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THE PELAGIC FISHERIES OF THE PHILIPPINES

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PHILIPPINES

INDO-PACIFIC TUNA DEVELOPMENT AND MANAGEMENT PROGRAMME
Colombo, Sri Lanka

The Indo-Pacific Tuna Development and Management Programme seeks to assist the governments in the area in the preparation of long-term management and development of tuna and tuna-like species. Recognizing the need for intensive efforts in selected countries to generate the information to support this management and development in the Government of Japan, established a trust fund with FAO to enable directed Investigation on Indian Ocean and Western Pacific Small Tuna Resources. These investigations form a valuable part of the overall Indo-Pacific Tuna Programme (IPTP). This publication is made possible by Japan's support.

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1. INTRODUCTION

The Republic of the Philippines ranked thirteenth of all countries and fourth of tropical countries in fisheries production for 1980. This country is unique among leading fisheries countries in the tropics in capturing more pelagic than demersal fish (FAO, 1981). The Philippines also differs from major fishing countries in temperate and subtropical areas in that the pelagic catch is comprised of many species. The 1980 Fisheries Statistics of the Philippines (1982) lists 16 "species" accounting for 94% of total pelagic landings. In comparison, the landings of only 2 and 3 species accounted for 100% and 97% of total pelagic landings for Iceland and Peru, respectively. The complexity of tropical marine communities dictates a variety of fishing gears and methods for full utilization of fisheries resources. The pelagic fisheries of the Philippines are highly diversified and innovative to exploit a broad spectrum of pelagic species.

Previous productivity estimates for the Philippines (both demersal and pelagic species combined) have been derived either by multiplying yield per unit area figures for the Gulf of Thailand by the area of continental shelf around the Philippines or calculating present production per unit area of continental shelf and assuming an arbitrary increase with improved technology (Smith, et al., 1980). These estimates are useful as a first approximation, but have to be taken with reservations because of the restricted trawlable area, dominance of pelagic fish and high captures beyond the continental shelf in the Philippines. A slightly different approach is used in the present analysis by considering the surface area of a body of water to calculate yields of pelagic fish. The principal objective is to derive estimates of pelagic fish yields for shallow water and deep water fishing zones. Yields of tunas are compared with estimates for other areas. The second objective of this exercise is to analyze landings by fishing gears to assess the contributions of accessory devices to the pelagic fisheries of the Philippines.

2. METHODS OF ANALYSIS

The Philippine archipelago is exposed to the Pacific Ocean along its entire eastern coast and to the South China Sea on the northwestern coast. The southwestern coast of the archipelago is exposed to the less extensive Sulu and Mindanao Seas^{1/}. Between the two largest islands of the archipelago, Luzon in the north and Mindanao in the south, are numerous smaller islands and protected seas, gulfs and straits.

Fisheries landings for the Philippines are given by 24 statistical fishing areas shown in Figure 1. There are 6 fishing areas on the Pacific Ocean coast and 3 areas on the South China Sea coast.

^{1/} The part of Celebes Sea bounded by the territorial limits of the Philippines is referred to in this country as the Mindanao Sea.

Six fishing areas are found in the Sulu and Mindanao Seas. The extent of these six areas can be delineated by land masses and the territorial limit of the Philippines. The area of continental shelf (less than 100 fathoms) within these fishing areas is most extensive around Cuyo Islands, east coast of Palawan, north coast of Borneo and the Sulu Archipelago. However, the area of continental shelf comprises only a small portion of the entire surface areas of the Sulu and Mindanao fishing areas. These are henceforth referred to as the deep water fishing areas.

The remaining 9 fishing areas are found interspersed in the central group of islands and can be delineated by land masses. The continental shelf areas are less than half the total surface areas in the Batangas coast, Sibuyan, Camotes and Bohol Seas, and are grouped as deep water fishing areas. Conversely, the areas of continental shelf are more than half the total surface areas of Tayabas Bay, Ragay Gulf, Samar Sea, Visayan Sea and Guimaras Strait. These are considered as the shallow water fishing areas.

The surface areas of the above fishing areas were measured from chart number 4200 of the Philippine Coast and Geodetic Survey with a polar planimeter. These are given in Table 1.

Table 1. Area for fishing and statistical areas of the Philippines

Fishing areas	Statistical areas	Area (km ²)
Shallow water	Tayabas Bay	4,000
	Ragay Gulf	5,000
	Samar Sea	10,100
	Visayan Sea	15,500
	Guimaras Strait	<u>7,000</u>
	Sub-Total Shallow Water Fishing Areas	41,600
Deep water	Batangas Coast	4,000
	Sibuyan Sea	30,600
	Camotes Sea	11,400
	Bohol Sea	28,700
	Davao Gulf	7,000
	Moro Gulf	114,000
	Sulu Sea (Cuyo Pass and West, South, East Sulu Sea)	<u>301,000</u>
	Total Deep Water Fishing Areas	496,700



Shallow water fishing areas



Deep water fishing areas

1. Lingayen Gulf
2. Manila Bay
3. Batangas Coast
4. Tayabas Bay
5. West Palawan water
6. Cuyo Pass
7. West Sulu Sea
8. South Sulu Sea
9. East Sulu Sea
10. Moro Gulf
11. Davao Gulf
12. Bohol Sea
13. Leyte Gulf
14. Camotes Sea
15. Visayan Sea
16. Guimaras Strait
17. Sibuyan Sea
18. Ragay Gulf
19. Samar Sea
20. Lagonoy Gulf
21. Lamon Bay
22. Casiguran Sound
23. Palanan Bay
24. Babuyan Channel

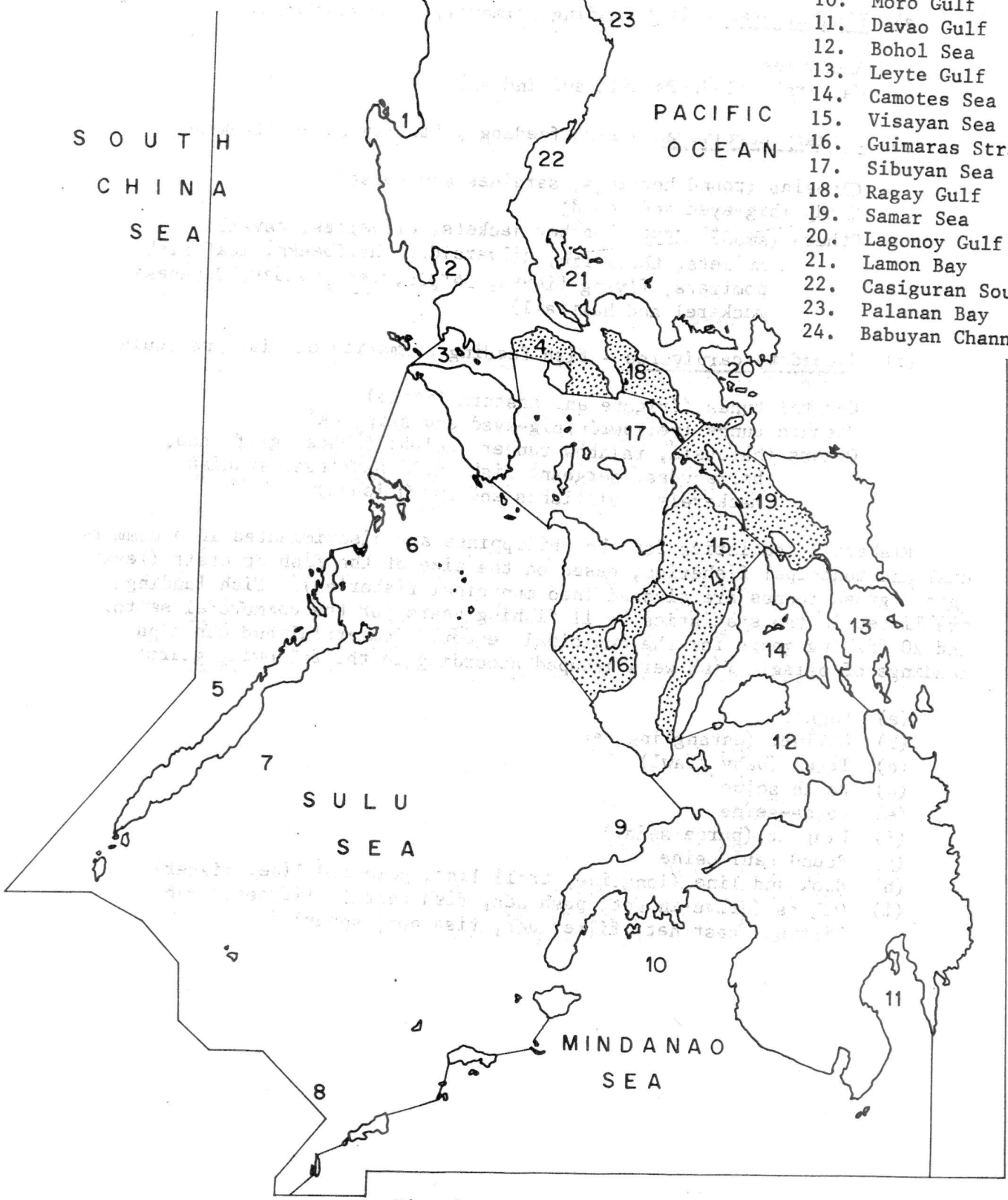


Fig. 1. Map of the Philippines showing territorial limits and fishing areas

For the following analysis, species of pelagic fish listed in the 1980 Fisheries Statistics of the Philippines (Philippines, 1982) were combined into 8 species groups. Six of these groups were based on taxonomic affinities and habitat similarities. The remaining 2 groups include a miscellanea of minor species. The 8 groups in turn were further grouped into 3 categories according to general feeding habits. These species groups and categories are as follows:

(a) Planktivores - fish feeding primarily on phytoplankton

Anchovies
Mackerels (Indo-Pacific and Indian)

(b) Primary carnivores - fish feeding primarily on zooplankton

Clupeids (round herrings, sardines and sprat)
Scads (big-eyed and round)
Others (smooth scad, leather jackets, crevalles, cavalla, mullets, threadfin, silversides, halfbeaks, leaf fish, pomfrets, flying fishes, tarpon, ten pounder, Japanese mackerel and hairtail)

(c) Secondary carnivores - fish feeding primarily on fish and squid

Coastal tunas (frigate and eastern little)
Oceanic tunas (yellowfin/big-eyed and skipjack)
Others (hardtail, rainbow runner, dolphinfishes, garfishes, barracudas, sergeant fish, wolf herrings, spanish mackerels, sailfishes and swordfishes)

Fisheries statistics for the Philippines are discriminated into commercial and municipal fisheries, based on the size of the fishing craft (less than 3 gross tonnes are classed into municipal fisheries). Fish landings are listed in the statistics by 11 fishing gears for the commercial sector and 20 fishing gears for the municipal sector. Commercial and municipal landings of pelagic fish were grouped according to the following gears:

- (a) Bagnet
- (b) Gillnet (entangling net)
- (c) Trawl (baby trawl)
- (d) Beach seine
- (e) Purse-seine
- (f) Ringnet (purse-seine)
- (g) Round haul seine
- (h) Hook and line (longline, troll line, pole and line, jigger)
- (i) Others (drive-in net, push net, fish corral, liftnet, crab liftnet, cast net, filter net, fish pot, spear)

3. RESULTS

3.1 Yields of pelagic fish

Marine pelagic fish production from capture fisheries in the Philippines during 1980 was 774,099 tonnes, representing 62% of the total marine landings. Areal distribution of pelagic landings is given in Table 2. Highest proportion of the landings was obtained from the deep water fishing areas (55%) followed by the shallow water areas (30%). Landings from the exposed coasts of the Pacific Ocean and South China Sea amounted to only 10% and 5% of the total pelagic landings, respectively.

Table 2. Landings of pelagic fish by fishing areas

Fishing areas	Tonnes
Tayabas Bay	25,694
Ragay Gulf	28,911
Samar Sea	27,371
Visayan Sea	133,350
Guimaras Strait	<u>17,736</u>
Sub-total shallow water areas	233,062 (30%)
Batangas Coast	28,289
Sibuyan Sea	14,164
Camotes Sea	14,970
Bohol Sea	44,432
Davao Gulf	18,649
Moro Gulf	109,395
Cuyo Pass	27,403
East Sulu Sea	33,605
South Sulu Sea	29,036
West Sulu Sea	<u>102,178</u>
Sub-total deep water areas	422,121 (55%)
Lingayen Gulf	9,187
Manila Bay	16,987
West Palawan Waters	<u>13,841</u>
Sub-total South China Sea Coast	40,015 (05%)
Babuyan Channel	2,879
Casiguran Sound	1,989
Lagonoy Gulf	6,748
Lamon Bay	43,519
Leyte Gulf	<u>23,766</u>
Sub-total Pacific Ocean Coast	78,901 (10%)
TOTAL	744,099

Landings and yields per unit area are given by species categories and fishing areas in Table 3. There is a 7-fold difference in total yields from the shallow water versus the deep water fishing areas. Yields of all species categories are higher for the shallow water area, but the difference is most pronounced for the planktivores.

Total yields for the shallow water fishing areas ranged from 2.5 to 8.5 t/km² and averaged 5.6 t/km². The range of total yields for the deep water areas was considerably greater, from 0.5 t/km² in the Sibuyan Sea to 7.1 t/km² for the Batangas coast. These fishing areas are contiguous, therefore, it is reasonable to assume that fish captured in the Sibuyan Sea are landed outside this area in centres of high population densities as in the Batangas coast. The total yield for these 2 fishing areas combined averages 1.2 t/km², which approximates the rates for other deep water fishing areas. Total yields for all deep water fishing areas averaged 0.8 t/km².

The perimeter of a body of water was defined by the coastline, boundaries and territorial limits. The surface areas calculated in the present analysis includes all depths encompassed within these parameters. Consequently, the average total yield of 5.6 t/km² for the shallow water fishing area is an under-estimate of the yield for the neritic regime because of the inclusion of less productive waters beyond the continental shelf (greater than 100 fathoms). Conversely, the deep water fishing areas include depths over the continental shelf. The average total yield of 0.8 t/km² for deep water fishing areas is an over-estimate of the yield from the oceanic regime because of the inclusion of more productive water over the continental shelf.

Smith, et al (1980) summarizes estimates of productivity determined by various authors for the Philippines and other tropical areas. Most of the estimates of productivity for the Philippine continental shelf are higher than the present estimate because of the different methods and basis for calculating areas and consideration of all fish species. However, the present estimate of pelagic fish yield for the **shallow water areas is higher** than estimates of productivity derived for other continental shelf areas. Productivity of demersal fish for the inner Gulf of Thailand is 3.85 t/km² and of all fish for hard bottom continental shelf areas range from 2.5 to 5.0 t/km² (Smith, et al., 1980). Estimates of maximum sustainable yields for 13 pelagic and 17 demersal fisheries in the tropical zone are given by Marten and Polovina (1982). Of these estimates, only that of the Java Sea pelagic fishery and of the north coast of Gulf of Mexico demersal fishery exceeds the rate derived in the present analysis for the shallow water fishing area. These estimates were obtained for the more productive inner continental shelf (0-50 m interval of the Java Sea and 0-110 m interval of the Gulf of Mexico).

Estimates of productivity derived by other authors in depths exceeding 200 m from around the Philippines ranges from 0.2 to 0.65 t/km² (Smith, et al., 1980). The results from the present analysis suggest the productivity for the oceanic regime around the Philippines to be in the upper end of this range.

Table 3. Landings and yields of pelagic fish categories by fishing areas

Fishing area	PLANKTIVORE		1 ^{ary} CARNIVORE		2 ^{ary} CARNIVORE		T O T A L	
	t	t/km ²	t	t/km ²	t	t/km ²	t	t/km ²
Tayabas Bay	5,845	1.5	11,345	2.8	8,504	2.1	25,694	6.4
Ragay Gulf	3,716	0.7	6,727	1.4	18,468	3.7	28,911	5.8
Samar Sea	9,106	0.9	13,192	1.3	5,073	0.5	27,371	2.7
Visayan Sea	11,411	0.7	94,935	6.1	27,004	1.7	133,350	8.5
Guimaras Strait	9,318	1.3	4,718	0.7	3,700	0.5	17,736	2.5
Total shallow water	39,396	0.9	130,917	3.1	62,749	1.5	233,062	5.6
Batangas Coast	4,337	1.1	7,530	1.9	16,422	4.1	28,289	7.1
Sibuyan Sea	5,457	0.2	5,913	0.2	2,794	0.1	14,164	0.5
Camotes Sea	3,517	0.3	7,833	0.7	3,620	0.3	14,970	1.3
Bohol Sea	13,507	0.5	10,827	0.4	20,098	0.7	44,432	1.6
Davao Gulf	2,407	0.3	6,988	1.0	9,254	1.3	18,649	2.7
Moro Gulf	10,883	0.1	58,944	0.5	39,568	0.4	109,395	1.0
Sulu Sea	16,665	0.1	118,138	0.4	57,419	0.2	192,222	0.6
Total deep water	56,773	0.1	216,173	0.4	149,175	0.3	422,121	0.8

Table 4 gives landings and yields by species groups and fishing areas. Yields of all species groups declined from the shallow to deep water fishing areas. Highest yield was obtained from clupeids in the shallow water and scads in the deep water fishing areas. Figure 2 shows the distribution of pelagic fish in the Indo-Pacific region based on the present analysis of Philippine landings and observations in other areas of the region. Anchovies, mackerels and clupeids are essentially confined to the neritic regime. Coastal tunas and scads are less associated with the neritic regime and extend out into the oceanic regime. Oceanic tunas are found principally in the oceanic regime. This distribution pattern is characteristic of continental shelves in the tropical province, except for the absence of mackerels (Rastrelliger sp.) in other regions (Williams, 1975).

3.2 Yield of tunas

Yields of tunas totalled 1.2 t/km^2 for the shallow water fishing areas, of which 0.9 t/km^2 was coastal tunas and 0.3 t/km^2 was oceanic tunas. These rates are high considering the trophic level of tunas. Table 5 gives yields for other countries with high landings of coastal tunas and the eastern tropical Pacific of oceanic tunas. The country yields were derived by dividing present landings by the area of continental shelf. These rates are not strictly comparable with the rates derived for the Philippines by considering the surface area of a body of water. However, these rates indicate the Philippines is not unique in the tropical province in having high productivity of coastal tunas.

Yields of coastal and oceanic tunas both averaged 0.2 t/km^2 for the deep water fishing areas. The yield for coastal tunas equals the estimated consumption of frigate tuna by yellowfin in the eastern tropical Pacific. On the other hand, yield of oceanic tunas in the eastern tropical Pacific is considerably lower than the yield from the deep water fishing areas of the Philippines. This is attributed to consideration of a much smaller area and possibly the capture of smaller fish in the Philippines. Also, densities of oceanic tunas may be higher near land masses than in the open ocean.

3.3 Accessory fishing devices

Pelagic fisheries in the Philippines are based to a very large extent on aggregating fish for capture with various fishing gears. Two accessory gears are universally used for aggregating pelagic fish. These are lights and payaos or anchored fish aggregating devices (FADs). Lights are used in conjunction with bagnets, ringnets and purse-seines. Bagnettters generally anchor in shallow water and rely entirely on lights to aggregate fish, principally small coastal species. Payaos are used in conjunction with ringnets, purse-seines and handlines. These devices are deployed from the outer continental shelf out to depths in excess of 5,000 m to attract clupeids, scads and surface-swimming tunas (de Jesus, 1982). Ringnetters and purse-seiners use lights at these payaos to further concentrate these fish for capture with their respective gears. Handliners tie onto the payaos and fish for large, deep-swimming tunas.

Table 4. Landings and yields of species groups by fishing areas

Species groups	Anchovies		Mackerels		Clupeids		Scads		Coastal tunas		Oceanic tunas	
	t	t/km ²	t	t/km ²	t	t/km ²	t	t/km ²	t	t/km ²	t	t/km ²
Tayabas Bay	4,749	1.2	1,096	0.3	1,596	0.4	4,370	1.1	2,060	0.5	4,804	1.2
Ragay Gulf	3,015	0.6	701	0.1	460	0.1	5,600	1.1	18,084	3.6	168	0.0
Samar Sea	4,364	0.4	4,742	0.5	7,838	0.8	2,912	0.3	2,261	0.2	104	0.0
Visayan Sea	2,920	0.2	8,491	0.5	62,086	4.0	23,090	1.5	11,525	0.7	7,193	0.5
Guimaras Strait	9,098	1.3	220	0.0	1,621	0.2	1,471	0.2	2,759	0.4	387	0.1
Total Shallow Water	24,146	0.6	15,250	0.4	73,601	1.8	37,443	0.9	36,689	0.9	12,656	0.3
Batangas Coast	1,941	0.5	2,396	0.6	1,566	0.4	5,395	1.4	11,028	2.8	3,739	0.9
Sibuyan Sea	4,952	0.2	505	0.0	2,842	0.1	1,410	0.1	927	0.0	532	0.0
Camotes Sea	2,835	0.2	682	0.1	586	0.1	5,796	0.5	3,247	0.3	137	0.0
Bohol Sea	8,009	0.3	5,498	0.2	3,905	0.1	2,900	0.1	16,596	0.6	2,193	0.1
Davao Gulf	2,250	0.3	157	0.0	770	0.1	4,216	0.6	1,588	0.2	6,891	1.0
Moro Gulf	6,926	0.1	3,957	0.0	21,835	0.2	31,199	0.3	13,249	0.1	23,102	0.2
Sulu Sea	7,318	0.0	9,347	0.0	30,197	0.1	72,381	0.2	26,800	0.1	23,724	0.1
Total Deep Water	34,231	0.1	22,542	0.0	61,701	0.1	123,297	0.2	73,435	0.1	60,318	0.1

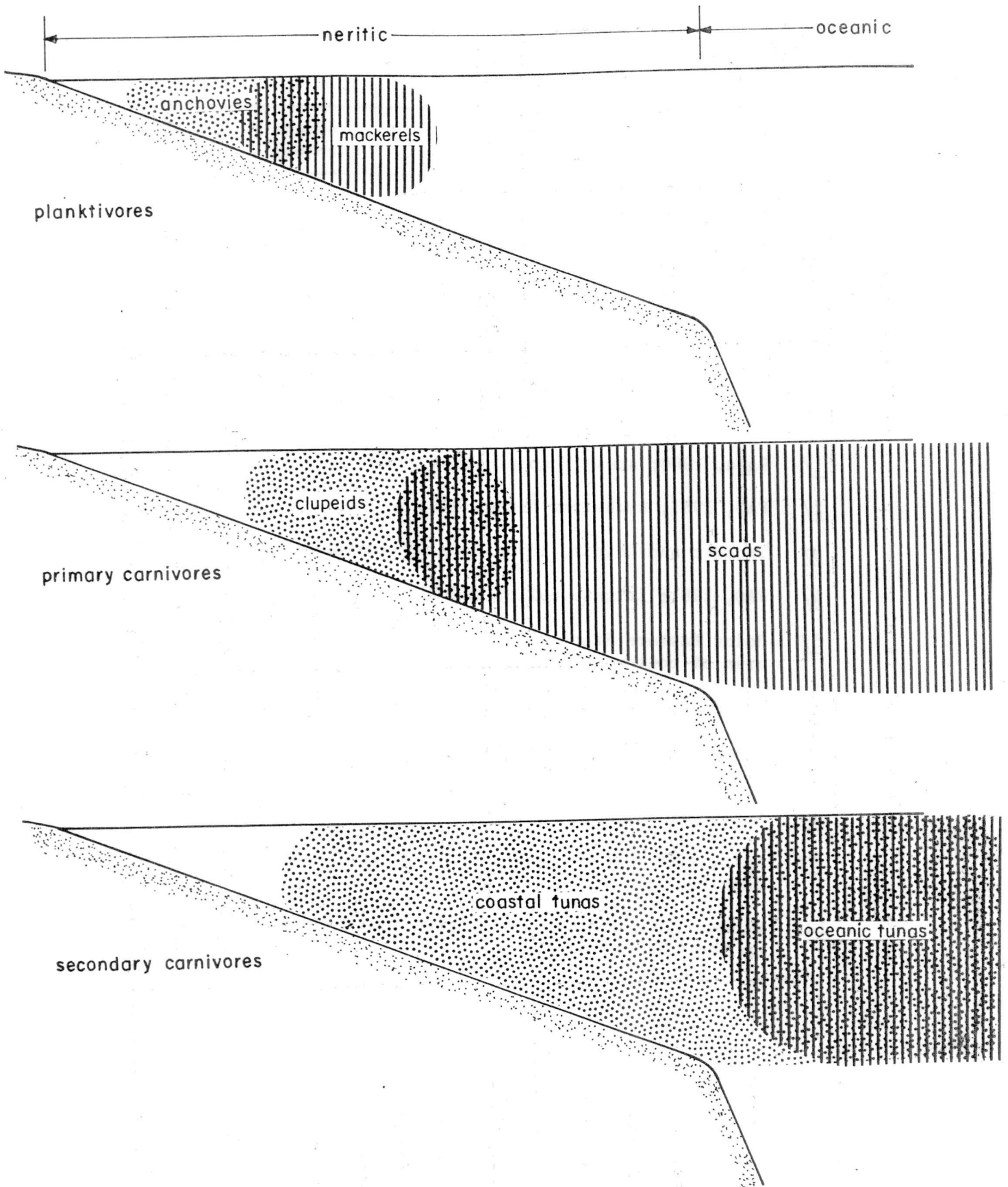


Fig. 2. Distribution of pelagic fish in the tropical province of the Indo-Pacific region

Table 5. Estimates of tuna yields for selected countries and area

Country or area	Surface area (km ²)	Landings (tonnes)	Tonnes/km ²
Sri Lanka	24,372 ^{1/}	8,666 ^{2/}	0.36
Ghana	20,200 ^{3/}	12,272 ^{4/}	0.61
Bali	2,500 ^{5/}	2,024 ^{6/}	0.81
CYRA ^{7/}	16,920,000 ^{8/}	332,400 ^{9/}	0.02
CYRA	16,920,000	2,000,000 ^{10/}	0.12

- 1/ Raja, 1980; area of continental shelf
- 2/ FAO, 1981; tuna-like fishes NEI
- 3/ Troadec and Garcia, 1980; area of continental shelf
- 4/ FAO, 1981; frigate bullet and little tunas
- 5/ Joint Eastern Tropical Indian Ocean Fishery Survey, pers. comm.; area of continental shelf
- 6/ Provincial Fisheries Office, Bali; principally bullet tuna
- 7/ Commission Yellowfin Regulatory Area of the Inter-American Tropical Tuna Commission
- 8/ Sharp and Francis, 1976
- 9/ Cole, 1980 and Forsbergh, 1980; total of yellowfin and skipjack landings for 1978
- 10/ Olson, 1981; estimate of frigate tuna consumed by yellowfin tuna in the CYRA during 1970.

Landings of species groups by different fishing gears are given in Table 6. Landings by fishing gears used in conjunction with lights and/or payaos are taken to represent the relative importance of these accessory devices in capturing species groups. Not all catches by purse-seine and ringnet are made with the aid of lights and payaos. All species groups are captured in free schools with these gears during the day and night. It is assumed that the proportion captured as free schools without accessory devices is constant for all species groups. Fishing gears used in conjunction with accessory devices accounted for approximately 40% of landing of anchovies, mackerels and clupeids. Landings by these gears and devices increased to 65% for coastal tunas, 70% for scads, and 90% for oceanic tunas.

Table 6. Landings by species groups and fishing gears

Species Categories	Planktivore		1 ^{ary} Carnivore		2 ^{ary} Carnivore	
	Anchovies	Mackerels	Clupeids	Scads	Coastal tunas	Oceanic tunas
Bagnet ^{1/}	29,535	2,609	28,871	29,197	23,903	848
Gillnet	7,609	12,232	76,915	11,083	10,927	7,209
Trawl	2,127	7,222	7,442	20,603	895	220
Beach seine ^{2/}	27,392	261	3,992	1,669	7,514	78
Purse-seine ^{2/}	569	11,853	20,949	67,374	26,245	17,323
Ringnet ^{2/}	3,884	2,079	11,326	28,369	28,024	10,144
Round haul seine	2,180	710	349	1,301	371	35
Hook and line	-	8,546	3	17,158	20,951	42,741 ^{3/}
Others	6,867	1,001	2,025	2,407	2,774	603
Total	80,163	46,513	151,872	179,161	121,604	79,201
Percent of landings ^{4/}	43	35	40	70	65	90

- ^{1/} Fishing gear used with lights.
- ^{2/} Fishing gears used with lights and payaos.
- ^{3/} Landing by fishing gears used with payaos.
- ^{4/} Percent of landings by fishing gears used in conjunction with lights and/or payaos.

Fisheries for anchovies, mackerels and clupeids are generally well developed in most countries in the tropical province. There are fisheries for coastal and oceanic tunas in several tropical countries including Ghana, Maldives, Sri Lanka, Indonesia, Papua New Guinea and the Philippines. There are no fisheries for scads in the tropical province outside of the South China Sea region. Significant landings of round and bigeyed scads are made only in the Philippines, Indonesia, Thailand, Malaysia and Hong Kong (Table 7). Lights and fish aggregating devices are used in the first 4 countries. Landings of scads has increased considerably in Thailand since 1973 with introduction of the luring purse-seine (Chullasorn and Shindo, 1981). Palm frond aggregating devices are anchored in suitable locations and lighted at night. Fish attracted to the device and lights are captured with purse-seines. These authors estimate that about 90% of the present landings of scads is captured by luring purse-seines. Similar palm frond aggregating devices are used in conjunction with purse-seines and liftnets in Peninsular Malaysia (Anonymous, 1981). Lights are used in Hong Kong to attract round scads for capture with purse-seine (W. Chan, pers. comm.)^{1/}.

Table 7. Landings of scads by species and countries

Country	Species		
	<u>Decapterus russelli</u>	<u>Decapterus</u> sp.	<u>Selar crumenophthalmus</u>
Africa			
Ghana	-	114	-
Others	-	188	-
Asia			
Territory of Hong Kong	-	9,168	-
Indonesia	-	81,383	-
Malaysia	19,695	-	-
Philippines	-	131,974	47,219
Singapore	-	174	-
Thailand	23,511	-	-
Others	-	863	-
South America			
Grenada	-	-	501
Venezuela	-	-	1,170

Source: FAO, 1981

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4. DISCUSSION

Petersen and Curtis (1980) show energy flow from primary production to higher trophic levels differs in temperate and tropical marine shelf ecosystems. Primary production in the temperate province is highly seasonal promoting benthic production and demersal fish. On the other hand, primary production is continuous in the tropics promoting continuous zooplankton production and ultimately pelagic fish. Estimates of maximum sustainable yields given in Marten and Polovina (1982) support this thesis of high production of pelagic fish on tropical shelf areas. The average of estimates for all shelf areas is 2.6 t/km² for pelagic fisheries and 2.3 t/km² for demersal fisheries. The results obtained in the present analysis also support the thesis of high pelagic fish production. An average pelagic fish yield of 5.6 t/km² was derived for the shallow water fishing areas of the Philippines. Higher yields of 6.4 and 8.5 t/km² were obtained for Tayabas Bay and Visayan Sea fishing areas, respectively. These yields were derived by considering the surface area of a body of water. Higher yields than these are likely with further detailed studies restricted to continental shelf areas.

Pelagic resources of the inner neritic regime in the tropical province are probably fully exploited. Anchovies, mackerels and clupeids are highly vulnerable to capture because of their accessibility and dense schooling behaviour. On the other hand, pelagic resources of the outer neritic and oceanic regimes are virtually unexploited, except in a few countries. Scads and tunas are circumtropical groups characteristic of the outer neritic and contiguous oceanic regimes. Yields of these species groups for the Philippines totalled 2.1 t/km² for the shallow water fishing areas and 0.4 t/km² for the deep water fishing areas. These figures suggest that significant increases in fisheries production can still be obtained from the continental shelves and contiguous oceanic regimes of most countries in the tropical province.

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4. DISCUSSION

Petersen and Curtis (1980) show energy flow from primary production to higher trophic levels differs in temperate and tropical marine shelf ecosystems. Primary production in the temperate province is highly seasonal promoting benthic production and demersal fish. On the other hand, primary production is continuous in the tropics promoting continuous zooplankton production and ultimately pelagic fish. Estimates of maximum sustainable yields given in Marten and Polovina (1982) support this thesis of high production of pelagic fish on tropical shelf areas. The average of estimates for all shelf areas is 2.6 t/km² for pelagic fisheries and 2.3 t/km² for demersal fisheries. The results obtained in the present analysis also support the thesis of high pelagic fish production. An average pelagic fish yield of 5.6 t/km² was derived for the shallow water fishing areas of the Philippines. Higher yields of 6.4 and 8.5 t/km² were obtained for Tayabas Bay and Visayan Sea fishing areas, respectively. These yields were derived by considering the surface area of a body of water. Higher yields than these are likely with further detailed studies restricted to continental shelf areas.

Pelagic resources of the inner neritic regime in the tropical province are probably fully exploited. Anchovies, mackerels and clupeids are highly vulnerable to capture because of their accessibility and dense schooling behaviour. On the other hand, pelagic resources of the outer neritic and oceanic regimes are virtually unexploited, except in a few countries. Scads and tunas are circumtropical groups characteristic of the outer neritic and contiguous oceanic regimes. Yields of these species groups for the Philippines totalled 2.1 t/km² for the shallow water fishing areas and 0.4 t/km² for the deep water fishing areas. These figures suggest that significant increases in fisheries production can still be obtained from the continental shelves and contiguous oceanic regimes of most countries in the tropical province.

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