Overview Of Biology And Exploitation Of The Small Pelagic Fish Resources Of The EEZ Of Sarawak, Malaysia

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ABSTRACT

Pelagic fish resource (especially small pelagic fish) is the single most important fisheries resources of Sarawak Malaysia in terms of biomass. In fact, the EEZ of Sarawak has the largest biomass at 879,548 tonnes for the whole of Malaysia. However, the pelagic fish resource is the least exploited with an annual average production at 25,000 mt. The government through the DOF has been trying to encourage entrepreneurs, corporate sectors and commercial fishermen to exploit this resource. This paper presents some research findings on the most common information required by the above sectors such as resource abundance, distribution, species composition, fishing seasons and fishing methods. Some environmental factors (e.g. effect of monsoon seasons and upwelling areas) and biology are also discussed. These information may help the cooperate sector to decide venturing into this small pelagic fish resource.

Keywords: pelagic fish, exploitation, abundance, biology

INTRODUCTION

The fisheries sector in Malaysia plays an important role in providing fish as a source of food and protein. In 2001, the total production from the fisheries sector amounted to 1,231,299 tonnes valued at RM4.17 billion and provided direct employment to 81,994 fishermen and 21,774 fish culturists *(Anon, 2002)*. Statistically, the fisheries sector again recorded an overall increase in both production and value at 3.45 % and 7.40% respectively. The indication that the fisheries industry is poised to remain an important industry is reflected by its steady contribution to the GDP, which at 1.60% is comparable to 1.66% in 1999 and 1.62% in 1998. Its contribution to the agricultural sector GDP was 18.24%.

Under The Third National Agricultural Policy (NAP3), Malaysia's expected fish need by 2010 is 1,705,000 tonnes. With the total production of 1,231,299 tonnes in 2001, Malaysia will need to produce an extra production of 473,707 tonnes. Indeed the focus now is to increase fish production either through aquaculture (target at 600,000 tonnes) and capture fisheries (target at 430,000 tonnes). However, marine

fish productions from capture fisheries for both the West Coast and East Coast Exclusive Economic Zone (EEZ) of Peninsular Malaysia have reached the maximum sustainable yield (MSY). The possible fish resources still available in order to increase production are the oceanic fish resources and the EEZ of East Malaysia particularly in Sarawak.

The EEZ of Sarawak occupies the southern part of the South China Sea with an area of 160,000 km^2. The physical features of the seabeds varies from the inshore to the deepsea. There are large areas of mangroves and coastal mudflats interphase with sandy beaches and substrates in the inshore area. The continental shelf with an area of 133,255 km^2 slopes to 200 metres depth, while the continental slope dip from 200 to 800 metres depth. There is also the present of deepsea trench stretching towards Sabah waters with depth ranging from 2,000 to 2,500 metres.

Within the EEZ of Sarawak with its diversity of habitats are riched in multispecies fish resources. Recent research surveys have indicated that one of the main fish resources that is abundance and still not fully exploited is the small pelagic fish. There is an urgent need to develop this resource to increase fish production from the deepsea.

Encounters with the private sector reveal that they need detail information on the fisheries resources which will help them plan their venture into deep sea fishing. The information required are resource abundance (how much fish is available?), distribution (where are the fish?), species composition (what type of fish, which decide return value), fishing seasons, and fishing techniques.

This paper presents an overview on the status of biology and exploitation of the small pelagic fish resources of Sarawak focusing on the information as required by the private sector. Information is obtained from several research surveys , studies on the biology of pelagic fish in the South China Sea off Sarawak, the fisheries statistical record and experimental fishing in the South China Sea.

STATUS AND EXPLOITATION OF PELAGIC FISH

In 2001, the total fish production for Sarawak is 156,708 tonnes, which is 12.7 percent of the national production (Table 1). The catch from the deepsea was 39,562 tonnes, 13.3 percent of the national total at 296,481 tonnes (Table 2). Generally fish production from Sarawak is the lowest when compare to Westcoast and Eastcoast Peninsular Malaysia and Sabah.

The catch from large and small pelagic fish amounted to 27,250 tonnes *(Anon, 2002)* or 17% of the total catch (Figure 2). The bulk of the catch came from demersal fish at 101,990 tonnes or 65% of the total catch at 156,708 tonnes. However, the trend in catches of pelagic fish for the last 17 years has been increasing from 12,050 tonnes in 1998 to 27,250 tonnes in 2001, an increase of 126 % (Figure 3). Small pelagic fish

catches came mainly from the coastal waters. Only 1013 tonnes (3.5 percent) of small pelagics were caught from the deepsea (Table 2).

The total national landing for pelagic fish in 2000 was 477,875 tonnes *(Anon, 2001*). The bulk of the landing came from the East Coast of Peninsular Malaysia at 205,210 tonnes. Landing from Sarawak has not been impressive, even though there is a gradual increase annually since 1985. Landing at 28,465 tonnes in 2000 is only 6 percent of the national small pelagic landing. Recent research surveys have shown that the small pelagic fish biomass in the EEZ of Sarawak is more than the East Coast of Peninsular Malaysia.

Most of the pelagic fish were caught by drift gill nets (44 %) and bottom trawl nets(40 %) (Figure 4). These two gears combined caught 84 percent of pelagic fish.. Generally, drift gill nets and hook and line caught large pelagic fish, purse seine net caught small pelagic fish and trawl net caught a mixture of both.

The low exploitation of pelagic fish especially the small pelagic fish is also due to the low number of purse seiners in Sarawak. In the East Coast of Peninsula Malaysia, small pelagic fish are mainly caught by purse-seiners. In 2001, there are only 25 purse seiners in Sarawak compare to 865 in Peninsular Malaysia(Table 4).For Sarawak there are only 11 boats above 70 GRT (the size of vessel fishing the deepsea) compare to 240 boats for Peninsular Malaysia. The Fisheries Department of Malaysia is encouraging the private sector to go for purse-seine fishing for small pelagic fish in order to increase production from this unexploited fish resource.

ABUNDANCE AND DISTRIBUTION

The small pelagic fish is an important fisheries resource to all countries bordering the South China. Recent surveys by SEAFDEC *(Anon, 1998)* have estimated the biomass of small pelagic fish within a range of 7 million tonnes; the bulk of which seemed to be in Thailand (highest recorded biomass of 2,757,470 tonnes) and Malaysia (2,435,930 tonnes) (Table 5). In Malaysia, the highest biomass was recorded in Sarawak at 879,548 tonnes. However, Vietnam and Western Philippines have high density of small pelagic fish at 17.5-18.9 tonnes/km^2 when compare to the moderate density of 5.6-6.2 tonnes/km^2 for East Coast of Peninsular Malaysia, Sabah and Sarawak. It is interesting to note that most countries bordering the South China Sea have reached the maximum sustainable yield of their small pelagic resource. The highest landings were recorded in Western Philippines at 711,038 tonnes (excluding the coastal landing of 245,301 tonnes), followed by Thailand at 661,686 tonnes. The only resource still abundance is in the waters of Sarawak (and probably Sabah). In Sarawak, 340,013 tonnes of small pelagic are yet to be exploited.

For countries bordering the South China Sea, small pelagic fish is mainly distributed closed to the shore and islands. In Sarawak small pelagic fish is distributed all over the continental shelf area, but concentration is more towards the coastal zone

(Figure 5). In the offshore area, the abundance is closely related to reef and shoals, edge of the continental shelf, offshore islands and atolls, and where divergence and convergence current are present *(Gambang, 1998)*. Fish abundance and distribution pattern is also influenced by the monsoon systems. During the calm season (April-October), they move inshore within 15-40 metres depth and during the rough season (October-March), they migrated offshore towards the more saline and deeper water *(Hadil and Richard, 1991).*

SPECIES COMPOSITION

Carangids and Scombrids form the backbone of the pelagic fishery with Mackerels (*Rastrelliger spp*.), Round Scads (*Decapterus spp.*) and Tunas as the main component of the fishery in countries bordering the South China Sea (Table 5). In Sarawak coastal area the main catch composition of small pelagic fish were mackerel, *Rastrelliger sp.* (13.6%); Scad, *Selar sp.* (9.6%); Sardine, *Dussumieria sp.*, *Sardinella sp.*, (9.5%); and Hardtail Scad, *Megalaspis cordyla* (8.3%). The main species found further offshore or in the deepsea were Round Scad, *Decapterus sp.* (57%), Scad, *Selar sp.* (25%) and Indian mackerel, *Rastrelliger sp.* (8%), (Table 4).

The recorded catches of large and small pelagic fish in 2000 were dominated by 7 main groups such as Mackerels, *Rastrelliger sp.*; Spanish mackerels, *Scomberomorus sp.*; Tuna, *Katsuwonus sp.*, *Thunnus sp.*, *Euthynnus sp.;* Sharks, Sardines, *Sardinella sp.*, *Dussumieria sp.*, Scad; *Selar sp.*, *Decapterus sp.*; and Hardtail Scad, *Megalaspis cordyla* (Table 4). For small pelagics, the main groups landed were Indian Mackerels, Tuna, Scads, Sardines and Hardtail Scad.

FISHING, FISH BEHAVIOUR, MOVEMENT

Several fishing expedition *(Hadil and Richard, 1991; Gambang, 2000)* using the Institute research vessel on small pelagic fish and observations on board the commercial purse seiners were carried though out the EEZ of Sarawak. Purse seine net used was 550m in length and a net height of 50m. A combination of Fish Aggregating Devices (FADs) and underwater light was used to attract and aggregate fish schools. Fishing operation started at 3.00 a.m. and completed by 11.00 a.m. The catch ranged from 3-8 tonnes. Catch by commercial purse seines ranged from 1.5-15 tonnes. The main species in the catch composition were Tuna, Bigeye Scad, Round Scad, Sardine and Hardtail Scad.

During these fishing expedition and observation on board the commercial purse-seiners fish behavior to fishing were noted.

Schooling Behavior:

Fish schools were usually small (large school encountered once in a while) and scattered over a wide area. The schools move fast in the open seas and there presence is unpredictable. Different species usually occurred in the same school.

Behavior to Fishing:
Small pelagic fish are fast swimmers, the school moves away and disperse as the boat approaches them. School may also exhibit vertical movement, moving into deep water beyond the reach of short-height net. Some school stayed below 40m depth, while others stayed between 60-200m depth zone. The best period for fishing is during dark night, when there is no moon, preferably 3 days before and 5 days after full moon. During full moon, fish are widely scattered and normally did not aggregate around FADs. As long as you can estimate the current speed and direction, and wind speed and direction, current and moderate wind speed should not cause any problem to fishing.

Fish Aggregating Devices (FADs):
Pelagic fish are attracted to floating objects in the sea such as floating log and to light. Therefore using FADs (Figure 6) in purse seine fishing for small pelagic is probably the most effective technique. Fish school, however, only stays 3-5 days around FADs (called by different local name: umpan/unjam/payoa) and then move on to another FADs or to other area. Fish school also stays 3-4 hours in lighted area at night such as underwater light. This is because large predator fish such as sharks, Spanish mackerel, and barracuda will start to appear and scared the fish school.

Quantity of Fish School:
With experience and patience observation, it is possible to have a rough estimate of fish school around FADs, floating logs etc. by looking at the thickness of echoes in the ordinary echosounder. Our estimate of fish school per FADs ranged from 3 to 20 tonnes.

FISHING SEASON

Fish abundance varies with season for different species and area and is influenced to a large extend by the two monsoon systems. The monsoon systems determine the current direction and occurrence of divergence and convergence. During the calm seasons (April-October), pelagic fish tends to move towards the coastal waters between 13-40 metres depth. Fish schools move offshore during the rough season (October-March), tending to move into deep waters *(Hadil and Richard, 1991)*. Occurrence of divergence and convergence tended to coincide with the rough season, usually occurring between the continental edge and the deepwater trench *(Gambang, 1998)*.

Fishing, however, can be carried out throughout the year (Figure 8). Species composition in the catch varies with season and years. For examples, they will be more round scad from May to October, while Indian mackerels is more between December to April with a peak in February. Hardtail Scad (*Megalaspis cordyla*) is abundance between April to May, while the sardine group (*Sardinella sp.*) is available between May and August. The fillet scad (*Selar sp.*) is abundance and present almost throughout the year, particularly in February, April, August and September *(Anon, 2002)*.

BIOLOGY

Although fish biology is considered academic to some fishermen, biological factors such as food, egg counts (fecundity), length at maturity, spawning grounds and spawning season determine to a large extent fish movement and fishing seasons. These factors are also important to resource management. Present focus of studies has been in the assessment of fisheries resources. Studies on spawning grounds, spawning seasons, reproductive biology and stomach content need to be given greater attention because of their importance in sustainable fish production and management.

Table 7 is a summary of some biological information from local and regional studies carried out on some pelagic fish species. Generally small pelagic fish are also pelagic feeders. They feed on phytoplanktons, zooplanktons, crustacean, fish larval and small fish. Most pelagic fish, relative to their body size, produced large amounts of eggs; round scad, *Decapterus macrosoma* between 67,000-106,200 eggs, Indian mackerel, *Rastrelliger kanagurta* produced between 118,685-22,455 eggs, and sardines, *Sardinella gibbosa* produced between 12,786-56,378 eggs *(Chullasorn and Martosubroto, 1986).* Some species (e.g. *Megalaspis cordyla*) spawn once a year, while some species (e.g. *Decapterus sp.*) spawn twice a year.

Generally, spawning occurs during Northeast monsoon (December-April) or during the onset of monsoon (July-November). Except for the Gulf of Thailand, where spawning grounds have been identified for some species, there is no or little information in this part of the region.

CONCLUSION

The exploitation of small pelagic fish at an average catch of 25,000 tonnes annually is still low compare to the fish biomass and potential yield available. The biomass at 879,548 tonnes is the highest in Malaysia, while the potential yield of 340,000 tonnes is yet to be exploited.

The number of purse seiners at 25 fishing for small pelagics is well below the national total of 865. The small pelagic fish resources (the deep sea resources) is able to support more than 200 boats above 70GRT and increase production to 300,000 tonnes annually.

Purse seine fishing for small pelagics need a combination of FADs and light to aggregate fish due to the scattered nature of fish school and unpredictable movement of pelagic fish. Fishing however could be carried out throughout the year.

Information and studies on fishing technique, fishing season, fish behaviour, movement and reproductive biology especially spawning seasons and grounds are important not only in improving technique of harvesting but also necessary for sustainable exploitation of the resource.

REFERENCE

Anonymous (1999). Proceedings of the second technical seminar on Marine Fishery Resource survey in the South China Sea Area II: West Coast of Sabah, Sarawak and Brunei Darussallam 14-15 December 1998, Kuala Lumpur, Malaysia. Southeast Asian Fisheries Development Center, Bangkok, Thailand.

Anonymous (1999). Deep-Sea Fisheries Resource Survey within the Malaysian Exclusive Economic Zone Final Report. Department of Fisheries Malaysia, Kuala Lumpur, Malaysia.

Anonymous (2001), Annual Fisheries Statistics 2000 Volume 1. Department of Fisheries Malaysia.

Anonymous (2002), Annual Fisheries Statistics 2001 Volume 1. Department of Fisheries Malaysia.

Chullasorn, S. and P. Martosubroto (1986). Distribution and important biological features of coastal fish resources in Southeast Asia. FAO Fisheries Technical Paper 278.

Gambang, A.C. (1998). Status Report (2) Sarawak. In: Report of the Third Regional Workshop on Shared Stocks in the South China Sea. Marine Fishery Resources Development and Management Department Southeast Asian Fisheries Development Centre, Kuala Terengganu, Malaysia. 6th-8th October 1997.

Gambang, A.C. (2000). Country Status Report (3) Sarawak. In: Report of the Fourth Regional Workshop on Shared Stocks: Research and Management in the South China Sea. Marine Fishery Resources Development and Management Department Southeast Asian Fisheries Development Centre, Kuala Terengganu, Malaysia. 24th-36th January 2000.

Hadil, R. and Richard, R. (1991). Distribution and biological status of the pelagic resources off Sarawak Malaysia. *Fisheries Bulletin* No. 68. Department of Fisheries Malaysia.

Jabatan Perikanan Malaysia 1987. Deepsea fisheries resources survey within the Malaysian Exclusive Economic Zone, Jabatan Perikanan, Kementerian Pertanian Malaysia.

King, M. 1995. Fisheries biology, assessment and management. Fishing News Books. 25 John Street, London WC1N2BL.

Mohsin, A.C. and Ambak, M.A. 1996. Marine fishes and fisheries Malaysia and neighbouring countries. Universiti Pertanian Malaysia. Press. Serdang, Selangor, Malaysia.

Rumpet, R. 1995. The maximum sustainable yield of the pelagic fishery of Sarawak. Fisheries Research Institute Sarawak Branch. Kuching, Sarawak, Malaysia (mimeo)

Rumpet, R. 1999. Distribution and productivity level of pelagic fish at Fish Aggregating Device (FAD) off Sarawak. Fisheries Research Institute, Sarawak Branch Kuching, Sarawak, Malaysia (mimeo)

SEAFDEC, 2000. The fourth regional workshop on shared stocks in the South China Sea Area. 24-26 Jan. 2000, Kuala Terengganu, SEAFDEC/MFRDMD, Chendring, Kuala Terengganu Malaysia.

Table 1: Landings and Values of Marine Inshore Fisheries, 2001

	Landings (Tonnes)	Value (RM)
West Coast of Peninsular Malaysia	489,026	1,782,784,648
East Coast of Peninsular Malaysia	398,175	1,226,709,726
Sabah	178,046	634,942,564
Sarawak	156,708	483,375,547
Federal Territory of Labuan	9,344	38,300,304
Total	1,231,299	4,166,122,789

Table 2: Landings of Deep Sea Fisheries by Gear Group, 2001 (Quantity in Tonnes)

	Trawls nets 70GRT & above	Fish Purse Seine nets 70GRT & above	Hooks and Lines 70GRT & above	Total
West Coast of Peninsular Malaysia	29,950	14,555	0	40,505
East Coast of Peninsular Malaysia	31,071	53,148	0	84,219
Sabah	1,328	5,752	214	7,294
Sarawak	38,202	1,013	347	39,562
Federal Territory of Labuan	529	969	7	1,505
Total	158,061	143,140	568	296,481

Table 3: Category of Purse Seine Fishery in Malaysia and Number of Seiners in each class, Year 2001

Gross Registered Tonnage (GRT)	Peninsular Malaysia	Sarawak	Total
0-4.9	1		1
5-9.9	29		29
10-14.9	60		60
15-19.9	67	1	68
20-24.9	52	2	54
25-39.9	102		102
40-69.9	314	11	325
Above 70	240	11	251
Total	**865**	**25**	**890**

Table 4: Small pelagics: Comparison of biomass, density, potential yield and catches between Regions/countries bordering the South China Sea

Countries	Biomass (tonnes)	Density (tonnes/km2)	Potential yield (tonnes)	Catches (Landings)tonnes
Sarawak	879,548	5.6	340,013	28,465 (2001: 8%)
Sabah	825,452	5.6	196,927	92,388 (1998: 49%)
East Coast Pen. Malaysia	193,364 - 730,930	1.7 - 6.2	77,000 - 292,000	205,210 (2000: 70-100%)
Gulf of Thailand	1,323,150 - 2,757,470		529,000 - 1,000,000	661,686 (1995: > 100%)
Vietnam	420,000	17.5	168,000	
Western Philippines	1,677,356	18.9	671,000	711,038 (1996: > 100%) 1.09mt (coastal + offshore)
Indonesia				245,301

Table 5: Main Small Pelagic Fish of Countries Bordering the South-China Sea

Round scad	*Decapterus macrosoma, Decapterus russeli* *Decapterus mamads*
Scad	*Selar mate* *Selar crumenopthalmus* *Selaroides leptolepis* *Megalaspsis cordyla*
Indian Mackerel	*Rastrelliger kanagurta* *Rastrelliger brachysoma*
Sardines	*Sardinella timbriata, Sardinella gibbosa, Sardinella sirim, Dussumiera acuta*

Table 6: Species composition of small pelagic fish in Sarawak

Coastal	**%**	**Offshore**	**%**
Indian Mackrel (Kembong)	**13.6**	**Round scad (Selayang)**	**57**
Scad (Selar)	**9.6**	**Scad (Selar)**	**25**
Sardine (Tamban)	**9.5**	**Indian Mackrel**	**8**
Hardtail scad (Cincaru)	**8.3**	**Sardines**	**0.1**
Round scad(Selayang)	**0.9**	**Hardtail scad**	**0.1**
Tuna (Tongkol)	**8.2**	**Others**	**9.8**
Sharks (Yu)	**7.2**		
Pomfret (Duai)	**5.4**		
Others	**37.3**		

Table 7: Percentage composition of pelagic species from East Coast Peninsular Malaysia, ECP M'sia and Sarawak, 2000

Fish group/species	**Sarawak**	**ECP M'sia**
Mackerel, *Rastrelliger sp.*	12.5	7.6
Spanish mackerel, *Scomberomorus sp.*	10.0	1.7
Tuna	9.3	14.2
Sharks	9.1	1.0
Longfin Herring, *Opisthopterus sp.*	9.0	0.1
Sardines, *Sardinella sp., Dussumieria sp.*	8.8	7.3
Scad, *Selar mate, Selar sp.*	7.8	26.2
Hardtail, *Trichiurus sp.*	7.5	0.7
Hardtail Scad, *Megalaspis cordyla*	6.9	2.6
Pomfret, *Pampus sp., Parasromateus sp.*	5.0	0.6
Shad, *Tenualosa sp.*	3.5	0.0
Trevally, *Caranx sp., Carangoides sp.*	3.1	1.4
Round Scad, *Decapterus sp.*	2.1	31.0
Wolf Herring, *Chirocentrus sp.*	1.5	0.6
Indian Threadfin, *Polynemus sp.*	1.4	0.1
Queenfish, *Chorinemus sp.*	1.2	0.1
Barracuda	0.7	0.7
Anchovy, *Stolephorus sp.*	0.5	4.0
Mullet, Mugillidae	0.1	0.1
Kingfish Cobia, *Rachycentron sp.*	0.0	0.2
TOTAL	100	100

Table 8: Biology of Small Pelagic Fish

Species	Food	Fecundity	Spawning Season	Fishing (abundance) Season	Vertical Distribution (m)	Mature to Max. Size (cm)	Other
Round Scad (Selayang) *Decapterus macrosoma*	Planktons	67,000-106,200	May-Oct (Indonesia) Dec-May (Gulf Thailand) Nov-Mar (Palawan)	Nov-Mar (Palawan) Feb-May (Brunei)	30-60	16.0-31.5	- Off shore near atolls, Luconia-PLC
D. maruadsi	Planktons	38,000-515,000 (Philippine) 36,700-139,502 (Vietnam)	2 times per year Feb-Mar Jul-Aug Jan-Sept (Vietnam)	May-Jul (East Coast P. M) Jul-Oct (Gulf Thailand)	30-70	17-25	- Life span 2-3 yrs
D. russelli	Planktons	28,700-48,000	Sept-Dec (Indonesia)		< 100	15-21	
Scad *Selar crumenopthalmus* (Selar Pucat)	Crustacean, small fish	82,000-141,000		Mar-Apr (East Coast P.M) Feb-Apr Aug-Sept	30-60	20-38.5	- Distributed over shelf coastal, atolls
Selar leptolepis (Selar Kuning)	Crustacean, small fish	6,304-37,375		May-Jun Jul-Aug (East Coast P.M)	15-20		
Megalaspis cordyla	Plankton, crustacean, small fish		2/yr Dec-May Aug-Nov (Gulf Thailand)	Apr-May (East Coast)	20-50	25-40	- Life span 5 yrs
Mackerels *Rastrelliger kanagurta*	Planktons	15,000-30,000	Mar-May, Oct-Nov (Indonesia) Dec-Apr (Gulf Thailand) May-Jul (East Coast P.M)	Sept-Nov (Sarawak) - Throughout year, peak Feb Jan-Jun (Sabah) Mar-Aug (Philippine)		16.6-37.2	- Coastal area

R. brachysoma	Planktons	118,685-222,458	Mar-Sept (East Coast P.M) Jan-Mar and Jan-Aug (Gulf Thailand) Mar-Oct (Vietnam)	Jan-Jul (Sabah)	< 60	16.5-17.0	- Growth rapid @ 1-2cm/month, migrate from Gulf to S.C.S in Jun-Jul - coastal area
Sardines *Sardinella timbriata*	Planktons		1/yr Aug-Feb			16	- Common Sarawak & Sabah - coastal waters
S. gibbosa	Planktons	12,786-56,378	Feb-Jun (S.C.S) Mar-Apr and Jul-Aug (Gulf Thailand) - Coincide with changes from Southwest to Northeast monsoon.	May -Aug		9.7	- Life span 1-1.5 yr.
Dussumiera acuta	Planktons				< 60		

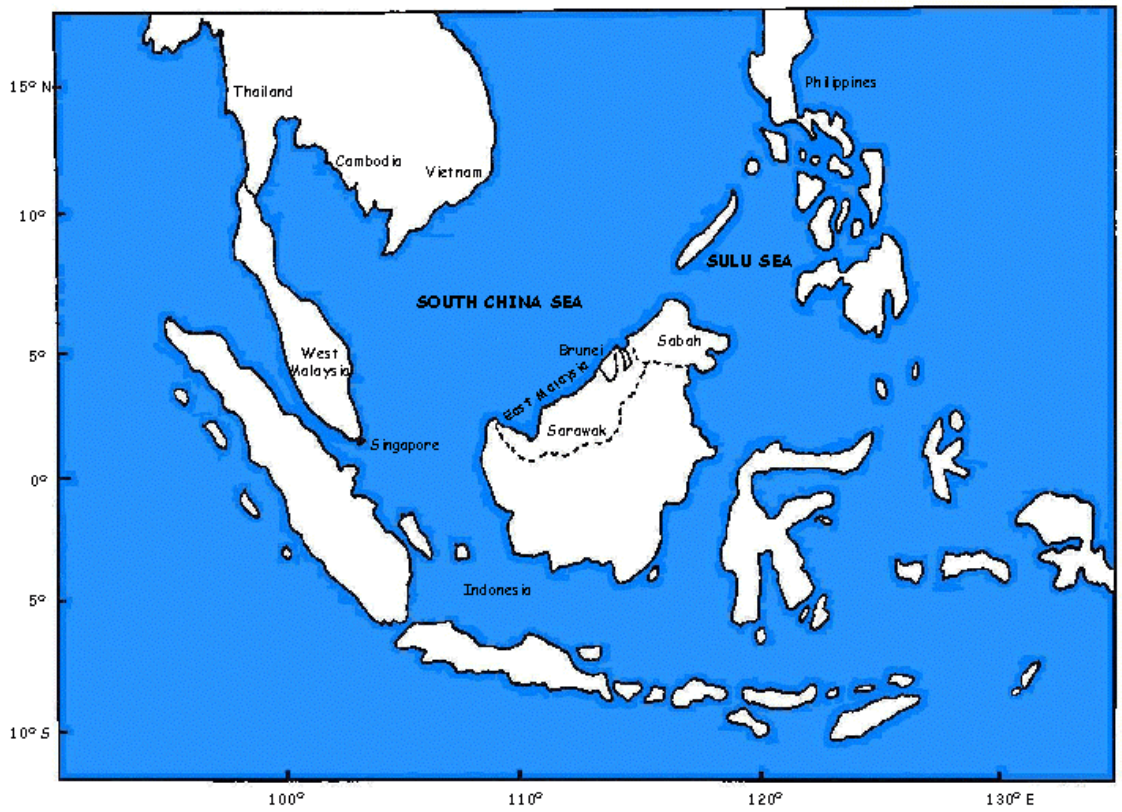


Figure 1: Regional Position of East Malaysia

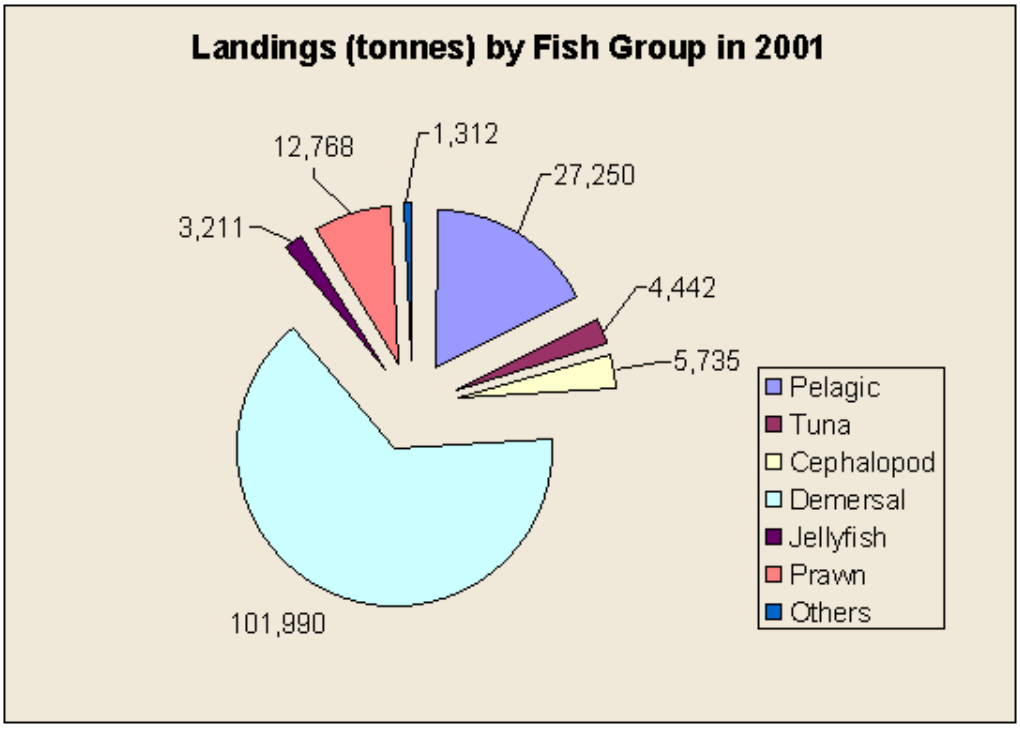


Figure 2. landings (tones) by fish group in 2001

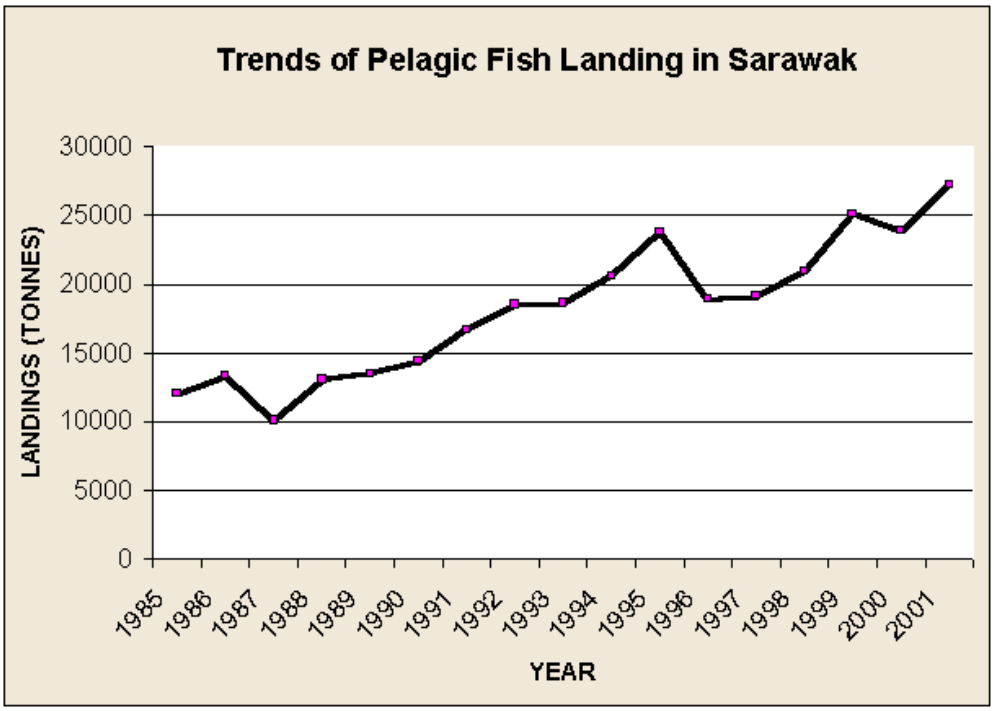


Figure 3. Trends of pelagic fish landing in Sarawak

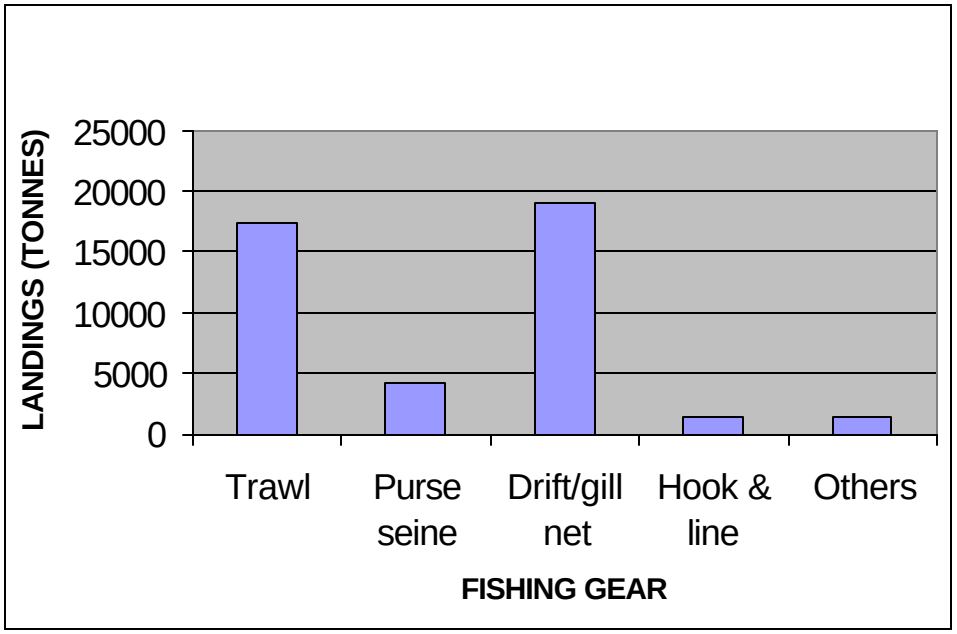


Figure 4: Landings of pelagic fish by gear group in Sarawak 2001

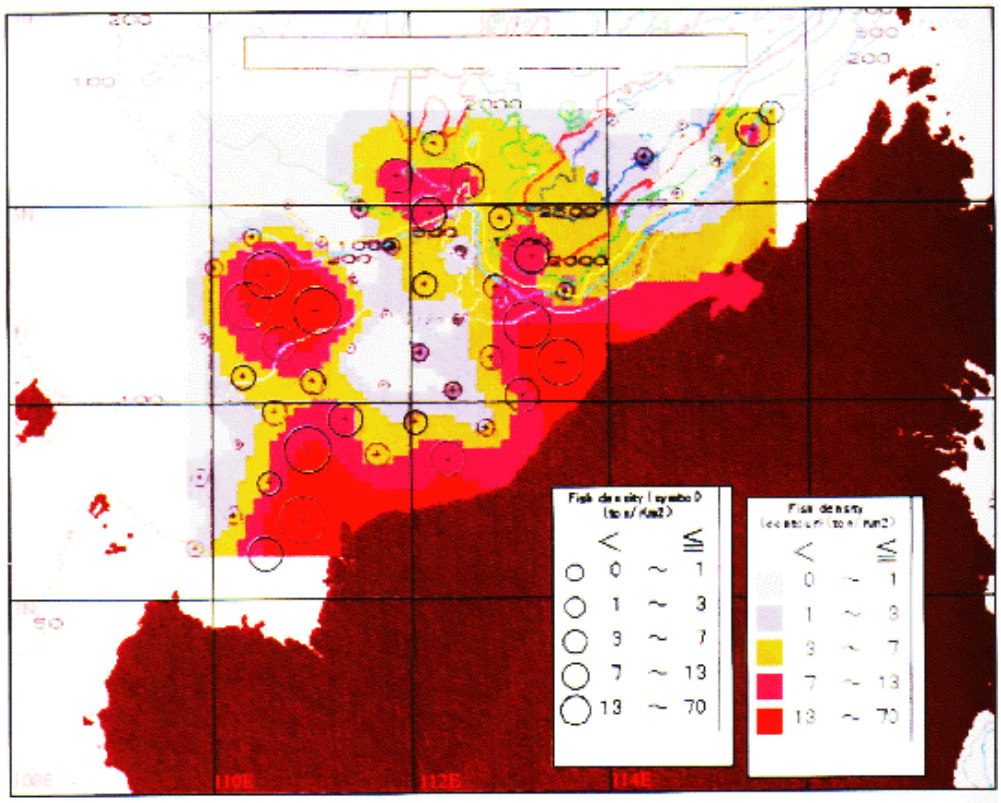
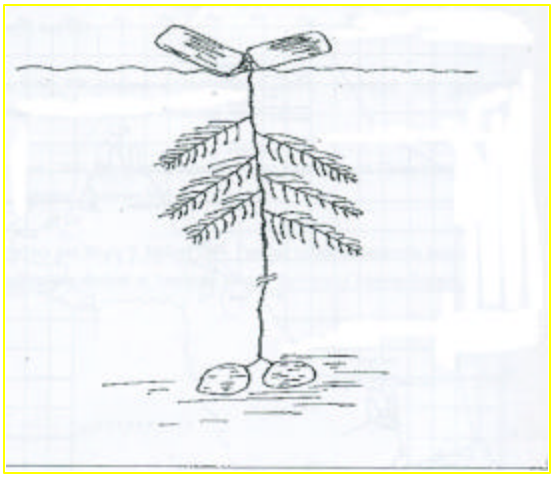
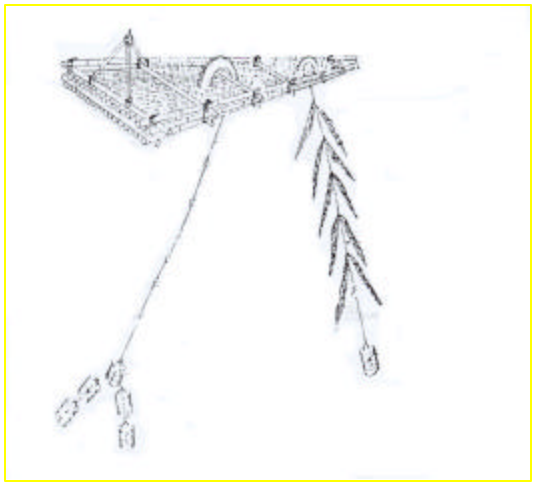
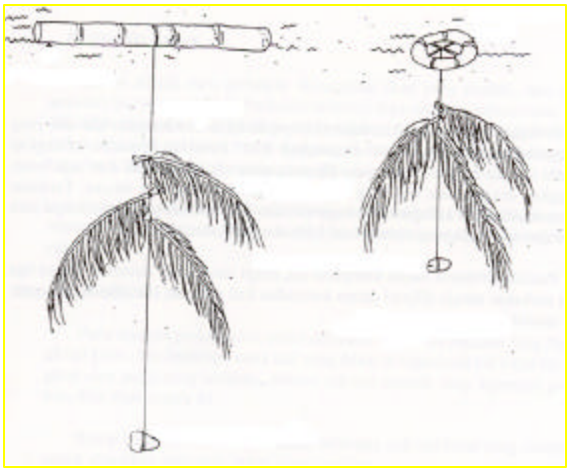


Figure 5: Distribution and abundance (tonnes/km2) of small pelagic fish

Figure 8: FADs and Fishing







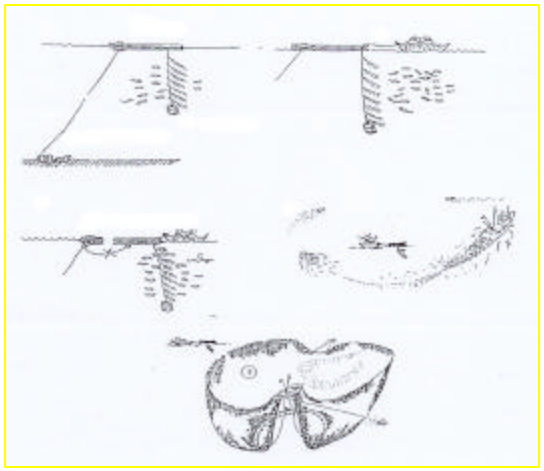


Figure 9: Landings of the common small pelagic fish by month in Sarawak, 2001