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Part 2: Conference poster papers and workshop papers

Queenstown, New Zealand, 1–5 December 2003
Dunedin, New Zealand, 27–29 November 2003

Cover photo:
Stern view of the fishing trawler *Austral Leader* (owned by Austral Fisheries Pty Ltd, Perth) that was built in 1967 in Bordeaux, France. This photo was taken near Heard Island, Australia, in 1997.
Courtesy of Captain Geiri Petursson.

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Preliminary investigation of artisanal deep-sea chondrichthyan fisheries in Eastern Indonesia

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1. INTRODUCTION

Indonesia has one of the richest elasmobranch faunas and the largest chondrichthyan fishery in the world, with an estimated 87 138 t and 100 000 t landed in 1993 and 1996, respectively (Bonfil 1994, Monintja and Poernomo 2000, Widodo 2000). However, there are few data on the species or size composition of these landings. The only information available on the catches of individual species is that provided by pelagic tuna fishers, who estimated that in 1999 they landed 5 217 tonnes of mako sharks (*Isurus paucus* and *I. oxyrinchus*) and 47 079 tonnes of other species (Priyono 2000). The high diversity of the elasmobranch fauna in Indonesia has been well documented by Gloerfelt-Tarp and Kailola (1984), Last and Stevens (1994) and Carpenter and Niem (1998, 1999). These authors highlighted the need for research in certain areas and in particular the acquisition of sound taxonomic data so that the various species could be readily identified and reliable data could be obtained for the geographical distribution and biology of many of the species.

All of the body parts of landed elasmobranchs are used. The flesh, which is often dried, is used for local consumption whereas the fins are dried and exported to other Asian countries where they are highly valued (Chen 1996). Squalene oil from the livers of some shark species (mainly squaloids) is also commonly exported with several companies in Indonesia exporting as much as 48 000 kg of liver oil annually (Chen 1996). Other exported shark products include the dried cartilage of larger individuals and there is a growing demand for specialist products at particular locations, such as the gill rakers of mobulid rays. The flesh of shark and rays are typically salted and dried and used for human consumption within Indonesia or exported.

The first detailed assessment of the compositions and relative abundances of species of chondrichthyans in the target and non-target fisheries of eastern Indonesia was conducted between April 2001 and December 2003. This project, which was funded by the Australian Centre for International Agricultural Research (ACIAR), involved staff at Murdoch University and the CSIRO Marine Research laboratories in Australia and the Indonesian Institute of Sciences (LIPI) and Research Institute of Marine Fisheries (RIMF) in Indonesia.

2. METHODS

A total of nine survey trips were undertaken between April 2001 and February 2003 in eastern Indonesia. Ten sites were surveyed on at least one occasion and six sites were surveyed on more than one occasion on most trips (Figure 1). The catches of deep-sea chondrichthyan fisheries were observed at four landing sites, i.e. Palabuhanratu (West Java), Cilacap (Central Java), Kedonganan (Bali) and Tanjung Luar (Lombok).

FIGURE 1
Distribution of survey sites in Indonesia

The initial focus was on determining which chondrichthyan species were present in the landings present on that day. The species were identified using the keys and, or, illustrations in Carpenter and Niem (1998, 1999), Compagno (1984) and Last and Stevens (1994). However, when a species was not recorded in the above keys, it was assigned to its appropriate genus and provided with an appropriate temporary name. Whenever possible, those species that could not be accurately identified using the above references were purchased and stored in plastic holding tanks containing 10 percent formalin for subsequent identification. Information on the gear characteristics and the duration and location of each fishing trip was also collected.

3. RESULTS

Summary of results of overall survey data

A total of 19 573 individual chondrichthyan were recorded throughout the project, representing 139 chondrichthyan species, of which 78 were sharks belonging to 16 families, 60 were rays belonging to 11 families and one species of chimaera. As many as 20 of these species appear to be undescribed. A reference collection of approximately 540 specimens representing 106 of the 139 species recorded was established during the project and these are currently stored in Jakarta, Indonesia or Hobart, Australia.

Target chondrichthyan fisheries, which are mainly artisanal, use a variety of fishing methods, such as gillnets, trammel nets, purse seines, longlines and droplines. The fisheries that land substantial catches of elasmobranchs as a bycatch include the prawn and fish fishery exploited by commercial trawlers and pelagic tuna fisheries. Deep-sea longlining for chondrichthyans primarily targets squaloids.

Deepwater longlining for squaloids

The length of the lines used in this fishery vary among the four sites with fishers at Kedonganan using short lines (~200 m in length) and those at Tanjung Luar using much longer lines (~5000 m in length). The longlines are set in depths of 150 to 600 m, with the majority of fishing occurring in depths of less than 300 m. No fishing occurring in depths greater than 600 m. The duration of the fishing trips also varies, with boats in Palabuhanratu spending only one or two days at sea while those in Tanjung Luar spend 7-14 days at sea. The number of boats involved in this fishery is low, i.e. two or three at Kedonganan and Palabuhanratu and about 5-10 in Tanjung Luar and Cilacap. These boats are all less than 15 m in length and usually have poor, if any, depth-sounding equipment (Figure 2).

FIGURE 2
Typical fishing boats at the landing site and market of Kedonganan, Jimbaran Bay in the south of Bali

The fishery for squaloids appears to be highly seasonal, peaking in January to March at Kedonganan and in March to July at the other three sites. At both Cilacap and Tanjung Luar, there is significantly less fishing effort in the off season while in Palabuhanratu and Kedonganan, there is similar fishing effort all year round.

Deepwater chondricthyan species composition

A total of 717 individual deepwater chondrichthyans were recorded, which represents only about 3.8 percent of all chondrichthyans observed during the project. A total of 22 species were recorded, consisting of 19 shark species representing six families, two ray species representing two families and a single chimaera species (see Table 1). The Squalidae and Centrophoridae were the most speciose and abundant families in the catches. The most abundant species by far was *Squalus* sp. 3 (short snout, v-shaped D2), which comprised ~51 percent of the total number of deepwater chondrichthyans recorded. The next most abundant species were *Centrophorus* cf *acus* (11 percent), *Hydrolagus* sp. 1 (9 percent) and *Squalus* sp. 1 (8 percent) (Figure 3).

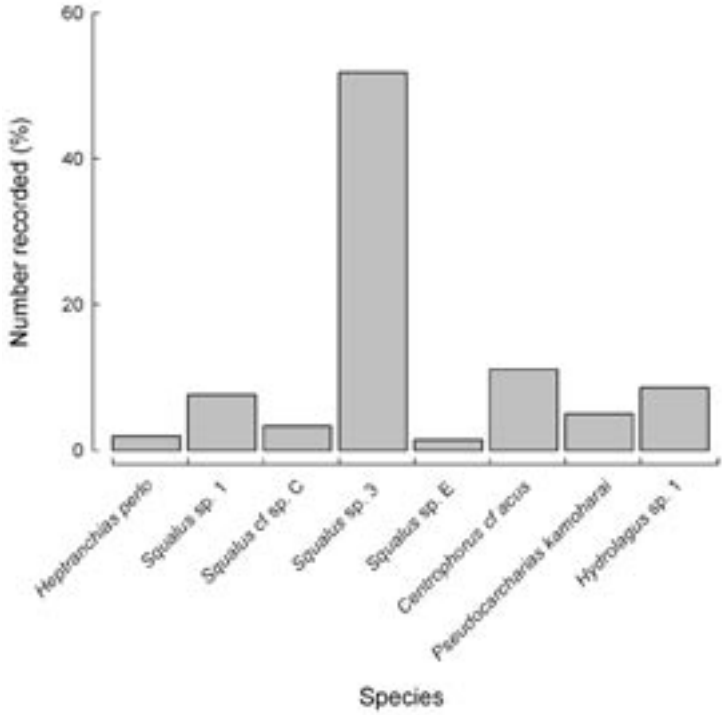
TABLE 1
Numbers and minimum and maximum sizes of all chondrichthyans recorded in the catches of the artisanal deep-sea longline fishery in eastern Indonesia between April 2001 and February 2003

Size refers to total length unless otherwise noted as disc width, i.e. DW.

Family	Species	Number recorded	*Minimum size* (mm)	*Maximum size* (mm)
Hexanchidae	*Heptranchias perlo*	14	750	980
	Hexanchus griseus	7	2190	3750
	Hexanchus nakamurai	2	950	1070
Squalidae	*Cirrhigaleus barbife*	2	800	995
	Squalus sp. 1	56	450	945

	Squalus sp. 3	373	420	780
	Squalus cf sp. C [Last & Stevens, 1994]	24	520	870
	Squalus sp. E [Last & Stevens, 1994]	10	460	600
Centrophoridae	*Centrophorus* cf *acus*	80	540	1640
	Centrophorus cf *atromarginatus*	7	600	802
	Centrophorus cf *lusitanicus*	5	840	930
	Centrophorus cf *moluccensis*	8	540	1070
	Centrophorus sp. (brown, longnose)	4	970	1010
	Centrophorus sp. (big eye)	7	600	750
	Centrophorus sp. 1 (longnose)	4	520	850
Pseudocarchariidae	*Pseudocarcharias kamoharai*	36	514	1060
Scyliorhinidae	*Cephaloscyllium* sp. E [FAO, WCP]	4	605	670
	Parmaturus cf *melanobranchias*	photo only	-	-
Triakidae	*Iago garricki*	1	650	650
Rajidae	*Dipturus* cf sp. I [Last & Stevens, 1994]	4	770 DW	1190 DW
Plesiobatidae	*Plesiobatis daviesi*	7	287 DW	1170 DW
Chimaeridae	*Hydrolagus* sp. 1	62	530	880

FIGURE 3
Frequency distribution of species recorded



Taxonomic related issues

One or more variants of a number of species, e.g. *Centrophorus* and *Squalus*, need to be examined in more detail in order to obtain more accurate species composition data. A number of species also appear to be undescribed, but these need to be compared with other closely-related species to confirm if they are undescribed. This work highlights the need to obtain accurate species composition data for a region. For example, *Centrophorus squamosus* is thought to be widely distributed, but closer examination of material identified as this species from Indonesia and Australia indicates that a species complex most likely exists for this species.

Preliminary reproductive data from squaloids

A single pregnant female each of *Centrophorus* sp. brown, longnose, *Centrophorus* cf *atromarginatus* and *Centrophorus* cf *moluccensis* were collected in March 2002. Each possessed only two embryos. The embryos in the former species were early term (~86 mm TL), while those in the latter two species were mid-late term embryos (170–210 mm TL). In contrast, several pregnant females of *Squalus* sp. 3 collected in

July 2001 contained 6–8 mid-late term embryos (~150 mm TL).

Processing of deepwater sharks

The most sought after produce of deepwater sharks is the valuable squalene oil of their livers and mainly derived from squalids and centrophorids. The livers are usually removed immediately on landing the shark (Figure 4) and are either dried or cooked to obtain the oil. This oil is bottled and exported or distributed within Indonesia depending on its quality. The fins are dried but are only considered of moderate quality in comparison to other shark fins, e.g. those from carcharhinids. The flesh of larger sharks is sliced into manageable pieces and salted in tanks after which it is dried on bamboo racks before distribution (Figure 5). Smaller sharks are typically sliced in half dorsolaterally, salted and then dried in a "butterfly" manner (Figure 6). The flesh from the large *Hexanchus griseus* is highly regarded and fetches a much higher price than that of other deepwater chondrichthyans. The vertebral columns of the larger squaloids are also dried and are typically exported either whole or powdered for there supposed medicinal properties. At Palabuhanratu, the enlarged yolked ova from *Centrophorus* species are considered a delicacy and are removed immediately upon landing (Figure 7).

FIGURE 4
Large *Centrophorus* cf *acus* with livers being excised immediately upon landing at Palabuhanratu in West Java

Figure 5
Drying of shark flesh on racks

Figure 6
Dried shark showing cut used to open body

4. FUTURE CONSIDERATIONS

Although waters greater than 600 m in depth are not currently exploited by deep-sea fishers, this is unlikely to be the case for much longer. Moreover, in the future, new fishing methods

Figure 7
Yolked ova of *Centrophorus* is a delicacy in Indonesia

(e.g. trawling) may be adopted, especially if foreign fishing vessels are allowed access to Indonesian waters, which have the potential to rapidly deplete the vulnerable deepwater chondrich-thyan fauna. Future expansion of this fishery in Indonesia is highly likely and protocols for managing such an expansion need to be developed in the near future. These management strategies need to be included into the National Plan of Action for sharks in Indonesia with the aim of preventing any significant expansion to deep-sea fishing in this country. Some anecdotal evidence suggests that squaloid catches from deep-sea longlining at one landing site, i.e. Cilacap, have declined rapidly in the last ten or more years despite it being only a relatively restricted fishery. This may be a result of localized depletion but further investigation is required since the fishers may have just begun using the nearby landing site at Sentolo kawat. Deep-sea longlining based at the landing sites of Kedonganan and Tanjung Luar appears to be a relatively new fishery. Thus, regular surveys of these ports are required to assess to what extent the catch compositions change over the years.

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