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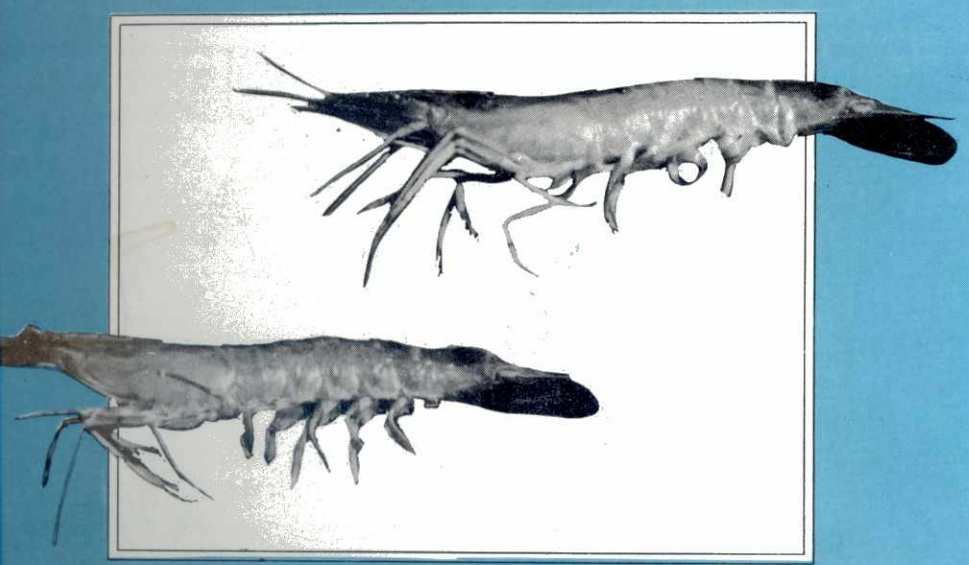

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Synopsis of Biological and Related Data on the Philippine Roundscads

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ABSTRACT

This paper includes information on species identification; catch data; fishing grounds and seasonality; and biological information such as length-weight relationships, sex ratio, food habit, fecundity, predators, recruitment pattern, chemical composition, distribution and behavior, domestic and export market. It also contains comments and recommendations for possible development and management of the Philippine roundscads.

About 25 published and unpublished papers from 1971 up to 1991 were reviewed.

Keywords: roundscad, pelagic fish

INTRODUCTION

The roundscads are considered the most important small pelagic fish species in terms of its availability throughout the year from municipal and commercial catches all over the country. Hence, it is always affordable as a common source of animal protein.

These group of fishes are marketed fresh or processed (smoked, dried, made into fish paste/sauce). At present, there is a great demand for these fishes as raw material for canning and other non-traditional product development.

Studies on the biology of roundscad fisheries was started by Tiew et al. (1975). Ronquillo (1975) reviewed the development of roundscad fishing in the Philippines with emphasis on the information on the major fishing grounds and seasonality.

Assessment and resources evaluation in the Philippine roundscad stocks was initiated by the South China Sea Programme (SCSP) through workshops (1976, 1977, 1978a and b) which came up with preliminary estimates of optimum

yields and effort based on the catch and effort data gathered from BFAR statistics. Similarly, Calvelo and Dalzell (1987) reviewed the status of the exploited stocks of Philippine roundscad using also the data gathered from the BFAR statistics of 1976 to 1988, with additional monthly summary data of catches landed at the Navotas Fishery Port Complex from the Philippine Fisheries Development Authority (PFDA) and other relevant information excerpted from other sources. Majority of the roundscad landed at Navotas are from off Palawan-Mindoro waters (Ronquillo, 1973).

Other studies on the Philippine roundscad are those of Ingles and Pauly (1984), Corpuz et al. (1985) and Gonzales-Lavapie (1987) using length frequency data to determine growth, mortality and recruitment parameters.

This paper contains the current situation of the Philippine roundscad fisheries and its outlook for possible development and management.

GENERAL INFORMATION - Genus *Decapterus* (Bleeker)

The genus *Decapterus* (Bleeker) commonly known as roundscads and locally known as *galongong* in the Philippines, can easily be distinguished from other genera of the family Carangidae by its single finlet behind the dorsal and anal fins. Because of their mackerel-like body, species of this genus are also referred to as mackerel scads.

The different species of roundscad can be recognized easily from each other by their individual characteristics, such as color of the body and fins, scutes along the lateral line, body form and other morphological features, and by their meristic characters.

There are five species identified from Philippine waters, namely, *Decapterus macrosoma; D. maruadsi; D. macarellus; D. russelli* and *D. kurroides*.

Table 1 and Figures 1a to 1c show the distinguishing characteristics of each of the species of the genus *Decapterus*.

CATCH DATA AND OTHER INFORMATION

The catch data presented here are gathered from the Fisheries Statistics of the Philippines (1978 to 1987) of the Bureau of Fisheries and Aquatic Resources (BFAR) and from the Fishery Statistics (1988 to 1991) of the Bureau of Agricultural Statistics (BAS).

Other information was extracted from various sources, i.e., published articles

references on roundscads; data from progress reports of research projects on roundscads and from other studies on pelagic fish species.

CATCH DATA ANALYSIS

Roundscad production

Between 1982 to 1991, the roundscads contributed an average production of 188,609 mt or 13.2% of the country's total marine fish production (Table 2).

The composition of important small pelagic fishes landed by commercial and municipal fishing gears from 1982 to 1991 are shown in Tables 3 and 4.

In this paper, the important small pelagic fish species grouped together with roundscads are anchovies, sardines, mackerel, roundherring, big-eyed scads and fusilliers (a dominant small pelagic fish caught around coral reef).

Roundscads rank fourth in the total municipal catch, with the average volume of 29,239 mt (11.78%), and first in the total commercial catch, with an average of 159,458 mt (50.18%).

More than 84.5% of the average total catch of roundscads are landed by the commercial gears, amounting to 159,458 mt, and about 15.5% or 29,152 mt by municipal gears (Table 5).

Analysis on the landings of roundscads caught by commercial gears showed that more than 55.6% or 70,013 mt are landed by purse seines. Bagnet catches followed with 18.88% (23,787 mt); trawl, 17.26% (21,745 mt); ringnet, 7.84% (9,876 mt) and other commercial gears with very minimal catch contribution of 0.55% (754.05 mt) (Fig. 2).

For municipal landings, gillnet ranked first with 32.38% (9,119.9 mt) followed by hook and line, 19.25% (5,421.7 mt) purse seine/ringnet, 14.01% (3,946.3 mt) and bagnet, 8.92% (2,512.3 mt). The rest of the gears with less than 50% share are the beach seine, fish corral, round haul seine, baby trawl, longline, muro-ami and other unidentified gears (Fig. 3).

Roundscad fishing grounds and seasonality

Figure 4 shows the most important fishing grounds and fishing seasons of roundscads in the Philippines.

The roundscads, being a pelagic fish species, are caught mostly in waters not exceeding 200 m deep, between Central Luzon and in the southern coast of Mindanao (Calvelo and Dalzell, 1987).

The Sulu Sea area is practically the richest fishing grounds for roundscads, which accounted for 60% of the total roundscad catch. The Visayan Sea ranked second, followed by Moro Gulf, then by the rest of fishing grounds as shown in Table 6.

In general, the fishing season for roundscads in the Philippines is throughout the year. Data from the Navotas Fish Port Complex, the biggest fish landing center of the Philippines, where almost all catches of the major fishing grounds are represented (Visayan Sea, Mindoro waters, especially the Sulu Sea), show that the highest production of roundscads occurs during the summer months (March, April and May). This was shown by the average monthly data from fish landings collected from 1980 to 1985 (Fig. 5). This pattern of production, however, may not be the same in other specific fishing grounds. In Mercedes Fish Landing, Daet, Camarines Norte, where roundscads are the most important bulk of the commercial bagnet catches from Lamon Bay, the peak season is during the southwest monsoon (June to August) as described by Calvelo, et al. (1991) (Fig. 6).

Studies done by Caliente (1987) showed that *Decapterus* spp. were caught by ringnet in big quantities in Camotes Sea, Western Samar, with *D. ruselli* as the major component of the *Decapterus* catch. The data gathered in a five-year period are evidence that the peak season for *D. ruselli* (and other roundscad species) in this area is during the summer months, which is in contrast to the peak season in Lamon Bay (Fig. 6a).

BIOLOGICAL INFORMATION

Length-Weight Relationship

The formula used in the analysis of length-weight relationship of roundscads was:

$W = aL^b$ or rewritten in linear form:

$\text{Log } W = a + b \text{ Log}^L$

Where W is the weight; a, intercept and b, slope, both of which are constant and L is the length.

Magnusson (1973) computed the length-weight relationship for both sexes of *D. macrosoma* and *D. russelli* based on 5,899 pcs. of *D. macrosoma* with lenghts ranging from 8-30 cm, and 3,744 individuals of *D. russelli*, with length ranging from 8.5 -28 cm.

The computed values of the length-weight data for both sexes of *D. macrosoma* and *D. russelli* from Sulu Sea are shown below:

Species	a	b	pcs
D. macrosoma	0.005639	3.15994	5,899
D. russelli	0.0099771	3.01520	3,744

Based on the above values, both species of roundscads exhibited an isometric growth, that is, the relative growth of the body parts is constant.

Gonad maturity and spawning period

A protracted spawning period from November to March was observed by Tiews et al. (1970) for both D. macrosoma and D. russelli samples taken from Palawan waters and Manila Bay approach. Spawning in Manila Bay seemed to be delayed by two months, extending to April to May.

Fish egg, larvae and juvenile stages of the family Carangidae (Fig. 7) were among other species towed in higher concentration from the area off Mindoro and Balayan Bay during the survey in March and April 1971. The data show that these areas and the adjacent regions are the spawning grounds of fish such as Thunnidae, Carangidae, Serranidae, Mullidae, etc. (Ordonez et al., 1973).

Most likely, the eggs, larvae and juvenile stages of the roundscads were included with the identified family Carangidae, considering that the area is one of the important fishing grounds for roundscads.

Studies conducted by Calvelo et al. (1991) in Lamon Bay, particularly around Calagua Island, showed that about 50% of the *D. macrosoma* and *D. maruadsi* samples belonged to the immature or maturing stages with very few mature individuals during the southwest monsoon period (August 1978 and July 1979). A considerable percentage of fry (3.5 cm TL) was also observed during the period.

The oceanographic fishing surveys conducted in April 1967 showed that fish eggs and larvae were present throughout the entire region of Lamon Bay and Approaches (Magnusson et al., 1973). The presence of fry from the catch of bagnet in Calagua Island , off Lamon Bay, may also suggest that these areas are spawning grounds and that the spawning period is a few months ahead.

The presence of fish eggs and larvae at the important fishing grounds of

roundscads at different periods as shown in Figures 8, 9 and 10, may be extensive fishing areas of roundscads. Ronquillo (1973) emphasized that the extensive fishing areas of roundscads may also possibly be their spawning grounds, although they differ in density.

Sex ratio

Sex ratio of *Decapterus spp.* species differ by areas and by species. Tiews et al. (1970) observed that there were slightly more male *D. russelli* but more female *D. macrosoma* during most of the study period in Manila Bay. But altogether in the Palawan waters and Manila Bay, the male-to-female ratio was almost equal.

The catch of ringnet from Camotes Sea, Western Leyte, showed that with regard to *D. russelli*, the male fish slightly dominated the female with a ratio of 1.05:1 (Caliente, 1984).

D. macrosoma and *D. maruadsi* from the catches of bagnets at Calagua Island, Lamon Bay, showed that female fish dominated the male with a ratio of 1.2:1 (Calvelo et al., 1991). Those from the Sulu Sea indicated a slight dominance of males, with a ratio of 1.04:1 for *D. macrosoma* and 1.8:1 for *D. maruadsi* (Unpublished).

Food habits

Decapterus macrosoma is a typical zooplankton feeder, while *D. russelli* feeds on smaller fishes.

FAO (1984) described that roundscad species in general are plankton feeders, they feed primarily on smaller plankton invertebrates.

Fecundity

For *D. macrosoma*, there were between 67,900 and 106,200 eggs while much fewer eggs were counted for *D. russelli*, 28,700 and 48,000 (Tiews et al., 1970).

Infestation with parasites

Numerous nematode parasites were noted in the mesenteries and omenta of both *D. macrosoma* and *D. russelli* from Palawan waters and Manila Bay approaches, but higher incidence were noted from Palawan, which may be an indication of autonomy of the fish stock in one area from the other. The average number of parasites and the infestation rate increased with the size of both

roundscad species. Although the parasites were present throughout the year, more parasites per fish were recorded towards the end of the year (Tiews et al., 1970).

The parasites are larval marine form of nematode belonging to subfamily *Anisakinae* (*Anisakis* and *Raphidascaris*) as identified by Valasquez (1972).

Predators

Ronquillo (1953) identified *Decapterus* as among the pelagic fishes found very often in the diet of tunas and dolphinfish.

Decapterus spp. ranked 10th in the food intake of yellowfin tuna (Barut, 1992).

Life span

Information on the life span of the *Decapterus* spp. are as follows: *D. maruadsi*, 4.2 years (Corpus et al., 1984); *D. russelli*, 2.8 years (Ingles and Pauly, 1984); and *D. macrosoma*, 3.2 years (Ingles and Pauly, 1984).

Recruitment pattern

Three general annual recruitment patterns were found for *D. macrosoma* and *D. russelli* from Palawan waters and Manila Bay, namely, (1) a single protracted pulse; (2) two distinct unequal, pulses with one stronger than the other; and, (3) one relatively short pulse (Ingles and Pauly, 1984). A similar pattern was observed for *D. macrosoma* and *D. maruadsi* from Burias Pass, Samar Sea, and Ragay Gulf but with two distinct pulses of unequal strength (Corpuz et al., 1985).

Other biological parameters

Table 7 shows the compilation of information on length infinity (L ∞); total mortality (Z); and exploitation rate (E) for *Decapterus* spp. from different fishing grounds of the Philippines from 1957 to 1986.

Chemical composition:

The fat content of *D. russelli* ranged from 6.8% to 19.3%, higher than *D. macrosoma* which ranged from 5.2% to 14.4% (Tiews et al., 1971).

The approximate chemical composition of *D. macrosoma* is as follows: Edible protein, 71.24%; non-edible protein, 28.76%; moisture, 74.19%; Ash (minerals), 1.81%; and protein (Nx6.25), 21.90% (Sulit et al., 1953).

Distribution and behavior

The roundscad is a schooling species. It occurs throughout Philippine marine waters with salinity value not lower then 30 ppt at water depth ranging from 20-25 fathoms to 100 fathoms (Tiews, et al., 1975).

The establishment of fish aggregating device (FAD) or *payao*, together with purse seine and ringnet operations, in the late 1970s in Philippine marine waters with depths ranging from 100 fms to 2,000 fms has contributed to changes in the distribution and behavior of roundscads.

Catches of purse seine and ringnet operations in the Moro Gulf, one of the richest tuna fishing grounds of the country, showed that the roundscad species *D. macarellus*, was caught along with tuna species as the main catch (BFAR Tuna Research Project, 1972). In Davao Gulf, *D. macrosoma*, *D. macarellus* and *D. kurroides* are present throughout the year based on the ringnet catch data , (BFAR Resource Assessment Project, 1985-86). *D. macarellus* is the oceanic type of roundscad which normally stays under the payao (Ronquillo, per. comm., 1988). This may also indicate that the other species mentioned are the offshore type in some stages of their life.

Both purse seine and ringnet use light during operation. It is noteworthy, however, that Tiews et al. (1973) reported that the breeding fish may have different habits and are no longer attracted to light, become more sedentary and feed on benthos. Nevertheless, this still needs further studies/observations.

The roundscads like the tuna belong to the circumtropical group of the outer Neritic and contiguous oceanic regime (Yesaki, 1983). This characteristic may be the basis for the idea that this resource is shared by the neighboring countries.

Marketing

Domestic Market

Because roundscad is available throughout the year, although the volume of catch depends on the monsoon season and the area, it is marketed for various forms of consumption nationwide.

As with other prime commodities, the price of fish follow the law of supply and demand. The price of roundscads are low during the summer months and high during the early and late months of the year. Studies conducted by Bimbao et al. (1991) confirmed the price seasonality pattern from 1991 to 1992 for wholesale and retail prices (Table 8).

Export Market

Roundscads are not only important for human consumption but they are also used as baits in sports fishing; as feeds in fish culture (fresh forms or processed into fish meal) and as chum for animals and mammals used for entertainment, like porpoise, turtles and dolphins.

There is no particular record of exported value and volume of roundscads, as this fish are lumped with other frozen fishes in the BFAR Export Processing records (per comm.).

INDICATIONS AND EVIDENCE OF OVERFISHING

Due to rapid development and improvement of fishing gears in the early 1960s, small pelagic production increased rapidly, but with continued increase in effort up to the early 1970s, there is no corresponding increase in catch. This situation is a sign of overexploitation as discussed by several authors.

The facts and figures of such severe overexploitation of small pelagic resources have been documented and presented in the form of time series of total small pelagic catch per unit effort, from 1948 to 1986 by Dalzell and Corpuz (1987) (Fig. 11). They indicate that the catch per unit effort has been continuously declining starting in the early 1970s.

The other basis of evaluation was mortality estimates, that is, the ratio of fishing mortality (F) to natural mortality (M), an indirect method of mortality estimates that indicates how heavily a stock is fished (Dalzell and Ganaden, 1987).

Gulland (1971) as cited by Dalzell and Ganaden (1987) suggested that optimum level of fishing effort is achieved when fishing mortality approaches natural mortality for F. Opt. 1= M. They explain further that Pauly (1984) based on Beddington and Coke (1983) proposed that optimum fishing mortality should be approximately 40% of the natural mortality, or F Opt. 2 = 0.4 M.

In the Philippines as in other Southeast Asian fisheries, the small pelagic fisheries are multigear and multispecies fisheries so that there is no direct method to examine the effect of fishing pressure on specific species like the roundscads.

However, Ingles and Pauly (1984) and Corpuz et al. (1985), as cited by Calvelo and Dalzell (1987), applied the same mortality estimate to indicate how heavily exploited the stock of *D. macrosoma* was from Palawan waters and other *Decapterus* spp. from Philippine waters. Figure 12 shows the plot of these F and M values with the lines corresponding to F Opt. 1 and F Opt. 2. It shows also that the ratio of F:M for the Palawan-Mindoro stock are higher then F Opt. 1. It

shows further that the values of the F:M ratio for all the *Decapterus* spp. including *D. macrosoma* are higher than the more conservative F Opt. 2. The present levels of apparent fishing mortality for the Philippine roundscad stocks indicate heavy overexploitation and overfishing.

On the other hand, using the surplus production curves of Shaefer or Fox type through conventional method approach of investigating the effect of fishing upon an exploited stock, Calvelo and Dalzell (1987) were able to draw data on the relationship between catch and effort of roundscads from 1978 to 1984, using the National Commercial Fisheries Production from purse seine, bagnet and ringnets (Fig 13a to 13c).

From the catch of the said gears, it is evident that the catch per vessels/gear of roundscads declined with the increase in vessels or effort. Calvelo and Dalzell (1987) stated that roundscad stock in the Philippines may currently be fished at or beyond the level of effort appropriate for generating MSY, if the result of catch per vessel relationships have some validity.

COMMENT AND RECOMMENDATION

More information on the roundscad resources are still needed.

Detailed biological aspects of the Philippine roundscad is scanty. Some biological studies have focused more *on D. macrosoma, D. maruadsi* and *D. russelli*. Researches should also be initiated for *D. macarellus* and *D. kurroides*.

Knowledge of fish eggs and larvae identification and recruitment pattern should likewise be considered an important information on this resource.

Work should also be conducted on tagging experiment to prove the theory that roundscads like tuna are shared stocks of the neighboring countries.

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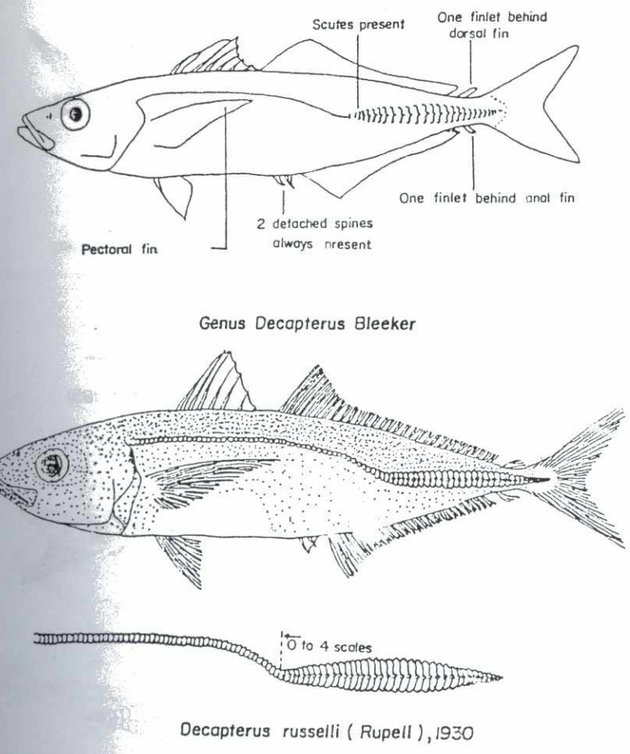
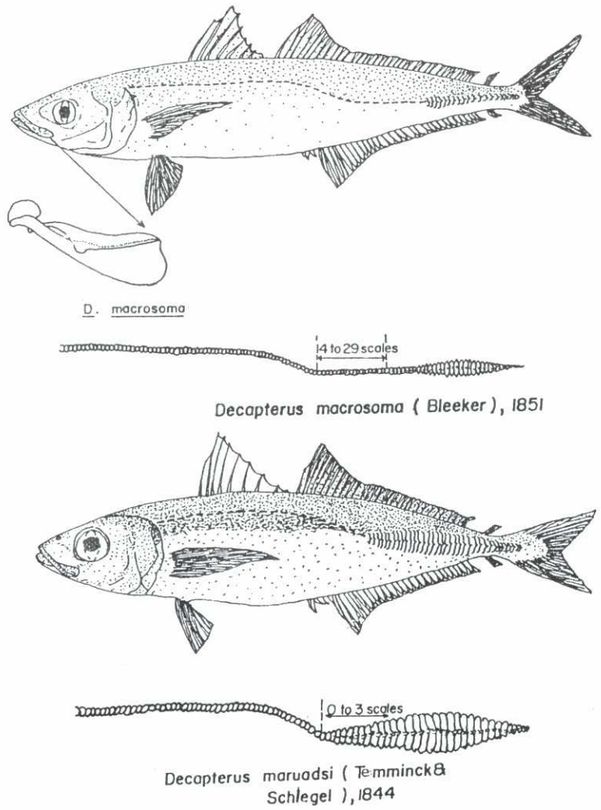


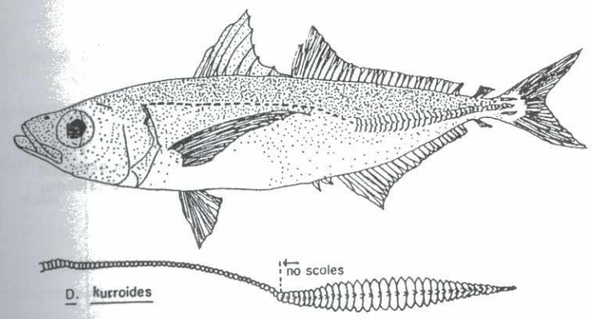
Figure 1a. **Genus *Decapterus* and *Decapterus resselli***



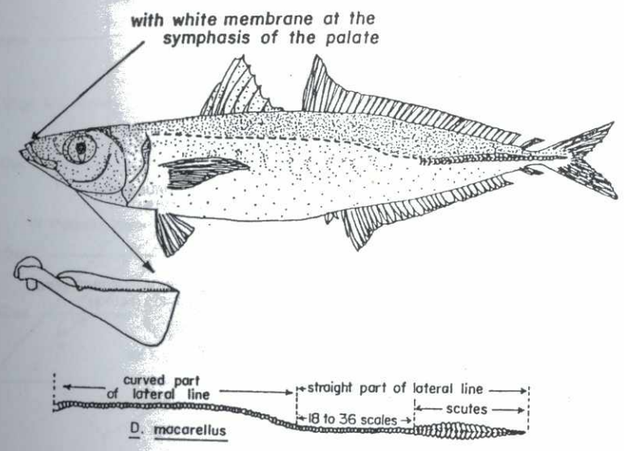
Decapterus macrosoma (Bleeker), 1851

Decapterus maruadsi (Temminck& Schlegel), 1844

Figure 1b. ***Decapterus macrosoma*** and ***D. maruadsi***



Decapterus kurroides (Bleeker), 1855



Decapterus macarellus (Cuvier), 1833

Figure 1c. ***Decapterus kurroides*** and ***D. macarellus***

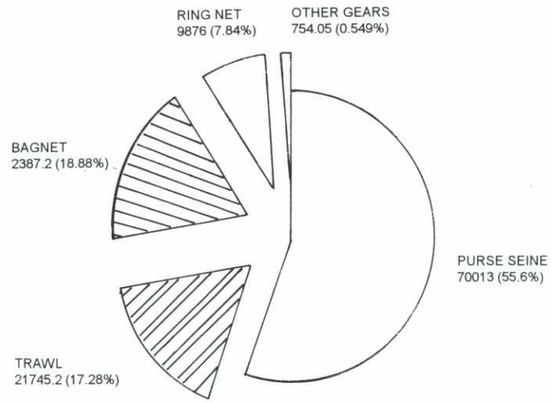


Figure 2. **Roundscad landing by commercial gear (1978-1987)**

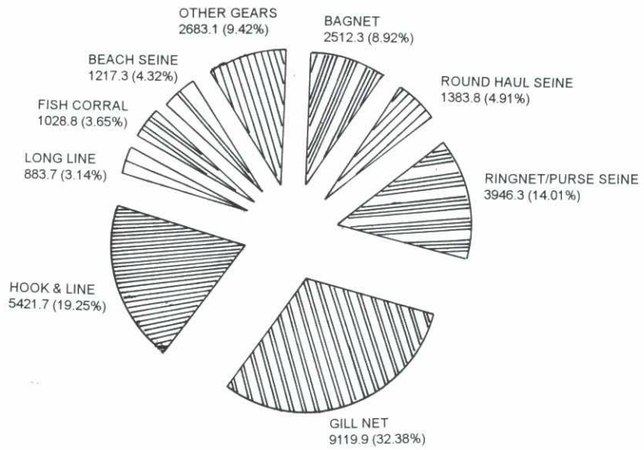


Figure 3. **Roundscad landing by municipal gear (1978-1987)**

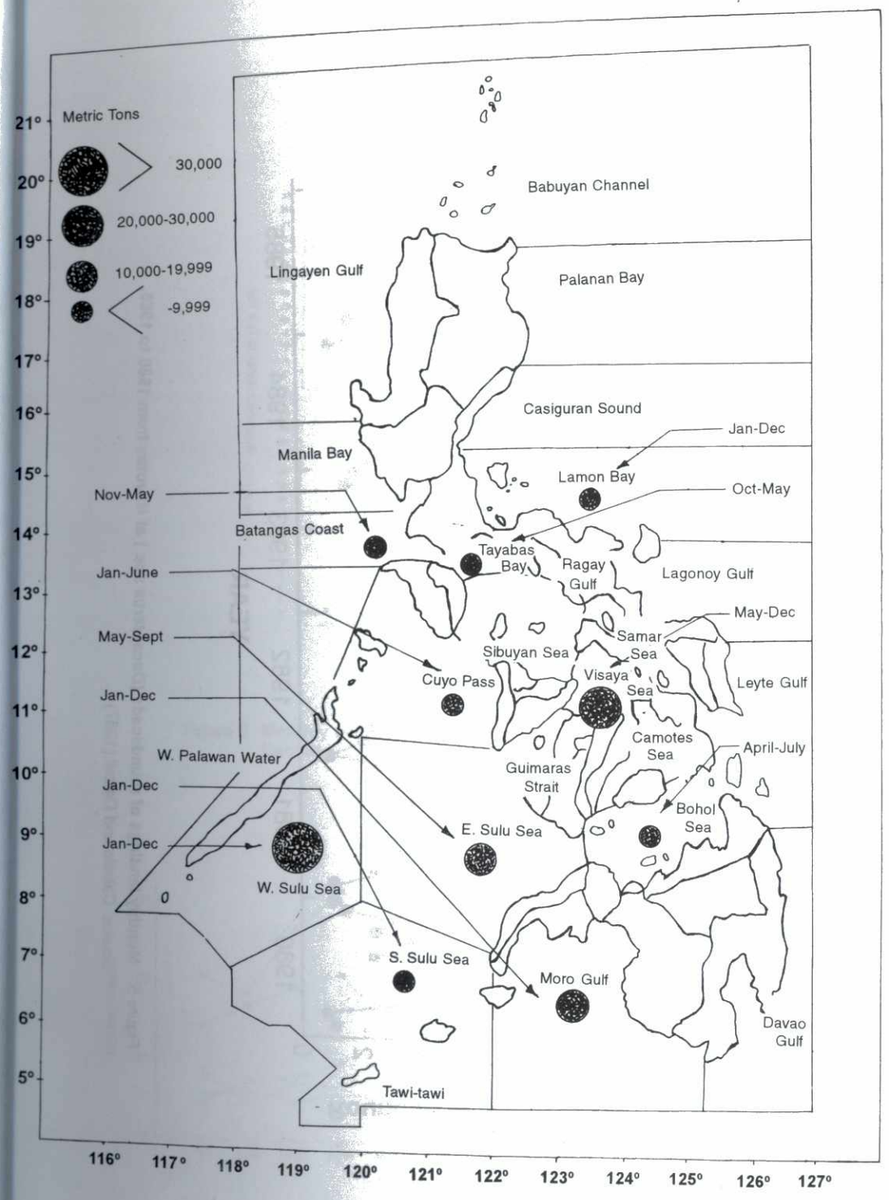


Figure 4. **The most important fishing grounds for the roundscads in the Philippines showing the average production from 1980 to 1987 and the fishing season.**

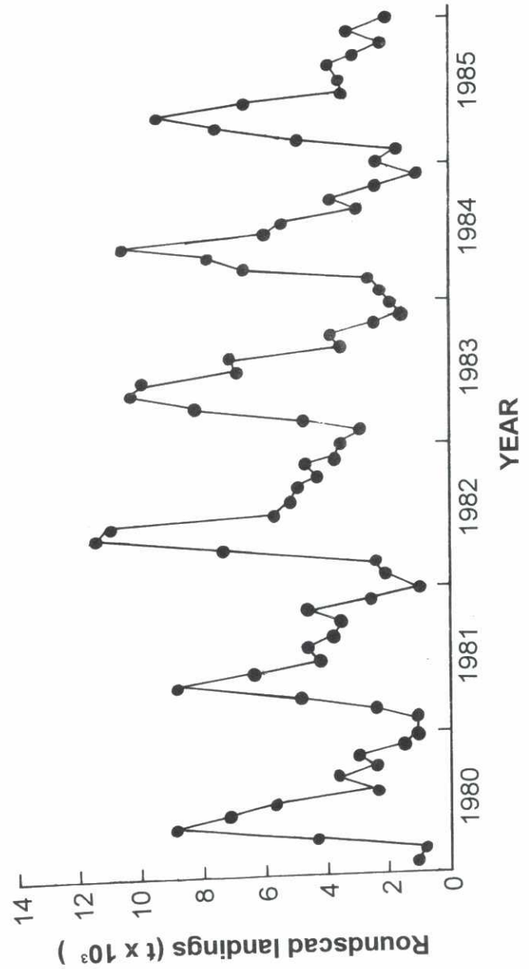


Figure 5. **Monthly landings of roundscads (*Decapterus* spp.) at Navotas from 1980 to 1985.** Source: Calvelo and Dalzell (1987)

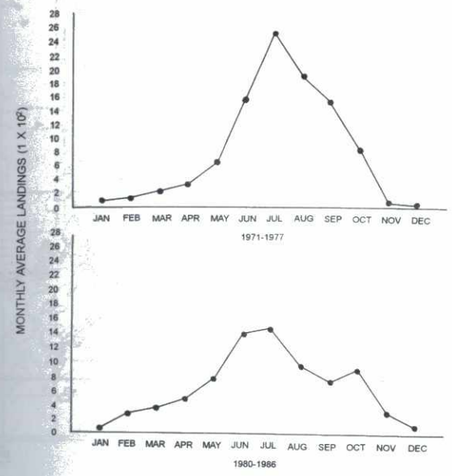


Figure 6. **Monthly average landings of bagnet catches at Mercedes, Camarines Norte**

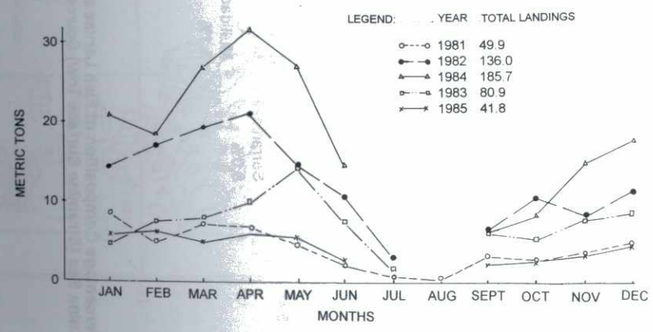


Figure 6a. **The monthly landings of D. ruselli in Western Leyte from 1981 to 1985. (Gear used-ring net)** Source: Caliente (1984)

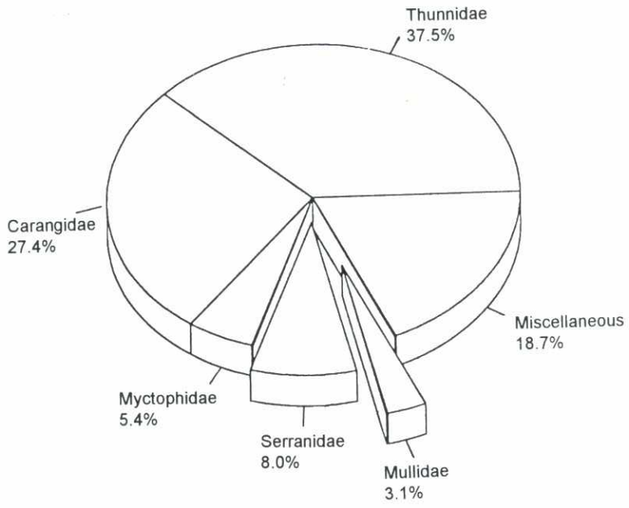


Figure 7. **Percentage Composition of Fish Larvae and Juvenile of South China Sea (Stramine Surface Tow)** Source: Ordonez et. al. (1973)

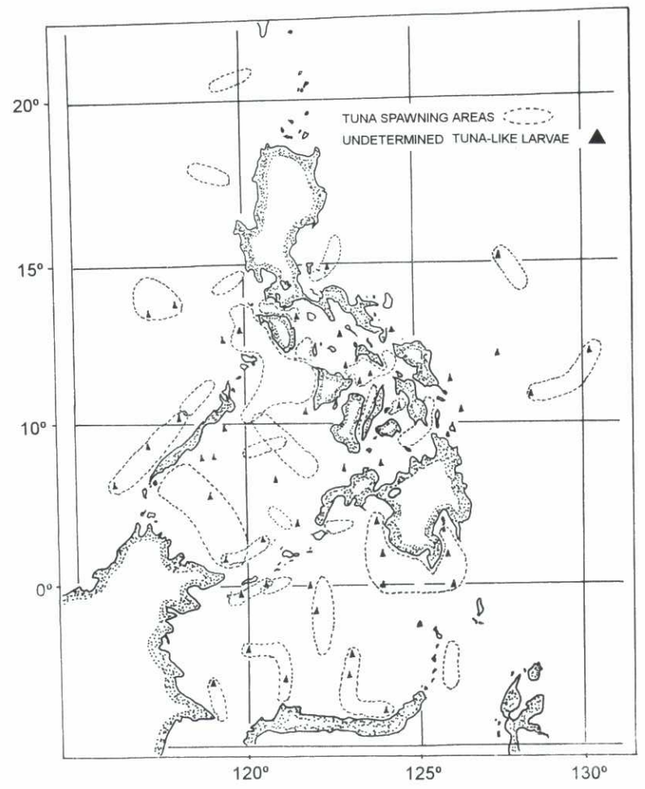


Figure 8. **Spawning areas of tuna and tuna-like larvae (after Wade, 1951.**

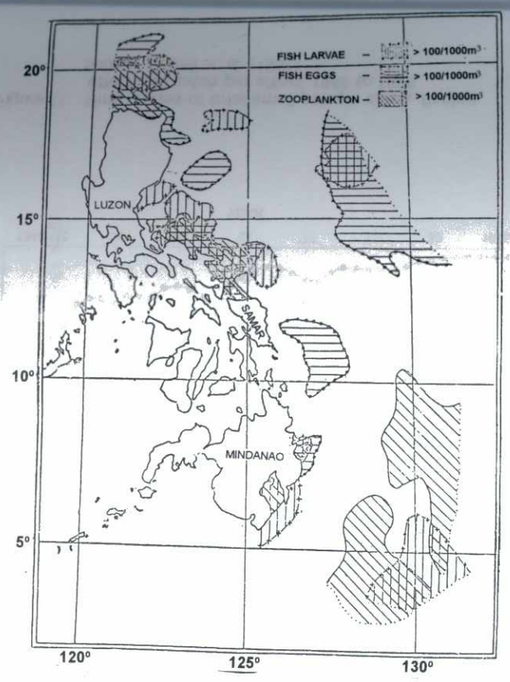


Figure 9. **Concentration of Zooplankton, fish eggs and larvae (100/1000m3 and above) east of the Philippines during the winter months (after Tan *et. al.*, modified)** Source: Ronquillo (1973)

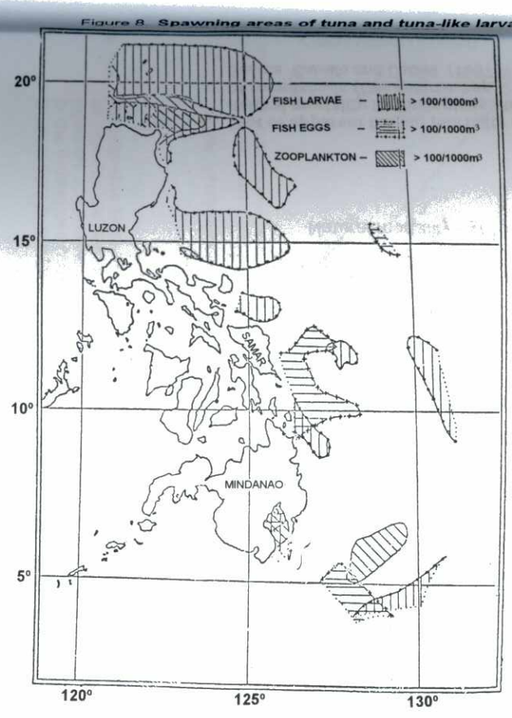
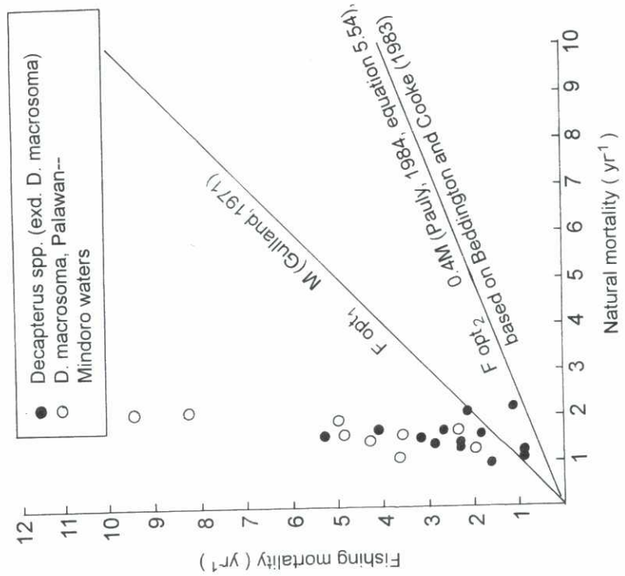


Figure 10. **Concentration of Zooplankton, fish eggs and larvae (100/1000m3 and above) east of the Philippines during the summer months (afterTan *et. al.*, modified)** Source: Ronquillo (1973)



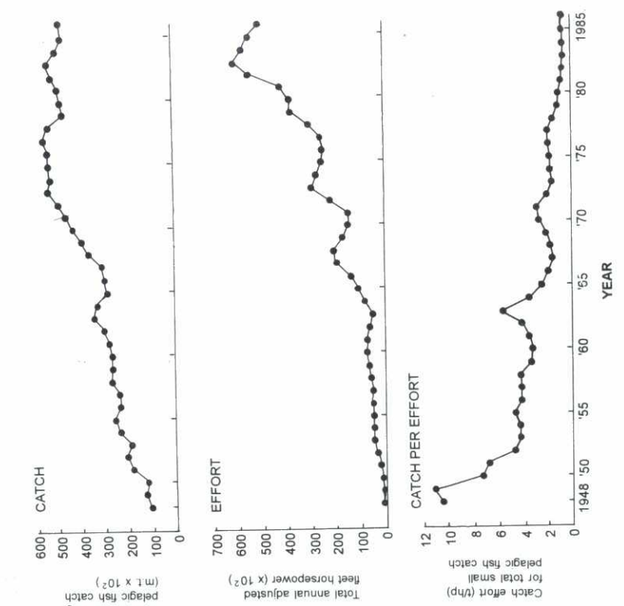


Figure 11. **Time series of total small pelagic catch, fishing effort and catch per effort, 1948 to 1986.** Source: Dalzell et. al. (1991)

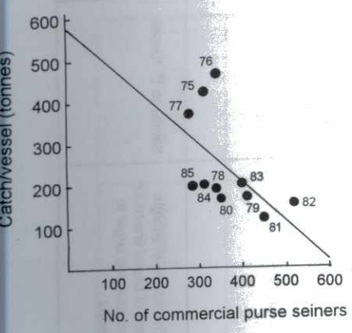


Figure 12. **Plot of apparent fishing mortality on natural mortality for Philippines stocks of roundscads (*Decapterus* spp.)** Source: Calvelo and Dalzell (1987)

re 13a. **Relationship between catch/vessel of roundscads (*Decapterus* spp.) and numbers of commercial purse seiners in the Philippines from 1975 to 1985.** Source: Calvelo and Dalzell (1987)

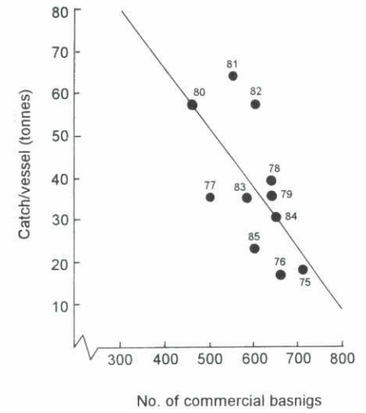


Figure 13b. **Relationship between catch/ vessel of roundscads (*Decapterus* spp.) and numbers of commercial basnigs in the Philippines from 1975 to 1985.** Source: Calvelo and Dalzell (1987)

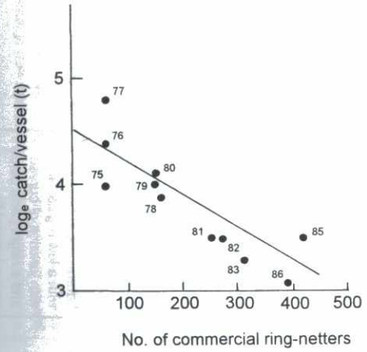


Figure 13c. **Relationship between the logarithm of the catch/ vessel of roundscads (*Decapterus* spp.) and number of commercial ring netters in the Philippines from 1975 to 1985.** Source: Calvelo and Dalzell (1987)

Table 1. Distinguishing characteristics of *Decapterus* spp.

Characteristics	SPECIES OF GENUS *Decapterus*				
	D. macrosoma **(Bleeker)**	***D. macarellus*** **(Cuvier)**	***D. maruadsi*** **(Temminck and Schlegel)**	***D. russelli*** **(Rupell)**	***D. kurroides*** **(Bleeker)**
I. Morphological					
1. Body form	Body very elongated, and nearly rounded in cross section with slender caudal peduncle	Body very elongated, slender and almost rounded in cross section similar to *D. macrosoma* caudal peduncle slender	Body somewhat compressed and shorter as compared with *D. macrosoma* and *D. macarellus* caudal peduncle slender	Body somewhat compressed and shorter similar to *D. maruadsi* with slender caudal peduncle and bigger head	Body shape somewhat compressed similar to *D. maruadsi* and *D. russelli* or a little deeper with bigger head and eyes. Caudal peduncle slender.
2. Lateral line	Lateral line anteriorly with a low regular arch with junction of curved and straight parts below second dorsal fin between 11th to 13th soft rays	Similar to *D. macrosoma*	Similar to *D. macrosoma*	Similar to *D. macrosoma*	Similar to *D. macrosoma*
3. Scutes	The scutes in straight part of lateral line is slender, short and much smaller in height	Similar to *D. macrosoma*	The scutes in straight part of lateral line much larger in height as compared with *D. macrosoma* and *D. macarellus*	The scutes in straight part of lateral line much broader and larger in height	Similar to *D. russelli*
4. Upper jaw	Posterior end of upper jaw concave above, rounded and produced below	Posterior end of upper jaw straight above, moderately rounded and slanting below with white membrane on symphysis of upper jaw in specimens> 16 cm fork length	Posterior end of upper jaw not concave above, rounded and produced below	Posterior end of upper jaw not concave above, rounded and produced below	Posterior end of upper jaw not concave above, rounded and produced below
II. Coloration	Body bluish green to metallic blue on back and silvery white on side and belly; small black blotch near the upper edge of the opercular margin Caudal fin hyaline to dusky; dorsal fin lobe sometimes dark distally; and other fins mostly pale	Body bluish green to metallic blue above, and silvery below and on side near the upper edge of the opercular margin Caudal fin dusky yellow, other fins dusky to white	Body bluish green above and silvery white below and on side and belly small black blotch near the upper edge of the operculum margin Caudal ad dorsal fins are very pale yellow, pelvic and anal fins are pale white	Body bluish green on back and silvery white on the side and belly; small black blotch near the upper edge of the opercular margin Caudal fin dusky brown-red, other fins generally clear and transparent except pelvic fin of adult males slightly dark	Body bluish green above, and silvery below and on the side and belly; small black blotch near the upper edge of the opercular margin Caudal fin conspicuously red, spinous dorsal and second dorsal fin lobe sometimes dark, other fins pale dusky to white

Table 2. **Average production and share of roundscads from the country's total marine production**

Year	Commercial	Municipal	Total Marine Production	Total Roundscads	% of Roundscad in Total Marine Catch
1982	526,273	708,016	1,234,289	183,253	14.8
1983	519,316	770,988	1,290,304	165,023	12.8
1984	513,335	789,975	1,303,310	131,583	10.1
1985	511,987	785,132	1,297,119	130,825	10.1
1986	546,230	807,275	1,353,505	175,861	13.0
1987	591,192	816,247	1,407,439	184,411	13.1
1988	599,995	838,366	1,438,361	178,687	12.4
1989	637,138	882,369	1,519,507	209,821	13.8
1990	700,564	895,040	1,595,604	249,300	15.6
1991	759,815	913,524	1,673,339	277,330	16.6
$\bar{x}$	590,585	820,693	1,411,278	188,609	13.2

Sources: BFAR Fisheries Statistics (1982-1987)
Bureau of Agricultural Statistics (1988-1991)

Table 3. **Annual landings (mt) of small pelagics by the Philippine municipal fisheries, 1982-1991.**

Year / Species	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Mean	%
Fusilers	9878	9604	6950	6669	6008	57976	4745	5830	5746	5962	11937	4.8
Big-eye scads	15710	14765	20717	20390	20092	21054	19921	20383	20550	21913	19550	7.9
Roundscads	32987	33762	26570	25446	24557	30352	29474	29948	28921	30370	29239	11.7
Round herrings	13663	12745	23118	18078	18349	18495	16976	19736	20874	20269	18230	7.3
Sardines	92517	92377	70467	49580	45031	55628	57684	62972	67380	63244	65688	26.4
Anchovies	47777	65995	63387	70781	68978	66935	78226	77877	81296	76585	69784	28.1
Mackerels	23933	28910	32113	32804	32631	31440	40470	36929	37399	40724	33735	13.6
Total	236465	258158	243322	223748	215646	281880	247496	253675	262166	259067	248162	100.0

Sources: BFAR Fisheries Statistics (1982-1987)
Bureau of Agricultural Statistics (1988-1991)

Table 4. **Annual landings (mt) of small pelagics by the Philippine commercial fisheries, 1982-1991.**

Year / Species	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Mean	%
Fusiliers	8483	7991	12867	9609	9005	10255	10383	12658	2225	5485	8896	2.80
Big-eye scads	1522	7737	16796	13091	14315	14407	16609	18231	20705	14351	13776	4.34
Roundscads	150266	131261	105013	106262	151298	154059	149213	179873	220379	246960	159458	50.18
Round herrings	7503	7762	12007	10761	9667	13377	18648	12385	5127	2602	9984	3.14
Sardines	55299	59107	38560	32347	28272	43066	38721	59493	89368	95378	53961	16.98
Anchovies	29718	25425	36158	39104	30709	41438	48147	44373	25740	24297	34511	10.86
Mackerels	24089	34969	29263	34107	33810	36613	39621	38032	51910	49299	37171	11.70
Total	276880	274252	250664	245281	277076	313215	321342	365045	415454	438372	317758	100.00

Sources: BFAR Fisheries Statistics (1982-1987)
Bureau of Agricultural Statistics (1988-1991)

Table 5. **Total annual catch (mt) of Roundscads (1982-1991)**

YEAR	MUNICIPAL	%	COMMERCIAL	%	TOTAL
1982	32,987	18.0	150,266	82.0	183,253
1983	33,762	20.5	131,261	79.5	165,023
1984	26,570	20.2	105,013	79.8	131,583
1985	24,578	18.8	106,247	81.2	130,825
1986	24,557	14.0	151,304	86.0	175,861
1987	30,352	16.5	154,059	83.5	184,411
1988	29,474	16.5	149,213	83.5	178,687
1989	29,948	14.3	179,873	85.7	209,821
1990	28,921	11.6	220,379	88.4	249,300
1991	30,370	11.0	246,960	89.0	277,330
$\bar{x}$	29,152	15.5	159,458	84.5	188,609

Sources: BFAR Fisheries Statistics (1982-1987)
Bureau of Agricultural Statistics (1988-1991)

Table 6. **The 10 most important fishing grounds for the roundscads resources in the Philippin showing the average production from 1980 to 1987.**

FishingGrounds	1980	1981	1982	1983	1984	1985	1986	1987	Average Production (mt)
1. West Sulu Sea	48450	46855	67993	25180	42205	46223	63608	66447	54245.13
2. Visayan Sea	17825	16542	18318	20343	17805	21827	33476	37377	22939.13
3. Moro Gulf	15783	15167	13985	13521	10508	9882	12782	16026	13456.75
4. East Sulu Sea	2049	3329	9423	21609	12702	10389	12200	13324	10628.13
5. South Sulu Sea	4222	23171	17406	12946	6273	3544	5869	6224	9956.88
6. Lamon Bay	9491	7392	12933	7745	6529	5397	8880	7608	8246.88
7. Cuyo Pass	4146	6167	7506	10274	4655	2555	7824	2551	5709.75
8. Tayabas Bay	3693	3270	2900	5164	3333	3557	5163	4283	3920.38
9. Batangas Cost	5264	1780	9093	1193	3816	3005	3270	3496	3864.63
10. Bohol Sea	1452	1830	2387	1730	2225	3600	1660	3060	2243.00

Sources: BFAR Fisheries Statistics

Table 7. **Compilation of information on length infinity ($L\infty$) ; growth (k); length at first capture (Lc); total Mortality (Z); and exploitation rate (E) for *Decapterus* spp.**

Date	Fishing Grounds	Species	Length infinity (L~)	Growth (k)	Mean length at first capture (Lc)	Total mortality (Z)	Exploitation rate (E)	Source
1957-1958	Manila Bay	*D. macrosoma*	31.5 cm	0.65	19.2 cm	3.74	0.64	Ingles & Pauly
	Approaches							
	- do -	*D. macrosoma*	31.5 cm	0.71	16.5 cm	3.80	0.63	- do -
1958	Palawan	*D. macrosoma*	27.0 cm	0.90	15.3 cm	4.01	0.57	- do -
1957-1958	waters	*D. macrosoma*	26.8 cm	0.71	16.7 cm	4.71	0.69	- do -
1958	- do -	*D. macrosoma*	26.5 cm	1.00	19.2 cm	6.89	0.73	- do -
1958-1959	- do -	*D. macrosoma*	27.8 cm	0.825	19.5 cm	6.46	0.75	- do -
1960	- do -	*D. macrosoma*	33.0 cm	0.50	17.7 cm	4.80	0.77	- do -
1960	- do -	*D. macrosoma*	27.5 cm	1.25	16.6 cm	10.5	0.80	- do -
1965	- do -	*D. macrosoma*	25.0 cm	1.20	13.9 cm	11.57	0.82	- do -
1965-1966	- do -	*D. macrosoma*	25.5 cm	0.85	16.6 cm	4.15	0.59	- do -
1966	- do -	*D. macrosoma*	33.0 cm	0.65	17.5 cm	3.38	0.61	- do -
1968	- do -	*D. macrosoma*	30.0 cm	0.74	19.5 cm	5.79	0.75	- do -
1968b	Manila Bay	*D. russelli*	27.0 cm	0.80	16.8 cm	6.89	0.77	- do -
1958-1959	approaches		30.0 cm	0.54	15.4 cm	2.06	0.42	- do -
1959	- do -	*D. russelli*	26.9 cm	0.69	15.6 cm	4.34	0.67	- do -
1958	Palawan	*D. russelli*	26.0 cm	0.73	18.2 cm	3.69	0.59	- do -
1959	waters	*D. russelli*	33.0 cm	0.45	15.4 cm	2.62	0.61	- do -
1968	- do -	*D. russelli*	23.0 cm	1.25	14.633 cm	3.286	0.334	Corpuz, Seager
1985	Samar Sea	*D. macrosoma*	23.5 cm	1.26	17.19 cm	4.496	0.529	and Sambilay
1985	Ragay Gulf	*D. macrosoma*	22.7 cm	0.82	16.041 cm	4.325	0.614	- do -
1985	Burias Pass	*D. maruadsi*	23.55 cm	0.81	15.181 cm	3.457	0.526	- do -
1985	Samar Sea	*D. maruadsi*	23.5 cm	0.52	16.107 cm	2.126	0.423	- do -
1985	Ragay Gulf	*D. maruadsi*	25.0 cm	0.80	15.0 cm	4.30	0.62	Lavapie-Gonzales
1985-1986	Davao Gulf	*D. maruadsi*						

Table 8. **Forecast prices of roundscad; wholesale, retail and margin by month, Philippines, 1991-1992**

	FORECAST PRICE			
	Retail	**Wholesale**	**Margin**	**DERIVED PRICE MARGIN**
1991	29.53	19.93	9.27	9.60
January	29.14	19.57	9.24	9.57
February	28.94	18.28	10.33	10.66
March	25.56	18.53	6.70	7.03
April	24.67	18.25	6.09	6.42
May	25.80	18.63	6.84	7.17
June	25.72	20.17	5.22	5.55
July	28.56	21.68	6.55	6.88
August	26.69	19.58	6.78	7.11
September	26.86	20.50	6.03	6.36
October	31.06	23.85	6.88	7.21
November	33.12	24.00	8.79	9.12
December				
Average	27.97	20.25	7.39	7.72
1992	31.18	21.33	9.52	9.85
January	24.79	19.95	4.51	4.84
February	24.79	19.38	5.08	5.41
March	23.70	18.88	4.49	4.82
April	23.55	17.86	5.36	5.69
May	25.07	20.43	4.31	4.64
June	27.55	19.63	7.59	7.92
July	27.44	21.14	5.97	6.30
August	26.26	18.51	7.42	7.75
September	25.63	19.28	6.02	6.35
October	32.62	24.81	7.48	7.81
November	35.86	25.70	9.83	10.16
December				
Average	27.37	20.58	6.47	6.80

Source: Bimbao et.al. (1991)