PROJECT REPORT

December 1996

SHARK FISHERIES AND TRADE IN TAIWAN

台灣的鯊魚魚獲與貿易

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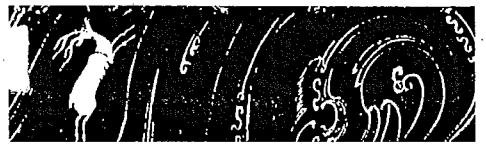

WWF

IUCN The World Conservation Union

SWAN International

Published by TRAFFIC East Asia-Taipei,
Taipei, Taiwan with
financial support from
the Rufford Foundation and from
WWF-UK, World Wide Fund for Nature.

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ACKNOWLEDGMENTS

TRAFFIC East Asia-Taipei's report on *Shark Fisheries and Trade in Taiwan* was made possible through the generous financial support of the Rufford Foundation and WWF-UK, World Wide Fund for Nature.

The authors also would like to thank the following organizations and individuals for their assistance during the preparation of this report: the Kaohsiung Fisheries Administration; the Kaohsiung Fishermen's Association; the Tungkang Fishermen's Association; the Suao Fishermen's Association; the Chengkung Fishermen's Association; Dr. Jen-Chyuan Lee, Dah-Wen Shieh, James Sha, and Cheng-Fei Huang, Fisheries Department, Council of Agriculture; Professor Bonnie Sun Pan, National Marine Science Museum Planning Office; Professor Shean-Ya Yeh, National Taiwan University; Shin-Fuu Fuh Taiwan Deep Sea Tuna Boatowners' and Exporters' Association; Dr. Shui-Kai Chang, Overseas Fisheries Development Council; Lucy Lin; and Jean-Jay Mao.

INTRODUCTION

The TRAFFIC Study

Sharks are used worldwide for their meat, skins, fins, cartilage, jaws and livers. There is increasing concern that heavy and largely unregulated trade in shark species is contributing to a decline in global shark stocks. Efforts by the IUCN/SSC Shark Specialist Group and relevant national and international authorities to gauge the current level of threat are hindered by a lack of data, including data on trade in shark products, and its effects on individual species. The TRAFFIC Network has undertaken to collect, analyze, and distribute information on the trade in sharks to assist these efforts.

Objectives of the TRAFFIC East Asia-Taipei study

Taiwan utilizes shark products in many ways, including: shark fin, shark meat, skin, intestines, cartilage, and teeth. Over the last 10 years, Taiwan's combined coastal and distant-water shark catch has averaged between 39 000 and 74 000 metric tons, accounting for roughly 7.25% of world catch in 1993 (FAO Yearbook; Taiwan Fisheries Bureau). Eighty-five percent of Taiwan's shark landings are from distant-water fisheries caught on the high seas or in other countries' exclusive economic zones (Taiwan Fisheries Bureau, 1994). Despite the large quantities of shark catch, the low price of shark meat has meant that it continues to be predominantly a bycatch species. As non-target species, detailed information on shark catch, effort, and fishing grounds has not been collected for inclusion in Taiwan's Fisheries Yearbook. Such information is a prerequisite for any fishery management decisions. TRAFFIC East Asia-Taipei, in cooperation with consultants from National Taiwan Ocean University, has undertaken to document which species of shark are utilized in Taiwan, the quantity harvested, the areas being fished, and the methods and gear employed. A further objective is to understand the complete range of utilization of shark products in Taiwan, especially the trade in shark fin and other products, both domestic and international.

Methodology

This report consists of three principal sections, the first dealing with Taiwan's shark fisheries; the second examining markets and trade in shark products; and the third section containing conclusions and recommendations. The fisheries section is divided into two parts: coastal and offshore fisheries, and distant-water fisheries. The markets and trade section outlines Taiwan's specific markets and trade in shark products. The final section summarizes findings of the report and recommends future action for the Taiwan authorities.

The fisheries section begins with an overview of Taiwan's fishery production sector, followed by a historical overview of Taiwan's shark fisheries, and the current status of shark fisheries for coastal and offshore fisheries, and distant-water fisheries.

The information contained in the historical overview of the fisheries section was adapted from a literature review. Information on the current status of coastal and offshore fisheries was summarized from a questionnaire used to interview local fishermen (no.=40) in early 1995. The information on shark yields and prices was gathered from species-specific daily catch and sales data for Nanfang Ao (Suao) and Chengkung fish markets.

Research for the second section, distant water fisheries, was conducted from November 1995 to March 1996. Two approaches were used: fishermen interviews; and sales data collection and analysis. Local fishermen interviews included interviewing captains of fishing vessels in Kaohsiung and Tongkang. Interviews of those

captains engaged in directed shark fisheries were more detailed and included: dominant species; catch volumes; fishing grounds; operations time; and fishing gears. For other fisheries with shark as bycatch, more general information was collected, including proportion of shark to total catch and dominant species. A total of 14 fishermen (four captains and 10 managers of fishing companies) were interviewed in Chengchen and three fishermen (one captain and two managers) in Tongkang.

Foreign sales records were collected from fishing companies and the foreign base landing records for Kaohsiung city. Domestic sales data were collected from sales records of Chengchen fish market. Annual shark bycatch data were taken from the Annual Catch Statistics of Taiwan's tuna longline fishery (Tuna Research Center, 1978-1994). Annual landings of distant-water shark fishery data were taken from the *Fisheries Yearbook - Taiwan Area* (1961-1994).

Information for the markets and trade section was collected from a number of reference sources, including the *Fisheries Yearbook Taiwan Area* and records of the ROC Directorate General of Customs. As information from these sources did not include details to the species level, additional surveys were conducted in Kaohsiung, Pingtung, and Tainan.

Volumes and values are presented in metric tons and US dollars. US dollar values are expressed in current dollars, not in real dollar terms, and are not adjusted for inflation. Exchange rates for 1980-1994 were taken from the *Statistical Abstract of the United States* (Anon., 1995b) while *Asian Wall Street Journal* (29/12/95) figures were used for 1995. Exchange rates used for 1980-1994 are listed in Appendix one, Tables A1-5 and A1-6. For 1995, an exchange rate of US$1: NT$27.322 was used.

BACKGROUND

Taiwan's geography

Taiwan straddles the Tropic of Cancer, about 150 kilometers off the southeast coast of mainland China (**Figure 1**). The island is 35 570 square kilometers in area with a coastline of over 1 000 kilometers in length. Off its east coast, the deep waters adjacent to the coast are an important migratory route for fish species. Taiwan's west plains gradually lead into a gently sloping sea floor which provides an excellent breeding ground for many species of fish and shellfish.

Taiwan's chondrichthyan fauna

The Class Chondrichthyes - the cartilaginous fishes - is comprised of sharks, skates, rays, and chimaeras. The cartilaginous fishes are further divided into two sub-classes - the Elasmobranchii or sharks, skates, and rays and the Holocephali or rat-fishes (chimaeras), rabbit-fishes, and elephant fish (Anon. 1990). Taiwan's waters are home to 8 orders, 25 families, 52 genera, and 91 species of shark as well as 3 orders, 16 families, 24 genera, and 55 species of skate and ray (Shen, 1993).

Overview of Taiwan's commercial fisheries

Definitions

The *Fisheries Yearbook Taiwan Area* defines fishery types in the following way:

i. Deep-sea - powered vessels fishing in areas beyond Taiwan's 200-nautical-mile economic zone (Note: to avoid confusion, deep-sea fisheries will be referred to as distant-water fisheries in this report);
ii. Offshore - powered vessels fishing in Taiwan's economic zone between 12 nautical miles to 200 nautical miles;
iii. Coastal - sampans and sailing craft fishing within 12 nautical miles;
iv. Aquaculture - culture of fisheries products (e.g. marine culture; brackish water pond; freshwater pond, and cage culture).

Production

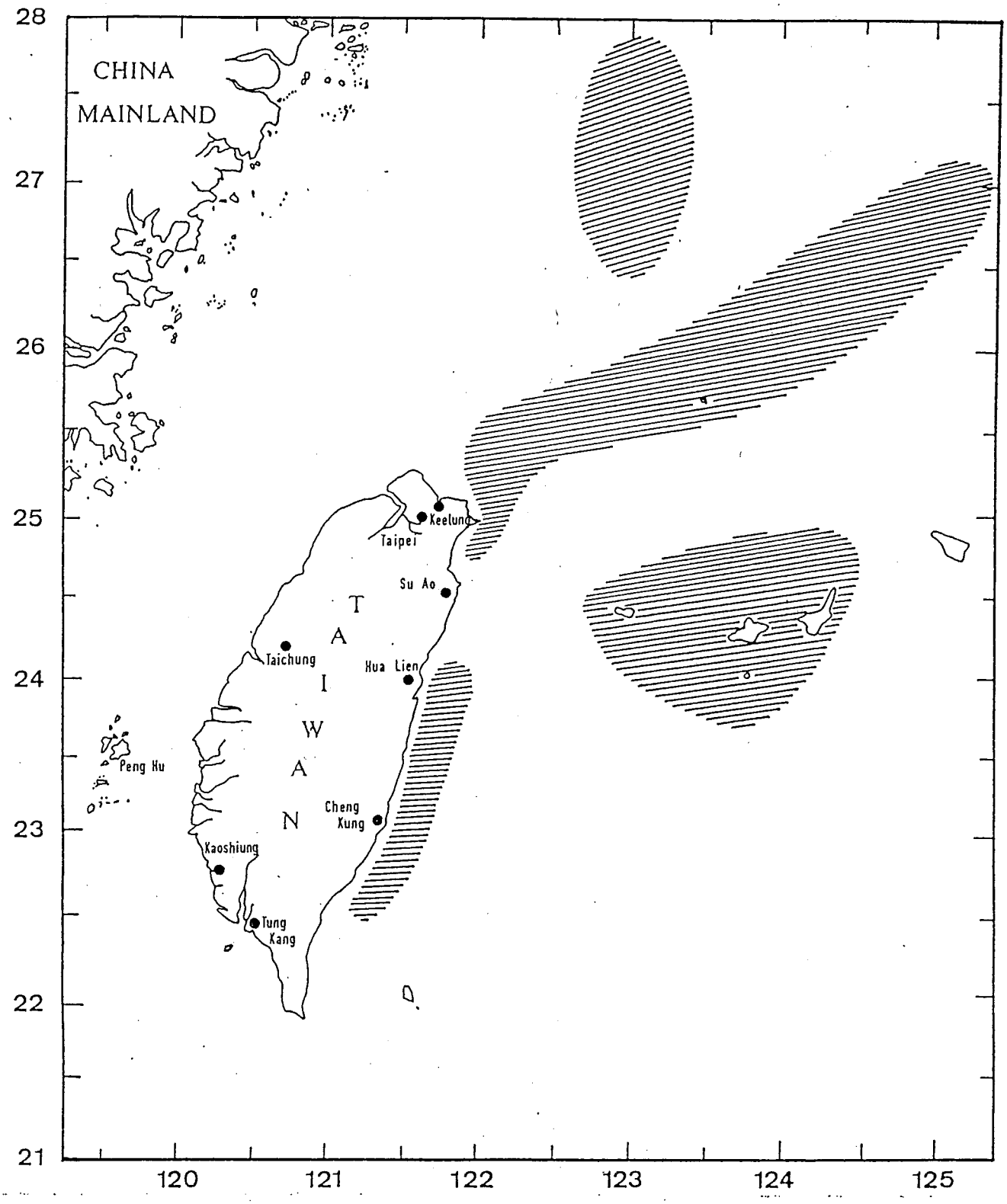
The *Fisheries Yearbook Taiwan Area* compiled by the Taiwan Fisheries Bureau records fish landings, but separate catch data is not recorded. In the case of distant-water fisheries, volumes of shark landings are based on the weight of dressed sharks. Figures are not adjusted to represent live shark weights. Information is not recorded to the species level for shark catch. Instead, sharks are recorded under the categories of "large" and "small."

Taiwan's total fisheries production (distant-water fisheries; offshore fisheries; coastal fisheries; marine culture; inland fisheries; and inland culture) for 1994 was 1 255 273mt, a decrease of 11.85% from 1993 levels. The value of the total catch was approximately US$ 3.4 billion, down 4.26% from 1993 levels. Fisheries production accounted for 23.8% of Taiwan's agricultural production. This represents a decrease of over 1% from 1993 production levels (Anon ., 1995a).

Distant-water fisheries was the principal source of production both in terms of volume (683 780mt) and value (US$ 1.4 billion), followed by offshore fisheries and inland culture. Tuna longline (209 319mt) and squid jigging (158 303mt) were the largest sources of distant-water catch.

Figure 1

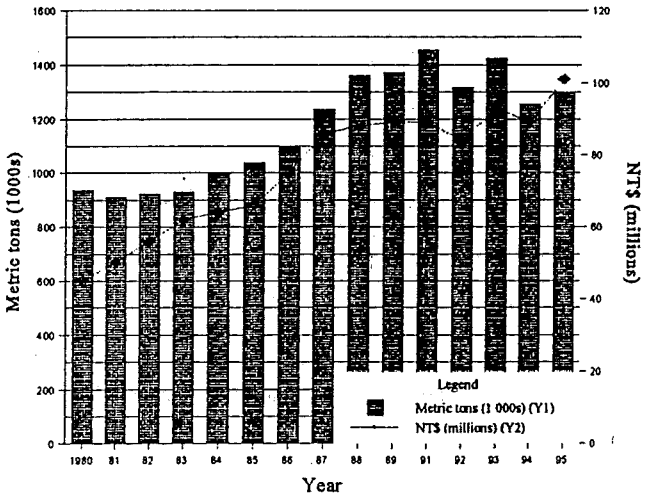
Map of Taiwan showing adjacent shark fishing grounds



Taiwan's fisheries production increased steadily in both volume and value from 1980 to 1990, but appears to have leveled off or declined slightly since then (See **Figure 2**).

Figure 2

Taiwan area fisheries production (mt and NT$ millions) 1980-1995



Source: Fisheries Yearbook Taiwan Area 1980-1995 (Taiwan Fisheries Bureau)

Fishing fleet

The total number of fishing crafts reached 29 562 in 1994 (Taiwan Fisheries Bureau, 1995). This represented a decrease in number of vessels (down 366 or -1.22%) from 1993, but a slight increase in total tonnage to 912 290.12 (+0.26%). Categories of vessels are described in **Table 1**.

The government's policy is to issue new licenses for fishing vessels on a replacement basis only (Dah-Wen Shieh, pers. comm., 1996). In addition, in 1991, the government began implementing an active buy-back programme to ease labor shortage problems, relieve resource exploitation pressure, and to prevent the use of old fishing boats for smuggling (Anon., 1993). At this time, the government stated its intention to buy back between 3 700 and 9 700 old boats of various sizes within a five-year period.

Legislation

Taiwan's fisheries are regulated under the Fisheries Act (first enacted in 1929 and re-enacted in present form on 1 February 1991) which contains 71 articles. The objectives of the Act, as stated in Article I are, "to conserve and rationally utilize aquatic living resources; to enhance fisheries productivity; to guide the complete development for fisheries; to foster the development of recreational fisheries; to maintain fisheries discipline; and to improve the standard of living of fishermen (Fisheries Act of the Republic of China, 1991, unofficial translation).

Table 1

Total number of fishing craft - 1994

Category of vessel	Number	Percentage change from 1993	Total tonnage	Percentage change from 1993
Newly built fishing vessel	405	+38.70%	17 270.39	-16.61%
Powered fishing crafts	13 268	-0.23+	911 578.16	+0.29%
Non-powered sampans	1 147	-17.48%	---	---
Powered rafts	13 276	-0.48%	---	---
Non-powered rafts	1 871	-1.53%	---	---

Source: Fisheries Yearbook Taiwan Area, 1994 (Taiwan Fisheries Bureau)
Note: Vessels listed under Newly built fishing vessel category (no. =405) are also included in numbers of vessels under other four categories.

The Fisheries Act states the need for a permit to engage in commercial fisheries (Article 6) and to build, reconstruct, lease, or import a fishing vessel for commercial purposes (Article 8). The Act allows the competent authorities to regulate the following through the fishing license: category of fisheries, operating period, and fishing grounds (Article 36). The Act also allows authorities to restrict the total number of fishing vessels and total gross tonnage for conservation of aquatic resources; modification of the fisheries structure; and in response to restrictions required by international fisheries agreements or overseas fisheries cooperation regulations (Article 37). The activities of fishing vessels and crews in foreign fishing bases are also regulated by the Act (Article 39).

Chapter 5 of the Act deals with conservation and management in eight articles (Articles 44-51). These articles refer to various restrictions which may be placed by the competent authority; the creation of conservation areas; the need for the competent authority to carry out studies and the requirement for fishermen to cooperate in providing needed information; prohibited fishing techniques, etc.

There are no regulations specifically pertaining to sharks.

Administration

Taiwan's Fisheries Authorities

The highest fishery authority in Taiwan is the Fisheries Department of the Council of Agriculture. A Director and Deputy Director oversee four divisions: Fishery Administration; Marine Fisheries; Aquaculture and Coastal Fisheries; and Fishery Engineering. The Fisheries Department is responsible for planning, policy and administration.

The next level of government administration consists of three sections: the Taiwan Fisheries Bureau

(Department of Agriculture and Forestry, Taiwan Provincial Government); the Kaohsiung Fisheries Administration (Bureau of Reconstruction, Kaohsiung Municipal Government); and the Fu-kien Provincial Government (Anon., 1993).

The Taiwan Fisheries Bureau is the executing fishery authority. The Bureau is headed by a Director, a Deputy Director, and a Secretary General. They oversee six divisions: Administration of Fisheries Policy; Extension and Improvement of Fishery Technologies; Supervision of Repairs and Construction of Fishing Harbors and Public Facilities Related to Fisheries; Supervision of Transportation and Marketing of Fishery Products and Fish Markets; Collection of Statistics on Fisheries; and Guidance on the Operations of Fishermen's Associations. The Bureau is responsible for promotion and improvement of fishery technology, marketing, and policy enforcement. It oversees the Fisheries Sections of local prefectural and township governments.

The structure of the Kaohsiung Fisheries Administration is similar to the Taiwan Fisheries Bureau. However, it consists of five rather than six divisions. They are: Administration of Fisheries Policy; Extension and Improvement of Fisheries Technologies and Collection of Statistics on Fisheries; Administration of Fishing Harbors and Supervision of Fish Market Operations; Supervision and Guidance of Distant-water Fisheries; and Guidance on the Operation of Fishermen's Associations. Finally, the Fu-kien Provincial Government consists of two sections overseeing fishing activities in Kinmen and Lian-Kiang prefectures.

Associations - Fishermen's and Boatowners'

In 1994, there were 38 regional fishermen's associations and one provincial association with a total membership of 260 762 (Taiwan Fisheries Bureau, 1995). Major fishermen's associations include the the Kaohsiung Fishermen's Association and various other local fishermen's associations. Company associations include the Kaohsiung Fishing Boats Commercial Guild; the Taiwan Deep Sea Tuna Boatowners and Exporters Association; and the Taiwan Squid Fishery Association.

In addition, the Overseas Fisheries Development Council was founded in 1989 as a non-profit corporation to assist the fishing industry in seeking opportunities for foreign fisheries cooperation and to provide legal aid to detained fishing vessels and their crews (Anon., undated).

Access agreements

The imposition of two-hundred-nautical-mile Exclusive Economic Zones or EEZs by most countries has had a major impact on distant-water fishing operations as access to almost 95% of the world's established fishing grounds is restricted (Anon ., 1993a). Taiwan has negotiated bilateral fishing agreements through both government authorities and private fishing organizations. In 1993, Taiwan had fishing agreements or arrangements with more than 20 countries or areas (Anon., 1993). These cooperative agreements involved an estimated total catch of 250 000mt.

Taiwan has formal agreements with five countries with which it has formal diplomatic relations: South Africa, the Solomon Islands, the Marshall Islands, Tonga, and Tuvalu (Anon., 1993). Agreements or arrangements have been established by private organizations with: Palau; Papua New Guinea; Fiji; Vanuatu; Philippines; Indonesia; India; Western Samoa; Pakistan; Sierra Leone; the Falkland Islands; the Cook Islands; Micronesia; Kiribati; Russia; Vietnam; Brazil; and the Sultanate of Oman. Private organizations or associations involved in fishing agreements include: the Overseas Fisheries Development Council; the Taiwan Fishermen Association; the Taiwan Deep-Sea Tuna Boat Owners Association; as well as private fishing companies.

Changes in management measures adopted by countries within their areas of jurisdiction have had a major impact on the fisheries of Taiwan and other fishing nations. An important example is the pelagic gill-net fishery operated by Taiwanese fishermen in the offshore waters of northern Australia from the early 1970s until mid-1986. Shark (particularly Australian Blacktip *Carcharinus tilstoni* and Spot-tail Shark *C. sorrah*), Longtail Tuna *Thunnus tonggol*, and mackerel *Scomberomorus* spp. were the target species with sharks comprising roughly 80% of the catch by weight (Stevens, 1991). Prior to the introduction of management measures, Taiwanese fishermen reported an average annual catch of 25 000mt live weight (Stevens, 1991) most of which was for domestic consumption.

When the Australian Fishing Zone (AFZ) was declared in 1979, both the fishing area and vessel numbers were restricted and a catch quota of 7 000mt (10 000mt live weight) was imposed (Stevens, 1991). A 1986 decision by the Australian government to limit the length of gill-nets to 2.5km in length effectively ended the Taiwanese gill-net operation within the AFZ.

In response to changing economic, political, and environmental factors, the Council of Agriculture drafted a "Fisheries Development Program" which was adopted in amended form by the Executive Yuan (Cabinet) in January 1990 (COA, 1993). Elements of the COA's strategy include: broadening the scope of international fisheries cooperation; exploring high-seas fishery resources; active participation in international fisheries organizations; and strict control of drift-net fishing (COA, 1993).

TAIWAN'S SHARK FISHERIES

Historical fisheries

1930-1960s

The first description of Taiwan's shark fishery dates back to the 1930s. Nakamura (1936) mentioned that the average annual yield of shark was about 6 000 metric tons, making it number one in terms of total catch and third in terms of total value in Taiwanese fisheries from 1929 to 1933. The major fishing methods for shark fisheries at that time were longline and bottom trawling. A brief description follows:

Longline fishery

The main bases for longline fishery were in Suao, Keelung and Kaohsiung. Sharks were the major target species in Keelung and Suao and were bycatch in Kaohsiung where tuna was the target species. The fishing vessels in Keelung and Suao were 20-30 metric tons and their fishing type belonged to one-day cruise coastal fishery. The fishing season was from October to the following April and the dominant catch species were Scalloped Hammerhead *Sphyrna lewini*, Shortfin Mako *Isurus oxyrinchus*, Pelagic Thresher *Alopias pelagicus*, and requiem sharks *Carcharhinidae*. Among these, Scalloped Hammerhead, Pelagic Thresher and Sandbar Shark *Carcharhinus plumbeus* comprised 70% of the total catch. The major fishing season was from February to March. The shark fins were used for shark-fin soup and meat was used as an ingredient in minced fish products.

The fishing grounds for tuna longliners in Kaohsiung extended to south Asian waters. A single voyage took two to three weeks and sharks were primarily bycatch. For economic reasons, the fishermen brought back shark fins only. The target species were similar to those of Suao including: Blacktip Reef shark *Carcharhinus melanopterus*, Silvertip Shark *C. albimarginatus*, Shortfin Mako and Pelagic Thresher. The utilization of sharks was the same as in Suao.

Bottom trawling fishery

The main base of this multi-species fishery was in Keelung and sharks (mostly small demersal sharks) were bycatch.

In the 1960s , the annual yield of sharks was about 17 000 metric tons, three times that of the 1930s, and it occupied second place in the fisheries. The major fishing methods were drift longline, bottom trawling, and harpoon (Teng, 1962).

Drift longline fishery

By the 1960s, the fishing vessels of Kaohsiung, Keelung, Aoti, and Suao had increased to 450 in number and vessels tended to be larger compared to 30 years earlier. Four hundred vessels were 20-50mt, and their main fishing grounds were in the South China Sea where one voyage took 7-10 days. Forty tuna longliners were 50-100mt and their fishing grounds extended to the East Indian Ocean where one voyage lasted one month. Four tuna longliners were larger than 350mt and their fishing grounds were in the west Indian Ocean where one voyage took about two months. The species caught by these vessels were similar to those 30 years earlier.

Bottom longline fishery

The main bases for this fishery were in Nanliao, Tahsi, Suao, Hualien, and Tongkang. The Armor Shark *Dalatias licha*, Taiwan Gulper shark *Centrophorus niaukang*, Japanese Stingray *Dasyatis akajei*, and Beaked Dogfish *Deania calcea* were the dominant catch species. The Sixgill Shark *Hexanchus griseus*, Sharphead Sevengill Shark *Heptranchias perlo*, Spiny Dogfish *Squalus mitsukurii*, and Silver Chimaera *Chimaera phantasma* were caught occasionally.

Bottom trawling fishery

There were 30 trawlers larger than 100mt and the remainder were 70-100mt. The operations area was in northern Taiwan, the Taiwan Straits, and the South China Sea. The major species caught by this multi-species fishery were Zebra Bullhead Shark *Heterodontus zebra*, Leopard Shark *Triakis semifasciata*, Zebra Shark *Stegostoma fasciatum*, Hardnose Shark *Carcharhinus macloti*, Spot-tail Shark *Carcharhinus sorrah*, Slender Bamboo Shark *Chioloscyllium indicum*, and Japanese Topeshark *Hemitriakis japonica*. The fishing season was from September to the following June.

Harpoon fishery

The main base of harpoon fishery was in Keelung, Suao, Hualien, Chengkung, and Henchien. The fishing season matched the trade wind season (October to the following April). The Smooth Hammerhead, Shortfin Mako and especially the Japanese Devil Ray *Mobula japonica* were the dominant catch species.

Current coastal and offshore fisheries

The major bases for coastal and offshore shark fishery are in Chengkung and Nanfang Ao. According to market data for 1993, these two harbors together landed 4 518mt of shark (See Tables 2 & 3) accounting for 84.55% of Taiwan's total coastal and offshore shark landings (5 343mt; Table 4). In addition, these two harbors are home to the only directed shark fishery vessels in Taiwan, so Nanfang Ao and Chengkung were chosen as focal points for the coastal and offshore section of this study.

There are 20 shark fishing vessels in Nanfang Ao. Most of these vessels target sharks from September to the following April and shift to other species such as tuna and billfish in the remaining months of the year. Only three to five fishing vessels target shark year-round. There are four major fishing grounds for sharks off Suao as follows: (1) the coastal waters from 121° 50' E to 122° 20' E and 24° 30' N to 25° 30'N where the dominant species are Bigeye Thresher *Alopias superciliosus* and Pelagic Thresher; (2) from 122° 30' E - 123° 30'E and 26° 30'N where the dominant species is the Shortfin Mako; (3) along the 200m isodepth contour line from Peng Jia Yeu through to the Tiaoyutai islands, Huang Wei Yeu, Chih Wei Yeu to 126°E where the dominant species are Smooth Hammerhead *Sphyrna zygaena*, Scalloped Hammerhead, Sandbar Shark, Silky Shark *Carcharhinus falciformis*, Oceanic Whitetip Shark *C. longimanus*, Spinner shark *C. brevipinna*, and Dusky Shark *C. obscurus*; (4) from 122° 40' E - 125° E and 24°N - 25°N where Tiger Shark *Galeccerdo cuvier* is the dominant species.

The major fishing method of shark fisheries in Nanfang Ao is the bottom longline. The fishing depth varies from 80m to 200m according to species and operating area. One voyage takes 4-7 days for the majority of fishing vessels and 1-3 days for the remaining vessels. The dominant species are Pelagic Thresher, Bigeye Thresher, Smooth Hammerhead, Scalloped Hammerhead, Sandbar Shark, Silky Shark, Oceanic Whitetip Shark, Spinner Shark, Shortfin Mako, Blue Shark *Prionace glauca*, and Dusky Shark.

There are three different fishing types in Chengkung: shark longline, drift-gill net, and set-net. However, only large-mesh drift-net and several mid-water longline specifically target sharks. The large-mesh drift-net target Bigeye Threshers and Pelagic Threshers. The mid-water longline target requiem sharks, Scalloped Hammerhead, Blue Shark and Shortfin Mako.

In addition to the above fishing methods, some other fishing methods (e.g. tuna longline, billfish gill-net and bonito gill-net) catch sharks as bycatch. Bycatch of these fishing methods include: Whale Shark *Rhiniodon typus*, Shortfin Mako, Great White Shark *Carcharodon carcharias*, Blacktip Reef Shark *C. melanopterus*, Blue Shark, Japanese Topeshark, Smooth Hammerhead, and Scalloped Hammerhead. Whale Sharks are also sometimes caught in set-nets as bycatch.

The fishing season and distribution of dominant shark species

Interviews were conducted with local fishermen in Nanfang Ao and Chengkung using a questionnaire. A total of 40 interviews, 20 for each site, were conducted. The results, including the fishing season and distribution of each dominant shark species, are summarized below:

1. Bigeye Thresher *Alopias superciliosus*

There are two main fishing grounds, one at 24° 30' - 25° 30'N and west of 122° 30'E for Nanfang Ao fishing vessels and the other at 22° 40' N -23° 20' N and west of 121° 40'E for Chengkung shark fishery vessels. This species can be caught year-round but January - May and November - December are the major seasons for Chengkung fishing vessels. The fishing methods are longline for Nanfang Ao fishing vessels at depths more than 50m and large-mesh drift-net at less than 50m for Chengkung fishing vessels.

2. Pelagic Thresher *A. pelagicus*

This species can be caught year-round with the major season from January - April and October - December for Nanfang Ao fishing vessels and February - April for Chengkung vessels, respectively. The fishing grounds and operational depths were similar to those for the Bigeye Thresher.

3. Scalloped Hammerhead *Sphyrna lewini*

The major fishing ground for this species caught by Nanfang Ao fishing vessels is along the 200m isodepth contour line from Peng Jia Yeu, Huang Wei Yeu, Chih Wei Yeu to the 126° E. The major fishing ground is from 22° 20'N - 22° 40'N and 121° E - 121° 20' for Chengkung fishing vessels. This species is caught by longline vessels at a depth of 40-100 meters for both sites. The Scalloped Hammerhead can be caught year-round.. However, due to the shift in target species to tuna and billfish in the summer, the peak was from September - March for Nanfang Ao and November - March for Chengkung.

4. Smooth Hammerhead *S. zygaena*

Except for a slight difference in fishing grounds in Chengkung, this species is the same as Scalloped Hammerhead in terms of the fishing grounds and season. The fishing ground in Chengkung is from 121° 20'E - 121° 40'E and 22° 20'N - 22° 40'N.

5. Sandbar Shark *Carcharhinus plumbeus*

This species can be found year-round but the major season is from September to the following March. Most catch of this species was from Nanfang Ao fishing vessels with little from Chengkung fishing vessels. The

major fishing ground is from Peng Jia Yeu along the 200m isodepth contour line to Huang Wei Yeu, Chih Wei Yeu waters. This species can be caught at depths of 40-120 meters.

6. Oceanic Whitetip Shark *C. longimanus*

Most catch of this species was by Nanfang Ao fishing vessels with few by Chengkung fishing vessels. The fishing season is from June to August and the fishing grounds are in the waters south to the 200m isodepth contour line of northeastern Taiwan. This species can be caught at a depth of 40-120m.

7. Silky Shark *C. falciformis*

This species is caught by longliners with most catch from Nanfang Ao fishing vessels. The fishing grounds for this species is the same as that of the Oceanic Whitetip Shark. The fishing season in Nanfang Ao is from October to December while from January to April in Chengkung.

8. Dusky Shark *C. obscurus*

All catch of this species was from Nanfang Ao fishing vessels with no recorded catch from Chengkung. This is an important species for the shark fishery in Nanfang Ao. Although this species can be caught year-round, the major season is from October to the following April. The fishing grounds are identical to those of Sandbar Shark, Oceanic Whitetip Shark and Silky Shark but at shallower depths.

9. Spinner Shark *C. brevipinna*

Most catch of this species is by longliners out of Nanfang Ao. Its fishing grounds and season are similar to those of the Dusky Shark.

10. Blue Shark *Prionace glauca*

The major fishing season of this species is from May to August and from February to May for Nanfang Ao and Chengkung respectively. This species can be caught year-round and has no specific fishing grounds.

11. Shortfin Mako *Isurus oxyrinchus*

This species can be caught year-round. The major season in Chengkung is from January to May and there are no specific fishing grounds. The major fishing season in Nanfang Ao is from November to April and fishing ground is from 122° 30' - 123° 30' and 26° 30'N - 27° 30'N.

12. Tiger Shark *Galeocerdo cuvier*

This species is caught by longliners from Nanfang Ao and Chengkung year-round. The major fishing season of this species in Chengkung is from February to April and fishing grounds are in waters close to the Philippines. The major fishing season of this species in Nanfang Ao is from June to July and the main fishing grounds are the waters around Yu Na Kuo Island, Shi Piao Island and Shi Huan Island (122° 30'E - 124° 30'E and 24° N - 24° 50' N).

Fluctuations in shark yield for coastal and offshore fisheries

Collection of this data is from sales records for a six-year period in Nanfang Ao (1989-1994) (**Table 2**), and a five-year period in Chengkung (1990-1994) (**Table 3**).

Nanfang Ao fishing port

The annual landing of sharks at Nanfang Ao (1989-1993) ranged from 1 608 metric tons to 2 045 metric tons with an average of 1 836 metric tons. As a percentage of the total catch, the Scalloped Hammerhead ranks first (accounting for 20.8% of all shark landings); followed by Shortfin Mako (19.0%), Dusky Shark (13.74%), Bigeye Thresher (12.99%), Pelagic Thresher (11.06%), Sandbar Shark (7.11%), and Spinner Shark (6.29%). Other species such as Smooth Hammerhead, Silky Shark, and Oceanic Whitetip Shark accounted for less than 5% of the total shark landings.

Although the Scalloped Hammerhead ranked first in total weight from 1989 to 1993, its yield decreased yearly from 451mt in 1989 to 287mt in 1993, down 36.3% .

The catch of Shortfin Mako increased from 328mt in 1989 to a peak of 412mt in 1991, declined 26% to 305mt in 1992 and slightly recovered in 1993 but at a lower level than in 1991.

The catches of the Bigeye Thresher, Spinner Shark and Dusky Shark exhibited similar trends as that of the Shortfin Mako which reached its peak in 1991, declined in 1992 and recovered slightly in 1993 but without regaining 1991 levels.

The catch of Pelagic Thresher, Silky Shark and Oceanic Whitetip increased but, with the exception of the Pelagic Thresher, only occupied a small portion of the total catch. The Sandbar Shark had the highest catch of 160mt in 1990 and declined one-third to 107mt in 1993. The catch of Smooth Hammerhead was steady but it accounted for only 3.5% of the total catch and was not a dominant species.

Although there is considerable variation in the above catch figures for individual species, the total catch does not show significant change. This stable total could be interpreted as meaning there is no overharvesting of sharks in Nanfang Ao. As detailed in **Table 2**, eleven potential target species of shark exist, allowing fishermen to compensate when one commercially important species decreases. This may allow reduced species an opportunity to recover. Another factor is the changeover from shark to other commercially prized species such as tuna from spring to autumn which may also allow for recovery of certain shark species.

Chengkung fishing port

The shark landings in Chengkung increased yearly from 169mt in 1990 to 266mt in 1993. The Bigeye Thresher ranked first (occupying 37.2% of all shark landings); followed by the Shortfin Mako (19.9%), Scalloped Hammerhead (17.1%), Blue Shark (14.8%), and Pelagic Thresher (8.2%). Other species such as Tiger Shark, Dusky Shark , Oceanic Whitetip Shark, Silky Shark, and Spinner Shark accounted for less than 5% of the total shark landings.

The major fishing method for the Chengkung shark fishery was the large-mesh drift-net which targets threshers. Hence, the yield of threshers (including Bigeye and Pelagic) occupied 45% of total shark landings. However, the Bigeye Thresher declined from 1991 in terms of absolute catch and percentage of total.

Table 2

Annual landing of sharks at Nanfang Ao fish market (mt) 1989-1994

Species	1989 (% of total)	1990	1991	1992	1993	1994	Overall Average
Alopias superciliosus	161.7 (9.4%)	197.2 (10.1%)	274.1 (13.4%)	180.3 (11.2%)	202.3 (10.9%)	320.0 (18.0%)	222.6 (12.2%)
Alopias pelagicus	215.2 (12.5%)	161.3 (8.3%)	190.7 (9.3%)	272.2 (16.9%)	353.2 (19.0%)	140.3 (7.9%)	222.2 (12.2%)
Carcharhinus brevipinna	92.8 (5.4%)	136.3 (7.0%)	179.9 (8.8%)	57.5 (3.6%)	110.9 (6.0%)	84.7 (4.8%)	110.4 (6.0%)
C. falciformis	31 (1.8%)	31.4 (1.6%)	33.9 (1.7%)	51.3 (3.2%)	52.2 (2.8%)	82.3 (4.6%)	47.0 (2.6%)
C. longimanus	27.7 (1.6%)	14.2 (0.7%)	16.6 (0.8%)	31.4 (2.0%)	31.6 (1.7%)	43.5 (2.5%)	27.5 (1.5%)
C. obscurus	204.2 (11.8%)	284.1 (14.6%)	339.2 (16.6%)	172.2 (10.7%)	261.9 (14.1%)	193.1 (10.9%)	242.5 (13.3%)
C. plumbeus	133.7 (7.7%)	160.4 (8.2%)	139.9 (6.8%)	112.1 (7.0%)	106.5 (5.7%)	95.6 (5.4%)	124.7 (6.8%)
Galeocerdo cuvier	12.9 (0.7%)	44.5 (2.3%)	10.6 (0.5%)	61.4 (3.8%)	34.8 (1.9%)	24.4 (1.4%)	31.4 (1.7%)
Isurus oxyrinchus	328.0 (19.0%)	361.0 (18.6%)	412.2 (20.2%)	304.9 (19.0%)	337.9 (18.2%)	417.9 (23.6%)	360.3 (19.7%)
Sphyrna zygaena	65.7 (3.8%)	65.1 (3.3%)	64.4 (3.1%)	57.9 (3.6%)	74.1 (4.0%)	65.7 (3.7%)	65.5 (3.59%)
Sphyrna lewini	450.9 (26.1%)	484.3 (24.9%)	383.1 (18.7%)	304.9 (19.0%)	287.4 (15.5%)	307.0 (17.3%)	369.6 (20.2%)
Others	1.9 (0.1%)	4.4 (0.2%)	0.6 (0.0%)	2.3 (0.1%)	2.8 (0.1%)	0.0 (0.0%)	2.0 (0.11%)
Annual yield	1 725.9	1 944.3	2 045.2	1 608.5	1 855.6	1 774.5	1 825.7

Source: Chen *et al.*, 1995

Table 3

Annual landing of sharks at Chengkung fish market (mt) 1990-1994

Species	1990 (% of total)	1991	1992	1993	1994	Overall Average
Alopias superciliosus	52.7 (31.2%)	104.4 (44.9%)	98.2 (40.5%)	85.7 (32.2%)	35.4 (14.5%)	75.3 (32.6%)
Alopias pelagicus	11.8 (7.0%)	29.3 (12.6%)	10.7 (4.4%)	23.4 (8.8%)	44.1 (18.1%)	23.9 (10.3%)
Carcharhinus brevipinna	7.1 (4.2%)	5.5 (2.4%)	2.4 (1.0%)	7.3 (2.8%)	9.8 (4.0%)	6.4 (2.8%)
C. falciformis	3.3 (2.0%)	12.3 (5.3%)	4.6 (1.9%)	4.9 (1.8%)	5.6 (2.3%)	6.1 (2.7%)
C. longimanus	0.5 (0.3%)	1.8 (0.8%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.5 (0.2%)
C. obscurus	4.0 (2.4%)	1.2 (0.5%)	0.01 (0.0%)	0.2 (0.1%)	0.0 (0.0%)	1.1 (0.5%)
Galeocerdo cuvier	1.8 (1.1%)	2.1 (0.9%)	4.0 (1.6%)	4.1 (1.6%)	6.7 (2.8%)	3.7 (1.6%)
Isurus oxyrinchus	31.2 (18.4%)	20.9 (9.0%)	30.3 (12.5%)	52.7 (19.8%)	53.3 (21.9%)	37.7 (16.3%)
Prionace glauca	20.8 (12.3%)	22.8 (9.8%)	46.3 (19.1%)	47.6 (17.9%)	48.6 (19.9%)	37.2 (16.1%)
Sphyrna zygaena	0.1 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	4.7 (1.9%)	1.0 (0.4%)
Sphyrna lewini	35.7 (21.1%)	32.0 (13.8%)	45.2 (18.6%)	40.1 (15.1%)	32.9 (13.5%)	37.2 (16.1%)
Others	0.0 (0.0%)	0.5 (0.2%)	0.8 (0.3%)	0.2 (0.1%)	2,8 (1.2%)	0.86 (0.4%)
Annual yield	169.0	232.8	242.6	266.2	243.9	230.9

Source: Chen *et al.*, 1995

The remaining species were caught by longline with the catch of Scalloped Hammerhead, Blue Shark, Shortfin Mako and Tiger Shark increasing yearly and compensating for the loss of threshers. The catch of Dusky Shark and Silky Shark also decreased. Catch of Spinner Shark increased threefold in 1993 and needs to be closely monitored.

In summary, there are two principal methods of shark fishing in Chengkung: longline and large-mesh drift-net. The increase in total catch is from longline fishing; catch from the large-mesh drift-net has decreased. The latter method specifically targets Bigeye Thresher and Pelagic Thresher which means the lack of alternative target species could lead to overfishing. Fortunately, the fishing season during which large-mesh drift-nets are employed is relatively short, limited to a two-month period from late February to early April. The catch yield from longline fishing, although increasing, is still a smaller portion of the total than the catch yield from large-mesh drift-nets. Some fishing vessels have begun to target sharks year-round.

The utilization of sharks from coastal and offshore fisheries

Most of the sharks caught in the coastal and offshore waters were by longline in Nanfang Ao and drift-net in Chengkung, only a small portion were by trawling. These sharks were utilized completely. The fins, including dorsal, pectoral, ventral, and caudal fins, after processing, are sold to restaurants for making shark fin soup. The meat is sold both as fresh meat and as mince. The cartilage is sold for medicinal use. The utilization of shark products in Taiwan is discussed in more detail in a later section.

The price of sharks in fishery markets

The price of sharks varies according to season and freshness, but the range of variation is not as large as that of billfish and tuna. The price of sharks in the winter (December through February) is higher than that in the summer. The landing price of sharks (US$/kg) caught by coastal and offshore fishery by species is summarized as follows: Pelagic Thresher, $1.28-$2.56; Bigeye Thresher, $0.92-$1.83; Smooth Hammerhead, $1.46-2.20; Scalloped Hammerhead, $1.83-$2.75; sandbar, $1.83; Oceanic Whitetip, $1.83; Tiger Shark, $1.10; Shortfin Mako, $1.83-$2.93; Silky Shark, $1.83-$2.20; Spot-tail shark *Carcharhinus sorrah*, $2.01; Spinner Shark, $2.01; Dusky Shark, $1.10-$1.46; dogfish sharks, $1.10; Blue Shark, $0.55-$0.73; Silvertip Shark, $1.83-$2.20; Basking Shark, $1.10; Whale Shark, $2.56-$6.59. Prices are those paid after landing at fishery markets (production sites) for whole specimens including fins and internal organs.

Observations on coastal and offshore fisheries

The coastal and offshore shark yield did not decrease significantly in recent years according to the annual fisheries statistics reports, and Nanfang Ao and Chengkung's daily catch records. Two possible reasons for the consistent catch are as follows: 1) there are more alternate species for coastal and offshore fishery because of their multi-species operating style; 2) the shark fishing vessels in Nanfang Ao and Chengkung do not target sharks year-round (seasons are October to the following April in Nanfang Ao and February to April in Chengkung), giving catch species an opportunity for recovery. However, an increase in demand for shark meat, that once had limited popularity, could result in a change in current fishing practices.

The Whale Shark, most expensive of all (US$2.56-$6.59 per kg), is a good example. Though no evidence exists showing a decrease in Whale Shark catch, this species needs to be closely monitored because of its characteristic slow growth and late maturity. Most Whale Sharks in Taiwan waters are caught by set-net and a small proportion by longline. Although there is no dedicated Whale Shark fishery at the moment, this could change as the price and demand for sharks increase.

Although the total catch of coastal and offshore shark fisheries did not decrease significantly, some species have

decreased as a percentage of total catch while others have increased. Certain demersal species once common in coastal and offshore fisheries have shown a decline in catch over the past 10 to 20 years. Although species-level catch data is unavailable, interviews with fishermen and fish market surveys have shown that, during the last decade, these species have become difficult to find:

- The Starspotted Smooth-hound *Mustelus manazo* and Spotless Smooth-hound *Mustelus griseus* were once common commercial species caught throughout Taiwan's waters. These species are now difficult to find outside of two localities: the waters off Chinshan and Kueishan island in northern Taiwan. As with certain demersal teleost species, the overexpansion of coastal trawl fisheries in Taiwan resulted in the decline of *Mustelus* spp. However, the multi-species nature of trawl fisheries makes species-specific management problematic.
- A similar picture emerged for certain deep-water species once commonly fished off Taiwan's east coast. *Squalidae* and *Centrophorus spp.*, formerly major catch species in Chengkung, Hualien and Tashi, have declined significantly in recent years and are no longer commercially important.

However, existing data are insufficient to draw reliable conclusions on trends in Taiwan's offshore and coastal shark fisheries. In future, more data on species catch levels and fishing effort must be collected. Only then will it be possible to create a workable management regime should that prove necessary.

Distant-water fisheries

Sources of shark catch

Approximately 90% of distant-water shark catch was landed at Chengchen harbor in Kaohsiung, 10% at Tongkang harbor in Pingtung, and small amounts in Suao harbor in Ilan and other fishing ports. Distant-water fishing vessels operate widely in the Pacific, Atlantic, and Indian Oceans.

Fishing types and methods

Distant-water fishing vessels include tuna longline (including vessels with super low temperature freezers), trawl, and gill-net fisheries. Tuna longliners (approximately 1 000 vessels) and trawlers (approximately 700 vessels) form the bulk of the distant-water fishing fleet and are the major source of shark bycatch.

Distant-water fishing vessels operate in groups and, in order to economize, utilize foreign supply bases rather than returning to Taiwan. Transportation vessels are used to transport catch back to Taiwan. These vessels are for transport only and do not engage in any fishing.

Fishing gear for tuna and shark fisheries are essentially the same, making it a simple matter for vessels to switch between the two by switching fishing areas and bait.

Major fishing grounds for sharks

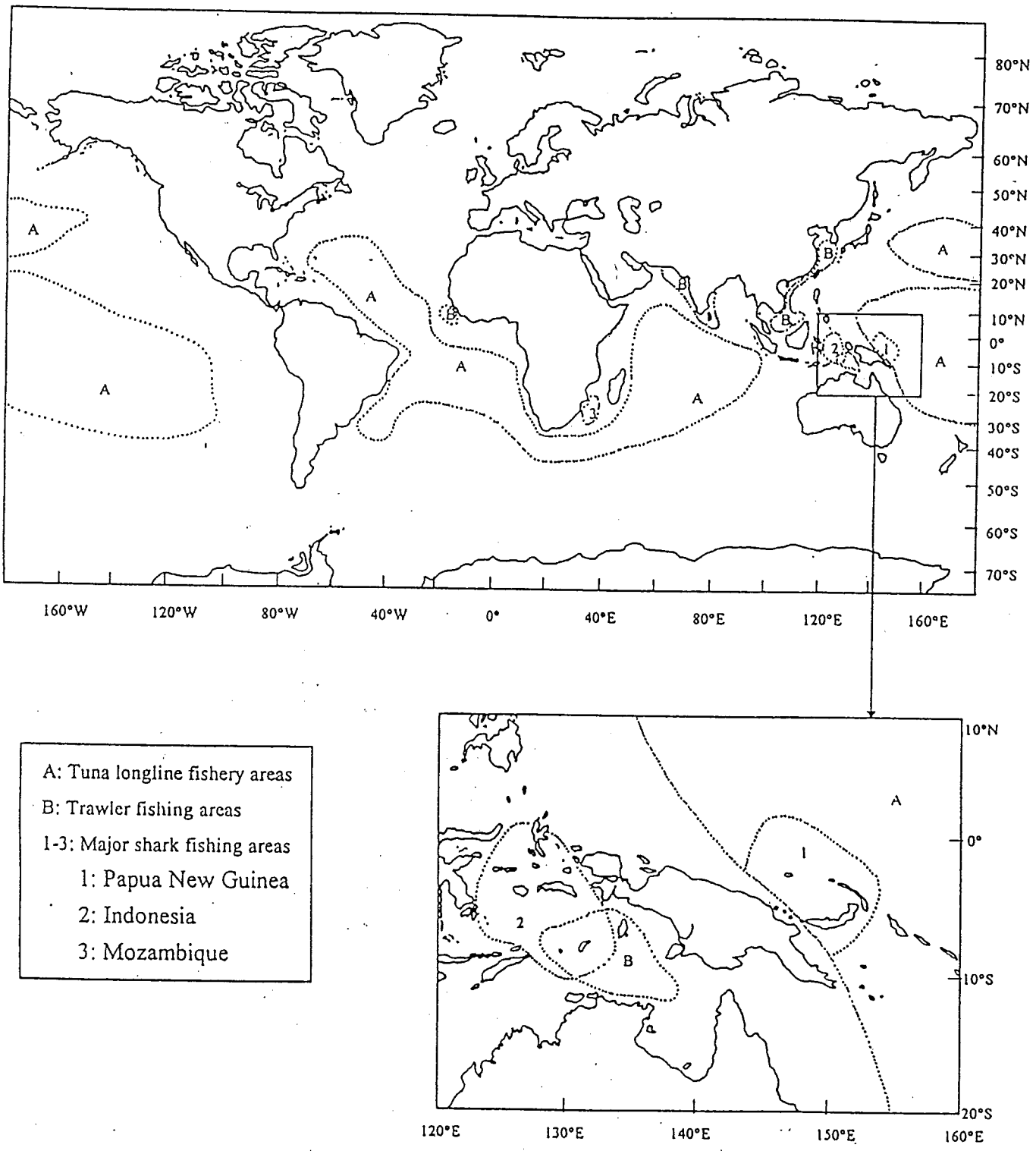
It is difficult to obtain information on specific fishing grounds for sharks caught by vessels targeting other species such as tuna. However, information can be obtained for the shark longline fishery. There are three major shark fishing grounds: 1) the waters around Papua New Guinea; 2) the waters around Indonesia; 3) the waters off Mozambique (See **Figure 3**).

Papua New Guinea (FAO fishing ground 71)

There were 40 directed shark fishing vessels in this area in 1995 and several tuna longliners which catch

Figure 3

Map showing global range of Taiwanese tuna longline and trawler fleets and distant-water shark fishing areas



shark as bycatch. Sixty percent of these vessels (24/40) were from Tongkang, 30% (12/40) from Kaohsiung, and 10% (4/40) from Suao. These vessels ranged in size from 50 to 100 tons. Major species caught included: Silky Shark; Oceanic Whitetip Shark; Shortfin Mako; thresher sharks; and hammerhead sharks. Silky Sharks comprised 60% of the total catch; Oceanic Whitetip comprised 30%; other species comprised the remaining 10%. The results of interviews indicated an approximate annual catch of 200 metric tons per vessel in this area for a total shark yield of 8 000 metric tons in 1995, given the total of 40 vessels.

Indonesia (FAO fishing ground 71)

There were eight directed shark fishing vessels operating in this area in 1995. The fishing ground was located at 122°E, 8°S. These vessels were all from Kaohsiung. Sharks comprised 90% of their catch with the remaining 10% being grouper species. The results of these interviews indicated an approximate annual catch of 300 metric tons per vessel for a total shark yield of 2 400 metric tons. Silky Shark was the dominant species.

Mozambique (FAO fishing ground 51)

There were four directed shark fishing vessels from Kaohsiung operating in these waters. The vessels were large (300mt) and made two voyages per year. Interviews indicated an average catch of 400 metric tons per vessel for a total catch of 1 600 metric tons for the four. Major species caught in these waters were Silvertip Shark, hammerhead sharks, Blue Shark, Oceanic Whitetip Shark, and thresher sharks.

In addition to catch from the above three fishing grounds, the bulk of Taiwan's remaining shark catch was bycatch from tuna longliners and trawlers.

The processing and pricing of sharks from distant-water fisheries

The price of shark is not as high as tuna or billfish (See **Table A1-10** in appendices). Therefore, primary processing was conducted immediately after each specimen was caught to maximize the economic value of the fishery by reducing the volume of fish and increasing the unit price. After the sharks were caught, the fins were cut and the head and internal organs (except for the stomach and intestines) were discarded. The gutted carcasses were transported back to Taiwan with two exceptions: small sharks (under 20kg); and Blue Sharks (*Prionace glauca*). As the latter is the least valued of shark species, it is processed in a different manner. Only the belly flaps are transported back to Taiwan (See **Figure 4**).

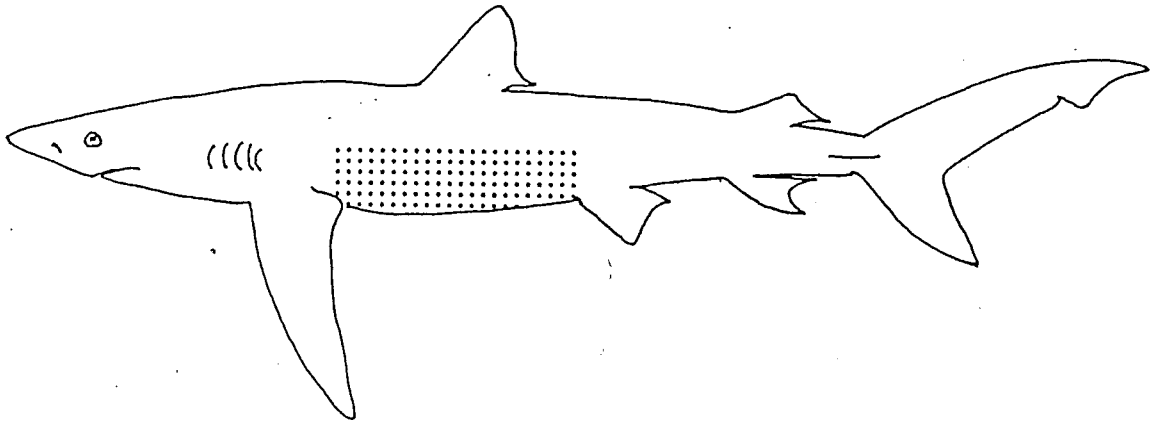
With the exception of the Blue Shark, landing prices for sharks from distant-water fisheries are similar among species. The Shortfin Mako has the best price of all, over US$2.93/kg; followed by Silky Sharks US$1.83-$2.38/kg (Price quotations supplied by buyers interviewed). Buyers can identify certain species of frozen dressed carcass even without the head and fins. Almost all sharks caught in distant water fisheries were transported back to Taiwan with the exception of the Shortfin Mako which is commonly sold through overseas bases. In 1994, sales records for Chengchen fish market (Kaohsiung) indicated the following auction prices: "large shark", US$0.18-$2.01/kg; Blue Shark, US$0.22-$0.77/kg; and shark fin (wet), US$0.55-$32.94/kg depending on the size and species.

The bycatch of shark from tuna longliners and trawlers

The annual bycatch of sharks from tuna longliners for a fourteen-year period (1981-1994) is listed in **Table 4**. This table indicates an average annual yield of shark bycatch between 2 000mt and 3 000mt with a peak of

Figure 4

Diagram showing portion of Blue Shark *Prionace glauca* utilized as belly flaps



10 000mt in 1989. Table 5 shows the breakdown of catch by ocean for a five-year period, 1989-1994.

The composition of shark catch for the same period (1981-1994) indicates an average annual yield of shark bycatch from trawlers of between 1 500mt and 25 000mt (5.4%-41.7% of total shark catch) with a peak of 25 769mt in 1990.

The fluctuation of shark catch from distant-water fisheries

According to the *Fisheries Yearbook Taiwan Area* (Taiwan Fisheries Bureau, 1958 through 1995), the shark landings from distant-water fisheries averaged 6 000mt in the 1960s, was 10 000mt in 1970, increased to 25 000mt in 1975, ranged from 25 000mt-40 000mt from 1975-1989, reached a historic high of 67 000mt in 1990 and then significantly declined. Landings in 1991 were about 60 000mt, with 57 000mt in 1992, 50 000mt in 1993, and 34 000mt in 1994 (See Figure 5).

A note on Taiwan's high-seas drift-net policy

In 1991, the United Nations passed a resolution requesting that all countries adopt a moratorium on the use of large-scale drift nets in high-seas fishing after 31 December 1992. In compliance with the UN resolution, the Council of Agriculture announced that, from 1 January 1993, drift-net fishing by Taiwanese vessels would be totally prohibited outside Taiwan's 200-mile Exclusive Economic Zone (EEZ). In addition, the COA took a number of actions to assist fishermen in adjusting to the new regulations. Measures included a buy-back program for vessels over 15 years old; subsidized loans to finance conversion to new gear types; allowing licenses to be combined to build new purse seiners of over 1 000 GRT; and market promotion schemes for species produced after vessels shifted from drift-net fishery (Anon., 1993).

Table 4

Shark yield in Taiwan fisheries (mt) 1981-1995

Year	**Total shark landings in Taiwan area**	Distant-water				Offshore				Coastal				
		Total landings	Trawl	Tuna longline	Others*	**Total landings**	Trawl	Gill- net	Longline and others	**Total landings**	Set-net	Gill- net	Spear	Others
1981	**40628**	**25737**	3784	18576	3377	**14246**	1262	2737	10247	**646**	129	331	0	186
1982	**44928**	**27104**	3200	17476	6428	**17313**	2262	3050	12001	**511**	56	350	0	105
1983	**41026**	**24738**	2666	16814	5258	**15470**	1999	2329	11142	**818**	382	258	0	178
1984	**45703**	**31304**	3664	19153	8487	**13772**	2483	2459	8830	**627**	162	343	0	122
1985	**53207**	**40482**	2204	20311	18327	**11557**	2854	2584	6119	**808**	96	411	0	301
1986	**44078**	**33280**	7394	11217	14669	**10144**	2246	1855	6043	**654**	173	420	0	61
1987	**48108**	**39984**	10233	11685	18066	**7545**	997	1569	4979	**579**	77	467	0	35
1988	**41426**	**32839**	12069	14322	6448	**8058**	986	1450	5622	**529**	68	444	0	17
1989	**51889**	**42084**	17548	14649	9887	**9241**	1262	1829	6150	**564**	35	188	209	132
1990	**73947**	**66950**	25769	26117	15064	**6626**	706	1072	4848	**372**	86	138	111	37
1991	**68097**	**60513**	21571	24933	14009	**7309**	1374	1030	4905	**275**	49	140	81	5
1992	**64048**	**57526**	12547	36031	8948	**5746**	1195	534	4017	**776**	296	120	338	22
1993	**55407**	**50064**	9938	40126	0	**4818**	952	617	3249	**525**	168	244	85	28
1994	**38924**	**33530**	7862	2401	23267	**4934**	1148	556	3230	**460**	105	240	86	29
1995	**43418**	**36844**	7429	8106	21309	**5859**	842	612	4405	**715**	117	265	39	294

Source: Fisheries Yearbook Taiwan Area, 1981 through 1995 (Taiwan Fisheries Bureau)

* Prior to 1993, the category of "other" included sharks caught in drift-net fishing operations while bottom longline shark catch was reported under tuna longline. Drift-net fishing was prohibited in Taiwan from 1 January 1993 resulting in a "0" entry for "other" in 1993. From 1994, bottom longline catch has been reported under the category of "other".

Table 5

Annual landings of Taiwan's distant-water tuna vessels by ocean, 1989-1994

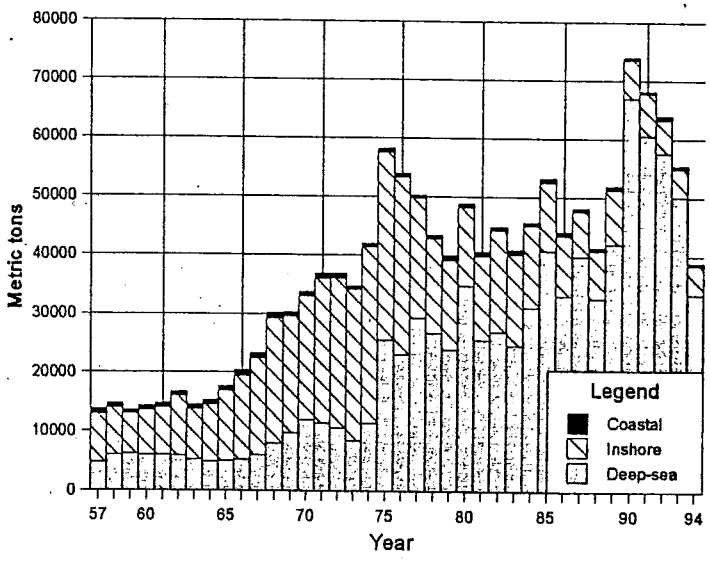
Ocean	Pacific		Atlantic		Indian		Total
Year	Tons	%	Tons	%	Tons	%	
1989	1 643	15.6	507	4.8	8 360	79.5	10 510
1990	1 320	63.5	599	28.8	161	7.7	2 080
1991	2 318	79.4	442	15.1	160	5.5	2 920
1992	2 274	83.4	347	12.7	104	3.8	2 725
1993	1 911	62	652	21.2	518	16.8	3 081
1994	1 223	51.1	880	36.7	293	12.2	2 396

Source: Fisheries Yearbook Taiwan Area, 1989 through 1994 (Taiwan Fisheries Bureau)

Note: Data set established in 1989

Figure 5

Taiwan's shark production (mt) by fishery 1957-1994



Source: Fisheries Yearbook Taiwan Area, 1957-1994 (Taiwan Fisheries Bureau)

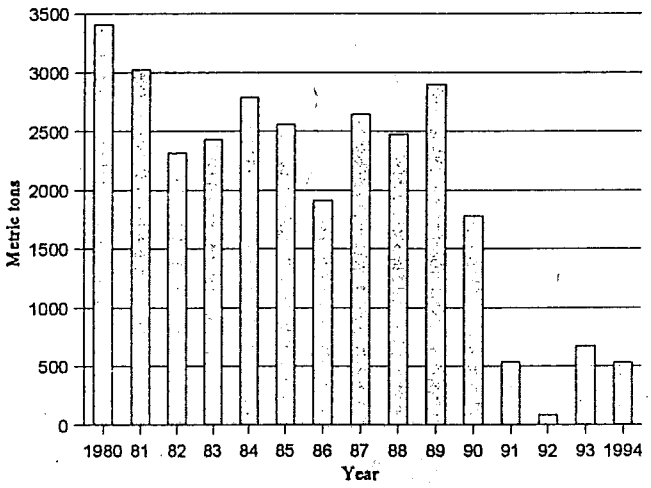
Note: Figures for 1980 did not record shark catch for Kaohsiung city by fishery. As Kaohsiung is primarily an international port, its overall catch was assigned to the deep-sea category in this table.

Skates and rays

Skates and rays are of little importance to Taiwan's chondrichthyan fisheries. In 1980, Taiwan's total production of skate and rays was just over 3 400 metric tons (6.5% of chondrichthyan catch). This number has declined steadily both in absolute terms and as a percentage of total chondrichthyan catch (See **Figure 6**). Of the fishery harbors and wholesale markets surveyed for this report, only Amping harbor (Tainan city) had significant catches of ray. In other locations, rays were treated as trash fish.

Figure 6

Taiwan's production of skates and rays (mt) 1980-1994



Source: Fisheries Yearbook Taiwan Area, 1980-1994 (Taiwan Fisheries Bureau)

Observations on distant-water fisheries

With increasing recognition of the importance of resource conservation in recent years, management regimes and restricted catch quotas have been applied to many important marine resources in the high seas. This includes the example of the quota system restricting tuna fisheries in the three oceans which has had a major impact on Taiwan's tuna longline fishery. This restricted access along with the increase in the price of shark, abundant numbers, and the low cost of fishing has made shark fishing more attractive.

Although interviews with various commercial fishery owners in 1995 and 1996 indicated that more vessels have engaged in shark fishing since 1990, shark catch from Taiwan's distant-water fisheries has decreased yearly since 1990, down 25% in 1994 from the average level of the 1990-1994 period. Whether these variations occurred as a result of overexploitation, changes in access agreements, or varying levels of catch effort (due to factors such as the increasing price of tuna and other target species) is still unknown. However, this is a signal that distant-water shark fishing needs to be monitored in greater depth.

TAIWAN'S SHARK MARKETS AND TRADE

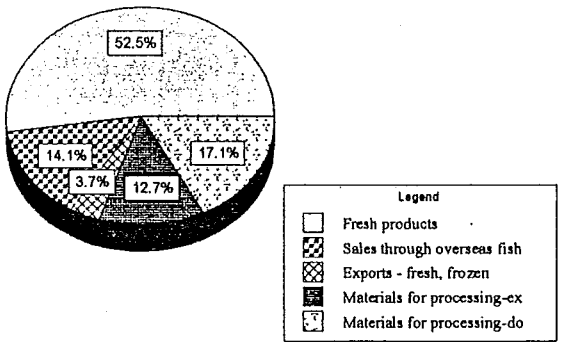
Overview of Taiwan's fishery products market

Taiwan's total fisheries production in 1994 reached 1 255 273 metric tons, a decrease of 11.85% from 1993. Total fisheries value was US$3.4 billion, down 4.26% from 1993. This represented 23.8% of Taiwan's total agricultural production in 1994 as compared to 25.3% in 1993 (Anon., 1995a).

Figure 7 illustrates the principal categories for utilization of fishery products in Taiwan. These are: fresh products; sale through overseas fishing bases (primarily tuna, swordfish, and squid); export of fresh or frozen products (primarily eel, shrimp, and frozen tuna); and as materials for further processing. The latter are further divided into processed products for domestic consumption and for export.

Figure 7

Utilization of fishery production in Taiwan (based on 1990 figures)



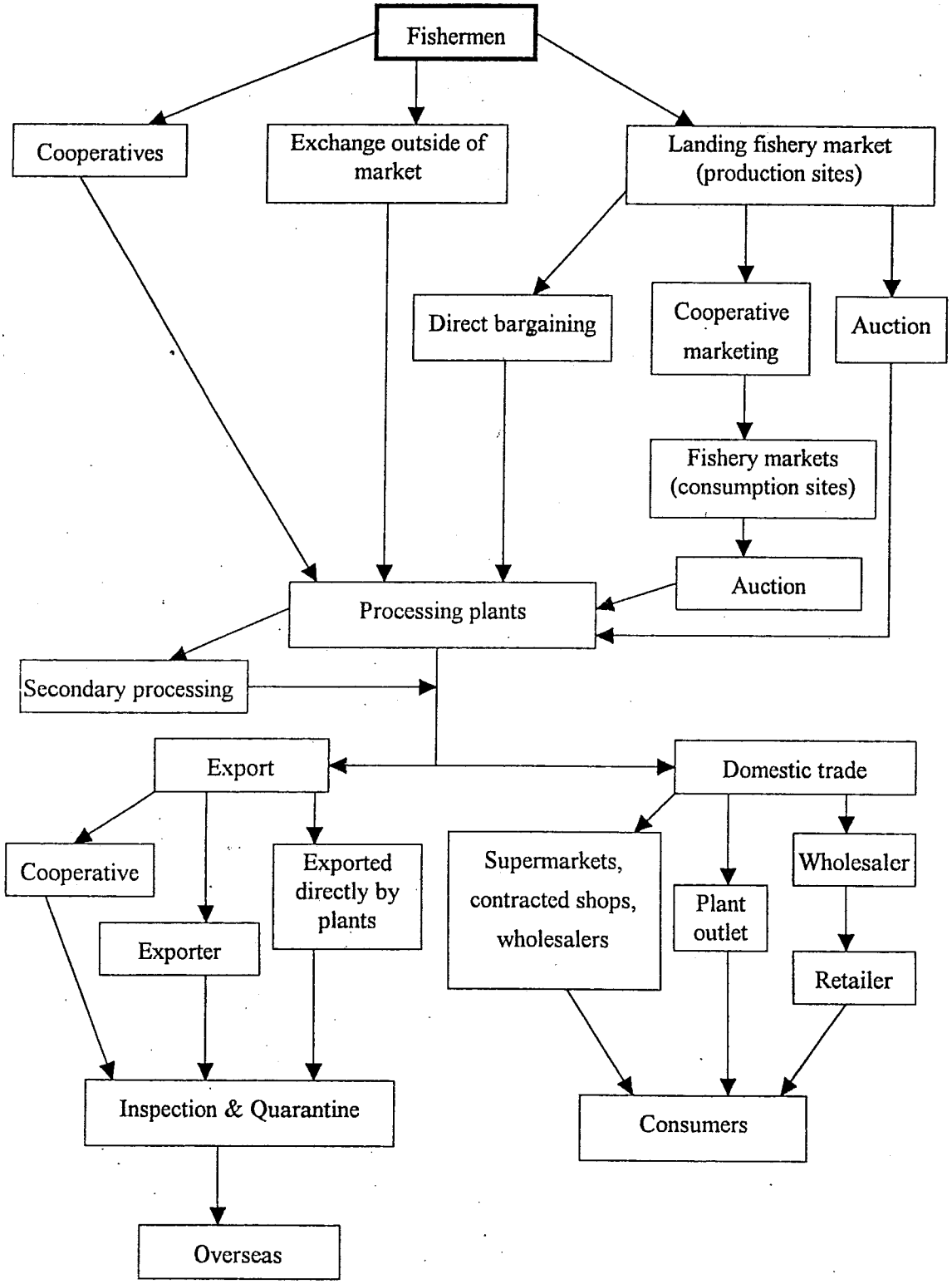
Source: Hsiao, 1990

The *1980 Fisheries Yearbook Taiwan Area* (Taiwan Fisheries Bureau, 1981) recorded two categories of processing facility: licensed plants and cottage industries. In 1989, a third category, Product Inspection Bureau- (PIB-) classified plants was added. The total number of processing plants has declined since 1980. In 1980, there were 2 969 plants (621 licensed; 2 348 cottage industry) in operation. By 1989, the number had decreased to 1 429 (licensed 79; PIB-classified 108; cottage industry 1 242) and, in 1994, the total was 888 (licensed 43; PIB- classified 121, cottage industries 676). The principal fishing harbors and wholesale fish markets are located in the southern part of Taiwan so the major concentration of processing plants is there also. Products are distributed throughout the island.

Figure 8 gives an overview of the general distribution system in Taiwan. The status of shark products is examined in further detail below.

Figure 8

Flow chart illustrating collection, processing, and trade of fishery products in Taiwan



Source: adapted from Wu, 1990

Shark products

Sharks form an important segment of Taiwan's overall fisheries production. Although in 1994 large sharks ranked tenth out of twenty in terms of major species production (2.63% of the total), between 1980 and 1993, shark generally ranked fifth overall, providing an average of 3-4% of total fisheries production (Taiwan Fisheries Bureau, 1980-1994). From 1980-1988, large shark and small shark were treated as a single category in calculating major species production in the Fisheries Yearbook. However, since 1989, the two have been treated as separate categories.

Although varying according to species and fishery type, shark utilization in Taiwan is relatively complete. Shark is utilized in both fresh and processed form. Products include: fresh meat, skin (edible), minced fish products, smoked and dried, seasonings, liver oil, cartilage, and the fin. **Table 6** details the preferred use of shark by species at Tongkang harbor in southern Taiwan.

Fresh and frozen meat

Most shark meat is used in the domestic production of minced fish products (see below). Some meat is consumed domestically and frozen fillets are exported. The processing methods for domestic use and export are different.

Meat processed for domestic use is handled in the following way: the head, fins, intestines and cartilage are removed; the shark is skinned; the carcass is cut into pieces, washed, and frozen in 36kg blocks, and sold. Meat for exportation is dressed the same way, but the carcass is then cut into two pieces; classified according to weight (40-49lbs and 50lbs+); frozen, packed, and exported (Tsai, 1990).

The meat of thresher sharks and Whale Shark is eaten although Whale Shark meat is seldom available. The meat from the area anterior to the dorsal fin or between the anal fin and the caudal fin is considered the best. The "belly" meat of the Blacktip Reef Shark *Carcharhinus melanopterus* is considered the most delicious (Mao, 1996).

Processed Products

Production trends for shark products were generally upward from 1980-1983, decreased from 1984 to 1988, and peaked in 1988 at a volume of 13 315 metric tons (valued at US$30 million). Production has continued to decrease in terms of both value and volume since then although overall per unit value has increased in response to the increased price of shark fin.

Minced fish products

Shark meat is a significant raw material in the production of minced fish products. Shark is particularly well suited to this production method because: 1) shark meat gives a firm and elastic texture to minced fish products; 2) this form of processing neutralizes the strong ammonia flavor often associated with shark meat (Chuang *et al*, 1977). The advantage of this production method is the ability to utilize most fish regardless of size or species as fish paste is easily shaped and flavored. The fish meat is mixed with salt and ground into thick paste. The paste is then shaped and heated until the protein coagulates (Wu, 1990).

Minced fish paste products include: fish balls, fish cakes, fish sausage, kamaboko (Japanese fish cake), fried minced fish products or tempura, analog (mock) crab or scallops, and fish "ham." Fish balls and tempura are very popular with consumers in Taiwan, but the status of production, although high, is difficult to assess.

Despite its popularity, overall production of paste produced with shark meat has declined since 1988 (See **Figure 9**).

Table 6

List of shark species and shark products in Tongkang Harbor

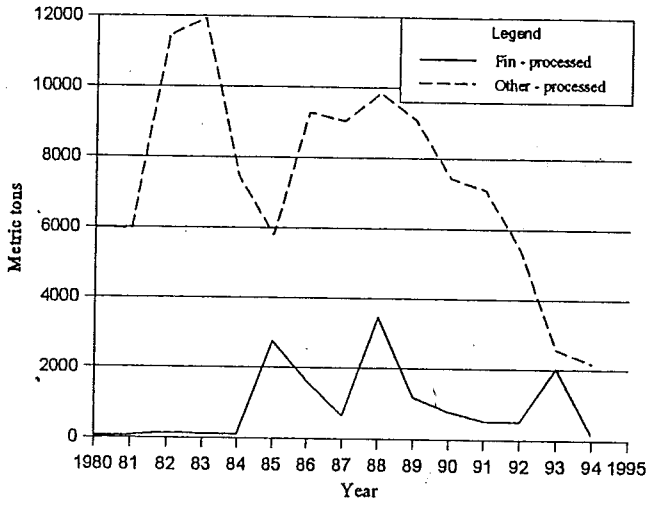
Species	Grade of fin	Fish paste	Meat	Skin	Liver	Stomach	Intestines	Fishmeal & fertilizer#
Carcharhinus obscurus	High	*		*				*
Carcharihinus ?	High	*		*				*
Carcharhinus ?	High	*						*
C. melanopterus	High	*						
Sphyrna lewini	High	*						
Sphyrna mokarran	High	*						
Sphyrna zygaena	High	*						
Galeocerdo cuvier	Middle		*					
Carcharodon carcharias	Middle	*						
Dalatias licha (kitefish)	---							
Isurus oxyrinchus	Middle		*					
Prionace glauca	Low		*		*	*	*	
Alopias superciliosus	Low / Misc		*		*	*	*	
Alopias pelagicus	Low / Misc		*		*	*	*	
Alopias vulpinus	Low / Misc		*		*	*	*	
Rhiniodon typus	---		*	*				

? Taiwanese common name could not be identified with scientific name
Majority comprised of offal and small sharks

Source: Mao, 1996

Figure 9

Volumes of processed shark products (mt) 1980-1994



Source: Fisheries Yearbook Taiwan Area, 1980-1994 (Taiwan Fisheries Bureau)

Shark skin

Shark skin products are consumed as food in Taiwan. Both the skin from the body and the skin from the caudal fin is eaten. Processing of shark skin for consumption is as follows: the skin is dried, the dermal denticles removed, followed by bleaching with hydrogen peroxide, rinsing and soaking in water to remove the bleaching agent residue, after which the skin is then dried again (Sun Pan, *in litt.* August 1996). Processing plants are located in Tainan, Chiayi, and Kaohsiung (Chen, 1990).

The product is rehydrated and used as a food ingredient. The skin from the Dusky Shark and the Whale Shark are served in restaurants as is the upper lobe of the caudal fin from thresher sharks. The best quality of caudal skin is from the White-spotted Guitarfish *Rhychobatus djiddensis* (Chen, 1990).

Shark fin

As might be expected with a product as expensive as shark fin, every aspect of the fin market is complex, from the purchase of the raw fins, to the processing, through to the final culinary presentation. Physical factors affecting the grading and pricing of shark fin include: the species of shark, the size and position of the fin, the density and wholesomeness of spindles in the fin, and its rehydration capacity (capacity of the dried fin to absorb water during cooking). Other factors range from the overall fin production, the freshness, the season and weather, and, very likely for a luxury good, the current economic climate.

Buyers of wet fin at Tongkang harbor in southern Taiwan recognize five grades of shark fin, based on weight and size. They are summarized in **Table 7.** Long, wide shark fins with a rough texture and high density of spindles are considered better quality. Miscellaneous fins refers to the larger fins of small sharks while "Chi A Ko" are the pelvic and anal fins of any shark species.

As indicated earlier in **Table 6**, Tongkang harbour also grades fins by species. At Tongkang, buyers cannot purchase only top-grade fins, but must also purchase lower and miscellaneous fins. The latter are sometimes discarded in the

market (Mao, 1996).

Table 7

Grading of wet fins in Tongkang harbor (by weight)

Grade of fin	Weight of fin (kg)	Price per kg
Upper	>2.0	US$7.69
Middle	1.5 to 2.0	$5.49
Lower	<1.5	$4.03
Miscellaneous	<1.0	$1.83
Chi A Ko	<1.0	$1.83

Source: Chen, 1990

Processing of shark fin is a laborious and time-consuming process. Fins may be first dried in the sun either on the boat or at the processing plant. Wet fins are washed and immersed in hot water until the placoid scales can be rubbed off easily. Flesh and cartilage are also removed from the fins. Fins are then bleached and dried with a final yield of 9-15% of the original weight (Chuang *et al.*, 1977). The processing of dried fin rays or spindles is similar, but with the use of mechanical rolling machines to separate the spindles from skin. The skin-free spindles are arranged in fan-shaped nets with fish collagen dissolved during preparation serving as the cohesive agent (Chuang *et al.*, 1977). Later, the dried fins or nets undergo further elaborate preparation and are served as shark fin soup at special banquets.

Researchers in Taiwan have attempted to quantify the factors used in the grading of fins. **Table 8** is a profile of different classes of shark fin according to their rating system. The most important of the characteristics listed are rehydration capacity and number of spindles. Interestingly, the highest quality of shark fin comes not from a shark but from a ray. The first and second dorsal fins, and anal fins of the White-spotted Guitarfish *Rhychobatus djiddensis* are considered superior shark fin (Chen, 1990). Smooth Hammerhead *Sphyrna zygaena* and Dusky Shark *Carcharhinus obscurus* are also considered upper grade.

Table 9 describes the volumes of production and average prices for processed shark fin in Taiwan from 1977-1994. There have been large variations in both the production volume and the price during this time period.

Other

Liver oil in Taiwan is produced from shark, tuna, swordfish, and squid. However, the importance of shark as a source of liver oil has declined substantially as a result of decreasing availability of source species; difficulty in collecting the liver; the strong odor of products; and competition from synthetic vitamin production (Wang, 1990). This was confirmed by fishery market workers who stated that the liver was usually damaged during the processing of the shark. In 1980, 64 tons of shark liver oil was produced but production declined to zero in 1988 and 1989. From 1991-1994, two tons of production was reported per year (Taiwan Fisheries Bureau, 1992-1995).

Table 8

Characteristics used to grade shark fin

Characteristic / Grade of fin	Water content (%)	Rehydration Capacity (%)	Number of spindles	Length of spindles (cm)	Degree of whiteness	Ash content (%)
Upper (e.g. dorsal of hammerhead)	14.9	328	146	7	69.7	0
Middle (e.g. dorsal of Dusky Shark)	14.6	259	129	8.5	68.9	0.93
Lower (e.g. dorsal of Blue Shark)	14.3	304	89	4.9	67.1	0.93
Chi A Ko (e.g. pelvic fin of Blue Shark)	13.3	297	64	5.3	72.8	0.86

Source: Chen, 1990

Table 9

Volume and value of shark fin production (mt; NT$; US$) 1977-1994

Year	Tons	Total value NT$1 000	Price/kg NT$	Price/kg US$
1977	195	65 880	337.85	--
1978	198	110 320	557.17	--
1979	218	113 655	521.35	--
1980	49	42 610	869.59	24.15
1981	65	55 960	860.92	23.36
1982	130	84 538	650.29	16.62
1983	106	91 458	862.81	21.54
1984	108	92 761	858.90	21.67
1985	2 771	162 802	58.75	1.47
1986	1 619	146 939	90.76	2.40
1987	644	132 005	204.98	6.45
1988	3 486	107 880	30.95	1.08
1989	1179	88 576	75.13	2.85
1990	782	170 924	218.57	8.12
1991	528	161 686	306.22	11.44
1992	498	115 098	231.12	9.19
1993	2 029	131 555.9	64.84	2.45
1994	162	291 378	1 798.63	67.96

Source: Fisheries Yearbook Taiwan Area, 1977-1994 (Taiwan Fisheries Bureau)

Note: Volume figures contain a mixture of wet and dry fins.

The market for shark cartilage has become increasingly important as a result of claims as to its efficacy as an anti-cancer agent. Processing is done in Kaohsiung and Suao. Processed and unprocessed cartilage is exported to Australia, New Zealand, Japan, and the USA. Data on the quantities processed and the price were unavailable, but the low cost of raw cartilage and the relatively high cost of cartilage pills seems to indicate high profits. Taiwan also imports shark cartilage powder from the USA and Japan for sale as preventative medicine or health supplements. The exact volume is unknown, but thought to be considerable.

Trade

Taiwan's trade statistics are compiled by the Statistical Department of the Directorate General of Customs of the Ministry of Finance. Additional information on Taiwan's import and export of fish products is recorded by the Statistics Office of the Council of Agriculture, Executive Yuan. Since 1989, Taiwan's Standard Classifications of Commodities has been based on the Harmonized Commodity Description and Coding System (HS) published by the Customs Cooperation Council (CCC). Five categories of shark products are recorded. These categories are: *dogfish and other sharks - fresh or chilled; dogfish and other sharks - frozen; shark fin - edible, fresh, chilled, or frozen; shark fin - dried; and shark fin - salted or brine*. A sixth category, *fins, prepared or preserved, canned,* includes shark, skate, and ray fins. Prior to 1989, only shark fin had specific categories. Two categories were recorded: *shark fin (edible); and shark fin.* Values are recorded on a CIF basis.

Between 1989 and 1994, Taiwan averaged exports of over 300 000 metric tons of fishery products annually with a value in excess of US$1.3 billion (Taiwan Fisheries Bureau, 1990-1995). In 1994, exports totaled 419 873 metric tons, valued at US$ 1 400 885 500. This represents 28.93% of Taiwan's total agricultural exports by value (Agricultural Trade Statistics of the ROC; COA, 1995) Japan was the largest importer of Taiwan's fishery products (124 493 metric tons valued at US$901 million). The US was the second-largest purchaser in terms of value (US$153 million) and third in volume (59 357 metric tons). Thailand, Hong Kong, Singapore, and South Africa were also important destinations for Taiwan's exports.

Taiwan's fishery products imports for 1994 totaled 581 720 metric tons valued at US$632 million. This represents 7.14% of the value of Taiwan's total agricultural imports (Anon., 1995a). Chile and Peru were the two most important suppliers (accounting for a combined total of 360 245 metric tons valued at US$180.5 million). The USA, Japan, Thailand, mainland China, and Australia were also important sources of fishery products for Taiwan.

Imports of Shark Products (1980-1995)

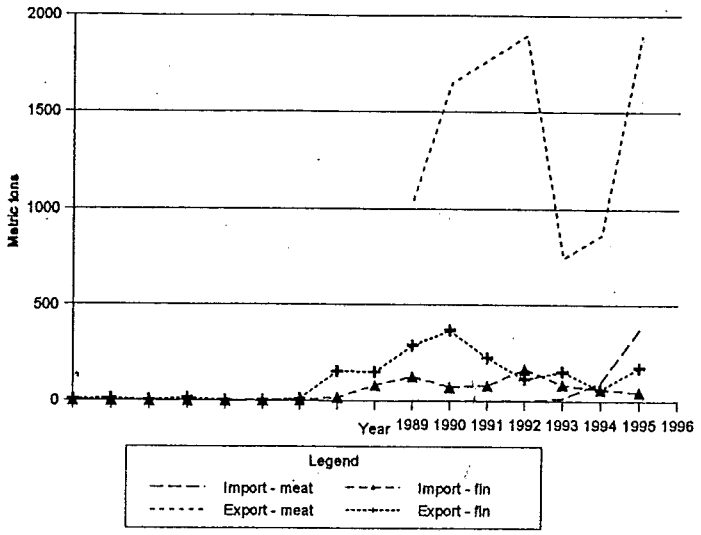
Records for the period 1980-1988 show little to no import of shark's fin from 1980-1986. Imports of shark fin reached 16 metric tons in 1987 and increased to almost 80 metric tons in 1988.

After 1988, imports of shark meat and shark fin were recorded. *Shark fin-dried* formed the bulk of imports, followed by *shark fin - edible, fresh, chilled, and frozen*. Very little *shark fin - salted, brine* was imported. Over 96 metric tons of dried shark fin was imported in 1989, but imports of dried shark fin have shown a decidedly downward trend since then with just over 20 metric tons being imported in 1995. Although Taiwan imported dried shark fin from as many as 24 different countries per year between 1989 and 1994, three countries - Hong Kong, Indonesia, and Singapore - regularly provided the bulk of the imports. The share of total imports held by each of these countries varied considerably year by year. A large quantity (88.5 metric tons) of prepared fin was imported in 1992, but, otherwise, imports have declined overall since 1989.

Recorded imports of shark meat were zero from 1989-1992. A total of 12.8 metric tons of meat was imported in 1993, 93.6mt in 1994, and 371.6mt in 1995. Major sources of shark meat imports were Hong Kong, Singapore, India, the Philippines, and Greenland. Although shark meat imports were 27.3% of total shark product imports in 1995, fins have been the major import in other years. **Figure 10** describes Taiwan's imports and exports of shark products over time.

Figure 10

Taiwan's import and export of shark products (mt) 1980-1995



Source: Monthly Statistics of Imports/Exports Taiwan District, Directorate General of Customs

Note: Prior to 1989, no separate Customs code existed for shark meat.

Export of Shark Products (1980-1995)

Taiwan's exports of *shark fin* and *shark fin - edible* from 1980-1986 totaled just over 41 metric tons. Exports of *shark fin - edible* in 1987 and 1988 exceeded 140 metric tons each year. After 1989, exports of *shark fin - edible, fresh, chilled, frozen* were 259mt for 1989 and 283mt for 1990. Exports of this category dropped to 165 tons in 1991 and continued to decline to a low of 2.3mt in 1994 and a slight increase to 4.5mt in 1995. Japan was the principal destination for these exports from 1989-1992 but imported none from 1993 to 1995. Exports of dried fin increased from eight metric tons in 1989 to a high of 116mt in 1995. Hong Kong was the major purchaser of dried fin, receiving over 90% of Taiwan's exports from 1993-1995.

After 1989, when shark meat was assigned two specific categories, substantial exports of frozen shark meat was recorded. Exports for 1989 exceeded 1 000mt and climbed annually to a high of almost 1 900mt in 1992. Exports fell to under 1 000mt in 1993 and 1994, but rebounded to 1 894mt in 1995. The USA. was the most consistent large importer of shark meat from Taiwan, importing over 60% of the total in 1993 and 1994. Japan, Germany, Singapore, Korea, and South Africa also imported significant volumes, although not on a regular annual basis.

In the seven-year period from 1989-1995, Taiwan's exports of meat and fin have fluctuated annually in both volume and value. However, the contribution of both meat and fin to export earnings over the period has been about equal in total value.

Sales through overseas bases

Sale of shark through overseas bases does occur. Interviews for the distant-water fisheries section of this report indicated that the Shortfin Mako in particular was often sold overseas rather than shipped back to Taiwan. However, as indicated in **Table 10**, overseas sales are not a major market for Taiwan shark fisheries with between 1.4% and 4.11% of Taiwan's total shark landings sold overseas in a six-year period.

Table 10

Overseas landings of sharks (mt; NT$1 000) by fishing area 1989-1994

Year / Area	1989	1990	1991	1992	1993	1994
Pacific	310	127	77	144	181	184
Indian	228	189	161	104	518	293
Atlantic	507	602	442	347	652	880
Total volume (mt)	1 045	917	679	595	1 352	1 357
Total value (NT$1 000)	26 277	29 895	40 072	23 902	43 734	46 080
% of total shark landings	2.54	1.48	1.16	1.04	2.71	4.11

Source: Fisheries Yearbook Taiwan Area, 1989-1994 (Taiwan Fisheries Bureau)

CONCLUSIONS AND RECOMMENDATIONS

Coastal, offshore, and distant-water fisheries

Coastal and offshore

The coastal and offshore shark yield did not decrease significantly in recent years according to the annual fisheries statistics reports, and Nanfang Ao and Chengkung's daily catch records. Two possible reasons for the consistent catch are as follows: 1) there are more alternate species for coastal and offshore fisheries because of their multi-species operating style; 2) the shark fishing vessels in Nanfang Ao and Chengkung do not target sharks year-round (seasons are October to the following April in Nanfang Ao and February to April in Chengkung) giving species an opportunity for recovery. However, the increase in demand for shark meat, that once had limited popularity, could result in a change in current fishing practices.

The Whale Shark *Rhiniodon typus*, most valuable of all (US$2.56-$6.59 per kg), has shown no evidence of a decrease in catch, but needs to be closely monitored because of its characteristic slow growth and late maturity. Although there is no dedicated Whale Shark fishery at the moment, this could change as the price and demand for sharks increase.

Although the total catch of coastal and offshore shark fisheries did not decrease significantly, some species have decreased as a percentage of total catch while others have increased. Certain demersal species once common in coastal and offshore fisheries have shown a decline in catch over the past ten to twenty years. Although species-level catch data are unavailable, interviews with fishermen and fish market surveys have shown that, during the last decade, these species have become difficult to find:

- The Starspotted Smooth-hound *Mustelus manazo* and Spotless Smooth-hound *Mustelus griseus* were once common commercial species caught throughout Taiwan's waters. These species are now difficult to find outside of two localities: the waters off Chinshan and Kueishan island in northern Taiwan. As with certain demersal teleost species, the overexpansion of coastal trawl fisheries in Taiwan resulted in the decline of *Mustelus* spp. However, the multi-species nature of trawl fisheries makes species-specific management problematic.
- A similar picture emerged for certain deep-water species once commonly fished off Taiwan's east coast. *Squalidae* and *Centrophorus spp.*, formerly major catch species in Chengkung, Hualien and Tashi, have declined significantly in recent years and are no longer commercially important.

However, existing data is insufficient to draw reliable conclusions on trends in Taiwan's offshore and coastal shark fisheries. In future, more data on species catch levels and fishing effort must be collected. Only then will it be possible to create a workable management regime should that prove necessary.

Distant-water fisheries

With increasing recognition of the importance of resource conservation in recent years, management regimes and restricted catch quotas have been applied to many important marine resources in the high seas. This includes the example of the quota system restricting tuna fisheries in the three oceans which has had a major impact on Taiwan's tuna longline fishery. This restricted access along with the increase in the price of shark, abundant numbers, and the low cost of fishing have made shark fishing more attractive.

Although more vessels have engaged in shark fishing since 1990, shark catch from Taiwan's distant-water fisheries has decreased yearly since 1990, down 25% in 1994 from the average in the 1990-1994 period. Whether these variations occurred as a result of overexploitation, changes in access agreements, or varying levels of catch effort is still unknown. However, this is a signal that distant-water shark fisheries need to be monitored more closely.

In Taiwan, as in many countries, there is no differentiation of shark species in fisheries records other than by size (small and large). As sharks caught in the distant-water fisheries are already dressed and frozen when landed, species-level identification is difficult. Furthermore, fisheries records for distant-water fisheries record the dressed weight only and must be converted to estimate actual live weights.

Markets and trade

Production

Like Taiwan's total fish production, shark production peaked several years ago (1990) and has declined since. The decline in shark production began earlier than that of total production, which hit a plateau in 1990 followed by a decline in 1991 and 1992, a slight recovery in 1993 and further decline in 1994. The decline in shark production began two years prior to Taiwan's banning of high-seas drift-netting in December 1992 and has continued since then.

Processing

Taiwan's processing of shark products (meat, minced, oil, etc.) peaked in 1983 at just over 12 000 metric tons and again in 1988 at 13 315 metric tons. However, the proportion of production consisting of shark fin was much higher in 1988. Production of non-fin products has steadily declined since 1988. Fin products on the other hand have shown a boom-bust pattern in the ten-year period from 1984-1994 with three peaks in 1985, 1988, and 1993 respectively. The price of non-fin products exhibited less volatility between 1980 and 1994 whereas the price of fins showed a very definite relationship with volumes of production. See **Table 9**.

Tables A1-5 to A1-8 in the appendices show the volumes and mean prices of shark in three main fish markets at the production level (Kaohsiung, Tongkang, and Suao) and three main fish markets at the consumption level (Taipei, Taichung, and Chiayi). These tables show relative consistency in production volumes for the markets, but values must be interpreted carefully. The values in these tables are in current dollars. Furthermore, the *Fisheries Yearbook* does not define the category of "shark" at either the production or the consumption end. In the production markets, shark likely includes the full gamut of products - meat, fin, oil - but at the consuming end, shark likely refers to meat only and perhaps skin. Processed paste products, the largest utilization category, would not be listed as shark.

Trade

Volumes and values of shark products in trade fluctuate wildly and more exploration of the reasons behind these fluctuations is needed. Exports of frozen meat have risen and fallen dramatically since 1989, but the six-year period is not long enough to warrant any firm conclusions. Volumes of trade in other shark products have been comparatively low. Summary tables based on Customs records for the period 1980-1995 are included as **Tables A1-1 to A1-4** in the appendices. In the period 1989 to 1995, exports of frozen meat and all categories of fin averaged out very closely if compared by export values. Shark fin, far more expensive on a per unit level, was not a substantially greater export dollar earner than the high-volume, lower-price frozen shark meat. This suggests that the lucrative fin trade, although an important reason for shark fisheries, is not the only rationale for fishermen to target and retain shark catch. **Table 11** presents the varying percentages.

One critical factor in evaluating Taiwan's consumption and trade in shark products is not captured in Customs or fisheries records nor has this study been able to adequately document the phenomenon: cross-strait trade with mainland China. Growing demand for shark fin from mainland China could offset any economic downturn in other traditional consuming countries. This issue merits continued investigation.

Table 11

A comparison of export earnings for frozen shark meat and all fin products by percentage

Year / Product	1989	1990	1991	1992	1993	1994	1995	Average %
Frozen meat (%)	37.1	46.1	65	71.4	55.5	38.1	35.3	49.79
Fin products (%)	62.9	53.9	35	28.6	44.5	61.9	64.7	50.21

Source: Customs statistics 1989-1995

Conservation implications

Most shark species can be classified as strong K strategists (Bonfil, 1994) which means that they are long-lived with slow growth rates and late sexual maturation. Most species have low fecundity and, as top predators, comparatively low abundances in their communities, giving them low reproductive potential. These biological and ecological factors make them vulnerable to overexploitation.

The dominant species for coastal and offshore shark fisheries include: Scalloped Hammerhead; Shortfin Mako; Dusky Shark; Bigeye Thresher; Pelagic Thresher; Sandbar Shark; Spinner Shark; and Blue Shark. The dominant shark species for distant-water fisheries are: Silky Shark, Blue Shark, Oceanic Whitetip Shark, Shortfin Mako, hammerhead sharks, and thresher sharks.

Campagno (1984) documented that the above species, with the exception of the Blue Shark, are viviparous and have few offspring: Silky Shark 2-14; Oceanic Whitetip 1-15; Shortfin Mako 4-16; Smooth Hammerhead 29-37; Scalloped Hammerhead 15-31; Bigeye Thresher 2-4; and Pelagic Thresher 2. The Blue Shark has the strongest reproductive capability among the elasmobranchs and can produce up to 135 pups per litter (Campagno, 1984). Still, the Blue Shark's reproductive ability may not be able to keep pace with intensive fishing.

The sharks, especially the viviparous, with their characteristics of slow growth, late maturity, and few offspring, are susceptible to overfishing. Therefore, research into ways of preventing the collapse of shark population is an important area for future work.

Recommendations

The conservation and management of shark resources is drawing increasing attention internationally. In 1991, IUCN/SSC established the Shark Specialist Group (SSG) to promote international research into the status and conservation of shark species. In 1994, the conference of the parties to CITES expressed their concern over increasing volumes of trade in shark products and the lack of available information to determine the impact of that trade.

Taiwan is home to an important distant-water fishing fleet and is a major fisher of sharks, in excess, perhaps, of 7% of the world's annual total. As such, the international community may, in future, call upon Taiwan to participate in global efforts to manage shark catch. Taiwan needs to be prepared to do so.

In 1995, Taiwan's top fishery authority, the Council of Agriculture, began preliminary investigations into shark bycatch by Taiwan's fishing fleet. However, the sheer number of vessels involved in distant-water fisheries (over 1 000 tuna longliners and 700 trawlers) makes it difficult to obtain reliable data. In order to improve future data collection, more resources - personnel and financial - need to be made available.

A comprehensive data collecting system needs to be established to collect fisheries information including species-level catch data (species, length, weight, sex, age, maturity); landings versus discards; geographical locations; and catch-per-unit effort data. This information can best be obtained through the combined use of log books and observers.

Also critical from a policy perspective is the collection and analysis of socio-economic information on fishermen and other user groups. This information, in tandem with biological information, is central to the construction of an effective management system to reach the goals of optimum utilization and conservation of shark resources.

REFERENCES

Anon. (undated). The Overseas Fisheries Development Council of the Republic of China. OFDC brochure. 6 pp

Anon. (1990). *Sharks: silent hunters of the deep*. Reader's Digest, New South Wales, Australia. 208pp

Anon. (1993). Fisheries development in the Republic of China: past, present and future. Council of Agriculture, Taiwan. 32 pp

Anon. (1993a). Industrial outlook report fishing industry 1991/1992. American Institute in Taiwan. SPR0404. 31 pp

Anon. (1995). Market brief on shark fins - overview of the world market. Market development series, International Trade Centre UNCTAD/GATT. 13 pp

Anon. (1995a). Agricultural trade statistics of the Republic of China 1994. Council of Agriculture, Taipei.

Anon. (1995b). Statistical abstract of the United States: 1995 (115th edition.) U.S. Bureau of the Census, Washington, DC.

Bonfil, R. (1994). Overview of world elasmobranch fisheries: FAO fisheries technical paper 341. Food and Agricultural Organization of the United Nations, Rome.

Chen, C.T. George, Kwang-Ming Liu, and Shou-Jean Joung (1995). Coastal and offshore shark fisheries in Taiwan: A TRAFFIC East Asia-Taipei field report. Unpublished report.

Chen, C.T. George, Kwang-Ming Liu, and Shou-Jean Joung (1996). Taiwan's distant-water shark fisheries: A TRAFFIC East Asia-Taipei field report. Unpublished report.

Chen, Chou-Kuei (1990). Fish skin. In: Wu, C.S. (ed.). *The status of Taiwan's fishery processing industry*. Taiwan Fishery Bureau, Taipei. (in Chinese)

Chuang, Jan-Lung, Bonnie Sun Pan, and Gin-Chen Chen (eds) (1977). *Fishery products of Taiwan*. JCRR Fisheries Series 25B, Taipei. 91 pp

Compagno, L. J. V. (1984). FAO species catalogue. Vol. 4. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. FAO Fish. Synop. No. 125. 655pp

Compagno, L.J.V. (1990). Shark exploitation and conservation. NOAA technical report NMFS 90.

Directorate General of Customs (MOF), Monthly statistics of imports / exports for the Republic of China Taiwan District 1980-1995. Statistical Department, Directorate General of Customs, Taipei.

FAO (1995). Yearbook of fisheries statistics: catches and landings, 1993, Vol. 76. Food and Agriculture Organization of the United Nations, Rome.

Fisheries Act of the ROC (1991) (unofficial translation)

Hsiao, Chuan-Yuan (1990). Preface to chapter One - general conditions. In: Wu, C.S. (ed.). *The status of Taiwan's fishery processing industry.* Taiwan Fishery Bureau, Taipei. (in Chinese)

Mao, Jean-Jay (1996). Shark products and processing in southern Taiwan: a TRAFFIC East Asia-Taipei field report. Unpublished report. (in Chinese)

Nakamura, H. (1936). The investigation of sharks in Taiwan. Experimental report of Taiwan Institute of Fisheries Research. 7:1. 54pp (in Japanese)

Shen, S.C. (1993). *Fishes of Taiwan.* Department of Zoology, National Taiwan University, Taipei. 960 pp (in Chinese) .

Stevens J.D. and S.R. Davenport (1991). Analysis of catch data from the Taiwanese gill-net fishery off Northern Australia 1979 to 1986; CSIRO Marine Laboratories Report 213, 51 pp.

Taiwan Fisheries Bureau. *Fisheries yearbook Taiwan area*, 1980 through 1995. Taiwan Fisheries Bureau, Taipei.

Tuna Research Center. *Annual catch statistics of Taiwan's tuna longline fishery*, 1978 through 1994. Institute of Oceanography, National Taiwan University, Taipei. (in Chinese)

Teng, H.T. (1962). *Classification and distribution of Chondrichthyes of Taiwan.* Taiwan, 171 pp (in Japanese)

Tsai, Chun-Hsiung (1990). Frozen shark. In: Wu, C.S. (ed.). *The status of Taiwan's fishery processing industry.* Taiwan Fishery Bureau, Taipei. (in Chinese)

Wang, Wen-Cheng (1990) Utilization and processing of shark liver oil. In: Wu, C.S. (ed.). *The status of Taiwan's fishery processing industry.* Taiwan Fishery Bureau, Taipei. (in Chinese)

Wu, Ching-Hsiung (ed.) (1990). *The status of Taiwan's fishery processing industry.* Taiwan Fishery Bureau, Taipei. 239pp (in Chinese)

Wu, Ching-Hsiung (1990). Preface to Chapter Four - minced fish products. In: Wu, C.S. (ed.). *The status of Taiwan's fishery processing industry.* Taiwan Fishery Bureau, Taipei. (in Chinese)

Table A1-1 Importation of shark products into Taiwan (mt; US$ 1000) 1980-1988

Product	1980-1984		1985		1986		1987		1988	
	quantity	value	quantity	value	quantity	value	quantity	value	quantity	value
sharks' fin, edible	0.00	0.00	0.08	0.65	0.06	0.34	0.00	0.00	0.29	2.51
sharks' fin,	0.00	0.00	0.84	8.55	1.60	15.01	16.43	237.28	78.74	1,313.31
Total	---	0.00	---	9.20	---	15.36	---	237.28	---	1,315.83

Source: Directorate General of Customs Statistics of Imports

Table A1-2 Importation of shark products into Taiwan (mt; US$ 1000) 1989-1995

	1989		1990		1991		1992		1993		1994		1995	
Product	quantity	value	quantity	value	quantity	value	quantity	value	quantity	value	quantity	value	quantity	value
dogfish & other sharks,	0.0	0.0	0.0	0.0	0.0	.0.0	0.0	0.0	0.0	0.0	84.5	148.0	71.4	188.6
fresh or chilled														
dogfish & other sharks,	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.8	7.3	9.1	9.0	300.4	210.9
frozen														
sharks' fin,	0.0	0.0	2.2	21.6	0.0	0.0	17.1	68.3	5.3	168.5	0.5	6.2	17.0	22.7
edible,fresh, chilled or frozen														
sharks' fin, dried	96.4	1,745.7	39.9	869.2	31.4	589.1	56.5	1,632.3	51.3	1,836.7	31.6	1,305.6	20.1	640.6
sharks' fin,	0.2	8.0	0.0	0.0	0.0	0.0	0.9	14.9	0.0	0.0	0.0	0.0	0.01	0.5
salted or in brine														
fins (incl. shark, skate & ray fins),	0.0	0.0	0.0	0.0	0.4	5.2	1.7	43.7	4.1	268.6	5.6	369.8	5.5	376.4
prepared or preserved, frozen														
fins (incl. shark, skate & ray fins),	20.0	132.8	27.0	219.1	47.1	425.1	82.9	569.3	14.4	264.8	17.3	100.4	1.8	4.9
prepared or preserved, canned														
other fins (incl. shark, skate & ray fins),	9.1	54.8	1.0	16.6	0.0	0.0	3.9	20.3	6.6	29.1	4.8	9.7	2.2	20.0
prepared or preserved														
Total	---	1,941.3	---	1,126.6	---	1,019.4	---	2,348.8	---	2,575.1	---	1,948.7	---	1,464.6

Source: Directorate General of Customs Statistics of Imports

Table A1-3 Exportation of shark products in Taiwan (mt; US$ 1000) 1980-1988

Product	1980		1981		1982		1983		1984	
	quantity	value	quantity	value	quantity	value	quantity	value	quantity	value
sharks' fin, edible	3.50	16.91	6.53	31.15	2.46	16.84	0.50	9.73	0.00	0.00
sharks' fin,	2.88	14.05	1.35	4.99	0.65	15.28	12.94	51.94	0.28	1.08
Total		30.96		36.15		32.13		61.67		1.08
	1985		1986		1987		1988			
Product	quantity	value	quantity	value	quantity	value	quantity	value		
sharks' fin, edible	0.00	0.00	0.00	0.00	149.61	765.34	147.60	973.18		
sharks' fin,	0.68	8.77	9.37	110.74	1.00	3.50	0.28	1.57		
Total		8.77		110.74		768.83		974.75		

Source: Directorate General of Customs Statistics of Exports

Table A1-4 Exportation of shark products from Taiwan (mt; US$ 1000) 1989-1995

Product	1989		1990		1991		1992		1993		1994		1995	
	quantity	value	quantity	value	quantity	value	quantity	value	quantity	value	quantity	value	quantity	value
dogfish & other sharks,	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
fresh or chilled														
dogfish & other sharks,	1,042.0	1,285.8	1,648.3	1,969.9	1,770.9	3,544.3	1,897.7	2,984.7	742.2	1,002.6	863.2	1,114.7	1,894.4	2,361.1
frozen														
sharks' fin,	259.0	1,716.4	283.0	1,884.3	165.1	1,399.8	75.2	757.0	94.9	45.8	2.3	14.5	4.5	30.0
edible, fresh, chilled or frozen														
sharks' fin, dried	8.3	317.5	8.3	68.2	25.6	322.4	35.7	438.8	54.6	758.7	45.6	1,709.6	116.3	3,705.6
sharks' fin,	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.3	465.3
salted or in brine														
fins (incl. shark, skate & ray fins),	1.1	19.9	55.2	217.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	62.9
prepared or preserved, frozen														
fins (incl. shark, skate & ray fins),	4.1	25.9	0.0	0.0	0.8	10.2	0.0	0.0	0.0	0.0	9.6	84.0	1.8	32.6
prepared or preserved, canned														
other fins (incl. shark, skate & ray fins),	15.0	97.7	19.8	135.8	31.5	177.2	0.0	0.0	0.0	0.0	0.0	0.0	4.7	40.6
prepared or preserved														
Total		3,463.2		4,275.9		5,453.9		4,180.4		1,807.0		2,922.8		6,698.2

Source: Directorate General of Customs Statistics of Exports

Table A1-5 Supplies and mean prices of shark in three major fish markets (consumption localities) 1980-1988

Year	Taipei		Taichung		Chiayi		Total volume	Average price NT$	US$:NT$ Exchange Rate	Average price US$
	Volume	Price	Volume	Price	Volume	Price				
1980	1197	12.42	355	29.87	556	20.65	2108	20.98	1:36.015	0.58
1981	1064	16.31	386	36.63	399	24	1849	25.65	1:36.84	0.70
1982	630	23.47	355	34.68	593	21.97	1578	26.71	39.124	0.68
1983	505	21.15	395	30.57	507	20.87	1407	24.20	1:40.065	0.60
1984	310	24.85	352	30.8	523	18.54	1185	24.73	1:39.63	0.62
1985	476	17.81	75	20.28	38	15.43	589	17.84	1:39.889	0.45
1986	466	27.03	189	34.85	462	17.78	1117	26.55	1:37.837	0.70
1987	488	24.78	338	29.94	425	18.59	1251	24.44	1:31.756	0.77
1988	450	23.8	339	28.6	432	18	1221	23.47	1:28.636	0.82

Table A1-6 Supplies and mean prices of shark in three major fish markets (consumption localities) 1989-1994

Year	Category	Taipei		Taichung		Chiayi		Total volume	Average price NT$	US$:NT$ Exchange Rate	Average price US$
		Volume	Price	Volume	Price	Volume	Price				
1989	Large	368	31.14	329	33.58	51	28.49	748	31.07	26.407	1.18
	Small	48	21.85	2	20.61	2408	12.96	2458	18.47	26.407	0.70
1990	Large	328	32.31	358	30.09	381	20.07	1067	27.49	26.91	1.02
	Small	43	21.3	---	---	---	---	43	21.3	26.918	0.79
1991	Large	331	32.38	333	32.19	346	17.65	1010	27.41	26.759	1.02
	Small	48	19.71	---	---	---	---	48	19.71	26.759	0.74
1992	Large	420	33.71	352	29.93	395	20.15	1167	27.93	25.16	1.11
	Small	---	---	---	---	---	---	0	0	25.16	0.00
1993	Large	---	---	---	---	---	---	0	0	26.416	0.00
	Small*	431	34.25	368	35.35	385	17.93	1184	29.18	26.416	1.10
1994	Large	332	36.6	274	38.32	352	23.7	958	32.87	26.465	1.24
	Small	---	---	---	---	---	---	0	0	26.465	0.00

Source: Fisheries Yearbook Taiwan Area, 1980 through 1994 (Taiwan Fisheries Bureau)

Table A1-7 Supplies and mean prices of shark in three major fish markets (production locality) 1980-1988

Year	Suao		Kaohsiung		Tongkang		Total volume	Average price NT$	US$:NT$ Exchange Rate	Average price US$
	Volume	Price	Volume	Price	Volume	Price				
1980	2162	33.78	24212	21.95	--	---	26374	27.87	1:36.015	0.77
1981	2466	37.77	21347	25.56	---	---	23813	31.665	1:36.849	0.86
1982	2436	37.43	19349	28.53	---	---	21785	32.98	1:39.124	0.84
1983	1901	38.42	19430	26.53	---	---	21331	32.48	1:40.065	0.81
1984	2080	37.46	22526	23.39	2103	28.55	26709	29.8	1:39.63	0.75
1985	2791	30.72	27760	18.28	2411	27.32	32962	25.44	1:39.889	0.64
1986	2571	33.33	17979	21.31	3031	28.6	23581	27.75	1:37.837	0.73
1987	2417	37.05	20201	20.18	2822	24.57	25440	27.27	1:31.756	0.86
1988	2232	40.73	12747	16.5	---	---	14979	28.62	1:28.636	1.00

Table A1-8 Supplies and mean prices of shark in three major fish markets (production locality) 1989-1994

Year	Category	Suao		Kaohsiung		Tungkang		Total volume	Average price NT$	US$:NT$ Exchange Rate	Average price US$
		Volume	Price	Volume	Price	Volume	Price				
1989	Large	454	45.89	12735	22.32	477	26.78	13666	31.66	1:26.407	1.20
	Small	—	—	2408	12.96	—	—	2408	12.96	1:26.407	0.49
1990	Large	2124	35.16	24193	17.51	3397	25.35	29714	26.01	1:26.91	0.97
	Small	—	—	2069	11.98	—	—	2069	11.98	1:26.918	0.45
1991	Large	2092	40.31	24611	21.77	3179	28.07	29882	30.05	1:26.759	1.12
	Small	—	—	1006	13.11	—	—	1006	13.11	1:26.759	0.49
1992	Large	1818	42.79	22419	15.58	2849	25.92	27086	28.10	1:25.16	1.12
	Small	—	—	1448	14.92	—	—	1448	14.92	1:25.16	0.59
1993	Large	—	—	20254	15.82	2280	27.01	22534	21.42	1:26.416	0.81
	Small*	1956	45.36	1081	15.21	—	—	3037	30.29	1:26.416	1.15
1994	Large	784	51.55	20103	18.31	1443	28.58	22330	32.81	1:26.465	1.24
	Small	977	48.44	1542	16.03	5	33	2524	32.49	1:26.465	1.23

Source for Tables A1-8 & A1-8: Fisheries Yearbook Taiwan Area, 1980 through 1994 (Taiwan Fisheries Yearbook)

Table A1-9 Total chondrichthyan yield (mt) for the Taiwan area 1980-1995

Year	Total	Large Shark	% of total	Small shark	% of total	Skates & rays	% of total	World total	Taiwan % of total
1980	52260	43598	83.4	5255	10.1	3407	6.5	-	
1981	43656	34073	78.0	6556	15.0	3027	6.93	627245	7
1982	47245	38475	81.4	6454	13.7	2316	4.90	629990	7.50
1983	43459	35431	81.5	5595	12.9	2433	5.60	584535	7.43
1984	48491	38514	79.4	7188	14.8	2789	5.75	604282	8.02
1985	55768	47571	85.3	5636	10.1	2561	4.59	618365	9.02
1986	45994	38496	83.7	5582	12.1	1916	4.17	637286	7.22
1987	50755	42967	84.7	5140	10.1	2648	5.22	655700	7.74
1988	43899	34872	79.4	6553	14.9	2474	5.64	687860	6.38
1989	54790	41114	75.0	10775	19.7	2901	5.29	671827	8.16
1990	75731	61917	81.8	12030	15.9	1784	2.36	678648	11.16
1991	68632	58576	85.3	9521	13.9	535	0.78	716100	9.58
1992	64136	57295	89.3	6753	10.5	88	0.14	701115	9.15
1993	50737	46157	91.0	3907	7.7	673	1.33	700108	7.25
1994	39457	33019	83.7	5905	15.0	533	1.35	---	---
1995	44065	38337	87.0	5081	11.5	647	1.47	---	---

Source: FAO Yearbook (1995); *Fisheries Yearbook Taiwan Area*, 1980 through 1995 (Taiwan Fisheries Bureau)

Table A1-10 Annual landings of fish and sharks (mt), price of shark, tuna and billfish (NT$/kg) in Taiwan area (1961-1995)

Year	Annual landing of fish (A)	Large shark				Small shark				Price of Tuna	Price of Billfish
		Catch (B)	B/A*100%	Value (C)	Price	Catch	D/A*100%	Value (E)	Price		
1961	312439	9691	3.10	55240	5.70	5063	1.62	27342	5.40	8.61	8.13
1962	327046	11613	3.55	579.61	4.99	5058	1.55	21380	4.22	7.39	8.24
1963	350729	9766	2.78	55976	5.73	4692	1.34	23731	5.06	8.27	8.12
1964	376398	9727	2.58	62105	6.38	5498	1.46	32195	5.86	9.51	9.45
1965	381688	11792	3.09	79886	6.77	5748	1.51	386.7	6.71	10.28	10.90
1966	425277	13665	3.21	96225	7.04	6670	1.57	35299	5.29	13.01	11.82
1967	458222	15674	3.42	106750	6.81	7653	1.67	38912	5.08	13.01	11.76
1968	531170	21147	3.98	141893	6.71	9020	1.70	49395	5.48	12.99	12.40
1969	560918	21083	3.76	159722	7.58	9250	1.65	55334	5.98	13.20	14.47
1970	613152	25447	4.15	206346	8.11	8288	1.35	49528	5.98	17.80	14.85
1971	650188	25090	3.86	209826	8.36	11733	1.69	72871	6.21	19.28	15.89
1972	694330	27406	3.95	247677	9.04	9433	1.36	61382	6.51	22.73	15.23
1973	758484	25526	3.37	287905	11.28	9262	1.22	76956	8.31	27.23	20.88
1974	697871	34064	4.88	374480	10.99	7848	1.12	55978	7.13	26.09	32.71
1975	779950	51046	6.55	558640	10.94	7090	0.91	67757	9.56	22.76	36.23
1976	810600	45212	5.58	692269	15.31	8680	1.07	107303	12.36	33.19	50.79
1977	854913	32783	3.83	633655	19.33	17487	2.05	277824	15.89	39.82	46.08
1978	885044	30227	3.42	604378	19.99	13220	1.49	209359	15.84	42.92	46.52
1979	929326	33549	3.61	659271	19.65	6180	0.66	103092	16.68	49.16	31.25
1980	936334	43598	4.66	939369	21.55	5255	0.56	111444	21.21	55.59	32.75
1981	911678	34073	3.74	1010367	29.65	6556	0.72	169332	25.83	70.92	54.32
1982	922520	38475	4.17	1154378	30.00	6545	0.70	164765	25.53	66.47	46.72
1983	930582	35431	3.81	992687	28.02	5595	0.60	136295	24.36	64.39	57.17
1984	1002599	38514	3.84	993072	25.78	7188	0.72	171070	23.80	69.44	55.83
1985	1037721	47571	4.58	1190882	25.03	5636	0.54	133220	23.64	67.86	56.24
1986	1094587	38496	3.52	964276	25.06	5582	0.51	136454	24.45	65.58	67.65
1987	1236170	42967	3.48	1096859	25.53	5140	0.42	106411	20.70	68.48	91.37
1988	1360868	34872	2.56	898213	25.76	6553	0.48	133654	20.40	67.08	73.83
1989	1371681	41114	3.00	1117822	27.19	10775	0.79	284957	26.45	72.02	91.88
1990	1455495	61917	4.25	1694617	27.37	12030	0.83	203522	16.92	65.95	139.42
1991	1316651	58576	4.45	1564479	26.71	9521	0.72	183077	19.23	60.11	131.30

1992	1326981	57295	4.32	1511369	26.38	6753	0.51	127936	18.95	68.55	91.89
1993	1423971	49708	3.49	1209126	24.32	5699	0.40	118623	20.81	94.05	135.50
1994	1255273	33019	2.63	952409	28.84	5905	0.47	153664	26.02	97.67	147.30
1995	1296886	38337	2.96	1506572	39.30	5081	0.39	140586	27.67	110.50	109.55

Source: *Fisheries Yearbook Taiwan Area*, 1961 through 1995 (Taiwan Fisheries Bureau).