



**THE THIRD REGIONAL WORKSHOP ON SHARED STOCKS  
IN THE SOUTH CHINA SEA AREA**

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**COUNTRY STATUS REPORT  
PHILIPPINES**

**SMALL PELAGIC FISHES IN  
THE PHILIPPINES**

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## 1. INTRODUCTION

The Philippines is a major fishing country. Considering the geographical characteristic and open access to its fishery resources, an estimated 12% of the population or roughly seven million Filipinos are dependent in some way on the fishing sector (Librero, 1985). The country's fishing industry itself provides employment to about a million Filipinos or 5% of the country's labor force (BFAR, 1996). Fish, a staple food for the Filipinos, provides 50-70% of the animal protein requirements (Ronquillo, 1975; Gonzales, 1985) and its production supports various sectors in the country's economy.

Production of marine fisheries for 1996 (Table 1) was estimated to reach 1.6 million metric tons (mt) or about 58% of the total fisheries production of 2.7 million mt (BFAR, 1996). Small pelagic fisheries contributed more than half of the marine fisheries production and about one-quarter of all fish landed in the Philippines. From 1984 to 1995, average annual catch of small pelagic fishes ranged from 652,532 mt to 976,333 mt or about 54.48% of the total marine production (Fig. 1).

Major small pelagic fishes landed, based on the average annual catch from 1984 to 1995 were Carangidae (36.4%), Scombridae (28.1%), Clupidae (18.6%) and Engraulidae (11.7%) (Fig. 2).

Based on the total commercial landings covering the period of 1991-95, the major fishing grounds for small pelagic fishes were South Sulu Sea (17.4%), West Palawan Waters (16.8%), Visayan Sea (14.9%) and Moro Gulf (7.2%) (Fig. 3).

This paper is a synthesis of all available data and information on small pelagic species selected for the third regional workshop on shared stocks in the South China Sea area. However, omission of some small pelagic species recognized in the recently APFIC meeting resulted to a minimal variations in some of the statistical figures.

## 2. STATUS OF SMALL PELAGIC FISHERIES

The Philippine small pelagic fisheries, as described by Dalzell *et al.* (1990), share four characteristics with that of the other fisheries in the South-East Asian region namely:

1. They are open access fisheries with little regulation,
2. They are both multispecies and multigear fisheries,
3. They are composed of relatively few commercial fishermen and large number of municipal fishermen, and
4. They are grossly overfished.

Several studies have also concluded that the small pelagic fisheries in the Philippines are biologically and economically overfished (Dalzell *et al.*, 1991, 1988a, 1988b, 1987a, 1987b). This is in fact, the significant finding of the Small Pelagic Management Project conducted by the Philippine Bureau of Fisheries and Aquatic Resources in collaboration with ICLARM last 1987 to 1988 which resulted to several publications describing the status of small pelagic fisheries in the Philippines.

A countrywide estimate of annual maximum sustainable yield ( $MSY_{ij}$ ) for small pelagic fishes was about half a million tons which could be taken with about half of the present levels of fishing effort (Dalzell *et al.*, 1987b) (Fig. 4). Correlation in the time series data of total small pelagic catch, fishing effort and catch per effort from 1948 to 1986 indicated overfishing (Fig. 5). The data showed that rapid increase in fishing effort began in mid 60's. Catches also increased rapidly from late 60's until

early 70's and became erratically decreasing until mid 80's. The overall trend for catch per effort was continuously declining. Based on these findings, the author recommended to reduce fishing effort on both municipal and commercial fisheries and further suggested the following steps to be implemented:

1. Selective bans or total closure of fishing grounds that are overfished and effective enforcement.
2. Reduction of both municipal and commercial fleet sizes and numbers of fishermen. A regulatory step would be to put a moratorium on the issuance of licenses or increase in license fees.
3. Increase other livelihood opportunities other than fishing for municipal fishermen.
4. Regional strengthening of fisheries management.
5. And continuous monitoring of Philippine small pelagic fishes to provide greater information on the status of fish stocks.

The above management measures which could be implemented to revive the dwindling small pelagic resources of the country was extensively discussed by Dalzell *et al.* (1991; 1988). Finally, management options for Philippine small pelagic fisheries was also presented by the same author (Dalzell *et al.*, 1991) (Fig. 6).

### **3. PRESENT MANAGEMENT ISSUES AND STRATEGIES**

The Philippine government through the Bureau of Fisheries and Aquatic Resources (BFAR), the agency responsible for fisheries monitoring and management, focused management programs not only for small pelagic fisheries but for the whole fisheries resources in the Philippines. The following are its highlighted efforts:

1. The ADB-funded fisheries Sector Program (FSP) implemented in 1991 to 1997 was an initial program of the government to address marine resource enhancement, environmental rehabilitation, control of destructive fishing activities and improve law enforcement through a community based management approach in the 12 priority bays of the country.
2. Monitoring, Control and Surveillance (MCS) System for the Philippines coastal areas and Exclusive Economic Zone is in its way for implementation. By its definition from Food and Agriculture Organization (FAO), monitoring involves data collection and analysis; control involves in legislation and formulation of administrative ordinances; and surveillance involves in law enforcement. The main thrust of the program is to provide a credible deterrent to the violation of fishery laws and regulations and prevent unlawful foreign and domestic fishing in the Philippine waters. In the conduct, it will include the collection of information on fishing effort/catches, vessel traffic and ocean sector activities, and such other data that are needed in formulating national policies or laws and making strategic and tactical decisions regarding ocean planning and management including enforcement (BFAR Primer).
3. The National Fishery Resources Assessment Program started its implementation last year in the fourteen regions in the country. The program is geared toward strengthening regional capability and establishment of continuous monitoring and analysis of landed catch and effort of fishery resources. This will also answer to the need of localization of fishery management and the improvement of the quality of stock assessment data needed to support future formulation of fisheries management options in each region of the country. The impact of the above FSP program in the coastal resources may also be deduced from the assessment results.

program in the coastal resources may also be deduced from the assessment results.

In addition, the following steps were recommended and are being implemented by the government:

1. Moratorium in the issuance of commercial fishing boat license (CFBL) for new fishing vessels except for large fleet that will operate in the EEZ and international waters is formulated for the approval of the Secretary of the Department of Agriculture.
2. Regulation on the use of fine mesh nets in fishing under fisheries Administrative Order No. 155 and 188;
3. Encouragement of the larger commercial fishing fleets to fish offshore or enter into joint-venture agreement with other countries with room for expansion of their fisheries.

Presently, there is a pending Bill, known as the "Fisheries code" being deliberated in the congress of the Philippines. The Bill entails the provisions for the development, management and conservation of the fisheries and aquatic resources. It has also provisions to revert BFAR into a line bureau from being a staff bureau. Consequently re-establishment of BFAR's regional offices will strengthen further fisheries administration at the regional level.

The obvious need for small pelagic fisheries is to reduce fishing effort and reallocate the excess to lightly fished areas. There are indications that this expansion has occurred since the work of Dalzell *et al.* (1987), (Barut *et al.*, 1997).

#### **4. CATCH-EFFORT AND FISHING GEAR**

Small pelagic fisheries in the Philippines consist of commercial and municipal landings, whereby the former involves fishing vessels of more than 3 gross tons and operates within water areas beyond 15 km away from and parallel to the coastline unto the limits of EEZ. While municipal landings on the other hand involves fishing vessels of less than 3 gross tons and operates within water areas from the shore unto the perimeter 15km away and parallel to the coastline.

Commercial landings constitute greater share in the small pelagis fisheries. It was estimated to have an average annual catch of 477, 486 metric tons or 57% of the annual small pelagic landings. Commercial catch showed an increasing trend from 323,680 mt in 1984 to 639,256 mt in 1995 (fig. 7) Prior to 1986, the quantities of commercial landings were inferior to the municipal landings. However from 1986 to 1995, the former surpassed the latter and increased continuously. The increase in catch most especially during the 90's was attributed to the expansion of fishing activities towards the high seas. While municipal landings, on the other hand, produced an average annual production of 356,080 mt or 47% of the total small pelagic catch. Annual municipal catch had minimal variation with catch ranging from 318,377 to 392,266 mt. The trend had a slight increase from 332,509 mt in 1985 to 392,266 mt in 1990. After 1990, the catch declined gradually to 318,377 mt in 1995. The decrease in municipal catch during the 90's was not clearly defined. However, it was assumed that municipal fishing folks shifted from catching small pelagic to large pelagic species due to higher economic value.

Roundscads (*Decapterus* spp.) dominated the commercial catch with an average annual catch of 189,993 mt comprising 40% of the total annual small pelagic catch followed by sardines (*sardinella* spp.), 92,115 mt; frigate & bullet tunas (*Auxis* spp.), 55,214 mt; mackerels (*rastrelliger* spp.), 40, 251 mt; anchovies (*stolephorus* spp.), 33,102; and others (Fig. 8).

The bulk of commercial landings of small pelagic species were caught by purse seines contributing 59% of the total catch from 1991 to 1995 followed by ringnets, 20%; bagnets, 9%; trawls, 6% and others (Table 2).

Unlike commercial catch, no single species distinctively dominated the municipal small pelagic landings (Fig. 9). Anchovies (*Stolephorus* spp.) ranked first with an average annual landings of 64,983 mt followed immediately by sardines (*Sardinella* spp.), 63,630 mt; frigate & bullet tunas (*Auxis* spp.), 44,838 mt; mackerel (*Rastrelliger* spp.) 37,459 mt; and other. Roundscads ranked fifth due to its oceanic dwelling behavior (Dalzell, 1987).

Though inventory was conducted in selected priority bays of the FSP in 1993, data on municipal fishing gears directed to small pelagic fisheries were incomplete.

## 5. BIOLOGICAL PARAMETERS

### Roundscads

Most biological studies were concentrated on the two dominant species of genus *Decapterus* (roundscads) namely *D. macrosoma* and *D. russelli*. Spawning period for these species was from November to March in Palawan waters and extends up to April and May in Manila Bay (Tiews *et al.*, 1970). Recruitment into the fishery occurs from January to April (Dalzell *et al.*, 1987) with lengths between 10 to 12 cm towards the end of their first year of life (Tiews, *et al.*, 1970); Ingles and Pauly, 1984). For Camotes Sea ringnet fishery in Central Visayas, the two recruitment peaks that were observed in a year may be associated with the two major monsoon periods in the Philippines. In the same area, the mean length at first capture for *D. macrosoma* was 12.9 cm and for *D. russelli* was 4.5 cm (Jabat and Dalzell, 1988).

Estimation using growth parameter revealed that roundscads have a maximum lifespan of 3-5 years (Dalzell and Ganaden, 1987a). Ingles and Pauly (1984) computed the life span of *D. macrosoma* and *D. russelli*, at 3.2 and 2.3 years respectively. Corpuz *et al.* (1985) also computed the life span of *D. maruadsi* to be 4.2 years. Results of estimated growth and mortality parameters of Philippine roundscads from different authors are given in Table 3.

### Sardines

FAO (1985) suggested that stocks of sardines in Southern Visayan Sea/Bohol Sea are contiguous with those of Sulu Sea and Celebes Sea. The lifespan of sardines in general appears to be 2-3 years and probably up to 4 years (Calvelo, 1997). *Sardinella longiceps* is the prevalent species in Camotes Sea with lengths ranging from 11.5 cm to 19.5 cm (Bognot, 1996). Some estimates of growth and mortality parameters of *Sardinella fimbriata*, *S. albella*, *S. longiceps* and *Amblygaster sirm* are presented in Table 4.

### Anchovies

Substantial studies have been undertaken on the biology of *Stolephorus* anchovies. Aside from biological studies by Tiews (1962) and Tiews *et al.* (1970) estimates of the growth and mortality of several anchovy species were made from length-frequency data by Ingles and Pauly (1984), Corpuz

*et al.* (1985) and just recently by Gonzales *et al.* (1997). Tiews *et al.* (1970) indicated that *S. heterolobus*, *S. devisi* and *S. punctifer* spawn through out the year but the peak of the activity is associated with northeast monsoon season (October to March). The average life span of stolephorids are 1-2 years, however with *S. indicus*, the largest in the genus, it could reach up to 2 years (Calvelo, 1997). Pauly (1982) has performed yield-per-recruit analyses of *S. heterelobus*, *S. indicus*, and *S. commersonii* in San Miguel Bay and showed that the mesh size being used are far too small for efficient exploitation of said species.

### **Indo-pacific mackerels**

There is little biological information on the various stocks of mackerels in the Philippines. Some estimates of growth and mortality parameters of *Rastrelliger kanagurta*, *R. faughnii* and *R. brachysoma* in Philippine waters have been made by the use of length-frequency data (Table 5). The spawning grounds were presumably in deeper water and recruitment patterns are generally either unimodal or bimodal (Dalzell and Ganaden, 1987). Growth parameters estimates for *R. kanagurta* and *R. brachysoma* suggest that life span of these mackerels are between 1.5 and 2 years (Ingles and Pauly, 1984).

### **Small tunas**

The species of small tunas referred here are *Auxis thazard*, *A. rochei* (frigate and bullet tunas) and *Euthynnus affinis* (kawakawa or eastern little tuna). The spawning season of *A. rochei* occurs in March, May to July and November to December in Batangas Bay (Arce, 1987). While for kawakawa, the spawning is all year round (Wade, 1950b). Data of size ranges of small tunas caught from Southern Philippines suggests that the exploited stocks are juveniles. Moreover, it appeared that there was a continuous recruitment into the fishery since size composition did not vary through the years (Arce, 1995). In Camotes sea, the modal size of *A. rochei* caught by ringnet around payao was 21 cm implying that the fishery is composed of fish of 1 to 2 years of age based on report that *A. rochei* reach 17, 29, 35 and 42 cm (FL) at ages of 1 and 4 years, respectively (Calvelo, 1997). Estimations of growth and mortality parameters are presented in Table 5:

## **6. OCEANOGRAPHIC, REMOTE SENSING AND ENVIRONMENTAL DATA**

Oceanographic studies in the Philippines have been very limited due primarily to the absence of a research vessel for its conduct. Current researches are focused on coastal oceanography particularly on the study of some hydrological and climatological parameters and its effect on the distribution and abundance of toxic dinoflagellates in selected areas (Bajarias, 1993, unpublished). Hence, present oceanographic data cannot be correlated with the small pelagic catch. Available oceanographic information presented in the 2<sup>nd</sup> workshop has no updates.

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Figure 1: Percentage share of small pelagic to the total marine landings

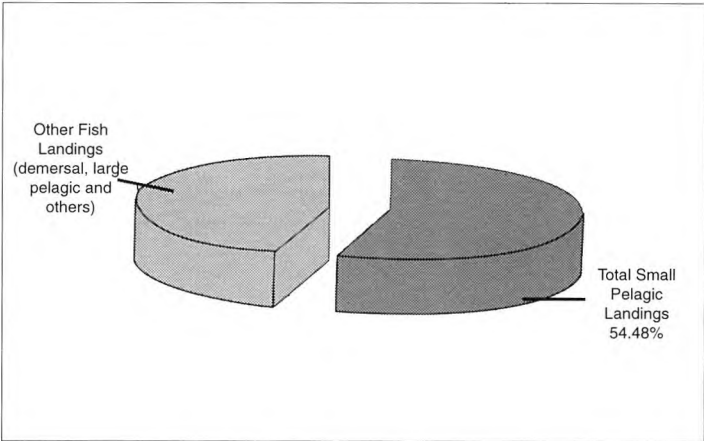


Figure 2: Catch distribution by abundance (mean annual landings, 1984-95)

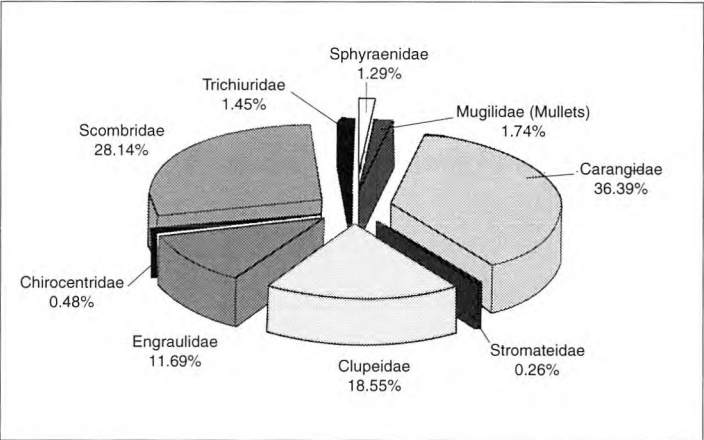


Figure 3: Catch distribution by fishing grounds (mean annual catch, 1991-95)

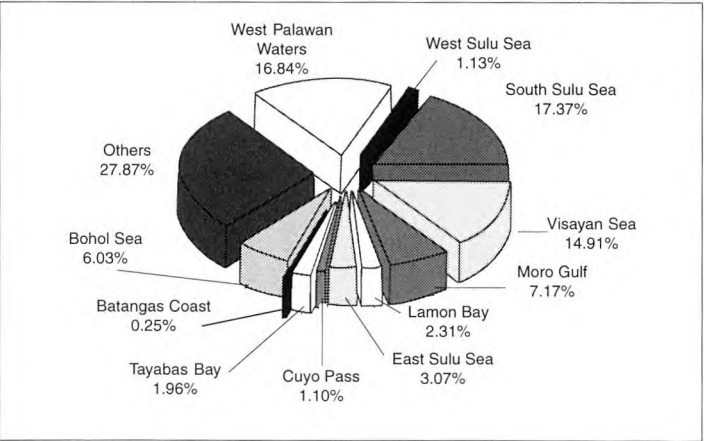


Figure 4: Surplus production model of small pelagic fisheries in the Philippines providing estimates of MSY and economic rent for exploited areas/resources (Source; Dalzell et al., 1987)

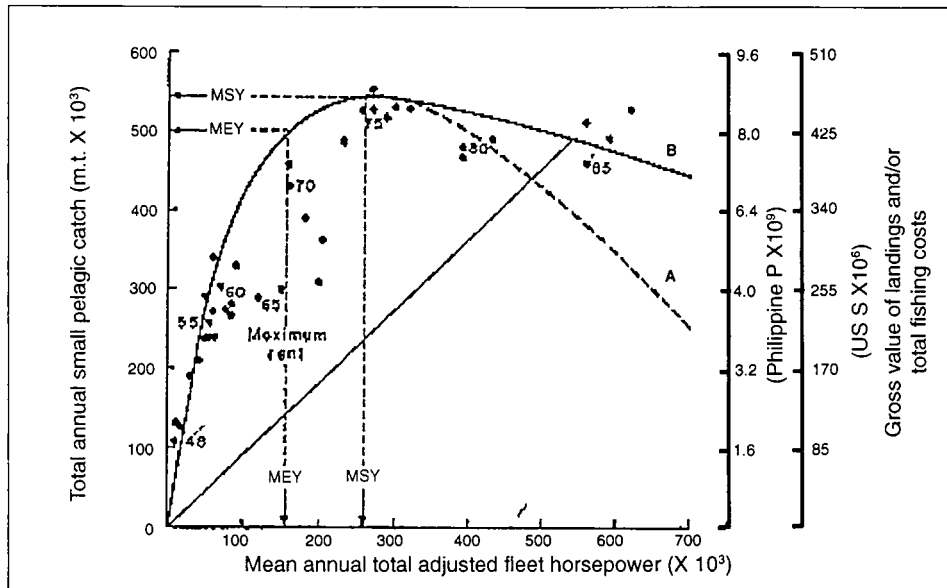
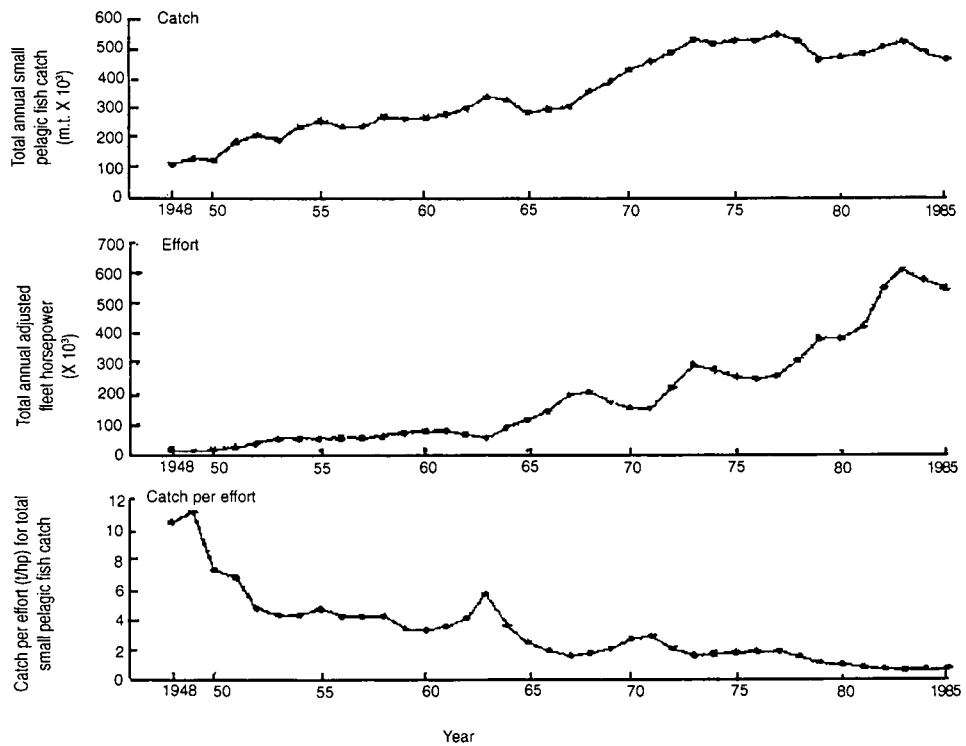


Figure 5: Time series of total small pelagic catch, fishing effort and catch per effort, 1948-1985.



Source: Dalzell *et. al.*, 1987

Figure 6: Management options for Philippine small pelagic fisheries.

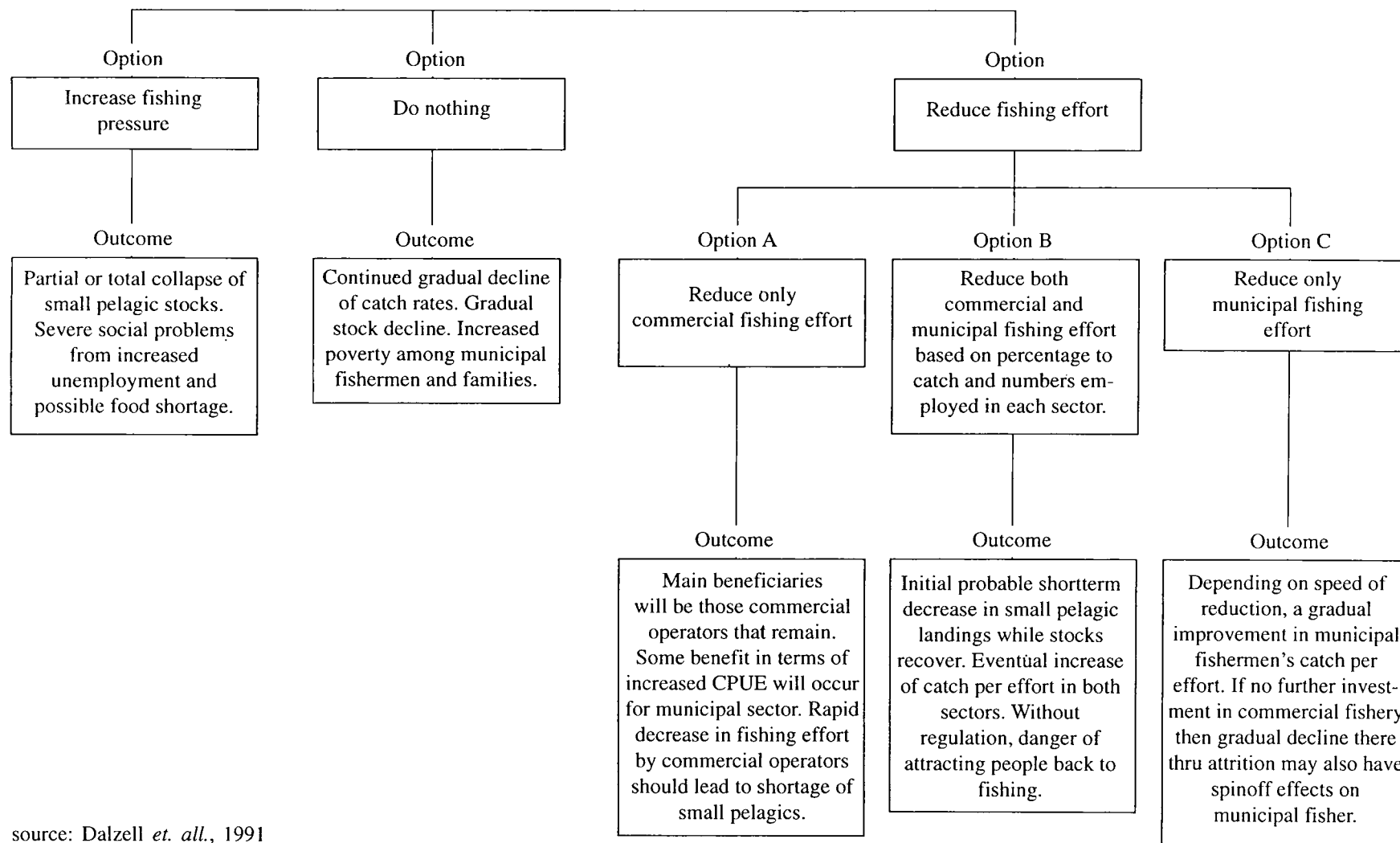


Figure 7: Small pelagic fisheries annual production, 1984-95.

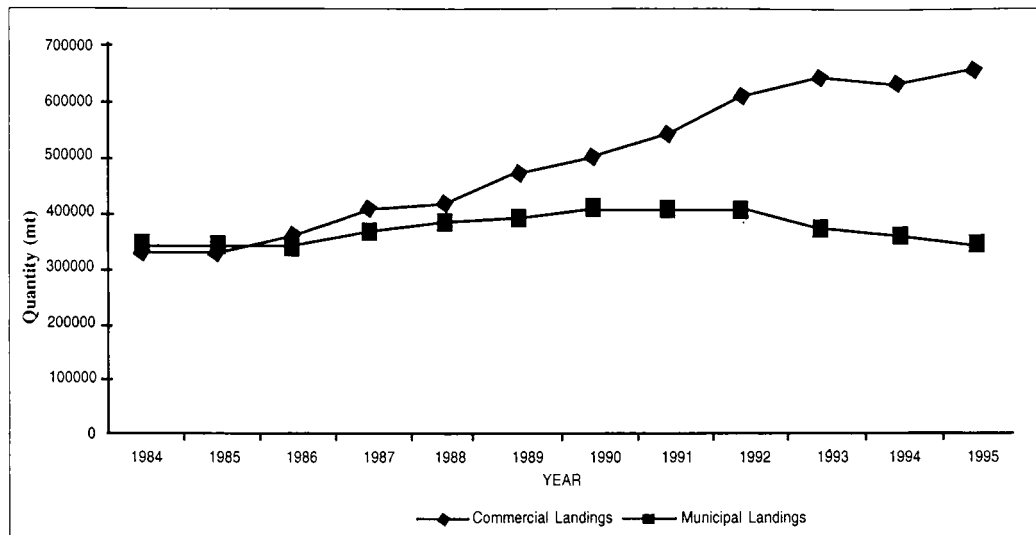


Figure 8: Commercial landings of small pelagic fishes (average annual catch, 1984-95)

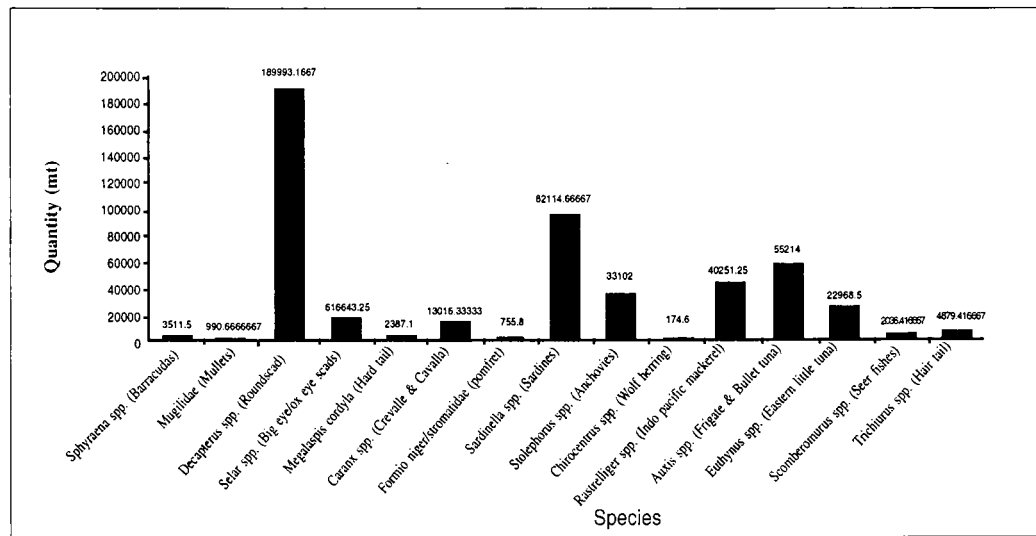


Figure 9: Municipal landings of small pelagic fishes (average annual catch, 1984-95)

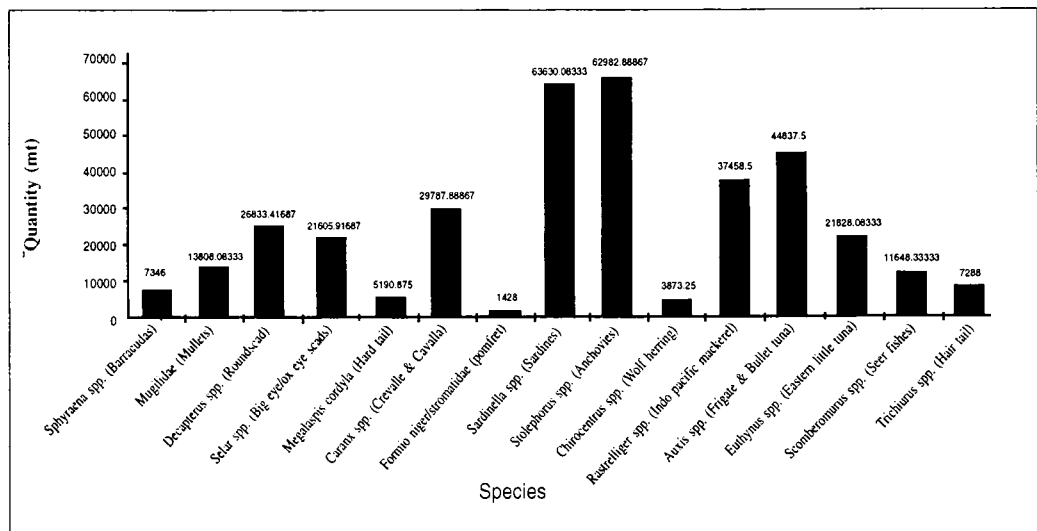
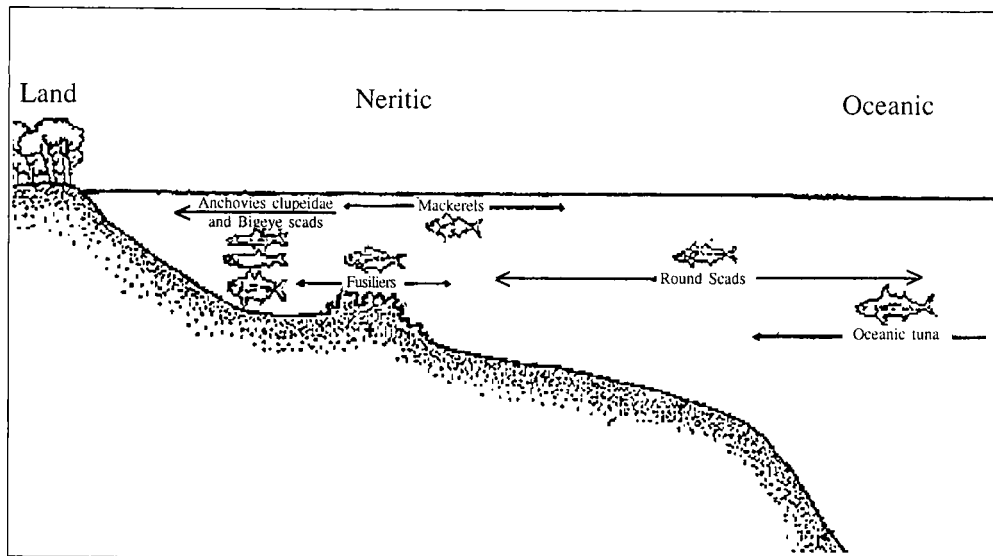


Figure 10: Schematic representation of the distribution of the seven principal small pelagic species groups with respect to inshore, neritic and oceanic zones.



source: Dalzell *et. all.*, 1987

Table 1: Annual marine fisheries production for 1984 to 1996.

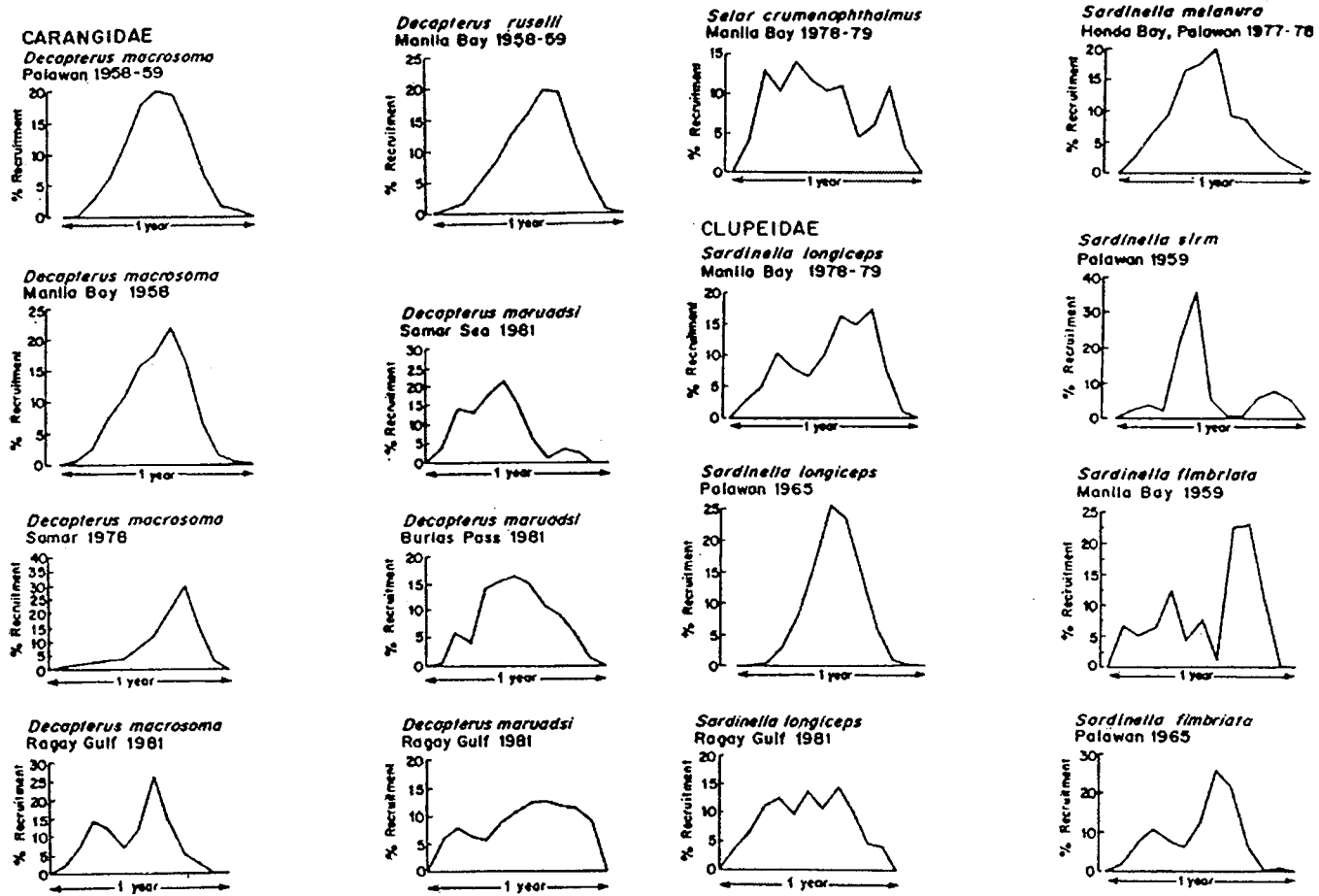
Year	Total commercial production	Total municipal production	Total marine production
1984	513,335	789,975	1,303,310
1985	511,987	785,132	1,297,119
1986	546,230	807,275	1,353,505
1987	591,192	816,247	1,407,439
1988	599,995	838,366	1,438,361
1989	637,138	882,369	1,519,507
1990	700,564	895,040	1,595,604
1991	759,815	913,524	1,673,339
1992	804,866	854,687	1,659,553
1993	845,431	803,194	1,648,625
1994	885,446	786,847	1,672,293
1995	926,887	785,369	1,712,256
1996	879,043	731,308	1,610,351

Table 2: Total small pelagic fisheries production per commercial fishing gears, 1991-95

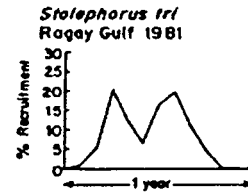
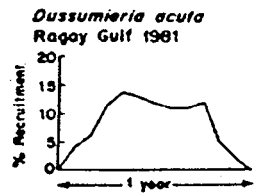
Family/Species	Trawl	Purse Seine	Ringnet	Bagnet	Gillnet	Round Haul Seine	Denish Seine	Others
Sphyraenidae								
<i>Sphyraena</i> spp. (Barracudas)	7,479	3,585	918	470	134	25	6,946	658
Mugilidae (Mulletts)	1,304	1,047	10	434	246		23	1,598
Carangidae								
<i>Decapterus</i> spp. (Roundscad)	35,072	878,391	161,543	110,007		1,429	22,254	5,055
<i>Selar</i> spp. (Big-eye/ox-eye scad)	5,301	43,995	24,656	2,568		137	4,275	4,633
<i>Megalaspis cordyla</i> (Hardtail)	3,192	5,140	1,290	639	121		4,492	383
<i>Caranx</i> spp. (Crevalle & Cavalla)	14,479	14,822	4,219	2,474	700		25,344	5,213
Stromateidae								
spp. (pomfrets)	736	988	320	77	268		2,657	375
Clupeidae								
<i>Sardinella</i> spp. (Sardines)	52,611	506,676	137,718	63,134		1,267	7,658	6,509
Engraulidae								
<i>Stolephorus</i> spp. (Anchovies)	19,191	12,188	24,423	59,939		5,366	1,571	8,877
Chirocentridae								
<i>Chirocentrus</i> spp. (Wolf herring)	175	164	5	5	1		372	197
Scombridae								
<i>Rastrelliger</i> spp. (mackerel)	25,183	133,793	28,006	7,421		618	19,832	5,646
<i>Auxis</i> spp. (Frigate & Bullet tunas)	1,953	106,063	126,264	20,763	5,457		844	10,065
<i>Euthynus</i> spp. (Eastern little tuna)	459	41,769	93,533	1,590	3		732	1,190
<i>Scomberomorus</i> spp. (seerfishes)	797	2,793	1,057	75	87		771	2,506
Trichiuridae								
<i>Trichiurus</i> spp. (Hairtail)	13,303	7,948	259	991	41		2,770	4,951
TOTAL	181,235	1,759,362	604,221	270,587	7,058	8,842	100,541	57,856

source: Bureau of agricultural Statistic (1991-1995)

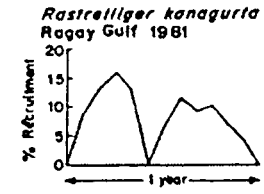
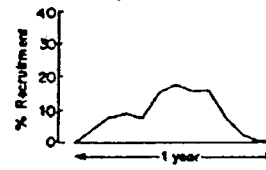
Figure 11: Recruitment patterns generated from length frequency data by ELEFAN II for various species of small pelagic fish from different locations in the Philippines (source: Dalzell et al., 1988)



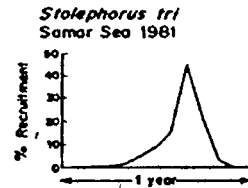
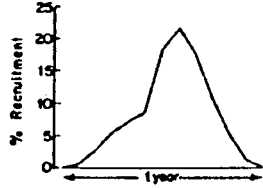
continue:



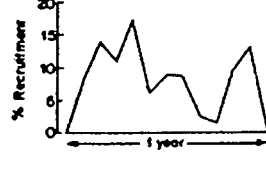
SCOMBRIDAE  
*Rastrelliger brachysoma*  
Manila Bay 1978-79



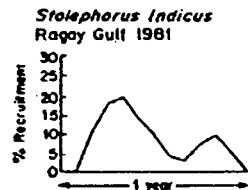
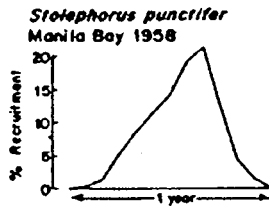
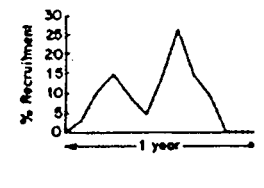
ENGRAULIDAE  
*Stolephorus heterotobus*  
Manila Bay 1961



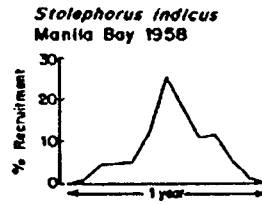
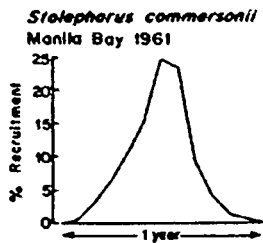
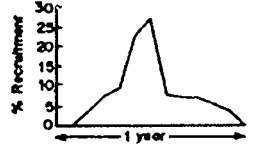
*Rastrelliger brachysoma*  
Samar Sea 1979-80



*Rastrelliger kanagurta*  
Samar Sea 1981



*Rastrelliger brachysoma*  
Ragay Gulf 1981



*Rastrelliger kanagurta*  
Palawan 1965

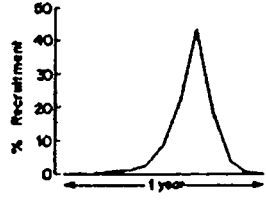




Table 3: Growth and mortality parameters for roundscad species in the Philippines

Family/Species	Area	L (cm)	Lmax (cm)	K (yr-1)	M (yr-1)	Z (yr-1)	Year (s)	References
CARANGIDAE								
<i>Decapterus macrosoma</i>	Camotes Sea	25.00		0.88	1.73			Jabat and Dalzell (1988)
<i>Decapterus macrosoma</i>	Manila Bay	31.50	28.00	0.65	1.33			Ingles and Pauly (1984)
<i>Decapterus macrosoma</i>	Manila Bay	31.50	28.00	0.71	1.41			Ingles and Pauly (1984)
<i>Decapterus macrosoma</i>	Palawan	27.00	25.00	0.90	1.72			Ingles and Pauly (1984)
<i>Decapterus macrosoma</i>	Palawan	26.80	25.00	0.71	1.47			Ingles and Pauly (1984)
<i>Decapterus macrosoma</i>	Palawan	26.50	25.00	1.00	1.85			Ingles and Pauly (1984)
<i>Decapterus macrosoma</i>	Palawan	27.80	25.00	0.83	1.61			Ingles and Pauly (1984)
<i>Decapterus macrosoma</i>	Palawan	33.00	31.00	0.50	1.10			Ingles and Pauly (1984)
<i>Decapterus macrosoma</i>	Palawan	27.50	21.00	1.25	2.12			Ingles and Pauly (1984)
<i>Decapterus macrosoma</i>	Palawan	25.00	20.00	1.20	2.12			Ingles and Pauly (1984)
<i>Decapterus macrosoma</i>	Palawan	25.50	22.00	0.85	1.68			Ingles and Pauly (1984)
<i>Decapterus macrosoma</i>	Palawan	25.50	22.00	0.80	1.62			Ingles and Pauly (1984)
<i>Decapterus macrosoma</i>	Palawan	33.00	30.00	0.65	1.31			Ingles and Pauly (1984)
<i>Decapterus macrosoma</i>	Palawan	30.00	27.00	0.74	1.47			Ingles and Pauly (1984)
<i>Decapterus macrosoma</i>	Samar Sea	23.00	22.00	1.25	2.19			Corpuz <i>et al.</i> (1985)
<i>Decapterus macrosoma</i>	Ragay Gulf	25.50	23.00	1.26	2.12			Corpuz <i>et al.</i> (1985)
<i>Decapterus macrosoma</i>	Leyte Gulf	27.30	27.62	1.40	2.28	4.67	1983-1988	Gonzales <i>et al.</i> (1997)
<i>Decapterus macrosoma</i>	Visayan Sea	31.30	29.57				1984-1988	Gonzales <i>et al.</i> (1997)
<i>Decapterus macrosoma</i>	Guimaras Strait	31.70	30.23				1984-1986	Gonzales <i>et al.</i> (1997)
<i>Decapterus macrosoma</i>	Samar Sea	27.00	27.11				1985-1987	Gonzales <i>et al.</i> (1997)
<i>Decapterus macrosoma</i>	Camotes Sea	28.00	30.02	1.60	2.47	5.13	1985-1987	Gonzales <i>et al.</i> (1997)
<i>Decapterus macrosoma</i>	Davao Gulf	29.90	31.21				1983-1986	Gonzales <i>et al.</i> (1997)
<i>Decapterus macrosoma</i>	South Sulu Sea	27.80	26.80	1.20	2.05	7.25	1983-1988	Gonzales <i>et al.</i> (1997)
<i>Decapterus macrosoma</i>	Moro Gulf/Illana Bay	21.40	24.48	2.30	3.38	4.25	1983-1988	Gonzales <i>et al.</i> (1997)
<i>Decapterus kurroides</i>	Davao Gulf	25.00		0.80	1.62			Gonzales (1991)
<i>Decapterus kurroides</i>	Visayan Sea	29.80	30.74				1983-1988	Gonzales <i>et al.</i> (1997)
<i>Decapterus kurroides</i>	Samar Sea	31.40	30.29				1983-1988	Gonzales <i>et al.</i> (1997)
<i>Decapterus kurroides</i>	Davao Gulf	24.80	25.97				1983-1988	Gonzales <i>et al.</i> (1997)
<i>Decapterus russelli</i>	Manila Bay	27.00	23.00	0.80	1.59			Ingles and Pauly (1984)
<i>Decapterus russelli</i>	Manila Bay	30.00	26.00	0.54	1.19			Ingles and Pauly (1984)
<i>Decapterus russelli</i>	Manila Bay	26.90	24.00	0.69	1.44			Ingles and Pauly (1984)
<i>Decapterus russelli</i>	Manila Bay	26.00	24.00	0.73	1.51			Ingles and Pauly (1984)
<i>Decapterus russelli</i>	Manila Bay	33.00	28.00	0.45	1.03			Ingles and Pauly (1984)
<i>Decapterus russelli</i>	Camotes Sea	33.70		0.36	0.89			Jabat and Dalzell (1988)
<i>Decapterus russelli</i>	Visayan Sea	36.50	38.64				1984-1987	Gonzales <i>et al.</i> (1997)
<i>Decapterus russelli</i>	Camotes Sea	35.10	34.50	1.40	2.13	6.71	1985-1988	Gonzales <i>et al.</i> (1997)
<i>Decapterus macarellus</i>	Pujada Bay	24.30	24.36	1.80	2.78	3.66	1986	Gonzales <i>et al.</i> (1997)
<i>Decapterus macarellus</i>	Davao Gulf	33.60	33.59				1986	Gonzales <i>et al.</i> (1997)
<i>Decapterus maruadsi</i>	Burias Pass	27.70	22.00	0.82				Corpuz <i>et al.</i> (1985)
<i>Decapterus maruadsi</i>	Samar Sea	23.55	23.00	0.81				Corpuz <i>et al.</i> (1985)
<i>Decapterus maruadsi</i>	Ragay Gulf	23.50	22.00	0.52				Corpuz <i>et al.</i> (1985)
<i>Decapterus maruadsi</i>	Tayabas Bay	27.30	26.69	1.10	1.95	5.39	1987	Gonzales <i>et al.</i> (1997)
<i>Decapterus maruadsi</i>	South Sulu Sea	25.00	24.03	1.20	2.11	3.51	1984-1986	Gonzales <i>et al.</i> (1997)
<i>Decapterus maruadsi</i>	Camotes Sea	31.17	29.56	1.30	2.10	6.86	1987-1988	Gonzales <i>et al.</i> (1997)
<i>Selar crumenophthalmus</i>	Manila Bay	36.50	34.00	0.89	1.57			Ingles and Pauly (1984)
<i>Selar crumenophthalmus</i>	Illana Bay	18.10	18.90	0.72	1.66	2.01	1988	Gonzales <i>et al.</i> (1997)
<i>Selar crumenophthalmus</i>	Pujada Bay	23.30	23.43	1.20	2.16	2.37	1986	Gonzales <i>et al.</i> (1997)
<i>Selar crumenophthalmus</i>	Davao Gulf	28.60	28.80	1.90	2.75	8.34	1983-1987	Gonzales <i>et al.</i> (1997)
<i>Selar crumenophthalmus</i>	South Sulu Sea	24.60	26.52	1.49	2.45	4.14	1987	Gonzales <i>et al.</i> (1997)
<i>Selar crumenophthalmus</i>	Leyte Gulf	26.40	27.31	1.50	2.41	3.86	1985-1987	Gonzales <i>et al.</i> (1997)
<i>Selar crumenophthalmus</i>	Camotes Sea	28.50	28.88	2.00	2.85	7.41	1983-1987	Gonzales <i>et al.</i> (1997)
<i>Atule mate</i>	Leyte Gulf	30.50	31.11	0.92	1.68	2.19	1987	Gonzales <i>et al.</i> (1997)

Table 4: Growth and mortality parameters for mackerel species in the Philippines

Family/Species	Area	L (cm)	L' max (cm)	K (yr-1)	M (yr-1)	Z (yr-1)	Year (s)	References
<i>Rastrelliger brachysoma</i>	Samar Sea	24.50	22.00	1.28	2.17			Corpuz <i>et al.</i> (1985)
<i>Rastrelliger brachysoma</i>	Samar Sea	25.00	23.00	1.30	2.32			Corpuz <i>et al.</i> (1985)
<i>Rastrelliger brachysoma</i>	Samar Sea	25.50	23.00	1.45	2.19			Corpuz <i>et al.</i> (1985)
<i>Rastrelliger brachysoma</i>	Manila Bay	34.00	30.00	1.10	1.84			Ingles and Pauly (1984)
<i>Rastrelliger brachysoma</i>	Samar Sea	25.00	22.00	1.60	2.56			Ingles and Pauly (1984)
<i>Rastrelliger brachysoma</i>	Manila Bay	34.00		0.98			1958-1960	BFAR files (unpublished)
<i>Rastrelliger brachysoma</i>	Visayan Sea	34.00		0.98			1983	BFAR files (unpublished)
<i>Rastrelliger brachysoma</i>	Visayan Sea	32.50		1.20			1984	BFAR files (unpublished)
<i>Rastrelliger brachysoma</i>	Samar Sea	29.75		1.30			1984	BFAR files (unpublished)
<i>Rastrelliger brachysoma</i>	Leyte Gulf	34.00		0.98			1984	BFAR files (unpublished)
<i>Rastrelliger faughni</i>	Camotes Sea	25.90		1.45	2.44			Jabal and Dalzell (1988)
<i>Rastrelliger kanagurta</i>	Illana Bay	39.00		0.72			1984	BFAR files (unpublished)
<i>Rastrelliger kanagurta</i>	Guimaras Strait	27.80		1.65			1985	BFAR files (unpublished)
<i>Rastrelliger kanagurta</i>	Samar Sea	26.50		1.60			1984	BFAR files (unpublished)
<i>Rastrelliger kanagurta</i>	Visayan Sea	37.00		0.70			1984	BFAR files (unpublished)
<i>Rastrelliger kanagurta</i>	Visayan Sea	29.50		1.50			1983	BFAR files (unpublished)
<i>Rastrelliger kanagurta</i>	Visayan Sea	38.00		0.80			1983-1987	Guanco (1991)
<i>Rastrelliger kanagurta</i>	Samar Sea	27.50	25.00	1.30	2.11			Corpuz <i>et al.</i> (1985)
<i>Rastrelliger kanagurta</i>	Samar Sea	28.00	26.00	1.31	2.13			Corpuz <i>et al.</i> (1985)
<i>Rastrelliger kanagurta</i>	Palawan Water	28.00	25.00	1.55	2.43			Ingles and Pauly (1984)
<i>Rastrelliger kanagurta</i>	Camotes Sea	25.50		1.50	2.45			Jabal and Dalzell (1988)
<i>Rastrelliger kanagurta</i>	Guimaras Strait	33.90	34.11	1.00	1.72	2.83	1984-1986	Gonzales <i>et al.</i> (1997)
<i>Rastrelliger kanagurta</i>	Visayan Sea	33.10	33.90				1983-1986	Gonzales <i>et al.</i> (1997)
<i>Rastrelliger kanagurta</i>	Camotes Sea	30.30	30.48				1987	Gonzales <i>et al.</i> (1997)
<i>Rastrelliger faughni</i>	Visayan Sea	28.10	28.21	1.50	2.37	3.60	1983-1987	Gonzales <i>et al.</i> (1997)
<i>Rastrelliger faughni</i>	Camotes Sea	27.03	27.45	2.20	3.08	5.22	1987	Gonzales <i>et al.</i> (1997)
<i>Rastrelliger faughni</i>	Leyte Gulf	30.10	30.91	2.00	2.80	3.79	1986-1987	Gonzales <i>et al.</i> (1997)
<i>Rastrelliger faughni</i>	Tayabas Bay	28.10	29.21				1987	Gonzales <i>et al.</i> (1997)
<i>Rastrelliger brachysoma</i>	Guimaras Strait	28.50	29.89	1.40	2.25	4.33	1984-1986	Gonzales <i>et al.</i> (1997)
<i>Rastrelliger brachysoma</i>	Visayan Sea	31.80	31.81				1983-1988	Gonzales <i>et al.</i> (1997)
<i>Rastrelliger brachysoma</i>	Leyte Gulf	27.30	27.08				1983-1987	Gonzales <i>et al.</i> (1997)
<i>Auxis thazard</i>	Camotes Sea	36.60	38.23	1.20	1.90	4.78	1983-1987	Gonzales <i>et al.</i> (1997)
<i>Auxis rochei</i>	Camotes Sea		36.69				1983-1987	Gonzales <i>et al.</i> (1997)

Table 5: Growth and mortality parameters for Sardines, Anchovy and Mullet species in the Philippines

Family/Species	Area	L (cm)	L'max (cm)	K (yr-1)	M (yr-1)	Z (yr-1)	Year (s)	References
SARDINELLA								
<i>Sardinella fimbriata</i>	South Sulu Sea	20.10	21.41				1983-1988	Gonzales <i>et al.</i> (1997)
<i>Amblygaster sirm</i>	South Sulu Sea	25.20	26.74	2.10	3.04	6.99	1983-1988	Gonzales <i>et al.</i> (1997)
<i>Amblygaster sirm</i>	Camotes Sea	31.00	24.28	1.35	2.15	6.88	1987	Gonzales <i>et al.</i> (1997)
<i>Sardinella albella</i>	Visayan Sea	26.40	25.40				1983-1986	Gonzales <i>et al.</i> (1997)
<i>Sardinella albella</i>	Guimaras Strait/ Samar Sea	23.00	23.93				1983-1986	Gonzales <i>et al.</i> (1997)
<i>Sardinella longiceps</i>	South Sulu Sea	19.40	20.82	1.00	2.01	2.54	1987	Gonzales <i>et al.</i> (1997)
<i>Sardinella longiceps</i>	Visayan Sea	30.40	27.14	0.98			1983-1987	Gonzales <i>et al.</i> (1997)
ENGRAULIDAE								
<i>Stolephorus commersonii</i>	Manila Bay	11.30	10.00	0.96	2.28			Ingles and Pauly (1984)
<i>Stolephorus commersonii</i>	Illana Bay	13.30	11.54				1983	Gonzales <i>et al.</i> (1997)
<i>Stolephorus punctifer</i>	Manila Bay	10.10	9.00	1.10	2.55			Ingles and Pauly (1984)
<i>Stolephorus punctifer</i>	Manila Bay	10.60	9.20	1.85	3.53			Ingles and Pauly (1984)
<i>Stolephorus punctifer</i>	Manila Bay	9.20	8.00	1.15	2.69			Ingles and Pauly (1984)
<i>Stolephorus punctifer</i>	Tayabas Bay	11.60	12.10				1987	Gonzales <i>et al.</i> (1997)
<i>Stolephorus punctifer</i>	South Sulu Sea	12.40	12.60	1.20	2.57	3.51	1987	Gonzales <i>et al.</i> (1997)
<i>Stolephorus indicus</i>	Manila Bay	16.30	15.00	1.42	2.67			Ingles and Pauly (1984)
<i>Stolephorus indicus</i>	Manila Bay	15.70	15.00	1.08	2.23			Ingles and Pauly (1984)
<i>Stolephorus indicus</i>	Ragay Gulf	14.50		1.30	2.55			Corpuz <i>et al.</i> (1985)
<i>Stolephorus tri</i>	Ragay Gulf	14.50		1.30	2.55			Corpuz <i>et al.</i> (1985)
<i>Stolephorus tri</i>	Samar Sea	14.50		1.30	2.55			Corpuz <i>et al.</i> (1985)
<i>Stolephorus heterolobus</i>	Tayabas Bay	11.60	12.00	2.30	4.01	5.78	1987	Gonzales <i>et al.</i> (1997)
<i>Stolephorus heterolobus</i>	South Sulu Sea	12.30	12.70	1.50	2.98	5.34	1987	Gonzales <i>et al.</i> (1997)
<i>Engraulis japonicus</i>	Tayabas Bay	12.90	13.50				1987	Gonzales <i>et al.</i> (1997)
<i>Engraulis japonicus</i>	South Sulu Sea	13.40	14.20				1987	Gonzales <i>et al.</i> (1997)
MUGILIDAE								
<i>Liza subviridis</i>	Manila Bay	36.50	3.19	0.63			1978-1979	Ingles and Pauly (1984)

Table 6: Annual landings of small pelagic fishes from 1984-1995

Family/Species	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	mean
Sphyraenidae													
<i>Sphyraena</i> spp. (Barracudas)	8,888	8,454	11,191	10,234	11,133	10,746	11,507	12,307	12,200	11,937	11,039	10,654	10,858
Mugilidae (Mulletts)	13,077	11,865	12,901	14,895	14,300	14,306	14,648	15,363	18,719	13,726	17,272	14,113	14,599
Carangidae													
<i>Decapterus</i> spp. (Roundscad)	131,673	131,708	175,855	184,411	178,687	209,821	249,300	277,330	296,979	272,049	233,160	260,946	216,827
<i>Selar</i> spp. (Big-eye/ox-eye scad)	37,513	33,481	34,407	35,461	36,530	38,614	41,255	36,264	37,766	33,498	50,288	43,913	38,249
<i>Megalaspis cordyla</i> (Hardtail)	5,106	5,943	6,586	6,790			8,453	9,297	10,316	8,345	3,032	1,530	6,540
<i>Caranx</i> spp. (Crevalle & Cavalla)	45,614	42,350	42,150	44,189	45,710	37,284	37,502	39,939	47,066	44,631	47,531	39,682	42,804
Stromateidae													
<i>Formio niger/Stromateus</i> spp. (pomfrets)	1,964	1,175	2,332	1,753			626	697	1,331	1,354	1,112	927	1,327
Clupeidae													
<i>Sardinella</i> spp. (Sardines)	109,027	81,927	73,303	98,694	96,405	122,465	156,748	158,622	195,879	256,744	248,834	270,289	155,745
Engraulidae													
<i>Stolephorus</i> spp. (Anchovies)	99,545	109,885	99,687	108,373	126,373	122,250	107,036	100,882	84,652	81,437	65,380	71,516	98,085
Chirocentridae													
<i>Chirocentrus</i> spp. (Wolf herring)	2,659	2,482	4,004	7,125			52	127	361	259	131	39	1,724
Scombridae													
<i>Rastrelliger</i> spp. (mackerel)	60,842	66,374	65,476	68,053	80,091	74,962	89,309	91,526	87,664	84,241	85,971	78,008	77,710
<i>Auxis</i> spp. (Frigate & Bullet tunas)	80,305	95,718	87,225	98,032	105,436	117,545	88,801	93,236	125,655	110,357	109,887	88,421	100,052
<i>Euthynus</i> spp. (Eastern little tuna)	41,899	41,060	42,445	46,934	56,266	57,899	43,762	47,850	31,943	26,670	46,321	54,486	44,795
<i>Scomberomorus</i> spp. (seerfishes)	13,725	12,746	15,150	17,852	13,796	17,908	14,995	16,187	9,072	12,959	9,234	10,593	13,685
Trichiuridae													
<i>Trichiurus</i> spp. (Hairtail)	8,664	7,364	9,658	9,795	10,387	11,235	14,320	13,845	16,730	15,320	16,175	12,516	12,167
<b>TOTAL</b>	<b>660,501</b>	<b>652,532</b>	<b>682,370</b>	<b>752,591</b>	<b>775,114</b>	<b>835,035</b>	<b>878,314</b>	<b>913,472</b>	<b>976,333</b>	<b>973,527</b>	<b>945,367</b>	<b>957,633</b>	<b>833,566</b>

Source: BFAR Fisheries Statistics (1984-1987)  
Bureau of Agricultural Statistics (1988-1995)

Table 7: Commercial landings of small pelagic fishes per fishing grounds from 191 to 1995

Family/Species	West Palawan Waters	West Sulu Sea	South Sulu Sea	Visayan Sea	Moro Gulf	Lamon Bay	East Sulu Sea	Cuyo Pass	Tayabas Bay	Batangas Coast	Bohol Sea	Others
<b>Sphyraenidae</b>												
<i>Sphyraena</i> spp. (Barracudas)	1,959	914	397	6,227	1,459	744	37	266	1,564	3	797	5,848
Mugilidae (Mulletts)	39	56	30	20	13	75	129	3	142		5	4,150
<b>Carangidae</b>												
<i>Decapterus</i> spp. (Roundscad)	421,682	11,632	303,874	109,882	137,832	44,122	27,092	10,360	24,083	2,541	21,924	98,727
<i>Selar</i> spp. (Big-eye/ox-eye scad)	8,986	2,131	19,829	12,203	11,253	2,605	1,307	842	617	91	3,659	22,042
<i>Megalaspis cordyla</i> (Hardtail)	1,315	429	171	3,991	401	49	278	645	907	3	78	6,716
<i>Caranx</i> spp. (Crevalle & Cavalla)	8,671	2,682	6,734	21,498	4,262	2,088	622	950	2,258	24	1,606	15,856
<b>Stromateidae</b>												
<i>Formio niger/Stromateus</i> spp. (pomfrets)	538	32	10	1,530	481	143	64	27	23		9	2,564
<b>Clupeidae</b>												
<i>Sardinella</i> spp. (Sardines)	75,437	10,971	214,870	248,171	43,515	6,584	36,861	2,754	6,061	897	48,270	81,182
<b>Engraulidae</b>												
<i>Stolephorus</i> spp. (Anchovies)	6,212	5,309	9,991	4,613	13,475	17,246	3,893	4,999	16,564	920	2,699	45,634
<b>Chirocentridae</b>												
<i>Chirocentrus</i> spp. (Wolf herring)	1		203	184	34	6	15	43		23		408
<b>Scombridae</b>												
<i>Rastrelliger</i> spp. (mackerel)	31,845	2,610	39,677	66,578	11,505	6,787	6,939	1,769	5,136	181	4,471	43,729
<i>Auxis</i> spp. (Frigate & Bullet tunas)	43,450	2,861	19,777	26,887	21,550	1,697	29,321	14,983	12,488	4,115	53,434	40,846
<i>Euthynus</i> spp. (Eastern little tuna)	2,265	40	7,882	23,406	10,574	388	3,581	1,769	20	5	79,346	10,000
<i>Scomberomorus</i> spp. (seerfishes)	744	433	925	986	1,161	355	92	149	8	3	218	3,012
<b>Trichiuridae</b>												
<i>Trichiurus</i> spp. (Hairtail)	2,398	380	66	10,109	327	238	52	92	578	10	160	15,853
<b>TOTAL</b>	<b>605,542</b>	<b>40,480</b>	<b>624,436</b>	<b>536,285</b>	<b>257,842</b>	<b>83,127</b>	<b>110,283</b>	<b>39,651</b>	<b>70,449</b>	<b>8,816</b>	<b>216,676</b>	<b>396,567</b>

Source: Bureau of Agricultural Statistics (1991-1995)