An overview of the exploitation, trade and management of chondrichthyans in Indonesia.

Nokome Bentley

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Preface

This report was completed in 1996 for TRAFFIC South East Asia. The TRAFFIC Network is an international organisation that acts as the wildlife trade-monitoring program of The World Wide Fund for Nature (WWF) and The World Conservation Union (IUCN). TRAFFIC's purpose is to help ensure that wildlife trade is at sustainable levels and in accordance with domestic and international laws and agreements.

In 1993, the IUCN Shark Specialist Group met in Thailand and due to a lack of information for use in assessing the conservation status of shark populations, requested TRAFFIC to review the trade in sharks and shark products. In early 1994, TRAFFIC began to address the need for reliable information on the exploitation of sharks, rays and other chondrichthyans, by initiating a global investigation to collect and analyse available data on shark fisheries and trade. This information will be used to determine priority regions and species of conservation concern, and develop recommendations for appropriate harvest and trade controls.

To contribute to the objectives of the TRAFFIC study, this report gives an overview of the exploitation of sharks, rays and other chondrichthyans in Indonesia.

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Notices

Acknowledgments

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1. Introduction

The TRAFFIC Network is an international organisation which acts as the wildlife trade monitoring program of The World Wide Fund for Nature (WWF) and the International Union for the Conservation of Nature (IUCN). In early 1994, TRAFFIC began to address the need for reliable information on the exploitation of sharks and other chondrichthyans (sharks, rays and chimaeras), by initiating a global investigation to collect and analyse available data on shark fisheries and trade. This information will be used to determine priority regions and species of conservation concern, and develop recommendations for appropriate harvest and trade controls.

In November 1994, the parties to CITES adopted Resolution Conf. 9.17: *Status of Trade in Sharks*, calling on Parties and international fisheries organisations to improve the collection of data on shark fisheries and trade for further discussion at the next Conference of the Parties. The TRAFFIC investigation will contribute to the review process. This report provides an overview of the exploitation of chondrichthyans in Indonesia to contribute to the objectives of the TRAFFIC global study.

Indonesia is an archipelago of more than 17000 islands which straddles the equator for about 5000 km (Figure 1, Lang 1992). With the declaration of the Indonesian Exclusive Economic Zone (EEZ) in 1983, the country gained control of over 5.8 million km^2 of sea (Wibowo and Susanto 1995). For thousands of years many of its people have had a close affinity with the sea and there is a long tradition of fishing. The country's large population meant that small scale traditional fishing alone produced a considerable catch. However, with the introduction of motorised vessels and more sophisticated fishing gears, production has increased further.

Figure 1. Map of Indonesia indicating cities, ports, seas and islands referred to in the text.

Chondrichthyans have undoubtedly been caught in Indonesia for thousands of years. However they have probably never represented a major part of the catch. Between 1987 and 1991, sharks and rays accounted for only 2.41% of fisheries production (Bonfil 1995). Despite the high value of some shark products they contribute an even lower proportion to the country's fisheries products export earnings (1.3% in 1993). Nonetheless, Indonesia has the largest chondrichthyan fishery in the world (87 138 t in 1993) with the highest sustained rate of growth (Bonfil 1995). Catches of both sharks and rays increased significantly during the early 1980s and have continued to rise (Figure 2). Between 1992 and 1993, shark and ray landings rose by 6999 t (8.73 %), the second highest increase since 1980.

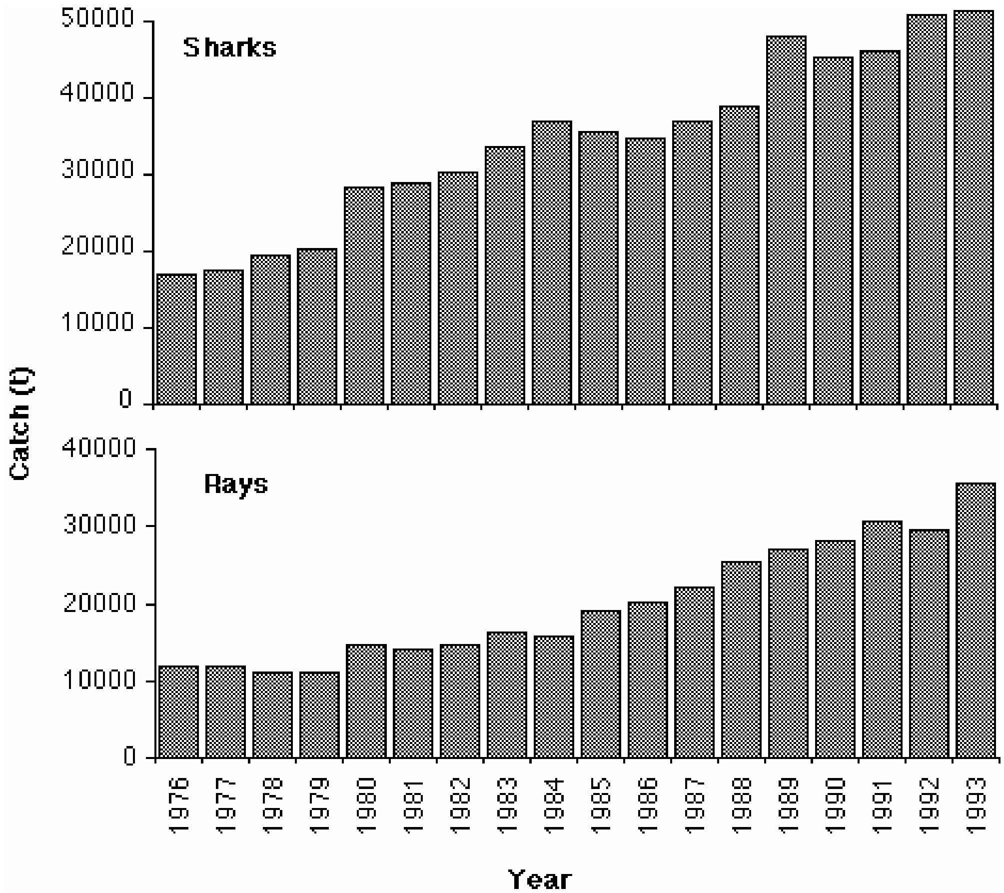

Figure 2. Total Indonesian catches of rays and sharks from 1976 to 1992. The value for ray catch in 1988 was estimated from Figure 2.28 in Bonfil 1995).

In accordance with the terms of reference and suggested reporting format of TRAFFIC South East Asia, this report provides the following information relating to chondrichthyans in Indonesian waters:

- a summary of the development of Indonesia's fisheries,
- the magnitude of catch in relation to the rest of the world,
- an overview of the Indonesian fauna,
- descriptions of the various types of chondrichthyan fisheries in Indonesia,
- an overview of the trade in shark products, including an analysis of trends in imports and exports and an assessment of data availability and reliability,

- a discussion of the implications of the above uses of chondrichthyans on their conservation, including an assessment of the relative importance of each,

- conclusions and recommendations.

Information was obtained from published material, interviews with fishers, traders and researchers and from the author's personal observations. Interviews were conducted by staff from the World Wide Fund for Nature Indonesia Programme based upon questions set by the author (Appendix 1). Colour plates of selected species from Last and Stevens (1994) were used to aid interviewees in species identification. This overview does not profess to be complete. Due to the limited amount of time available for collection of data in Indonesia, some relevant information may have been overlooked. The author apologises to Indonesian researchers and fisheries managers, involved in chondrichthyan resource management, whose work is not recognised here.

The report is written for an audience that is not necessary familiar with the principles of fisheries science and management. In some cases explanations, which may not be necessary for all readers, are given in order to clarify conclusions.

2. Indonesia's chondrichthyan fauna

Indonesia has the richest chondrichthyan fauna in the world. In most parts of the world there are less than 200 shark, ray and chaemerid species. Australia's waters are comparatively rich in having around 300 species. Only relatively small amounts of chondrichthyan research have been done in Indonesian and there is little published information on it's fauna. However, Indonesia's shallow water elasmobranch fauna is at least as rich as Australia's, and although little is known about its deeper waters, the same appears true for this habitat. It is estimated that Indonesia has at least 350 chondrichthyan species (P. Last, pers. comm. 1996).

The geographic and depth distributions of some Indonesian elasmobranch species are presented in Table 1. This list is drawn from species distributions in Last and Stevens (1995) and Compagno (1984) and is not complete. In particular there are likely to be more ray species than are listed. For instance, trawl surveys off the Indian Ocean coasts of Sumatra and Java have found members of the families Rajidae (*Irolita spp*, *Raja spp*), Torpedinidae (*Torpedo spp*), Narcinidae (*Narcine spp*), Urolophidae and Gymnuridae (*Gymnura spp*, *Aetoplatea spp*) (Gloerfelt-Tarp and Kailola 1984). The paucity of deepwater research also means that there are likely to be more squalids (members of the family Squalidae) than are presented here. However, since most fisheries are confined to shallow waters, Table 1 probably includes most species that dominate the catch.

Table 1. The geographic and depth distributions of some Indonesian elasmobranch species. Geographic distribution, S: Sumatra, J: Java, K: Kalimantan, N: Nusa Tenggara, U: Sulawesi, M: Maluku, I: Irian Jaya; w: west, n: north, e: east, s: south. Depth distribution 1: 0 to 100 m, 2: 100 to 1000 m, 3: > 1000 m. Species which are thought to be most important to fisheries are shaded. See text for details.

		Distribution	
Common name	Scientific Name	Geographic	Depth
F. Hexanchidae			
Sharpnose Seven Gill Shark	*Heptranchias perlo*	wN	1,2,3
Bluntnose Six Gill Shark	*Hexanchus griseus*	S	2
F. Squalidae			
Endeavour Dogfish	*Centrophorus moluccensis*	wM	2,3
F. Heterodontidae			
Zebra Bullhead	*Heterodontus zebra*	S	1
F. Orectolobidae			
Taselled Wobbegong	*Eucrossorhinus dasypogon*	I	1
Ornate Wobbegong	*Orectolobus ornatus*	I	1
F. Hemiscylliidae			
Grey Bamboo Shark	*Chiloscyllium grisium*	S,J,I,?All	1
Slender Bamboo Shark	*C. indicum*	S,J,?All	1
Whitespotted Bamboo Shark	*C. plagiosum*	S,J,?All	1
Brown Banded Bamboo Shark	*C. punctatum*	S,J	1
Indonesian Spekled Carpet Shark	*Hemiscyllium freycineti*	I	1

Epaulette Shark	*H. ocellatum*	I	1
F. Stegostomatidae			
Zebra Shark	*Stegostoma fasciatum*	S,J,N,?K,?U	1
F. Ginglymostomatidae			
Tawney Nurse Shark	*Nebrius ferrugineus*	S,J,N,I	1
F. Rhiniodontidae			
Whale Shark	*Rhincodon typus*	All	1
F. Alopiidae			
Pelagic Thresher Shark	*Alopias pelagicus*	All	1,2
Bigeye Thresher Shark	*A. superciliosus*	All	1,2,3
Thresher Shark	*A. vulpinus*	S,?All	1,2
F. Lamnidae			
Shortfin Mako	*Isurus oxyrinchus*	All	1,2
F. Scyliorhinidae			
Coral Catshark	*Atelomycterus marmoratus*	S,J,I	1
Speckled Catshark	*Halaelurus boesemani*	M	2
Brownspotted Catshark	*Scyliorhinus garmani*	All	1
F. Proscyliidae			
Graceful Catshark	*Proscyllium habereri*	J	1
F. Hemigaleidae			
Hooktooth Shark	*Chaenogaleus macrostoma*		
Sicklefin Weasel Shark	*C. microstoma*	J,eS	1,2
F. Carcharinidae			
Tiger Shark	*Galeocerdo cuvier*	S, J, N, ?K, ?U	1,2
Blue Shark	*Prionacea glauca*	All	1,2
Sliteye Shark	*Loxodon macrorhinus*	S, J, N	1,
Australian Sharpnose Shark	*Rhizoprionodon taylori*	sI	1
Grey Sharpnose Shark	*Rhizoprionodon oligolinx*	S, J, ?M	1

Lemon Shark	*Negaprion acutidens*	S, J, N, I	1
Whitetip Reef Shark	*Triaenodon obesus*	All	1
Silvertip Shark	*Carcharhinus albimarginatus*	?J, nU	1,2,3
Oceanic Whitetip Shark	*C. longimanus*	All	1
Grey Reef Shark	*C. amblyrhynchos*	S, J, I	1,2
Spot-tail Shark	*C. sorrah*	S, J, K, ?M	1
Blacktip Reef Shark	*C. melanopterus*	All	1
Common Blacktip Shark	*C. limbatus*	S, J, K, I	1
Spinner Shark	*C. brevipinna*	S, J, N	1
Pigeye Shark	*C. amboinensis*	J, M, ?S, ?K,?I	1
Bull Shark	*C. leucas*	K, I	1,2
Hardnose Shark	*C. macloti*	I, ?J,?N, ?K	1,2
Whitecheek Shark	*C. dussumieri*	J, K, ?I	1,2
Spadenose Shark	*Scoliodon laticaudus*	S, J, K	1
F. Sphyrnidae			
Winghead Shark	*Eusphyra blochii*	S, J, K, M , N, U	1
Scalloped Hammerhead	*Sphyrna lewini*	All	1,2
F. Rhinobatidae			
Giant Shovelnose Ray	*Rhinobatos typus*	All	1
F. Rhynchobatidae			
Whitespotted Guitarfish	*Rhynchobatus djiddensis*	All	
Shark Ray	*Rhina ancylostoma*	All	1
F. Pristidae			
Narrow Sawfish	*Anoxypristis cuspidata*	All	1
Green Sawfish	*Pristis zijsron*	All	1
F. Dasyatidae			
Cowtail Stingray	*Patinachus sephen*	All	1

Blue-spotted Fantail Ray	*Taeniura lymma*	All	1
Bloched Fantail Ray	*T. meyeni*	All	1
Porcupine Ray	*Urogymnus asperrimus*	All	1
Blue-spotted Maskray	*Dasyatis kuhlii*	All	1
Mangrove Whipray	*Himantura granulata*	J, wI, ?S	1
Jenkins Whipray	*H. jenkinsii*	eS, wI, ?J	1
Blackspotted Whipray	*H. toshi*	wI, ?J, ?N	1
Reticulate Whipray	*H. uarnak*	All	1
Leopard Whipray	*H. undulata*	All	1
Pink Whipray	*H. fai*	?N	1
Whitespot Whipray	*H. gerrardi*		
Bleeker's Whipray	*H. bleekeri*		
Patchwork Whipray	*H. favus*		
F. Myliobatidae			
Whitespotted Eagle Ray	*Aetobatus narinari*	All	1
Banded Eagle Ray	*Aetomylaeus nichofii*	All	1
Ornate Eagle Ray	*A. vespertilio*	nJ, sK, sM	1
Eagle Ray	*A. maculata*		
F. Mobulidae			
Manta Ray	*Manta birostris*	All	1
Pygmy Devilray	*Mobula eregoodootenkee*	All	1
F. Rhinopteridae			
Javanese Cownose Ray	*Rhinoptera javanica*		

Concern over the sustainability of chondrichthyan fisheries arises from their peculiar life history traits. The reproductive strategy of chondrichthyans is quite different to most other exploited fishes. Most fish produce large numbers (hundreds to millions) of poorly developed young of which only a small proportion survive. Large variations in survival rates occur due to fluctuations in environmental conditions. In some species, survival may also be dependent on the size of the current population. When there is a limit on the number of individuals that can live in an area, reproduction may be in excess of this number. Therefore, because of their high fecundity, it is possible for a very low parental stock to produce enough offspring to sustain the population.

In contrast, most chondrichthyans have a long gestation period in which a few (an average of about 20) young develop to an advanced stage and thus have a greater chance of survival (Compagno 1990, Hoenig and Gruber 1990, Pratt and Casey 1990). The young are therefore less prone to fluctuations in environmental conditions. However, the low fecundity of chondrichthyans means that the number of recruits to the population is highly dependent on the size of the parental stock. There is less plasticity in the reproductive system such that compensation can not be made when population levels are low.

In addition chondrichthyans generally have lower rates of growth and natural mortality (Compagno 1990, Hoenig and Gruber 1990, Pratt and Casey 1990). These characteristics further contribute to the low productivity of the group.

The population structure and distribution of a species are also important determinants in its susceptibility to overfishing. Small populations with restricted ranges are generally the most susceptible. Despite the widespread distribution of many of Indonesia's elasmobranch fauna, specific habitat requirements may mean that some species are nonetheless susceptible to over exploitation from concentrated fishing effort.

Reproductive strategy, growth and mortality are important determinants of the susceptibility of all exploited populations. A knowledge of these is essential in formulating appropriate management regimes. There can be significant variation between species, populations and locations in all of these traits. To reliably manage various forms of exploitation, detailed studies need to be performed in the area of interest. Unfortunately little is known about the Indonesian chondrichthyan fauna. The necessary research to determine traits such as growth and mortality rates are often expensive and time consuming. In a developing country like Indonesia, funds for such work are often unavailable. In their absence we must often rely upon the extrapolation of research done elsewhere. Generalisations about population biology and analyses of trends in the fishery are our best tools in providing much needed assessments of sustainability.

3. Fisheries

No evidence of chimaerid (Sub class Holocephali) catches was found and the lack of deepwater trawl fisheries means they are unlikely. Therefore, further discussion is limited to elasmobranchs (sharks and rays).

3.1. Fisheries landings data

Indonesia has a well designed system for the collection and publication of fisheries statistics. Annual publications provide summaries of data such as catches of each species or group, gears used, sizes of boats and number of fishermen for each region or province (Figure 3). More detailed fisheries statistics such as catches in each district, the types of processing, and the gear used to catch each species or group are available in separate publications for each province. The unification and detail in the system are far in excess of those in many industrialised nations. This reflects the importance of such data in developing countries, as often the only available tool for fisheries management.

Figure 3. Map of Indonesia showing the regions and provinces for which separate data is provided in annual fisheries statistics summaries.

Unfortunately deficiencies do exist in the system. (i) The data is limited in its taxonomic detail. While separate catches are estimated for many species, data for chondrichthyans is only provided at the level of 'sharks' and 'rays'. As discussed in Section 2 variations in the life history traits of species mean that they can act differently to fishing pressure. Such differences are masked when collective categories such as these are used. (ii) Dudley and Harris (1987) concluded that there may be significant inaccuracies in the data. They found that incorrect sampling procedures were often used and that there were errors in recording. They estimated that landings recorded in each district can be inaccurate by a factor of as much as 0.8 or 3.8. They added however, that when the estimates for each district are summed to provide a total for the province such inaccuracies may be cancelled out. Furthermore, as long as such errors do not vary consistently with time the data is still suitable for an analysis of trends in various fisheries. As with most fisheries statistics systems these data are *estimates* of catches and as such caution should be used in interpreting their absolute values.

The current system of fisheries statistics collection was initiated in 1976 (Dudley and Harries 1987) and the data available to date is tabulated in Appendix 2. Explanatory notes in *Fisheries Statistics of Indonesia* define fishery production as ‘the live weight equivalent of the landing, i.e. "the round, fresh", "round, whole" or "ex-water" weight equivalent of the quantities recorded at the time of landing'. This suggests that data for each province represents the amount landed there and not necessarily what was caught in adjacent waters. Statistics on the numbers of 'set gillnets' and 'set longlines' were also obtained.

3.1.1. Sharks

While there has been an increase in the overall shark catch (Figure 2), there has also been a significant shift in its geographical distribution. During the late 1970s landings of sharks were concentrated around the central and western provinces, in the Java Sea, Strait of Malacca and Indian Ocean (Figures 4). During the next five years, landings increased relatively uniformly although proportionally large increases occurred in South Sulawesi and the north and south coasts of West Java (Figures 4 & 5).

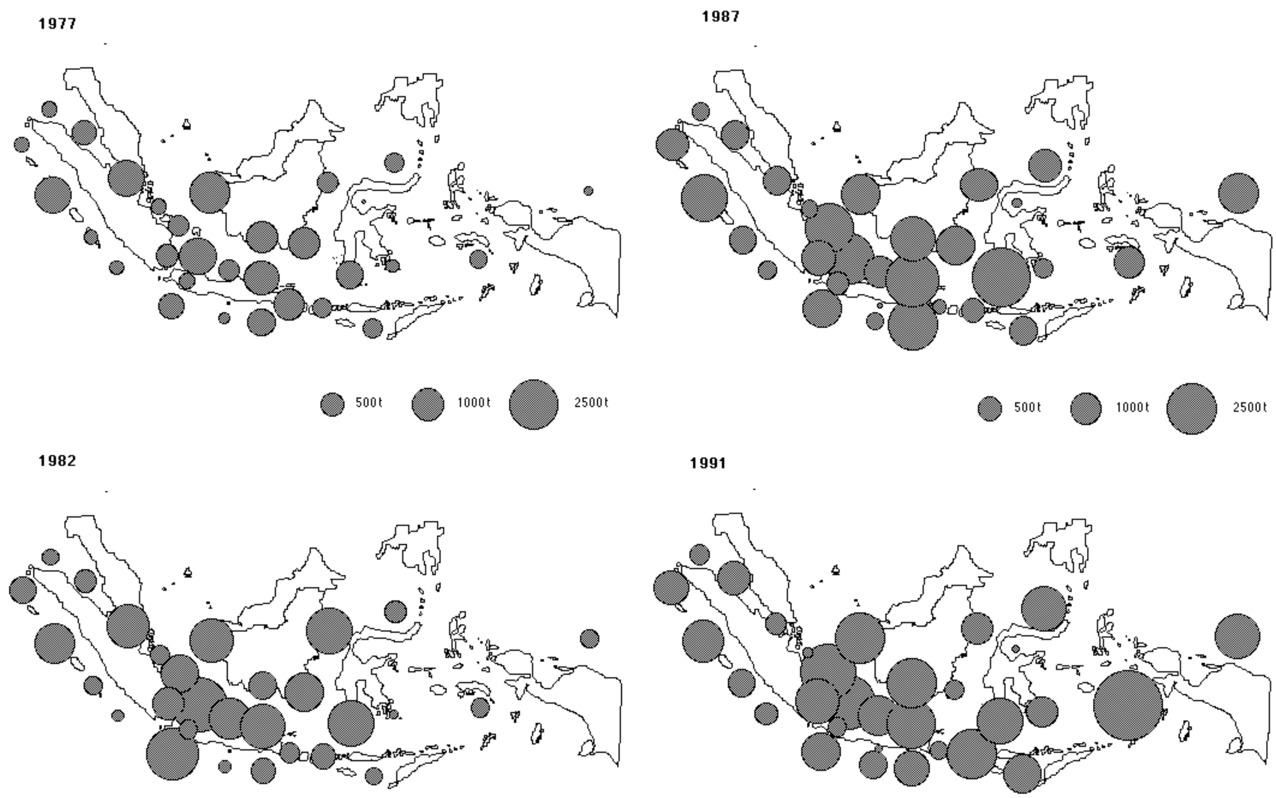

Figure 4. Geographic distribution of shark catches in 1977, 1982, 1987 and 1991. The area of the circles is proportional to the amount of catch in that region/province.

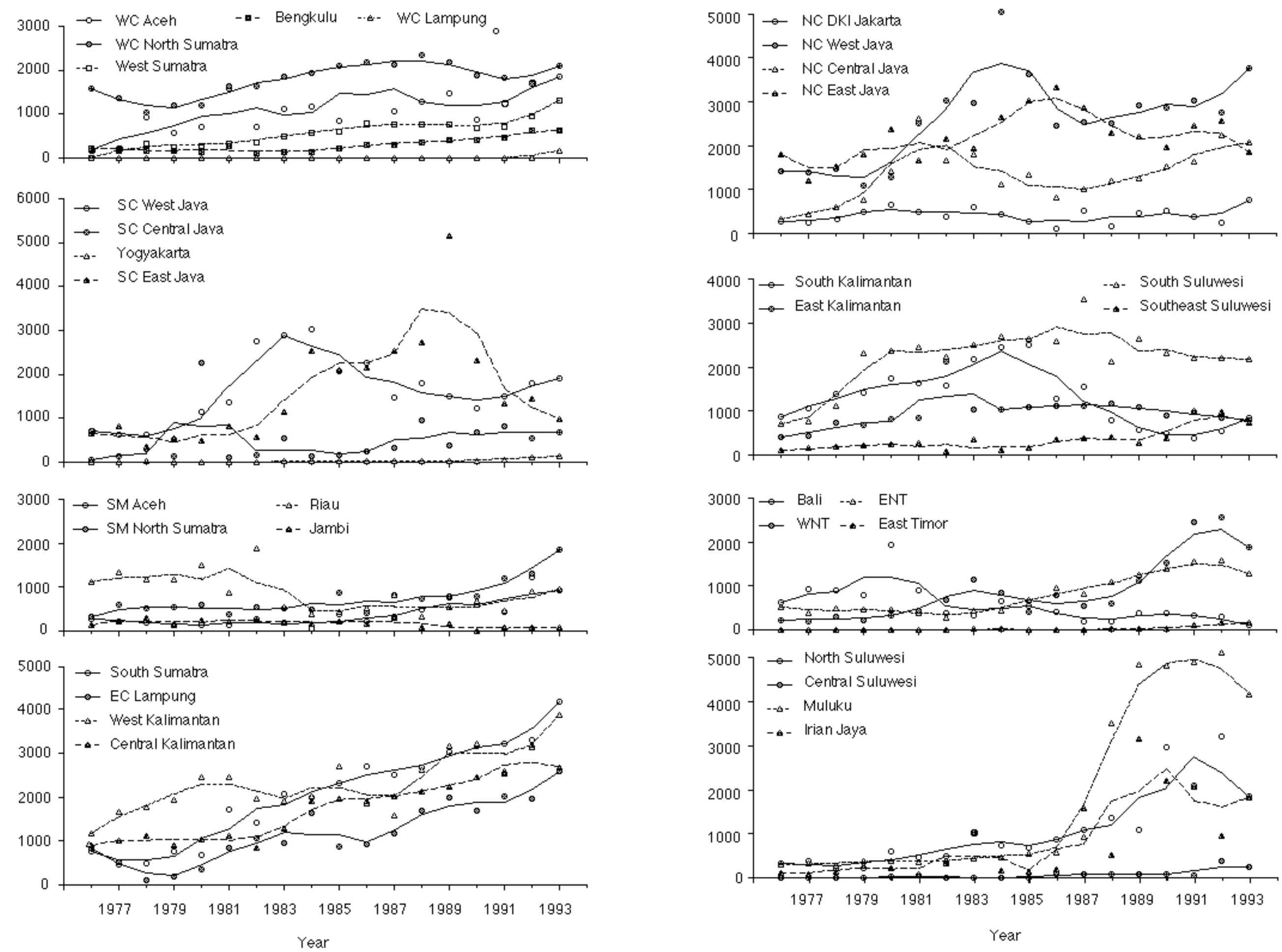

Figure 5. Changes in the catch of sharks in each region/province from 1976 to 1993. Lines represent a three year moving average, except for first and last years, where absolute values have been used.

By 1990 most of the regions with historically larger landings, had experienced significant decreases at some time. These included the west coast of North Sumatra; Riau; the north and south coasts of West Java and East Java; the north coast of Central Java and South Kalimantan (Figures 4 & 5). Landings in some of these regions, particularly those which experienced declines around the mid 1980s, have had increases since. For example, the south coast of West Java, the north coast of Central Java and South Kalimantan. Landings in other regions, such as the north coast of East Java and South Kalimantan, continued on decreasing trends (Figure 5).

Landings in the other western provinces, such as West Sumatra, the west coast of Lampung, Bengkulu and the Strait of Malacca coasts of Aceh and North Sumatra, have continued to increase although as of 1993 none have reached 2000 t (Figure 5). The provinces of South Sumatra, the east coast of Lampung and Central Kalimantan are all in the Java Sea. Unlike neighbouring regions along the north coast of Java landings were initially low but have a continually increasing trend (Figure 5).

Most of the western and central provinces saw the greatest expansion in catch during the early 1980s. Since then catches have generally decreased or remained relatively level. However in the eastern provinces, particularly Maluku, North Sulawesi, West Nusa Tenggara and Irian Jaya, there were large increases in the late 1980s (Figure 5). Apart from Irian Jaya, there were no consistent decrease in landings in any of these provinces from 1985 to 1992. However, in 1993 West and East Nusa Tenggara, Maluku and North Sulawesi all had decreases in landings of between 18 and 42 %.

3.1.2. Rays

The geographical distribution of ray catches has differed from that of sharks with only relatively few regions dominating production. In the late 1970s the Straits of Malacca supported the largest catches (Figure 6). However in the early 1980s the area's relative importance decreased due to a decline in its own production and increased catches from South Sumatra, the north coast of Java, Central Kalimantan and South Sulawesi (Figures 6 and 7). The late 1980s saw the continued expansion of fisheries in most central provinces as well as increases on the west and Strait of Malacca coasts of North Sumatra (Figures 6 and 7). However, by this time there were significant decreases in South Sulawesi and the north coast of West Java (Figure 7). The early 1990s also saw the development of fisheries in the more distant eastern provinces such as East and West Nusa Tenggara, East Kalimantan, Maluku and Irian Jaya. In particular there was a dramatic increase in landings in East Nusa Tenggara in 1993 (Figure 7).

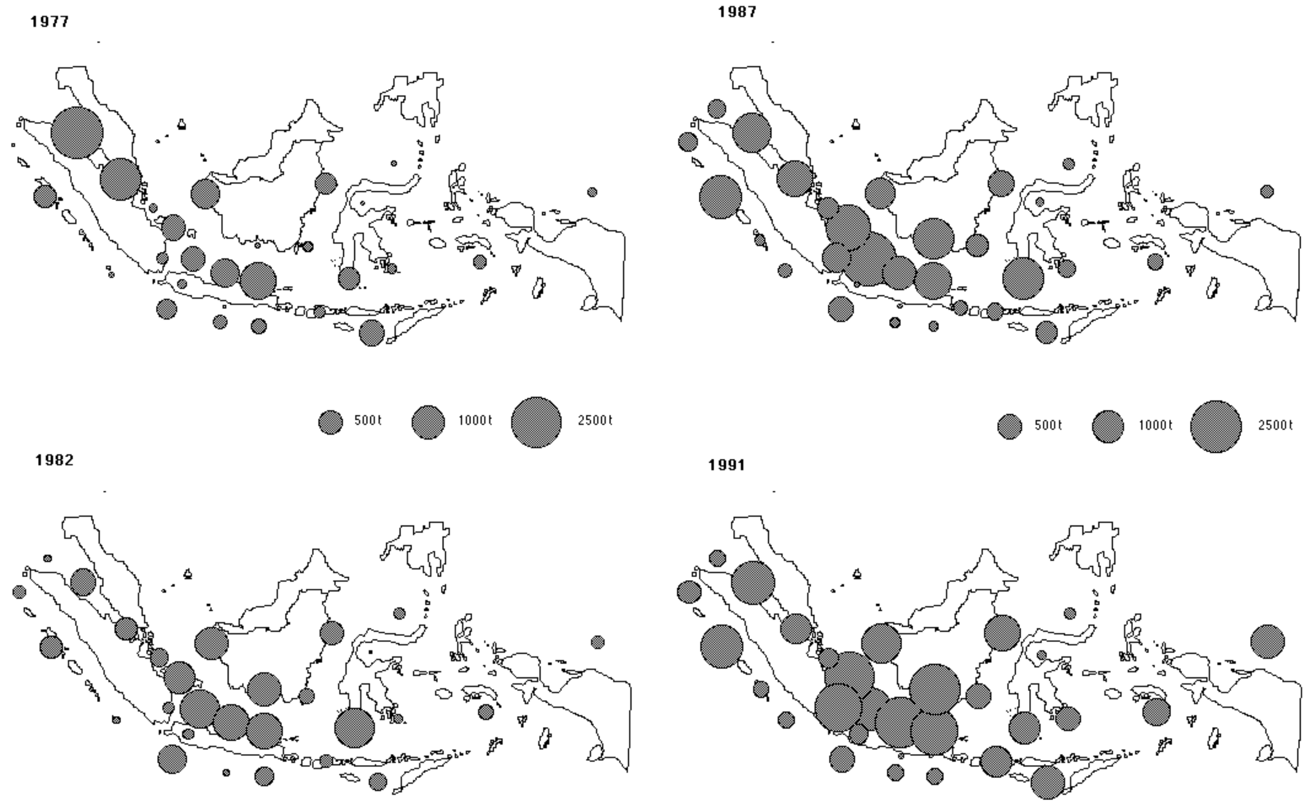

Figure 6. Geographic distribution of ray catches in 1977, 1982, 1987 and 1991. The area of the circles is proportional to the amount of catch in that region/province.

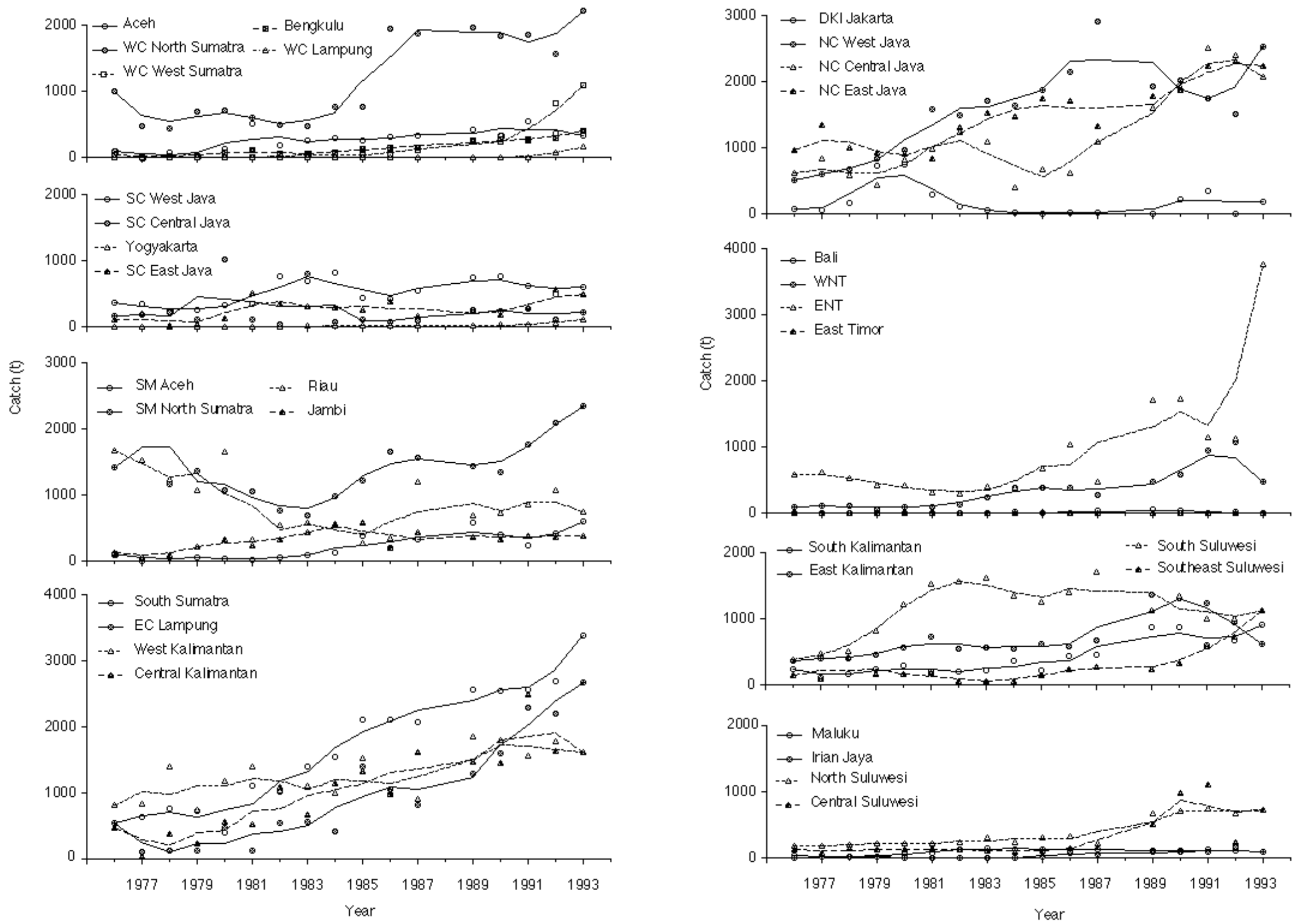

Figure 7. Changes in the catch of rays in each region/province from 1976 to 1993. Lines represent a three year moving average, except for first and last years, where absolute values have been used.

3.1.3. Interpreting changes in catches

The changes in landings observed in each of the provinces could be a result of changes in fishing effort or fish population abundance. Since recruitment in elasmobranch populations is largely unaffected by environmental fluctuations (see Section 2) any changes in catches is most likely to be a reflection of a populations response to fishing, or changes in the fishing activity itself. For example, increases in catch may be a result of increased fishing effort, increased efficiency or the exploitation of previously unfished populations. While demand for the product remains stable, decreases are more likely to result from decreased population abundance than decreased effort or efficiency.

Variations in catches due to changes in effort can be removed by the use of appropriate effort indices. These are used to calculate a catch rate, or catch per unit effort. This then provides a more accurate reflection of population abundance providing an appropriate index of effort is used. Generalised measures of effort such as the number of vessels fishing can be prone to increases in efficiency which increase the effective effort of each unit. Effects such as serial depletion of stocks can also result in increasing or stable catch rates despite localised overfishing. For these reasons changes in catch rates must be interpreted with caution.

There is a close correlation between the total catches of sharks and rays and the total number of gillnets and longlines (Table 2 and Figure 8a). Such a correlation does not necessarily imply that these are the only methods which catch elasmobranchs. However, it is in concordance with anecdotal evidence which suggests that these are the primary methods used to catch sharks and rays (see Sections 3.2 and 3.3).

Table 2. Pearson product-moment correlations between annual catches of sharks and rays and the number of set gillnets and set longlines in each region/province. Fourteen years of data were used: 1976-1982, 1986, 1987, 1989-1993. Insignificant correlations (< 0.532) are not shown.

	Sharks		Rays	
Province	Longlines	Gillnets	Longlines	Gillnets
Aceh	0.67	0.83	0.59	0.78
North Sumatra	0.83	0.95	0.89	0.88
West Sumatra	0.87	0.71	0.80	
Bengkulu	0.66	0.90	0.56	0.91
Lampung				
West Java	0.87	0.85	0.84	0.95
Central Java		0.65		0.66
Yogyakarta				
East Java		0.83	0.58	0.86

Aceh	0.70	0.72	0.81	0.86
North Sumatra	0.77	0.86	0.80	0.78
Riau	0.54	0.65	0.57	0.67
Jambi		0.62		0.85
South Sumatra		0.98		0.98
Lampung	0.92		0.90	
DKI Jakarta		0.55		
West Java	0.77	0.93	0.71	0.87
Central Java	0.69	0.80	0.66	0.72
East Java		0.93		0.91
Bali		0.67		
NTB	0.64	0.95	0.64	0.94
NTT		0.95	0.75	0.79
East Timor		0.98		0.83
West Kalimantan	0.78	0.97	0.79	0.97
Central Kalimantan	0.61		0.59	
South Kalimantan	0.76	0.64	0.92	0.80
East Kalimantan		0.92	0.72	0.91
South Suluwesi	0.96	0.96	0.97	0.95
Southeast Suluwesi	0.83	0.86	0.86	0.86
North Suluwesi		0.88		0.98
Central Suluwesi	0.95	0.84	0.75	0.87
Maluku	0.90	0.80	0.94	0.90
Irian Jaya	0.55	0.84	0.65	0.86
All Areas	1.00	1.00	0.99	0.99

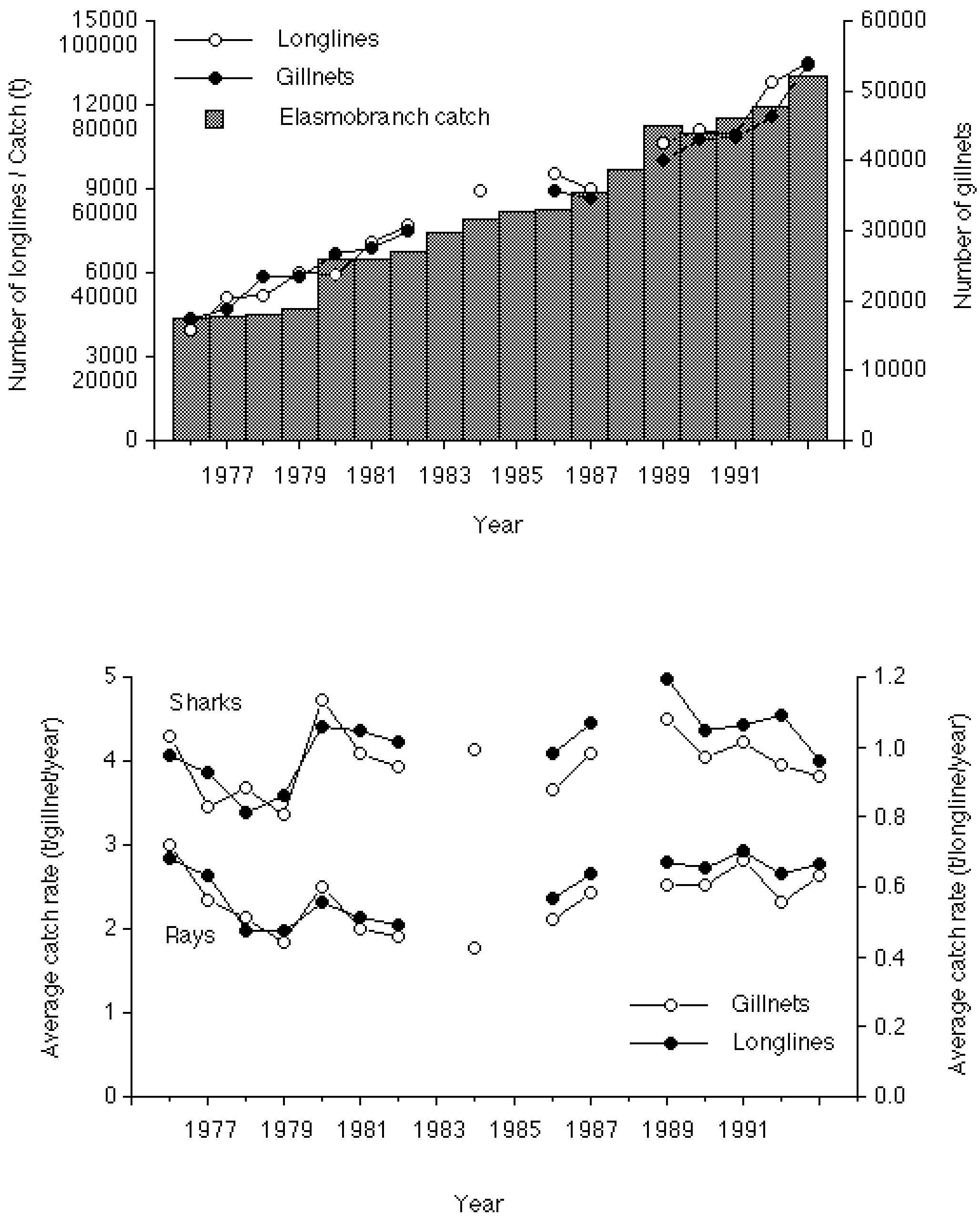

Figure 8. A. Correlation between total Indonesian elasmobranch catch and the total numbers of gillnets and longlines. B. Changes in the average Indonesian catch rates of sharks and rays by gillnets and longlines.

Although these correlations are high, there have been fluctuations in catch rates. During the latter half of the 1970s there was a decrease in the catch rates of both sharks and rays, by both methods. There was a rapid increase in 1980, but afterwards the decline resumed. In the late 1980s further increases occurred but since this time, catch rates have been decreasing for sharks and relatively stable for rays (Figure 8b).

The close correspondence between the sudden increases in the catch rates of both groups by both gears during the 1980s, suggests that they are due to factors other than increases in population densities. These could include increased catches of both groups by other types of gear, and the fishing of previously unexploited populations. This reinforces the need to study catch rates at a smaller spatial scale and with a wider range of effort indices (see Section 6).

Changes in the number of each of these gears does not explain all the fluctuations in catches that have occurred. At the provincial level the correlations between catches and the number of gear units are weaker (Table 2). In general there is a closer relationship between catch and the number of gillnets than the number of longlines. In a number of provinces there are no records of set longlines being used. In general there have been increases in both the catch of sharks and the number of gear units. In some provinces the ratio between units and catch has remained relatively constant (e.g. South Sumatra, Figure 9). However, elsewhere there have been disproportionately high or low increases in catch relative to the number of units of gear (e.g. North Sulawesi and Maluku, Figure 9). Decreases in catch that have been observed in some provinces can be partially explained by decreases in the number of gear units but discrepancies do also exist (e.g. South Kalimantan, Figure 9).

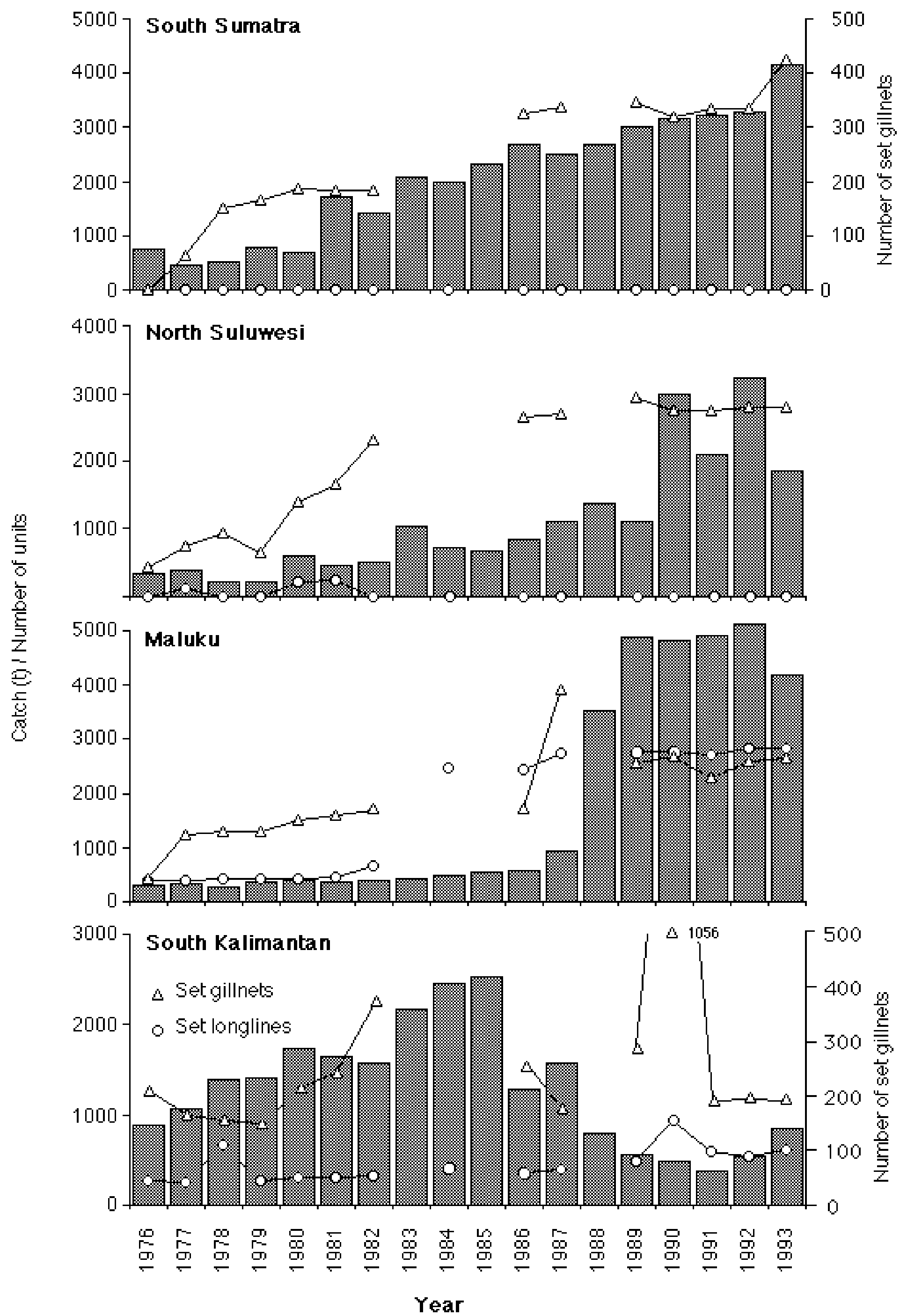

Figure 9. Correlations between shark catches and the number of set gillnets and set longlines in selected provinces. Values for the number of set gillnets in Sumatra have been multiplied by ten. Some data was unavailable for some years.

Similar cases are observed for ray catches. Some provinces have similar rates of increase in catch and effort (e.g. South Sumatra, Figure 10) while in others they appear unrelated (e.g. North Sumatra and North Coast, West Java, Figure 10). The rapid increase in ray catches in East Nusa Tenggara occurred while the number of gillnets was decreasing. However in 1993 there was a slight increase in the number of longlines used in the province (Figure 10).

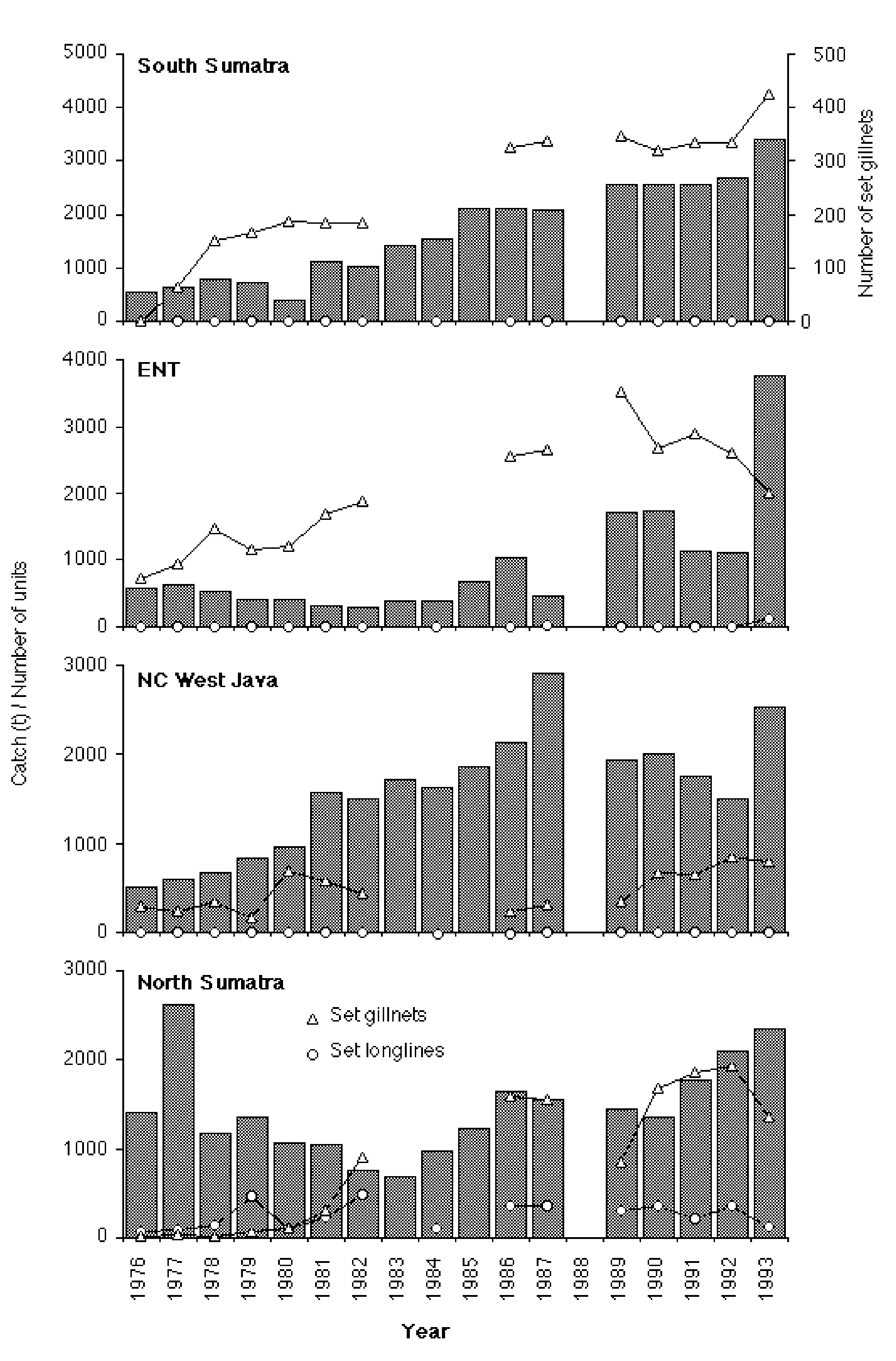

Figure 10. Correlations between ray catches and the number of set gillnets and set longlines in selected provinces. Some data was unavailable for some years.

Catch rates of sharks and rays by set longlines and set gillnets can be highly variable. In some provinces they have varied by more than an order of magnitude (e.g. Rays/Longlines, Lampung, Figure 11). Such variation is unlikely to be a result of fluctuations in population abundance alone. It is most likely to be a result of changes in catches of sharks and rays by other methods.

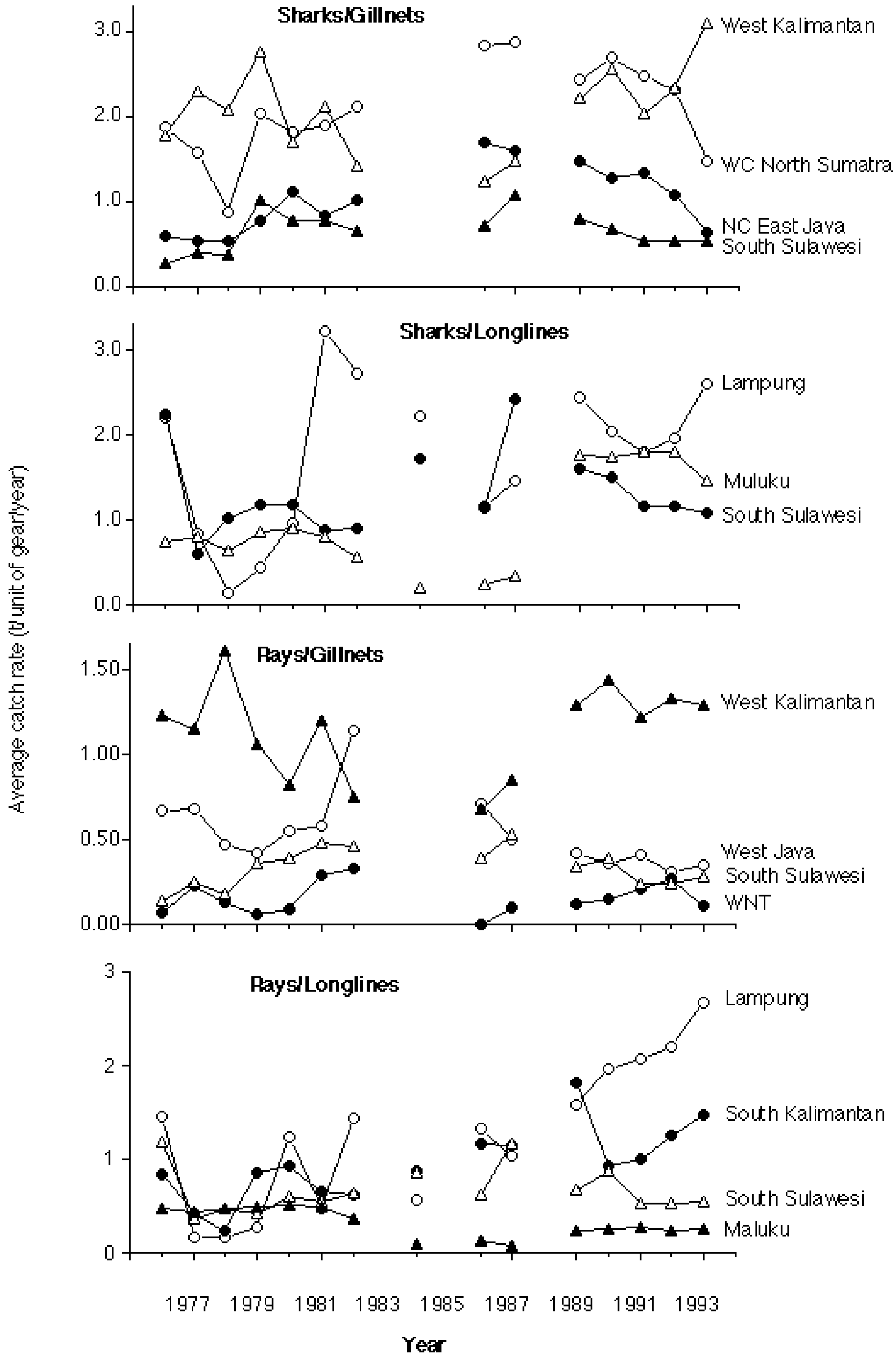

Figure 11. Average catch rates for various species group and gear combinations in a sample of provinces/regions.

In general catch rates have shown more stable trends since 1989. Since that time various provinces have had increases (e.g. Sharks/Gillnets, West Kalimantan and Rays/Longlines, Lampung, Figure 11) and decreases (e.g. Sharks/Gillnets, west coast North Sumatra, NC East Java, South Sulawesi) in catch rates. While catch rates do show some evidence of reduced population abundance, the indices of effort that are currently available do not permit an simple interpretation of the observed changes in catches.

3.2. Domestic fisheries

Much of Indonesia's fisheries are artisinal, that is they are based on relatively small and technologically simple fleets. Throughout Indonesia, but particularly in the eastern provinces, the people of southern Sulawesi dominate fishing activities. These people, the Bugis, Makassarese, Bajau and Butonese, have wide ranging fleets and well organised trading structures. One Makassarese fishermen from the Spermonde Archipelago described the boundaries of his activities as Kalimantan, the Philippines, Irian Jaya and Australia. They have also moved to other areas since their local region has been overfished. For example, Osi Island off the north coast of Seram (Figure 1) is inhabited by fishermen from south Sulawesi who fish towards the east in places like Irian Jaya. Similar settlements have been established along the coast of Irian Jaya and on the islands of Nusa Tenggara.

Much of these people's fishing activity occurs during voyages of two to three months. Often a group of fishermen will share the expenses and profits from a trip. Most commonly about 6 people contribute half a million rupiahs each. This money is used for food, fuel and other supplies. On a good trip they will return with a total of about 30 million rupiahs worth of catch. They all have an equal share in the takings, although often a captain will be designated. Australian fisheries officers report that handicapped persons are sometimes taken on illegal fishing trips to Australian waters. If the boat is apprehended these people are used as scapegoats by the rest of the crew who claim them to be the captain.

There also appears to be an increase in the number of 'fishing bosses'. These people are known as *pongawas* and act as creditors to the fishermen. They will lend them fishing equipment or money for fuel, supplies and boat maintenance. In return they are able to buy the fishermen’s catch at a low price. One example given was that the *pongawa* may lend a fisherman Rp 500, 000 (US $ 220). The fisherman is then obliged to sell all his fish, regardless of the value of the species, to the *pongawa* at the low price of Rp 1, 500/kg (US $ 0.65). One *pongawa* in Ujung Pandang had 43 boats and a total of 200 families in his fleet. He took 66% of catch and the fishermen took the remainder. At the time, twenty of his boats were on two month trips fishing for shark fins in Maluku. He recently had two of his boats burnt after they were apprehended fishing in Australian waters.

The *pongawas* appear to have extensive control over fishing activities in eastern Indonesia. At Bulukumba in South Sulawesi the Fisheries Department's official landing place had been closed for a couple of years because all the catch was being directly collected by *pongawas*. It is not known whether these activities are illegal, however *pongawas* were described by one person as 'enemies of the government'.

3.2.1. Bycatch

Fisheries statistics indicate that sharks and rays are caught throughout Indonesia. Much of this catch is a result of artisinal fishing activities in which elasmobranchs are caught on an opportunistic basis or as a bycatch while targeting other species. When using set gillnets, set longlines and handlines, sharks and rays are caught along with other species. Although they are not the target species, elasmobranchs can represent a significant proportion of the catch.

Most of these activities occur in shallow water coral reef and coastal environments. The species composition of the elasmobranch catch seen in local markets often corresponds with these habitats. The blacktip reef shark, blue-spotted maskray and blue-spotted fantail ray are common coral reef species which are widespread in Indonesia (Last and Stevens 1994). These species dominate the elasmobranch catch in many fish markets (author’s pers. obs.)

Longlines are often used to target demersal teleosts such as snappers (Family Lethrinidae) and groupers (Family Serranidae). The baits used are also attractive to sharks. One fisherman in South Sulawesi reported using longlines 100m long with twelve size 1 or 2 hooks. He set these in waters about 30m deep and got catches rates of about 3 sharks per day.

Bottom set gillnets are used in similar depths around coral reefs. They are about 100m long and 3m high with 15 cm stretched mesh size. Fishermen reported up to ten small sharks per day using such gear. Rays were also reported to be a common bycatch of this method.

3.2.2. Target

In addition to widespread opportunistic catch of elasmobranchs, there are several target fisheries. These can be differentiated not because they are managed as separate fisheries but because they target different species or are in distinct areas.

3.2.2.1. Rhynchobatids for fins

There are a number of locations where demersal elasmobranchs are being targeted specifically for their fins. In particular the white-spotted guitarfish (Family Rhynchobatidae) is sought after. Their fins are worth around 1.5 times more than those from other species (see Section 4.2.1). This species occurs in sandy shallow waters throughout Indonesia and have probably been caught in the Java Sea for some time. However in recent years they have been heavily targeted in the eastern provinces of Maluku and Irian Jaya. This could be the primary reason for the rapid increase in shark landings from these provinces during the late 1980s. (Although it is technically a ray the white-spotted shovelnose ray is shark like in appearance and is probably included under this category).

Aru Islands, Maluku

The Aru Islands in southeast Maluku (Figure 1) are a major focus for the exploitation of Rhynchobatids for fins. Locals in the area catch small sharks in gillnets that they deploy close to shore from canoes or sailing vessels (Hitipeuw *et al* 1994, Ruhunlela pers. comm. 1996, B. Wenno pers. comm. 1996). Shark fins are reported to have been an export from the islands for centuries (B. Wenno pers comm. 1996). However since the mid 1970s there has been an increasing number of boats fishing the waters around the islands. They are generally small motorised boats of between 10 and 50 t from Sulawesi, Kalimantan and Flores (B. Wenno pers. comm. 1996, Amir 1988). Thousands of fishermen are reported to stay in the area for 2 to 4 months during the peak season from October to January. Many come from South Sulawesi in a long and expensive journey. From Spermonde Archipelago it takes a boat of 10-12 horsepower, four days and nights and about 220 gallons of fuel to reach the Aru Islands. However the rewards are great with a two month trip resulting in 100-200 kg of fins per boat worth at least Rp 15 million (US $ 6500)

The boats use bottom set gillnets made from monofilament nylon with a stretched mesh size of about 50 cm. The nets are 9 meshes deep and are made up of 10 to 12 pieces which are each 60 to 70 m long. Each boat uses 3 to 4 nets. The nets are set overnight in 25 to 45 m of water (Amir 1988). Sandy or muddy substrates in relatively turbid waters have the best catch rates. Such fishing grounds are found in the large area of shallow water to the south and east of the islands (Amir 1988, B. Wenno pers. comm. 1996). Boats fish in these areas for one to two weeks and then return to the islands for freshwater and supplies (Amir 1988, B. Wenno pers. comm. 1996).

There is evidence that these boats sometimes fish in Australian waters. It takes the average vessel only 7 to 8 hours from Dobo to the edge of the Australian Exclusive Economic Zone.

Fishermen reported fishing illegally in Australian waters and vessels based in Dobo have been apprehended there by fisheries enforcement officers (M. Flanagan pers. comm. 1996).

Amir (1988) studied the catch on such a vessel during a 21 day trip in November and December 1987. He recorded 121 'rays' (52 %), 71 white-spotted guitarfish (31 %), 11 teleost fish (5 %), 10 giant shovelnose rays (4 %), 8 whale shark (3 %), 7 green turtles (*Chelonia mydas*, 3 %) and 3 tuna (1 %). These catches seem quite low and translate to only 3.4 white-spotted guitarfish per day. However in a survey of 15 shark fishing boats around the Aru Islands, Amir (1988) reported an average price of Rp 72 268 per individual of this species (Table 3). Such prices mean that even low catch rates of this species may be economically viable.

Table 3. Average catch weights and values of species caught by 15 shark fishing vessels around the Aru Islands in 1987 (Survey data from Amir, 1988).

	Average catch		Average price	
	Individuals	Weight (kg)	Rp / indiv.	Rp / kg
White-spotted guitarfish	925.5	1110.6	72249	60207
Giant shovelnose ray	192.4	77.0	13886	34714
Whale shark	86.7	62.2	32831	45763

From 1976 to 1986, shark landings in South East Maluku represented a large proportion of the province's total. In this period there was only a gradual increase in landings and gillnet effort in South East Maluku (Figure 12). The average catch rate increased slightly after 1978 and may reflect an increased efficiency of the vessels and / or gillnets or increasingly more distant fishing grounds (Figure 12).

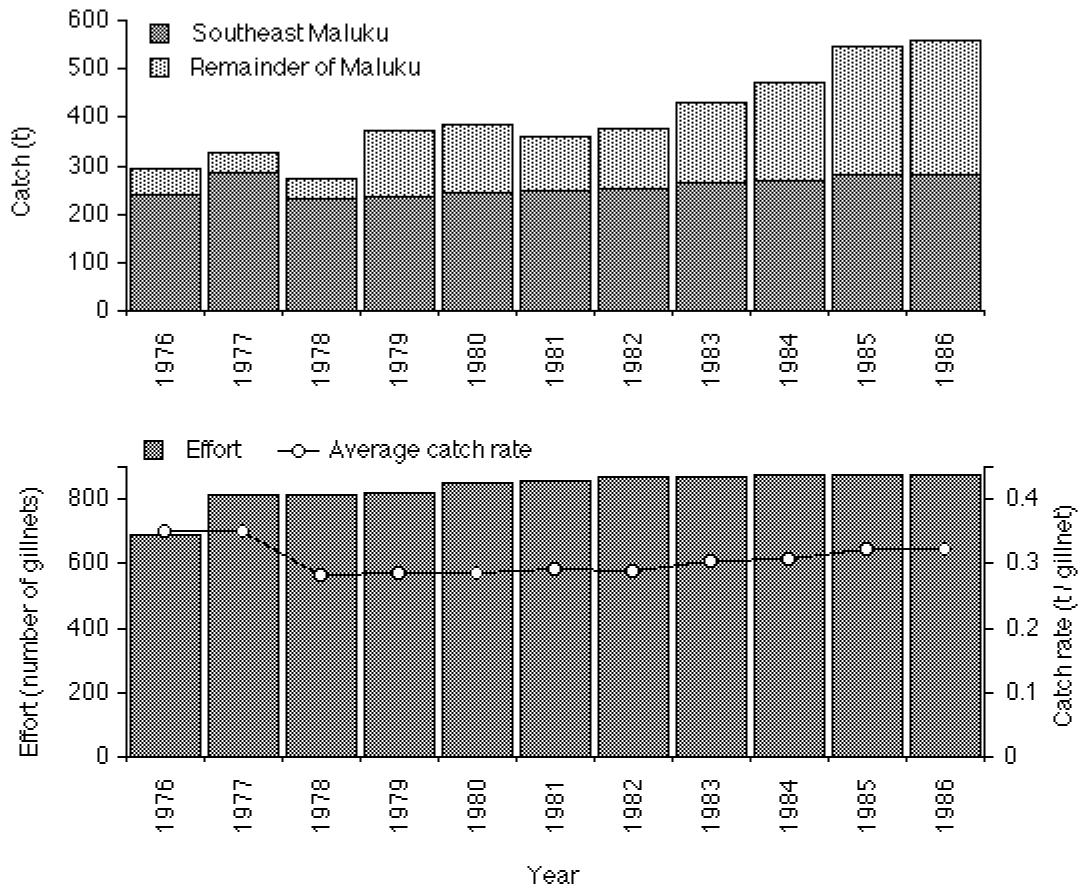

Figure 12. Fluctuations in catch, effort and average catch rate in Southeast Maluku from 1976 to 1986 (Data from Amir, 1988).

For Amir's (1988) fifteen survey boats the average catch weight of fins in 1993 was 1249.8 kg. Assuming an average of 4 gillnets per vessel (Amir 1988) these figures are similar to catch rates calculated from government statistics of about 0.3 t/gillnet. This suggests that at least prior to 1987 catch statistics were not for live weights but actual landings of fins. After 1986 there was rapid increase in catches in Maluku (Figure 5) and this may reflect a conversion to recording live weights. Whatever caused the increased in recorded landings in the late 1980s, prior to this time annual live weight catches of sharks in Southeast Maluku probably averaged at least 4 000 t[1].

[1]Estimated using the average annual landings between 1976 and 1986 (257.5 t) and a conservative fin to live weight conversion factor of 16.67 (based on the two dorsal fins and upper lobe of the caudal fin (see Section

The fishery for white-spotted guitarfish around the Aru Islands appears to have already reached its peak. After its inception in the 1970s, the fishery rapidly expanded. Reports suggest a 'boomtime' in Dobo, with one doctor said to have left his practice to become involved in the more profitable shark fin trade. The number of boats reached a peak in 1987 when there were about 500 involved. However there has been a decline in catch rates since and now there are only about one hundred (F. Amir pers. comm. 1996). There are reports that the boats are having to fish further from the island and a number of vessels from Dobo have been apprehended in Australian waters (Wallner and McLoughlin 1995, M. Flanagan pers. comm. 1996). One fin exporter said that although the fins of the white-spotted guitarfish were the most valuable there were now fewer of them.

Merauke, Irian Jaya

Similar methods are used by vessels based in Merauke, Irian Jaya (author's pers. obs. 1996). There appear to be a number of separate companies in this port, each with several shark fishing boats. These boats are about 10 to 20 m long and also use bottom set gillnets with large monofilament nylon meshes (Plate 1). Many of the boats are equipped with electronic navigation equipment, radio communications and hydraulic net haulers (Wallner and McLoughlin 1995).

Large numbers of dried shark skins (Plate 2) and backbones are present around the docks and outside several warehouses and/or factories. Many of the skins appear to be from Rhynchobatids and other demersal species. Information from crews of these vessels suggest that they fish offshore and close to and sometimes within Australian waters. The smaller vessels were reported to fish closer inshore. It is likely that shark fishing operations out of Merauke are similar to those around the Aru Islands and have a similar catch composition. However they are probably fishing in the area to the south of Yos Sudarso Island. At least some fishing activity also occurs in Australian waters. Shark fishing vessels from Merauke which are apprehended are generally in the Arafura Sea north of the Gulf of Carpentaria (C. Melon pers. comm. 1996).

Other areas

4.2.1) representing 6 % of total weight). The total wet fin weight represents between 4 and 6 % of total weight for most shark species (Kreuzer and Ahmed 1978). The conversion factor used assumes that fins have not been dried. In reality they have probably been at least partially dried during fishing trips and as such the catch weight could be at least twice as high.

Similar shark fishing methods have also been reported in a number of other areas. Bugis people are reported to gillnet for sharks near Sorong and the western coast of Irian Jaya (Figure 1). Both areas are adjacent to large areas of shallow water which are probably suitable for this type of fishing. Muller (1990) reported that there is a Bugis population in the town of Agats with 15 gillnetting boats which specialise in catching sharks for their fins: "The dried fins are exported to Singapore, Hong Kong and Taiwan to end up in shark's-fin soup. These boats, which stay out at sea for up to a month at a time, motor out of Agats most of the year. During the local season of high waves, November / December through March / April, the vessels shift their operation to the seas around Merauke." Similar shark fishing operations exist elsewhere along this coast including around Konkonau (Muller pers. comm. 1996).

Vessels operating out of Muara Angke in Jakarta fish with large mesh bottom set gillnets in the Sunda Strait and surrounding waters (Figure 1). Nets have a stretched mesh size of about 50 cm and are 9 meshes deep. Thirty to fourty pieces each 65 to 96 m long make up a single gillnet. Boats are about 13 m long with a 33 horsepower inboard motor and undertake 23 to 27 day trips (Mappeati 1991). These vessels fish in 40 to 80 m of water and catch a wide variety of elasmobranchs. These include hammerhead sharks, carcharhinid sharks, sawfish, white-spotted guitarfish, eagle rays and stingrays. During one twenty day long trip Mappeati (1991) recorded a catch composition of 116 rays (57.4 %), 23 sharks (11.4 %) and 63 guitarfish (*Rhynchobatus spp.*).

One *pongawa* in Ujung Pandang targeted white-spotted guitarfish for fins around Tarakan, Kalimantan and near the Malaysian border (Figure 1) for one year during the late 1980s. Crews of six used 5 to 7 t boats to fish shallow waters with gillnets. They used a total of about 5 km of gillnets which were set overnight on the bottom. The nets were made in Taiwan although they were modified so that the 10 cm mesh size was increased to 30 cm.

3.2.2.2. Carcharhinids for fins

The targeting of carcharhinid sharks such as the white and black tip reef shark appears to have a long history in Indonesia. Specialist shark fishermen from southeast Sulawesi have targeted sharks for centuries. During long annual voyages they fished for sharks using handlines. They used shark rattles made from coconut shells and a bamboo pole to attract sharks. (Wallner and McLoughlin 1995). However the increase in the price of shark fins has resulted in greater fishing effort being direct towards these species.

There has been a increase in the fishing power of vessels with a shift towards using longlines. A single vessel usually has a number of these, with up to one hundred hooks each. Baits used include skipjack, dolphin, dugong, cow and cat. In the more remote areas shark flesh is often used. Some fishermen reported occasionally using dynamite fishing while targeting sharks. This serves the dual purpose of providing bait and attracting sharks.

It is apparent that overfishing has resulted in localised depletion such that these activities are now only worthwhile in more remote areas. For example, fishermen report having caught large number of carcharhinids in the Spermonde Archipelago during the 1940s and 50s. Now only a few generally small individuals are caught in the area and they must go further afield to catch fins large enough to sell.

Target fishing for these species is now focussed on areas such as Nusa Tenggara, and the Timor Sea. There are reports that the island off North Sulawesi, northern Maluku and northern Irian Jaya have also recently attracted such activities. One source reported two warehouses full of shark fins on the island of Sangihe, between North Sulawesi and the Philippines.

These areas have not traditionally had as high fishing pressure and presumably have greater shark populations. For example, the indigenous people of Sumba in East Nusa Tenggara (Figure 1) do not traditionally have a close affinity with the sea. As a result the seas around the island have not been as heavily exploited as those around southern Sulawesi. Sumba is now one of the latest areas in which Bugis and Makassarese fishermen are focussing their efforts, particularly for high value products such as shark fins. Such situations probably exist elsewhere. Similar fishing methods are used by boats based in Pelabuhanratu, Java (Figure 1). They use longlines to target sharks including hammerheads, spot-tail sharks, tiger sharks in waters as far off as Christmas Island and Sumatra.

The shallow shoals in the northern Timor Sea between Roti and Western Australia have attracted Bajau specialist shark fishers for hundreds of years. Whether this was due to a depletion of stocks in their home grounds or because of naturally greater abundance in these areas is unclear. In 1968 Australia declared sovereignty over a number of offshore reefs and islands in the Timor Sea. These had been traditional fishing grounds for Indonesians targeting demersal reef fish and trepang. However, in 1974 a *Memorandum of Understanding* (MOU) was signed by the Australian and Indonesian governments. This allowed subsistence fishing by non motorised vessels on these reefs. The area accessible to such activities was extended to include the waters between these reefs thus forming the 'MOU box'. However this demarkation failed to recognise the importance of areas such as the Sahul and Holothuria Banks as traditional fishing grounds for shark fishermen. A number of vessels have been caught illegally fishing in these areas.

There have been significant changes in shark fishing activities within Australian waters. Fishers from southern Sulawesi have settled on Roti and Timor (Figure 1) in order to have easier access to the 'MOU box'. Their influence, and the increased price for shark fins has lead to increased effort by generalist fishers on these islands. Prior to 1988 less than 10% of vessels boarded by Australian fisheries officers caught shark. Since then 80% of traditional boats have had shark on board. There has also been an increase in the technological sophistication of the gears used. Many vessels are now using longlines with up to 100 hooks (Waller and McLoughlin 1995).

As well as these 'traditional' sailing vessels there has also been a number of motorised vessels apprehended in Australian waters fishing exclusively for shark fin. These vessels are based in a variety of places but are almost always manned by Butonese fishermen (Wallner and McLoughlin 1995). Many of these boats use Kupang, Timor as a stop off for refuelling and restocking before continuing on south (M. Flannagan pers. comm. 1996)

Based on Australian surveillance and boarding data, Wallner and McLoughlin (1995) estimated that in 1994 there were 160-240 and 80-120 shark fishing trips by Indonesian sailing and motorised vessels respectively. These caught an estimated 570 to 961 t. Although some Australian waters are traditional shark fishing grounds there has been an increase in these activities. Fishermen claim that there is increasing pressure to fish these areas because of overfishing in Indonesian waters (M. Flannagan pers. comm. 1996). This is despite the fact that fishers run the risk of fines and their boat being destroyed. Some *pongawas* reported that they intentionally send older more decrepit boats to fish illegally in Australian waters. A brief stay in an Australian prison, enjoying relative luxuries such as chicken and apples, and a free aeroplane trip home are often not enough to deter the crew.

*3.2.2.3. Dasyatids for flesh and skins.*There appears to be a large target fishery for rays in the Java Sea. Vessels involved in this fishery are based in Muara Angke and Muara Baru, Jakarta. These boats use mostly trawls and fish for 8 to 14 days (P. Last pers. comm. 1996) off the north coast of Java, South Sumatra, Lampung (including the Sunda Strait) and Riau. However these areas are only fished during the dry season from May to October and for the rest of the year the vessels are based in eastern provinces such as Maluku.

Adjacent to Muara Angke there is a large fish drying area of about 10 to 15 hectares. Approximately 30 to 40 % of the product drying there is ray flesh (P. Last pers. comm. 1996). This supports the assertion that large amounts of ray are landed in Jakarta despite the relatively low landings recorded for this province. In 1993, only 182 t of rays were recorded as landed in Jakarta compared to at least 2000 t for the adjacent areas of South

Sumatra, the east coast of Lampung, and the north coasts of West, Central and East Java (see Section 3.1.2, Figure 6).

On a typical voyage of 8 to 14 days during the dry season a single boat catches approximately 8 t of rays (P. Last pers. comm. 1996) These are mainly the white spot ray (*Himantura gerrardi*) and Bleeker's whipray (*H. bleekeri*) but the patchwork whipray (*H. favus*), the reticulate whipray (*H. uarnak*), the leopard whipray (*H. undulata*), the pink whipray (*H. fai*) and the eagle ray (*Aetomylaeus maculata*) are also caught (author's pers. obs. 1996, P. Last pers. comm. 1996). Most individuals landed are 0.8 to 1 m in disk diameter (author's pers. obs. 1996) but can be larger (e.g. Plate 3). Other elasmobranchs are landed at Muara Angke and Muara Baru, including the zebra shark (1 to 2.5 m total length), shark ray (0.7 m TL), white-spotted guitarfish (1.5 m TL), carcharhinids (probably blacktip reef shark or spot tail) (0.4 to 1.5 m TL) and scalloped hammerheads (1.5 to 2 m TL). At least some of these are probably caught while targeting rays.

Similar ray catches have been recorded around South Sulawesi using *jantrang* a 'trawl modification'. Catches of about 50 rays per shot were reported. These are mostly eagle rays which are sold to central Java.

3.2.2.4. Squalids and Hexanchids for squalene and oil

There is evidence of a growing exploitation of some deep sea shark species for liver oil and squalene. Interviewees identified several ports as being bases for such activities, including Pelabuhanratu, Java; Bontang, Kalimantan; Mamuju, South Sulawesi; Fak-Fak, Irian Jaya and the north coast of Seram, Maluku. The company PT Latoka Hiutama in Cilengsi, Bogor processes the livers of deep sea dogfish to extract squalene. Their pamphlet claims that fishermen use demersal longlines in 300-1000m to catch members of the family Squalidae. It is reported that the company pays fishermen at Ujung Genteng, near Pelabuhanratu to catch these species. Mamuju in South Sulawesi is well known by local fishermen for its catch of dogfish. The sea product exporting company PT Mutiara Mas in Ujung Pandang is reported to sell about 1000 drums of liver oil per year (1 drum weighs about 48 kg). It is likely that most of this product comes from the operations at Mamuju.

Suitable species of sharks for the production of oil and squalene exist in waters between about 300 and 1000m (Wibowo and Susanto 1995). All of the above ports are adjacent to such areas (Figure 13). The origin of liver oil exports also corresponds with some of these locations (see Section 4.3, Figure 15). There are reports of similar fishing in waters about 300m deep off Merauke. However such depths of water do not exist in the Indonesian EEZ within at least 800 km of this port.

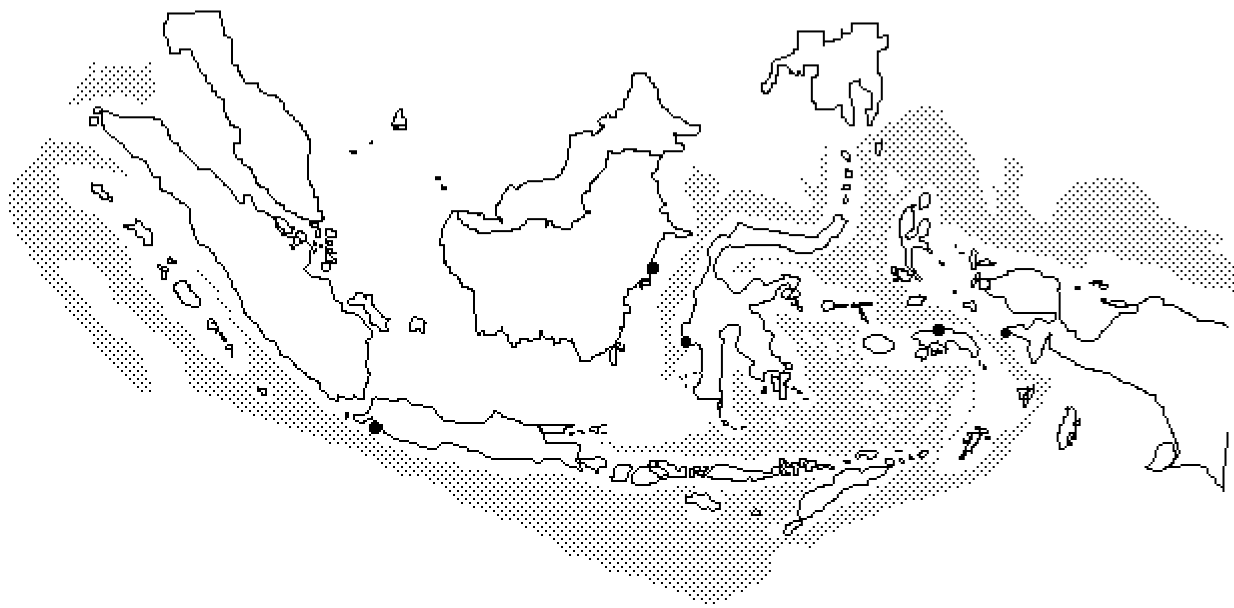

Figure 13. Approximate distribution of waters between 300 and 1000 m within the Indonesian Exclusive Economic Zone.

There is no definitive information on the species which are caught for liver oil extraction. Many interviewees identified members of the Family Hexanchidae as being caught for this purpose[2]. PT Latoka Hiutama claim to use the leafscale gulper shark (*Centrophorus squamosus*) and the greeneye spurdog (*Squalus mitsukurii*). The latter species has large amounts of vitamin A but very little squalene (J. Stevens, pers. com. 1996). Wibowo and Susanto (1995) listed *Centrophorus squamosus*, *Hexanchus spp.*, *Dalatias licha* and *Centrophorus uyato* as species that occurred in Indonesia which may be suitable for the production of squalene. With the exception of *Hexanchus griseus* none of these species have been recorded in Indonesia (Last and Stevens 1994). This confusion is partly a result of the lack of deepwater chondrichthyan research that has been done in Indonesia. Indeed previously undescribed species may be being exploited.

3.3. Foreign3.3.1 Target

3.3.1.1. Taiwanese longlining.

Evidence from Indonesian fishers suggest that there are large numbers of foreign vessels targeting shark in eastern Indonesia. The majority claimed these to be of Taiwanese origin

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[2]Note that the identification guide that was compiled was not comprehensive for deepwater Indonesian elasmobranchs.

although others mentioned that there were also Korean boats. While not all fishers were clear as to where these boats operated they said that they generally fished in deeper offshore waters. The Banda Sea, between East Timor and the island of Seram (Figure 1) was mentioned in particular. All generally agreed that these boats were based in Bitung, North Sulawesi. In May 1995 eighteen Taiwanese longliners were docked here (author's pers. obs. 1995). These were all very similar, around 20m in length and had longlines and radiotransmitter floats (Plate 4). It appeared that most of the crew of these boats were Indonesian but that the captains may have been Taiwanese. One vessel was loading frozen shark carcasses onto a larger Taiwanese mothership (Plate 5). According to its crew it was loading on the catch of all of the smaller boats and then returning to Taiwan. The head and fins of the sharks had been removed but they appeared to be all of the same species of carcharhinid and about 2 to 3 m long. Fins were being unloaded separately. Judging by the shape, size and colour of fins and carcases they were probably blue sharks (*Prionace glauca*). The surface longline gear being used further supports this assertion. The crew and local people said that only sharks were caught and that they were not bycatch from tuna fishing operations.

Export statistics show that almost all the frozen and fresh shark that was exported from Indonesia in 1993 originated from Bitung (see Section 4.3, Figure 15). Furthermore almost all of these products were exported to Taiwan that year (see Section 4.3, Table 5). This is almost certainly the catch that is being loaded onto these Taiwanese motherships. *Fisheries Statistics of Indonesia 1993* list the total shark landings in North Sulawesi as 1860 t. However, according to Indonesian *International Trade (Exports) of Fisheries Commodities 1993*, a total of 9231 t of shark products (8292 t frozen, 938.5 t fresh or chilled, 0.178 t brined fins) were exported from Bitung in 1993. Based on carcass weight alone, these landings are the largest in Indonesia. This fishery probably caught at least 12 900 t[3] live weight of blue shark in 1993. This represents more than 20% of the country's shark catch in that year. Once source suggests that there were about 40 of these vessels fishing in Indonesian waters in 1995 but that there are none at present (G. C-T. Chen, pers. comm., 1996).

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[3]Based on exports of 9231 t of fresh and frozen carcasses and a conversion factor of 1.4. This is a conservative value based on a percentage carcass weight of 70 % and does not account for loss of weight during freezing. Carcass weight has been shown to represent between 41.8 and 67.3 % of total weight for a number of carcharinids (Kreuser and Ahmed 1978).

3.3.1.2. Taiwanese gillnetting

In the early 1970s Taiwanese vessels began fishing in the Arafura Sea for sharks. They used drifting gillnets up to 8 km long to catch species such as the Australian blacktip shark (*Carcharhinus tilstoni*), the spot-tail shark and tunas . During this time average annual catches were about 17000 t processed weight (about 25 000 live weight of which about 78% was sharks, Stevens and Davenport 1991). When the Australian Fishing Zone[4] (AFZ) was declared in 1979 a quota was placed on catches within Australian waters. Continued restrictions forced the vessels to end fishing in the AFZ in 1986. There are reports that at this time most of the fleet switched operations to Indonesian waters in the Arafura Sea. McLoughlin *et al* (1994) reported that 55 Taiwanese gillnetting vessels were licensed to fish in Indonesian waters. While the activities of this fleet were undoubtedly an important component of Indonesia's shark fishery, no evidence of its existence was found during this study.

3.3.2. Bycatch

Foreign vessels also catch elasmobranchs as bycatch during trawling operations. Trawling is only allowed in waters east of 130°E (see Section 5.3). However, in this area there are large numbers of domestic and foreign trawlers (Amir pers. comm. 1996, Wenno pers comm. 1996). In particular, many trawlers have been reported in the shallow waters around the Aru Islands. Discarded fish, including sharks and rays, are often washed up on the beaches of the southeastern islands (Ruhunlela pers. comm. 1996, Adhyakso 1995). Allegedly, foreign vessels sometimes illegally fish within territorial waters (within 12 nm from the coast) during the night and leave prior to dawn.

The larger, mostly foreign vessels, target demersal teleosts. Foreign trawlers use the ports of Bitung, Ambon and Merauke (author’s pers. obs. 1995,1996). In April 1996, twelve large Taiwanese trawlers were at anchor in Ambon Harbour (Plate 6). Three similar sized Thai trawlers were present in Merauke in June 1995. Both of these ports had very large exports of frozen fish (62 757 t and 28 179 t respectively) to Thailand, Korea and Taiwan (see Section 4.3.4). This suggests that foreign trawlers are catching large quantities of fish which are then directly transported back to their home country. Similar export statistics were recorded for other ports (see Section 4.3) suggesting similar activities elsewhere. The proportion of elasmobranch bycatch from these activities is unknown. However the high landings, mean that even a low proportion could represent a significant part of the regions shark and ray catch.

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[4]Now the Australian Exclusive Economic Zone

Prawn trawling, which appears to be done mainly by smaller domestic vessels, could also catch large amounts of sharks and rays. Elasmobranch bycatch has been shown to be significant in similar prawn fisheries operating in nearby northern Australia (Pender *et al* 1992).

4. Trade

4.1. Trade routes

Indonesia has quite different trading systems for various elasmobranch products. This reflects their different values and end markets. Shark fins which are the most valuable product are destined for overseas markets. Some fins are consumed domestically, particularly in Chinese restaurants, but this is likely to be insignificant relative to the large amounts exported. Fins are sold and eventually exported, through networks that span the country. Trade data show that three cities, Jakarta, Surabaya and Ujung Pandang, dominate fin exports (see Section 4.3). Virtually all of the fins caught in the country are funnelled to these cities. Anecdotal evidence suggests that there is a hierarchy of buyers ranging from local villagers up to ethnic Chinese, who dominate the export business. According to one exporter the fin may be bought and sold up to ten times before it is actually exported.

Particularly in the eastern provinces the Bugis, Makassarese and Butonese people dominate fishing activities and probably have their own collection system. Many of these fishers are based in South Sulawesi and return their catch directly to a *pongawa* or exporter in Ujung Pandang. In the main street at Poatere Harbour, Ujung Pandang there are about twenty establishments that deal in shark fins. It is not clear whether these businesses export fins however it seems that a few larger firms fill this role. Estimates from researchers, exporters and *pongawas* suggest that there are 10-15 shark fin exporters in Ujung Pandang.

One exporter claimed to sell at least 1 t of fins each month. Previously he sold more than 2 t per month but catches had since declined. He bought fins from about 20 boats mainly in Sinjai and the Buton islands. He said that most of these fins had come from Australian waters. One pongawa reported that in 1987 there was a firm with a its own boat that it used to ship fins directly to Hong Kong and China but that it has since gone bankrupt.

Exporters in Ujung Pandang have received increasing competition from companies based in Surabaya, Java (Figure 1). While Ujung Pandang receives fins from mainly local fishers, Surabaya gets them from all over the country. For instance, in the Aru Islands there are collectors who buy fins from local fishermen and transport them to Surabaya and nearby

Gresik. Kupang is reportedly also used as a collection point for fins from the Timor Sea and Australian waters. These are then sent to Surabaya. Some fishers from Ujung Pandang also reported selling their fins directly to Surabaya because of the higher prices received there.

One person said he used to work for a Korean company buying shark fins from fishermen in towns on the north coast of Java such as Tuban, Jepara and taking them to Rembang where ethnic Chinese vendors were involved. He also reported that rays from the same areas are taken to the Belimby district of Surabaya.

In many cases the shark carcasses are dumped after their fins have been removed. This appears to be particularly true in more remote areas where there is less demand for the often large amounts of flesh caught. Transport costs to major population centres are often prohibitive and facilities for keeping carcasses fresh usually absent. Shark carcases do appear in markets, although they generally sell for low prices. Higher prices are received for rays which have better quality flesh. In particular whiprays, the blue-spotted maskray, eagle rays and the blue-spotted fantail ray are often seen in local markets.

Another use of rays has been the manufacture of leather goods. The company PT Dian Mandala[5] produces wallets and purses under the brand name *Parri*. These products are made in Yogyakarta although the tanning factory is in Jakarta. Their information lists '*Trygon sephen* and *T. kuhlii'* as species used[6]. However, the pattern of denticles on the leather goods the author inspected was fairly consistent and most resembled that on the cowtail ray. There are large salting and drying facilities that deal primarily with rays close to Muara Angke and most of the ray landed here is processed in this area (P. Last pers. comm 1996). These are probably the source of skins for these leather goods.

4.2. Prices

4.2.1. Fins

The price of fins can vary greatly depending upon the degree of processing, species and size. For instance small blacktip reef shark fins are sold fresh in the Muara Angke market, Jakarta for Rp 4000/kg (US $ 1.80/kg). In contrast, fully processed fins are sold dried and packaged in supermarkets for up to Rp 750 000/kg (US $ 330/kgWibowo and Susanto 1995).

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[5]Jl. Kaliurang Km 7, PO Box 19, Bulaksumur, Yogyakarta. Tel: 0274 880650 Fax: 563423

[6] These are probably the cowtail ray (*Patinachus sephen*) and the blue-spotted maskray (*Dastatis kuhlii*).

Although fin prices are significantly affected by the degree of processing most fins are traded with minimal value adding. During fishing operations the fins are generally cut from the carcass with a straight base which leaves relatively large amounts of flesh at their base. This is not valuable but makes the fins heavier. Fins which have this flesh cut away such that the fin base is lunate have a higher price per kilogram. This appears to be the maximum amount of processing that most fins receive in Indonesia. The relatively low average price of dried fin exports (about Rp 68 000 (US $ 32/kg) in 1993, see Section 4.3), suggests that only a small proportion of exports are further processed. The following discussion is limited to the prices received by fishermen for dried fins with the base cut out.

Size is another major determinant of shark fin price. Prices as low as Rp 15 000/kg (US $ 6/kg) were quoted for the smallest blacktip fins. In contrast some very large fins, suspected to be from a hammerhead shark, were priced at Rp 300 000/kg (US $ 132/kg) (Plate 7). Generally a set of fins from an individual is graded upon the length of the pectoral fins (Table 4). The boundaries for the various grades does differ between traders but the overall trend remains the same. Fins below about 20 cm pectoral fin length are worth far less.

Table 4. Grades and associated prices of dried sharks fins. †: Note these prices are for blacktip reef shark fins.

		Price†	
Grade	Size	Rp	US $
'Super'	>30	175000	77
I	25-30	125000	55
II	20-25	100000	44
III	15-20	65000	29
IV	<15	0	0

Although less significant than processing and size, the species also affects fin price. According to fishers and traders the first and second dorsal fins and the upper lobe of the caudal fin from the white-spotted guitarfish are the most valuable. At around Rp 200 000 to 300 000/kg (US $ 88 to 132/kg) for grade I and 'super' fins, they fetch prices about 1.5 times higher than other species. There are reports of as set of fins from a single shark of this species fetching up to Rp 900 000 (US $ 396/kg).

Although they are less valuable, fins from blacktip reef sharks appear to be a significant part of fin trade. As with most carcharhinid species four fins are taken from this species: 2 pectoral fins, 2 dorsal fins and the lower lobe of the caudal fin. Grade I and 'super' fins from this species are worth about Rp 125 to 175 000 / kg (US $ 55 to 77 / kg).

Wibowo and Susanto (1995) reported that fins from blue, mako, and tiger sharks are also valuable. However, one shark fin dealer quoted a lower price per kilogram for blue shark fins (Rp 100 000 / kg, US $ 44 / kg) than for smaller blacktip fins (Rp 150 000 / kg, US $ 66 / kg). Sawfish (Family Pristidae) fins are also said to be very expensive. Lower prices were reported for hammerhead shark fins Rp 70 000 to 90 000 / kg (US $ 31 to 40 / kg). Fishermen said that although there is a market for fins from the grey carpet shark, zebra shark, thresher sharks and shark ray, they are worth very little. Fins from species such as the nurse shark (*Nebrius ferrugineus*) are worthless (Wibowo and Susanto 1995).

The price of shark fins has varied considerably over the time. During the 1950s, shark fins were brought from fishermen for about Rp 130 / kg. Although there has been massive inflation since this time, this was a low price compared to the standard commodity, rice. Prices continued to increase, however it was only in the early 1980s that it becameworth while to target sharks for fins. There was a rapid increase in shark fin prices during the late 1980s but export prices (see Section 4.3) and reports from fishermen suggest that they have dropped recently. The head of a fishing company based in Ujung Pandang, South Sulawesi claimed that since 1957 his company had been selling shark fins. Since the late 1980s this had been his fleets primary target product. However in 1993 there was a decrease in shark fin prices and it was now more profitable to target live fish for export. Live coral reef fish are worth about Rp 25 000 / kg (US $ 11 / kg) and are exported to elsewhere in Asia for the restaurant market. There are other valuable competing products such as sea cucumbers, trochus and black coral. It has also been suggested that there has been a reduction in the profitability of targeting shark fins because their average size has decreased.

4.2.2. Shark flesh

Shark meat is not considered to be good eating and is probably not a traditional food item in Indonesia. Prices reported ranged from Rp 500 / kg (US $ 0.20 / kg) for salted shark flesh to Rp 3000 / kg (US $ 1.30 / kg) for whole small blacktip reef shark. A fish meal plant in the Aru islands was reported to buy white-spotted guitarfish for 150 Rp / kg (US $ 0.10 / kg) in the late 1980s. However, this activity has since stopped for reasons unknown.

4.2.3. Ray flesh

Ray flesh is considered to be of better eating quality than shark. It is sold in markets for Rp 3000 to 7500 / kg (US $ 1.3 to 3.3 / kg). Large whiprays (*Himantura spp*) sell for around Rp 10 000 to 20 000 (US $ 4.4 to 8.8) per individual. The pink and Jenkins whiprays appear to be most valuable.

4.2.4. Oil

Fishermen reported receiving Rp 23 000 to 29 000 / kg (US $ 10.1 to 12.8 / kg) for shark liver oil in 1996. This is higher than average export prices in 1993 (see Section 4.3) and may reflect an increase in its value.

4.3. Exports

4.3.1. Fins

Dried shark fins have been exported from Indonesia in large quantities for a least the last two decades. By the 1980s exports were over 200 t and rising steadily (Figure 14, Table 5). Despite increased landings of sharks (Figure 2) there was a drop in export volume in 1984 . Exports recovered the following year and continued to rise to a peak of 547 t in 1987. This is equivalent to catches of about 40 000 to 60 000 t[7] live weight. Recorded landings of shark in that year where 36 884 t.

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[7] Rough estimates based on published values for the percentage of total body weight of dry shark fins. These range from 0.9% to 1.4% (Anderson and Ahmed 1993, Compagno 1990) resulting in conversion factors of between 71 to 111. Note that this will vary depending upon a number of factors including species and the extent of drying.

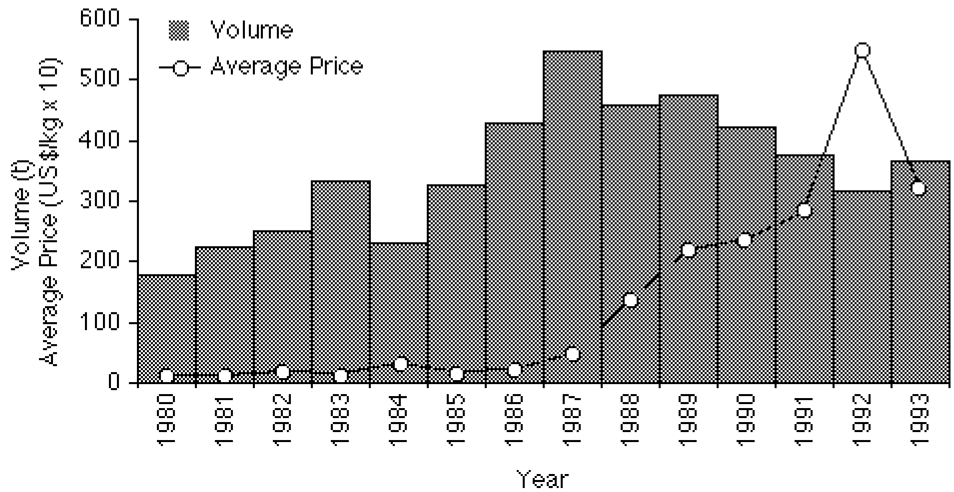

Figure 14. Changes in the volume and average price of dried shark fin exports from Indonesia 1980 to 1993.

Table 5. Total volume and average price of exports of various shark products from 1980 to 1993. -: Data not recorded.

	Frozen		Fresh		Dried		Brined	
Year	Volume (t)	Value (US$/kg)	Volume (t)	Value (US$/kg)	Volume (t)	Value (US$/kg)	Volume (t)	Value (US$/kg)
1980	-	-	-	-	179	1.45	-	-
1981	-	-	-	-	225	1.17	-	-
1982	-	-	-	-	249	2.00	-	-
1983	-	-	-	-	334	1.80	-	-
1984	-	-	-	-	232	3.44	-	-
1985	-	-	-	-	327	2.07	-	-
1986	-	-	-	-	429	2.41	-	-
1987	-	-	-	-	547	4.93	-	-

1988	-	-	-	-	458	13.74	-	-
1989	-	-	-	-	474	22.10	43	13.73
1990	240	0.45	0	-	422	23.60	136	9.07
1991	1438	0.65	0	-	376	28.44	18	47.21
1992	2679	0.80	0	-	316	54.94	148	17.81
1993	8293	0.44	971	1.98	367	32.41	193	11.21

Although prices continued to rise rapidly, the volume of dried fin exports decreased during the late 1980s and early 1990s. This was not directly related to an overall reduction in shark landings (Figure 2). The reduction in dried fin exports may be partly related to an increase in that of brined fins (Table 3). In 1993 brined fin exports were more than half of the weight of dried fins exports. However, the higher density of brined fins means that their weight correponds to lower live weight landings than those for dried fins.

Despite the widespread distribution of shark fisheries there are only a few major export points for fins: Jakarta, Surabaya and Ujung Pandang (Figure 15). Although these places appear to command an unusually high proportion of the trade they are Indonesia's largest cities and are important in the trade of most commodities. This pattern of dominance is not peculiar to shark fins and is very similar in dried fish goods in general (Figure 16).

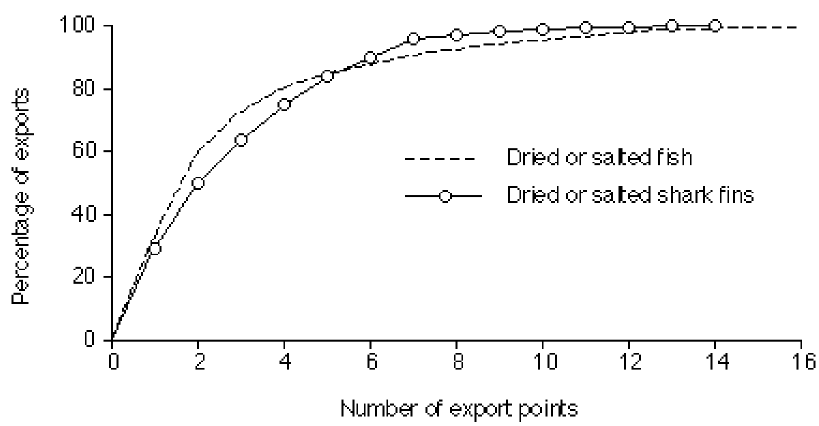

Figure 16. Dominance of dried shark fin export by a few points. This is similar to that for exports of dried or salted fish products in general.

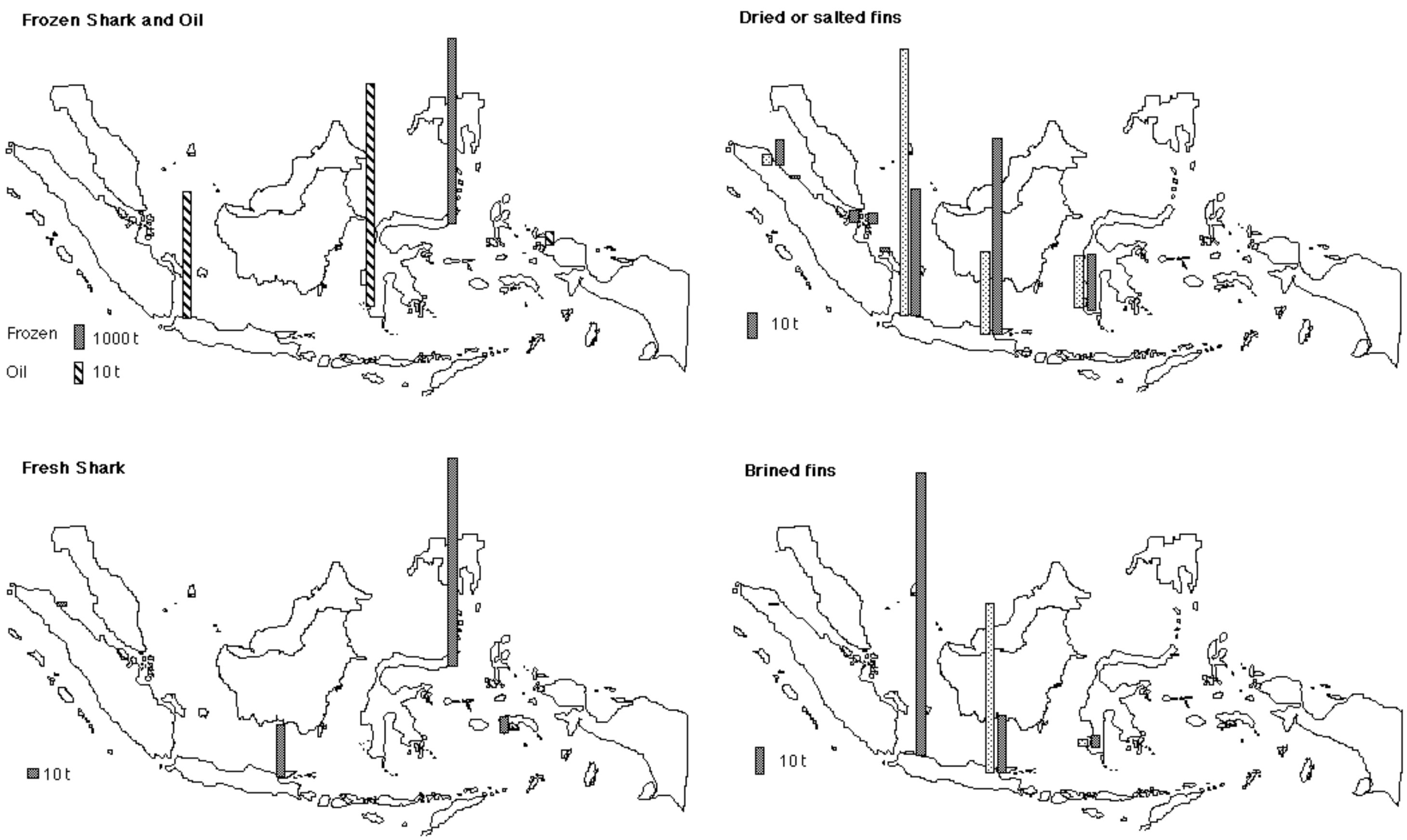

Figure 15. Spatial distribution of exports of various shark products in 1993. Light bars indicate export from an airport, solid bars indicate export from a seaport.

In 1993 most dried fins were exported to Hong Kong and Singapore although a far greater price was obtained for those sent to Japan (Table 6). One fin dealer reported that most fins were currently being sold to Malaysia and Singapore because they were offering higher prices than Hong Kong.

Table 6. Volume and average price of exports of shark products to various countries in 1993.

	Frozen		Fresh		Dried		Brined	
Country	Volume (t)	Value (US$/kg)	Volume (t)	Value (US$/kg)	Volume (t)	Value (US$/kg)	Volume (t)	Value (US$/kg)
Hong Kong	0.00	-	0.00	-	169.97	38.94	31.51	6.51
Singapore	23.30	0.26	1.00	1.65	139.12	23.55	160.21	12.01
Malaysia	0.00	-	0.11	3.00	38.31	4.69	0.00	-
Japan	0.00	-	0.00	-	16.61	105.90	0.40	25.00
Taiwan	945.95	1.99	8292.00	4.40	2.21	13.02	0.13	70.37
Korea	0.00	-	0.00	-	0.21	6.00	0.30	35.00
USA	2.00	15.58	0.00	-	0.00	-	0.00	-

4.3.2. Fresh and frozen flesh

There has also been an increase in the exports of fresh and frozen carcasses (Table 3). In particular there were large amounts of frozen shark carcasses exported in the early 1990s. In 1993 a total of 8293 t of "Frozen fish, Dogfish" was exported, all from Bitung, North Sulawesi (Figure 15). In the same year most "Fish, fresh or chilled, Dogfish" was exported from the same port (Figure 15).

4.3.3. Shark liver oil

A separate classification for shark liver oil is not given in export statistics. However there are categories for "Cod liver oils" and "Other fish liver oils". In 1993 a total of 177 301 kg of "Other fish liver oils" with an average price of US $ 9.31/kg was exported from Indonesia. Most came from Ujung Pandang (Figure 10) and was sent to South Korea (56.5 %), Japan (20.9 %) and the Netherlands (22.6 %). There is potential for shark liver oil to have been misclassified as cod liver oil. In 1993 a total of 150 110 kg of cod liver oil with an average price of US $ 9.3/kg was exported mainly from Surabaya. It was sent to Japan and South Korea.

4.3.4. Other

There were eight Indonesian ports with more than 25 000 t of fisheries exports in 1993. Of these, ports such as Tanjung Priok, Jakarta (total of 39 178 t of fisheries exports); Tanjung Perak, Surabaya (81 377 t) and Belawan, North Sumatra (30 831 t) all have mixed exports of numerous different products.

However, in the other five ports obscure, or poorly defined products dominate exports. Bitung, North Sulawesi (44 144 t) had exports dominated by "Frozen fish, Other flatfishes" (35.9% of all fisheries exports). This represented 89.5 % of Indonesia's exports of this product most of which was sent to Taiwan (59.6 %) and Japan (37.1 %). Tanjung Balai Asahan, North Sumatra (31 655 t) exported 23 754 t (75.0%) of "Fish, fresh or chilled, Other salmon". This represented 85.0 % of Indonesia's exports of this product most of which was sent to Malaysia (89.9 %). Terempa a small town in Riau (62 972 t) exported 62 485 t (99.2 %) of "Fish, fresh or chilled, Other". This accounted for 85.6 % of all exports of this product, most of which was exported to Thailand (85.2 %)

Merauke, Irian Jaya (28 179 t) exported 28 151 t (99.9%) of "Frozen fish, Others". The largest volume of any single product from one port in 1993 was a massive 62 757 t of "Frozen fish, Others" from Ambon, Maluku (76 740 t). Merauke and Ambon accounted for 96.3 % of the exports of "Frozen fish, Others" in 1993. Most of this product was exported to Thailand (45.6 %), Korea (28.5 %) and Taiwan (20.8 %) and represent 17.8 % of Indonesia's total fisheries exports in that year.

These latter five ports are not major trading centres and there is no evidence that they support such large domestic fisheries. This and the dominance of their exports by a single commodity suggests that foreign fishing vessels are catching fish in the area, using these ports as a base and then returning to their home country to unload catch. This supported by the author's personal observations and information from fishers. (See Section 3.3.2 for a discussion of the potential for elasmobranch bycatch from these fisheries).

4.4. Imports

Only very small amounts of shark products are imported into Indonesia. In 1993 only 1307 kg of dried fins and 1830 kg of fins in brine were imported. These were worth an average of US $ 21.57/kg and US $ 21.28/kg respectively. No fresh or frozen shark was imported.

The average price of both dried and brined fin imports varied greatly with the country of origin (Table 7). However many are of higher value than exports of similar products (Table 6). This probably reflects a more highly processed product. Most of the dried fins were imported to Tanjung Perak, the port of Surabaya. However the greatest value of dried fins arrived at the Soekeorno-Hatta Airport, Jakarta where only 194 kg had a value of US $ 21 297. The same differences are seen with brined fins. Although 1500 kg of brined fins arrived at Belawan Harbour, North Sumatra from Sri Lanka it was valued at only US $ 4.02/kg. In contrast 130 kg imported to Soekeorno-Hatta Airport from Batam had an average price of US $ 191.12/kg. (Batam is an Indonesian island which is very close to Singapore and which was declared a free-trade zone in 1989). A complete time series of import data is not currently available but total imports of dried fins were only 3 kg and 650 kg in 1988 and 1990 respectively.

Table 7. Volume and average price of imports of shark products from various countries in 1993.

	Dried		Brined	
Country	Volume (t)	Value (US$/kg)	Volume (t)	Value (US$/kg)
Sri Lanka	0.58	5.40	1.50	4.02
Saudi Arabia	0.53	6.76	0.00	-
Korea	0.00	-	0.20	40.36
Batam	0.07	186.20	0.13	191.12
South America	0.07	127.91	0.00	-
Taiwan	0.07	10.33	0.00	-

5. Management Indonesia is made up of 27 provinces, each with its own government. The national government based in Jakarta provides the overall directives and guidelines for laws and regulations. Implementation of these is then usually the responsibility of the provincial governments. In addition the provincial governments may implement new or more stringent and specific regulations relevant to their region. Due to the short time frame of this study it was impossible to determine the fisheries management policies of each provinces. However, Lang (1992) reviewed national regulations pertaining to the marine environment and most of the following is drawn from that work. It should be noted that relevant provincial regulations may exist but are not covered here due to the limited scope.

Article 33 of the 1945 Constitution stipulates that the earth and water and the natural wealth conceived thereunder should be governed by the State and should be used for the people's utmost welfare. To this end *Indonesian Law No.9, 1985 re Fisheries* was enacted to optimise the development and management of fisheries. To implement this law the Minister of Agriculture has the authority to stipulate, among others, which fish catching devices are allowed, a total allowable catch, and size limits. The Department of Agriculture's Directorate General of Fisheries is responsible for the management of all Indonesian fisheries

At the next legislative level, *Government Regulation No.15, 1984 re Management of Living Natural Resources within the Indonesian Exclusive Economic Zone* gives the Minister of Agriculture the authority to stipulate the Total Allowable Catch (TAC) in the EEZ. This is based upon the research done by a number of sub-departments within the Directorate General of Fisheries. It appears that TACs are calculated for broad fisheries definitions, for example Pelagic, Tuna, Skipjack and Demersal fishes, rather than individual species. TACs are mainly used for determining whether foreign interests should be allowed to fish a resource and are not directly enforced by means such as a quota system.

5.1. Domestic fishing activities

Domestic fishing activities are managed through input controls which are enacted through *Government Regulation No. 15, 1990 re Fishery Business* . This requires all commercial fishing entities to have a fishing business licence (IUP) which specifies, the area fished, the number and size of fishing vessels and the type of equipment used. Each vessel must posses a fish catching permit (SIP). The Minister of Agriculture authorises the granting of IUP and SIPs to larger firms. Provincial governors or appointed officials have the authority to grant IUPs and SIPs to companies without foreign capital investment or personnel, and who have vessels of less than 90 horsepower. Holders of IUPs are required to submit business activity reports every six months. Each year the grantor of the permit reviews the stipulations of the IUP. This allows for regular adjustments of regulations dependent upon reviews of the status of the fishery. IUPs can be revoked if biannual reports are not submitted or if its stipulations have not been adhered to.

5.2. Foreign fishing activities

The TAC estimate made by the Director General of Fisheries is used in the granting of foreign fishing access. In accordance with the United Nations Convention on the Law of the Sea (UNCLOS) if the TAC is not being fully utilised by Indonesian fishing companies then foreign vessels, in cooperation with an Indonesian company holding an IUP, are permitted to fish within the EEZ. The local companies require an Approval for the Utilisation of Foreign vessels (PPKA) and an international fish catching licence (SIPI) for each foreign vessel used. The fishing area, size of vessel and allowable equipment are specified in these permits. The PPKA is valid for three years. Renewals of SIPI are reviewed each year depending upon the ability of Indonesian vessels to utilise the TAC. Only the Minister of Agriculture is authorised to grant PPKAs and SIPIs. Under *Decree of the Minister of Agriculture No. 417/Kpts/IK250/6/1988 re Control of the Utilisation of the Fishery Resources in the Indonesian Exclusive Economic Zone* no new licences will be issued to foreign vessels which use gill nets, purse seines and dragnets.

5.3. All fishing activities

Presidential Decree No. 39, re Abolishing Trawl Nets was enacted to encourage the further development of traditional small scale fisheries and reduce conflict with trawl vessels. Regulations were introduced to ban trawling from Java, Bali and Sumatra by January, 1981 and from the whole of Indonesian territory by January, 1983. However, *Presidential Decree No.85, 1982 re Utilisation of Shrimp Dragnets*, allows the use of "shrimp dragnets" in waters greater than 10 meters deep around the Kei, Tanimbar and Aru Islands, Irian Jaya and the Arafura Sea east of Longitude 130°E. This has been seen by some as a *de facto* approval for trawl fishing in these sparsely populated areas. 'Since there is virtually no control, the obliged by-catch excluding devices are never used, which makes the "shrimp net" an euphemistic name for an ordinary bottom trawl' (Hitipeuw et al 1994). *Decree of the Minister of Agriculture No. 769/Kpts/HK 210/0/1988 re Use of Bottom Lampara Nets* allows for bottom lampara nets to be used east of 130°E. This legislation further supports the use of trawl analogues in the area.

The ‘Sentani shark’ (*Pristis spp*) is protected under *Decree of the Mister of Agriculture No. 716/Kpts/Um/10/1980 re Determination of several Types of Wild Animals to be Protected.* This sawfish is said to only occur in Lake Sentani, Irian Jaya and is the only easmobranch species currently protected in Indonesia. Dugongs (*Dugong dugong*) and dolphins are protected under similar decrees.

5.4. Problems

The guidelines issued by the national government are mostly well aligned towards the aim of the continued sustainability of fisheries. However, there are severe short comings in the system. While the flexibility of the current approach allows for the application of more appropriate regulations in each province, it may have resulted in a lack of coordination and vague implementation. Although fishing licences provide a uniform basis for restricting effort through input controls, there is no evidence that they serve this purpose since there does not appear to be any system for setting limits to the number of IUPs or SIPs issued. This means that the number of fishing vessels can continue to increase. The vague specification of limits on the IUPs also allows for increases in the fishing power of each vessel. For example the IUP in Appendix 2 was issued by the Fisheries Department office in Southeast Maluku to a fishing company in Dobo. It specifies that the company is allowed to use a single Indonesian fishing boat to fish for sharks in the waters around the Aru Islands using a maximum of 25 longlines. It does not place any limits on the size of the boat or the length or number of hooks on the longline and is thus ineffective in restricting the fishing power of the company.

There also appears to be major deficiencies in the enforcement of management regulations. Although fisheries, police and naval officers have the authority to enforce laws and regulations within the EEZ they are limited in their resources. The large numbers of fishers makes it hard to prevent even the most blatant crimes. Although banned, dynamite fishing continues to be widespread and protected species such as the Napoleon wrasse (*Cheilinus undulatus*) appear in markets. In comparison regulations such as the type of gear and number of boats used are far harder to enforce. For example, a number of sources claimed that companies were operating greater numbers of foreign fishing vessels than allowed, by simply forging SIPIs. Although these boats are not allowed to fish within territorial waters (within 12 nm of the coast), there are claims that they often break this rule. There are also claims of official corruption and protection in association with fishing activities. However, the present inadequacy of the regulatory and enforcement framework with respect to chondrichthyan fisheries, probably makes corruption unnecessary for the continued expansion of effort.

6. Conclusions and Recommendations

Indonesia's elasmobranch catch is the largest in the world. In 1993, recorded landings totalled 87 138 t. However there are indications that landings data underestimate the live weight catches of shark and rays. For instance, independent research has shown that the large fishery targeting white-spotted guitarfish off the Aru Islands catches large amounts of rays, most of which are probably dead when discarded. It also appears that, for at least some of the time it has been operating, landings for the same fishery have been recorded as fin weight only (see Section 3.2.2.1). Since most shark is caught only for its fins such under recording may be widespread. Export data for dried shark fins and carcases also suggests that more sharks are caught than are recorded in landings (see Sections 4.3.1 and 3.3.1.1). Given this apparent underreporting the actual catch could be well over 100 000 t

Despite being very high, the total elasmobranch catch has continued to increase. However, this overall pattern masks significant changes that are occurring at a smaller scales within the country. Trends in landings in each province suggest, that while Indonesia's total shark catch continues to increase, most regions are fully or overexploited. In many of the provinces where shark landings had historically been high, there was a levelling or decline in catches. The rapid development of shark fisheries in the central and western provinces during the early 1980s was followed by stable or decreased catches (see Section 3.1). Anecdotal evidence also suggests overfishing has occurred in some areas. Fishers report a decline in both catch rates and the average size of sharks. At least some traditional fishing grounds have been overexploited and fishers are having to go further afield to maintain viable catch rates.

Changes in the distribution of catch support the inference that overexploitation has occurred in some areas. Only in those areas where landings have been historically low have there been significant increases in catch since the late 1980s. The eastern provinces such as Maluku, North Sulawesi and Irian Jaya, sustained much of the increase in overall shark catch during the late 1980s and early 1990s (see Section 3.1.1). These increases were not in proportional to humanpopulation increases in the area. Fishers generally undertake long and expensive trips to fish in such areas and would not do so if there was potential for greater catches in their home grounds. Increased shark fishing effort in Australian waters also suggests that Indonesian waters are at least fully exploited (see Section 3.2.2.2).

Export data also suggest an inability of Indonesian fisheries to meet an increased demand for shark fins. Although, export prices have risen rapidly there has been a decrease in the quantity exported (see Section 4.3.1).

Most of the shark catch results from the targeting of fins. Carcasses are usually dumped, particularly in the more remote fishing grounds. No use is made of the large amounts of flesh landed. The dumping of such large quantities of a food cannot be considered 'optimal utilisation of a natural resource for the benefit of the people' as stipulated under Article 33 of the Indonesian Constitution. Such activities could be deemed unconstitutional regardless of their sustainability.

Despite apparent problems with shark fishing activities in Indonesia, current management appears ineffective at restricting catches. Due to a lack of resources and the large amount of fishing activities, enforcement agencies appear to have limited regulatory effect. Further input controls are unlikely to have a significant effect on restricting the shark catch (see Section 5.4).

The shark fishery in Indonesia is primarily driven by the export market for fins. Restricting exports of fins could act as *de facto* output control. If quotas on the amount of exports were set properly, they could reduce the targeting of sharks specifically for fins, but still allow fishermen to sell the fins of sharks they catch incidentally.

Recommendation 1. That the Indonesian government introduce a quota on the quantity of shark fins that can be exported each year.

Such a control may be circumvented through smuggling, an activity which is reported to be quite common in Indonesia. For example, boats from Singapore are reported to enter Indonesian waters and barter alcohol and electronic goods for fish. Corruption may also allow for the circumvention of such a quota. These factors may necessitate a more general worldwide restriction on the trade in shark fins.

Patterns in the catches of rays are less pronounced than those for sharks. However, as with shark catches, provinces which have had historically high landings of rays have experienced decreases at some time. Nonetheless, in most provinces, landings rose during the 1980s. There has not been such a dramatic shift in the distribution of ray catches and there is less evidence of overexploitation. However, landings in most provinces stabilised during the early 1990s (see Section 3.1.2). The continuation of high catches in the Java Sea are of particular concern. Such intense fishing pressure on species with low reproductive and growth rates could result in localised stock depletions.

Recommendation 2. That via specifications on fishing business licences (IUPs), the number of vessels using trawls (or analogues thereof) to catch rays in the Java Sea be restricted to current levels, until the sustainable catch is determined and appropriate management measures implemented.

There is also cause for concern over the recent increase in the exploitation of deep sea sharks for liver oil and squalene. As with shark fins, these commodities have the potential to provide valuable export earnings. Utilisation of deep sea resources could also reduce fishing pressure on shallow water habitats. However, the generally slow growth of these deepwater elasmobranch species means that careful attention needs to be paid to such fisheries. Indonesia has a large fishing fleet and with the potential decline of other fisheries there could be a dramatic shift in effort towards this valuable resource. Indonesia does not currently appear to have the necessary research and enforcement capabilities to ensure proper management of this resource should such a shift occur. As with fins the most appropriate controls on such effort may be the imposition of trade restrictions.

Recommendation 3. That the Indonesian government restrict the trade in shark liver oil and squalene to current levels, until the sustainable catch is determined and appropriate management measures implemented.

It is apparent that foreign vessels are taking large amounts of sharks in target longline operations (see Section 3.1.1.1). These are probably blue sharks, a species which, although more productive than many other elasmobranchs, is experiencing high fishing pressure around the world. Although sustainable levels of catch are not known, landings in Indonesian waters should be monitored carefully.

Foreign trawling operations are also catching significant amounts of demersal fish. Export data suggest than more than 190 000 t was caught by such vessels in 1993 (see Section 4.3.4). This is a massive catch, equivalent to at least of 6 % of Indonesia's total recorded marine fisheries landings in that year. The elasmobranch bycatch of such operations whether kept or discarded is likely to be significant. Demersal trawling has been shown to have a detrimental effect on tropical seabed communities elsewhere (e.g. North West Shelf Australia, Sainsbury 1987). This could be indirectly affecting elasmobranch populations.

Foreign fleets are taking large catches in Indonesian waters. Their technological sophistication makes them more efficient and fundamentally different from much of the domestic fishing fleet. More attention needs to be paid to these activities to ensure that any present monetary gains they generate, are not at the expense of the continued sustainability of fisheries.

Recommendation 4. That the Indonesian government review the processes for the granting of Approvals for the Utilisation of Foreign Vessels (PPKAs) to ensure that they do not result in the overexploitation of elasmobranch, and other fish stocks.

A knowledge of each stock's population dynamics is a fundamental requirement for effective management of fisheries resources. Unfortunately, data is lacking with respect to elasmobranch fisheries in Indonesia. For many of the species caught, even their taxonomy is unclear. More research on elasmobranch stocks is a primary need for reaching the constitutional goal of their optimal utilisation.

Recommendation 5. That more research be done on the taxonomy, stock structure and population dynamics of Indonesian elasmobranchs.

Inferences made during this report concerning the sustainability of elasmobranch fisheries in Indonesia are based upon a simple examination of fisheries catch and export data, anecdotal evidence and generalisations about elasmobranch population dynamics. A thorough assessment of sustainable catch levels requires expensive and time consuming research into population dynamics. However, the Indonesian statistics available provide a detailed means of quantifying changes in the elasmobranch fishery. This presents a quicker and cheaper means of assessing its sustainability. For example, an analysis of the elasticity in the price of exports could aid in determination of whether supply or demand has restricted export quantities. More detailed statistics available at the provincial level allows the calculation of more interpretable catch rates.

Recommendation 6. That there be a more formal and rigorous statistical analysis of catch and export statistics be undertaken to more formally asses the sustainability of Indonesia's elasmobranch fisheries.

For a developing country fisheries statistics provide an important tool for fisheries management. Unfortunately, research suggests that there were inaccuracies in the Indonesian data collection program. It is not clear whether such problems still exist, however the importance of these data warrants further attention to their accuracy. Dudley and Harris (1987) claimed that improvements could be made simply by better training of field staff.

Recommendation 7: That the system of fisheries statistics collection in Indonesia be reviewed and action taken to improve it's accuracy and precision.

One deficiency of the current statistics collection system is its lack of detail in the specification of some species groups. 'Sharks' and 'rays' are the only statistical category used which include more than one family. Most families of elasmobranch are readily distinguished. Indeed many species which appear to dominate the shark and ray catch are distinctive. These include the white-spotted guitarfish, shark ray, zebra shark, blue-spotted maskray, blue-spotted fantail ray, leopard whipray and reticulate whipray. The hardest group to separate are the carcharhinids. However species such as the tiger shark and blue shark are easily identifiable and the remainder could be divided into separate groups based upon simple characters such as fin colour. Any reclassification could be readily implemented through appropriate staff training.

Recommendation 8: That fisheries statistics be collected for elasmobranchs at more specific taxonomic levels.

There is increasing fishing pressure on coral reef and coastal habitats in Indonesia. Many of these areas have already been severely denuded of a variety of species. The overfishing of elasmobranchs is only part of the general overexploitation of these marine environments. However in some respects, it represent the worst case of this. The fishing of sharks for fins, like that for trochus, sea cucumbers, and live fish, is driven, not for the provision of food for local inhabitants but by luxury overseas markets. These products fetch high prices but much of the profit goes to traders rather than fishermen. Fishing communities still derive benefit from the activity, but to the potential detriment of future food supplies. The high price of fins, means that shark fishing remains economically viable despite low catch rates. The peculiar population dynamics of sharks mean that they are vulnerable to overfishing and that stocks may take generations to recover. The wastage of more than 90% of the catch when carcasses are dumped represents a gross inefficiency in the use of a vulnerable resource. The effects on the whole marine ecosystem of removing large numbers of these apex predators are unpredictable but could potentially be drastic. Unfortunately it appears that much damage has already been done to elasmobranch stocks.

7. References

Adhyakso, L.L. (1995). *Report reviewing conservation in the Aru Tengarra Marine Strict Nature Reserve*. World Wide Fund For Nature Indonesia Programme, Jakarta.

Anderson, R.C. and Ahmed, H. (1993). The shark fisheries of the Maldives: A review. Ministry of Fisheries and Agriculture, Male and FAO, Rome. 73 pp.

Amir, F. (1988). *Suatu studi tentang pengoperasian shark set bottom gill net di perairan Kepulauan Aru, Maluku.* Unpublished thesis, Fisheries Department, Hasanuddin University, Ujung Pandang.

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. Part 1-Hexanchiformes to Lamniformes: vii, 1-250. Part 2-Carchariniformes: x, 251-655. *FAO Fisheries Synopsis* 125: 1-655.

Compagno, L.J.V. (1990). Shark exploitation and conservation. In *Elasmobranchs as Living Resorces: Advances in the Biology, Ecology, Systematics, and the Status of the Fisheries* (H.L. Pratt Jr., S.H. Gruber and T. Taiuchi, eds.). NOAA Technical Report 90: 391-415

Dudley, R.G. and Harris, K.C. (1987). The fisheries statistics system of Java, Indonesia: operational realities in a developing country. *Aqualculture and Fisheries Management* 18: 365-374.

Gloerfelt-Tarp, T. and Kailola, P.J. (1984). *Trawled fishes of southern Indonesia and northwestern Australia*. Australian Development Assistance Bureau; Directorate General of Fisheries, Indonesia; German Agency for Technical Cooperation, 406 pp.

Hitipeuw, C., Lefmanut, J., Raymakers, C., Ruhunlela, V.S., Putra, K.S. and van der Wal, M. (1994). *Awareness and education programme for a community based management of the marine resources in South-East Aru Strict Nature Reserve*. Universitas Pattimura, Ambon.

Hoenig, J.M. and Gruber, S.H. (1990). Life-history patterns in elasmobranchs: implications for fisheries management. In *Elasmobranchs as Living Resorces: Advances in the Biology, Ecology, Systematics, and the Status of the Fisheries* (H.L. Pratt Jr., S.H. Gruber and T. Taiuchi, eds.). NOAA Technical Report 90: 1-16

Kreuzer, R. and Ahmed, R. (1978). Shark utilisation and marketing. FAO Rome, 186 pp.

Lang, S.E. (1992). *Rules and reguations in the Republic of Indonesia regarding the impact of tourism, fisheries and marine pollution on the marine environment*. A report for the World Wide Fund for Nature Indonesian Programme (WWF/IP) in cooperation with the Department of Forestry; Directorate General of Forest Protection and Nature Conservation. Vol. 1. 65 pp

Last, P.R. and Stevens, J.D. (1994). *Sharks and rays of Australia*. CSIRO Australia. 513 pp.

Mappeati, Y. (1991). *Studi tentang penangkapan ikan cuct dengan bottom bottom gill net di perairan Selat Sunda*. Unpublished thesis, Fisheries Department, Hasanuddin University, Ujung Pandang.

McLoughlin, K., Slack-Smith, R. and Stevens, J. (1995). Northern Shark, pp. 31-36. In *Fisheries Status Reports 1993-Resource Assesments of Australian Commonwealth Fisheries* (McLoughlin, Staples, D. and Maliel, M eds.). Bureau of Resource Sciences, Canberra.

Muller, K. (1990). *Irian Jaya: Indonesian New Guinea*. Periplus Editions (HK) Ltd., Singapore.

Pender, P.J., Willing, R.S. and Ramm, D.C. (1992). *Northern prawn fishery bycatch study: Distribution, abundance, size and use of bycatch from the mixed species fishery*. Final Report to the Advisory Committee, Northern Territory Fishing Industry Research and Development Trust Account. Northern Territory Department of Primary Industry and Fisheries, Fishery Report 26, 70 pp.

Pratt, H.L. and Casey, J.G. (1990). Shark reproductive strategies as a limiting factor in directed fisheries, with a review of Holden's method of estimating growth-parameters.. In *Elasmobranchs as Living Resorces: Advances in the Biology, Ecology, Systematics, and the Status* *of the Fisheries* (H.L. Pratt Jr., S.H. Gruber and T. Taiuchi, eds.). NOAA Technical Report 90: 97-109

Sainsbury, K.J. (1987). Assesment and management of the demersal fishery on the continental shelf of northwestern Australia. pp 46-503, in *Tropical snappers and groupers. Biology and fisheries management* (J.J. Polovina and Ralston, S., eds.). Westview Press, Boulder and London.

Stevens, J.D. and Davenport, S. (1991). Analysis of catch data from the Taiwanese gillnet fishery off northern Australia 1979 - 1986. *CSIRO Marine Laboratories Report* 213, 51 pp.

Wallner, B. and McLoughlin, K. (1995). Indonesian fishing in northern Australia, pp. 115-121. In *Fisheries Status Reports 1994-Resource Assesments of Australian Commonwealth Fisheries* (McLoughlin, K., Wallner, B. and Staples, D., eds.). Bureau of Resource Sciences, Canberra.

Wibowo, S. and Susanto, H. (1995). *Sumber daya dan pemanfaatan hiu*. Penebar Swadaya, Jakarta. 156pp