersal and pelagic fish (Fig. 12) coupled with a high percentage (62.51%) of trash fish (Fig. 13) landed at SSME 1. Overall SSME 2 was not so productive, having the lowest average catch rate (Fig. 14 and 15). It can also be rightly said for SSME 3 where the average catch rate was not substantially high (Fig. 16) even though the percentage of demersal fish caught was high at 47.95% (Fig. 17).

Table 6: Average catch rates (kghr^{-1}) for different fish groups caught by KK MANCHONG trawl at different SSME waters EEZ Malaysia Sulu-Sulawesi seas, East Coast Sabah

Fish group	SSME 1 Average Catch rate (kghr^{-1})	%	SSME 2 Average Catch rate (kghr^{-1})	%	SSME 3 Average Catch rate (kghr^{-1})	%
Demersal fish	39.40	29.00	14.72	33.84	23.59	47.95
Pelagic fish	27.63	20.34	11.20	25.75	6.63	13.47
Elasmobranchs	0.47	0.35	0.12	0.28	0.67	1.36
Crabs	0.98	0.72	0.86	1.98	0.46	0.93
Shrimps	0.11	0.08	0.08	0.17	0.49	1.01
Molluscs	0.53	0.39	0.01	0.02	0.09	0.19
Lobsters	0.19	0.14	0.08	0.18	0.04	0.09
Cephalopods	4.03	2.97	1.70	3.90	1.00	2.02
Trash fish	62.51	46.02	14.73	33.86	16.23	32.99
Total	135.85	100	43.49	100	49.20	100
No. of station	5		15		13	

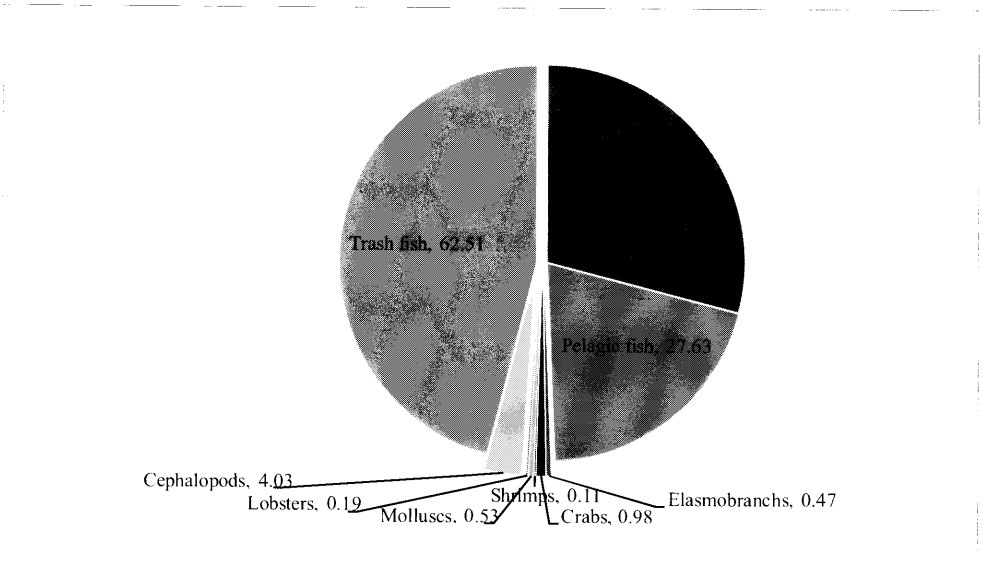

Figure 12: KK MANCHONG trawl average catch rate (in kghr^{-1}) composition for SSME 1 waters East Coast Sabah 2009

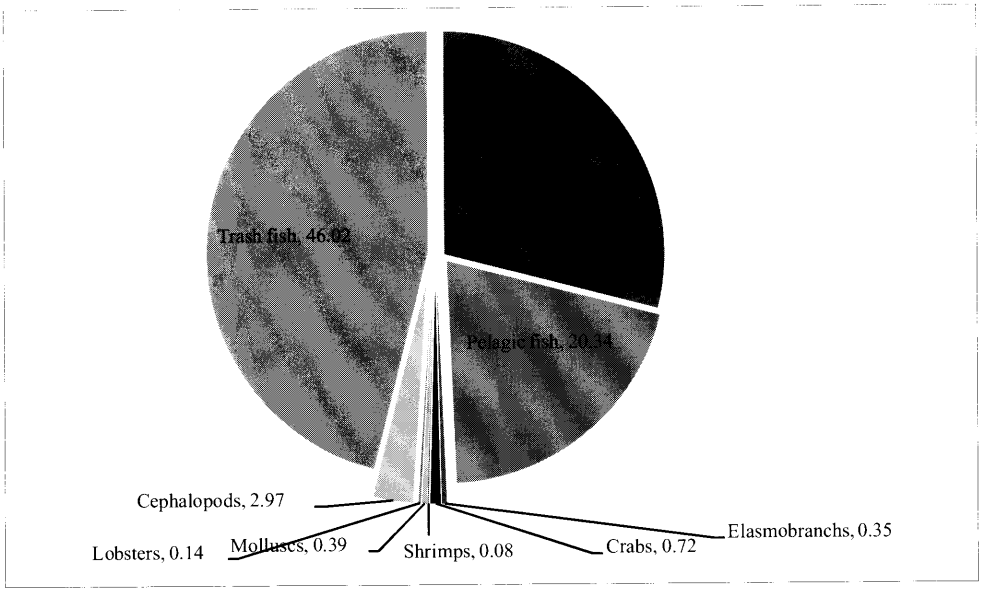

Figure 13: KK MANCHONG trawl average catch rate (in percentage) composition for SSME 1 waters East Coast Sabah 2009

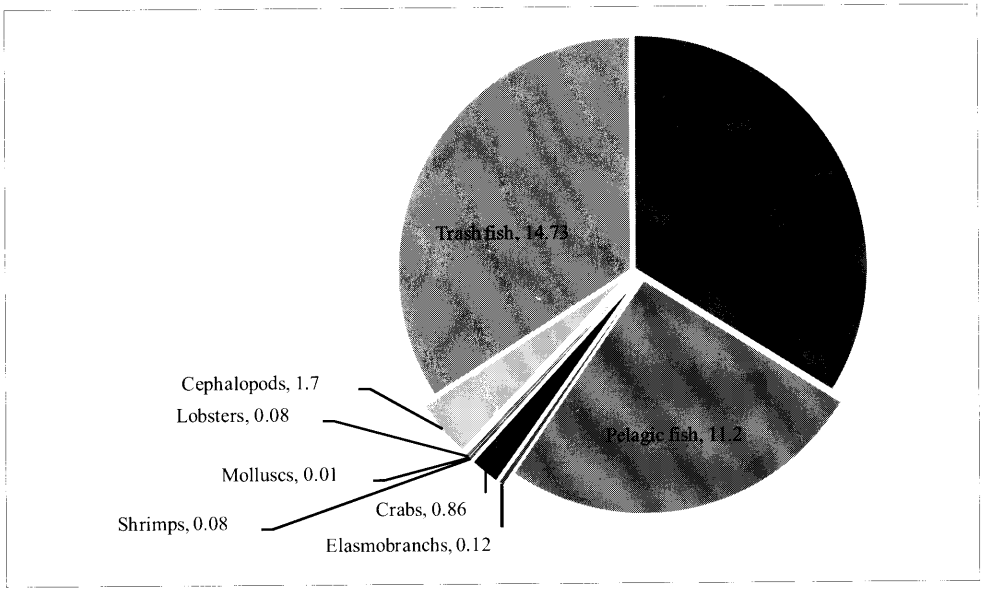

Figure 14: KK MANCHONG trawl average catch rate (in $kghr^{-1}$) composition for SSME 2 waters East Coast Sabah 2009

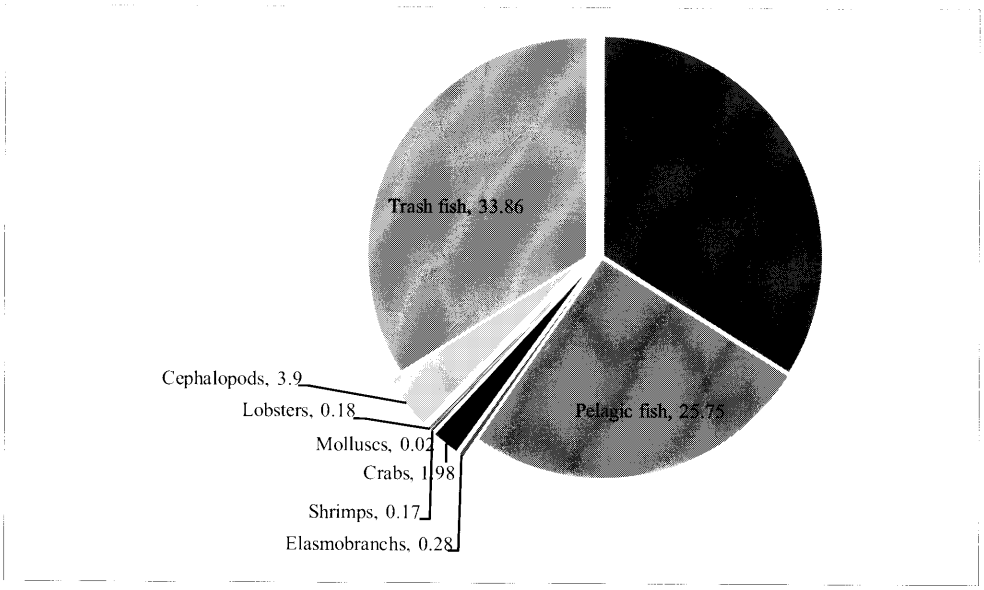

Figure 15: KK MANCHONG trawl average catch rate (in percentage) composition for SSME 2 waters East Coast Sabah 2009

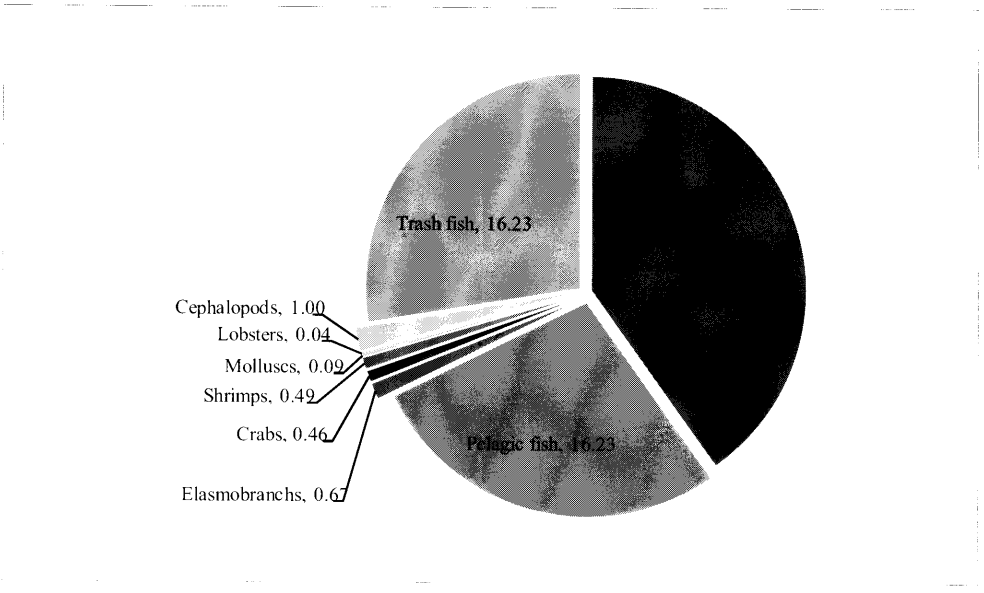

Figure 16: KK MANCHONG trawl average catch rate (in $kghr^{-1}$) composition for SSME 3 waters East Coast Sabah 2009

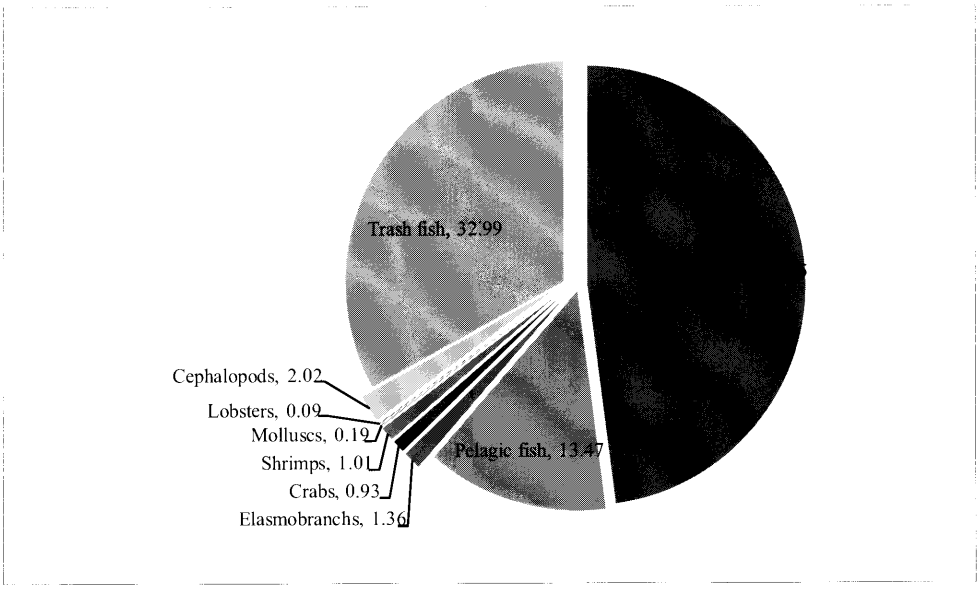

Figure 17: KK MANCHONG trawl average catch rate (in percentage) for SSME 3 waters East Coast Sabah 2009

A total of 213 species (78 demersal fish, 39 pelagic fish, 8 elasmobranchs, 7 crabs, 9 shrimps, one mollusc, 2 lobsters, 4 cephalopods and 65 trash fish) were recorded during this survey (Appendices 2a-g). Table 7 shows the dominant 30 species caught by KK MANCHONG. The dominant species identified in term of higher average catch rate were *Leiognathus* sp. (9.8 $kghr^{-1}$); Jellyfish (3.78 $kghr^{-1}$); *Plotosus lineatus* (2.70 $kghr^{-1}$); *Leiognathus splendens* (2.45 $kghr^{-1}$); *Saurida undosquamis* (2.32 $kghr^{-1}$); *Rachycentron canadum* (1.76 $kghr^{-1}$); *Saurida tumbil* (1.52 $kghr^{-1}$); *Pentaprion longimanus* (1.20 $kghr^{-1}$); *Loligo* sp. (1.20 $kghr^{-1}$) and others. Beside *Rachycentron canadum* and *Pentaprion longimanus*, the other dominant pelagic fish species caught were *Stolephorus indicus* (0.89 $kghr^{-1}$); *Selar crumenophthalmus* (0.64 $kghr^{-1}$); *Scomberomorus commerson* (0.51 $kghr^{-1}$) and *Rastrelliger brachysoma* (0.44 $kghr^{-1}$).

Density and biomass estimates of demersal fish for the east coast Sabah calculated using Swept Area Method is summarized in Table 8. The biomass was almost 15,000 tons when catchability coefficient, q equals 1.0 and close to 25,000 tons when q equals 0.6. The biomass distribution among the fish groups seems to show that the demersal fish resource was comparable to the trash fish component. Pelagic fish resource available to trawl was quite substantial that was at 20% of the overall biomass. Contributing to only 5% of the overall biomass, the invertebrate resources were quite scarce in the surveyed area.

There was an obvious pattern of density distribution along the east coast of Sabah as shown by Fig. 18. Significantly high density (>3 $tonNM^{-2}$) of demersal resource seems to concentrate in the northern part, Kudat or the SSME 1 region. Then, the density decreased towards SSME 2 of Sandakan and SSME 3 of Tawau regions.

Table 7: The 30 dominant demersal and pelagic species caught by KK MANCHONG trawl in the waters of East Coast Sabah 2009

Species	Total catch weight	Total catch No.	Average catch weight/haul	St. dev catch weight	Average catch No. / haul	St. dev catch No.
Leiognathus sp.	323.45	60,888	9.80	22.78	1845.1	4,402.50
Jellyfish	124.70	157	3.78	20.79	4.8	21.20
Plotosus lineatus	89.00	405	2.70	15.73	12.3	71.59
Leiognathus splendens	80.89	6,588	2.45	14.13	199.6	1,159.50
Saurida undosquamis	76.49	2,843	.32	3.87	86.2	227.35
Rachycentron canadum	58.00	98	1.76	11.37	3.0	19.21
Saurida tumbil	50.13	345	1.52	1.81	10.5	17.24
Pentaprion longimanus	39.69	3,025	1.20	2.46	91.7	177.22
Loligo sp.	39.61	2,679	1.20	1.50	81.2	112.81
Gazza minuta	32.33	1,613	0.98	5.94	48.9	287.29
Scolopsis taeniopterus	31.70	871	0.96	2.63	26.4	92.74
Nemipterus nemurus	31.66	438	0.96	2.60	13.3	31.02
Priacanthus macracanthus	30.80	346	0.93	1.97	10.5	24.48
Priacanthus tayenus	30.57	564	0.93	1.11	17.1	29.06
Saurida longimanus	29.49	2,884	0.89	1.86	87.4	195.42
Stolephorus indicus	29.31	1,204	0.89	2.30	36.5	61.56
Nemipterus furcosus	28.80	682	0.87	2.31	20.7	69.37
Apogon ellioti	27.51	1,805	0.83	1.17	54.7	137.35
Upeneus sulphureus	27.32	1,311	0.83	1.86	39.7	103.87
Alepes vari	25.60	154	0.78	5.00	4.7	29.99
Nemipterus bathybius	23.79	439	0.72	2.10	13.3	39.97
Caranx sexfasciatus	22.70	133	0.69	3.73	4.0	22.40
Selar crumenophthalmus	21.26	241	0.64	1.09	7.3	13.73
Upeneus japonicus	19.98	819	0.61	1.62	24.8	66.04
Tentoriceps cristatus	17.98	313	0.54	1.34	9.5	25.01
Dussumieria acuta	17.17	501	0.52	1.18	15.2	36.35
Scomberomorus commerson	16.95	18	0.51	1.89	0.5	1.34
Carangoides malabaricus	16.64	250	0.50	1.06	7.6	14.96
Nemipterus nematophorus	16.47	472	0.50	0.94	14.3	31.75
Rastrelliger brachysoma	14.68	133	0.44	1.96	4.0	16.83
Nemipterus marginatus	13.83	461	0.42	0.78	14.0	30.55

Table 8: The density and biomass derived by "swept area" method based upon different catchability coefficients, q for east coast Sabah (total area-8445 NM^2) demersal survey 2009

"Swept area" = a					
Velocity, V (knot=$NMhr^{-1}$)	Duration, t (hr)	Distant, D=V*t	Headrope length, h=20.5m (NM)	Gear mouth opening, x	a=D*h*x (Nm^2)
4	1	4	0.0111	0.76	0.0337

Fish Group	Catch rate, ($kghr^{-1}$)	CR per unit area @ density (Cw/t)/(a/t) $kgNM^{-2}$	Biomass, Bc (tons) at q=1	q=0.6
Demersal Fish	21.95	652.40	5,510	9,183
Pelagic Fish	11.89	353.30	2,984	4,973
Elasmobranchs	0.39	11.63	98	164
Crabs	0.72	21.41	181	301
Shrimps	0.25	7.31	62	103
Molluscs	0.12	3.57	30	50
Lobsters	0.08	2.41	20	34
Cephalopods	1.78	52.75	446	743
Trash Fish	22.56	670.40	5,662	9,436
Total	59.74	1,775.18	14,993	24,989

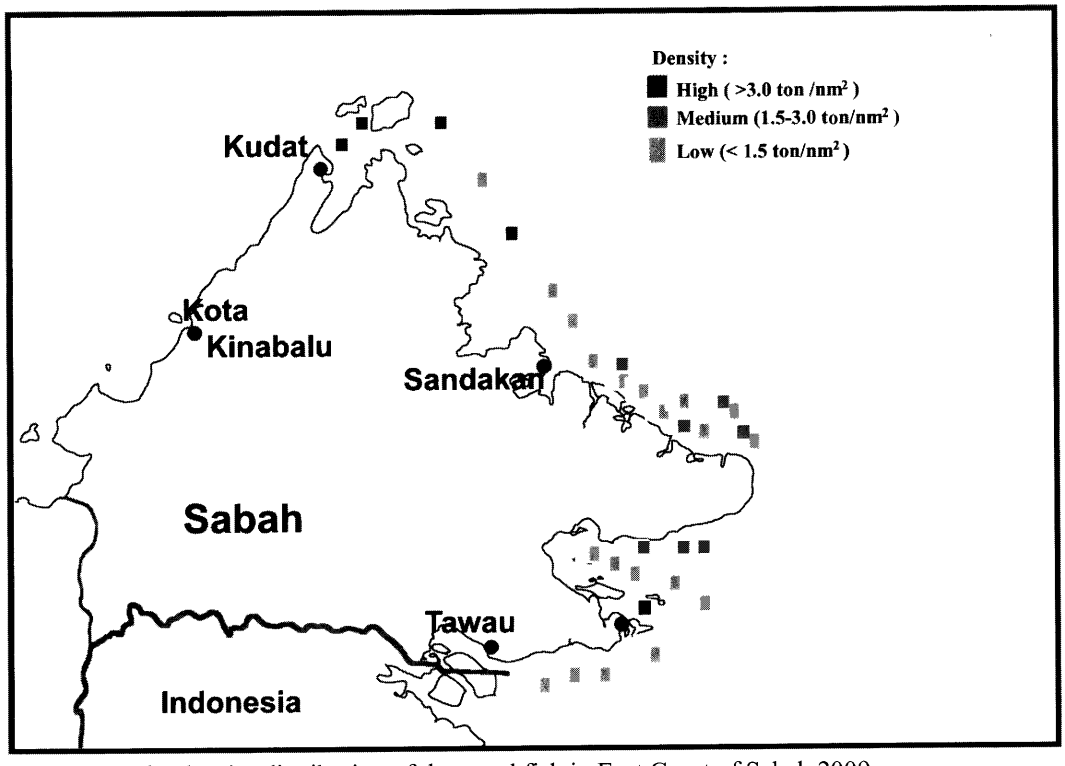

Figure 18: The density distribution of demersal fish in East Coast of Sabah 2009

Table 11: The density and biomass of various fish groups for Stratum >92m (area-5395 NM^2) East Coast Sabah derived by "swept area" method

Fish Group	Catch rate, CR (kg/hr)	CR per unit area @ density (Cw/t)/(a/t) $kgNM^{-2}$	Biomass, Bc (tons) at q=1	q=0.6
Demersal Fish	34.45	1,032.77	5,523	9,205
Pelagic Fish	0.11	3.27	18	29
Elasmobranchs	1.90	56.46	305	508
Cephalopods	0.50	14.86	80	134
Trash Fish	2.75	81.72	441	735
Total	39.71	1,180.09	6,367	10,611

Tables 12, 13 and 14 give the values of densities and biomasses of the demersal fish resources within the waters of SSME 1, SSME 2 and SSME 3 respectively. SSME 1 water was the richest with density at 4.0 $tonNM^{-2}$; followed by SSME 3 (1.5 ton NM^{-2}) and SSME 2 (1.3 $tonNM^{-2}$). This trend was also been depicted by Fig. 18. Biomass per unit area followed the density trend. Although SSME 1 had a smaller area, the density being high, the biomass recorded for the area was the highest as compared to SSMEs 3 and 2. About 29% of the SSME 1 demersal resource biomass was attributed to demersal fish with the larger portion at 46% contributed by trash fish. But demersal fish contributions seem to increase toward SSMEs 2 (34%) and 3 (48%). The reverse holds true for trash fish contribution: SSME 2 (34%) and SSME 3 (33%). Biomass was distributed 45% at SSME 1 water; 30% at SSME 2 and the remaining 25% contributed by SSME 3.

Table 12: The density and biomass of various fish groups for SSME-1 waters (area-2193 NM2) East Coast Sabah derived by "swept area" method

Fish Group	Catch rate, CR ($kghr^{-1}$)	CR per unit area @ density (Cw/t)/(a/t) $kgNM^{-2}$	Biomass, Bc (tons) at q=1	q=0.6
Demersal Fish	39.40	1,170.75	2,567	4,279
Pelagic Fish	27.63	821.04	1,801	3,001
Elasmobranchs	0.47	13.97	31	51
Crabs	0.98	29.12	64	106
Shrimps	0.11	3.27	7	12
Molluscs	0.53	15.75	35	58
Lobsters	0.19	5.65	12	21
Cephalopods	4.03	119.88	263	438
Trash Fish	62.51	1,857.77	4,074	6,790
Total	135.85	4,037.19	8,854	14,756

Table 13: The density and biomass of various fish groups for SSME-2 waters (area-2799 NM^2) East Coast Sabah derived by "swept area" method

Fish Group	Catch rate, CR ($kghr^{-1}$)	CR per unit area @ density (Cw/t)/(a/t) $kgNM^{-2}$	Biomass, Bc (tons) at q=1	q=0.6
Demersal Fish	14.72	437.42	1,224	3,401
Pelagic Fish	11.20	332.88	932	2,588
Elasmobranchs	0.12	3.67	10	28
Crabs	0.86	25.62	72	199
Shrimps	0.08	2.26	6	18
Molluscs	0.01	0.22	1	2
Lobsters	0.08	2.34	7	18
Cephalopods	1.70	50.46	141	392
Trash Fish	14.73	437.64	1,225	3,403
Total	43.49	1,292.50	3,618	10,049

Table 14: The density and biomass of various fish groups for SSME-3 waters (area-3453 NM2) East Coast Sabah derived by "swept area" method

Fish Group	Catch rate, CR (kghr^{-1})	CR per unit area @ density (Cw/t)/(a/t) kgNM^{-2}	Biomass, Bc (tons) at q=1	q=0.6
Demersal Fish	23.59	701.08	2,421	4,035
Pelagic Fish	6.63	196.96	680	1,133
Elasmobranchs	0.67	19.91	69	115
Crabs	0.46	13.60	47	78
Shrimps	0.49	14.70	51	85
Molluscs	0.09	2.74	9	16
Lobsters	0.04	1.26	4	7
Cephalopods	1.00	29.58	102	170
Trash Fish	16.23	482.29	1,665	2,776
Total	49.20	1,462.13	5,049	8,415

The available data on current yield (Y) taken from the survey area are the landings of all demersal fish species in 2008 (Anon., 2009) and this gives the yield at 45,450.60 tons for East Coast Sabah. Natural mortality (M) values for demersal fish in the area surveyed were rather limited (Abu Talib *et al.*, 2003). However many workers in the region had estimated M using the formula of Pauly (1980). Since most values of M were between one and two, these values were used in the equations to determine MSY. For comparison with the results obtained from KK MANCHONG west coast Sabah survey in 1998, a value of M equal 1.66 (Anon., 2000; Abu Talib *et al.*, 2003) was also used to calculate the maximum sustainable yield, MSY or the exploitable potential yield.

Table 15 gives the MSY for selected values of q and M. The MSY of between 26,328 to 42,738 tons of demersal fish in the area surveyed as estimated using the Cadima's equation (Sparre and Venema, 1992) at Y=45,450.60 tons. The MSY values calculated under Schaefer's Model (Garcia *et al.*, 1989) were between -73,836 to 223,482 tons and these values obtained were unrealistic. The exploitation rate for any combination of q and M at Y=45,450.60 tons was in the range of 0.53 to 0.79 (Table 15), indicating over-fishing.

Table 15: Maximum Sustainable Yield, MSY and exploitation rate, E(yr^{-1}) for the demersal fish resource in the EEZ Malaysia waters, East Coast Sabah 2009 assessed at catchability coefficient, q=0.6 and q=1.0; using different model and mortality coefficient, (M)

Formula [Model-Reference]	q=0.6, Bc=20,013 tons M=1.0	M=1.66	M=2.0	q=1.0, Bc=12,008 tons M=1.0	M=1.66	M=2.0
MSY=0.5*(Y+MBc) Cadima (Spare and Venema, 1992)	32,732	39,336	42,738	26,328	32,692	34,733
MSY=M^{2}Bc^2/(2MBc-Y) Schaefer (Garcia *et al.*, 1989)	-73.836	52,574	46,301	-6,727	-71,147	223,482
Parameter	q=0.6, Bc=20,013 tons MSY followed Cadima's			q=1.0 Bc=12,008 tons MSY followed Cadima's		
Natural mortality (M)	M=1.0	M=1.66	M=2.0	M=1.0	M=1.66	M=2.0
E=(Y/Bc)/[(Y/Bc)+M]	0.69	0.58	0.53	0.79	0.70	0.65

The yield, Y or landings of demersal fish for SSME 3 east coast Sabah in 2008 (Anon., 2009) was at 19,813.65 tons

Using specific yield figures from different SSME regions: 10,025.22 tons (SSME 1); 15,611.73 tons (SSME 2) and 19,813.65 tons (SSME 3), the demersal fish MSY and exploitation rate of the respective SSME were derived as shown by Tables 16, 17 and 18. The MSY values for the demersal fish resource of SSME 1 were between 8,539 to 16,768 tons with the exploitation rates of between 0.30 to 0.59 per annum (Table 16). MSY values for SSME 2 were between -80,720 to 15,645 tons with the exploitation rate of between 0.51 to 0.85 per annum (Table 17). For SSME 3 (Table 18), the MSY values calculated were between -32,636 to 17,188 tons having the exploitation rate figures between 0.58 to 0.82 per annum.

Table 16: Maximum Sustainable Yield, MSY and exploitation rate (yr^{-1}) for the demersal fish resource in the SSME 1 waters, East Coast Sabah 2009 assessed at catchability coefficient, q=0.6 and q=1.0; using different model and mortality coefficient, (M)

Formula [Model-Reference]	**q=0.6, Bc=11,755 tons**			**q=1.0, Bc=7,053 tons**		
	M=1.0	**M=1.66**	**M=2.0**	**M=1.0**	**M=1.66**	**M=2.0**
MSY=0.5*(Y+MBc) Cadima (Spare and Venema, 1992)	10,890	14,769	16,768	8,539	10,867	12,066
$MSY=M^2Bc^2/(2MBc-Y)$ Schaefer (Garcia *et al.*, 1989)	10,247	13,129	14,941	12,190	10,237	10,941
Parameter	q=0.6, Bc=11,755 tons MSY followed Cadima's			q=1.0 Bc=7,053 tons MSY followed Cadima's		
Natural mortality (M)	M=1.0	M=1.66	M=2.0	M=1.0	M=1.66	M=2.0
E=(Y/Bc)/[(Y/Bc)+M]	0.46	0.34	0.30	0.59	0.54	0.42

The yield, Y or landings of demersal fish for SSME 1 east coast Sabah in 2008 (Anon. 2009) was at 10,025.22 tons

Table 17: Maximum Sustainable Yield, MSY and exploitation rate (yr^{-1}) for the demersal fish resource in the SSME 2 waters, East Coast Sabah 2009 assessed at catchability coefficient, q=0.6 and q=1.0; using different model and mortality coefficient, (M)

Formula [Model-Reference]	**q=0.6, Bc=7,461 tons**			**q=1.0, Bc=2,686 tons**		
	M=1.0	**M=1.66**	**M=2.0**	**M=1.0**	**M=1.66**	**M=2.0**
MSY=0.5*(Y+MBc) Cadima (Spare and Venema, 1992)	11,536	13,999	15,267	9,149	10,035	10,492
$MSY=M^2Bc^2/(2MBc-Y)$ Schaefer (Garcia *et al.*, 1989)	-80,720	16,748	15,645	-705	-2,970	-5,928
Parameter	q=0.6, Bc=7,461 tons MSY followed Cadima's			q=1.0 Bc=2,686 tons MSY followed Cadima's		
Natural mortality (M)	M=1.0	M=1.66	M=2.0	M=1.0	M=1.66	M=2.0
E=(Y/Bc)/[(Y/Bc)+M]	0.68	0.56	0.51	0.85	0.78	0.74

The yield, Y or landings of demersal fish for SSME 2 east coast Sabah in 2008 (Anon., 2009) was at 15,611.73 tons

Table 18: Maximum Sustainable Yield, MSY and exploitation rate (yr^{-1}) for the demersal fish resource in the SSME 3 waters, East Coast Sabah 2009 assessed at catchability coefficient, q=0.6 and q=1.0; using different model and mortality coefficient, (M)

Formula [Model-Reference]	q=0.6, Bc=7,281 tons M=1.0	M=1.66	M=2.0	q=1.0, Bc=4,369 M=1.0	M=1.66	M=2.0
Cadima (Spare and Venema, 1992) MSY=0.5*(Y+MBc)	13,547	15,950	17,188	12,091	13,533	14,275
Schaefer (Garcia *et al.*, 1989) MSY=$M^2Bc^2/(2MBc-Y)$	-10,095	33,510	22,776	-1,723	-9,904	-32,636
Parameter	q=0.6, Bc=7,281 tons MSY followed Cadima's			q=1.0 Bc=4,369 tons MSY followed Cadima's		
Natural mortality (M)	M=1.0	M=1.66	M=2.0	M=1.0	M=1.66	M=2.0
E=(Y/Bc)/[(Y/Bc)+M]	0.73	0.62	0.58	0.82	0.73	0.69

The yield, Y or landings of demersal fish for SSME 3 east coast Sabah in 2008 (Anon., 2009) was at 19,813.65 tons

Discussion

This was the first ever demersal survey conducted in the Sulu-Sulawesi seas east coast Sabah. The area covered by this survey was generally the whole extend of the Malaysian EEZ where the furthest area was slightly over 30 NM. The first Malaysian EEZ survey using the R.V.RASTRELLIGER (Anon., 1988) was conducted in 1986 to 1987 covered the whole EEZ area of Malaysia with the exception of east coast Sabah.

In this survey using bottom trawl net, pelagic fish will inevitably also be caught due to the "high opening" of the net and the diurnal vertical migration of pelagic fish. Densities of demersal fish, comprising the commercial and trash species, were calculated from total catch rates after the pelagics were excluded. This was done because the pelagic nature and the schooling behaviour of pelagic fish violate the assumption of normally distributed demersal fish stock

The catch rates from this demersal fish survey show the productivity of East Coast Sabah. Compared to the previous survey using the same vessel, K.K.MANCHONG (Anon., 2000; Abu Talib *et al.*, 2003) in west coast Sabah (catch rate -71.6 $kghr^{-1}$), the total catch rate from this survey (catch rate -47.85 $kghr^{-1}$) was substantially low by at least 30%.

For comparison, in 1972 and 1973, the coastal (shallower waters of 10 to 60 m deep) demersal fish resource surveys were conducted by K.K. JENAHAK in the west coast Sabah, gave average catch rates of 512 and 210 $kghr^{-1}$ respectively (Mohammed Shaari *et al.*, 1976). K.K. MANCHONG conducted an exploratory trawling in the area between 10 to 100 m deep on the West Coast of Sabah in 1993 gave an average catch rate of commercial and trash fish of 169 $kghr^{-1}$ for coastal and at 265 $kghr^{-1}$ for offshore waters (Biusing *et al.*, 1995).

The overall catch rates by depth recorded from this survey did not show any large variation from the shallow to the deep stratum. Significantly high contribution of demersal and pelagic fish for the 3 SSMEs ranging from 49 to 70% for stratum 1 and 2 indicated that the productivity of the water is still sizeable. But, contribution by demersal fish in term of weight and percentage of the total catch rate seems to increase substantially from the shallow to the deepest stratum. This was obvious as the catches of pelagic fish and trash fish were lower from the deeper waters. In fact, the trend of decreasing catch rate appeared from Stratum 1 to 3, but this was not really significant. The fact that only one station was in the deepest stratum did not qualify to represent the depth stratum and this maybe an artifact of the limited number of stations.

In this survey, SSME 1 water was found to be the most productive. Therefore the fishing ground off Kudat is richer than the grounds off Sandakan and Tawau. High catch rate of demersal fish as well as trash fish was probably due to the fact that the area was subjected to large water outflow during the period of June-August. This large water interchange brings in nutrients from the Sulu Sea to South China Sea through the Balabac strait (Wyrtki, 1961).

In the east coast Sabah, commercial trawl landings comprised 56% demersal fish; 23% pelagic fish and 21% invertebrates (Biusing, 2001). But invertebrates caught by KK MANCHONG trawl contributed only about 4%. This was probably due to the fact that commercial trawlers tend to fish in shallower and near coastal waters where there is high concentration of invertebrates like shrimps, cephalopods, crabs and lobsters. At 20% of the total catch, pelagic fish composition caught by KK MANCHONG was similar to that of commercial trawl landings.

The dominant groups and species recorded in trawl commercial landings (Biusing, 2001) and the current survey was comparable in that the dominant commercial groups (nemipterids, synodontids, leiognatids and mullids) were similar. The order of dominant in trawl commercial landings was slightly different due to commercial preferences.

The overall density of demersal fish (commercial and trash fish) for east coast Sabah was 1.42 tonsNM^{-2} compared to about 6.86 tonsNM^{-2} (2 tonskm^{-2}) for west coast Sabah ten years ago (Anon., 2000; Abu Talib *et al.*, 2003). The demersal fish density of west coast Sabah has declined by about 36% in 10 years (Anon., 2000; Abu Talib *et al.*, 2003). If the demersal fish density of East Coast Sabah assumed to decline in a similar pattern as for the West Coast Sabah, the value would be about 2.22 tonsNM^{-2} ten years ago.

Mohammed Shaari (1976) estimated the density of fish in the continental shelf area of West Coast Sabah less than 60 m deep at 17 tonsNM^{-2}. Assuming this was the density when the demersal fishery was in virgin state for the whole of Sabah water, the decline in the fish density from the virgin state is approximately 90%. However it is believed that the 18-55 m deep area is richer in fish compared to the deeper areas, thus the density of deeper waters would be lower than 17 tonsNM^{-2} when in the virgin state.

Based on the current estimated density, the total biomass of demersal fish calculated from this survey, using q=0.6, was 20,016 tons. The total area used in this calculation was 8,445 NM^2. For West Coast Sabah, ten years ago the estimated biomass was 23,723 tons in an area of 5,437 NM^2 at the same q value (Anon., 2000). Assuming that the rate of exploitation was the same for both East and West coast Sabah, obviously the biomass had declined substantially in ten years, not considering the larger area covered in this current survey. Assuming a density of 17 tonsNM^{-2} (Mohammed Shaari, 1976), the virgin biomass in this area before the onset of trawling could have been 143,565 tons (if q=0.6). Following this, the estimated MSY using Gulland's formula (Sparre and Venema 1992) would be around 72,000 tons (assuming M=1).

The biomass of demersal fish estimated here was based on the results of only one survey conducted over a limited period only. A better biomass estimate using the average result from a series of surveys conducted in different months in the same area would provide a better estimate of the actual standing stock. A series of surveys should cover the seasonal variation in the standing stock.

The MSY of the demersal fish resources was estimated from the biomass estimates. The value of 44,718 tons was accepted as the potential for exploitation. This estimate was derived from using assumptions for values like the catchability coefficient (q), natural mortality (M) and yield from the fisheries (Y), which was estimated from the landings of demersal fish species. In such a situation, a change in either one of the three variables used will change the estimate of MSY and potential yield.

Different values of catchability coefficients were used because the actual performance of the trawl is not known. It could be possible that some fish may escape being caught or all the fish in the area swept could be caught. The choice of natural mortality values used also affects the MSY estimated. In Gulland's formula (Sparre and Venema 1992), the use of M=2 instead of M=1 will almost double the MSY. The choice

of M values used here was based on values of M determined for tropical fish in this region. Natural mortality, M=1.66 was derived from fish species data collected from previous survey in the west coast of Sabah (Abu Talib *et al.*, 2003). This value was finally chosen for the estimate of potential yield

In the estimates of current demersal yield, it was based on all demersal fish species landed from the east coast of Sabah in 2008 (Anon., 2009). It would be preferable to use landings of 2009 when this survey was conducted.

Fish productivity ($tonsNM^{-2}yr^{-1}$) is the value derived from the estimated maximum potential yield, MSY per unit area represented. The demersal fish productivity of east coast Sabah derived from the chosen MSY (39,336 tons) was at 4.66 $tonsNM^{-2}yr^{-1}$ (1.36 $tonskm^{-2}yr^{-1}$). SSME 1 was the most productive where the demersal fish productivity was estimated at 6.73 $tonsNM^{-2}yr^{-1}$ or 1.96 $tonskm^{-2}yr^{-1}$ followed by SSME 2 at 5.00 $tonsNM^{-2}yr^{-1}$ and SSME 3 at 4.62 $tonsNM^{-2}yr^{-1}$. Its shows that the waters of east coast Sabah is still relatively productive as compared to the Philippines part of the Sulu sea where the estimate of productivity was at 0.91 $tonskm^{-2}yr^{-1}$ (3.12 $tonsNM^{-2}yr^{-1}$) for demersals (Miclat *et al.*, 2003).

The estimate of exploitation (E) rates for demersal fish resource ranges from 0.34 to 0.62 yr^{-1} for the three SSME regions with an average value of 0.58 yr^{-1} for the whole east coast Sabah. The exploitation rates were comparable to the status of the west coast Sabah in 1997. In the survey carried out in 1997 (Anon., 2000; Abu Talib *et al.*, 2003) the length frequency data on 10 demersal fish, three pelagic fish and one cephalopod analysed gave a mean E value of 0.62 yr^{-1}. The result of this present survey shows that the east coast Sabah demersal fish resource is experiencing over-exploitation. Thus, the demersal fisheries on the east coast of Sabah cannot be further developed through the addition of fishing effort.

Conclusion

This was the very first demersal survey ever carried out in East Coast Sabah. It was estimated that about 44,718 tons of demersal fish can be harvested annually but currently, east coast Sabah is experiencing over-exploitation of this resource. The demersal fisheries of east coast Sabah are exploited mainly by trawlers. The efficiency of trawlers has increased many-fold compared to the efficiency of those used in the early seventies when they were first introduced to the region. Most of the trawls presently being used are "high opening". Trawlers currently used bigger nets and more powerful engines. Area of fishing operation is very near to the port and transporting back of catches is extremely easy. While the licensing of fishing boats and gear has helped to control the increase in fishing effort, this was insufficient since fishing efficiency and total fishing effort has increased through the use of additional and new technology in fishing.

Effective management measures must be implemented and enforced to reduce the fishing effort before the demersal fisheries collapse. Besides just limiting fishing effort through licence limitation, additional technical measures like having juvenile and turtle excluder device, JTED and increasing the cod-end mesh of commercial trawlers should be seriously considered. The cod-end mesh size permitted by regulation is now 38 mm. With the use of JTED and a larger cod-end mesh size, large proportion of under-sized fish will be allowed to escape and these fish will contribute to a larger yield when caught at a later stage and at a large size

In order to evaluate the effectiveness of any management measure implemented, continuous monitoring and research preferably by annual experimental surveys should be undertaken following the implementation and effective enforcement of such a measure. Monitoring the performance of commercial fishing boats should be conducted parallel to experimental fishing by research vessels to ensure that the current status of the fisheries is known, fisheries being dynamic in nature. This is also to ascertain that new and additional information is made available for the formulation of new and the refinement of the old ones.

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Appendix 1 : KK MANCHONG trawl log for the 40 stations carried out from 15th July to 31st July 2009 in East Coast Sabah, the Sulu-Sulawesi seas Malaysian EEZ waters

Date	Station No.	SSME	Net release (hr)	Trawling				Speed (knot)	Heading	Hauling				Net haul up (hr)
				Time (hr)	Depth (m)	Position (Lat/Long)	Log			Time (min)	Depth (m)	Position (Lat/Long)	Log	
15/7	1	1	0815	0820	21.6		2	3.0	135	60	21.9	06° 59 200 116° 53 100	2	0935
	2		1125	1133	32.3	07° 10 800 116° 57 200	2	3.0	220	40	39.1	07° 09 000 116° 57 000	2	1215
16/7	3		0905	0923	31.6	07° 06 106 117° 21 636	2	2.8	120	60	32	07° 05 500 117° 24 100	2	1023
	4		1442	1452	20.5	06° 48 000 117° 38 450	1	2.8	080	45	24	06° 48 478 117° 40 200	1	1537
17/7	5		0655	0704	27.1	06° 22 500 117° 54 900	1	2.8	100	60	27.5	06° 24 397 117° 56 856	1	0804
	6	2	1140	1146	26.9	06° 08 000 118° 09 100	1	2.8	206	60	15.3	06° 05 600 118° 07 900	1	1246
	7		1440	1444	36	06° 01 700 118° 16 300	2	2.8	;071	60	40	06° 02 000 118° 19 200	1	1544
19/7	8		1445	1452	34	05° 51 595 118° 28 312	2	2.8	130	60	33.6	05° 50 173 118° 30 828	2	1552
	11		1655	1703	40	05° 49 400 118° 34 700	3	3.0	108	60	43.8	05° 48 300 118° 37 500	3	1805
20/7	10		0700	0707	26.6	05° 46 300 118° 34 600	2	3.0	145	60	31.5	05° 44 900 118° 37 200	2	0807
	9		0857	0905	20.7	05° 43 480 118° 37 520	1	2.8	111	40	10	05° 43 100 118° 39 400	1	0945
	13		1130	1140	39	05° 40 600 118° 44 630	3	2.8	038	60	50.7	05° 48 300 118° 37 503	3	1240
	14		1340	1347	54.6	05° 41 950 118° 50 050	4	3.0	116	60	62.1	05° 40 500 118° 52 750	4	1505
	12		1630	1640	34.2	05° 36 700 118° 49 100	2	2.8	141	60	29.1	05° 34 900 118° 51 250	2	1752
21/7	15		0615	0625	40.5	05° 33 900 118° 53 600	3	2.8	042	60	62.5	05° 35 800 118° 55 700	4	0738
25/7	36	3	1430	1440	27.3	04° 09 600 118° 10 600	2	2.8	070	60	36.2	04° 10 600 118° 13 200	2	1555
	35		1639	1650	29.0	04° 12 400 118° 17 800	2	2.8	034	60	19.5	04° 14 700 118° 18 750	2	1752
	37-40		Aborted-water too deep											
26/7	33		Aborted-very rough bottom											
	32		0730	0740	21.1	04° 18 300 118° 43 400	1	3.2	075	60	22.8	04° 18 900 118° 46 400	1	0845
	31		Aborted-very rough bottom											
	30		Aborted-very rough bottom											
	34		1525	1535	19.5	04° 16 600 118° 27 650	1	2.8	074	60	20.9	04° 17 700 118° 30 350	1	1647
29/7	26		1650	1703	78	04° 42 500 118° 41 600	5	2.9	297	60	76.4	04° 43 800 118° 38	5	1820

Appendix 2a: Catch rates (Wt-kg & N-number per hour) of species caught by KK Manchong trawl for 33 stations in east coast of Sabah, the Sulu-Sulawesi seas EEZ of Malaysia in 2009

Station no.		**1**		**2**		**3**		**4**		**5**	
Date		**15/07**		**15/07**		**16/07**		**16/07**		**17/07**	
Depth (m) : start - finish		**21.6 - 21.9**		**32.3 - 39.1**		**31.6 - 32.0**		**20.5 - 24.0**		**27.1-27.5**	
Species		**Wt**	**N**	**Wt**	**N**	**Wt**	**N**	**Wt**	**N**	**Wt**	**N**
1	*Abalistes stellaris*	0.2	4					0.19	8		
2	*Acanthurus mata*										
3	*Aesopia cornuta*										
4	*Alectis ciliaris*							0.86	4		
5	*Alectis indica*	0.16	1								
6	*Alepes vari*	25.5	153								
7	*Alutera monoceros*										
8	*Alutera sp.*					0.67	20				
9	*Amblygaster sirm*										
10	*Amusium pleuronectes*					1.7	69			0.95	35
11	*Anodontostoma chacunda*									0.35	7
12	*Antennarius striatus*										
13	*Antigonia capros*										
14	*Apogon aureus*										
15	*Apogon ellioti*					0.07	13	0.07	1		
16	*Apogon lineatus*										
17	*Ariomma indica*										
18	*Arius thalassinus*										
19	*Arothron immaculatus*										
20	*Arothron manillensis*										
21	*Arothron stellatus*										
22	*Atule mate*	0.4	2	1.65	36	0.1	2			0.1	1
23	*Calappa lophos*										
24	*Calappa philargius*										
25	*Canthigaster compresso*										
26	*Carangoides armatus*			0.27	5	0.33	20				
27	*Carangoides chrysophrys*	1.8	12					0.4	4		
28	*Carangoides chrysophrys*	1.8	12					0.4	4		
29	*Carangoides fulvoguttatus*										
30	*Carangoides hedlandensis*										
31	*Carangoides malabaricus*			0.45	11			1.16	7	0.2	1
32	*Carangoides sp.*										
33	*Caranx ignobilis*										
34	*Caranx sexfasciatus*	20.5	123							0.2	1
35	*Carcharhinus sorrah*									1.5	1
36	*Champsodon longispinis*										
37	*Charybdis feriatus*	0.8	4			1.3	8	0.15	1		
38	*Charybdis natator*	0.5	4			0.1	1	0.7	2	0.35	1
39	*Chiloscyllium plagiosum*										
40	*Chirocentrus dorab*									0.2	1
41	*Choerodon schoenleinii*							0.11	5		
42	*Choerodon sp.*										
43	*Cynoglossus bilineatus*										
44	*Dactyloptena orientalis*										
45	*Dactylopus dactylopus*										
46	*Dasyatis kuhlii*										
47	*Decapterus russelli*			0.3	5	0.05	1				
48	*Diagramma pictum*							0.13	3		
49	*Diodon holocanthus*							0.27	3		

Appendix 2a: Continue ...

Station no.		1		2		3		4		5	
Date		15/07		15/07		16/07		16/07		17/07	
Depth (m) : start - finish		21.6 - 21.9		32.3 - 39.1		31.6 - 32.0		20.5 - 24.0		27.1 -27.5	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
50	*Diodon hystrix*										
51	*Dipterygonotus balteatus*										
52	*Dussumieria acuta*							0.67	11	4.5	149
53	*Echeneis naucrates*			0.9	2			3.72	3		
54	*Elates ransonneti*										
55	*Engyroprosopon sp.*										
56	*Epinephelus areolatus*										
57	*Epinephelus bleekeri*										
58	*Epinephelus caeruleopunctatus*										
59	*Epinephelus coioides*										
60	*Epinephelus heniochus*										
61	*Epinephelus sexfasciatus*			0.15	2					0.6	9
62	*Epinephelus sp.*										
63	*Fistularia commerson*										
64	*Fistularia petimba*					0.67	33				
65	*Gazza minuta*									32.0	1600
66	*Gerres abbreviatus*										
67	*Gerres oyena*	0.7	14								
68	*Gnathonodon speciosus*	0.8	6								
69	*Grammatobothus polyophthalmus*					0.2	20				
70	*Gymnocranius elongatus*										
71	*Halieutaea sp.*										
72	*Harpiosquilla harpax*									0.2	2
73	*Heterocarpus spp.*										
74	Jellyfish	10	5	87	66			0.7	5		
75	*Lactoria cornuta*										
76	*Lactoria fornasini*							0.07	3		
77	*Lagocephalus inermis*										
78	*Lagocephalus lunaris*										
79	*Lagocephalus sceleratus*					0.06	20	0.13	5	0.8	8
80	*Lagocephalus spadiceus*			0.15	2						
81	*Leiognathus bindus*			0.45	44						
82	*Leiognathus equulus*										
83	*Leiognathus leuciscus*										
84	*Leiognathus longispinis*										
85	*Leiognathus smithursti*										
86	*Leiognathus splendens*									80	6560
87	*Leiognathus spp.*					46.6	6993			40	5760
88	*Leiognathus stercorarius*	7.0	350					0.07	48		
89	*Lepturacanthus savala*										
90	*Lethrinus nebulosus*							0.13	5		
91	*Lethrinus sp*										
92	*Loligo edulis*										
93	*Loligo spp.*	2	47	6.3	108	5.7	124	0.15	4	0.26	16
94	*Loxodon macrohinus*										
95	*Lutjanus lutjanus*										
96	*Lutjanus malabaricus*									0.4	8
97	*Lutjanus vitta*										
98	*Megalaspis cordyla*									2	11
99	*Mene maculata*										

Appendix 2a: Continue ...

Station no.		1		2		3		4		5	
Date		15/07		15/07		16/07		16/07		17/07	
Depth (m) : start - finish		21.6 - 21.9		32.3 - 39.1		31.6 - 32.0		20.5 - 24.0		27.1 -27.5	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
100	*Metapenaeus sp.*										
101	*Monacanthus chinensis*							0.2	3		
102	*Monodactylus argenteus*										
103	*Nemipterus aurora*										
104	*Nemipterus balinensis*										
105	*Nemipterus bathybius*										
106	*Nemipterus furcosus*	1.1	26	0.15	2	9.37	332	9.31	226	0.2	4
107	*Nemipterus hexodon*	0.2	1	0.38	2	0.06	1			2.5	38
108	*Nemipterus isacanthus*										
109	*Nemipterus japonicus*										
110	*Nemipterus marginatus*			0.9	11					3.3	146
111	*Nemipterus nematophorus*										
112	*Nemipterus nematophus*										
113	*Nemipterus nemurus*	0.1	1			1.03	14			0.4	8
114	*Nemipterus peronii*	0.1	1							0.6	13
115	*Nemipterus virgatus*										
116	*Octopus*										
117	*Odonus niger*										
118	*Ophichthus sp.*										
119	*Ostracion nasus*							0.13	1		
120	*Panulirus polyphagus*										
121	*Parachaetodon ocellatus*										
122	*Paramonacanthus sp.*			0.15	2			0.13	3		
123	*Parapercis alboguttata*										
124	*Paraplagusia bilineata*										
125	*Parascolopsis tanyactis*										
126	*Parastromateus niger*									1.5	11
127	*Pardachirus pavoninus*							0.05	1		
128	*Parupeneus heptacanthus*							0.29	3		
129	*Penaeus indicus*										
130	*Penaeus japonicus*										
131	*Penaeus longistylus*										
132	*Penaeus monodon*										
133	*Penaeus penicillatus*									0.15	5
134	*Penaeus semisulcatus*									0.4	13
135	*Penaeus sp.*										
136	*Pennahia anea*										
137	*Pentapodus setosus*	0.1	2			1.1	38	2.93	92		
138	*Pentaprion longimanus*			0.15	3	10.79	879			0.8	88
139	*Pinjalo pinjalo*										
140	*Platax batavianus*										
141	*Platycephalus indicus*										
142	*Plectranthias sp.*										
143	*Plotosus lineatus*	89	405								
144	*Podophthalmus vigil*										
145	*Portunus pelagicus*					0.4	1	0.25	2		
146	*Portunus sanguinolentus*			0.05	1	0.1	1				
147	*Priacanthus blochii*										
148	*Priacanthus macracanthus*			0.3	5						
149	*Priacanthus tayenus*	0.7	4	0.9	18	1.43	41			2.85	154

Appendix 2a: Continue ...

Station no.		1		2		3		4		5	
Date		15/07		15/07		16/07		16/07		17/07	
Depth (m) : start - finish		21.6 - 21.9		32.3 - 39.1		31.6 - 32.0		20.5 - 24.0		27.1 -27.5	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
150	*Pristigenys niphonia*										
151	*Pristipomoides typus*										
152	*Pristotis jerdoni*					0.67	40				
153	*Psettodes erumei*										
154	*Pseudorhombus arsius*										
155	*Pseudorhombus quinquocellatus*							0.2	13		
156	*Pseudorhombus sp*										
157	*Pseudotriacanthus strigilifer*										
158	*Pterois sp.*										
159	*Pterygotrigla sp.*										
160	*Rachycentron canadum*	58	98								
161	*Raja (Okamejei) bosemani*										
162	*Raja (Okamejei) sp.*										
163	*Rastrelliger brachysoma*									0.6	6
164	*Rastrelliger faughni*					0.1	1				
165	*Rastrelliger kanagurta*	1.5	9								
166	*Rhinobatus sp.*										
167	*Samaris cristatus*										
168	*Sardinella sp.*										
169	*Sardinella gibbosa*							0.53	5	0.34	11
170	*Saurida gracilis*										
171	*Saurida longimanus*			0.15	3						
172	*Saurida tumbil*			0.15	2					0.8	9
173	*Saurida undosquamis*					3.36	199			0.24	16
174	*Saurida wanieso*			0.24	2						
175	*Scolopsis monogramma*										
176	*Scolopsis taeniopterus*	1.05	22	0.3	5	13.05	521	2.79	59	2.24	80
177	*Scomberoides tala*										
178	*Scomberomorus commerson*									1.8	5
179	*Scomberomorus guttatus*									3.0	8
180	*Secutor insidiator*										
181	*Secutor ruconis*										
182	*Selar boops*	0.2	1								
183	*Selar crumenophthalmus*									0.1	1
184	*Selaroides leptolepis*	0.8	26			0.7	15				
185	*Sepia pharaonis*	1.1	2			0.8	8				
186	*Sepia spp.*	2.9	16	0.3	3	0.1	3	0.4	10	0.16	1
187	*Seriolina nigrofasciata*	0.1	1								
188	*Siganus canaliculatus*					0.4	59.9	0.44	8	0.4	8
189	*Sirembo imberis*										
190	*Sirembo jerdoni*										
191	*Solenocera choprai*										
192	*Solenocera spp*										
193	*Sphyraena forsteri*									0.45	7
194	*Sphyraena obtusata*					3.13	67.9			0.2	5
195	*Sphyraena putnamae*									0.1	1
196	*Sphyrna lewini*									0.85	1
197	*Stolephorus indicus*					12.7	100	0.07	4	0.8	136
198	*Synodus hoshinonis*										
199	*Tachypleus sp.*										

Appendix 2a: Continue ...

Station no.		1		2		3		4		5	
Date		15/07		15/07		16/07		16/07		17/07	
Depth (m) : start - finish		21.6 - 21.9		32.3 - 39.1		31.6 - 32.0		20.5 - 24.0		27.1 -27.5	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
200	*Tentoriceps cristatus*										
201	*Terapon jarbua*									0.0	
202	*Tetrosomus gibbosus*										
203	*Thenus orientalis*	0.4	3					0.35	4	0.2	2
204	*Thryssa hamiltonii*									0.0	
205	*Trachynocephalus myops*	0.1	1	0.15	2	0.33	13.3	0.05	3		
206	*Trichiurus lepturus*									2.2	4
207	*Upeneus japonicus*			0.15	3	2	153				
208	*Upeneus moluccensis*										
209	*Upeneus sp*										
210	*Upeneus sulphureus*					0.05	2				
211	*Upeneus tragula*	0.7	44			5.3	452	0.6	35	4	224
212	*Upeneus vittatus*										
213	*Uraspis uraspis*										

Appendix 2b: Catch rates (Wt-kg & N-number per hour) of species caught by KK Manchong trawl for 33 stations in east coast of Sabah, the Sulu-Sulawesi seas EEZ of Malaysia in 2009

Station no.		**6**		**7**		**8**		**11**		**10**	
Date		**17/08**		**17/09**		**19/07**		**19/07**		**20/07**	
Depth (m) : startfinish		**26.9-15.3**		**36-40**		**33.6-34**		**40-43.8**		**26.6-31.5**	
Species		**Wt**	**N**	**Wt**	**N**	**Wt**	**N**	**Wt**	**N**	**Wt**	**N**
1	*Abalistes stellaris*										
2	*Acanthurus mata*										
3	*Aesopia cornuta*										
4	*Alectis ciliaris*										
5	*Alectis indica*										
6	*Alepes vari*	0.1	1								
7	*Alutera monoceros*										
8	*Alutera* sp.					0.05	1				
9	*Amblygaster sirm*										
10	*Amusium pleuronectes*					0.11	1				
11	*Anodontostoma chacunda*	0.17	2								
12	*Antennarius striatus*										
13	*Antigonia capros*										
14	*Apogon aureus*										
15	*Apogon ellioti*					0.4	4	0.22	66	0.83	66
16	*Apogon lineatus*	0.23	46								
17	*Ariomma indica*										
18	*Arius thalassinus*					0.75	1	0.5	1		
19	*Arothron immaculatus*										
20	*Arothron manillensis*										
21	*Arothron stellatus*										
22	*Atule mate*					0.15	2			0.35	5
23	*Calappa lophos*										
24	*Calappa philargius*										
25	*Canthigaster compresso*										
26	*Carangoides armatus*					0.4	4			2.64	247
27	*Carangoides chrysophrys*										
28	*Carangoides chrysophrys*										
29	*Carangoides fulvoguttatus*										
30	*Carangoides hedlandensis*									0.1	1
31	*Carangoides malabaricus*	0.36	8	0.95	6	0.16	3	0.6	13	0.5	14
32	*Carangoides* sp.										
33	*Caranx ignobilis*										
34	*Caranx sexfasciatus*	0.2	2								
35	*Carcharhinus sorrah*										
36	*Champsodon longispinis*										
37	*Charybdis feriatus*			0.35	2			0.2	1		
38	*Charybdis natator*										
39	*Chiloscyllium plagiosum*										
40	*Chirocentrus dorab*					0.39	1	0.6	2		
41	*Choerodon schoenleinii*							1.1	22		
42	*Choerodon* sp.										
43	*Cynoglossus bilineatus*										
44	*Dactyloptena orientalis*										
45	*Dactylopus dactylopus*										
46	*Dasyatis kuhlii*										
47	*Decapterus russelli*										
48	*Diagramma pictum*										
49	*Diodon holocanthus*										
50	*Diodon hystrix*							6.6	44		
51	*Dipterygonotus balteatus*										
52	*Dussumieria acuta*	0.55	18			2.9	89	0.3	3	4	112
53	*Echeneis naucrates*										
54	*Elates ransonneti*							0.22	198		
55	*Engyroprosopon* sp.										
56	*Epinephelus areolatus*										
57	*Epinephelus bleekeri*										
58	*Epinephelus caeruleopunctatus*										
59	*Epinephelus coioides*							0.9	1		
60	*Epinephelus heniochus*										
61	*Epinephelus sexfasciatus*	0.07	1	0.25	1			1.4	9		
62	*Epinephelus* sp.										

Appendix 2b: Continue ...

Station no.		6		7		8		11		10	
Date		17/08		17/09		19/07		19/07		20/07	
Depth (m) : startfinish		26.9-15.3		36-40		33.6-34		40-43.8		26.6-31.5	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
63	*Fistularia commerson*										
64	*Fistularia petimba*							0.66	22		
65	*Gazza minuta*									0.05	1
66	*Gerres abbreviatus*			0.08	1						
67	*Gerres oyena*										
68	*Gnathonodon speciosus*										
69	*Grammatobothus polyophthalmus*										
70	*Gymnocranius elongatus*										
71	*Halieutaea* sp.										
72	*Harpiosquilla harpax*							0.4	3		
73	*Heterocarpus* spp.										
74	Jellyfish										
75	*Lactoria cornuta*										
76	*Lactoria fornasini*										
77	*Lagocephalus inermis*										
78	*Lagocephalus lunaris*					0.04	4				
79	*Lagocephalus sceleratus*	4.6	46					1.1	22		
80	*Lagocephalus spadiceus*	2.3	23	0.05	1			1.1	22	0.6	9
81	*Leiognathus bindus*										
82	*Leiognathus equulus*	0.81	26	0.18	1	0.4	10			0.23	3
83	*Leiognathus leuciscus*										
84	*Leiognathus longispinis*										
85	*Leiognathus smithursti*					0.05	1				
86	*Leiognathus splendens*	0.69	23								
87	*Leiognathus* spp.	20.7	3726	2.15	387	1.0	285	22.0	4400	26.4	5280
88	*Leiognathus stercorarius*										
89	*Lepturacanthus savala*										
90	*Lethrinus nebulosus*										
91	*Lethrinus sp*										
92	*Loligo edulis*										
93	*Loligo spp.*	2.5	175	1.3	82	1.4	147	1.3	4	1	90
94	*Loxodon macrohinus*										
95	*Lutjanus lutjanus*							0.1	1		
96	*Lutjanus malabaricus*										
97	*Lutjanus vitta*							0.2	2		
98	*Megalaspis cordyla*	0.11	2			0.7	3	0.2	1	0.38	6
99	*Mene maculata*										
100	*Metapenaeus* sp.										
101	*Monacanthus chinensis*										
102	*Monodactylus argenteus*										
103	*Nemipterus aurora*										
104	*Nemipterus balinensis*										
105	*Nemipterus bathybius*										
106	*Nemipterus furcosus*							0.1	1		
107	*Nemipterus hexodon*	0.6	22			0.25	2	0.3	2		
108	*Nemipterus isacanthus*										
109	*Nemipterus japonicus*	0.26	22	0.13	1	1.2	32	0.6	6	0.27	11
110	*Nemipterus marginatus*	0.15	5	0.12	3	2.1	87	0.8	23	0.3	10
111	*Nemipterus nematophorus*					0.4	22	2.48	62	0.35	12
112	*Nemipterus nematophus*										
113	*Nemipterus nemurus*										
114	*Nemipterus peronii*										
115	*Nemipterus virgatus*										
116	*Octopus*										
117	*Odonus niger*										
118	*Ophichthus* sp.										
119	*Ostracion nasus*										
120	*Panulirus polyphagus*									0.38	1
121	*Parachaetodon ocellatus*										
122	*Paramonacanthus* sp.										
123	*Parapercis alboguttata*										
124	*Paraplagusia bilineata*										
125	*Parascolopsis tanyactis*										

Appendix 2b: Continue ...

Station no.		6		7		8		11		10	
Date		17/08		17/09		19/07		19/07		20/07	
Depth (m) : startfinish		26.9-15.3		36-40		33.6-34		40-43.8		26.6-31.5	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
126	*Parastromateus niger*			0.05	1			0.1	2		
127	*Pardachirus pavoninus*										
128	*Parupeneus heptacanthus*										
129	*Penaeus indicus*										
130	*Penaeus japonicus*										
131	*Penaeus longistylus*										
132	*Penaeus monodon*	0.08	1								
133	*Penaeus penicillatus*										
134	*Penaeus semisulcatus*							0.2	1		
135	*Penaeus sp.*	0.03	1					0.2	1		
136	*Pennahia anea*									0.07	1
137	*Pentapodus setosus*										
138	*Pentaprion longimanus*			0.15	7	0.25	30	1.1	88		0
139	*Pinjalo pinjalo*							0.1	1		
140	*Platax batavianus*										
141	*Platycephalus indicus*							2.55	74		
142	*Plectranthias sp.*										
143	*Plotosus lineatus*										
144	*Podophthalmus vigil*										
145	*Portunus pelagicus*					0.8	1				
146	*Portunus sanguinolentus*									0.75	9
147	*Priacanthus blochii*										
148	*Priacanthus macracanthus*										
149	*Priacanthus tayenus*	3.1	7	0.3	4	1.9	32	1.05	19	0.42	9
150	*Pristigenys niphonia*										
151	*Pristipomoides typus*										
152	*Pristotis jerdoni*										
153	*Psettodes erumei*										
154	*Pseudorhombus arsius*							0.08	1		
155	*Pseudorhombus quinquocellatus*										
156	*Pseudorhombus sp*										
157	*Pseudotriacanthus strigilifer*										
158	*Pterois sp.*										
159	*Pterygotrigla sp.*										
160	*Rachycentron canadum*										
161	*Raja (Okamejei) bosemani*										
162	*Raja (Okamejei) sp.*										
163	*Rastrelliger brachysoma*									0.3	4
164	*Rastrelliger faughni*	0.08	1								
165	*Rastrelliger kanagurta*	0.1	1								
166	*Rhinobatus sp.*										
167	*Samaris cristatus*										
168	*Sardinella sp.*									0.14	4
169	*Sardinella gibbosa*							0.2	3		
170	*Saurida gracilis*										
171	*Saurida longimanus*	0.46	69	0.08	9	0.15	13	3.08	418	2.97	149
172	*Saurida tumbil*	0.5	6			0.1	1	2.5	39	1	17
173	*Saurida undosquamis*			0.05	2			0.9	22		
174	*Saurida wanieso*										
175	*Scolopsis monogramma*										
176	*Scolopsis taeniopterus*	0.09	4					0.08	1		
177	*Scomberoides tala*									0.15	1
178	*Scomberomorus commerson*	0.3	1					0.75	2	0.4	1
179	*Scomberomorus guttatus*										
180	*Secutor insidiator*	0.46	23								
181	*Secutor ruconis*										
182	*Selar boops*					0.2	1				
183	*Selar crumenophthalmus*					0.1	1	4.5	24		
184	*Selaroides leptolepis*							0.27	44		
185	*Sepia pharaonis*										
186	*Sepia spp.*									0.3	1
187	*Seriolina nigrofasciata*										
188	*Siganus canaliculatus*										

Appendix 2b: Continue ...

Station no.		6		7		8		11		10	
Date		17/08		17/09		19/07		19/07		20/07	
Depth (m) : startfinish		26.9-15.3		36-40		33.6-34		40-43.8		26.6-31.5	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
189	*Sirembo imberis*										
190	*Sirembo jerdoni*										
191	*Solenocera choprai*										
192	*Solenocera spp*										
193	*Sphyraena forsteri*			0.26	3	0.6	1				
194	*Sphyraena obtusata*					0.14	4	1	14	0.11	2
195	*Sphyraena putnamae*	0.48	3			0.36	3			0.24	2
196	*Sphyrna lewini*										
197	*Stolephorus indicus*			0.45	82	0.12	33	2.3	92	1.65	231
198	*Synodus hoshinonis*										
199	*Tachypleus sp.*										
200	*Tentoriceps cristatus*										
201	*Terapon jarbua*	0.3	1								
202	*Tetrosomus gibbosus*										
203	*Thenus orientalis*					0.8	1				
204	*Thryssa hamiltonii*	0.25	1								
205	*Trachynocephalus myops*										
206	*Trichiurus lepturus*	0.6	1	0.08	2						
207	*Upeneus japonicus*										
208	*Upeneus moluccensis*										
209	*Upeneus sp*					0.05	1				
210	*Upeneus sulphureus*	0.35	15	0.1	4			0.2	7	0.37	19
211	*Upeneus tragula*										
212	*Upeneus vittatus*										
213	*Uraspis uraspis*					0.1	1				

Appendix 2c: Catch rates (Wt-kg & N-number per hour) of species caught by KK Manchong trawl for 33 stations in east coast of Sabah, the Sulu-Sulawesi seas EEZ of Malaysia in 2009

Station no.		9		13		14		12		15	
Date		20/07		20/07		20/07		20/07		21/07	
Depth (m) : startfinish		20.7-10.0		39.0-50.7		54.6-62.1		34.2-29.1		40.5-62.5	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
1	*Abalistes stellaris*										
2	*Acanthurus mata*										
3	*Aesopia cornuta*										
4	*Alectis ciliaris*										
5	*Alectis indica*										
6	*Alepes vari*										
7	*Alutera monoceros*										
8	*Alutera sp.*										
9	*Amblygaster sirm*										
10	*Amusium pleuronectes*										
11	*Anodontostoma chacunda*					0.2	2	1.0	17		
12	*Antennarius striatus*										
13	*Antigonia capros*										
14	*Apogon aureus*										
15	*Apogon ellioti*	0.29	29	1.2	88	0.48	12	12.45	480		
16	*Apogon lineatus*					0.3	18				
17	*Ariomma indica*					0.5	4				
18	*Arius thalassinus*										
19	*Arothron immaculatus*										
20	*Arothron manillensis*										
21	*Arothron stellatus*										
22	*Atule mate*	0.45	8	0.2	1						
23	*Calappa lophos*										
24	*Calappa philargius*										
25	*Canthigaster compresso*										
26	*Carangoides armatus*	0.08	5	0.91	27	0.5	7	1.5	18	0.1	1
27	*Carangoides chrysophrys*			0.2	1						
28	*Carangoides chrysophrys*			0.2	1						
29	*Carangoides fulvoguttatus*										
30	*Carangoides hedlandensis*			0.1	1						
31	*Carangoides malabaricus*			0.16	8	1.7	39	0.4	13		
32	*Carangoides sp.*										
33	*Caranx ignobilis*										
34	*Caranx sexfasciatus*			0.1	1			0.25	1		
35	*Carcharhinus sorrah*					1.4	1				
36	*Champsodon longispinis*									0.01	1
37	*Charybdis feriatus*			0.5	2	0.2	1				
38	*Charybdis natator*										
39	*Chiloscyllium plagiosum*										
40	*Chirocentrus dorab*							0.2	1	2.4	3
41	*Choerodon schoenleinii*										
42	*Choerodon sp.*										
43	*Cynoglossus bilineatus*										
44	*Dactyloptena orientalis*										
45	*Dactylopus dactylopus*										
46	*Dasyatis kuhlii*										
47	*Decapterus russelli*										
48	*Diagramma pictum*										
49	*Diodon holocanthus*										

Appendix 2c: Continue ...

Station no.		9		13		14		12		15	
Date		20/07		20/07		20/07		20/07		21/07	
Depth (m) : start-finish		20.7-10.0		39.0-50.7		54.6-62.1		34.2-29.1		40.5-62.5	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
50	*Diodon hystrix*										
51	*Dipterygonotus balteatus*										
52	*Dussumieria acuta*	1.65	38	0.1	3			2.2	62		
53	*Echeneis naucrates*										
54	*Elates ransonneti*										
55	*Engyroprosopon sp.*										
56	*Epinephelus areolatus*										
57	*Epinephelus bleekeri*										
58	*Epinephelus caeruleopunctatus*										
59	*Epinephelus coioides*										
60	*Epinephelus heniochus*										
61	*Epinephelus sexfasciatus*			0.15	1						
62	*Epinephelus sp.*			0.08	8						
63	*Fistularia commerson*										
64	*Fistularia petimba*			0.1	1						
65	*Gazza minuta*			0.08	8						
66	*Gerres abbreviatus*										
67	*Gerres oyena*										
68	*Gnathonodon speciosus*										
69	*Grammatobothus polyophthalmus*										
70	*Gymnocranius elongatus*										
71	*Halieutaea sp.*										
72	*Harpiosquilla harpax*							0.08	3		
73	*Heterocarpus spp.*										
74	Jellyfish									4.0	
75	*Lactoria cornuta*										
76	*Lactoria fornasini*										
77	*Lagocephalus inermis*										
78	*Lagocephalus lunaris*										
79	*Lagocephalus sceleratus*										
80	*Lagocephalus spadiceus*	1.2	25.5					4.5	210	0.5	9
81	*Leiognathus bindus*										
82	*Leiognathus equulus*										
83	*Leiognathus leuciscus*										
84	*Leiognathus longispinis*										
85	*Leiognathus smithursti*										
86	*Leiognathus splendens*										
87	*Leiognathus spp.*	13.9	3074	16.0	3320	2.4	462				
88	*Leiognathus stercorarius*										
89	*Lepturacanthus savala*			0.8	1	3.7	9				
90	*Lethrinus nebulosus*										
91	*Lethrinus sp*										
92	*Loligo edulis*										
93	*Loligo spp.*	0.6	35	0.08	48	1.6	320	1.4	103	0.25	18
94	*Loxodon macrohinus*										
95	*Lutjanus lutjanus*										
96	*Lutjanus malabaricus*					0.2	1				
97	*Lutjanus vitta*										
98	*Megalaspis cordyla*			0.1	1	0.1	1	0.3	6	0.45	3

Appendix 2c: Continue ...

Station no.		9		13		14		12		15	
Date		20/07		20/07		20/07		20/07		21/07	
Depth (m) : startfinish		20.7-10.0		39.0-50.7		54.6-62.1		34.2-29.1		40.5-62.5	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
99	*Mene maculata*			0.5	4	0	0	0.35	3	1.0	8
100	*Metapenaeus sp.*									0.15	46
101	*Monacanthus chinensis*										
102	*Monodactylus argenteus*			0.1	2			0.45	30		
103	*Nemipterus aurora*										
104	*Nemipterus balinensis*										
105	*Nemipterus bathybius*										
106	*Nemipterus furcosus*							0.1	1		
107	*Nemipterus hexodon*	0.27	4.5	0.4	1	0.5	1				
108	*Nemipterus isacanthus*										
109	*Nemipterus japonicus*	0.33	6	0.8	6	0.7	6	0.6	9	0.2	1
110	*Nemipterus marginatus*	0.23	6	0.13	4	0.2	3	0.9	45		
111	*Nemipterus nematophorus*			2.9	90	2.1	128				
112	*Nemipterus nematophus*										
113	*Nemipterus nemurus*										
114	*Nemipterus peronii*										
115	*Nemipterus virgatus*										
116	*Octopus*										
117	*Odonus niger*										
118	*Ophichthus sp.*										
119	*Ostracion nasus*										
120	*Panulirus polyphagus*										
121	*Parachaetodon ocellatus*										
122	*Paramonacanthus sp.*										
123	*Parapercis alboguttata*										
124	*Paraplagusia bilineata*										
125	*Parascolopsis tanyactis*										
126	*Parastromateus niger*									1.8	10
127	*Pardachirus pavoninus*										
128	*Parupeneus heptacanthus*										
129	*Penaeus indicus*										
130	*Penaeus japonicus*							0.05	1		
131	*Penaeus longistylus*										
132	*Penaeus monodon*							0.1	1		
133	*Penaeus penicillatus*	0.08	2								
134	*Penaeus semisulcatus*										
135	*Penaeus sp.*							0.05	1		
136	*Pennahia anea*										
137	*Pentapodus setosus*										
138	*Pentaprion longimanus*	0	0	3	250	0.9	36	1.2	90	0	0
139	*Pinjalo pinjalo*					0.3	12	0.05	1		
140	*Platax batavianus*										
141	*Platycephalus indicus*			0.4	16			0.1	2		
142	*Plectranthias sp.*										
143	*Plotosus lineatus*										
144	*Podophthalmus vigil*					0.2	1	0.1	1		
145	*Portunus pelagicus*										
146	*Portunus sanguinolentus*							0.3	3		
147	*Priacanthus blochii*										

Appendix 2c: Continue ...

Station no.		9		13		14		12		15	
Date		20/07		20/07		20/07		20/07		21/07	
Depth (m) : start|finish		20.7-10.0		39.0-50.7		54.6-62.1		34.2-29.1		40.5-62.5	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
148	*Priacanthus macracanthus*			0.2	3	5.6	112	0.3	5		
149	*Priacanthus tayenus*	0.75	12	0.9	20			3.15	75	0.2	2
150	*Pristigenys niphonia*										
151	*Pristipomoides typus*										
152	*Pristotis jerdoni*										
153	*Psettodes erumei*			0.15	1			0.1	1		
154	*Pseudorhombus arsius*			0.18	2						
155	*Pseudorhombus quinquocellatus*										
156	*Pseudorhombus sp*										
157	*Pseudotriacanthus strigilifer*										
158	*Pterois sp.*										
159	*Pterygotrigla sp.*										
160	*Rachycentron canadum*										
161	*Raja (Okamejei) bosemani*										
162	*Raja (Okamejei) sp.*										
163	*Rastrelliger brachysoma*	0.23	3	11.0	94	0.25	2	1.8	19	0.35	4
164	*Rastrelliger faughni*										
165	*Rastrelliger kanagurta*			0.55	4			0.5	4	0.2	1
166	*Rhinobatus sp.*										
167	*Samaris cristatus*										
168	*Sardinella sp.*	0.08	3								
169	*Sardinella gibbosa*	0.08	2					0.3	9		
170	*Saurida gracilis*			0.1	3						
171	*Saurida longimanus*	0.28	29	2.1	264	2.4	228				
172	*Saurida tumbil*	0.6	5	1.25	15	0.3	2	23	5		
173	*Saurida undosquamis*			1.4	46			0.1	1		
174	*Saurida wanieso*					0.4	1				
175	*Scolopsis monogramma*										
176	*Scolopsis taeniopterus*			0.2	2						
177	*Scomberoides tala*										
178	*Scomberomorus commerson*			1	2					10.0	1
179	*Scomberomorus guttatus*									2.2	2
180	*Secutor insidiator*										
181	*Secutor ruconis*										
182	*Selar boops*										
183	*Selar crumenophthalmus*			1.1	12	0.5	4	0.2	2	0.5	6
184	*Selaroides leptolepis*					0.05	1				
185	*Sepia pharaonis*							0.8	2		
186	*Sepia spp.*										
187	*Seriolina nigrofasciata*										
188	*Siganus canaliculatus*										
189	*Sirembo imberis*										
190	*Sirembo jerdoni*										
191	*Solenocera choprai*										
192	*Solenocera spp*										
193	*Sphyraena forsteri*										
194	*Sphyraena obtusata*			0.6	10	0.5	7	0.25	5	0.1	1
195	*Sphyraena putnamae*			0.3	2	1	5	3.3		1.1	7
196	*Sphyrna lewini*										

Appendix 2c: Continue ...

Station no.		9		13		14		12		15	
Date		20/07		20/07		20/07		20/07		21/07	
Depth (m) : start/finish		20.7-10.0		39.0-50.7		54.6-62.1		34.2-29.1		40.5-62.5	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
197	*Stolephorus indicus*	1.45	203	1.1	41	1.5	54	0.75	15		
198	*Synodus hoshinonis*										
199	*Tachypleus sp.*										
200	*Tentoriceps cristatus*			0.2	2	3.3	78	1.05	19	2.8	46
201	*Terapon jarbua*							0.25	1		
202	*Tetrosomus gibbosus*										
203	*Thenus orientalis*										
204	*Thryssa hamiltonii*										
205	*Trachynocephalus myops*										
206	*Trichiurus lepturus*			0.15	1	0.65	3	0.2	1	2.6	9
207	*Upeneus japonicus*										
208	*Upeneus moluccensis*										
209	*Upeneus sp*										
210	*Upeneus sulphureus*			0.5	12	0.5	16	1.05	45		
211	*Upeneus tragula*										
212	*Upeneus vittatus*										
213	*Uraspis uraspis*			1.1	12	0.65	9	0.1	2		

Appendix 2d: Catch rates (Wt-kg & N-number per hour) of species caught by KK Manchong trawl for 33 stations in east coast of Sabah, the Sulu-Sulawesi seas EEZ of Malaysia in 2009

Station no.		35		36		32		34		26	
Date		25/07		25/07		26/07		26/07		29/07	
Depth (m) : start - finish		19.5-29.0		27.3-36.2		21.1-22.8		19.5-20.9		76.4-78.0	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
1	*Abalistes stellaris*	0.2	1			0.2	1				
2	*Acanthurus mata*	7.5	18								
3	*Aesopia cornuta*										
4	*Alectis ciliaris*									0.1	1
5	*Alectis indica*										
6	*Alepes vari*										
7	*Alutera m onoceros*										
8	*Alutera sp.*										
9	*Amblygaster sirm*	0.5	10								
10	*Amusium pleuronectes*							1.2	61		
11	*Anodontostoma chacunda*										
12	*Antennarius striatus*	0.01	1					0.1	1		
13	*Antigonia capros*										
14	*Apogon aureus*	0.2	28	0.09	90						
15	*Apogon ellioti*	0.05	2							2.92	59
16	*Apogon lineatus*										
17	*Ariomma indica*										
18	*Arius thalassinus*										
19	*Arothron immaculatus*	0.1	1	0.1	1						
20	*Arothron manillensis*	1.0	4								
21	*Arothron stellatus*							0.2	1		
22	*Atule mate*			0.6	2						
23	*Calappa lophos*										
24	*Calappa philargius*	0.2	2	0.15	1						
25	*Canthigaster compresso*					0.25	18				
26	*Carangoides armatus*	0.8	14								
27	*Carangoides chrysophrys*	0.3	1								
28	*Carangoides chrysoph rys*	0.3	1								
29	*Carangoides fulvoguttatus*										
30	*Carangoides hedlandensis*							0.2	1		
31	*Carangoides malabaricus*	0.3	3	3.9	38						
32	*Carangoides sp.*	0.1	1								
33	*Caranx ignobilis*							0.3	1		
34	*Caranx sexfasciatus*	0.15	1	0.3	1	0.3	1				
35	*Carcharhinus sorrah*										
36	*Champsodon longispinis*			0.09	9			0.05	1	0.01	1
37	*Charybdis feriatus*	0.9	5	0.15	2						
38	*Charybdis natator*										
39	*Chiloscyllium plagiosum*										
40	*Chirocentrus dorab*	0.7	1								
41	*Choerodon schoenleinii*										
42	*Choerodon sp.*										
43	*Cynoglossus bilineatus*										
44	*Dactyloptena orientalis*										
45	*Dactylopus dactylopus*							0.05	1		
46	*Dasyatis kuhlii*					3.95	5				
47	*Decapterus russelli*	0.6	8								
48	*Diagramma p ictum*	0.2	2								
49	*Diodon holocanthus*					7.1	12				
50	*Diodon hystrix*					6.35	5				
51	*Dipterygonotus balteatus*										
52	*Dussumieria acuta*			0.2	13						
53	*Echeneis naucrates*										

Appendix 2d: Continue ...

Station no.		35		36		32		34		26		
Date		25/07		25/07		26/07		26/07		29/07		
Depth (m) : start - finish		19.5-29.0		27.3-36.2		21.1-22.8		19.5-20.9		76.4-78.0		
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N	
54	*Elates ransonneti*											
55	*Engyroprosopon sp.*											
56	*Epinephelus areolatus*	0.2	3							0.3	1	
57	*Epinephelus bleekeri*											
58	*Epinephelus caeruleopunctatus*									0.0		
59	*Epinephelus coioides*	4.3	1									
60	*Epinephelus heniochus*									1.8	3	
61	*Epinephelus sexfasciatus*	0.65	7									
62	*Epinephelus sp.*											
63	*Fistularia commerson*											
64	*Fistularia petimba*	0.3	16			0.01	1			0.2	11	
65	*Gazza minuta*											
66	*Gerres abbreviatus*											
67	*Gerres oyena*	0.2	2					1.0	16			
68	*Gnathonodon speciosus*											
69	*Gram matobothus polyophthalmus*	0.05	1							2.92	59	
70	*Gymnocranius elongatus*	0.08	1	1.1	13							
71	*Halieutaea sp.*											
72	*Harpiosquilla harpax*											
73	*Heterocarpus spp.*											
74	Jellyfish											
75	*Lactoria cornuta*					0.5	2					
76	*Lactoria fornasini*											
77	*Lagocephalus inermis*	0.05	2	0.1	2							
78	*Lagocephalus lunaris*											
79	*Lagocephalus sceleratus*			1.7	18							
80	*Lagocephalus spadiceus*	2.2	38	0.2	2							
81	*Leiognathus bindus*							1.0	40			
82	*Leiognathus equulus*	0.2	2	1.1	13							
83	*Leiognathus leuciscus*							3.05	118			
84	*Leiognathus longispinis*	0.3	3									
85	*Leiognathus smithursti*							2.0	40			
86	*Leiognathus splendens*			0.2	5							
87	*Leiognathus spp.*			1.8	450					105.3		22,522
88	*Leiognathu s stercorarius*											
89	*Lepturacanthus savala*											
90	*Lethrinus nebulosus*											
91	*Lethrinus sp*					1.5	45					
92	*Loligo edulis*											
93	*Loligo spp.*	0.3	3	0.8	68	0.2	4	0.3	12	0.65	34	
94	*Loxodon macrohinus*											
95	*Lutjanus lutja nus*											
96	*Lutjanus malabaricus*											
97	*Lutjanus vitta*											
98	*Megalaspis cordyla*	0.4	1									
99	*Mene maculata*											
100	*Metapenaeus sp.*											
101	*Monacanthus chinensis*											
102	*Monodactylus argenteus*											
103	*Nemipterus aurora*											
104	*Nemipterus balinensis*											
105	*Nemipterus bathybius*											
106	*Nemipterus furcosus*	2	29			0.3	8	0.1	1			
107	*Nemipterus hexodon*	1.4	14	1.65	24			0.9	9			

Appendix 2d: Continue ...

Station no.		35		36		32		34		26	
Date		25/07		25/07		26/07		26/07		29/07	
Depth (m) : start - finish		19.5-29.0		27.3-36.2		21.1-22.8		19.5-20.9		76.4-78.0	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
108	*Nemipterus isacanthus*	0.2	1								
109	*Nemipterus japon icus*			0.4	7						
110	*Nemipterus marginatus*	1.8	45	1.2	34			1.6	38		
111	*Nemipterus nematophorus*									1.75	17
112	*Nemipterus nematophus*	0.8	23					1.05	25	0.2	1
113	*Nemipterus nemurus*	0.2	2								
114	*Nemipterus peronii*	0.2	2								
115	*Nemipte rus virgatus*										
116	*Octopus*										
117	*Odonus niger*	0.8	2								
118	*Ophichthus sp.*										
119	*Ostracion nasus*										
120	*Panulirus polyphagus*	0.5	5								
121	*Parachaetodon ocellatus*	0.2	2								
122	*Paramonacanthus sp.*										
123	*Parapercis alboguttata*									0.01	3
124	*Paraplagusia bilineata*										
125	*Parascolopsis tanyactis*										
126	*Parastromateus niger*										
127	*Pardachirus pavoninus*	0.1	1								
128	*Parupeneus heptacanthus*	0.8	10								
129	*Penaeus indicus*	0.2	1								
130	*Penaeus japonicus*	0.2	2								
131	*Penaeus longistylus*										
132	*Penaeus monodon*	0.1	3								
133	*Penaeus penicillatus*										
134	*Penaeus semisulcatus*	0.2	2					0.55	9		
135	*Penaeus sp.*							0.3	7	0.1	4
136	*Pennahia anea*										
137	*Pentapodus setosus*							3	103		
138	*Pentaprion longimanus*			2	193			4	300	8.77	293
139	*Pinjalo pinjalo*										
140	*Platax batavianus*	1.5	2					0.15	1		
141	*Platycephalus indicus*							0.1	2		
142	*Plectranthias sp.*									0.05	1
143	*Plotosus lineatus*										
144	*Podophthalmus vigil*	0.05	1								
145	*Portunus pelagicus*	0.7	3	0.15	1			0.5	2		
146	*Portunus sanguinolentus*										
147	*Priacanthus blochii*										
148	*Priacanthus macracanthus*			1.3	12						
149	*Priacanthus tayenus*	1.2	28					1.95	34	1.4	10
150	*Pristigenys niphonia*										
151	*Pristipomoides typus*										
152	*Pristotis jerdoni*					0.1	3				
153	*Psettodes erumei*										
154	*Pseudorhombus arsius*	0.3	4								
155	*Pseudorhombus quinquocellatus*	0.3	3								
156	*Pseudorhombus sp*										
157	*Pseudotriacanthus strigilifer*										
158	*Pterois sp.*							0.2	4		
159	*Pterygotrigla sp.*										
160	*Rachycentron canadum*										
161	*Raja (Okamejei) bosemani*										

Appendix 2d: Continue ...

Station no.		35		36		32		34		26	
Date		25/07		25/07		26/07		26/07		29/07	
Depth (m) : start - finish		19.5-29.0		27.3-36.2		21.1-22.8		19.5-20.9		76.4-78.0	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
162	*Raja (Okamejei) sp.*										
163	*Rastrelliger brachysoma*										
164	*Rastrelliger faughni*			0.8	5			0.55	20	0.1	1
165	*Rastrelliger kanagurta*	0.4	4	0.2	2			0.2	1		
166	*Rhinobatus sp.*										
167	*Samaris cristatus*										
168	*Sardinella sp.*										
169	*Sardinella gibbosa*										
170	*Saurida gracilis*										
171	*Saurida longimanus*			0.91	64						
172	*Saurida tumbil*	2.5	30	1.42	28			1.9	22	0.5	8
173	*Saurida undosquamis*	0.2	4	0.3	4						
174	*Saurida wanieso*	1.7	15	0.2	1			0.95	33	1.3	4
175	*Scolopsis monogra*										
176	*Scolopsis taeniopterus*	7.5	71	0.1	2			2	50		
177	*Scomberoides tala*										
178	*Scomberomorus commerson*			0.4	1						
179	*Scomberomorus guttatus*			0.4	1						
180	*Secutor insidiator*										
181	*Secutor ruconis*										
182	*Selar boops*										
183	*Selar crumenophthalmus*			1.6	14			0.7	7	0.8	5
184	*Selaroides leptolepis*					0.5	14	0.25	6		
185	*Sepia pharaonis*					0.5	2				
186	*Sepia spp.*	0.4	7			0.2	1				
187	*Seriolina nigrofasciata*										
188	*Siganus canaliculatus*										
189	*Sirembo imberis*										
190	*Sirembo jerdoni*										
191	*Solenocera choprai*										
192	*Solenocera spp*										
193	*Sphyraena forsteri*										
194	*Sphyraena obtusata*	0.3	4	0.7	20			0.6	10	0.4	8
195	*Sphyraena putnamae*	0.2	1								
196	*Sphyrna lewini*										
197	*Stolephorus indicus*			3	118						
198	*Synodus hoshinonis*							0.05	1		
199	*Tachypleus sp.*							3.5	1		
200	*Tentoriceps cristatus*										
201	*Terapon jarbua*										
202	*Tetrosomus gibbosus*										
203	*Thenus orientalis*							0.05	1		
204	*Thryssa hamiltonii*										
205	*Trachynocephalus myops*										
206	*Trichiurus lepturus*			0.3	2					1	3
207	*Upeneus japonicus*										
208	*Upeneus moluccensis*										
209	*Upeneus sp*										
210	*Upeneus sulphureus*	0.2	4	0.8	40					2.92	176
211	*Upeneus tragula*										
212	*Upeneus vittatus*	0.7	7	0.1	1						
213	*Uraspis uraspis*										

Appendix 2e: Catch rates (Wt-kg & N-number per hour) of species caught by KK Machong trawl for 33 stations in east coast of Sabah, the Sulu-Sulawesi seas EEZ of Malaysia in 2009

Station		29		28		25		24	
Date		29/07		30/07		30/07		30/07	
Depth (m) : start - finish		75.3-78.4		51.1-61.0		61.3-79.4		52.9-70.0	
Species		Wt	N	Wt	N	Wt	N	Wt	N
1	*Abalistes stellaris*								
2	*Acanthurus mata*								
3	*Aesopia cornuta*								
4	*Alectis ciliaris*	0.13	2	0.2	1	0.15	1	2.2	5
5	*Alectis indica*								
6	*Alepes vari*								
7	*Alutera monoceros*							0.4	1
8	*Alutera sp.*								
9	*Amblygaster sirm*								
10	*Amusium pleuronectes*								
11	*Anodontostoma chacunda*								
12	*Antennarius striatus*								
13	*Antigonia capros*								
14	*Apogon aureus*			1.3	104				
15	*Apogon ellioti*	5.98	778	0.88	82	0.91	73		
16	*Apogon lineatus*			0.13	13				
17	*Ariomma indica*								
18	*Arius thalassinus*								
19	*Arothron immaculatus*								
20	*Arothron manillensis*								
21	*Arothron stellatus*								
22	*Atule mate*			3.14	102			0.2	1
23	*Calappa lophos*								
24	*Calappa philargius*								
25	*Canthigaster compresso*								
26	*Caran goides armatus*			0.3	8			0.4	6
27	*Carangoides chrysophrys*			0.2	5				
28	*Carangoides chrysophrys*			0.2	5				
29	*Carangoides fulvoguttatus*			0.5	2				
30	*Carangoides hedlandensis*			0.1	1	0.2	4	0.8	2
31	*Carangoides malabaricus*			0.1	1			1.2	16
32	*Caran goides sp.*								
33	*Caranx ignobilis*					1.1	1		
34	*Caranx sexfasciatus*							0.6	1
35	*Carcharhinus sorrah*								
36	*Champsodon longispinis*	1.06	43			0.02	18	0.18	72
37	*Charybdis feriatus*								
38	*Charybdis natator*								
39	*Chiloscyllium pla giosum*	1.46	2						
40	*Chirocentrus dorab*							3.0	5
41	*Choerodon schoenleinii*								
42	*Choerodon sp.*					0.18	18		
43	*Cynoglossus bilineatus*								
44	*Dactyloptena orientalis*	0.67	7						
45	*Dactylopus dactylopus*								
46	*Dasyatis kuhlii*								
47	*Decapterus russelli*			0.1	4				
48	*Diagramma pictum*								
49	*Diodon holocanthus*								
50	*Diodon hystrix*								
51	*Dipterygonotus balteatus*								
52	*Dussumieria acuta*								
53	*Echeneis naucrates*								

Appendix 2e: Continue ...

Station		29		28		25		24	
Date		29/07		30/07		30/07		30/07	
Depth (m) : start-finish		75.3-78.4		51.1-61.0		61.3-79.4		52.9-70.0	
Species		Wt	N	Wt	N		N	Wt	N
54	*Elates ransonneti*								
55	*Engyroprosopon sp.*								
56	*Epinephelus areolatus*								
57	*Epinephelus bleekeri*								
58	*Epinephelus caeruleopunctatus*								
59	*Epinephelus coioides*			0.3	1			1.3	1
60	*Epinephelus heniochus*	0.67	4						
61	*Epinephelus sexfasciatus*			0.3	3				
62	*Epinephelus sp.*								
63	*Fistularia commerson*								
64	*Fistularia petimba*	0.27	8			1.8	45		
65	*Gazza minuta*					0.1	1		
66	*Gerres abbreviatus*								
67	*Gerres oyena*								
68	*Gnathonodon speciosus*								
69	*Grammatobothus p olyophthalmus*								
70	*Gymnocranius elongatus*								
71	*Halieutaea sp.*					0.3	1		
72	*Harpiosquilla harpax*								
73	*Heterocarpus spp.*							0.18	72
74	Jellyfish								
75	*Lactoria cornuta*								
76	*Lactoria fornasini*								
77	*Lagocepha lus inermis*								
78	*Lagocephalus lunaris*								
79	*Lagocephalus sceleratus*								
80	*Lagocephalus spadiceus*	0.13	3						
81	*Leiognathus bindus*								
82	*Leiognathus equulus*			0.1	1			6	66
83	*Leiognathus leuciscus*								
84	*Leiognathus long ispinis*			0.2	3			0.6	10
85	*Leiognathus smithursti*								
86	*Leiognathus splendens*								
87	*Leiognathus spp.*								
88	*Leiognathus stercorarius*	2.0	519						
89	*Lepturacanthus savala*								
90	*Lethrinus nebulosus*								
91	*Lethrinus sp*							9.0	2250
92	*Loligo edulis*								
93	*Loligo spp.*			1.55	99	1.44	450	0.9	36
94	*Loxodon macrohinus*					1.4	2		
95	*Lutjanus lutjanus*								
96	*Lutjanus malabaricus*								
97	*Lutjanus vitta*								
98	*Megalaspis cordyla*			6.04	255	2	5		
99	*Mene mac ulata*							3.35	16
100	*Metapenaeus sp.*								
101	*Monacanthus chinensis*								
102	*Monodactylus argenteus*								
103	*Nemipterus aurora*								
104	*Nemipterus balinensis*								
105	*Nemipterus bathybius*								
106	*Nemipterus furcosus*							0.6	3

Appendix 2e: Continue ...

Station		29		28		25		24	
Date		29/07		30/07		30/07		30/07	
Depth (m) : start-finish		75.3-78.4		51.1-61.0		61.3-79.4		52.9-70.0	
Species		Wt	N	Wt	N	Wt	N	Wt	N
107	*Nemipterus hexodon*								
108	*Nemipterus isacanthus*								
109	*Nemipterus japonicus*					0.2	1		
110	*Nemipterus marginatus*								
111	*Nemipterus nematophorus*	1.69	8	2.2	56	0.1	1		
112	*Nemipterus nematophus*	4.78	108			1.1		0.4	6
113	*Nemipteru s nemurus*					13	130		
114	*Nemipterus peronii*								
115	*Nemipterus virgatus*	0.67	2	0.2	1	0.7	3		
116	*Octopus*								
117	*Odonus niger*								
118	*Ophichthus sp.*								
119	*Ostracion nasus*								
120	*Panulirus polyphagus*								
121	*Parachaetod on ocellatus*							0.2	2
122	*Paramonacanthus sp.*	0.2	40						
123	*Parapercis alboguttata*								
124	*Paraplagusia bilineata*								
125	*Parascolopsis tanyactis*								
126	*Parastromateus niger*								
127	*Pardachirus pavoninus*								
128	*Parupene us heptacanthus*								
129	*Penaeus indicus*								
130	*Penaeus japonicus*								
131	*Penaeus longistylus*								
132	*Penaeus monodon*	0.67	3						
133	*Penaeus penicillatus*								
134	*Penaeus semisulcatus*								
135	*Penaeus sp.*	2.36	777						
136	*Pennahia anea*								
137	*Pentapodus setosus*								
138	*Pentaprion longimanus*	0.39	40	1.95	299	1.45	96	0.72	270
139	*Pinjalo pinjalo*								
140	*Platax batavianus*								
141	*Platycephalus indicus*	0.2	20						
142	*Plectranthias sp.*					0.9	18		
143	*Plotosus lineatus*								
144	*Podophthalmus vigil*								
145	*Portunus pelagicus*								
146	*Portunus sanguinolentus*								
147	*Priacanthus blochii*								
148	*Priacanthus macracanthus*								
149	*Priacanthus tayenus*	0.67	8			0.4	3	0.1	1
150	*Pristigenys niphonia*								
151	*Pristipomoides typus*								
152	*Pristotis jerdoni*								
153	*Psettodes erumei*							1.2	2
154	*Pseudorhombus arsius*								
155	*Pseudorhombus quinquocellatus*								
156	*Pseudorhombus sp*	4.0	479	0.65	26	0.18	36	0.18	36
157	*Pseudotriacanthus strigilifer*								
158	*Pterois sp.*							0.2	4
159	*Pterygotrigla sp.*								

Appendix 2e: Continue ...

Station		29		28		25		24	
Date		29/07		30/07		30/07		30/07	
Depth (m) : start-finish		75.3-78.4		51.1-61.0		61.3-79.4		52.9-70.0	
Species		Wt	N	Wt	N	Wt	N	Wt	N
160	*Rachycentron canadum*								
161	*Raja (Okamejei) bosemani*								
162	*Raja (Okamejei) sp.*								
163	*Rastrelliger brachysoma*								
164	*Rastrelliger faughni*					0.4	5		
165	*Rastrelliger kanagurta*					0.2	1		
166	*Rhinobatus sp.*								
167	*Samaris cristatus*								
168	*Sardinella sp.*								
169	*Sardinella gibbosa*								
170	*Saurida gracilis*								
171	*Saurida longimanus*			0.13	91	0.9	162	9	990
172	*Saurida tumbil*			0.7	6	0.9	5	10	65
173	*Saurida undosquamis*	6.64	104	0.2	3	2	23	5	39
174	*Saurida wanieso*			1.2	6	1.8	5	5.0	9
175	*Scolopsis monogramma*								
176	*Scolopsis taeniopterus*								
177	*Scomberoides tala*								
178	*Scomberomorus commerson*								
179	*Scomberomorus guttatus*								
180	*Secutor insidiator*								
181	*Secutor ruconis*			4.55	1,001				
182	*Selar boops*								
183	*Selar crumenophthalmus*			0.5	4	1	6		
184	*Selaroides leptolepis*								
185	*Sepia pharaonis*			0.4	1				
186	*Sepia spp.*							1	38
187	*Seriolina nigrofasciata*								
188	*Siganus canaliculatus*								
189	*Sirembo imberis*	0.47	27						
190	*Sirembo jerdoni*								
191	*Solenocera choprai*								
192	*Solenocera spp*	0.07	4						
193	*Sphyraena forsteri*								
194	*Sphyraena obtusata*			0.2	3	0.4	3		
195	*Sphyraena putnamae*								
196	*Sphyrna lewini*								
197	*Stolephorus indicus*			1.1	42	0.25	9		
198	*Synodus hoshinonis*			0.39	13				
199	*Tachypleus sp.*								
200	*Tent oriceps cristatus*			0.9	12	0.25	4		
201	*Terapon jarbua*								
202	*Tetrosomus gibbosus*								
203	*Thenus orientalis*								
204	*Thryssa hamiltonii*								
205	*Trachynocephalus myops*								
206	*Trichiurus lepturus*			1.5	17	0.15	2	3.2	35
207	*Upeneus japonicus*								
208	*Upeneus moluccensis*								
209	*Upeneus sp*								
210	*Upeneus sulphureus*	8.24	519	1.24	43	0.1	4	0.55	10
211	*Upeneus tragula*								
212	*Upeneus vittatus*								
213	*Uraspis uraspis*							0.2	1

Appendix 2f: Catch rates (Wt-kg & N-number per hour) of species caught by KK Manchong trawl for 33 stations in east coast of Sabah, the Sulu-Sulawesi seas EEZ of Malaysia in 2009

Station		23		22		21		27		20	
Date		30/07		30/07		30/07		30/07		31/07	
Depth : start-finish		78.0-95.0		64.0-67.5		71.4-76.1		100.0-118.0		34-43	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
1	*Abalistes stellaris*			0.73	15	0.7	8				
2	*Acanthurus mata*										
3	*Aesopia cornuta*										
4	*Alectis ciliaris*										
5	*Alectis indica*										
6	*Alepes vari*										
7	*Alutera monoceros*					0.05	1				
8	*Alutera sp.*										
9	*Amblygaster sirm*										
10	*Amusium pleuronectes*										
11	*Anodontostoma chacunda*										
12	*Antennarius striatus*										
13	*Antigonia capros*							0.05	2		
14	*Apogon aureus*					3.3	247				
15	*Apogon ellioti*			0.15	29						
16	*Apogon lineatus*										
17	*Ariomma indica*										
18	*Arius thalassinus*										
19	*Arothron immaculatus*										
20	*Arothron manillensis*										
21	*Arothron stellatus*										
22	*Atule mate*										
23	*Calappa lophos*										
24	*Calappa philargius*										
25	*Canthigaster compresso*										
26	*Carangoides armatus*	0.55	33	0.3	31	0.2	3				
27	*Carangoides chrysophrys*			0.2	2						
28	*Carangoides chrysophrys*			0.2	2						
29	*Caran goides fulvoguttatus*										
30	*Carangoides hedlandensis*										
31	*Carangoides malabaricus*									4.5	69
32	*Carangoides sp.*										
33	*Caranx ignobilis*										
34	*Caranx sexfasciatus*			0.1	1						
35	*Carcharhinus sorrah*										
36	*Champs odon longispinis*							0.01	1		
37	*Charybdis feriatus*									0.4	3
38	*Charybdis natator*										
39	*Chiloscyllium plagiosum*										
40	*Chirocentrus dorab*										
41	*Choerodon schoenleinii*										
42	*Choerodon sp.*			0.05	1						
43	*Cynoglossu s bilineatus*										
44	*Dactyloptena orientalis*	0.1	1			1.9	15				
45	*Dactylopus dactylopus*										
46	*Dasyatis kuhlii*										
47	*Decapterus russelli*	3.6	63	3.6	91						
48	*Diagramma pictum*										
49	*Diodon holocanthus*			0.05	1	1.76	22				
50	*Diodon hystrix*										
51	*Dipterygonotus balteatus*										
52	*Dussumieria acuta*									0.1	3
53	*Echeneis naucrates*										

Appendix 2f: Continue ...

Station		23		22		21		27		20	
Date		30/07		30/07		30/07		30/07		31/07	
Depth : start-finish		78.0-95.0		64.0-67.5		71.4-76.1		100.0-118.0		34-43	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
54	*Elates ransonneti*										
55	*Engyroprosopon sp.*	2.8	64					0.35	16		
56	*Epinephelus areolatus*							0.5	1		
57	*Epinephelus bleekeri*										
58	*Epinephelus caeruleopunctatus*							0.1	1		
59	*Epinephelus coioides*										
60	*Epinephelus heniochus*										
61	*Epinephelus sexfasciatus*										
62	*Epinephelus sp.*							13	1		
63	*Fistularia commerson*	0.7	1	0.15	29						
64	*Fistularia petimba*	0.1	6	1.16	29			0.1	5		
65	*Gazza minuta*										
66	*Gerres abbreviatus*										
67	*Gerres oyena*										
68	*Gnathonodon speciosus*										
69	*Grammatobothus polyophthalmus*										
70	*Gymnocranius elongatus*										
71	*Halieutaea sp.*	0.5	2								
72	*Harpiosquilla harpax*									0.2	3
73	*Heterocarpus spp.*					8.8	1298				
74	Jellyfish										
75	*Lactoria cornuta*										
76	*Lactoria fornasini*										
77	*Lagocephalus inermis*										
78	*Lagocephalus lunaris*										
79	*Lagocephalus sceleratus*										
80	*Lagocephalus spadiceus*									0.8	5
81	*Leiognathus bindus*										
82	*Leiognathus equulus*										
83	*Leiognathus leuciscus*										
84	*Leiognathus longispinis*										
85	*Leiognathus s mithursti*										
86	*Leiognathus splendens*										
87	*Leiognathus spp.*									20.7	3726
88	*Leiognathus stercorarius*										
89	*Lepturacanthus savala*									0.9	2
90	*Lethrinus nebulosus*										
91	*Lethrinus sp*										
92	*Loligo edulis*										
93	*Loligo spp.*			2.5	70			0.5	3	1.03	140
94	*Loxodon macrohinus*										
95	*Lutjanus lutjanus*					0.3	6				
96	*Lutjanus malabaricus*										
97	*Lutjanus vitta*										
98	*Megalaspis cordyla*									0.2	2
99	*Mene maculata*										
100	*Metapenaeus sp.*										
101	*Monacanthus chinensis*										
102	*Monodactylus argenteus*										
103	*Nemipterus aurora*			2.9	49	7.5	104	0.5	5		
104	*Nemipterus balinensis*										
105	*Nemipterus bathybius*			7.45	190			3	48		
106	*Nemipterus furcosus*			0.9	8	3	18				
107	*Nemipterus hexodon*										

Appendix 2f: Continue ...

Station		23		22		21		27		20	
Date		**30/07**		**30/07**		**30/07**		**30/07**		**31/07**	
Depth : start-finish		**78.0-95.0**		**64.0-67.5**		**71.4-76.1**		**100.0-118.0**		**34-43**	
Species		**Wt**	**N**	**Wt**	**N**	**Wt**	**N**	**Wt**	**N**	**Wt**	**N**
108	*Nemipterus isacanthus*										
109	*Nemipterus japonicus*									0.15	2
110	*Nemipterus marginatus*										
111	*Nemipterus nematophorus*										
112	*Nemipterus nematophus*			1.2	15	0.2	2	0.1	2		
113	*Nemipterus nemurus*	0.15	3	2.1	44	7	105	1.9	36		
114	*Nemipterus peronii*										
115	*Nemipterus virgatus*	0.1	2								
116	*Octopus*	0.2	4					0.9	19		
117	*Odonus niger*										
118	*Ophichthus sp.*					0.05	1				
119	*Ostracion nasus*					0.4	1				
120	*Panulirus polyphagus*										
121	*Parachaetodon ocellatus*										
122	*Paramonacanthus sp.*					3.3	737				
123	*Parapercis alboguttata*			1.7	19	1.1	23				
124	*Paraplagusia bilineata*										
125	*Parascolopsis tanyactis*					0.1	1	0.6	18		
126	*Paras tromateus niger*										
127	*Pardachirus pavoninus*										
128	*Parupeneus heptacanthus*			0.1	2	0		0.1	1		
129	*Penaeus indicus*										
130	*Penaeus japonicus*					0.4	12				
131	*Penaeus longistylus*					0.65	2				
132	*Penaeus monodon*										
133	*Penaeus penicillatus*										
134	*Penaeus semisulcatus*										
135	*Penaeus sp.*										
136	*Pennahia anea*										
137	*Pentapodus setosus*			1.55	16						
138	*Pentaprion longimanus*			1.57	61						
139	*Pinjalo pinjalo*										
140	*Platax batavia nus*							0.2	1		
141	*Platycephalus indicus*			0.15	15	3.3	154				
142	*Plectranthias sp.*										
143	*Plotosus lineatus*										
144	*Podophthalmus vigil*										
145	*Portunus pelagicus*			0.4	2	0.66	132				
146	*Portunus sanguinolentus*										
147	*Priacanthus blochii*							0.15	1		
148	*Priacanthus macracanthus*			5.8	58	1	10			0.3	1
149	*Priacanthus tayenus*							0.5	2		
150	*Pristigenys niphonia*							0.1	2		
151	*Pristipomoides typus*							0.1	1		
152	*Pristotis jerdoni*										
153	*Psettodes erumei*										
154	*Pseudorhombus arsius*										
155	*Pseudorhombus quinquocellatus*			0.73	15	1.1	22	0.45	5		
156	*Pseudorhombus sp*			0.15	15			0.2	10		
157	*Pseudotriacanthus strigilifer*					2.2	44				
158	*Pterois sp.*							0.2	4		
159	*Pterygotrigla sp.*							0.1	2		
160	*Rachycentron canadum*										

Appendix 2f: Continue ...

Station		23		22		21		27		20	
Date		30/07		30/07		30/07		30/07		31/07	
Depth : start-finish		78.0-95.0		64.0-67.5		71.4-76.1		100.0-118.0		34-43	
Species		Wt	N	Wt	N	Wt	N	Wt	N	Wt	N
161	*Raja (Okamejei) bosemani*										
162	*Raja (Okamejei) sp.*							0.8	1		
163	*Rastrelliger brachysoma*									0.15	1
164	*Rastrelliger faughni*	0.2	6								
165	*Rastrelliger kanagurta*									6	44
166	*Rhinobatus sp.*							1.1	1		
167	*Samaris cristatus*							0.4	8		
168	*Sardinella sp.*										
169	*Sardinella gibbosa*										
170	*Saurida gracilis*										
171	*Saurida longimanus*									1.15	23
172	*Saurida tumbil*									1.2	12
173	*Sauri da undosquamis*	2.9	63	13.2	873	9.4	150	12	105		
174	*Saurida wanieso*			0.3	1						
175	*Scolopsis monogramma*			0.73	15						
176	*Scolopsis taeniopterus*			0.25	3	0.08	1				
177	*Scomberoides tala*										
178	*Scomberomorus commerson*									2.3	5
179	*Scomberomorus guttatus*										
180	*Secutor insidiator*										
181	*Secutor ruconis*										
182	*Selar boops*										
183	*Selar crumenophthalmus*			3.79	65					1.6	30
184	*Selaroides leptolepis*										
185	*Sepia pharaonis*			0.1	7	0.4	4			0.1	1
186	*Sepia spp.*			0.8	8					0.3	2
187	*Seriolina nigrofasciata*					0.05	1				
188	*Siganus canaliculatus*										
189	*Sirembo imberis*										
190	*Sirembo jerdoni*					0.05	1				
191	*Solenocera choprai*					0.3	8				
192	*Solenocera spp*					0.5	10				
193	*Sphyraena forsteri*										
194	*Sphyraena obtusata*										
195	*Sphyraena putnamae*									2.6	19
196	*Sphyrna lewini*										
197	*Stolephorus indicus*										
198	*Synodus hoshinonis*			0.05	1			0.2	9		
199	*Tachypleus sp.*										
200	*Tentoriceps cristatus*										0
201	*Terapon jarbua*										
202	*Tetrosomus gibbosus*							0.1	1		
203	*Thenus orientalis*										
204	*Thryssa hamiltonii*										
205	*Trachynocephalus myops*	0.9	13			3.95	30				
206	*Trichiurus lepturus*									0.2	3
207	*Upene us japonicus*	3.8	111			2.5	60	1.3	47		
208	*Upeneus moluccensis*			0.2	5						
209	*Upeneus sp*										
210	*Upeneus sulphureus*			4.35	145	5.5	242			0.1	2
211	*Upeneus tragula*							0.1	7		
212	*Upeneus vittatus*									0.5	6
213	*Uraspis uraspis*										

Appendix 2g: Catch rates (Wt-kg & N-number per hour) of species caught by KK Manchong trawl for 33 stations in east coast of Sabah, the Sulu-Sulawesi seas EEZ of Malaysia in 2009

Station		17		16		18		19	
Date		31/07		31/07		31/07		31/07	
Depth : start -finish		66 -69		60 -67		73 -76		66 -67	
Species		Wt	N	Wt	N	Wt	N	Wt	N
1	*Abalistes stellaris*	0.1	1			0.1	1		
2	*Acanthurus mata*								
3	*Aesopia cornuta*			0	0	0.04	1		
4	*Alectis ciliaris*			0.2	2			0.2	3
5	*Alectis indica*								
6	*Alepes vari*								
7	*Alutera monoceros*								
8	*Alutera sp.*								
9	*Amblygaster sirm*								
10	*Amusium pleuronectes*								
11	*Anodontostoma chacunda*								
12	*Antennarius striatus*								
13	*Antigonia capros*								
14	*Apogon aureus*								
15	*Apogon ellioti*			0.08	2	0.53	21		
16	*Apogon lineatus*								
17	*Ariomma indica*								
18	*Arius thalassinus*			1.3	1				
19	*Arothron immaculatus*								
20	*Arothron manillensis*								
21	*Arothron stellatus*								
22	*Atule mate*								
23	*Calappa lophos*					0.3	1		
24	*Calappa philargius*					0.3	1		
25	*Canthigaster compresso*	0.11	11						
26	*Carangoides armatus*	0.2	5			0.31	22		
27	*Carangoides chrysophrys*	0.15	1						
28	*Carangoides chrysophrys*	0.15	1						
29	*Carangoides fulvoguttatus*								
30	*Carangoides hedlandensis*								
31	*Carangoides malabaricus*								
32	*Carangoides* sp.								
33	*Caranx ignobilis*								
34	*Caranx sexfasciatus*								
35	*Carcharhinus sorrah*								
36	*Champsodon longispinis*	0.53	210					0.14	125
37	*Charybdis feriatus*					0.5	3	0.65	5
38	*Charybdis natator*						0		
39	*Chiloscyllium plagiosum*								
40	*Chirocentrus dorab*			1.2	1				
41	*Choerodon schoenleinii*								
42	*Choerodon* sp.								
43	*Cynoglossus bilineatus*	0. 1	2					0.27	14
44	*Dactyloptena orientalis*								
45	*Dactylopus dactylopus*								
46	*Dasyatis kuhlii*							0.25	1
47	*Decapterus russelli*	0.63	33	0.1	1	0.91	40		
48	*Diagramma pictum*								
49	*Diodon holocanthus*								
50	*Diodon hystrix*								

Appendix 2g: Continue ...

Station		17		16		18		19	
Date		31/07		31/07		31/07		31/07	
Depth :	start -finish	66 -69		60 -67		73 -76		66 -67	
Species		Wt	N	Wt	N	Wt	N	Wt	N
51	*Dipterygonotus balteatus*	1.34	179						
52	*Dussumieria acuta*								
53	*Echeneis naucrates*								
54	*Elates ransonneti*								
55	*Engyroprosopon sp.*	0.53	32			0.11	21	0.68	81
56	*Epinephelus areolatus*	0.4	2						
57	*Ep inephelus bleekeri*							0.25	1
58	*Epinephelus caeruleopunctatus*								
59	*Epinephelus coioides*								
60	*Epinephelus heniochus*							0.5	1
61	*Epinephelus sexfasciatus*								
62	*Epinephelus sp.*								
63	*Fistularia commerson*								
64	*Fistularia petimba*	2.1	32			0.41	38	0.68	53
65	*Gazza minuta*			0.1	3				
66	*Gerres abbreviatus*								
67	*Gerres oyena*								
68	*Gnathonodon speciosus*								
69	*Grammatobothus polyophthalmus*								
70	*Gymnocranius elongatus*								
71	*Halieutaea* sp.								
72	*Harpiosquilla harpax*								
73	*Heterocarpus* spp.	1.05	32						
74	Jellyfish							23	81
75	*Lactoria cornuta*								
76	*Lactoria fornasini*								
77	*Lagocephalus inermis*								
78	*Lagocephalus lunaris*								
79	*Lagocephalus sceleratus*								
80	*Lagocephalus spadiceus*								
81	*Leiognathus bindus*								
82	*Leiognathus equulus*								
83	*Leiognathus leuciscus*								
84	*Leiognathus longispinis*								
85	*Leiognathus smithursti*								
86	*Leiognathus splendens*								
87	*Leiognathus spp.*	3.15	462					1.35	41
88	*Leiognathus stercorarius*								
89	*Lepturacanthus savala*			7.8	20				
90	*Lethrinus nebulosus*								
91	*Lethrinus sp*								
92	*Loligo edulis*					1.8	12	2.1	10
93	*Loligo spp.*			0.5	46	0.05	2	3.05	391
94	*Loxodon macrohinus*								
95	*Lutjanus lutjanus*			0.1	1	0.2	2		
96	*Lutjanus malabaricus*								
97	*Lutjanus vitta*								
98	*Megalaspis cordyla*								
99	*Mene maculata*	0.45	5	4.2	33	0.1	1		
100	*M etapenaeus sp.*								

Appendix 2g: Continue ...

Station		17		16		18		19	
Date		31/07		31/07		31/07		31/07	
Depth : start -finish		66 -69		60 -67		73 -76		66 -67	
Species		Wt	N	Wt	N	Wt	N	Wt	N
101	*Monacanthus chinensis*								
102	*Monodactylus argenteus*								
103	*Nemipterus aurora*	0.2	2			1.8	31		
104	*Nemipterus balinensis*	2.05	113	0.2	2	4.84	188		
105	*Nemipterus bathybius*	1.5	21			8.9	106	2.94	74
106	*Nemipterus furcosus*					0.7	4	0.87	19
107	*Nemipterus hexodon*	0.1	2						
108	*Nemipterus isacanthus*								
109	*Nemipterus japonicus*			0.8	7				
110	*Nemipterus marginatus*			0.1	1				
111	*Nemipterus nematophorus*			2.5	76				
112	*Nemipterus nematophus*								
1 13	*Nemipterus nemurus*	1.13	19			3.55	62	1.1	14
114	*Nemipterus peronii*	0.1	1						
115	*Nemipterus virgatus*								
116	*Octopus*	0.2	1						
117	*Odonus niger*								
118	*Ophichthus sp.*								
119	*Ostracion nasus*	3.68	21						
120	*Panulirus polyphagus*								
121	*Parachaetodon ocellatus*								
122	*Paramonacanthus sp.*					0.11	42		
123	*Parapercis alboguttata*			0.1	2	0.84	42		
124	*Paraplagusia bilineata*	0.2	1						
125	*Parascolopsis tanyactis*					1.85	39		
126	*Parastromateus niger*								
127	*Pardachirus pavoninus*								
128	*Parupeneus heptacanthus*	0.1	1			0.1	1		
129	*Penaeus indicus*								
130	*Penaeus japonicus*							0.2	1
131	*Penaeus longistylus*								
132	*Penaeus monodon*								
133	*Penaeus penicillatus*								
13 4	*Penaeus semisulcatus*								
135	*Penaeus sp.*								
136	*Pennahia anea*								
137	*Pentapodus setosus*	0.15	1			0.6	3		
138	*Pentaprion longimanus*					0.5	2		
139	*Pinjalo pinjalo*								
140	*Platax batavianus*								
141	*Platycephalus indicus*	5.25	4 20					0.41	14
142	*Plectranthias sp.*								
143	*Plotosus lineatus*								
144	*Podophthalmus vigil*								
145	*Portunus pelagicus*								
146	*Portunus sanguinolentus*								
147	*Priacanthus blochii*					0.3	5		
148	*Priacanthus macracanthus*	4.9	36	2.1	28	7	61	2	15
149	*Priacanthus tayenus*	0.7	12	1	10			5	59
150	*Pristigenys niphonia*								
151	*Pristipomoides typus*								

Appendix 2g: Continue ...

Station		17		16		18		19	
Date		31/07		31/07		31/07		31/07	
Depth : start - finish		66 - 69		60 - 67		73 - 76		66 - 67	
Species		Wt	N	Wt	N	Wt	N	Wt	N
152	*Pristotis jerdoni*								
153	*Psettodes erumei*			0.5	4				
154	*Pseudorhombus arsius*								
155	*Pseudorhombus quinquocellatus*					0.05	1		
156	*Pseudorhombus sp*								
157	*Pseudotriacanthus strigilifer*					0.12	54		
158	*Pterois sp.*								
159	*Pterygotrigla sp.*	0.53	21						
160	*Rachycentron canadum*								
161	*Raja (Okamejei) bosemani*					0.2	1		
162	*Raja (Okamejei) sp.*								
163	*Rastrelliger brachysoma*								
164	*Rastrelliger faughni*								
165	*Rastrelliger kanagurta*	0.11	1	0.4	2	0.5	3	0.6	4
166	*Rhinobatus sp.*								
167	*Samaris cristatus*								
168	*Sardinella sp.*								
169	*Sardinella gibbosa*								
170	*Saurida gracilis*								
171	*Saurida longimanus*					1.68	210	4.05	162
172	*Saurida tumbil*	0.3	2	0.3	3	0.21	63		
173	*Saurida undosquamis*	4.9	164	2.1	20	0.8	19	10.8	986
174	*Saurida wanieso*								
175	*Scolopsis monogramma*								
176	*Scolopsis taeniopterus*	0.4	8	0.1	2	0.6	14	0.87	26
177	*Scomberoides tala*								
178	*Scomberomorus commerson*								
179	*Scomberomorus guttatus*							1.3	3
180	*Secutor insidiator*								
181	*Secutor ruconis*								
182	*Selar boops*								
183	*Selar crumenophthalmus*	0.8	20	0.3	2	0.8	7	2.37	31
184	*Selaroides leptolepis*								
185	*Sepia pharaonis*					0.4	2		
186	*Sepia spp.*	0.51	115			3	42	0.1	1
187	*Seriolina nigrofasciata*	1.8	4					0.5	2
188	*Siganus canaliculatus*							1.08	14
189	*Sirembo imberis*								
190	*Sirembo jerdoni*								
191	*Solenocera choprai*								
192	*Solenocera spp*								
193	*Sphyraena forsteri*								
194	*Sphyraena obtusata*	0.1	1						
195	*Sphyraena putnamae*								
196	*Sphyrna lewini*								
197	*Stolephorus indicus*							2.07	44
198	*Synodus hoshinonis*								
199	*Tachypleus sp.*					7.3	2		
200	*Ientoriceps cristatus*			4.8	109			4.68	43
201	*Terapon jarbua*								

Appendix 2g: Continue ...

Station		17		16		18		19	
Date		31/07		31/07		31/07		31/07	
Depth : start -finish		66 -69		60 -67		73 - 76		66 -67	
Species		Wt	N	Wt	N	Wt	N	Wt	N
152	*Pristotis jerdoni*								
153	*Psettodes erumei*			0.5	4				
154	*Pseudorhombus arsius*								
155	*Pseudorhombus quinquocellatus*					0.05	1		
156	*Pseudorhombus sp*								
157	*Pseudotriacanthus strigilifer*					0.12	54		
158	*Pterois sp.*								
159	*Pterygotrigla sp.*	0.53	21						
160	*Rachycentron canadum*								
161	*Raja (Okamejei) bosemani*					0.2	1		
162	*Raja (Okamejei) sp.*								
163	*Rastrelliger brachysoma*								
164	*Rastrelliger faughni*								
165	*Rastrelliger kanagurta*	0.11	1	0.4	2	0.5	3	0.6	4
166	*Rhinobatus sp.*								
167	*Samaris cristatus*								
168	*Sardinella sp.*								
169	*Sardinella gibbosa*								
170	*Saurida gracilis*								
171	*Saurida longimanus*					1.68	210	4.05	162
172	*Saurida tumbil*	0.3	2	0.3	3	0.21	63		
173	*Saurida undosquamis*	4.9	164	2.1	20	0.8	19	10.8	986
174	*Saurida wanieso*								
175	*Scolopsis monogramma*								
176	*Scolopsis taeniopterus*	0.4	8	0.1	2	0.6	14	0.87	26
177	*Scomberoides tala*								
178	*Scomberomorus commerson*								
179	*Scomberomorus guttatus*							1.3	3
180	*Secutor insidiator*								
181	*Secutor ruconis*								
182	*Selar boops*								
183	*Selar crumenophthalmus*	0.8	20	0.3	2	0.8	7	2.37	31
184	*Selaroides leptolepis*								
185	*Sepia pharaonis*					0.4	2		
186	*Sepia spp.*	0.51	115			3	42	0.1	1
187	*Seriolina nigrofasciata*	1.8	4					0.5	2
188	*Siganus canaliculatus*							1.08	14
189	*Sirembo imberis*								
190	*Sirembo jerdoni*								
191	*Solenocera choprai*								
192	*Solenocera spp*								
193	*Sphyraena forsteri*								
194	*Sphyraena obtusata*	0.1	1						
195	*Sphyraena putnamae*								
196	*Sphyrna lewini*								
197	*Stolephorus indicus*							2.07	44
198	*Synodus hoshinonis*								
199	*Tachypleus sp.*					7.3	2		
200	*Tentoriceps cristatus*			4.8	109			4.68	43
201	*Terapon jarbua*								

Appendix 2g: Continue ...

Station		**17**		**16**		**18**		**19**	
Date		**31/07**		**31/07**		**31/07**		**31/07**	
Depth : start -finish		**66 -69**		**60 -67**		**73 -76**		**66 -67**	
Species		**Wt**	**N**	**Wt**	**N**	**Wt**	**N**	**Wt**	**N**
202	*Tetrosomus gibbosus*								
203	*Thenus orientalis*								
204	*Thryssa hamiltonii*			0.2	3				
205	*Trachynocephalus myops*								
206	*Trichiurus lepturus*	0.3	4						
207	*Upeneus japonicus*	2.2	129			7.95	313	0.08	3
208	*Upeneus moluccensis*	4.2	336			0.41	89	1.86	136
209	*Upeneus sp*								
210	*Upeneus sulphureus*			0.2	6				
211	*Upeneus tragula*								
212	*Upeneus vittatus*								
213	*Uraspis uraspis*	1.45	18	0.75	7	0.75	6	0.65	7

Appendix 3: List of personnel involved in the demersal fish stock assessment study of Sulu-Sulawesi seas, east coast Sabah 7th July- 4th August 2009

No.	NAME	POSITION
1	Hadil bin Rajali	Coordinator cum Chief Scientist
2	Jamil bin Musel	Chief Researcher cum Cruise Leader
3	Abd. Haris Hilmi Bin Ahmad Arsad	Fish larvae scientist, FRI Kpg.Acheh
4	Mohd. Affendi Bin Ngah	Research Assistant, FRI Rantau Abang
5	Wan Mohd. Jamel Bin Hussein	Research Assistant, FRI Rantau Abang
6	Mohd. Nazir Bin Taib	Research Assistant, FRI Kpg. Aceh
7	Mohd.Zakaria Bin Morshidi	Officer in-charge
8	Annie Lim Pek Khiok	Taxonomist
9	Harun Duin	Research Officer, Sabah
10	Kamal Salleh	Research Assistant, Sabah
11	Amjah Hj. Kadis	Captain, Sabah
12	Arabi bin Materang	Captain in chief
13	Afandi Bin Abg. Hashim	Captain
14	Mohd. Adnan Bin Salma	Captain
15	Edwin Ak. Linggang	Chief engine-man
16	Wan Yusup Bin Wan Alla	Engine - man
17	Azizan Bin Amid	Engine - man
18	Alek Bin Kip	Deck - hand
19	Denis Bin Salus	Deck - hand
20	Yusup Bin Sapong	Deck - hand
21	Hassan Bin Arshad	Deck - hand
22	Muriatter George Gantung Lapu	Deck - hand
23	Adnan Bin Pata	Crew
24	Faizal Bin Udai	Crew
25	Shahrani Bin Jubli	Crew
26	Mohd. Nazri Bin Jamari	Crew
27	Abdul Karim Bin Faiz	Crew
28	John Ak Chandang	Greaser
29	Nazrul Bin Ahmad Zaidi	Greaser
30	Mohd. Iswandi Bin Abd. Manan	Greaser
31	Othman Bin Mahon	Net maker
32	Hady Bin Asek	Camera-man