NORTH AUSTRALIA'S MULTI-SPECIES SHARK FISHERY

EXPLORATORY FISHING SURVEY OF SHARK AND OTHER PELAGIC FISH RESOURCES FOUND IN NORTHERN TERRITORY INSHORE WATERS.

J. M. LYLE AND G. J. TIMMS

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FOREWORD

This Report is the fourth volume of a series that examines the potential for development of a shark fishing industry in northern Australian waters.

The pelagic fish resource in the waters adjacent to the Northern Territory may offer considerable potential to Australian fishermen. Although there have been a number of studies examining its potential for exploitation by Australians, none has been sufficiently detailed or specifically orientated to a commercial style fishing operation to answer many of the questions raised by government and industry. The Northern Territory Fisheries Division recognised this need and initiated the present survey, the aims of which were to investigate and evaluate fishing gear technology, assess potential catch rates and provide a description of the resource. In the main these objectives have been achieved and the survey has demonstrated that shark and other pelagic fish can be caught in commercial quantities in the inshore waters surrounding the Northern Territory.

Not withstanding research undertaken by this Division and other organisations there can be no substitute for local knowledge and experience in the fishery. The next phase of the fishery's development relies on the involvement of fishermen, processors and distributors who are committed to developing the shark fishery industry.

At present the major constraint appears to be in the marketing of the product. This aspect will require the co-operation of all sectors of the fishing industry if markets are to be developed and the fishery realise its full potential.

S.P. SAVILLE
Secretary

ABSTRACT

Results of gillnet and longline fishing trials in Northern Territory inshore waters indicate that considerable potential exists for the development by Australians of a shark fishery.

Two monofilament gillnets were used in the trials, a 'commercial' gillnet of 1200 m length with a stretched mesh of 150 mm, and a mesh selectivity gillnet incorporating three 189 m panels with mesh sizes of 100, 150 and 200 mm.

Gillnet catches proved highly variable with the largest catches of over three tonnes per set taken in Fog Bay and adjacent to Croker Island. Catches in excess of one tonne per set were achieved at various fishing stations within each of the localities surveyed.

Sharks represented the major component of the 'commercial' gillnet catches, 86 percent of the numbers and 95 percent of the total weight. Although fifteen species of shark were caught, two species of black-finned school shark, *Carcharhinus limbatus* and *C. sorrah*, together accounted for 65 percent of the shark catch. Species of secondary importance included hammerheads, milk sharks and grey whaler sharks. Teleosts or scale fish were of minor significance, about 5 percent of the total catch weight, with *Apolectus niger* (black pomfret), several species of mackerel (*Scomberomorus* spp.), tuna (mainly *Thunnus tonggol* and *Euthynnus affinis*) and *Eleutheronema tetradactylum* (blue salmon) the most frequently occurring teleosts.

On average, catch rates were higher at night, in the order of 2.3 times those for day sets. The average catch at night was 584 kg per set, equivalent to 258 kg per net hour.

Comparison of mesh sizes demonstrated that 150 mm was the most suitable in terms of the likely market constraints of species and size composition for shark.

Only a small number of longline sets were made since catches were generally poor, an average of less than 8 sharks per 100 hooks. Further work would be necessary to comment on the commercial viability of this fishing method.

The implications of size restrictions on sharks due to mercury levels in addition to processing losses are considered in relation to marketing the catch.

1. INTRODUCTION

It has long been recognised that the pelagic fish resources in the waters adjacent to northern Australia may offer considerable potential for Australian fishermen. Taiwanese gillnetters have fished the area since 1974 but it was not until the Australian Fishing Zone (AFZ) was declared in November 1979 that the fishery came under Australian control. Taiwanese gillnet catches reportedly peaked at over 20,000 tonnes in 1978, although in that year the Taiwanese also operated in areas that now fall within the Indonesian 200-mile fishing zone (Millington and Walter 1981). Following the establishment of the AFZ, the Taiwanese were restricted to specified offshore areas and an annual catch quota of 7,000 tonnes was imposed on the fishery. Sharks represent the major component of the gillnet catch, about 70 percent, with mackerel and tuna of secondary importance.

In recent years small quantities of shark have been landed in the Northern Territory, primarily as by-product of the prawn and barramundi fisheries. According to catch returns, landings of shark in the Northern Territory peaked at 221 tonnes in 1980-81. Prior to this, the catch was 1 to 12 tonnes and subsequent landings have been in the order of 40 tonnes per annum. The peak in 1980-81 was largely attributable to the operation of a single shark boat which later withdrew from the fishery due to marketing difficulties.

Interest in the development of a shark fishing industry by Australian operators has prompted a number of investigations in northern Australia. During the late 1960's, the then Northern Territory Administration undertook fishing trials for shark using gillnet and longline techniques (Puffet 1969). Although few details were given, it was concluded that a considerable potential existed for a commercial shark fishery. More recently, the Northern Territory Fisheries Division undertook a programme to collect sharks for mercury analysis as part of a Government initiative to develop new fisheries (Church 1981; Lyle 1984a,b). Most sharks were taken by gillnets and although the aim of the study was not a fishery assessment in itself, good catches of shark (over 200 per set) were recorded in Fog Bay, around the Goulburn Islands, Crocodile Islands and Groote Eylandt (unpublished data). In 1981 the Taiwanese research vessel 'HAI KUNG' undertook gillnet fishing trials in the region west and north of Bathurst and Melville Islands (Church *et al.* 1982). Catches proved variable, ranging from 18 to 6640 kg per set. This maximum would have been higher but over 60 percent of the net was lost due to the weight of shark in the net. Also, in 1981 the Western Australian Fisheries and Wildlife Department undertook a four month exploratory fishing survey in the region from the Northern Territory/Western Australian border to North West Cape

(Donohue *et al.* 1982). The primary objective of this survey was to assess the viability of catching mackerel by gillnet. In this respect the method was demonstrated to be uneconomical, but it did prove suitable for catching shark. Although these studies have indicated that reasonable quantities of shark may be caught in northern Australian waters, each has been limited in scope, using gear and/or procedures (eg prolonged set durations) that would be unsuitable in a commercial fishery.

The need for a more specific evaluation of the potential of the pelagic fish resources for exploitation by Australians prompted the Northern Territory Fisheries Division to initiate the present survey. The primary objectives of which were to investigate and evaluate fishing gear technology, assess catch rates and to provide a description of the resource. The survey represents a component of a broader programme which has included examination of mercury concentrations in shark (Lyle 1984a,b) and marketing trials, including consumer acceptability of tropical shark (Welsford *et al.* 1984).

2. MATERIALS AND METHODS

2.1 GENERAL

Fishing operations were undertaken from the gillnet fishing vessel 'RACHEL', details of which are given in Appendix I. The charter period of 59 days was spread over six cruises conducted between February and December 1983 (Table 1).

The survey was conducted between Joseph Bonaparte Gulf to the west and Goulburn Islands to the east because of ready accessibility from Darwin. Inshore waters were selected for survey since anecdotal reports had suggested that better catch rates could be attained in inshore as opposed to offshore waters. For convenience of reporting results, the region was subdivided into six localities, designated I to VI as shown in Figure 1. Localities roughly correspond to the following areas:

I	-	Peron Islands to Treachery Bay
II	-	Fog Bay
III	-	Bathurst Island
IV	-	north coast of Melville Island
V	-	Croker Island
VI	-	Goulburn Islands

Each locality was sampled at least twice during the programme while Fog Bay (Locality II) was surveyed on all six cruises (Table 1).

TABLE 1 Cruise details.

Cruise	Dates	Localities Fished
A	1/ 2/83 - 13/ 2/83	II,V,VI
B	7/ 4/83 - 17/ 4/83	I,II
C	22/ 5/83 - 2/ 6/83	II,III,IV
D	27/ 8/83 - 6/ 9/83	II,V,VI
E	18/10/83 - 28/10/83	II,III,VI
F	30/11/83 - 7/12/83	I,II

2.2 FISHING GEAR

'Commercial' Gillnet

A near-surface drift net of 1200 m length, 150 mm monofilament mesh and 100 mesh drop, was used in fishing trials. A lead-cored 'lead line' weighted the net, while polystyrene floats, attached by 3.6 m float lines to the head rope, buoyed the net. Details of the net are summarised in Table 2.

The net had been used for commercial shark fishing in northern Australian waters prior to the survey and had sustained some damage, including broken meshes and ripped panels. Ripped sections accounted for approximately 60 m of the total net length, reducing the effective net length to about 1140 m.

TABLE 2 Details of gillnets.

	'Commercial' Gillnet	Mesh Selectivity Gillnet		
Stretched mesh size	150 mm	100 mm	150 mm	200 mm
Drop	100 mesh	135 mesh	101 mesh	67 mesh
Hanging coefficient	0.63 (4 meshes in 38 cm)	0.63 (6 meshes in 38 cm)	0.63 (4 meshes in 38 cm)	0.63 (3 meshes in 38 cm)
Hung Length	1200 m	189 m	189 m	189 m
Hung Depth	11.6 m	10.5 m	11.7 m	10.5 m
Monofilament gauge	30	18	30	70
Head rope (diameter)	16 mm	16 mm	16 mm	16 mm
Lead rope (diameter)	8 mm	8 mm	8 mm	8 mm
Length of float lines	3.6 m	3.0 m	3.0 m	3.0 m
Spacing between floats	19.5 m	20 m	20 m	20 m

Mesh Selectivity Gillnet

To investigate gear selection through mesh size, a net that incorporated three panels of different mesh size - 100 mm, 150 mm and 200 mm - was constructed. Each panel was 189 m in length and was separated from adjoining panels by 100 m of rope. The drop in meshes for each panel was varied in an attempt to produce nets of approximately equal depth (Table 2). The mesh selectivity gillnet was buoyed and weighted similar to the commercial net.

Longline

A longline with detachable snoods was tested in fishing trials. Snoods were made from 3 mm braided cord and were either 50 cm or 100 cm long. Mustad 11/0 long-shanked (137 mm) hooks were used. Snoods were attached to the mainline, 7 mm Kuralon tarred rope, by shark clips. The longline was held near the surface by polystyrene floats attached to 5 m float lines which in turn were attached to the mainline by shark clips. Baited snoods and float lines were attached to the mainline at 8 m and 40 m intervals respectively.

2.3 FISHING OPERATIONS

Gillnet

Gillnets were hauled and stored on hydraulically powered net reels located at the stern of the vessel. During the setting operation the vessel headed down-wind and the net was fed off the reel and over the stern gunwale. As the net unwound, floats were attached by shark clips to the float lines. When the entire net was shot away, a rope attached to the end of the net was fed forward, over the bow roller and then tied back onto the net reel. This allowed the vessel to turn and hang off the net by the bow and placed it in position to haul the net.

Whilst setting, the vessel's heading was maintained by the autopilot and the speed of the vessel was controlled by remote controls at the stern. Two people were involved in setting which took approximately 25 minutes. One person attached the floats to the float lines and the other passed floats and regulated the speed of the vessel and the speed with which the net was fed off the net reel.

Although the vessel usually hung off the net and drifted with it, the net could be cast free and retrieved later. This was the usual action taken in the event of a distinctive change in wind or current direction.

The net was hauled over the bow roller, down the length of the vessel and fed back onto the net reel. In general the vessel was hauled up onto the net by the operation of the net reel. In rough conditions, however, the vessel steamed slowly up onto the net, taking the strain off the net and net reel. As each section of the net came aboard, fish and floats were removed.

Longline

The longline was set over the stern gunwale and was anchored and buoyed at either end. Hauling of the longline followed basically the same procedure outlined for the gillnets, although at the completion of hauling the mainline was removed from the net reel and was stored in an emptied brine tank. Snoods and float lines were removed from the mainline as they came on board. Records of whether hooks contained fish, bait or were empty were kept . Broken snoods were also noted.

2.4 FISHING STRATEGY

Given the exploratory nature of the programme, cruises were designed to survey as much area as possible in the time that was available. In order to avoid concentration of fishing effort in areas with good catch rates, fishing operations were generally restricted to one day in any particular area. Exceptions arose when unfavourable sea conditions restricted the area of operation.

The actual positioning of sets was made at the discretion of the cruise leader and skipper but was influenced by water depth, proximity of reefs and shoals and the presence of other fishing vessels. The time of set and haul, position, depth and sea conditions were recorded at each fishing station. Fishing operations were primarily conducted at night although some day-time sets were attempted. Most sets with the 'commercial' net were of about 2 hours duration, although some were extended to boost catches while others were shortened, primarily due to changes in the prevailing weather conditions. As catches tended to be small for the mesh selectivity nets, sets were generally extended beyond 2 hours in order to provide more data on selectivity. Longline sets were of between 1½ and 2½ hours duration.

2.5 CATCH COMPOSITION

Shark

All sharks captured were identified to species, sex recorded and, with the exception of saw sharks (*Pristis cuspidatus*), lengths measured. Fork lengths rather than total lengths were applied because fork length is an easier and more accurate measurement to obtain. Since previous studies have reported total lengths (eg Lyle 1984a,b), total lengths were also measured in sub-samples of each species to facilitate comparisons between studies. Equations relating fork length and total length for the more abundant species are presented in Appendix II. Sub-samples of the abundant shark species and, where possible, all individuals of the rarer species were weighed to an accuracy of 0.1 kg for sharks of less than 25 kg and to 0.5 kg accuracy for those heavier than 25 kg. Length-weight relationships have been determined and are given in Appendix III.

In mesh selectivity sets, sharks were categorised as being either 'gilled' or 'rolled' dependent upon how they were caught in the net. Sharks were judged to be gilled if they had been enmeshed at or behind the first gill slit by an unbroken mesh. All other sharks were recorded as rolled. Sharks were often found to have rolled up in the net and were entangled in a large quantity of netting. When this occurred, it was only possible to judge whether the shark had first been gilled or not by disentangling it.

Biological information, including reproductive and stomach content data, was collected from sub-samples of the catches. This information will be reported elsewhere in scientific publications.

In an effort to reduce unnecessary killing, sharks captured alive were measured and released. As part of a co-operative study with CSIRO Division of Fisheries Research, live *Carcharhinus limbatus* (black-tip shark) and *C. sorrah* (school or sorrah shark) were tagged and released. A total of 682 sharks were tagged during the survey.

Other Pelagics

Teleosts or scale fish were identified to species or family level, fork lengths measured and, with the exception of small fish (less than 0.2 kg), weighed. Length-weight relationships for the more abundant species are given in Appendix III.

The presence of rays and cetaceans (dolphins) was noted but measurements were not made.

2.6 PROCESSING CATCH

A sub-sample of the shark catch was processed to trunk form for market acceptability trials. Tuna were also retained whole for canning trials. Results of these tests can be obtained by contacting the Fisheries Division. In order to calculate recovery rates, trunk and fillet weights were determined for selected individuals of *Carcharhinus limbatus* and *C. sorrah*.

3. RESULTS

3.1 GENERAL

Eighty-three sets were made with the 'commercial' net, 31 sets with the mesh selectivity net* and 5 with the longline. General positions of each set are shown in Figure 2 and details of positions, times, depth and sea conditions are presented in Appendix IV. Catch compositions, by weight and numbers, for each set are given in Appendix V and cruise summaries are given in Appendix VI.

3.2 'COMMERCIAL' GILLNET

Catch Composition

Sharks represented the major component of the gillnet catch accounting for 86 percent of the total numbers and nearly 95 percent of the weight of fish caught (Table 3). Although fifteen species of shark were recorded (not including saw sharks and rays), two species, *Carcharhinus limbatus* and *C. sorrah*, together formed over 65 percent of the shark catch by numbers and weight. Species of secondary importance included *Rhizoprionodon acutus* (milk shark), *C. macloti* (milk shark), *Sphyrna blochii* (handle bar hammerhead), *S. lewini* (scalloped hammerhead), *S. mokarran* (great hammerhead), *C. fitzroyensis* (sand shark), *C. amblyrhynchoides* (grey whaler shark) and *C. amboinensis* (grey whaler shark). Length-frequency distributions for these species are presented in Figures 3 and 4 and mean or average sizes, with ranges, of all the shark caught by the 'commercial' net have been tabulated in Table 4. It is evident from these results that *C. macloti*, *C. dussumieri*, *R. acutus* and *R. taylori* are small species and may, therefore, be of limited commercial value because of their small size. Some particularly large sharks were also caught by gillnet, the biggest shark recorded was a 280 cm fork length (FL) *S. mokarran* weighing an estimated 241 kg.

Teleosts, which accounted for about 13 percent by numbers, only represented 5 percent of the catch weight (Table 3). The most abundant teleost was *Apolectus niger* (black pomfret), but out of the 519 individuals caught by the 'commercial' gillnet 453 were taken in a single shot (set C20). Four species of mackerel were taken by gillnet, *Scomberomorus commerson* (narrow-barred spanish mackerel), *S. semifasciatus* (grey mackerel), *S. munroi* (Australian spotted mackerel) and *S. queenslandicus* (Queensland school mackerel), with grey mackerel dominant. Five species of tuna were caught, *Thunnus tonggol* (long-tail tuna), *Euthynnus affinis* (mackerel tuna), *Auxis thazard* (frigate mackerel),

* Note only the 150mm panel was used in sets F15 and F16.

Sarda australis (Australian bonito) and *Cybiosarda elegans* (leaping bonito), but only the first two species mentioned were of sufficient size to be of commercial importance. Length-frequency distributions for mackerel and tuna are given in Figure 5. Species less frequently encountered but likely to be of some commercial significance included *Eleutheronema tetradactylum* (blue salmon), *Lutjanus* sp. (snapper) and *Scomberoides commersonianus* (queenfish).

Catch per Set

Catches, by weight and number, for the 'commercial' gillnet have been grouped by locality and are summarised in Table 5 and Figure 6. The combined weight for all 'commercial' sets was 37,395 kg whole weight, an average catch per set of 450 kg. Comparison of day and night-time sets showed that, with few exceptions (notably sets F08 and F09), night sets produced better catches than day sets. The average catch at night was 584 kg/set which compared with 237 kg/set for day sets. Catches were, however, highly variable between sets, even those made in close proximity, and about half of the total number of 'commercial' sets yielded catches of less than 200 kg whole weight.

The biggest catch of 3157 kg, primarily shark, was taken east of Croker Island (set A02). Another notable catch was taken in Fog Bay (set D14) and was comprised of 1030 fish with a combined weight of 3050 kg. Sets yielding greater than 1000 kg were recorded from adjacent Cape Scott (set F08), Anson Bay (set B18), Fog Bay (sets A23, D14, C01), Bathurst Island [adjacent Cape Fourcroy (set C04) and adjacent Rocky Point (set E06)], Melville Island [adjacent Point Jahleel (set E03)], Croker Island (sets A01, A02, D12), and adjacent the Goulburn Islands (set D09) (Figure 6).

Catches of teleosts were consistently low when compared to those for shark. The largest quantity of teleosts taken in a set was 397 kg, almost entirely black pomfret. The best catches of tuna and mackerel in a set were 114 kg (34 fish) and 124 kg (28 fish) respectively.

Catch Rates

Total catches do not account for differences in set duration and it is, therefore, more appropriate to standardise the actual fishing effort when making comparisons between sets. Due to the nature of gillnetting it is difficult to define effective 'soak' or 'fishing' time since during setting and hauling part of the net will be in the water and fishing. Whilst setting time was more or less standard, the duration of the haul was significantly influenced by the quantity of fish in the net. A large catch retarded hauling and prolonged the time that at least part of the net remained in the water and continued to fish. For

example, an empty or near empty net could be retrieved within 30 minutes whereas the longest haul took approximately 6 hours. A further complication is that an increase in fishing time may not necessarily result in a proportional increase in the size of the catch. For instance, some fishermen feel that a net with fish in it may fish better than an empty one, alternatively others suggest most fish are caught shortly after setting and increased set duration will not produce substantially better results. Resolution of these issues was not attempted in this survey.

For the purposes of the present survey, set duration or 'fishing' time was defined as the time elapsed from the completion of the set to the commencement of the haul, that is the duration that the entire net was in the water and fishing.

Catch rates expressed in kilograms per net hour are presented in Table 5. The highest catch rate recorded was 1452 kg/h and was attained in Fog. Bay (set D14) while the average for all sets was 202 kg/h (258 kg/h and 113 kg/h for night and day sets respectively). The average catch rate for sharks was 192 kg/h which compared with only 10 kg/h for teleosts. Catch rates by area and cruise have been summarised diagrammatically in Figure 7.

Locality and Seasonal Effects

Depending on locality, *C. limbatus* and *C. sorrah* together represented between 45 and 79 percent of the shark catch (Table 6). Although there was some variability, *C. limbatus* was generally the most frequ ntly caught shark. The prominence of *R. acutus* around the Goulburn Islands (Locality VI) can be largely attributed to a single set (D09) in which 199 out of the total 217 *R. acutus* for the locality were recorded.

In terms of species diversity, the inshore waters surrounding Bathurst Island (Locality III) proved particularly interesting (Table 6). Five species of shark, *C. fitzroyensis*, *C. amboinensis*, *C. macloti*, *S. blochii* and *R. taylori*, which were poorly represented in gillnet catches elsewhere (less than 20 percent by numbers), together accounted for nearly half of the sharks caught in this locality. *S. blochii* was also relatively abundant around Melville Island (Locality IV) while *C. amboinensis* was frequently taken in the coastal region south of the Peron Islands (Locality I).

C. limbatus and *C. sorrah* caught in Fog Bay (Locality II) are distinguished from those caught elsewhere in Figure 3. These results demonstrate considerable similarity in the catch size composition for *C. sorrah* from Fog Bay and for the other localities combined but marked differences for *C. limbatus*. Mean fork length of *C. sorrah* from Fog Bay was 70.6 cm [number (n) = 984; standard deviation (SD) = 7.04] compared with 74.1 cm

(n = 1087; SD = 8.18) for the other localities combined. On the other hand, the average size of *C. limbatus* caught in Fog Bay was only 62.2 cm (n = 1138; SD = 12.15) which was considerably smaller than 86.3 cm (n = 1139; SD = 21.92) for the remaining localities. Nearly 90 percent of the *C. limbatus* caught in Fog Bay were less than 70 cm in length, compared with only 30 percent for the other localities.

Related to limited number of sets and variability in catches it was not possible to discern definite patterns in catch rates that may be directly attributable to season and/or locality effects. The inshore region south of Anson Bay (southern half of Locality I) may be a poor area for shark, the best catch was only 235 kg (set B09). This area was sampled only once, in April, at which time the water was noticeably muddy due to run off from the Victoria, Fitzmaurice and Keep Rivers. As far as seasonal trends are concerned, only Fog Bay (Locality II) was fished regularly throughout the survey. A marked decline in catch rates was recorded in October and November/December (Cruises E and F) compared with the earlier months of the year (Table 5). More work would be necessary to establish whether these findings are indicative of seasonal variability or are due to other influences.

3.3 MESH SELECTIVITY

Catch Composition

Sharks were dominant in the three mesh sizes tested, with *C. limbatus* and *C. sorrah* representing over half of the catch by numbers in each case (Table 7). The most conspicuous difference in species composition was the higher occurrence of the smaller species of sharks, eg *R. acutus*, *R. taylori* and *C. macloti*, in the 100 mm mesh net as compared with the two larger mesh sizes. Results also indicated that species diversity declined with increasing mesh size, from 15 species of shark for the 100 mm net to 11 species for the 200 mm net. While this may be due in part to the ability of the smaller meshes to retain small as well as large sharks, findings are probably biased due to the relatively small sample sizes involved. Teleosts were poorly represented in the catches compared with sharks, and mackerels were the most frequently occurring group in each of the mesh sizes (Table 7).

Size Composition

Length-frequency distributions by mesh size for the combined shark catch are shown in Table 8 and Figure 8. Results for *C. limbatus* and *C. sorrah* have also been treated separately and are presented in Table 9 and Figure 9.

On average, bigger sharks were caught by the larger mesh sizes, the mean fork lengths for the combined shark catches in the 100, 150 and 200 mm mesh sizes were 62,

75 and 90 cm respectively (Table 8). Length-frequency distributions for the 100 and 150 mm nets were unimodal and skewed to the right, that is with a single discrete peak which tailed off towards the larger size groups (Figure 8). Considering all species of shark, peak catches occurred within the 50-69 cm range and 55-79 cm range for the 100 and 150 mm nets respectively. A well defined peak was not evident for the 200 mm net and, with the exception of particularly small or large individuals, most size groups were well represented in the catches. Basically similar patterns were observed for *C. limbatus* and *C. sorrah* (Figure 9).

Each mesh size retained some large sharks, in the case of the 100 and 150 mm nets this was due to large sharks rolling up in the net rather than being caught at or behind the gills (refer to Figures 8 and 9). The fact that sharks roll up in the gillnets largely accounts for the skewed length-frequency distributions noted for the 100 and 150 mm nets. Damage to gillnets by large sharks was not extensive as nets were not anchored and had sufficient give to absorb the initial impact and subsequent struggles of entangled sharks.

All three nets were fished simultaneously at each station, except sets F15 and F16, and although net dimensions were standardised, comparison of catch rates is not strictly valid as nets were set and hauled in a specific order. Thus there was some variation in the actual fishing time for each net - the first net shot away was always the last to be hauled.* In spite of this complication it was observed that the numbers of shark caught dropped with increasing mesh size (Table 7). The high catch for the 100 mm net was particularly influenced by the capture of small sharks (Table 8). For example, 261 sharks of less than 55 cm were caught in the 100 mm net compared with only 30 and 1 for the 150 and 200 mm nets respectively. In terms of weight, the combined shark catch for the 150 mm net (3085 kg) was considerably greater than for both the 100 and 200 mm nets (2306 kg and 2470 kg respectively). In general, variation in fishing time between nets was not great, it is unlikely, therefore, that this factor would fully account for the observed differences in catch weights and numbers between nets.

3.4 LONGLINE

The combined catch for five longline sets (a total of 501 hooks) is summarised in Table 10. The actual catch for individual sets varied between 3 and 11 sharks, with the maximum catch weight attained in a set of 25 kg. These low catch figures were also reflected in the high occurrence of untouched baits (336 hooks were retrieved with bait intact). Damage to snoods was negligible, with only one break-off recorded.

* The order of hauling was first the 200 mm followed by the 150 mm and then the 100 mm net.

3.5 RECOVERY RATES

Both 'fins on' and 'fins off' trunk weights were determined for *C. limbatus* and *C. sorrah*.* Relationships indicate that the recovery ratio for these species was between 62 and 65 percent for 'fins on' and 55 and 57 percent for 'fins off' trunks (Table 11 and Figure 10). A small sample of sharks was also filletted, skinned and trimmed. The recovery for *C. limbatus* fillets was 31.2 percent (n=17; SD = 2.16) compared with 33.6 percent (n=9; SD = 1.48) for *C. sorrah*.

3.6 OTHER

Incidental catches of cetaceans were very rare, in fact dolphins were caught in only 2 of the 114 gillnet sets. Four spinner dolphins (*Stenella longirostris*) and one irrawaddy dolphin (*Orcaella brevirostris*) were captured. All specimens were given to the Darwin Museum for study.

Gamefish were rarely taken by gillnet. Three sailfish (*Istiophorus platypterus*), weighing 12.4, 17.0 and 17.5 kg respectively, were caught.

* The head was removed by a straight cut between the origin of the pectoral fins. Viscera were also discarded but belly flaps were left intact. Pectoral, first dorsal and caudal fins were removed for 'fins off' trunks. Note: it is common commercial practice to cut forward from the pectoral fins to the base of the head, thus producing slightly higher yields than indicated here.

4. DISCUSSION

4.1 GENERAL

Results of fishing trials indicate that there is considerable potential for the development of a gillnet fishing industry by Australians in the waters adjacent to the Northern Territory. The resource is multi-species, with sharks representing the major component. In this survey, sharks accounted for 86 percent of the numbers and 95 percent of the weight of fish caught by the 'commercial' gillnet. Whilst fifteen species of shark were taken by gillnet, two species of black-finned school shark, *C. limbatus* and *C. sorrah*, dominated catches and together represented over 65 percent of the shark component. Species of secondary importance included various species of hammerheads, milk sharks and grey whaler sharks.

Substantial quantities of shark, over 1000 kg per set, were caught at different locations spread over most of the area surveyed, with the best and most consistent catches taken in Fog Bay, adjacent Bathurst Island and around Croker Island. From other surveys (unpublished data) and anecdotal accounts it is apparent that commercial quantities of shark also occur outside the study area, with the inshore regions surrounding Port Essington, Gove and Groote Eylandt being particularly productive.

A feature of gillnetting was the level of variability in catches between sets, even those made in close proximity to each other. The distribution of sharks appeared to be localised and patchy, probably reflecting some form of schooling or aggregating behaviour by the more abundant species. Circumstantial evidence supports this premise as it was not uncommon for large catches of a particular species to be dominated by one sex and/or similar sized individuals.

With few exceptions, night sets produced better catches than day sets, demonstrating that fishing operations would be more profitably conducted at night than during the day-light hours. Puffet (1969) reached a similar conclusion in an earlier survey in Northern Territory waters. The fact that Taiwanese gillnetters conduct their fishing operations at night (Millington and Walter 1981) also corroborates this finding.

The average catch for a night set was 584 kg, equivalent to a catch rate of 258 kg/h. It needs to be emphasised that this average was attained under survey conditions and commercial fishing operations would be expected to improve on these figures. Comparison can be made between these catch rates and those obtained in the offshore gillnet fishery. Analysis of the Taiwanese commercial catch indicates an average catch per set of approximately 1500 kg whole weight (DPI 1983).

Taiwanese gillnetters utilize up to 16,000 m of multifilament gillnet (average of about 10,000 m) and set duration (as defined in Section 3.2) is in the order of 5 to 6 hours. By expressing the Taiwanese catch in units comparable to the present study, the catch rate becomes about 30 kg/1200 m net/h, substantially lower than determined here for inshore areas. A further comparison can be made with a gillnet survey conducted in Western Australian waters. The biggest catch in any set was 1208 kg with an average catch of 99 kg/set (Donohue *et al.* 1982)*. No details of set duration were given except that sets were generally of less than 7 hours duration. This particular survey had been designed specifically to assess the viability of catching mackerel with gillnets. In consequence fishing operations were targeted around reef and shoal areas likely to contain mackerel and this may partly explain the comparatively poor catches.

The significance of the relationships between species composition and locality to the fishery lies in the fact that certain species may be of limited commercial importance, for example hammerheads (high concentrations of mercury, Lyle 1984a,b) and milk sharks (small size). Results of fishing trials showed that highest proportions of both groups occurred around Bathurst Island (Locality III) and Goulburn Island (Locality VI) (refer to Table 6). The observation that at least some of the shark species undertake extensive movements (J.D. Stevens personal communication) would suggest, however, that the species composition in an area continually changes. Catch compositions reported here will, therefore, pertain only to the particular area in respect to the time that it was fished. In addition some of the apparent locality differences may be artefacts resulting from comparatively small sample sizes. This aspect of the fishery clearly requires further attention.

It was observed that fishing in turbid or muddy waters produced poor catches, which were dominated by species such as *C. amboinensis*, *S. blochii* and to a lesser extent *C. fitzroyensis* (for example some inshore areas around Bathurst Island and the region south of Anson Bay). In contrast, gillnetting in close proximity to prawn trawlers often resulted in good catches and examination of stomach contents indicated that many of the sharks had consumed small fish of the type discarded by prawn fishermen.

C. limbatus caught in Fog Bay were generally smaller than those individuals caught elsewhere (62.2 cm FL compared with 86.3 cm FL) (Figure 3). Size at first maturity in this species occurs at about 85 cm in males and between 90-100 cm FL in females (J.D. Stevens

* F.V. 'RACHEL' was chartered for this survey and the same 'commercial' gillnet was used in fishing trials.

personal communication). The high occurrence of immature individuals in Fog Bay suggests that the area may be a nursery ground for juvenile *C. limbatus* for at least part of the year.

Mesh size influenced both the species and size composition of the catch. Commercially these findings have relevance since it has been suggested that some restrictions may need to be applied to the marketing of shark within Australia because of mercury content (refer to Lyle *et al.* 1984). Maximum sizes of either 100 cm or 135 cm total length (TL), which are equivalent to fork lengths of about 78 cm and 107 cm respectively, have been recommended as an interim guide depending on the State or Territory in which the product is to be marketed. Further, it is reasonable to assume that shark of less than 55 cm FL (approximately 1.6 kg whole weight) would be of little commercial importance because of small size. The proportions of the total catches for each mesh size that fall within these size ranges have been determined (Table 12). Due to the prominence of *C. limbatus* and *C. sorrah* in the catches, these species have also be considered individually (Table 12). The retained portion (percentage of total catch) was generally highest by numbers for the 150 mm net, whereas by weight, marginally higher for the 100 mm net. Although not studied directly there was some indication that the catch rate for the 150 mm mesh size was higher than for either the 100 or 200 mm nets. In terms of the actual weight retained, best retention was in fact attained by the 150 mm mesh size gillnet. These findings suggest that of the mesh sizes compared, the 150 mm mesh size is the most suitable for the commercial fishery.

A primary concern to industry is not necessarily the quantity of fish that can be caught but rather the proportion of the catch that is useable (marketable). By considering the size restrictions mentioned above it was estimated that 38 percent by weight of the 'commercial' gillnet catch fell between 55 and 78 cm FL while 71 percent was between 55 and 107 cm FL (Table 12). In theory, at a maximum total length of 100 cm, a catch of 1000 kg of shark would be equivalent to only 380 kg whole weight or 240 kg of trunks of marketable product. Alternatively, at a maximum length of 135 cm TL, 1000 kg of shark would be equivalent to 710 kg whole weight or nearly 450 kg of marketable trunks. In practice, the actual size composition of individual catches was variable and therefore the recovery ratio would vary accordingly. These considerations only apply to domestic markets and will, no doubt, represent important factors in the future development of the gillnet fishery, including establishment of markets.

Teleosts comprised a very minor component of the gillnet catches, only 5 percent of the total catch weight. Although markets are already available for mackerel, reef fish, pomfrets, etc, the contribution of teleosts to the economics of the gillnet fishery is likely to be

minimal. In contrast, the proportion of teleosts taken by Taiwanese gillnetters is significantly higher, about 31 percent of the annual catch weight, mainly mackerel and tuna (DPI 1983). These differences suggest higher abundance of pelagic teleosts offshore and/or that the Taiwanese target their operations at mackerel and tuna, not an unreasonable assumption since these species command better prices than shark.

Insufficient attention was given to longlining in this study to enable a detailed appraisal of the commercial viability of this method as an alternative to gillnetting. In a more extensive study conducted in Northern Territory waters, Puffet (1969) averaged catch rates of 14 sharks per 100 hooks (average fillet weight per shark of 2 kg) which compares with less than 8 sharks per 100 hooks achieved here. Observations made during commercial longline fishing operations in the Port Essington region indicated similar catch rates to those reported by Puffet (T. Angeles personal communication). It is clear, however, that longlining would involve considerable effort to achieve catches comparable to those for gillnets.

4.2 MERCURY SITUATION

Weighted mean mercury concentrations for several of the shark species caught in the 'commercial' gillnet have been calculated using length-mercury relationships reported by Lyle (1984a,b) (Table 13). With the exception of *C. sorrah*, each of the species considered exceeded a mean of 0.5 mg/kg, with highest values of over 2 mg/kg for *S. mokarran* and *C. amblyrhynchoides*. Interim maximum size restrictions for shark of 1.0 and 1.35 m TL have been recommended by Lyle *et al.* (1984) in an attempt to constrain the weighted mean mercury concentrations of gillnet catches to below 0.5 mg/kg (National Health and Medical Research Council standard for mercury) and 1.0 mg/kg (South Australian and Tasmanian standards for mercury) respectively. At a maximum size equivalent to a total length of 1.0 m (ie 78 cm FL), the weighted mean mercury concentrations for the 'commercial' gillnet catch of *C. sorrah* and *C. limbatus* would have been 0.38 mg/kg and 0.49 mg/kg respectively (0.43 mg/kg for the species combined). Similarly, at a maximum total length of 1.35 m (ie 107 cm FL), means of 0.45 mg/kg and 1.02 mg/kg would apply for *C. sorrah* and *C. limbatus* respectively (0.75 mg/kg for the species combined). These analyses demonstrate that for these species at least, the recommended maximum sizes would have been effective in constraining the mercury levels to within the specified limits.

4.3 FURTHER CONSIDERATIONS

While this survey has demonstrated that substantial quantities of shark may be taken by gillnets, there are many factors that warrant further attention. For

instance, the relationships between tides, depth, sea conditions and even the phase of the moon and catch rates need consideration. With regards to the latter for example, Taiwanese fishermen consider that catches tend to be poorest on moonlit nights.

Insufficient information is currently available to account for differences in abundance in respect of geographic area and season. At least some of the shark species undergo extensive movements and knowledge of migratory patterns could have considerable bearing on the timing and location of commercial fishing operations.

At the present time it is not known how long an area can withstand fishing pressure and continue to produce commercial quantities of shark, nor is it known how long an area will take to 'recover' after being fished. The effects of discarding shark heads and guts on a ground will need to be considered since, in southern shark fisheries, it is generally believed that sharks are repelled from an area by the presence of shark remains.

In the initial phases of the fishery's development, trial and error will play an important role. However, as experience is gained in the fishery and on the completion of current research (Anon. 1983) many of the fishermen's questions should be answered.

4.4 RECOMMENDATIONS AND CONCLUSIONS

The following recommendations and conclusions regarding the catching and handling of shark are based on experiences gained in the current fishing trials.

1. Most inshore waters around the Northern Territory have the potential to yield commercial quantities of shark. The precise distribution of the shark appears very patchy and fishing operations will, therefore, involve a considerable amount of searching before good grounds are located.

2. Gillnetting, with near surface drift nets, was proven to be an efficient method of catching shark. Recommended gear specifications are monofilament gillnet (30 gauge is suitable) of between 500 and 1200 m in length, 150 mm stretched mesh with drop of 50 to 100 meshes.

3. Fishing operations are best conducted at night.

4. Related to the level of variability in catch rates it is recommended that gillnets are set for short periods (less than one hour) in new areas in order to gauge potential catch rates. A 'trial set' should reduce loss of fishing time due to poor catches or excessive spoilage due to large catches.

5. Since deterioration in the quality of shark is rapid in the warm northern waters, sets of greater than two hours duration may result in spoilage of product. As indicated in Appendix IV hauling times were variable, taking up to 6 hours depending on the catch. Although commercial operators would be expected to clear nets at a faster rate, spoilage of product may still occur where prolonged hauling times delay processing. Consideration will need to be given to this aspect when planning fishing operations.

6. It is essential that sharks are properly bled as soon as they come onboard and, if not processed immediately, are held at reduced temperature (eg refrigerated sea water) prior to processing. It was found that with the longer sets a high proportion of sharks were already dead in the net.

7. Fishing in turbid waters generally yielded poor catches dominated by less desirable species (grey whalers and hammerheads).

In conclusion, very encouraging prospects exist for the development of a shark fishery in northern Australian waters. Fishing trials reported here affirm the feasibility of catching commercial quantities of shark using technology appropriate to an Australian style fishing operation. At the present stage, the major constraint to the development of the fishery would appear to be marketing. If the fishery is to realise its full potential it is clear that all sectors of the fishing industry will need to work closely together in order to develop new markets and ensure consistently high product quality.

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TABLE 3 'Commercial' Gillnet: Catch composition by numbers and weight.

SPECIES	PERCENTAGE NUMBER	WEIGHT
	SHARK COMPONENT	
Carcharhinus limbatus	35.8	41.1
C. sorrah	31.2	24.3
C. fitzroyensis	2.5	2.2
C. amblyrhynchoides	1.5	2.7
C. brevipinna	0.2	0.2
C. amboinensis	3.0	6.5
C. melanopterus	0.1	0.1
C. macloti	3.0	1.1
C. dussumieri	0.6	0.3
Sphyrna lewini	4.3	6.5
S. mokarran	1.4	6.1
S. blochii	4.0	4.2
Rhizoprionodon acutus	10.6	4.3
R. taylori	1.6	0.1
Hemipristis elongatus	0.1	0.1
TOTAL	100	100
	TELEOST COMPONENT	
Scomberomorus commerson	1.5	5.6
S. munroi	1.9	2.3
S. semifasciatus	10.2	22.7
S. queenslandicus	0.6	0.7
Thunnus tonggol	7.8	16.9
Euthynnus affinis	4.8	7.9
Other tunas	0.4	0.2
Apolectus niger	50.1	23.3
Eleutheronema tetradactylum	6.0	3.3
Scomberoides commersonianus	1.8	5.4
Lutjanus sp.	1.2	3.7
Catfish	2.8	4.6
Other	10.9	3.4
TOTAL	100	100

TOTAL CATCHES

	NUMBER	WEIGHT (kg)
SHARK	6642	35,510
TELEOST	1035	1,885
OTHER*	41	**

* Rays, saw sharks, cetaceans ** weights not determined

TABLE 4 Lengths and weights of shark species caught by 'commercial' gillnet.

SPECIES	NUMBER	FORK LENGTH (cm) MEAN	FORK LENGTH (cm) RANGE	WEIGHT (kg)* MEAN	WEIGHT (kg)* RANGE
Carcharhinus limbatus	2377	74.7	41.0 - 171.0	6.1	0.7 - 65.3
C. sorrah	2071	72.4	51.5 - 101.2	4.2	1.3 - 12.2
C. fitzroyensis	167	75.5	55.0 - 109.5	4.8	1.6 - 14.6
C. amblyrhynchoides	100	87.2	50.8 - 129.2	9.8	1.7 - 30.5
C. brevipinna	15	81.3	65.5 - 114.0	5.8	2.4 - 15.0
C. amboinensis	202	83.3	54.0 - 183.0	11.4	2.0 - 105.8
C. melanopterus	8	82.1	64.7 - 89.8	6.3	2.9 - 8.2
C. macloti	202	62.4	55.0 - 84.4	2.0	1.3 - 5.3
C. dussumieri	40	64.3	57.0 - 72.9	2.4	1.6 - 3.6
Sphyrna lewini	286	85.8	43.4 - 152.4	8.1	0.8 - 35.9
S. mokarran	91	115.1	51.8 - 280.0	23.6	1.1 - 241.2
S. blochii	266	81.3	46.5 - 120.0	5.5	0.7 - 18.8
Rhizoprionodon acutus	705	65.8	42.0 - 79.3	2.2	0.5 - 3.9
R. taylori	104	40.6	32.7 - 51.7	0.5	0.2 - 1.1
Hemipristis elongatus	8	84.8	62.0 - 116.0	6.3	2.0 - 18.0

* Weights determined from length-weight relationships.

TABLE 5 'Commercial' Gillnet: Catch and catch rates by set and locality. (Figures in parentheses represent numbers of fish)

SET			CATCH (kg)				CATCH RATE
CODE	DURATION (h)	D/N+	TOTAL	SHARK	TELEOST	OTHER*	TOTAL (kg/h)
			LOCALITY I				
B06	2.1	D	351.4 (66)	351.4 (66)	0	(0)	167.3
B07	2.2	N	568.8 (87)	566.8 (83)	2.0 (4)	(0)	258.5
B09	2.2	N	234.6 (23)	234.6 (22)	** (1)	(0)	106.6
B10	2.0	D	162.9 (27)	162.0 (26)	0.9 (1)	(0)	81.5
B11	2.3	N	49.0 (19)	38.6 (8)	10.4 (10)	(1)	21.3
B13	2.2	D	5.4 (2)	5.4 (2)	0	(0)	2.4
B14	2.0	N	198.6 (43)	198.1 (38)	0.5 (1)	(4)	99.3
B15	2.0	D	7.3 (1)	7.3 (1)	0	(0)	3.6
B16	3.2	N	144.8 (29)	82.7 (15)	62.1 (14)	(0)	45.2
B17	2.25	N	28.5 (8)	22.2 (6)	6.3 (2)	(0)	12.7
B18	4.0	N	1045.6 (188)	979.8 (167)	65.8 (20)	(1)	261.4
F06	2.2	D	26.2 (4)	26.2 (4)	0	(0)	11.9
F07	2.25	N	129.0 (12)	125.7 (4)	3.3 (8)	(0)	57.3
F08	2.0	D	2078.0 (161)	2078.0 (161)	0	(0)	1039.0
F09	2.0	N	36.4 (15)	28.4 (9)	8.0 (6)	(0)	18.2
F11	2.5	D	407.9 (35)	407.3 (34)	0.5 (1)	(0)	163.1
F12	2.0	N	259.5 (43)	259.5 (43)	0	(0)	129.7
F14	2.1	D	170.7 (27)	166.3 (26)	4.4 (1)	(0)	81.3
			LOCALITY II				
A22	2.1	D	396.0 (84)	350.1 (74)	45.9 (10)	(0)	188.6
A23	2.0	N	2589.0 (586)	2589.0 (536)	0	(0)	1294.5
B01	2.0	D	174.1 (36)	174.1 (36)	0	(0)	87.0
B02	2.4	N	692.3 (155)	691.2 (153)	1.1 (2)	(0)	288.4
B04	2.2	N	136.0 (21)	78.2 (3)	57.8 (18)	(0)	61.8
B19	2.1	N	928.7 (219)	923.5 (214)	5.2 (5)	(0)	442.2
C01	2.2	N	1133.8 (301)	1133.8 (301)	0	(0)	515.4

Table 5 (contd.)

SET			CATCH (kg)				CATCH RATE
CODE	DURATION (h)	D/N+	TOTAL	SHARK	TELEOST	OTHER*	TOTAL (kg/h)
			L O C A L I T Y II (contd.)				
C02	2.0	D	213.8 (66)	212.2 (65)	1.6 (1)	(0)	106.9
C19	2.1	D	201.7 (28)	191.5 (25)	10.2 (2)	(1)	96.1
C20	2.2	N	783.7 (608)	387.1 (149)	396.6 (459)	(0)	356.2
D13	2.1	D	35.5 (11)	34.5 (10)	1.0 (1)	(0)	16.9
D14	2.1	N	3049.5 (1030)	2950.5 (1003)	99.0 (27)	(0)	1452.1
D15	2.1	D	141.7 (47)	135.2 (40)	6.5 (7)	(0)	67.5
E21	2.0	D	41.8 (10)	37.5 (8)	4.3 (2)	(0)	20.9
E22	2.0	N	151.0 (46)	135.5 (34)	15.5 (11)	(1)	75.5
F01	2.1	N	69.3 (31)	27.5 (6)	41.8 (22)	(3)	33.0
F02	2.25	N	117.4 (32)	89.9 (14)	27.5 (16)	(2)	52.2
F03	2.1	D	36.5 (6)	36.5 (6)	0	(0)	17.4
F04	2.0	N	544.8 (122)	417.4 (82)	127.4 (32)	(8)	272.4
			L O C A L I T Y III				
C04	2.3	N	1302.1 (166)	1261.4 (149)	40.7 (17)	(0)	566.1
C05	2.1	D	26.0 (3)	26.0 (3)	0	(0)	12.4
C06	2.1	N	419.8 (76)	407.1 (67)	12.7 (7)	(2)	199.9
C08	2.3	D	16.2 (4)	16.2 (2)	0 (2)		7.0 (0)
C09	1.4	N	736.3 (69)	731.6 (66)	4.7 (3)	(0)	525.9
C13	2.0	N	637.1 (74)	549.9 (50)	87.2 (24)	(0)	318.5
C15	2.1	D	0	0	0	(0)	0
C16	2.3	N	196.4 (30)	170.4 (24)	26.0 (6)	(0)	85.4
E13	2.3	D	210.0 (70)	208.2 (68)	1.8 (1)	(1)	91.3
E14	2.1	N	380.6 (77)	301.7 (61)	78.9 (16)	(0)	181.2
E15	2.2	D	88.4 (15)	88.4 (15)	0	(0)	40.2
E16	2.1	N	2362.5 (532)	2360.8 (530)	1.7 (2)	(0)	1125.0
E17	2.1	N	270.0 (36)	255.6 (33)	14.4 (3)	(0)	128.6
E19	1.7	D	53.3 (6)	52.7 (5)	0.6 (1)	(0)	31.3
E20	2.0	N	220.0 (52)	209.2 (42)	10.8 (10)	(0)	110.0

Table 5 (contd.)

SET			CATCH (kg)				CATCH RATE
CODE	DURATION (h)	D/N+	TOTAL	SHARK	TELEOST	OTHER*	TOTAL (kg/h)
			L O C A L I T Y IV				
C10	2.2	D	199.1 (20)	196.1 (19)	3.0 (1)	(0)	90.5
C11	2.2	N	175.4 (28)	163.0 (27)	12.4 (1)	(0)	79.7
E01	2.1	N	189.4 (33)	181.5 (31)	7.9 (2)	(0)	90.2
E02	2.2	D	280.6 (49)	277.2 (48)	3.4 (1)	(0)	127.5
E03	2.3	N	1212.6 (80)	1200.6 (76)	12.0 (3)	(1)	527.2
E05	2.0	D	540.0 (125)	535.3 (124)	4.7 (1)	(0)	270.0
E06	2.2	N	114.2 (31)	114.2 (31)	0	(0)	51.9
E08	2.2	N	94.6 (27)	89.4 (26)	5.2	(0)	43.0
E10	2.0	D	20.0 (4)	20.0 (4)	0	(0)	10.0
E11	2.1	N	209.3 (33)	205.4 (32)	3.9 (1)	(0)	99.7
			L O C A L I T Y V				
A01	2.2	D	1271.8 (116)	1271.8 (116)	0	(2)	578.1
A02	2.8	N	3157.3 (448)	3129.5 (438)	27.8 (10)	(0)	1127.6
A18	2.25	N	367.6 (38)	367.6 (38)	0	(0)	163.4
A20	2.5	N	190.2 (39)	190.2 (39)	0	(0)	76.1
D01	2.1	D	9.5 (3)	5.1 (2)	4.4 (1)	(0)	4.5
D02	2.1	N	209.7 (19)	193.9 (17)	15.8 (2)	(0)	99.8
D03	2.1	D	63.1 (10)	56.9 (8)	6.2 (2)	(0)	30.0
D04	2.2	N	441.7 (57)	440.1 (55)	1.6 (2)	(0)	200.8
D10	2.2	N	64.8 (13)	40.7 (8)	24.1 (5)	(0)	29.4
D12	3.3	N	1315.1 (373)	1269.9 (325)	45.2 (40)	(8)	398.5
			L O C A L I T Y VI				
A04	1.8	N	178.7 (33)	172.9 (31)	5.8 (2)	(0)	99.3
A08	1.7	N	36.6 (11)	31.4 (9)	5.2 (2)	(0)	21.5
A10	2.0	D	14.0 (1)	14.0 (1)	0	(0)	7.0

Table 5 (contd.)

SET			CATCH (kg)				CATCH RATE
CODE	DURATION (h)	D/N+	TOTAL	SHARK	TELEOST	OTHER*	TOTAL (kg/h)
			L O C A L I T Y VI (contd.)				
A11	2.1	N	13.8 (1)	13.8 (1)	0	(0)	6.6
A12	1.9	N	79.4 (17)	21.5 (1)	57.9 (16)	(0)	41.8
A13	2.2	N	284.3 (32)	278.7 (20)	5.6 (11)	(0)	129.2
A15	2.1	D	319.0 (32)	319.0 (32)	0	(0)	151.9
A16	2.1	N	438.5 (54)	360.3 (28)	78.2 (26)	(0)	208.8
D06	2.4	N	439.0 (97)	312.7 (53)	126.3 (44)	(0)	182.9
D08	2.1	D	34.3 (11)	34.3 (11)	0	(0)	16.3
D09	3.25	N	1168.3 (446)	1027.3 (358)	141.0 (87)	(1)	359.4

\+ D = day-time, N = night-time.
* includes saw sharks, rays and cetaceans, numbers only.
** weight not recorded.

TABLE 6 'Commercial' Gillnet: Species composition (percentage) of sharks by area.

SPECIES	LOCALITY I	II	III	IV	V	VI
Carcharhinus limbatus	40.3	40.4	30.0	28.9	34.6	25.0
C. sorrah	38.7	34.9	14.7	42.3	32.6	24.3
C. fitzroyensis	1.0	0.7	10.3	5.0	0.4	-
C. amblyrhynchoides	0.6	0.9	2.2	1.4	3.6	0.2
C. brevipinna	0.6	0.2	0.2	-	0.1	0.4
C. amboinensis	7.3	0.5	9.3	3.1	1.8	-
C. melanopterus	-	0.1	0.3	0.2	0.1	0.2
C. macloti	-	1.2	9.8	0.7	5.2	0.4
C. dussumieri	-	0.5	0.3	-	0.7	3.0
Sphyrna lewini	1.2	5.3	1.8	4.6	6.4	4.3
S. mokarran	1.2	1.7	1.3	1.2	0.8	1.1
S. blochii	4.2	1.5	9.7	10.3	4.0	-
Rhizoprionodon acutus	4.6	11.2	3.6	1.9	8.9	40.5
R. taylori	0.3	0.7	6.6	0.2	0.6	0.4
Hemipristis elongatus	-	0.1	-	-	0.3	0.4
TOTAL NO.	715	2816	1112	418	1044	536

TABLE 7 Mesh selectivity: Species composition.

SPECIES	MESH SIZE 100 mm NUMBER	100 mm PERCENT	150 mm NUMBER	150 mm PERCENT	200 mm NUMBER	200 mm PERCENT
			SHARK COMPONENT			
Carcharhinus limbatus	313	39.9	294	53.3	143	57.7
C. sorrah	93	11.9	158	28.7	46	18.5
C. fitzroyensis	22	2.8	11	2.0	2	0.8
C. amblyrhynchoides	4	0.5	7	1.3	10	4.0
C. amboinensis	-	-	5	0.9	4	1.6
C. brevipinna	1	0.1	-	-	1	0.4
C. macloti	48	6.1	13	2.3	1	0.4
C. melanopterus	-	-	1	0.2	-	-
C. dussumieri	14	1.8	3	0.5	-	-
C. amblyrhynchos	1	0.1	-	-	-	-
Sphyrna lewini	14	1.8	7	1.3	6	2.4
S. mokarran	8	1.0	7	1.3	11	4.4
S. blochii	17	2.2	16	2.9	23	9.3
Rhizoprionodon acutus	111	14.1	23	4.2	1	0.4
R. taylori	127	16.2	6	1.1	-	-
Loxodon macrorhinus	10	1.3	-	-	-	-
Galeocerdo cuvieri	1	0.1	-	-	-	-
TOTAL	784	100	551	100	248	100
			TELEOST COMPONENT			
Scomberomorus commerson	8	8.4	1	1.7	3	18.7
S. munroi	13	13.7	-	-	-	-
S. semifasciatus	8	8.4	33	56.9	5	31.2
S. queenslandicus	17	17.9	-	-	1	6.3
Thunnus tonggol	-	-	-	-	-	-
Euthynnus affinis	-	-	-	-	-	-
Apolectus niger	5	5.3	7	12.1	2	12.5
Eleutheronema tetradactylum	17	17.9	7	12.1	-	-
Scomberoides commersonianus	-	-	1	1.7	-	-
Catfish	1	1.0	-	-	1	6.3
Other	27	27.4	9	15.5	4	25.0
TOTAL	96	100	58	100	16	100

TABLE 8 Mesh Selectivity: Length - frequency distribution (percentages) by mesh size for the entire shark catch.

LENGTH CLASS (cm)	MESH SIZE 100 mm	150 mm	200 mm
30 - 34	0.3	-	-
35 - 39	4.0	0.5	-
40 - 44	8.3	0.2	-
45 - 49	5.4	0.8	-
50 - 54	15.3	3.9	0.4
55 - 59	14.7	7.3	1.6
60 - 64	18.7	16.5	6.1
65 - 69	15.2	24.5	9.3
70 - 74	4.7	10.2	9.7
75 - 79	2.3	8.2	8.9
80 - 84	1.8	4.9	9.3
85 - 89	1.8	4.9	6.1
90 - 94	2.1	5.2	12.2
95 - 99	1.6	2.4	7.3
100 - 104	1.1	3.2	7.6
105 - 109	0.7	1.7	6.1
110 - 114	0.3	1.4	3.3
115 - 119	0.5	2.0	5.2
120 - 124	0.3	0.7	3.3
125 - 129	0.5	0.4	0.4
> 130	0.5	1.1	3.2
TOTAL NUMBER	784	551	248
Mean length (cm)	61.8	74.7	90.1
Standard deviation	16.8	18.8	22.5

TABLE 9 Mesh Selectivity: Length - frequency distribution (percentages) by mesh size for *Carcharhinus limbatus* and *C. sorrah*.

LENGTH CLASS (cm)	MESH SIZE 100 mm	150 mm	200 mm
	Carcharhinus limbatus		
45 - 49	3.5	0.7	-
50 - 54	34.5	6.8	0.7
55 - 59	19.8	11.5	1.4
60 - 64	13.8	17.7	7.0
65 - 69	9.9	18.7	7.7
70 - 74	2.2	4.8	4.9
75 - 79	2.9	6.5	4.9
80 - 84	0.3	3.0	11.2
85 - 89	1.6	5.8	4.2
90 - 94	3.5	6.5	12.5
95 - 99	2.2	3.4	10.5
100 - 104	2.9	5.1	11.2
105 - 109	1.3	2.7	7.0
110 - 114	0.3	1.0	4.2
115 - 119	0.7	3.8	7.7
120 - 124	0.3	0.7	4.9
125 - 129	0.3	0.7	-
> 130	-	0.7	-
Number	313	294	143
Mean length (cm)	63.0	75.4	91.2
Standard deviation	15.8	19.4	18.1
	C. sorrah		
45 - 49	3.3	-	-
50 - 54	3.3	0.6	-
55 - 59	8.6	0.6	-
60 - 64	24.7	11.4	-
65 - 69	20.4	38.6	13.0
70 - 74	20.4	21.5	28.3
75 - 79	4.3	13.3	21.7
80 - 84	5.4	6.9	4.4
85 - 89	6.5	3.8	13.0
90 - 94	3.2	3.2	17.4
95 - 99	-	-	2.2
Number	93	158	46
Mean length (cm)	67.9	71.4	78.8
Standard deviation	10.1	7.3	8.6

TABLE 13 Weighted mean mercury concentrations, based on 'commercial' gillnet catches, for seven species of shark from Northern Territory waters. (Figures in parentheses represent the sample sizes of sharks measured for length frequency).

	Weighted Mean Mercury Concentration (mg/kg)		
	S E X		
SPECIES	MALES	FEMALES	COMBINED
Carcharhinus limbatus	1.46 (1124)	1.47 (1253)	1.47 (2377)
C. sorrah	0.44 (1220)	0.46 (851)	0.45 (2071)
C. fitzroyensis	1.21 (111)	1.00 (56)	1.12 (167)
C. amblyrhynchoides	2.83 (95)	2.08 (5)	2.79 (100)
Sphyrna lewini	1.73 (239)	0.64 (47)	1.67 (286)
S. mokarran	2.18 (37)	3.47 (54)	3.17 (91)
S. blochii	1.17 (210)	1.01 (56)	1.13 (266)

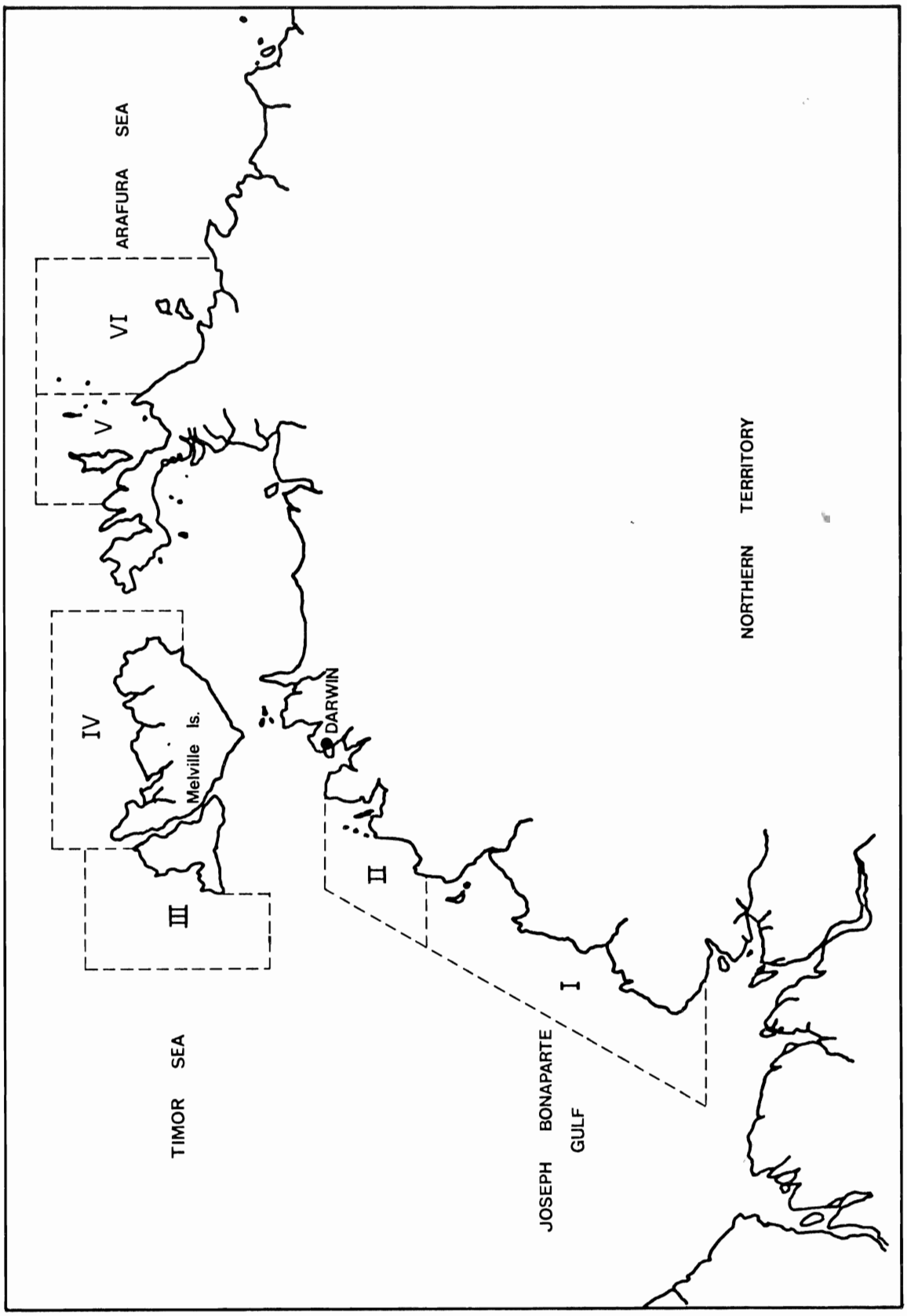

FIGURE 1 Map of localities (designated by roman numerals) in which fishing trials were conducted.

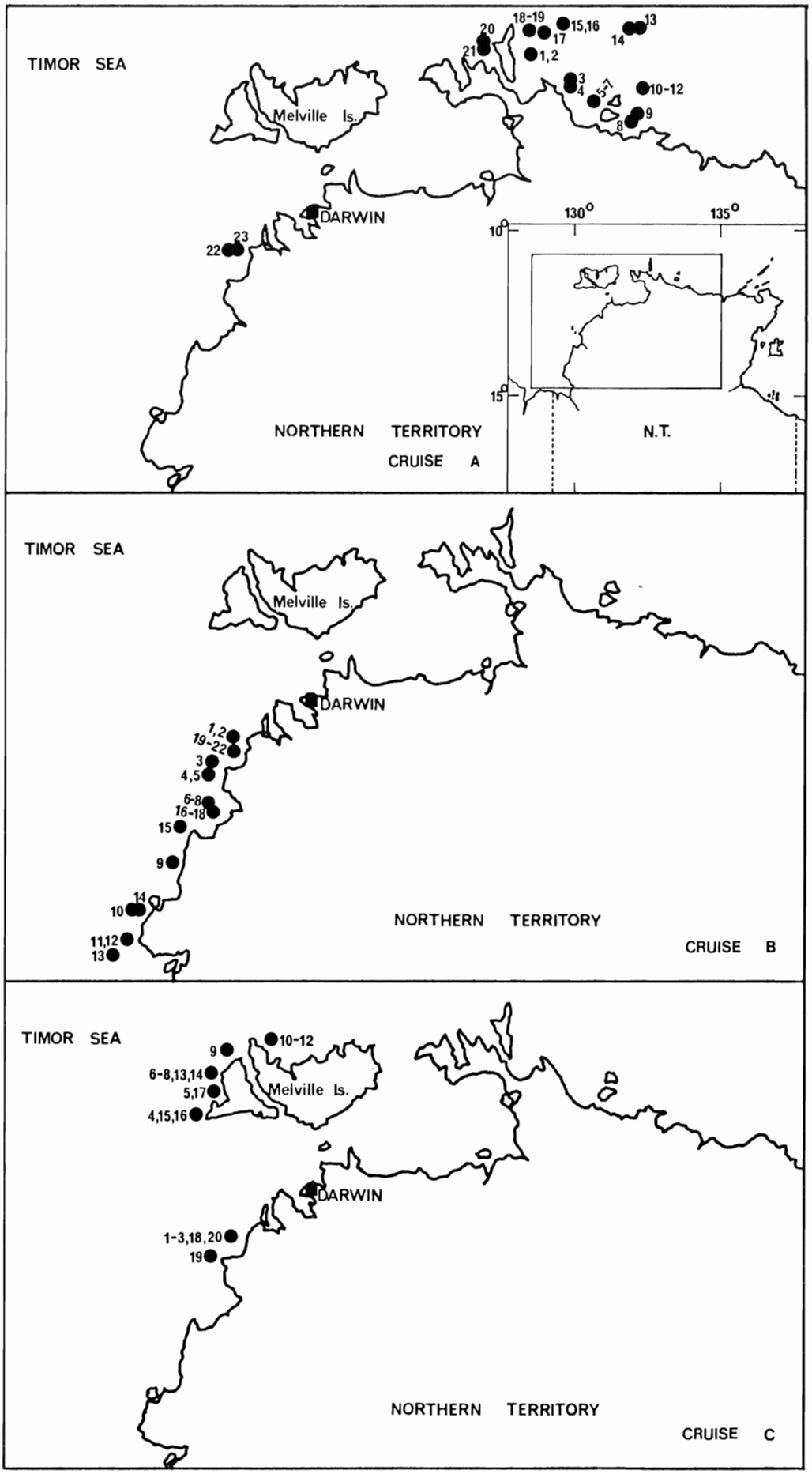

FIGURE 2 General positions of all sets. (Figures represent set codes)

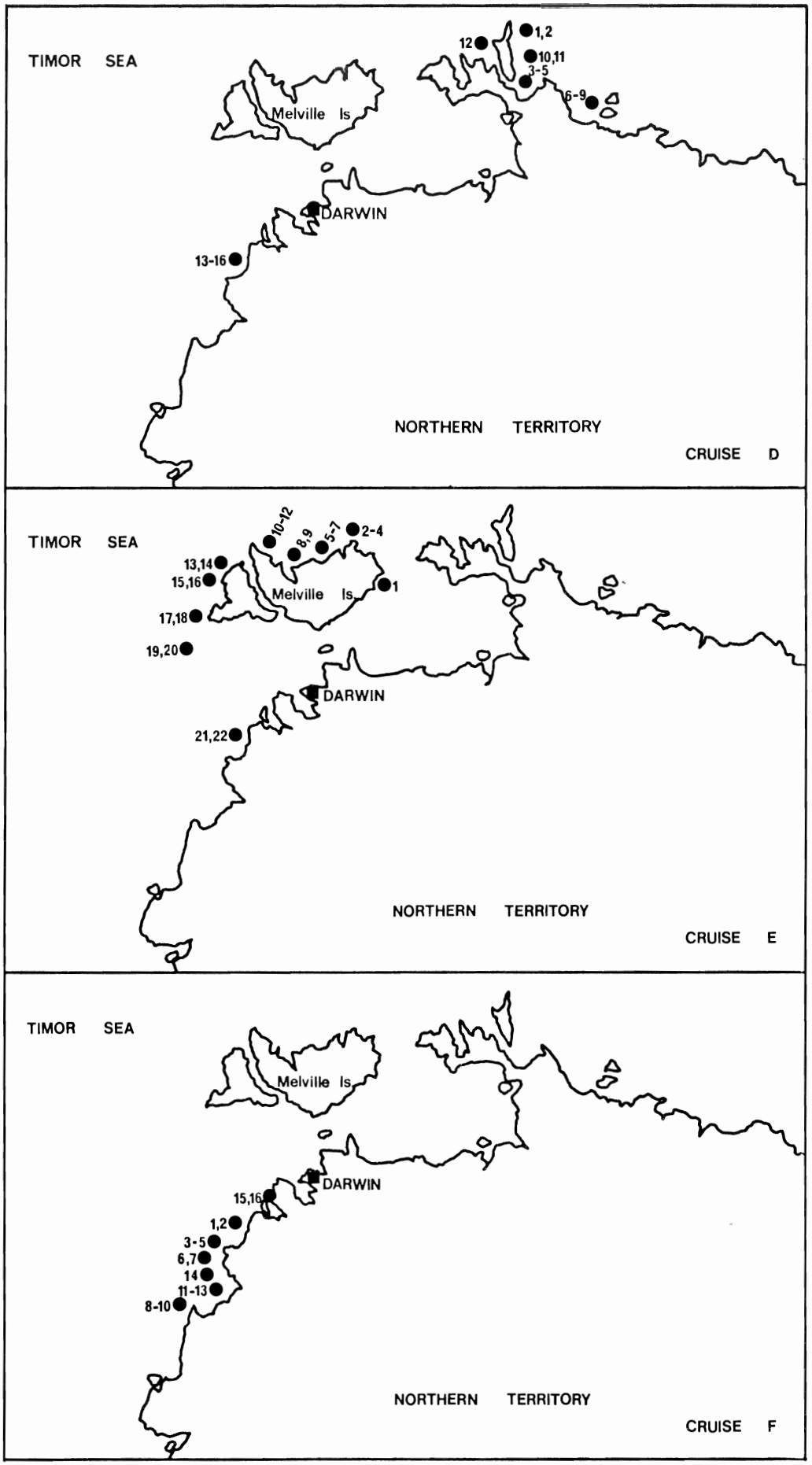

FIGURE 2 (contd.)

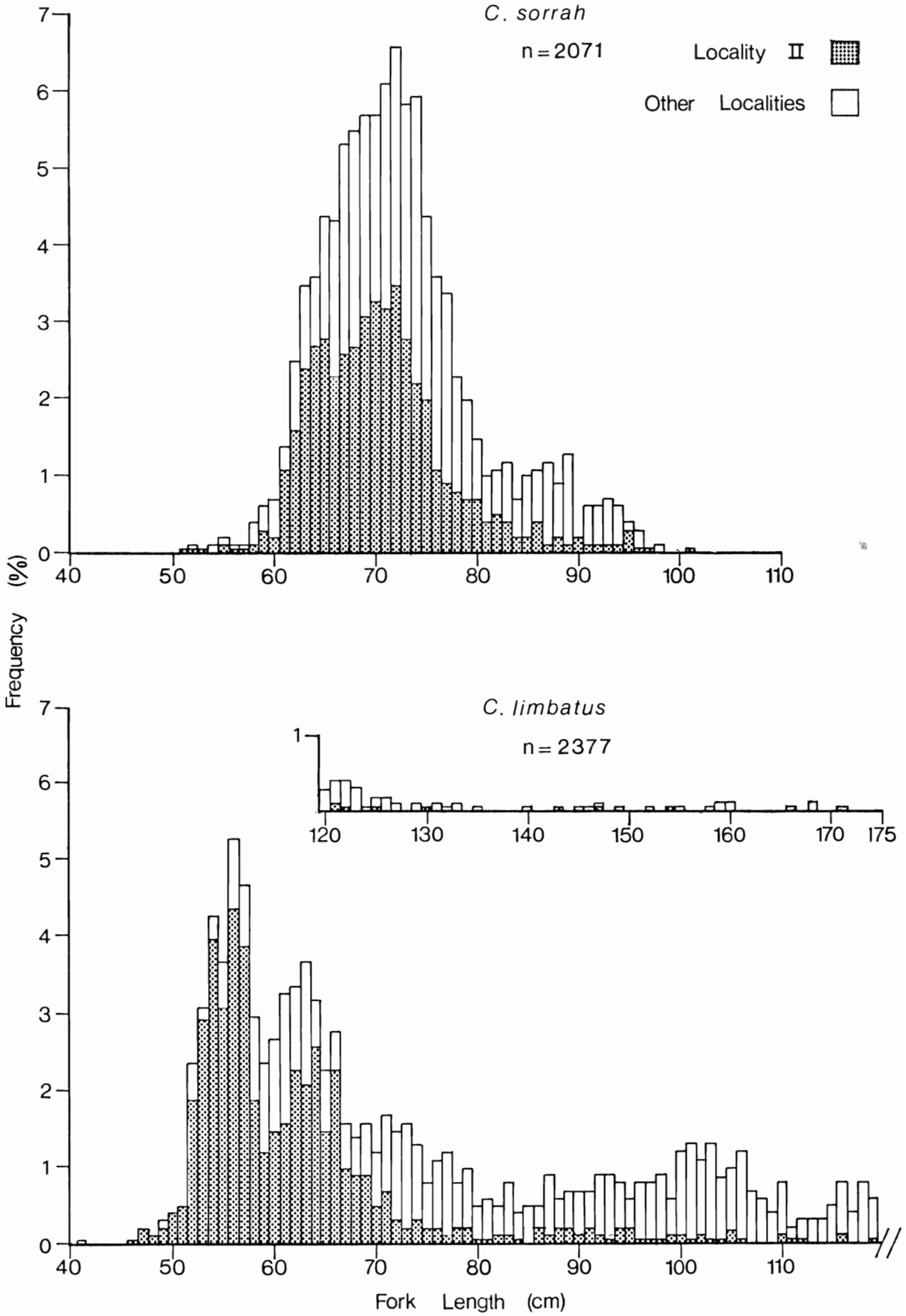

FIGURE 3 Length-frequency distributions for C. *limbatus* and C. *sorrah* caught in the 'commercial' gillnet. Samples from Locality II (Fog Bay) have been highlighted. (n is sample size)

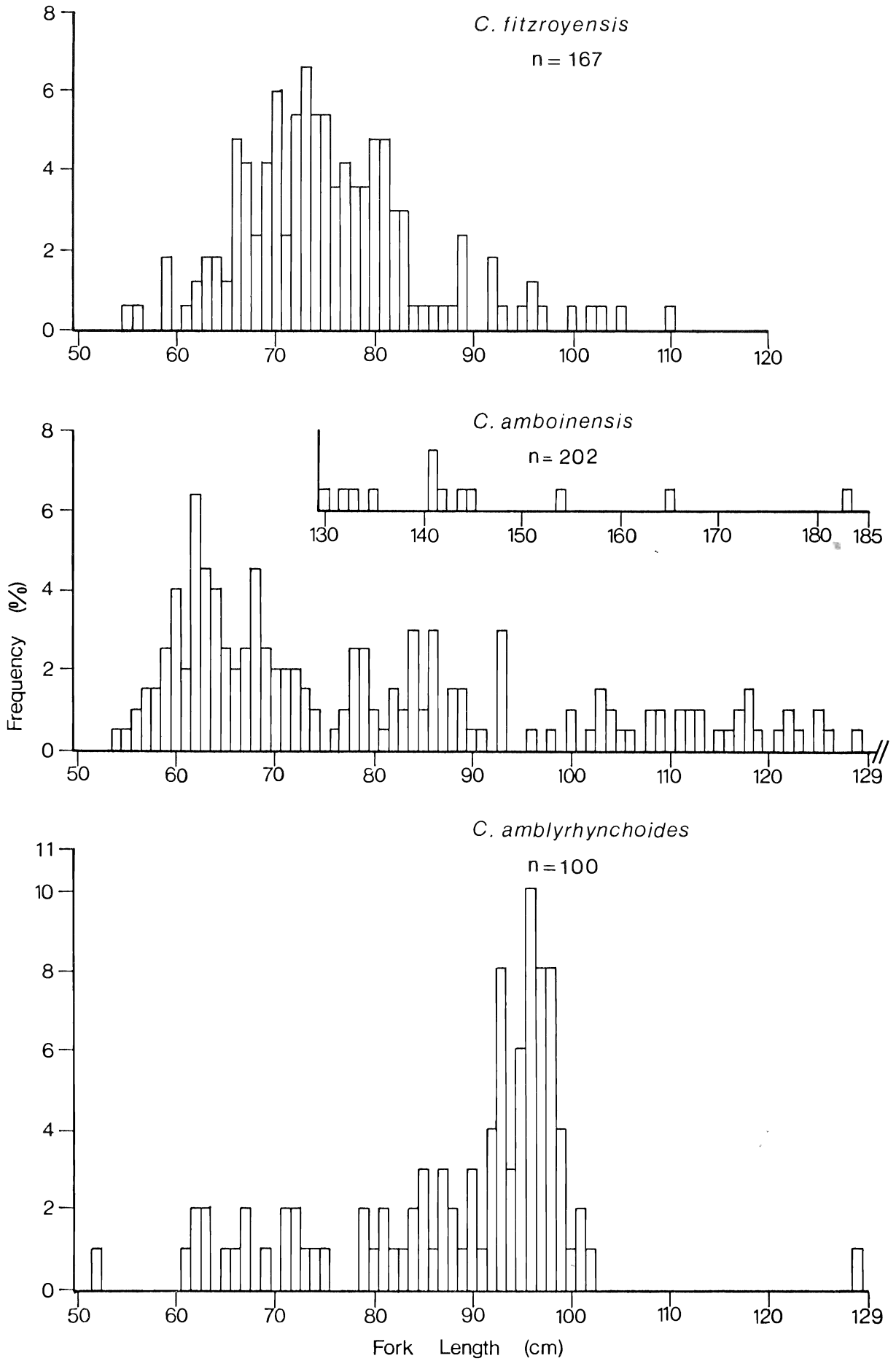

FIGURE 4 Length-frequency distribution for several species of shark caught in the 'commercial' gillnet. (n is sample size)

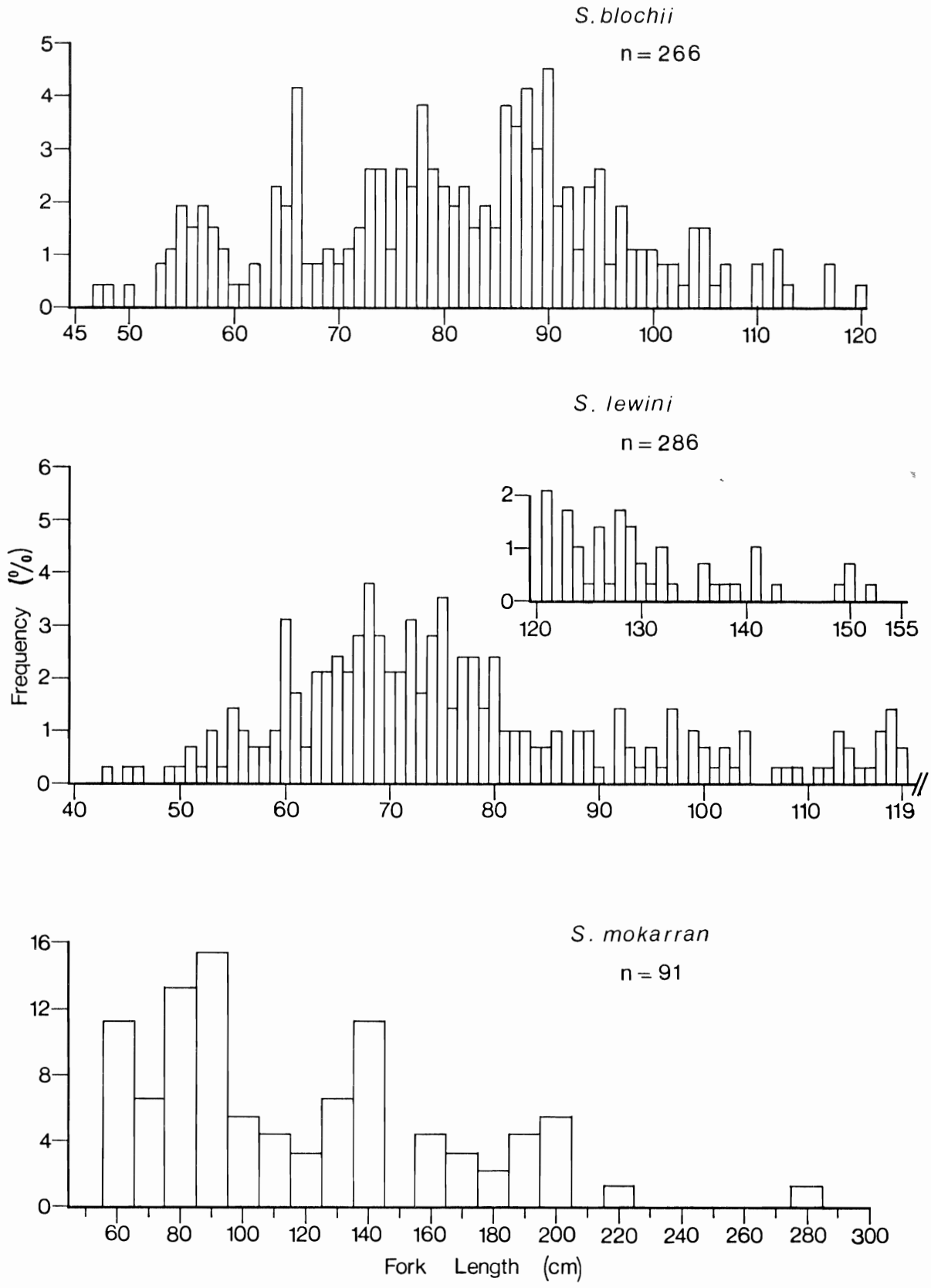

FIGURE 4 (contd.)

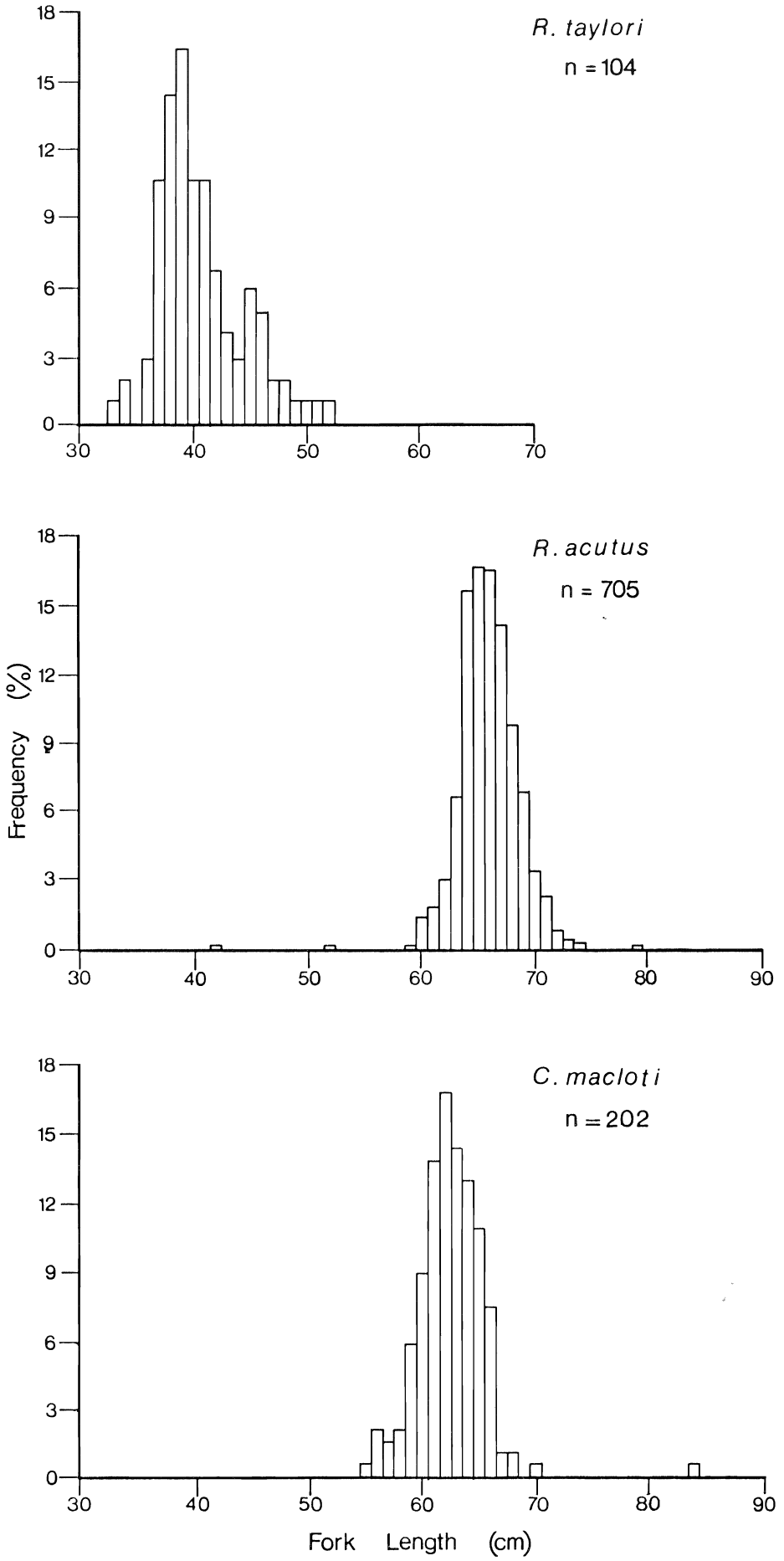

FIGURE 4 (contd.)

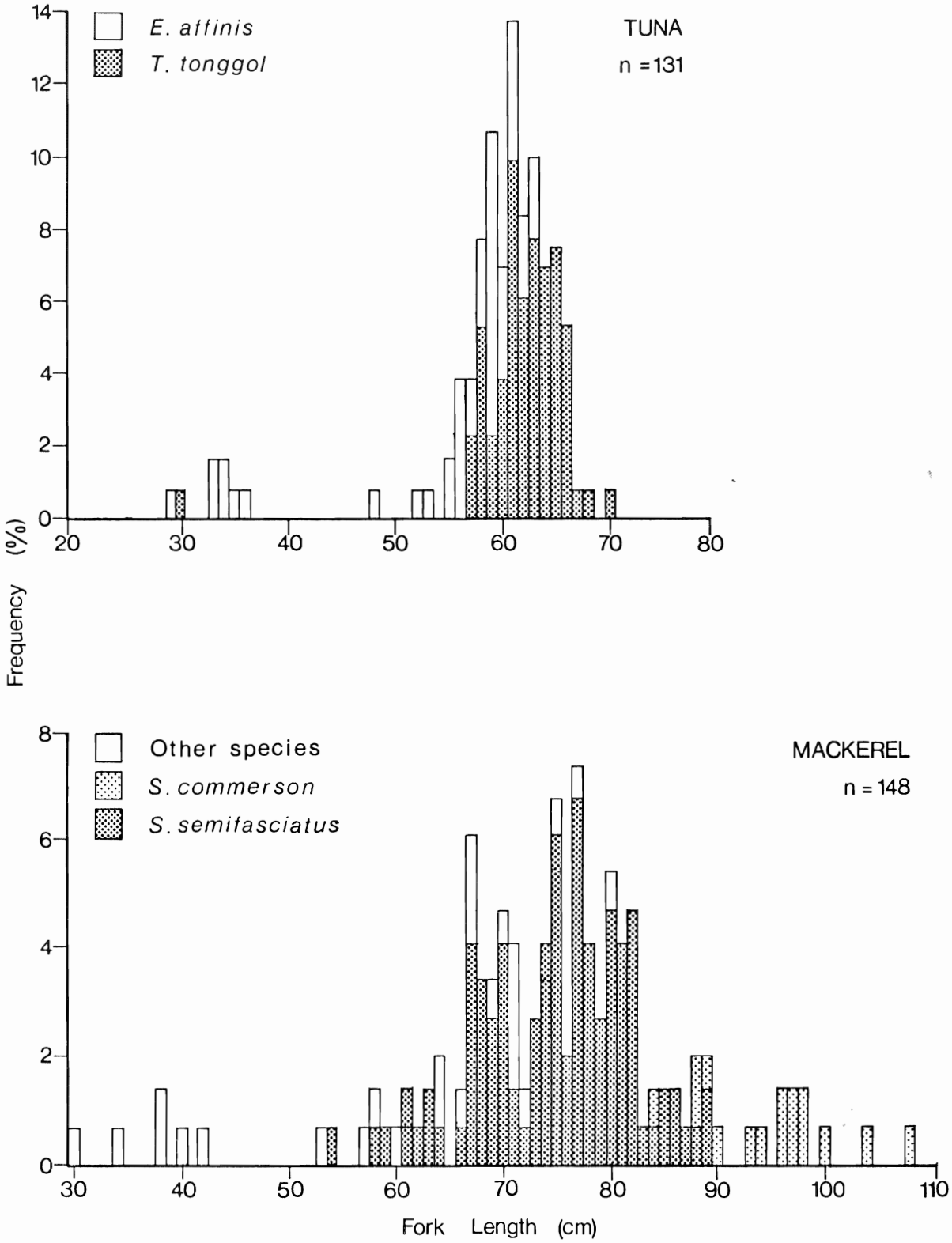

FIGURE 5 Length-frequency distributions for mackerel and tuna caught in the 'commercial' gillnet. (n is sample size)

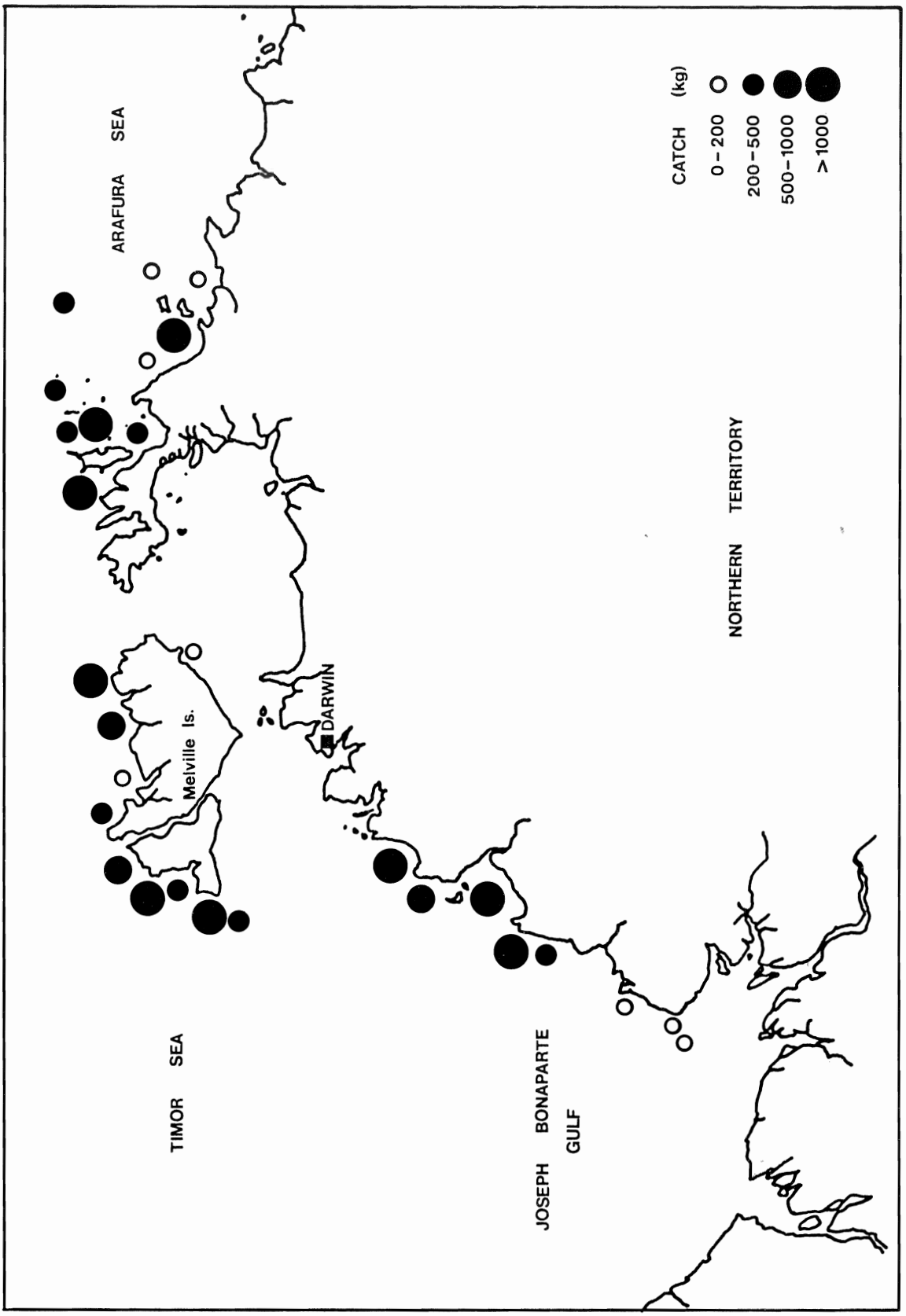

FIGURE 6 'Commercial' Gillnet: Map summary of catch per set over the entire survey period.(where more than one set was made at a particular fishing station, the maximum catch is indicated)

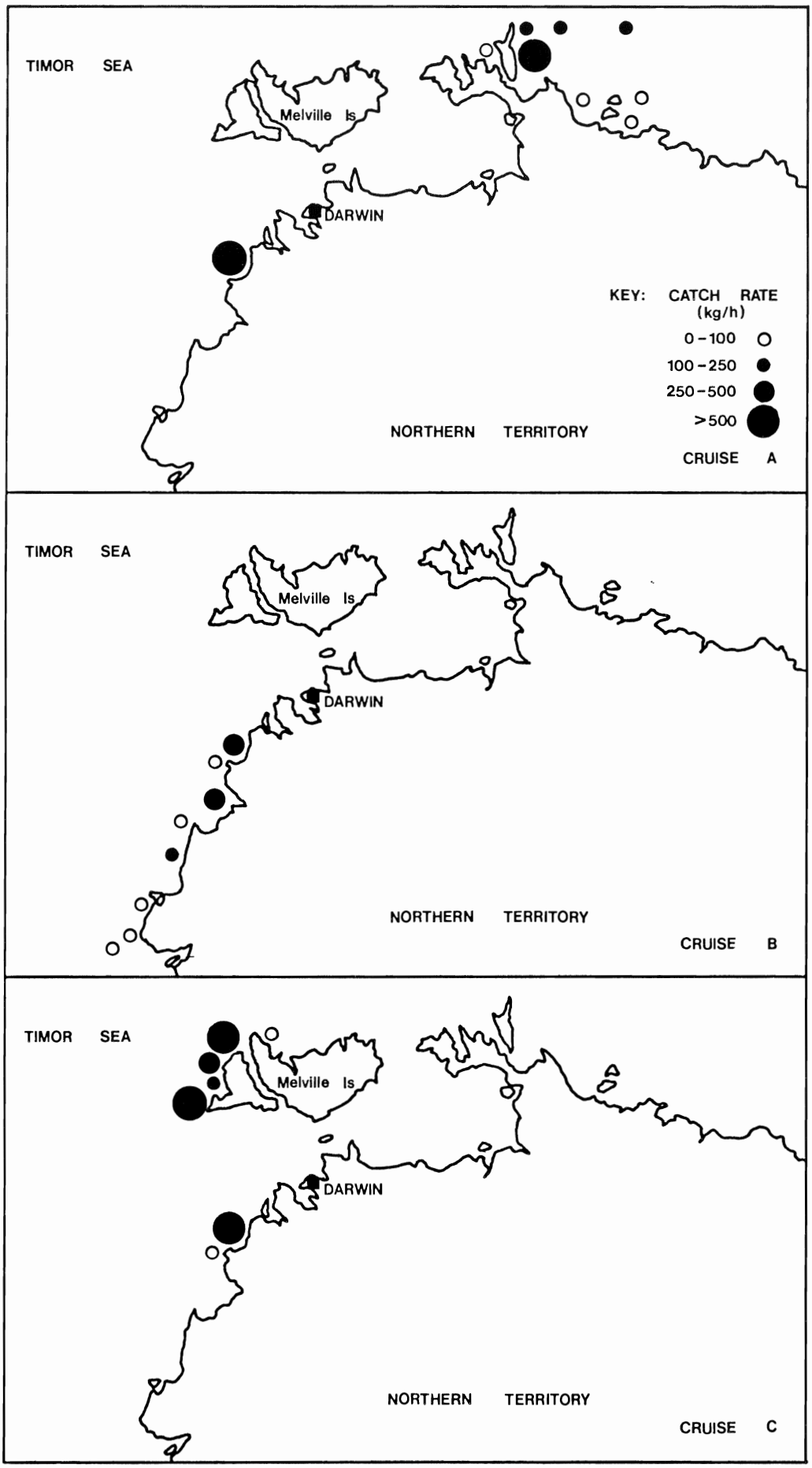

FIGURE 7 'Commercial" Gillnet: Map summary of catch rates by cruise. (where more than one set was made at a particular fishing station, the maximum catch is indicated)

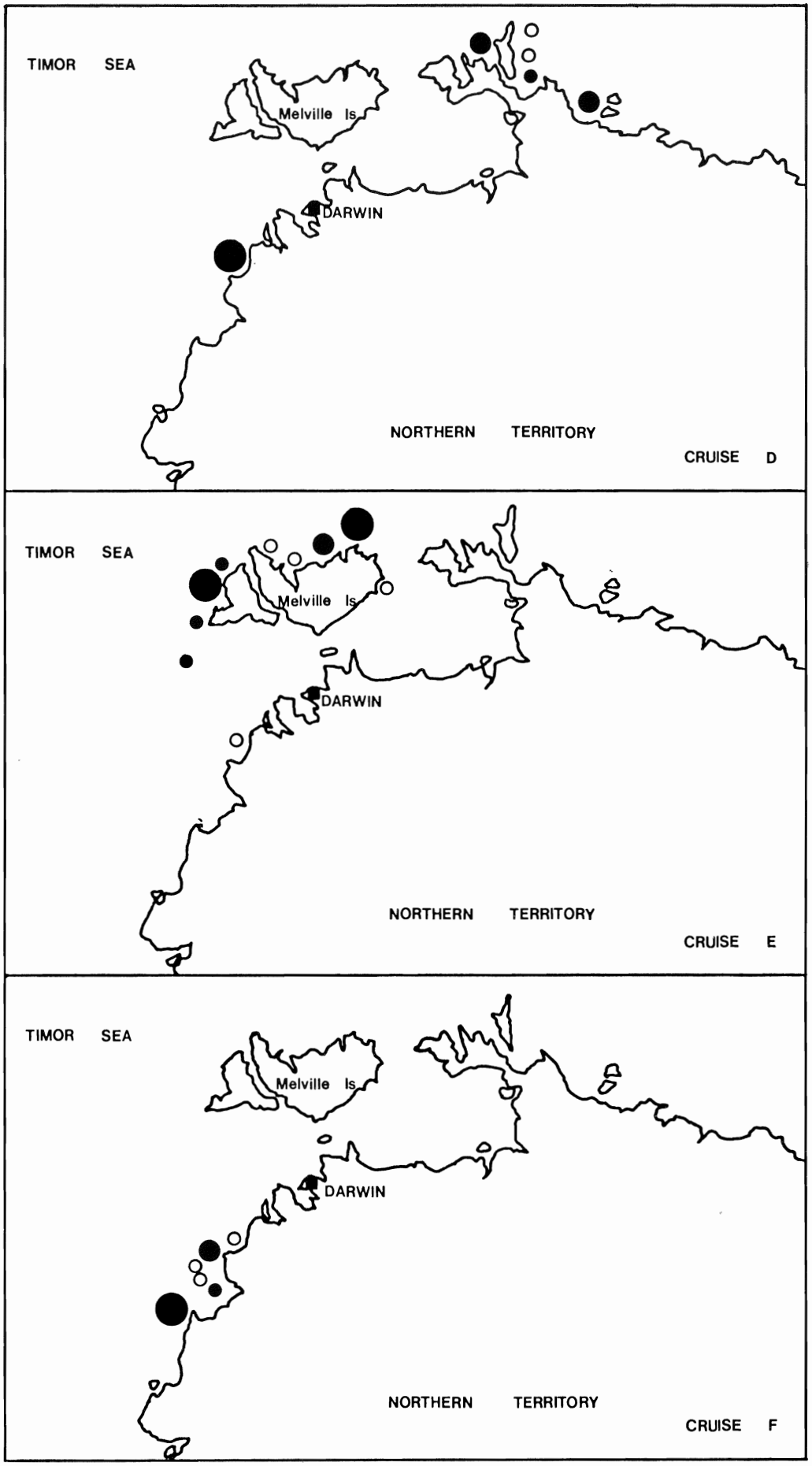

FIGURE 7 (contd.)

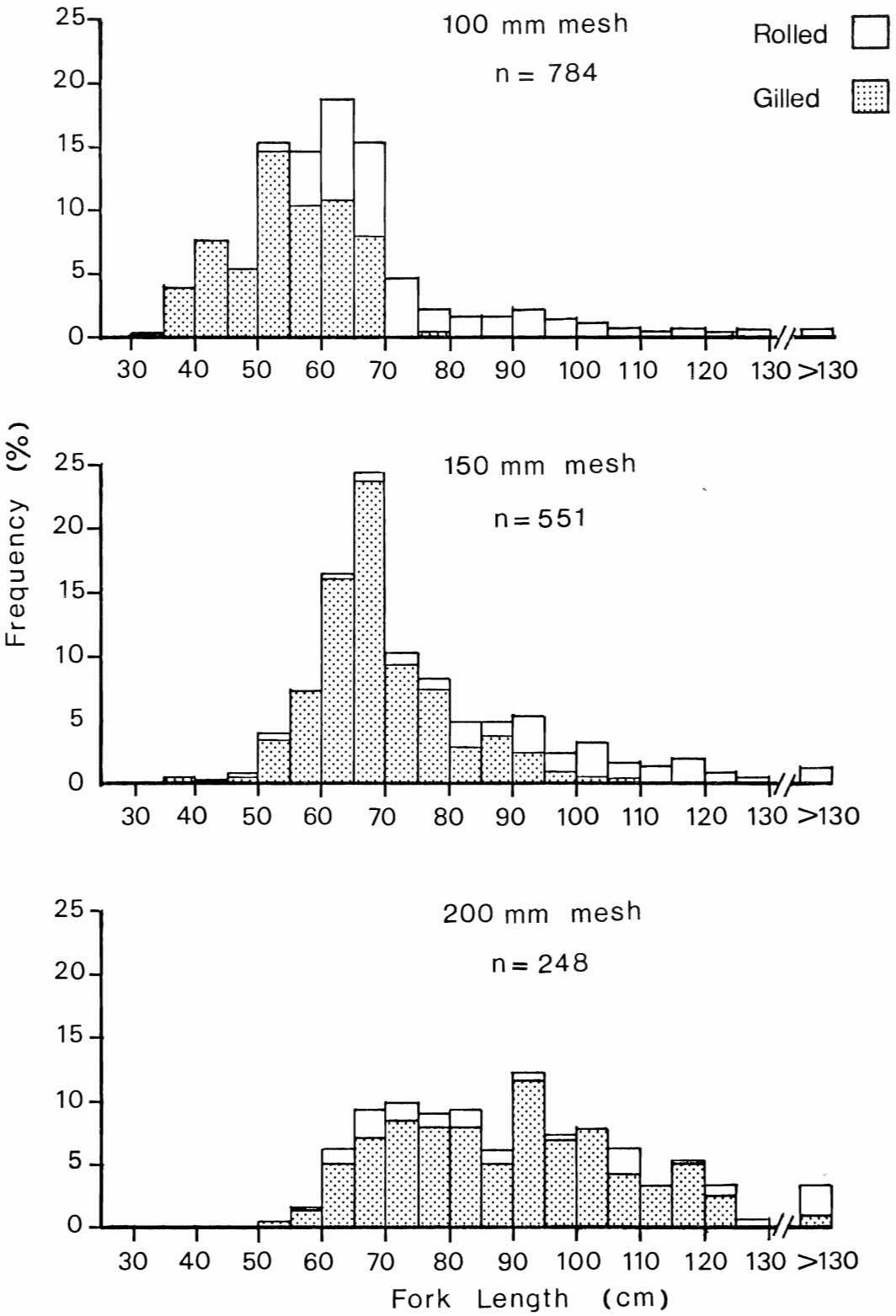

FIGURE 8 Mesh selectivity: Length-frequency distribution by mesh size for the combined shark catch.

(a) *C. limbatus*

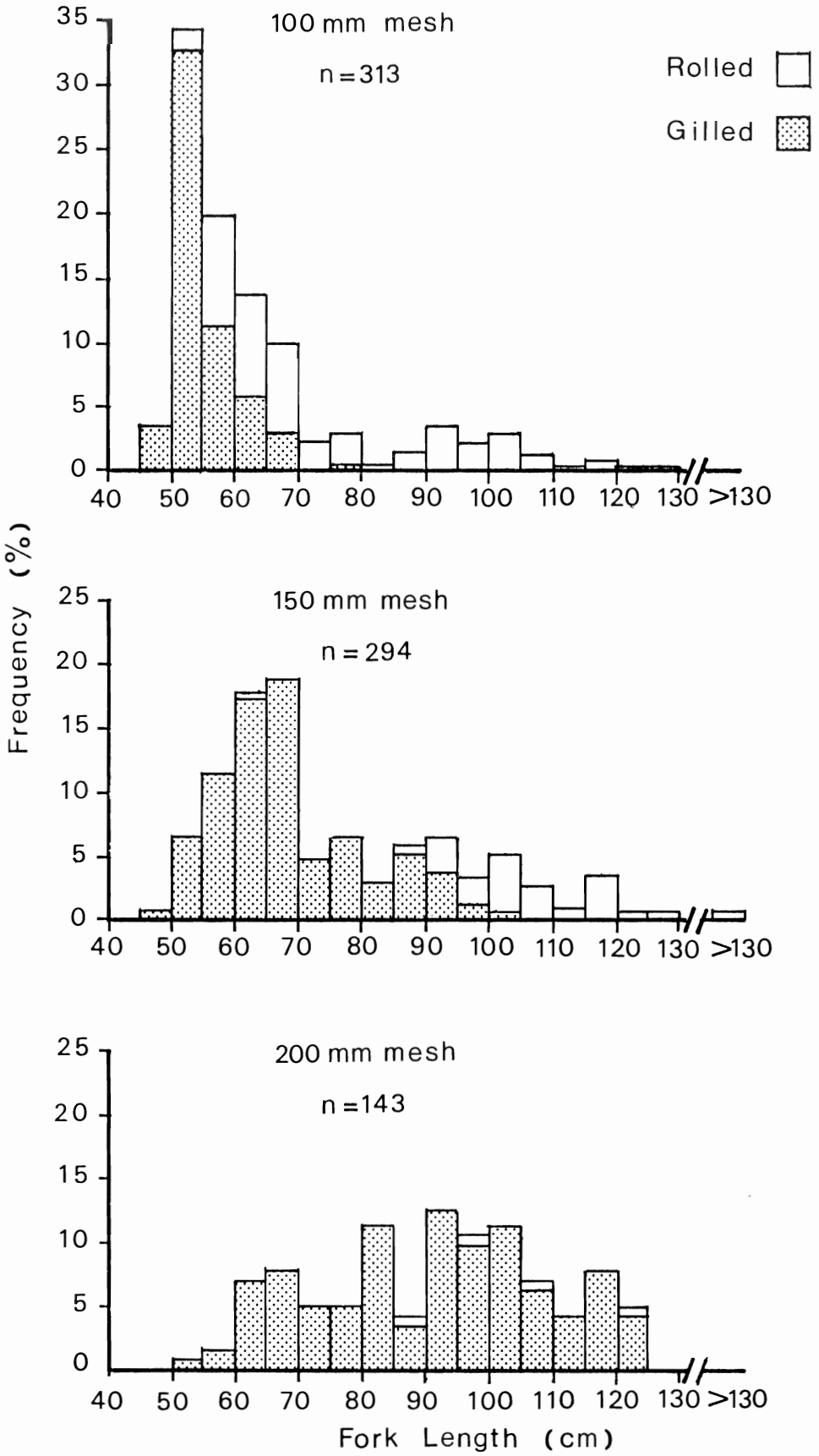

FIGURE 9 Mesh selectivity: Length-frequency distribution by mesh size for (a) *C. limbatus* and (b) *C. sorrah*.

(b) *C. sorrah*

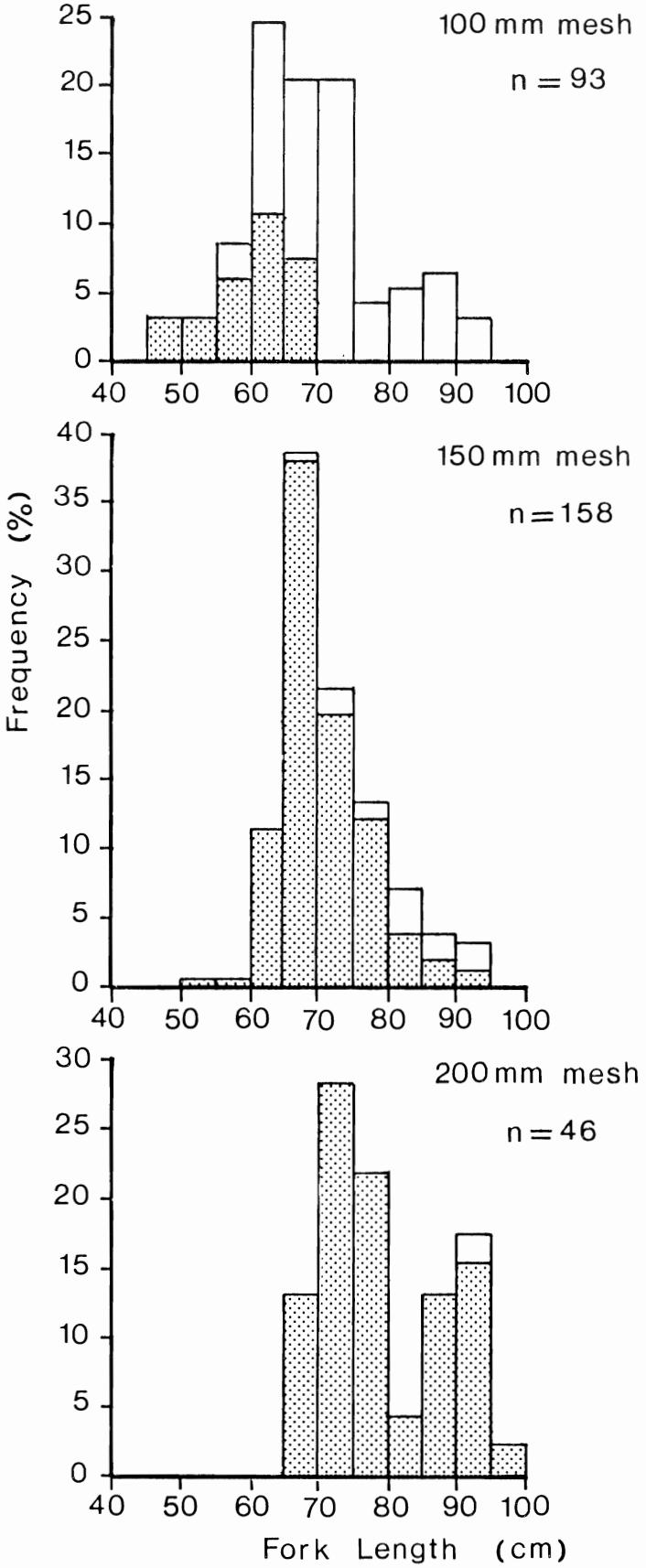

FIGURE 9 (contd.)

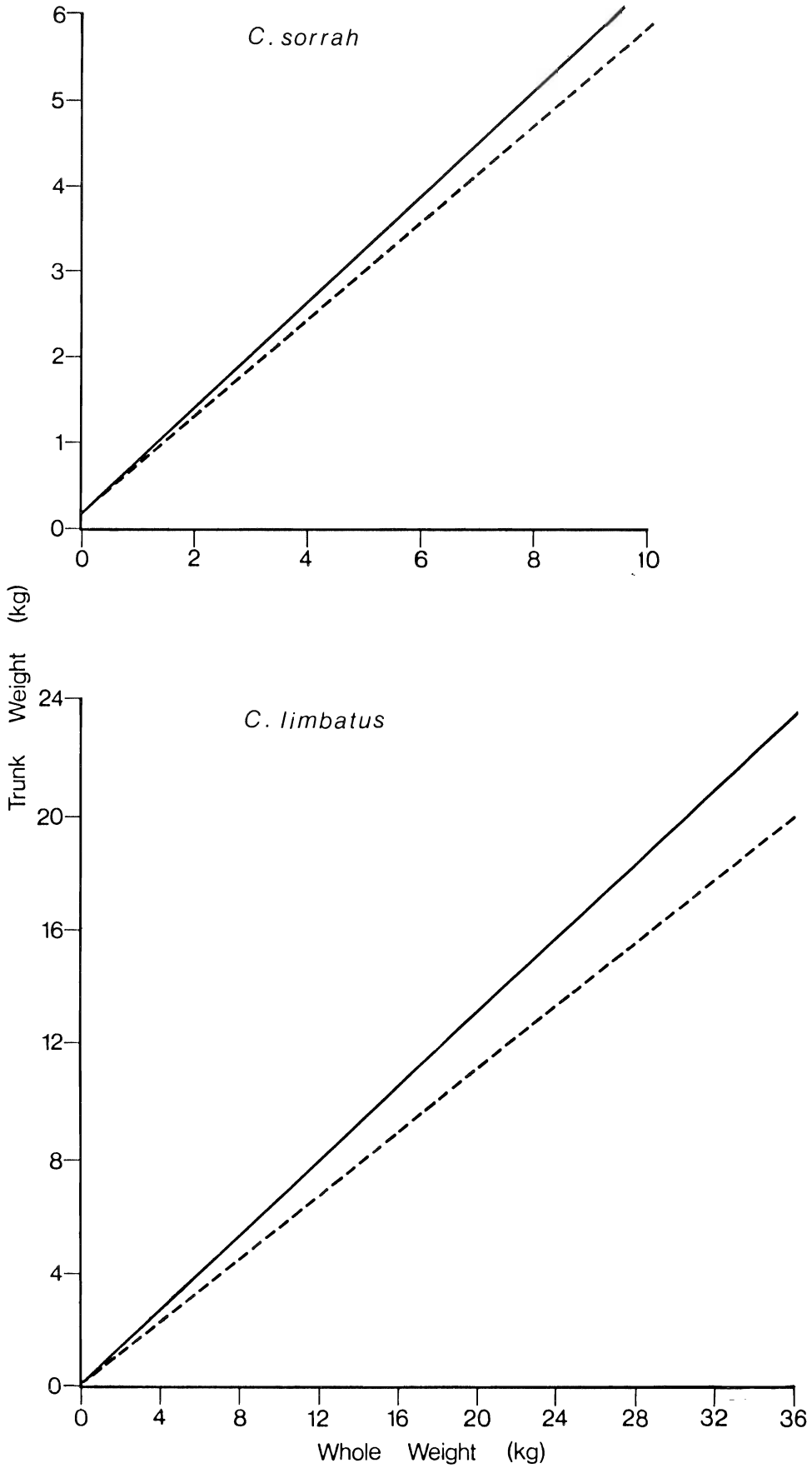

FIGURE 10 Whole weight - trunk weight relationships for *C. limbatus* and *C. sorrah*. ['Fins-on' trunks (——) 'fins-off' trunks (----)]

APPENDIX I Specifications of Fishing Vessel ' RACHEL'.

Survey: Western Australian Survey Standards.

Details of Vessel:

Length	:	21.3 m L.O.A.
Beam	:	6.7 m
Draft	:	3.1 m
Construction	:	Steel
Displacement	:	70.25 tonnes/GRT (Melbourne). 97.44 tonnes.
Date of Construction	:	1975

Main Engine:

Make and Model	:	Kelvin TS-8 Diesel
No. of Cylinders	:	8
RPM	:	1000
Power	:	320 HP

Auxiliaries

Make and Model	:	Dorman 4LDZ
Power	:	71 HP
AC/DC voltages available	:	220/400 AC., 24 D6

Range of Vessel : 3500 nautical miles

Fuel Capacity : 13620 litres

Net Drums

Type of Drive	:	Raymond low pressure hydraulic
Power available	:	25 HP
Retrieving Rate	:	Variable
Drum Diameter	:	1800 mm
Drum Width	:	1300 mm

APPENDIX I (contd.)

Fish Handling and Holding

Refrigeration

Blast freezer	:	Twin Kelvinator
Capacity	:	3000 kg, throughput per 24 h - 3000 kg
Holding Capacity	:	1200 kg (40 m^3)
Holding Temperature	:	-30°C
Refrigerated Sea Water Tank Capacity	:	14000 kg, immersion

Navigation

1. Echo Sounder

Make and Model	:	Furuno FUV 12
Depth Range	:	500 fathoms
Frequency	:	28 and 200 KHz

2. Radar

Make and Model	:	Furuno FRC - 40
Range	:	113 km

3. Satellite Navigator

Make and Model	:	Magnavox MX 4102

4. R.D.F.

Make and Model	:	Furuno Automatic ADF - 5

APPENDIX II Fork length - total length relationships for several species of shark from Northern Territory waters.* TL is total length (cm), FL is fork length (cm) and r is the correlation coefficient.

SPECIES	NUMBER	EQUATION	r**
Carcharhinus limbatus	536	TL = 1.903 + 1.242 FL	0.999
C. sorrah	344	TL = 7.831 + 1.175 FL	0.997
C. fitzroyensis	175	TL = 4.168 + 1.194 FL	0.998
C. amblyrhynchoides	90	TL = 1.763 + 1.235 FL	0.998
C. amboinensis	173	TL = 0.783 + 1.269 FL	0.999
C. macloti	132	TL = 5.153 + 1.160 FL	0.989
C. dussumieri	50	TL = 4.441 + 1.144 FL	0.990
Sphyrna lewini	188	TL = 0.167 + 1.321 FL	0.999
S. mokarran	89	TL = 1.799 + 1.318 FL	0.997
S. blochii	263	TL = 2.823 + 1.313 FL	0.998
Rhizoprionodon acutus	330	TL = 6.057 + 1.144 FL	0.984
R. taylori	200	TL = 1.638 + 1.173 FL	0.986

** All relationships highly significant ($p < 0.01$).

* Total length was determined with the upper lobe of the caudal fin extended parallel to the body axis.

APPENDIX III Length - weight relationships for several species of sharks and teleosts from Northern Territory waters. FL is fork length (cm), W is weight (kg) and r is the correlation coefficient based on the linear regression of ln(W) and ln(FL).

SPECIES	NUMBER	EQUATION	r**
SHARKS			
Carcharhinus limbatus	404	$W=(4.52\times10^{-6})FL^{3.206}$	0.997
C. sorrah	390	$W=(2.29\times10^{-6})FL^{3.355}$	0.977
C. fitzroyensis	104	$W=(5.11\times10^{-6})FL^{3.166}$	0.978
C. amblyrhynchoides	63	$W=(9.01\times10^{-6})FL^{3.093}$	0.991
C. amboinensis	83	$W=(4.67\times10^{-6})FL^{3.251}$	0.986
C. macloti	77	$W=(2.06\times10^{-6})FL^{3.328}$	0.923
C. dussumieri	45	$W=(2.38\times10^{-6})FL^{3.317}$	0.886
Sphyrna lewini	141	$W=(7.97\times10^{-6})FL^{3.048}$	0.996
S. mokarran	68	$W=(3.94\times10^{-6})FL^{3.182}$	0.996
S. blochii	177	$W=(1.16\times10^{-6})FL^{3.468}$	0.988
Rhizoprionodon acutus	177	$W=(3.17\times10^{-6})FL^{3.209}$	0.905
R. taylori	132	$W=(7.15\times10^{-7})FL^{3.612}$	0.892
TELEOSTS			
Scomberomorus commerson	24	$W=(8.35\times10^{-6})FL^{2.983}$	0.988
S. munroi	27	$W=(4.34\times10^{-6})FL^{3.164}$	0.993
S. semifasciatus	148	$W=(1.94\times10^{-5})FL^{2.827}$	0.978
S. queenslandicus	15	$W=(1.93\times10^{-5})FL^{2.784}$	0.973
Apolectus niger	129	$W=(6.28\times10^{-5})FL^{2.713}$	0.939
Eleutheronema tetradactylum	84	$W=(2.52\times10^{-6})FL^{3.463}$	0.975
Thunnus tonggol	81	$W=(4.66\times10^{-5})FL^{2.747}$	0.978
Euthynnus affinis	50	$W=(4.34\times10^{-5})FL^{2.763}$	0.992

** All relationships highly significant ($p<0.01$).

APPENDIX IV Summary of set details: Cruise A

(GN = commercial gillnet; MS = mesh selectivity gillnets; LL = longline)

SET CODE	DATE	POSITION OF SET		START OF SET		POSITION AT HAUL		TIME OF HAUL		DEPTH (m)	SEA CONDITIONS
		LAT.	LONG	START	FINISH	LAT.	LONG.	START	FINISH		
A01(GN)	2.2.83	11°06'	132°44'	1104	1150	11°04'	132°42'	1404	1630	36 - 38	Calm
A02(GN)	2/3.2.83	11°06'	132°45'	1850	1919	11°08'	132°45'	2208	0415	40 - 46	Slight
A03(LL)	3.2.83	11°24'	133°05'	1640	1655	11°24'	133°05'	1830	1852	31	Calm
A04(GN)	3.2.83	11°26'	133°26'	1911	1937	11°25'	133°06'	2123	2220	31 - 33	Calm
A05(MS)	4.2.83	11°31'	133°16'	0953	1017	11°32'	133°17'	1315	1340	25	Calm
A06(LL)	4.2.83	11°33'	133°16'	1418	1430	11°33'	133°16'	1628	1643	25	Calm
A07(MS)	4.2.83	11°32'	133°16'	1838	1853	11°33'	133°17'	2210	2315	21 - 24	Calm
A08(GN)	5.2.83	11°42'	133°35'	1840	1902	11°43'	133°34'	2045	2118	17 - 18	Slight
A09(MS)	5/6.2.83	11°40'	133°37'	2205	2219	11°40'	133°36'	0410	0607	19 - 20	Slight
A10(GN)	6.2.83	11°24'	133°38'	1625	1650	11°24'	133°38'	1850	1920	28 - 30	Slight
A11(GN)	6.2.83	11°25'	133°38'	1930	1954	11°27'	133°38'	2200	2235	27 - 28	Slight/Moderate
A12(GN)	6/7.2.83	11°17'	133°38'	2345	0010	11°18'	133°38'	0205	0245	29 - 35	Slight/Moderate
A13(GN)	7.2.83	10°50'	133°29'	1840	1900	10°50'	133°29'	2110	2210	60	Calm/Slight
A14(MS)	7/8.2.83	10°50'	133°25'	2222	2239	10°50'	133°28'	0625	0700	60 - 61	Moderate/Rough
A15(GN)	8.2.83	10°53'	132°59'	1555	1618	10°53'	132°59'	1825	1925	39 - 40	Slight
A16(GN)	8.2.83	10°53'	132°59'	1932	1957	10°53'	132°59'	2205	2316	39	Slight/Moderate
A17(MS)	9.2.83	10°57'	132°46'	1335	1345	11°00'	132°46'	1710	1750	25	Slight
A18(GN)	9.2.83	10°56'	133°40'	1845	1910	10°57'	133°40'	2125	2225	24 - 37	Slight
A19(MS)	9/10.2.83	11°00'	133°42'	2308	2330	11°01'	133°42'	0310	0415	38 - 43	Slight
A20(GN)	10.2.83	10°59'	132°25'	1825	1847	10°59'	132°27'	2115	2220	17 - 20	Calm
A21(LL)	11.2.83	11°02'	132°25'	0012	0025	11°02'	132°25'	0220	0250	12 - 13	Calm
A22(GN)	12.2.83	12°39'	130°12'	1430	1452	12°40'	130°15'	1700	1825	18 - 20	Slight/Moderate
A23(GN)	12/13.2.83	12°39'	130°15'	1915	1937	12°38'	130°15'	2137	0155	18 - 19	Slight

Appendix IV (contd.) : Cruise B

SET CODE	DATE	POSITION OF SET LAT.	POSITION OF SET LONG	START OF SET START	START OF SET FINISH	POSITION AT HAUL LAT.	POSITION AT HAUL LONG.	TIME OF HAUL START	TIME OF HAUL FINISH	DEPTH (m)	SEA CONDITIONS
B01(GN)	7.4.83	12°45'	130°10'	1534	1555	12°45'	130°11'	1755	1859	18 - 19	Calm
B02(GN)	7.4.83	12°44'	130°10'	1916	1943	12°44'	130°08'	2205	2350	20	Calm
B03(MS)	8.4.83	12°55'	129°55'	1137	1151	12°58'	129°59'	1558	1628	18	Slight
B04(GN)	8.4.83	12°58'	129°59'	1812	1832	12°58'	129°58'	2046	2130	17 - 18	Slight
B05(MS)	8/9.4.83	12°58'	129°58'	2148	2206	12°59'	127°57'	0030	0115	16 - 17	Calm
B06(GN)	9.4.83	13°20'	129°59'	1323	1347	13°21'	129°59'	1553	1701	24 - 27	Slight
B07(GN)	9.4.83	13°21'	129°58'	1801	1825	13°21'	129°58'	2035	2208	27	Slight
B08(LL)	9/10.4.83	13°19'	130°00'	2250	2320	13°19'	130°00'	0200	0230	28	Calm
B09(GN)*	10.4.83	13°45'	129°38'	1820	1842	13°44'	129°37'	2056	2230	21 - 23	Calm
B10(GN)	11.4.83	14°12'	129°22'	1353	1415	14°16'	129°21'	1614	1708	19 - 25	Calm
B11(GN)	11.4.83	14°20'	129°20'	1818	1846	14°18'	129°18'	2102	2151	23 - 25	Slight
B12(MS)	11/12.4.83	14°15'	129°20'	2206	2222	14°10'	129°20'	0110	0138	20 - 22	Calm
B13(GN)	12.4.83	14°19'	129°08'	1311	1336	14°18'	129°07'	1550	1630	23 - 27	Moderate
B14(GN)	12.4.83	14°10'	129°26'	1940	2002	14°06'	129°26'	2203	2309	17 - 19	Slight
B15(GN)	13.4.83	13°25'	129°48'	1540	1612	13°26'	129°48'	1812	1837	19	Slight
B16(GN)	13/14.4.83	13°23'	129°58'	2010	2030	13°20'	129°56'	2343	0036	24 - 25	Slight
B17(GN)	14.4.83	13°17'	129°53'	0112	0132	13°17'	129°53'	0347	0440	22 - 24	Slight
B18(GN)	14/15.4.83	13°23'	130°04'	1836	1934+	13°22'	130°00'	2335	0206	17 - 18	Slight
B19(GN)	15.4.83	12°48'	130°14'	1819	1841	12°47'	130°13'	2050	2314	15	Slight
B20(MS)	15/16.4.83	12°45'	130°10'	0028	0046	12°45'	130°10'	0254	0340	15 - 16	Calm
B21(MS)	16.4.83	12°47'	130°13'	1343	1355	12°48'	130°14'	1640	1730	13 - 14	Calm
B22(LL)	16.4.83	12°44'	130°16'	1847	1901	12°44'	130°16'	2136	2153	11 - 12	Calm

* End of net tangled around propeller - approx. 5 m of net was lost.

Appendix IV (contd.) : Cruise C

SET CODE	DATE	POSITION OF SET LAT.	POSITION OF SET LONG	START OF SET START	START OF SET FINISH	POSITION AT HAUL LAT.	POSITION AT HAUL LONG.	TIME OF HAUL START	TIME OF HAUL FINISH	DEPTH (m)	SEA CONDITIONS
C01(GN)	23.5.83	12°46'	130°14'	0016	0044	12°46'	130°15'	0254	0605	12 - 14	Calm
C02(GN)	23.5.83	12°45'	130°14'	1348	1409	12°45'	130°14'	1611	1811	14 - 15	Calm
C03(MS)	23.5.83	12°44'	130°14'	1850	1905	12°43'	130°13'	2152	2338	14 - 15	Calm
C04(GN)	24/25.5.83	11°42'	130°01'	1907	1934	11°38'	130°01'	2155	0040	23 - 27	Calm
C05(GN)	25.5.83	11°27'	130°05'	1331	1352	11°28'	130°04'	1555	1656	23 - 31	Calm
C06(GN)	25.5.83	11°21'	130°05'	1830	1855	11°23'	130°05'	2100	2233	13 - 16	Calm
C07(MS)	25/26.5.83	11°19'	130°05'	2307	2323	11°20'	130°05'	0123	0210	14 - 15	Calm
C08(GN)	26.5.83	11°15'	130°03'	1253	1318	11°17'	130°02'	1535	1606	29 - 36	Calm
C09(GN)	26.5.83	11°07'	130°07'	1822	1845	11°07'	130°07'	2008***	2132	18 - 24	Calm
C10(GN)	28.5.83	11°13'	130°34'	1400	1422	11°13'	130°32'	1635	1724	18 - 19	Moderate
C11(GN)	28.5.83	11°12'	130°33'	1822	1844	11°12'	130°31'	2058	2150	20 - 21	Moderate
C12(MS)	28/29.5.83	11°12'	130°31'	2219	2236	11°12'	130°29'	0002	0048	14 - 17	Slight
C13(GN)	29.5.83	11°19'	130°05'	1810	1834	11°16'	130°04'	2035	2200	15 - 17	Slight
C14(MS)	29/30.5.83	11°17'	130°06'	2237	2250	11°21'	130°00'	0057	0138	13 - 22	Slight
C15(GN)	30.5.83	11°42'	130°00'	1455	1519	11°43'	129°59'	1727	1759	31 - 58	Slight
C16(GN)	30.5.83	11°38'	130°02'	1915	1940	11°36'	130°02'	2157	2255	17 - 20	Slight
C17(MS)	31.5.83	11°36'	130°01'	0021	0034	11°35'	130°00'	0240	0308	17 - 21	Calm
C18(MS)	31.5-1.6.83	12°47'	130°14'	2318	2333	12°45'	130°01'	0132	0237	12 - 13	Slight
C19(GN)	1.6.83	12°55'	130°05'	1452	1514	12°53'	130°05'	1718	1820	13 - 15	Calm
C20(GN)	1.6.83	12°48'	130°14'	1930	1953	12°48'	130°13'	2204	0020	13	Calm

*** Hauled early due to wind change.

Appendix IV (contd.) : Cruise D

SET CODE	DATE	POSITION OF SET		START OF SET		POSITION AT HAUL		TIME OF HAUL		DEPTH (m)	SEA CONDITIONS
		LAT.	LONG	START	FINISH	LAT.	LONG.	START	FINISH		
D01(GN)	28.8.83	10°59'	132°48'	1322	1343	10°59'	132°46'	1549	1623	19 - 23	Slight/Moderate
D02(GN)	28.8.83	11°01'	132°47'	1815	1836	11°04'	132°49'	2042	2142	18 - 28	Slight
D03(GN)	29.8.83	11°22'	132°44'	1334	1353	11°23'	132°42'	1601	1645	14	Slight
D04(GN)	29.8.83	11°25'	132°46'	1812	1833	11°25'	132°45'	2043	2200	13 - 14	Slight
D05(MS)	29.8.83	11°25'	132°46'	2251	2306	11°25'	132°45'	0104	0133	14 - 16	Slight
D06(GN)	30.8.83	11°33'	133°20'	1812	1835	11°35'	133°21'	2100	2225	16 - 22	Slight
D07(MS)	30/31.8.83	11°37'	133°20'	2306	2320	11°37'	133°19'	0131	0211	15 - 20	Slight
D08(GN)	31.8.83	11°39'	133°17'	1356	1415	11°40'	133°15'	1620	1700	12 - 13	Slight
D09(GN)	31.8.83	11°38'	133°18'	1755	1808	11°40'	133°17'	2123	0043	14	Slight
D10(GN)	1.9.83	11°10'	132°51'	1812	1837	11°11'	132°49'	2048	2128	22 - 31	Slight
D11(MS)	1/2.9.83	11°05'	132°50'	2236	2254	11°07'	132°49'	0209	0415	22 - 25	Slight
D12(GN)	2/3.9.83	11°05'	132°26'	1813	1838	11°06'	132°25'	2155	0020	11 - 12	Slight
D13(GN)	4.9.83	12°45'	130°14'	1321	1343	12°46'	130°15'	1550	1628	16	Calm
D14(GN)	4/5.9.83	12°45'	130°13'	1830	1855	12°45'	130°13'	2103	0146	14 - 16	Calm
D15(GN)	5.9.83	12°45'	130°14'	1343	1403	12°46'	120°14'	1608	1700	16 - 17	Calm
D16(MS)	5.9.83	12°45'	130°14'	1815	1830	12°45'	130°15'	2000	2050	14 - 16	Calm

Appendix IV (contd.) : Cruise E

SET CODE	DATE	POSITION OF SET		START OF SET		POSITION AT HAUL		TIME OF HAUL		DEPTH (m)	SEA CONDITIONS
		LAT.	LONG	START	FINISH	LAT.	LONG.	START	FINISH		
E01(GN)	18/19.10.83	11°33'	131°34'	2041	2104	11°32'	131°34'	2313	0015	39 - 40	Calm
E02(GN)	19.10.83	11°10'	131°19'	1304	1326	11°11'	131°21'	1537	1649	16 - 27	Calm
E03(GN)	19.10.83	11°10'	131°23'	1806	1825	11°10'	131°22'	2042	2232	36 - 43	Calm
E04(MS)	19/20.10.83	11°07'	131°21'	2320	2337	11°08'	131°19'	0125	0157	39 - 40	Calm
E05(GN)	20.10.83	11°09'	131°03'	1347	1414	11°09'	131°02'	1618	1744	21	Slight
E06(GN)	20.10.83	11°07'	131°04'	1835	1859	11°07'	131°02'	2110	2204	20 - 21	Moderate
E07(MS)	20/21.10.83	11°08'	131°01'	2225	2247	11°09'	130°59'	0035	0100	20 - 22	Moderste
E08(GN)	21.10.83	11°12'	130°44'	1812	1837	11°12'	130°43'	2049	2152	22 - 23	Slight
E09(MS)	21/22.10.83	11°13'	130°43'	2225	2244	11°13'	130°39'	0105	0134	20 - 22	Calm/Slight
E10(GN)	22.10.83	11°11'	130°31'	1350	1416	11°11'	130°29'	1618	1650	16 - 22	Slight/Moderate
E11(GN)	22.10.83	11°11'	130°30'	1812	1835	11°11'	130°29'	2040	2131	16 - 28	Slight/Moderate
E12(MS)	22/23.10.83	11°08'	130°30'	2155	2210	11°07'	130°28'	0006	0043	28 - 29	Slight/Moderate
E13(GN)	23.10.83	11°17'	130°06'	1505	1522	11°21'	130°06'	1738	1839	17 - 20	Slight
E14(GN)	23.10.83	11°18'	130°05'	1927	1954	11°14'	130°04'	2202	2308	18 - 20	Calm
E15(GN)	24.10.83	11°30'	130°02'	1317	1344	11°33'	120°01'	1553	1637	29 - 35	Calm
E16(GN)	24/25.10.83	11°30'	130°00'	1855	1917	11°35'	130°00'	2121	0230	41 - 50	Calm
E17(GN)	25.10.83	11°46'	129°57'	1811	1840	11°47'	129°57'	2048	2144	50 - 65	Calm
E18(MS)	25/26.10.83	11°47'	129°57'	2200	2313*	11°42'	129°55'	0119	0212	58 - 76	Calm
E19(GN)	26.10.83	12°07'	129°53'	1522	1558	12°07'	129°52'	1742	1821	22 - 32	Calm
E20(GN)	26.10.83	12°07'	129°52'	1837	1900	12°09'	130°01'	2102	2159	50 - 58	Slight
E21(GN)	27.10.83	12°46'	130°14'	1247	1307	12°45'	130°15'	1509	1547	14 - 16	Slight
E22(GN)	27.10.83	12°46'	130°14'	1750	1812	12°46'	130°15'	2010	2107	14	Slight

* Set time extended due to tangled net.

Appendix IV (contd.) : Cruise F

SET CODE	DATE	POSITION OF SET LAT.	POSITION OF SET LONG	START OF SET START	START OF SET FINISH	POSITION AT HAUL LAT.	POSITION AT HAUL LONG.	TIME OF HAUL START	TIME OF HAUL FINISH	DEPTH (m)	SEA CONDITIONS
F01(GN)	30.11.83	12°46'	130°13'	1837	1859	12°46'	130°14'	2112*	2243	14 - 16	Slight
F02(GN)	30/11-1/12.83	12°42'	130°13'	2330	2350	12°42'	130°15'	0205	0252	20 - 21	Slight
F03(GN)	1.12.83	12°53'	130°04'	1414	1436	12°54'	130°05'	1640	1710	19 - 20	Slight
F04(GN)	1.12.83	12°57'	130°02'	1817	1840	12°55'	130°02'	2041	2222	19 - 20	Slight
F05(MS)	1/2.12.83	12°54'	130°01'	2254	2315	12°54'	130°04'	0121	0236	19 - 20	Slight
F06(GN)	2.12.83	13°04'	129°53'	1537	1558	13°04'	129°55'	1809	1955	25 - 27	Slight
F07(GN)	2.12.83	13°06'	129°54'	2025	2048	13°04'	129°55'	2303	2346	20 - 23	Moderate
F08(GN)	3.12.83	13°32'	129°43'	1352	1410	13°33'	129°45'	1610	1825	21 - 22	Slight
F09(GN)	3.12.83	13°34'	129°44'	1911	1931	13°32'	129°44'	2133	2209	20 - 22	Moderate
F10(MS)	3/4.12.83	13°34'	129°43'	2250	2304	13°34'	129°44'	0110	0135	18 - 21	Moderate
F11(GN)	4.12.83	13°21'	130°02'	1400	1420	13°21'	130°05'	1648**	1748	14 - 20	Moderate
F12(GN)	4.12.83	13°20'	130°01'	1855	1913	13°19'	130°01'	2116	2213	27	Moderate
F13(MS)	4/5.12.83	13°18'	130°03'	2230	2244	13°18'	129°59'	0112	0132	25 - 28	Moderate
F14(GN)	5.12.83	13°15'	129°52'	1336	1351	13°16'	129°56'	1559*	1843	23 - 25	Moderate/Rough
F15 ‡	6.12.83	12°33'	130°32'	1742	1750	12°33'	130°32'	1813	1827	25 - 32	Slight
F16 ‡	6.12.83	12°32'	130°31'	1901	1905	12°32'	130°31'	2017	2027	25 - 32	Slight

* Haul times extended due to net rollups.

** Start of haul delayed due to mechanical problems.

‡ Net employed : 189 m of 15 cm monofilament gillnet, floats attached to head rope.

APPENDIX V Summary of catches by set, expressed as weight (kg) and numbers. Values in parentheses are numbers of fish.

CRUISE A	SET CODE											
SPECIES	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10	A11	A12
Carcharhinus limbatus	788.5 (62)	1682.7 (188)		50.5 (6)	3.2 (1)	14.3 (2)	450.8 (41)	9.7 (3)	949.3 (163)	14.0 (1)	13.8 (1)	21.6 (1)
C. sorrah	295.6 (50)	1102.8 (209)	14.8 (3)	68.7 (18)	5.4 (2)	4.1 (1)	167.2 (47)	15.0 (5)	79.7 (24)			
C. fitzroyensis												
C. amblyrhynchoides		14.1 (1)					18.0 (2)		126.5 (10)			
C. amboinensis	105.8 (1)								90.1 (3)			
C. brevipinna				3.3 (1)								
C. macloti		1.8 (1)										
C. melanopterus						7.1 (1)		6.7 (1)				
C. dussumieri		2.0 (1)					2.2 (1)					
Rhizoprionodon acutus		32.8 (17)		1.9 (1)			10.6 (5)		16.0 (7)			
R. taylori												
Sphyrna lewini		283.6 (20)		48.3 (5)			28.2 (2)		121.1 (6)			
S. mokarran	81.9 (1)	9.7 (1)							106.6 (4)			
S. blochii							12.3 (1)					
Other elasmobranchs	- (2)								46.0 (3)			
Mackerel		27.8 (6)		5.8 (2)	3.3 (2)		9.3 (9)	5.2 (2)	16.8 (6)			5.8 (1)
Tuna												41.3 (12)
Other		- (4)					1.9 (3)		- (15)			10.7 (3)
TOTAL	1271.8 (116)	3157.3 (448)	14.8 (3)	178.7 (33)	11.9 (5)	25.5 (4)	700.5 (111)	36.6 (11)	1552.1 (241)	14.0 (1)	13.8 (1)	79.4 (17)

APPENDIX V (contd.)

CRUISE A (contd.)	SET CODE										
SPECIES	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23
Carcharhinus limbatus	274.7 (20)	72.8 (6)	214.3 (14)	287.3 (18)	87.7 (8)	260.4 (18)	416.1 (30)	19.6 (3)		87.6 (34)	716.0 (214)
C. sorrah	4.0 (1)	19.6 (2)	104.7 (18)	44.7 (8)	51.6 (10)	98.4 (18)	46.1 (8)	37.1 (8)		44.3 (15)	948.6 (260)
C. fitzroyensis								13.7 (3)			12.8 (3)
C. amblyrhynchoides								9.8 (2)	2.8 (1)	32.9 (3)	56.8 (5)
C. amboinensis										19.6 (2)	36.6 (1)
C. brevipinna										5.0 (1)	4.4 (1)
C. macloti										6.5 (3)	12.1 (7)
C. melanopterus						6.7 (1)					6.5 (1)
C. dussumieri									3.9 (2)		2.2 (1)
Rhizoprionodon acutus					2.1 (1)	2.1 (1)	13.2 (7)		10.3 (5)		34.6 (17)
R. taylori				0.6 (1)							
Sphyrna lewini				27.7 (1)			3.8 (1)	44.2 (11)	4.2 (1)	0.9 (1)	597.7 (50)
S. mokarran					80.1 (1)			4.7 (1)		121.8 (9)	83.8 (11)
S. blochii								61.1 (11)	4.0 (1)	31.5 (6)	71.9 (14)
Other elasmobranchs											5.0 (1)
Mackerel				0.3 (1)			1.7 (1)			40.4 (7)	
Tuna	5.6 (8)	1.6 (1)		77.8 (22)							
Other	- (3)			- (3)	17.5 (1)					5.5 (3)	
TOTAL	284.3 (32)	94.0 (9)	319.0 (32)	438.5 (54)	239 (21)	367.6 (38)	480.9 (47)	190.2 (39)	25.2 (10)	396.0 (84)	2589.0 (586)

APPENDIX V (contd.)

CRUISE B	SET CODE											
SPECIES	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12
Carcharhinus limbatus	63.9 (11)	96.5 (29)	100.0 (3)	78.2 (3)		235.6 (36)	383.0 (36)		177.9 (13)	15.1 (1)		
C. sorrah	73.8 (23)	302.2 (82)	34.3 (5)		0.8 (1)	104.8 (28)	172.0 (46)	3.8 (1)	38.6 (7)		4.4 (1)	
C. fitzroyensis										4.4 (1)		12.5 (3)
C. amblyrhynchoides										7.8 (1)		
C. amboinensis							11.8 (1)		15.9 (1)	71.0 (12)	10.1 (3)	
C. brevipinna		4.2 (1)				11.0 (2)						
C. macloti		8.7 (4)										
C. melanopterus												7.5 (1)
C. dussumieri		5.4 (2)										
Rhizoprionodon acutus		37.7 (18)			4.7 (4)			18.3 (9)	2.1 (1)			
R. taylori										0.4 (1)		1.8 (4)
Sphyrna lewini	25.1 (1)	196.7 (15)										
S. mokarran	11.3 (1)	39.8 (2)			162.5 (3)							
S. blochii										63.3 (10)	24.1 (4)	36.1 (7)
Other elasmobranchs					– (1)						– (1)	
Mackerel		1.1 (2)	2.9 (1)	8.7 (3)	21.1 (5)							
Tuna				49.1 (13)								
Other				– (2)	10.1 (2)		2.1 (4)		– (1)	0.9 (1)	10.4 (10)	1.9 (2)
TOTAL	174.1 (36)	692.3 (155)	137.2 (9)	136.0 (21)	199.2 (16)	351.4 (66)	568.8 (87)	22.1 (10)	234.5 (23)	162.9 (27)	49.0 (19)	59.8 (17)

APPENDIX V (contd.)

CRUISE B (contd.)	SET CODE									
SPECIES	B13	B14	B15	B16	B17	B18	B19	B20	B21	B22
Carcharhinus limbatus		37.6 (2)	7.3 (1)	50.6 (6)		382.9 (35)	347.6 (73)	73.8 (21)	77.4 (17)	5.1 (2)
C. sorrah		76.9 (17)		25.9 (6)	20.2 (5)	303.7 (86)	186.5 (51)	5.0 (1)	15.2 (5)	11.4 (4)
C. fitzroyensis		18.8 (2)				19.3 (3)	27.9 (8)		13.7 (2)	2.3 (1)
C. amblyrhynchoides							83.4 (7)	11.5 (1)	36.5 (3)	
C. amboinensis	5.4 (2)	39.7 (10)				36.2 (4)	47.5 (4)		42.1 (2)	
C. brevipinna							20.1 (3)			
C. macloti							14.8 (7)	3.4 (2)	1.9 (1)	1.7 (1)
C. melanopterus										
C. dussumieri								5.3 (2)	9.0 (5)	
Rhizoprionodon acutus				6.2 (3)	2.0 (1)	54.3 (26)	72.3 (34)	18.5 (9)	31.3 (15)	1.7 (1)
R. taylori		0.4 (1)					0.5 (1)			0.7 (2)
Sphyrna lewini						101.0 (8)	85.8 (15)		20.1 (4)	
S. mokarran						52.2 (2)	14.1 (4)	1.9 (1)	103.6 (4)	
S. blochii		24.8 (6)				30.2 (3)	22.9 (7)	6.4 (1)	12.7 (3)	
Other elasmobranchs		– (4)				– (1)				
Mackerel					6.3 (2)	42.2 (11)			4.5 (1)	
Tuna				62.1 (14)						
Other		0.5 (1)				23.7 (9)	5.3 (5)	1.4 (5)	17.5 (2)	
TOTAL	5.4 (2)	198.6 (43)	7.3 (1)	144.8 (29)	28.5 (8)	1045.6 (188)	928.7 (219)	127.2 (43)	385.5 (64)	22.9 (11)

APPENDIX V (contd.)

CRUISE C	SET CODE											
SPECIES	C01	C02	C03	C04	C05	C06	C07	C08	C09	C10	C11	C12
Carcharhinus limbatus	240.3 (76)	77.5 (27)	391.8 (158)	227.6 (19)	12.1 (1)	23.0 (1)			109.9 (7)	29.4 (2)	32.8 (2)	40.0 (5)
C. sorrah	731.6 (185)	124.8 (35)	516.3 (114)	253.0 (57)	7.2 (1)	11.5 (2)	4.0 (1)			69.5 (15)	40.2 (11)	39.7 (11)
C. fitzroyensis		3.6 (1)	23.6 (5)	191.1 (29)		104.0 (30)	76.2 (22)	4.4 (1)	45.4 (7)		10.9 (1)	
C. amblyrhynchoides	22.6 (2)			74.7 (6)		39.1 (3)	18.2 (2)		118.1 (12)	11.8 (1)	12.6 (1)	
C. amboinensis				76.4 (8)		53.7 (4)		11.8 (1)	328.3 (21)			
C. brevipinna				15.0 (1)								
C. macloti	14.7 (7)		29.1 (17)	19.2 (8)			1.8 (1)				2.1 (1)	2.4 (2)
C. melanopterus						14.5 (2)						
C. dussumieri	6.6 (3)		5.7 (3)			6.1 (3)						
Rhizoprionodon acutus	20.2 (9)		10.0 (5)	13.7 (6)					6.2 (3)		8.5 (4)	15.3 (8)
R. taylori			0.7 (2)	2.4 (4)		7.1 (12)	16.7 (33)		2.6 (3)			
Sphyrna lewini	42.7 (14)	6.3 (2)	11.3 (3)	39.6 (2)					15.4 (2)		55.9 (7)	56.6 (3)
S. mokarran	55.1 (5)		13.0 (3)	320.0 (2)		113.8 (4)	5.4 (2)		27.2 (2)	85.3 (1)		
S. blochii			24.0 (3)	28.7 (7)	6.7 (1)	34.3 (6)	21.0 (5)		78.6 (9)			
Other elasmobranchs						- (2)						
Mackerel			2.4 (2)	29.7 (7)		8.6 (3)	2.7 (2)		3.8 (1)	3.0 (1)		10.0 (4)
Tuna												
Other		1.6 (1)	1.1 (2)	11.0 (10)		4.1 (4)	4.6 (3)		0.9 (2)		12.4 (1)	
TOTAL	1133.8 (301)	213.8 (66)	1029.0 (317)	1302.1 (116)	26.0 (3)	419.8 (76)	150.6 (71)	16.2 (2)	736.3 (69)	199.0 (20)	175.4 (28)	164.0 (33)

APPENDIX V (contd.)

CRUISE C (contd.)	SET CODE							
SPECIES	C13	C14	C15	C16	C17	C18	C19	C20
Carcharhinus limbatus	20.9 (2)			54.8 (3)	20.1 (1)	55.6 (33)	80.0 (11)	136.7 (52)
C. sorrah	7.8 (2)	4.1 (1)		42.9 (6)		11.0 (3)	36.9 (10)	123.3 (37)
C. fitzroyensis	28.2 (7)	11.4 (3)		11.3 (3)				
C. amblyrhynchoides	38.1 (3)			9.1 (1)		14.9 (2)		
C. amboinensis	362.3 (19)			19.5 (2)	45.0 (4)			
C. brevipinna						7.0 (1)		
C. macloti	2.1 (1)					55.3 (34)	1.6 (1)	2.2 (1)
C. melanopterus				2.9 (1)				
C. dussumieri					2.5 (1)			3.6 (2)
Rhizoprionodon acutus					4.0 (2)	7.9 (4)	2.5 (1)	91.2 (44)
R. taylori	6.1 (13)	16.1 (31)		2.1 (3)	1.7 (3)	3.4 (9)		3.9 (9)
Sphyrna lewini							7.1 (1)	1.3 (1)
S. mokarran	72.6 (1)				15.4 (1)		63.4 (1)	24.9 (1)
S. blochii	11.8 (2)	28.7 (6)		27.8 (5)	2.2 (1)	73.2 (18)		
Other elasmobranchs		- (1)			- (1)	- (1)	- (1)	- (2)
Mackerel	4.0 (1)	6.7 (5)				1.7 (2)	10.2 (2)	18.2 (5)
Tuna	80.5 (20)			26.6 (6)				
Other	2.8 (3)	10.1 (13)				1.4 (1)		378.4 (454)
TOTAL	637.2 (74)	77.1 (60)	0	196.4 (30)	90.9 (14)	231.4 (108)	201.7 (28)	783.7 (608)

APPENDIX V (contd.)

CRUISE D	SET CODE											
SPECIES	D01	D02	D03	D04	D05	D06	D07	D08	D09	D10	D11	D12
Carcharhinus limbatus		120.2 (8)		341.3 (43)	56.8 (8)	68.1 (6)	38.3 (7)	19.1 (6)	183.6 (59)	16.5 (2)	1226.2 (202)	94.9 (37)
C. sorrah	3.0 (1)	46.1 (8)	8.2 (2)	29.6 (7)	2.9 (1)	52.3 (18)	20.3 (8)	13.1 (4)	180.9 (58)	1.5 (1)	4.5 (3)	154.8 (36)
C. fitzroyensis												7.7 (1)
C. amblyrhynchoides									30.5 (1)			247.0 (35)
C. amboinensis												59.4 (18)
C. brevipinna				2.8 (1)					2.4 (1)			
C. macloti	2.2 (1)		6.2 (3)						4.1 (2)		5.8 (4)	104.4 (49)
C. melanopterus												
C. dussumieri				2.8 (1)		2.0 (1)			37.2 (15)	2.4 (1)		9.4 (4)
Rhizoprionodon acutus			2.4 (1)		4.3 (2)	59.7 (25)	43.0 (19)	2.2 (1)	457.5 (199)	4.4 (2)	7.0 (3)	166.3 (72)
R. taylori						0.4 (1)				0.5 (1)	25.3 (46)	2.6 (5)
Sphyrna lewini		27.6 (1)		45.5 (2)			14.2 (1)		67.4 (17)	15.4 (1)		162.4 (32)
S. mokarran			23.0 (1)	18.1 (1)		130.1 (2)	63.6 (3)		55.5 (4)			15.4 (3)
S. blochii			17.1 (1)								15.5 (1)	213.3 (30)
Other elasmobranchs									8.2 (3)			32.3 (11)
Mackerel		14.8 (2)	6.2 (2)	0.5 (1)	8.5 (4)	11.7 (3)			124.4 (28)	24.2 (5)	43.3 (14)	7.3 (3)
Tuna						114.3 (34)			7.6 (2)			
Other	4.4 (1)			1.2 (1)	0.1 (2)	0.3 (7)	1.8 (3)		9.0 (57)		1.8 (1)	37.9 (37)
TOTAL	9.5 (3)	209.7 (19)	63.1 (10)	441.7 (57)	72.6 (17)	439.0 (97)	181.2 (41)	34.3 (11)	1168.3 (446)	64.8 (13)	1329.4 (274)	1315.1 (373)

APPENDIX V (contd.)

CRUISE D (contd.)	SET CODE			
SPECIES	D13	D14	D15	D16
Carcharhinus limbatus	5.3 (2)	1226.0 (538)	43.8 (21)	55.2 (32)
C. sorrah	16.8 (4)	902.8 (229)	56.4 (15)	113.2 (33)
C. fitzroyensis		22.8 (5)		
C. amblyrhynchoides		66.5 (6)		15.5 (1)
C. amboinensis		102.3 (5)		
C. brevipinna				
C. macloti		7.7 (4)		1.8 (1)
C. melanopterus		5.3 (1)		
C. dussumieri		4.8 (2)		8.3 (4)
Rhizoprionodon acutus	6.1 (3)	350.9 (167)	4.0 (2)	11.6 (5)
R. taylori		0.3 (1)		
Sphyrna lewini		215.7 (40)		6.6 (2)
S. mokarran	6.4 (1)	43.5 (4)	31.0 (2)	54.1 (1)
S. blochii				
Other elasmobranchs		2.0 (1)		
Mackerel		77.7 (18)		15.6 (5)
Tuna				
Other	1.0 (1)	21.3 (9)	6.5 (7)	4.3 (9)
TOTAL	35.5 (11)	3049.6 (1030)	141.7 (47)	286.2 (93)

APPENDIX V (contd.)

CRUISE E	SET CODE											
SPECIES	E01	E02	E03	E04	E05	E06	E07	E08	E09	E10	E11	E12
Carcharhinus limbatus	9.1 (1)	20.0 (2)	753.7 (23)		290.7 (72)	12.8 (3)	10.9 (1)	15.9 (6)	6.3 (2)	3.7 (1)	54.1 (9)	
C. sorrah	12.3 (3)	40.7 (9)	240.6 (42)		119.5 (33)	73.0 (21)	5.9 (2)	73.5 (20)	31.1 (8)	11.5 (2)	134.3 (21)	15.4 (4)
C. fitzroyensis	70.1 (13)	22.3 (5)			6.0 (2)							
C. amblyrhynchoides					23.2 (3)	7.4 (1)						
C. amboinensis		6.9 (2)	200.5 (9)		49.5 (2)							
C. brevipinna												
C. macloti		3.7 (2)										
C. melanopterus											8.2 (1)	
C. dussumieri									3.1 (1)			
Rhizoprionodon acutus						7.7 (4)	1.9 (1)					9.1 (5)
R. taylori	0.4 (1)			1.5 (2)			1.0 (1)					
Sphyrna lewini					35.0 (11)						8.8 (1)	
S. mokarran	15.8 (1)					13.4 (2)				4.8 (1)		
S. blochii	74.0 (12)	183.7 (28)	5.8 (2)	3.5 (2)	11.4 (1)		7.1 (1)					
Other elasmobranchs												
Mackerel	7.9 (2)	3.4 (1)	12.0 (3)		4.7 (1)			5.2 (1)			3.9 (1)	
Tuna												
Other			– (1)									
TOTAL	189.4 (33)	280.6 (49)	1212.6 (80)	5.0 (4)	540.0 (125)	114.2 (31)	26.8 (6)	94.6 (27)	40.5 (11)	20.0 (4)	209.3 (33)	24.5 (9)

APPENDIX V (contd.)

CRUISE E (contd.)	SET CODE									
SPECIES	E13	E14	E15	E16	E17	E18	E19	E20	E21	E22
Carcharhinus limbatus				1452.4 (288)	38.2 (4)	40.0 (2)		111.1 (9)	7.3 (4)	21.8 (10)
C. sorrah		5.7 (2)		278.3 (66)	103.6 (23)		14.2 (3)	3.6 (1)	3.6 (1)	16.9 (4)
C. fitzroyensis	101.5 (26)	17.1 (4)		36.3 (8)						10.1 (3)
C. amblyrhynchoides						3.1 (1)				11.6 (1)
C. amboinensis	57.0 (7)	143.8 (7)	41.4 (6)	175.3 (28)						
C. brevipinna				11.5 (1)						
C. macloti			3.5 (2)	175.6 (97)	2.1 (1)					
C. melanopterus										
C. dussumieri										
Rhizoprionodon acutus						6.3 (3)		66.2 (31)		
R. taylori	5.2 (12)	9.8 (25)		0.6 (1)					0.5 (1)	0.8 (2)
Sphyrna lewini				46.6 (13)	1.7 (1)		38.6 (2)			6.4 (1)
S. mokarran		65.6 (1)		38.3 (1)	82.5 (2)	29.7 (1)		28.4 (1)	26.2 (2)	17.1 (4)
S. blochii	44.5 (20)	59.8 (22)	43.5 (7)	146.1 (27)	27.6 (2)					50.8 (9)
Other elasmobranchs	- (4)					9.6 (10)				- (1)
Mackerel		0.4 (1)			4.7 (1)	6.6 (3)		10.0 (2)	3.4 (1)	8.6 (3)
Tuna				1.1 (1)			0.6 (1)			
Other	1.8 (1)	78.5 (15)		0.6 (1)	9.7 (2)	0.2 (6)		0.8 (8)	0.9 (1)	6.9 (8)
TOTAL	210.0 (70)	380.6 (77)	88.4 (15)	2362.5 (532)	270.0 (36)	95.5 (26)	53.3 (6)	220.0 (52)	41.8 (10)	151.0 (46)

APPENDIX V (contd.)

CRUISE F	SET CODE											
SPECIES	F01	F02	F03	F04	F05	F06	F07	F08	F09	F10	F11	F12
Carcharhinus limbatus	1.4 (1)	10.9 (2)		145.5 (30)	35.0 (9)	8.3 (1)	15.4 (1)	1889.7 (132)	6.4 (2)		6.4 (1)	138.7 (13)
C. sorrah	9.1 (1)	7.9 (1)	9.0 (1)	148.9 (30)	5.3 (3)	18.0 (3)		121.3 (27)	19.7 (6)			109.4 (27)
C. fitzroyensis											4.9 (1)	
C. amblyrhynchoides		12.6 (1)		8.4 (1)							37.7 (3)	
C. amboinensis		33.8 (1)	8.4 (1)	9.0 (1)							155.2 (19)	
C. brevipinna					8.0 (1)						4.5 (1)	3.0 (1)
C. macloti												
C. melanopterus												
C. dussumieri		5.0 (2)		6.2 (2)								
Rhizoprionodon acutus		6.9 (3)	2.1 (1)	12.7 (6)	61.0 (30)				2.2 (1)			2.2 (1)
R. taylori	0.9 (2)	1.5 (3)		0.5 (1)	1.0 (1)							
Sphyrna lewini			4.1 (1)	46.9 (6)	36.3 (5)		15.0 (1)					
S. mokarran			8.0 (1)	21.6 (1)			84.0 (1)	66.9 (2)		77.5 (1)	169.3 (3)	6.2 (1)
S. blochii	16.1 (2)	11.5 (1)	4.9 (1)	14.5 (3)	70.9 (6)		11.3 (1)			11.7 (1)	29.4 (6)	
Other elasmobranchs	- (3)	- (2)		3.2 (9)	- (1)							
Mackerel				25.5 (9)			3.3 (1)		2.5 (1)	3.7 (1)		
Tuna									5.5 (1)			
Other	41.8 (22)	27.5 (16)		101.9 (23)	3.0 (9)		- (7)		- (4)	4.7 (1)	0.5 (1)	
TOTAL	69.3 (31)	117.4 (32)	36.5 (6)	544.8 (122)	220.5 (65)	26.2 (4)	129.0 (12)	2078.0 (161)	36.4 (15)	97.6 (4)	407.9 (35)	259.5 (43)

APPENDIX V (contd.)

CRUISE F (contd.)	SET CODE			
SPECIES	F13	F14	F15	F16
Carcharhinus limbatus		89.2 (8)		
C. sorrah		77.1 (18)		
C. fitzroyensis				
C. amblyrhynchoides				
C. amboinensis				
C. brevipinna				
C. macloti				
C. melanopterus				
C. dussumieri				
Rhizoprionodon acutus				
R. taylori				0.8 (1)
Sphyrna lewini				
S. mokarran	2.7 (1)			
S. blochii				
Other elasmobranchs				
Mackerel		4.4 (1)	54.8 (15)	26.4 (7)
Tuna				
Other				2.1 (3)
TOTAL	2.7 (1)	170.7 (27)	54.8 (15)	29.3 (11)

APPENDIX VI Catch composition (numbers) by cruise.

SPECIES	CRUISE A	B	C	D	E	F	TOTAL No.	%
SHARK								
Carcharhinus limbatus	834	289	400	971	437	200	3131	32.9
C. sorrah	707	369	491	428	265	117	2377	24.9
C. fitzroyensis	6	20	109	6	61	1	203	2.1
C. amblyrhynchoides	24	12	33	43	5	5	122	1.3
C. amboinensis	7	39	59	23	61	22	211	2.2
C. brevipinna	3	6	2	2	1	3	17	0.2
C. macloti	12	15	73	64	102	-	266	2.8
C. melanopterus	4	1	3	1	1	-	10	0.1
C. dussumieri	8	11	12	28	1	4	64	0.7
C. amblyrhynchos	-	-	-	-	1	-	1	0.01
Sphyrna lewini	98	43	35	96	29	13	314	3.3
S. mokarran	28	17	23	22	16	11	117	1.2
S. blochii	33	41	63	32	133	21	323	3.4
Rhizoprionodon acutus	62	121	86	501	44	42	856	9.0
R. taylori	3	9	122	54	45	8	241	2.5
Loxodon macrorhinus	-	-	-	-	10	-	10	0.1
Hemipristis elongatus	1	-	-	6	-	1	8	0.08
Galeocerdo cuvieri	1	-	-	-	-	-	1	0.01
TOTAL SHARK	1831	993	1511	2277	1212	448	8272	86.8
OTHER ELASMOBRANCHS								
Pristis cuspidatus (saw shark)	2	6	6	9	4	13	40	0.4
Shovel nose ray	-	-	1	-	-	-	1	0.01
Rays (eagle ray, manta ray, etc.)	2	1	1	1	1	1	7	0.07
TELEOST								
Scomberomorus commerson	11	3	2	9	3	-	28	0.3
S. semifasciatus	6	18	20	60	13	35	152	1.6
S. munroi	7	2	10	10	4	-	33	0.4
S. queenslandicus	13	2	3	6	-	-	24	0.2
Thunnus tonggol	32	22	26	-	-	1	81	0.9
Euthynnus affinis	10	4		36	-		50	0.5
Auxis thazard	1	1	-	-	1	-	3	0.03
Sarda australis	-	-	-	-	1	-	1	0.01
Cybiosarda elegans	-	-	-	3	-	-	3	0.03

APPENDIX VI (contd.)

SPECIES	CRUISE A	B	C	D	E	F	TOTAL No.	%
TELEOST (contd.)								
Rastrelliger kanagurta	24	2	-	59	6	-	91	1.0
Rachycentron canadus	1	1	-	-	-	-	2	0.02
Apolectus niger	5	15	468	20	13	12	533	5.6
Eleutheronema tetradactylum	-	16	23	32	1	14	86	0.9
Polynemus sheridani	1	-	-	-	-	-	1	0.01
Trachysuridae (catfish)	1	2	1	4	1	22	31	0.3
Istiophorus platypterus	1	1	1	-	-	-	3	0.03
Sciaenidae (jewfish)	-	1	-	-	1	-	2	0.02
Scomberoides commersonianus	-	-	-	-	2	18	20	0.2
Remora remora	1	1	-	-	-	-	2	0.02
Leptobrama mulleri	-	-	1	-	-	-	1	0.01
Elops australis	-	-	-	1	-	-	1	0.01
Carangidae (trevally)	1	2	-	1	-	2	6	0.06
Caranx bucculentus	-	1	-	8	-	17	26	0.3
Gnathanodon speciosus	-	-	-	1	-	-	1	0.01
Megalops cyprinoides	-	2	-	3	-	-	5	0.05
Chirocentrus dorab	-	-	-	1	-	-	1	0.01
Drepane punctata	-	-	-	1	-	-	1	0.01
Lutjanus sp.	-	-	-	-	13	-	13	0.1
Megalaspis cordyla	-	-	-	-	1	-	1	0.01
Epinephelus sp.	-	-	-	-	-	1	1	0.01
TOTAL TELEOST	115	96	555	255	60	122	1251	13.1
CETACEANS								
Orcaella brevirostris (Irrawaddy dolphin)	-	-	-	-	1	-	1	0.01
Stenella longirostris (Spinner dolphin)	-	-	-	-	4	-	4	0.04
TOTAL	1950	1096	2074	2542	1282	584	9528	100

7. OTHER FISHERIES PUBLICATIONS

Fishery Report No. 1 March 1979	- A Review of the Northern Territory Barramundi Fishery
Fishery Report No. 2 July 1979	- The Fog Bay Banana Prawn Fishery
Fishery Report No. 3 August 1979	- A Review of the Northern Territory Mackerel and Reef Fisheries
Fishery Report No. 4 July 1981	- Northern Territory Mackerel Fishing Programme 1980/81
Fishery Report No. 5 1981	- Barramundi Review - limited August edition reprint of Technical Bulletin No. 49
Fishery Report No. 6 November 1981	- Report on a Dropline Fishing Operation of the TAKURYO MARU No. 11 during Feasibility Fishing Operations in the Australian Fishing Zone
Fishery Report No. 7 March 1982	- Report of Public Meeting to discuss future Management of the Northern Territory Barramundi Fishery
Fishery Report No. 8 April 1982	- Report on a Gillnet/Bottom Trawl Survey. Observations of the HAI KUNG during a Fishing Survey and Research work in the Arafura Sea
Fishery Report No. 9 April 1982	- Game Fishing Prospects in Northern Territory Waters - A Discussion Paper
	- A Survey of Game Fishing Grounds in Northern Territory Waters: A supplement to the above Discussion Paper May 1983
Fishery Report No. 10 September 1983	- Tiger and Endeavour Prawn Closure Study Western Gulf of Carpentaria

Fishery Report No. 11 February 1984	-	Individual Transferable Catch Quotas - Their Role, Use and Application.
Fishery Report No. 12 1984	-	North Australia's Multi-species Shark Fishery. Vol.1: A Preparatory Evaluation of the Development of a Shark Fishing Industry in Northern Territory waters. Vol.2: Mercury in Shark from Northern Territory waters. Vol.3: Consumer Acceptability of Shark.
Fishery Report No. 13 August 1984	-	Development Prospects for an Off-shore Reef Fish Fishery.
Technical Report No. 1 October 1979	-	Barramundi - *Lates calcarifer*.
Technical Report No. 2 December 1982	-	A Survey of Amateur Angling for Barramundi in the Northern Territory.
Technical Bulletin No. 49 August 1981	-	Northern Territory Barramundi Fishery Review of Management - Situation Paper.