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Catch composition of the Western Australian temperate demersal gillnet and demersal longline fisheries, 1994 to 1999

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The primary function of the Fisheries Research Division is to provide scientific advice to government in the formulation of management policies for developing and sustaining Western Australian fisheries.

Contents

Catch composition of the Western Australian temperate demersal gillnet and demersal longline fisheries, 1994 to 1999

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Abstract

Catch composition data were collected from Western Australia's temperate demersal gillnet and demersal longline fisheries, between Eucla and Geraldton, over a five-year period from July 1994 to June 1999. Results were compared to Department of Fisheries catch records compiled from fishers' monthly catch returns. Discarded bycatch of several species was estimated by bootstrapping their observed catch rates. Dusky shark, Carcharhinus obscurus*, gummy shark, Mustelus antarcticus, whiskery shark,* Furgaleus macki*, and Port Jackson shark,* Heterodontus portusjacksoni*, were identified as the main components of the fisheries' catch, however, catches were found to vary regionally. School shark,* Galeorhinus galeus*, dogfish of the family Squalidae and the sandbar shark,* Carcharhinus plumbeus*, were regionally important in the south-east, mid-southern and west coast regions, respectively. Teleosts comprised between 5.4% and 16.6% of the total demersal gillnet and longline catch, with Buffalo bream,* Kyphosus cornelii*, West Australian Dhufish,* Glaucosoma hebraicum *and dusky morwong,* Dactylophora nigricans *identified as the main components of the teleost catch. Estimating catches from research catch per unit effort data indicated that catches of secondary elasmobranch species may have been underreported in commercial fishing returns. Records of non-fish bycatch were also compiled from observer data. The rates of capture of non-fish bycatch were low in all regions, with an overall occurrence of less than one capture per 1,000 kilometre gillnet hours.*

1.0 Introduction

1.1 History

Commercial shark-fishing began in Western Australia in 1941 with a single boat using demersal longlines in the Leschenault Inlet to catch, primarily, gummy sharks, *Mustelus antarcticus*. In the same year, other vessels began fishing in the inlet and adjacent offshore waters and by 1942, there were 6 shark-fishing boats operating around the south-western port of Bunbury. During the late 1940s and early 1950s the shark fishery expanded to other ports including Albany, Fremantle and Geraldton and despite remaining a largely part time occupation for most fishers, shark-fishing effort increased steadily as more operators entered the fishery.

Throughout the 1960s, the shark fishery gradually moved further offshore and demersally set multifilament gillnets gradually replaced longlines as the preferred fishing method. By 1965 the catch of shark had exceeded 300 tonnes yr^{-1} (Figure 1). Catches rose steadily throughout the late 1960s, until in the early 1970s, public concern over the level of mercury in shark flesh contributed to a dramatic decrease in demand for shark and catches declined sharply

(Heald, 1987; Simpfendorfer and Donohue, 1998). Following research carried out by the Fisheries Department of Western Australia, the WA Health Department introduced regulations in 1974 prohibiting the sale of shark flesh with mercury concentrations in excess of 0.5 parts per million (Hancock and Edmonds, 1977) and consumer confidence gradually returned. As the markets for shark flesh began to recover and the introduction of new management regulations restricted access to other fisheries, effort in the shark fisheries began to rise dramatically.

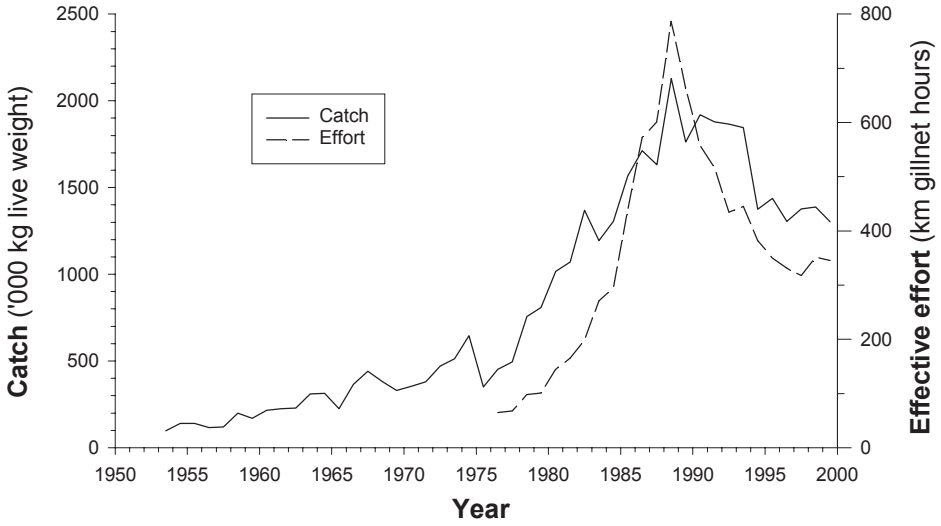


Figure 1. Historical shark catch and effort.

Throughout the 1980s, shark fishing became an increasingly full time occupation. Operators began using larger and faster vessels equipped with satellite navigation systems and colour echo-sounders, which enabled them to operate further offshore and in areas that had previously been out of range. New fishing gear technology, such as monofilament gillnets and powered net-reels, also significantly increased the amount of net that fishers were able to operate. By this time, the use of monofilament gillnet was widespread with longlines only being used by a handful of smaller operators. Fishing effort peaked in 1987 at 787,000 km gillnet hours (Figure 1), more than 4 times the effort in 1980. Annual demersal gillnet and longline effort values are also presented in Appendix I.

Unregulated fishing effort, together with declining catch rates of key shark species, prompted the introduction of the first management plan for Western Australia's shark fishery. Under an agreement between the State and Commonwealth governments the area between latitude 33°S (Cape Bouvard) and the South Australian border, (129°E, Figure 2) was declared as a limited entry fishery in 1988, with access restricted to fishers who could demonstrate a historical use of the stock. The fishery, known as the Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery (JASDGDLF), was divided into 2 zones: Zone 1 between 33° S and Chatham Island (116° 30'E) and Zone 2 from Chatham Island (116° 30'E) to the South Australian border (129°E). Effort was limited by the allocation of time/gear units, with each unit allowing the use of 600m of demersal gillnet or 200 longline hooks for one month. Following stock assessments for the 3 main target shark species (dusky sharks, *Carcharhinus obscurus*, gummy sharks, *Mustelus antarcticus* and whiskery sharks, *Furgaleus macki*) in the mid 1990's, which indicated that stocks were either fully or over exploited, the amount of net (or number of hooks) allowed by each unit has gradually been reduced by 60% (McAuley and Lenanton, 2002).

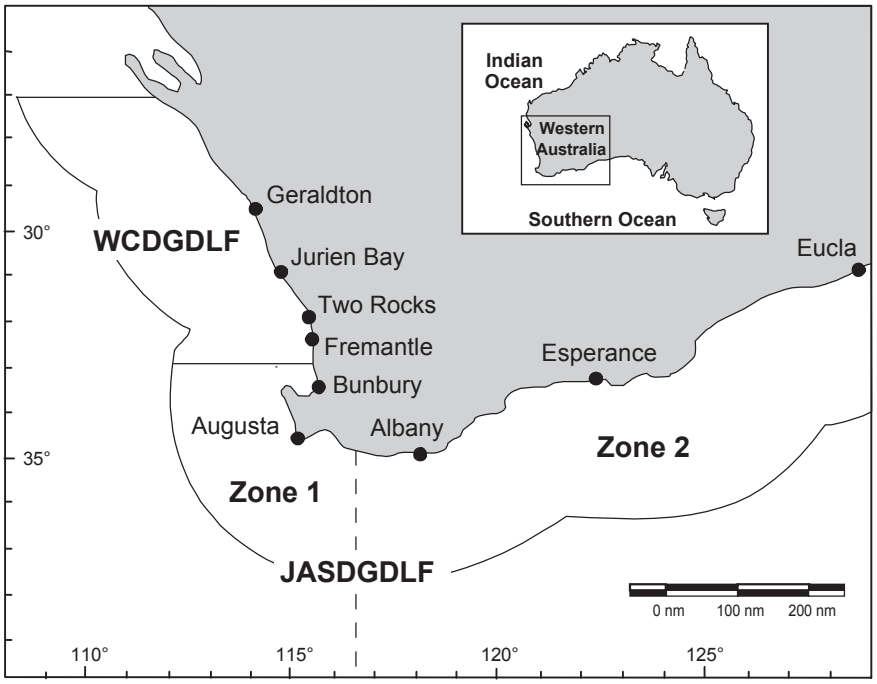


Figure 2. WA demersal gillnet and demersal longline fisheries. **JASDGDLF** = *Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery*; **WCDGDLF** = *West Coast Demersal Gillnet and Demersal Longline Fishery.*

The number of vessels authorised to use powered net-reels in the area north of 33°S was also restricted in 1988 to limit the exploitation of the target shark species outside the managed fishery. Additionally, a prohibition on the use of metal traces on longline and dropline gear in the area between Steep Point (26° 30'S) and a line drawn north from North West Cape (114° 06'E) was introduced in 1993 to prevent the capture of large sharks. Following the inception of the JASDGDLF however, the amount of shark fishing effort on the west coast increased throughout the late 1980s and early 1990s. An interim management plan for shark fishing between Cape Bouvard and Steep point was introduced in 1997, which established the West Coast Demersal Gillnet and Demersal Longline Fishery (WCDGDLF) with similar management arrangements as the JASDGDLF.

In the 2001/2002 financial year, the combined annual value of the southern and west coast demersal gillnet and demersal longline fisheries was estimated at approximately $4.8 million (McAuley and Lenanton, 2002).

1.2 Description of the gear

Because the majority of vessels in the fishery use demersal gillnets and as all research data were collected from demersal gillnet vessels, demersal longline configurations have not been described in the following description. Nets are constructed of nylon monofilament with a diameter of between 35 mm and 70 mm (line 35-line 70). Mesh is hung between a negatively buoyant 'ground line', which sinks the net to the seabed and a positively buoyant 'head line', which stands the net vertically off the bottom (Figure 3). The net is attached to the head and ground lines using a hanging ratio of 1.5 to 2 metres of net for every metre of line to ensure enough slack in the mesh for fish to be caught ('gilled'). Permitted mesh sizes are

restricted to between 165 mm (6.5”) and 178 mm (7”) and nets may not exceed 20 meshes in depth (263 cm with a 7” mesh). Ballast is usually attached to each end of the net and often intermittently along it’s length to prevent dragging. Floats are attached at each end to assist with relocation and recovery. Intermediate surface float lines are usually attached to nets to reduce the amount of net that is susceptible to two double ‘bite-offs’, where both the head line and ground line are severed twice between float lines, which can result in sections of net being lost.

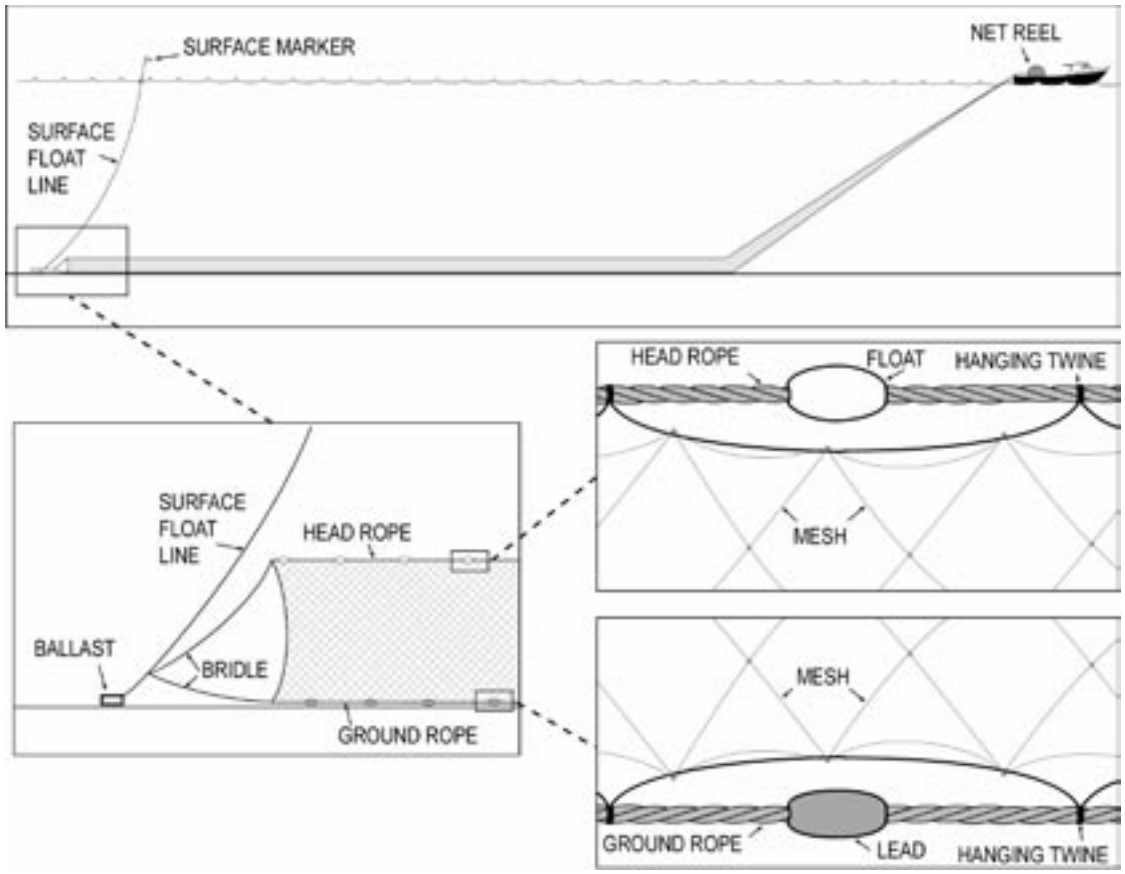


Figure 3. Typical demersal gillnet configuration.

Fishers generally set between 1 and 4 nets at any one time, depending on their unit allocation, vessel size, area of operation, expected catch rates, *etc*. Each net is typically between 1,000 m and 3,000 m long and each vessel’s nets may be set in close proximity to each other or separated by distances of several kilometres. Most vessels deploy their gear overnight (the mean observed ‘soak time’ for nets in these fisheries is 17 hours) but some operators deploy and recover their gear twice per day.

1.3 Objectives of this report

This report provides a snapshot of the catch composition of the Southern and West Coast Demersal Gillnet and Demersal Longline fisheries over a five-year period between 1994 and 1999. Because fishery landings records do not include discarded bycatch and, in some cases, fishers do not report all catch to species level or are unable to identify less common species, research data collected during extensive at sea sampling provides the

best source of information with which to validate the catches of minor species and record of the bycatch in these fisheries. This information is particularly useful in undertaking Ecologically Sustainable Development (ESD) assessment of these fisheries, a requirement of the Environment Protection and Biodiversity Conservation (EPBC) Act, 1999, to maintain their export approval. It is also intended that these data will provide fishery scientists and managers with a clearer understanding of all components of the catches by these fisheries and provide baseline data for future management arrangements.

Data presented in this report were collected during two research projects which were part-funded by grants from the Fisheries Research and Development Corporation: FRDC projects 93/67, 'Stock Assessment of Large Coastal and Demersal Sharks' and 96/130 'Biology and Stock Assessment of Western Australia's Commercially Important Shark Species'. The information in this report was not incorporated into the final FRDC project reports as it was largely outside the projects' aims and objectives.

2.0 Methods

2.1 Data collection

Data for this study have come from two sources: the Department of Fisheries' (WA DOF) Catch and Effort Statistics System (CAESS) records of commercial fishers' monthly returns, which are submitted as a condition of renewal of their licences, and from research conducted by Department of Fisheries Shark Research Section staff on board commercial gillnet fishing vessels during their regular fishing activities in the JASDGDLF and the WCDGDLF. No trips were undertaken on board the few vessels operating demersal longlines. Research data were collected between July 1994 and June 1999 on vessels operating from the ports of Geraldton, Jurien Bay, Two Rocks, Fremantle, Bunbury, Augusta, Albany, Esperance and Eucla (Figure 2). Research trips were conducted in March, April, May (Autumn), July (Winter), September, October and November (Spring). Where possible, each trip took place for one week either side of the full moon, depending on weather conditions, availability of vessels and other logistical constraints. Fishers took researchers to sea on a voluntary basis and consequently data were not collected from all vessels in these fisheries.

During research trips, observers recorded the date, time, depth, latitude and longitude of all gillnet 'sets'. Nets were set either once or twice each day, depending on the vessel, catches, weather conditions, etc. Catch was identified to the lowest possible taxa and measured as soon as practical after being removed from the net. Total lengths (TL) of scalefish (teleosts) were measured as a straight line from the tip of the snout to a line perpendicular with the tip of the upper lobe of the caudal fin, with it held in a 'natural' position (Figure 4). Fork lengths (FL) of sharks were measured as a straight line from the tip of the snout to the rear margin of the fork of the tail and total length was measured as a straight line from the tip of the snout to the tip of the caudal fin when it was held in a 'natural position' (Figure 4). For practical reasons, sharks of less than 140cm TL were measured using measuring boards fitted with fixed end plates and larger fish were measured on deck with tape measures. All lengths were recorded to the nearest centimetre. Whenever possible, sharks were also sexed.

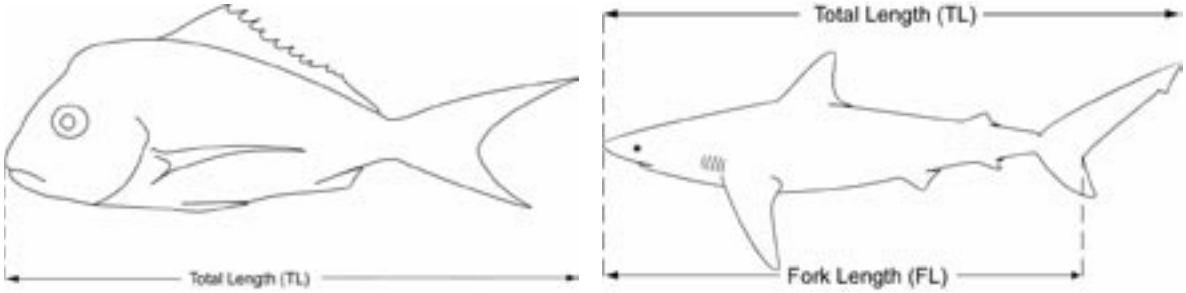


Figure 4. Length measurements.

Discarded catch (i.e. damaged fish or species of no commercial value) was also identified and counted. Where available, size frequency data from gillnet mesh selectivity experiments (Simpfendorfer and Unsworth, 1998a), were used to calculate the weight of catches of discarded species. Only data from the 6.5 (16.5 cm) and 7 inch (17.8 cm) experimental net panels, which correspond to commercial mesh sizes, are included in this report.

2.2 Data analysis

2.2.1 Commercial data

Catch and effort (CAESS) data from the JASDGDLF and WCDGDLF were subdivided into 6 regions: Region 1, between longitudes 124°E and 129°E; Region 2, between longitudes 119°E and 124°E; Region 3, between longitudes 116°E and 119°E; Region 4, between longitude 116°E and latitude 33°S; Region 5, between latitudes 33°S and 30°S and Region 6, between latitudes 30°S and 27°S (Figure 5). The mean annual reported catch of each species (or category) and effort from each region between July 1994 and June 1999 were calculated from these regional data.

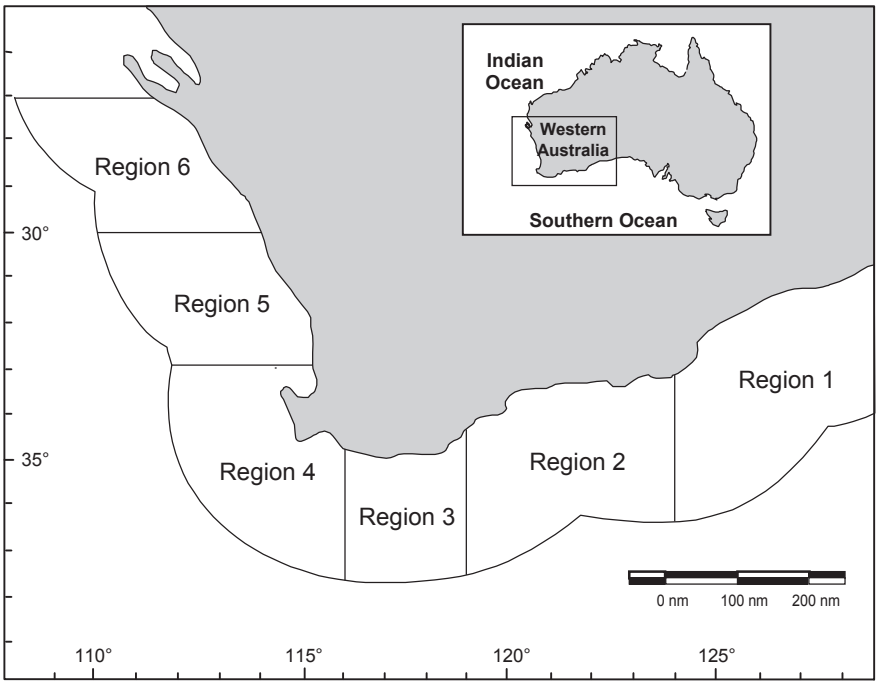


Figure 5. Regional boundaries.

Due to the wide variety of marine finfish fauna caught in Western Australia and because fishers can use multiple names to describe the same species, a small number of species were not recognised by the CAESS database. Unrecognised species, which could not be properly identified from the original fishing returns, were designated as 'unspecified'. In Figures 6-13, all species or species, which comprised less than 1% or 100kg of the reported catch, were combined as 'minor species'. The full species breakdown of the commercial catch is given in Appendix I.

Demersal longline fishing effort was converted to equivalent gillnet effort by using the original net-to-hook conversion specified by the management plan (ie. 600m gillnet:200 hooks) . The combined gillnet and longline effort is referred to as 'gillnet equivalent' effort in this report and all effort figures are expressed in units of kilometre gillnet hours, unless otherwise specified. Catch per unit effort (CPUE), was calculated by dividing the catch by the corresponding 'gillnet equivalent' effort.

This report only considers records from the temperate demersal gillnet and longline fisheries (JASDGDLF and WCDGDLF) and data may not necessarily match those reported in WA DOF annual Status and Stock Assessment reports, which are inclusive of data from all licensed Western Australian fishing vessels.

2.2.2 Research data

Research observer effort was calculated for each commercial gillnet 'set' observed between July 1994 and June 1999 by multiplying the recorded net length by 'soak' time (the difference between the set time and the haul time). For a small number of sets, where soak time was not available, the mean set time for that vessel in the same month was used. Also for a small number of sets, where net length was not recorded, the net length used by that vessel on either the previous day or next day was used. Effort is summarised regionally and expressed in units of km gillnet hours (km gn hr).

In order to compare observer data with CAESS records, the research-observed catch was converted to weights of measured fish. Weights were calculated using fork length to total length relationships (Appendix II), derived from the WA DOF Shark Research Section's database, and a combination of published and previously unpublished length-weight relationships, which were empirically measured during commercial and recreational sampling programs (Appendix III). All weights referred to in this report are whole weights, unless stated otherwise. Unmeasured fish were assigned the regional mean weight for their species and sex, with unsexed fish given the sex-combined mean regional weight. Where regional averages were not available (i.e. when sample sizes were too small) the total average weight for the species, across all regions, was used (Appendix IV).

Because they were generally discarded and due to difficulties in handling them safely, stingrays (families Dasyatididae and Urolophidae) and eagle rays (family Myliobatididae) were not measured by observers. Average weights were therefore estimated from the authors' personal observations. Other rarely encountered discard species, such as gurnards, gurnard perch, carpet sharks, boxfish, harlequin fish and north-west blowfish were usually unmeasured and their average weights were also estimated. No suitable length-weight relationship for dusky morwong was available at the time of writing. Therefore, the relationship for a related species, the banded morwong, *Cheilodactylus spectabilis,* was tried but was judged as giving too high an average value (12.89kg) so the average weight of dusky morwongs was adjusted to 9 kg.

As with commercial catch summaries, small components of the observed catch (i.e. those that were <1% of the regional catch or were <50kg) were combined as 'minor species'. A full description of these catches is given in Appendix V.

The following elasmobranch species were generally considered unsaleable and, therefore, discarded: Port Jackson sharks, *Heterodontus portusjacksoni*; eagle rays, family Myliobatididae; angel sharks, family Squatinidae; western wobbegongs, *Orectolobus sp*. A (Last and Stevens, 1994); cobbler wobbegongs, *Sutorectus tentaculatus;* saw sharks, family Pristiophoridae; shovelnose rays, families Rhinobatidae and Rhynchobatidae; stingrays and stingarees, families Dasyatididae and Urolophidae, carpet sharks, family Parascyllidae and broadnose sevengill sharks, *Notorynchus cepedianus*. Discarded teleosts were: buffalo bream, *Kyphosus cornelii;* dusky morwong, *D. nigricans;* red-lipped morwong*, Cheilodactylus rubrolabiatus;* north-west blowfish, *Lagocephalus scleratus;* gurnards, family Triglidae; gurnard perches, Neosebastes spp.; sea carp, family Aplodactylidae; boxfish, family Ostraciidae; scorpionfish, family Scorpaenidae and stargazers, family Uranoscopidae.

2.2.3 Catch estimation using research observed CPUE data

In an attempt to validate the accuracy of commercial CAES reporting in the WA temperate demersal gillnet and demersal longline fisheries and to estimate the fisheries' level of discarded bycatch, observed catch rates were used to back-calculate commercial catches between 1994 and 1999. The overall (all regions) annual catch per unit effort (CPUE) was calculated for the 18 most commonly observed (by number) species of sharks and 14 species of scalefish. In regions where 5 years of observer data were available (regions 2-5), regional catch rates were also calculated for the 9 most common shark species and 4 of the most common scalefish. The 'expected' CPUE for each species was calculated by fitting a linear regression to the annual research observed data. By randomly sampling the variance from the expected CPUE regression, 500 'bootstrapped' CPUE datasets were generated. The mean annual catch of each species and 95% confidence intervals were then estimated by multiplying the bootstrapped CPUE data by the annual commercially reported effort.

2.2.4 Non fish Bycatch

Observer data sheets were examined for notes regarding the capture of non-fish bycatch and records were tabulated. To confirm that these records were complete, field staff were questioned about the possibility of unrecorded incidents. All confirmed that, with the possible exception of very occasional rock lobster and gastropod captures, all such captures were recorded.

3.0 Results

3.1 Effort

Between 1994 and 1999, demersal gillnetting was, by far, the preferred fishing method, accounting for more than 97% of total effort in the fisheries (Table 1). Vessels operating in Region 6 reported the highest proportion of longline effort, where it accounted for 11.8% of regional 'gillnet equivalent' effort. Mean annual fishing effort was greatest in region 5 (47,296 km gn.hr) and least in region 2 (30,364 km gn.hr). During the last year of the study however, region 4 reported the highest level of effort (50,470 km gn.hr) and region 3 the lowest (26,573 km gn.hr). Whilst the overall level of fishing effort decreased by 6.2% between 1994 and 1999, during the same period, effort increased in regions 1, 2, 4 and 6 (Appendix I). Effort also increased appreciably in region 5 between 1994 and 1998 before declining sharply in 1998/99. Only region 3 reported a steadily declining trend during this period.

Research staff observed 7.4% of total fishery effort during the study period, all of which was on board gillnet vessels. Regionally, research coverage ranged between 1.8% (Region 2) and 19.8% (Region 4) of commercial effort.

Table 1. Southern and West Coast Demersal Gillnet and Longline Fishery effort and research 'observed' effort, July 1994 to June 1999.

	Commercial			Research	
Region	gillnet effort (km gn hours)	longline effort ('000 hook hours)	'gillnet equivalent' effort (km gn hours)	observed effort (km gn hours)	% of commercial effort observed
1	155,046	3	155,055	3,984	2.6
2	151,616	68	151,819	2,792	1.8
3	168,138	1,273	171,957	7,614	4.4
4	223,430	266	224,229	44,404	19.8
5	229,784	2,233	236,482	19,975	8.4
6	148,460	5,863	166,048	3,121	1.9
All	1,076,473	9,706	1,105,590	81,890	7.4

3.2 Catch composition

3.2.1 Commercial elasmobranch catch

Due to the magnitude of fluctuation in fishing effort and because species catches are confounded with vessels' targeting behaviour, the following trends in landings should not necessarily be considered representative of changes in species' abundance. The mean annual temperate demersal gillnet and demersal longline fisheries' catch of elasmobranchs was 1,298.6 tonnes. Total annual shark and ray catches declined by 151.1 tonnes (11.6%) between 1994 and 1999, corresponding to the 6.2% reduction in effort resulting from management adjustments to the fisheries' unit allowances. The largest decrease in elasmobranch catch (105.6 tonnes) occurred in region 5, where effort dropped by 29.8% (Appendix I). Region 4 reported the largest mean annual regional catch of elasmobranchs (262.8 tonnes) and region 6, the smallest (142.4 tonnes). Annually, 72.7 tonnes (5.6 % of the total elasmobranch catch) of shark was either undescribed by fishers on their returns or unrecognised by CAESS.

The group of sharks recorded as 'bronze whaler' (primarily dusky sharks, *Carcharhinus obscurus*), was the single largest component (28.8%) of the commercially reported

elasmobranch catch (Figure 6). Annual 'bronze whaler' catches showed a gradual decline from 425.6 tonnes in 1994/95 to 336.9 tonnes in 1998/99, with a mean annual catch of 374.2 tonnes. Gummy shark, *Mustelus antarcticus*, was the second most important species with a mean annual catch of 282.1 tonnes (21.7%). Despite a dramatic decline in 1995/96, annual gummy shark catches increased from 271.1 tonnes in 1994/95 to 314.4 tonnes in 1998/99. Whiskery shark, *Furgaleus macki,* was the third largest component, with a mean annual catch of 198.8 tonnes (15.3%). Whiskery shark catches fell by 19% between 1994/95 and 1998/99. Sandbar (known locally as thickskin) shark, *Carcharhinus plumbeus*, catches doubled between 1994/95 and 1998/99. On average, the annual sandbar shark catch was 120.2 tonnes (9.3%), making it the fourth largest component of the fisheries' elasmobranch catch.

Two species of sharks which were caught by the temperate WA demersal gillnet and demersal longline fisheries were protected under the Endangered Species Protection Act 1992[1] (ESP) during the course of this project, causing rapid declines in their reported catches. There was no reported catch of great white sharks, *Carcharodon carcharias*, in 1998/99 (Appendix I), following their listing in December 1997. Smaller quantities of grey nurse sharks, *Carcharias taurus*, which were also listed under the ESP Act in December 1997, continued to be reported from State waters (outside of the jurisdiction of Commonwealth legislation) in 1998/99 until their protection under the State's Wildlife Conservation Act in December 1999.

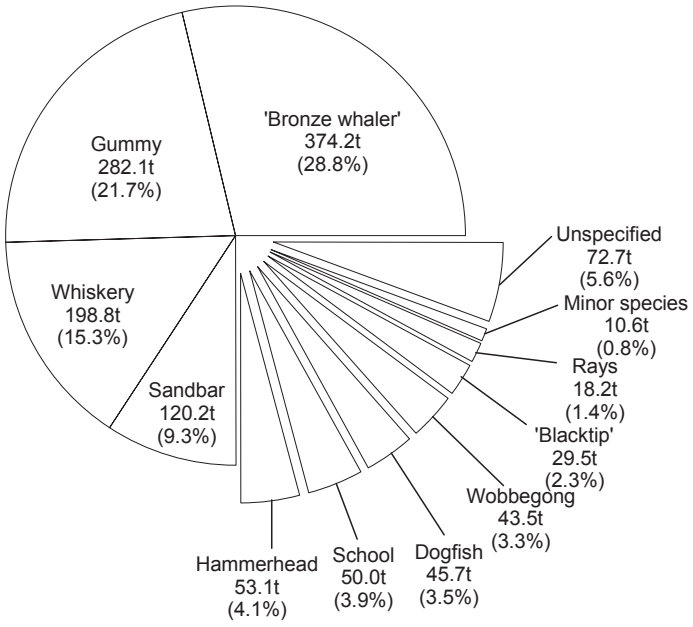


Figure 6. All regions mean annual elasmobranch catch reported by demersal gillnet and demersal longline fishers, July 1994 to June 1999.

'Bronze whaler' was an important part of the fisheries' catch in all six regions (Figure 7), accounting for between 9.3% (region 2) and 49.4% (region 4) of regional catches. *F. macki*, catches were also significant in all six regions, comprising between 7.3% (region 6) and 21.7% (region 4). *M. antarcticus*, were by far the largest component of the elasmobranch catch in regions 1 and 2 (49.7% and 58.1% respectively) and also an important portion of the catch in region 3 (24.1%). However, they were caught in only small quantities in the other three regions. Sandbar sharks, *C. plumbeus,* were caught in insignificant quantities in regions 1, 2, 3 and 4, however they were a major portion of the catch in region 5 (17.8%) and the primary component of the catch in region 6 (40.8%), although catches in region 6 only began

[1] The ESP Act was superceded by the Environment Protection and Biodiversity Conservation Act in 1999.

to exceed those of 'bronze whaler' in 1996/97 (Appendix I). Whilst small overall, catches of school shark, *Galeorhinus galeus,* (20.4% in region 1) and 'dogfish', family *Squalidae,* (11.2% in region 2 and 9.6% in region 3) were locally significant.

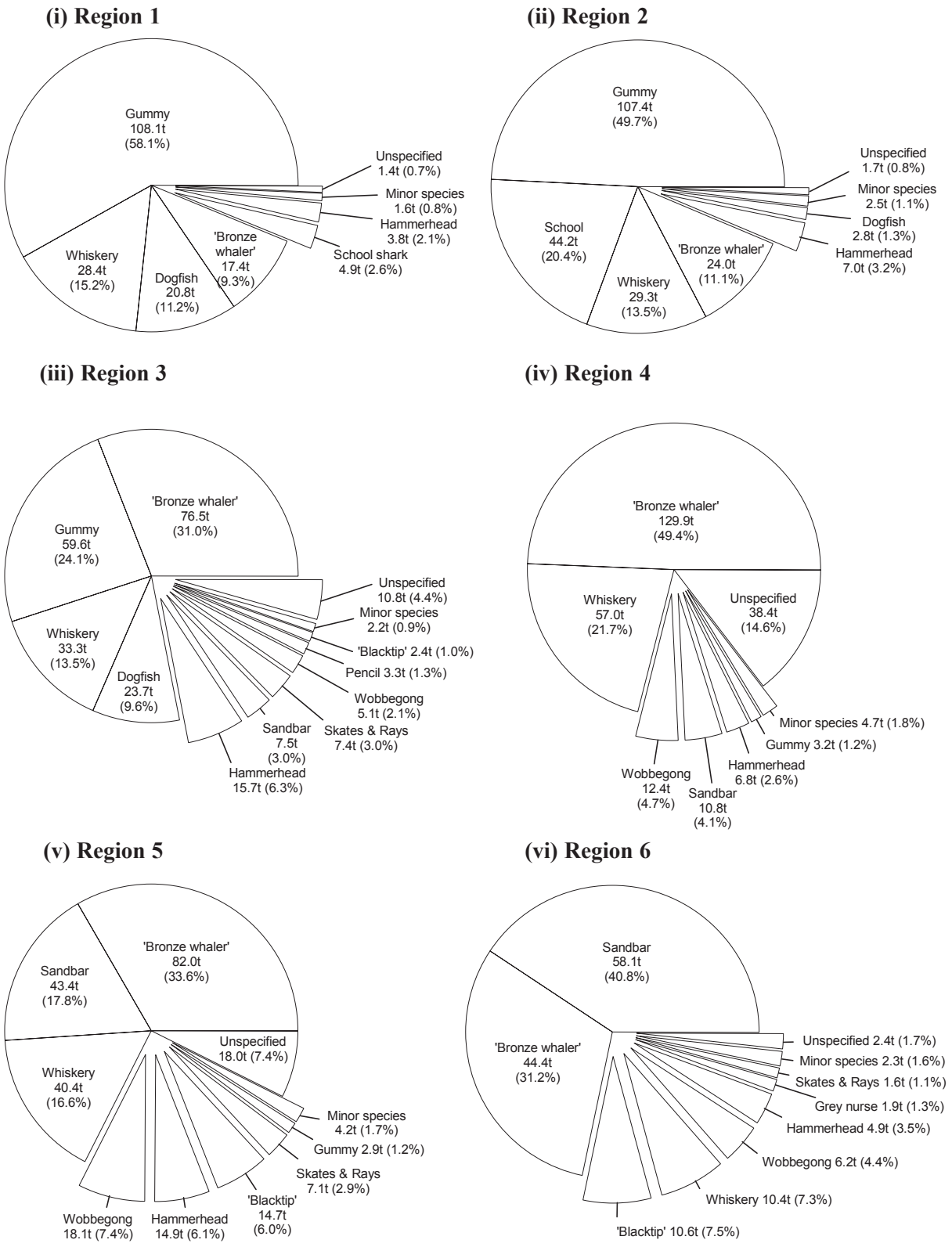


Figure 7. Regional mean annual elasmobranch catches reported by demersal gillnet and demersal longline fishers, July 1994 to June 1999.

3.2.2 Commercial teleost catch

Between 1994 and 1999, the annual teleost (scalefish) catch averaged 196.6 tonnes (13.1% of total landings). The proportion of scalefish in the fisheries' total catch increased by 14.8%, from 183.3 tonnes (11.1%) in 1994/95, to 210.3 tonnes (13.3%) in 1998/99 (Appendix I). Unidentified scalefish accounted for 16.9% of all scalefish caught. Queen snapper, *Nemadactylus valenciennesi,* (24.9%) was the primary component of the scalefish catch in the two fisheries, with a mean annual catch of 48.9 tonnes. The next largest components were, blue groper, *Achoerodus gouldii,* (15.1%); West Australian dhufish, *Glaucosoma hebraicum,* (10.4%) and pink snapper, *Pagrus auratus*, (9.9%). Annual catches of queen snapper, blue groper and dhufish remained fairly steady over this five-year period (Appendix I). The annual pink snapper catch, however, nearly doubled from 13.8 tonnes in 1994/95 to 25.0 tonnes in 1998/99, with a minimum 9.8 tonnes in 1995/96. The highest proportion of 'unidentified' scalefish (15.0 tonnes yr^{-1}) was reported from region 4, where it accounted for 33.5% of the regional catch (Figure 9).

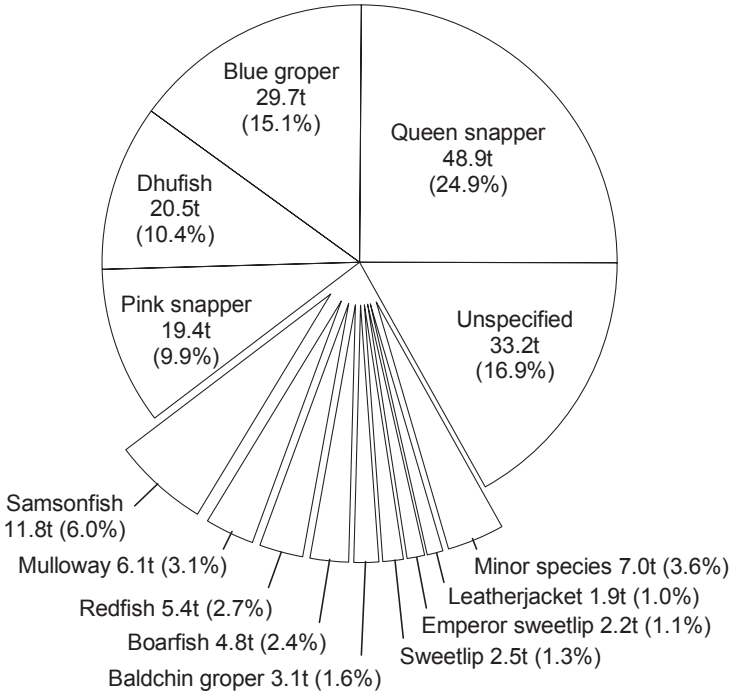


Figure 8. All regions mean annual teleost catch reported by demersal gillnet and demersal longline fishers, July 1994 to June 1999.

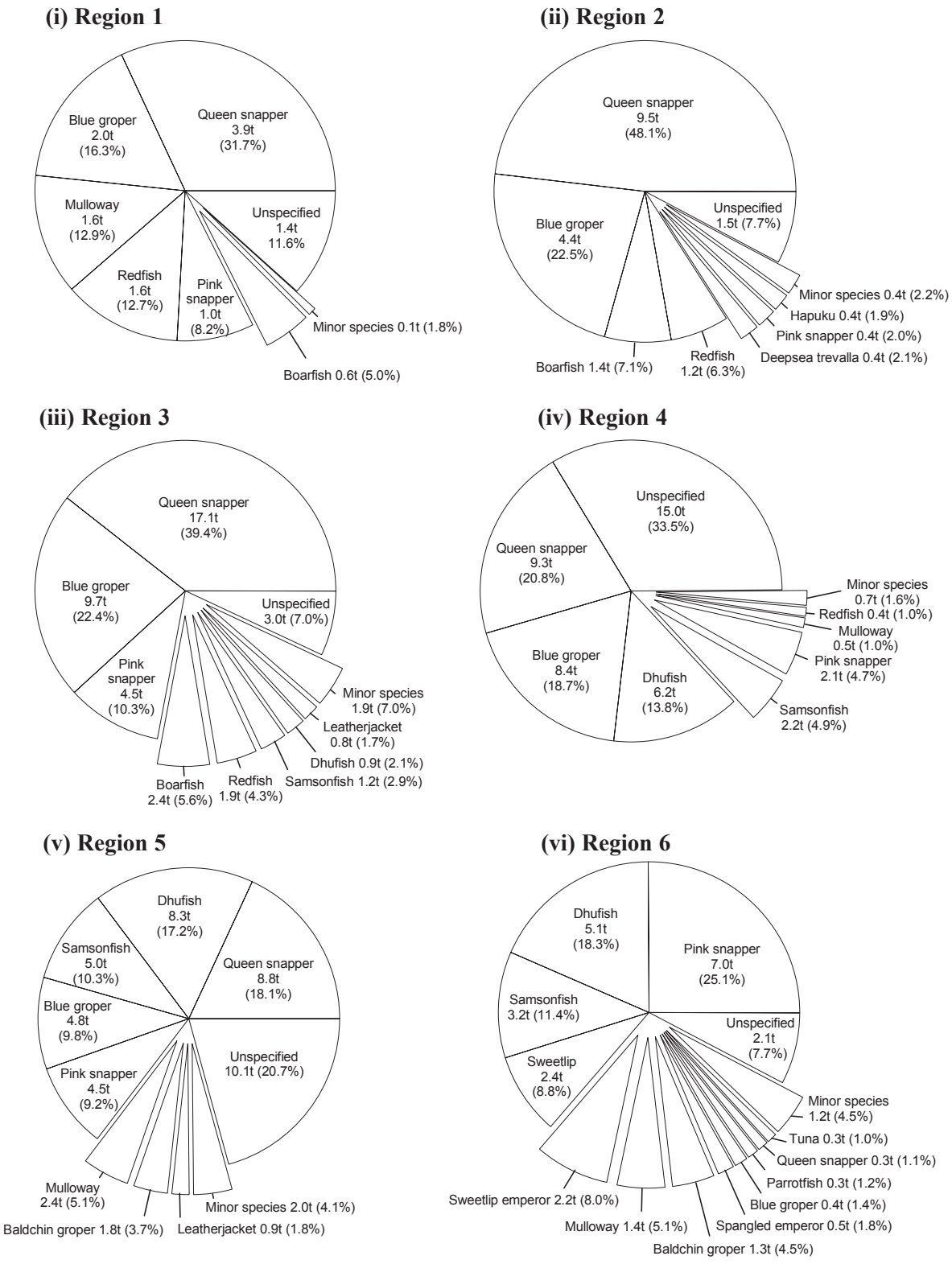


Figure 9. Regional mean annual teleost catches reported by demersal gillnet and demersal longline fishers, July 1994 to June 1999.

Region 5 reported the largest scalefish catch (mean of 48.4 tonnes yr^{-1}) and region 1, the smallest (mean of 12.4 tonnes yr^{-1}). Queen snapper, *N. valenciennesi,* was the principal component of the scalefish catch in regions 1 (31.7%), 2 (48.1 %) and 3 (39.4%) but accounted for only 20.8% and 18.1% and 1.1% of the scalefish catch in regions 4, 5 and

6 respectively. Blue groper, *A. gouldii*, was the next most significant scalefish species in regions 1 (16.3%), 2 (22.5%), 3 (22.4%) and 4 (18.7%). Blue groper was also a valuable part of the scalefish catch in region 5 (9.8%) but was also only caught in very small quantities in region 6 (1.4 %). Pink snapper, *P. auratus*, was the principal scalefish species in region 6, where fishers landed an average of 7.0 tonnes yr^{-1} (25.1%) and was also important in region 3 (10.3%) and region 5 (9.2%). Other regionally important species were mulloway, *Argyrosomus hololepidotus,* and 'redfish' (*Centroberyx spp*.), in region 1 (12.9% and 12.7% respectively); samsonfish, *Seriola hippos*, in regions 5 and 6 (10.3% and 11.4% respectively) and emperor sweetlip, *Lethrinus miniatus*, (8.0%) in region 6.

3.2.3 Research observed elasmobranch catch

The three main components of the observed elasmobranch catch were *Carcharhinus obscurus,* (28.9%), *Mustelus antarcticus* (15.4%) and *Furgaleus macki* (11.6%) (Figure 10). In total, 11 species were generally discarded (Appendix V), estimated to be 13.7% by weight of the observed catch. The majority of discarded bycatch was the Port Jackson shark, *Heterodontus portusjacksoni,* which accounted for 10.3% of the total elasmobranch catch.

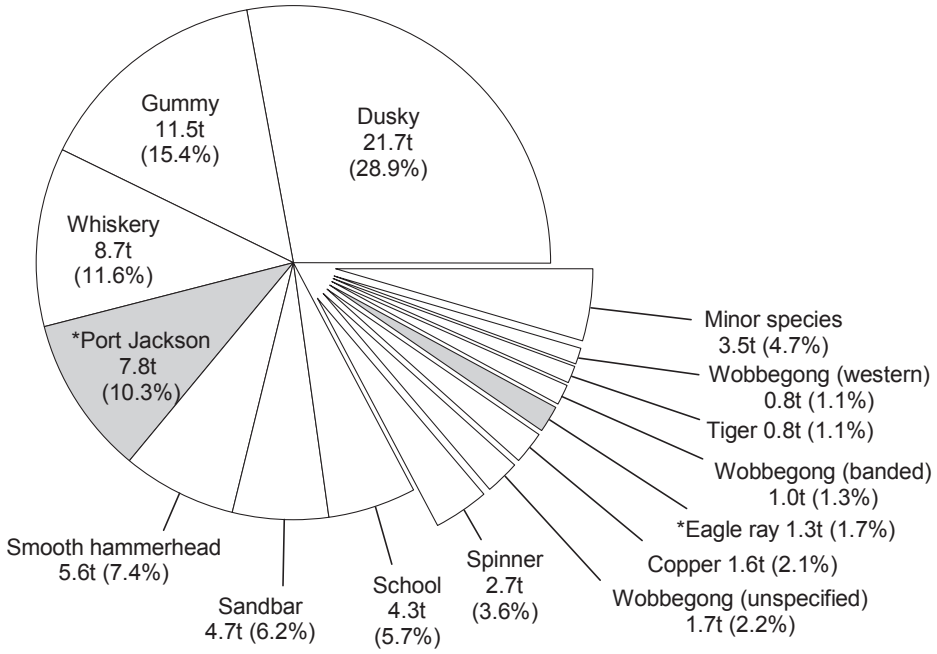


Figure 10. All regions research observed mean annual elasmobranch catch, July 1994 to June 1999. Shaded species indicate discarded catch.

Figure 11 summarises the regional elasmobranch catches observed by research staff. School shark, *Galeorhinus galeus*, was the most commonly observed species in region 1 (31.6%), *M. antarcticus*, was the most common in regions 2 (57.8%) and 3 (38.3%), *C. obscurus*, was the most common in regions 4 (37.7%), 5 (22.4%) and sandbar shark, *Carcharhinus plumbeus*, was the most common in region 6 (41.6%). *C. obscurus* was also caught in significant quantities in regions 2, 3 and 6 (11.8%, 25.6% and 20.2%, respectively). *Furgaleus macki*, was also significant in regions 2-5, comprising between 8.1% (region 3) and 14.3% (region 4) of the catch. Sandbar sharks were also responsible for 19.4% of the catch in region 5, 7.5% in region 4 and 10.7% in region 3 but were not reported at all in regions 1 and 2.

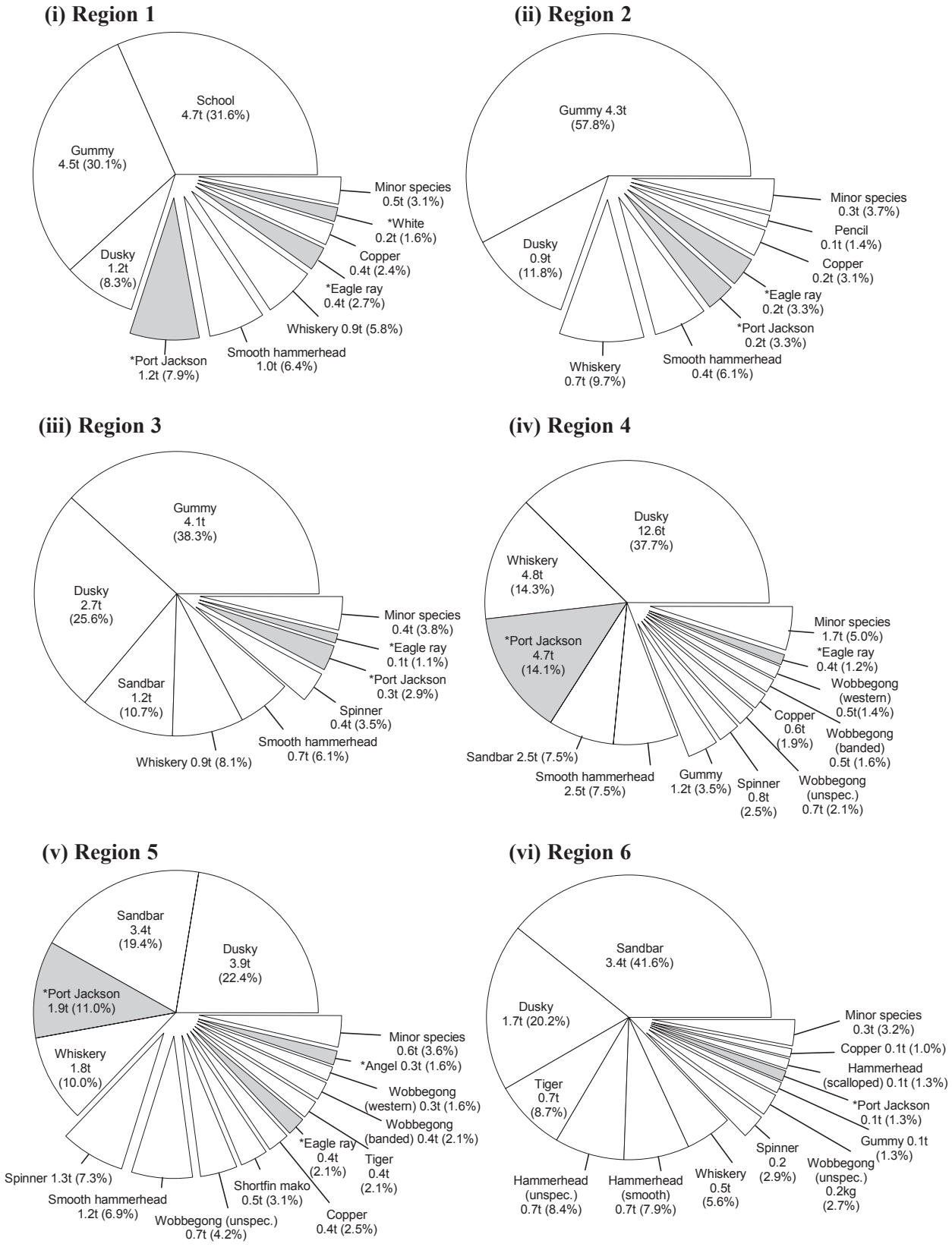


Figure 11. Regional research observed mean annual elasmobranch catches, July 1994 to June 1999. Shaded species indicate discarded catch.

Region 4 had the highest overall incidence of discarded elasmobranch bycatch (17.6%), followed by region 5 (15.7%) and region 1 (13.5%). Region 3 had the lowest recorded quantity of elasmobranch bycatch (0.05%). Port Jackson sharks were the most frequently observed discarded species in all regions, estimated to account for between 1.3% (region 6) and 14.1% (region 4) of regional catches. Eagle rays, were the next most common group but only accounted for 1.7% of the total elasmobranch catch and between 0.1% (region 6) and 3.3% (region 2) regionally.

3.2.4 Research observed teleost catch

The observed teleost catch is summarised in Figure 12. The most important commercially-valuable teleost species were *G. hebraicum*, at 16.3% of the catch, followed by *N. valenciennesi*, (10.5%), *A. gouldii*, (10.0%) and *P. auratus* (4.8%). Only 10 of the 46 observed species of scalefish were discarded, however these amounted to 32.1% of the estimated weight of the catch. Two species were responsible for almost all of the discarded teleost bycatch; buffalo bream, *Kyphosus cornelii* and dusky morwong, *Dactylophora nigricans,* which accounted for 19.6% and 12.4% of the weight of the catch, respectively.

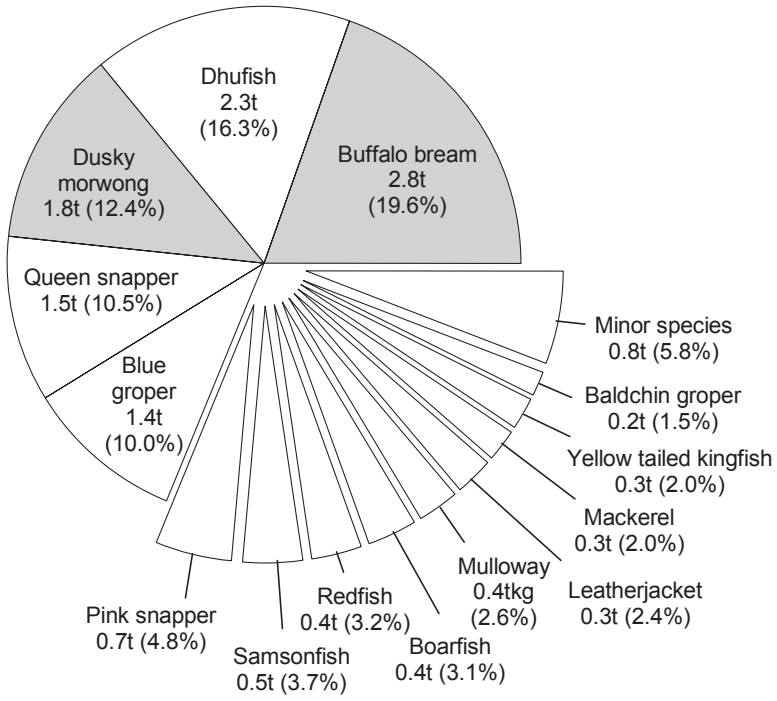


Figure 12. All regions research observed mean annual teleost catch, July 1994 to June 1999. Shaded species indicate discarded catch.

Region 1 had the highest overall incidence of discarded teleosts (73.4% of the catch by weight), followed by region 6 (37.5%); region 5 (34.6%); region 4 (31.6%) and region 2 (23.4%). Region 3 had the lowest occurrence (10.8%). The only regions where a discarded species was not the predominant component of the scalefish catch were regions 3, where *N. valenciennesi,* accounted for 34.7% of the catch and region 5, where *G. hebraicum* made up 22.5% of the catch (Figure 13). *K. cornelii* was the dominant scalefish species in region 1 (63.2%), region 4 (18.1%) and region 6 (36.6%), whilst *D. nigricans* was the major scalefish species in region 2 (20.7%).

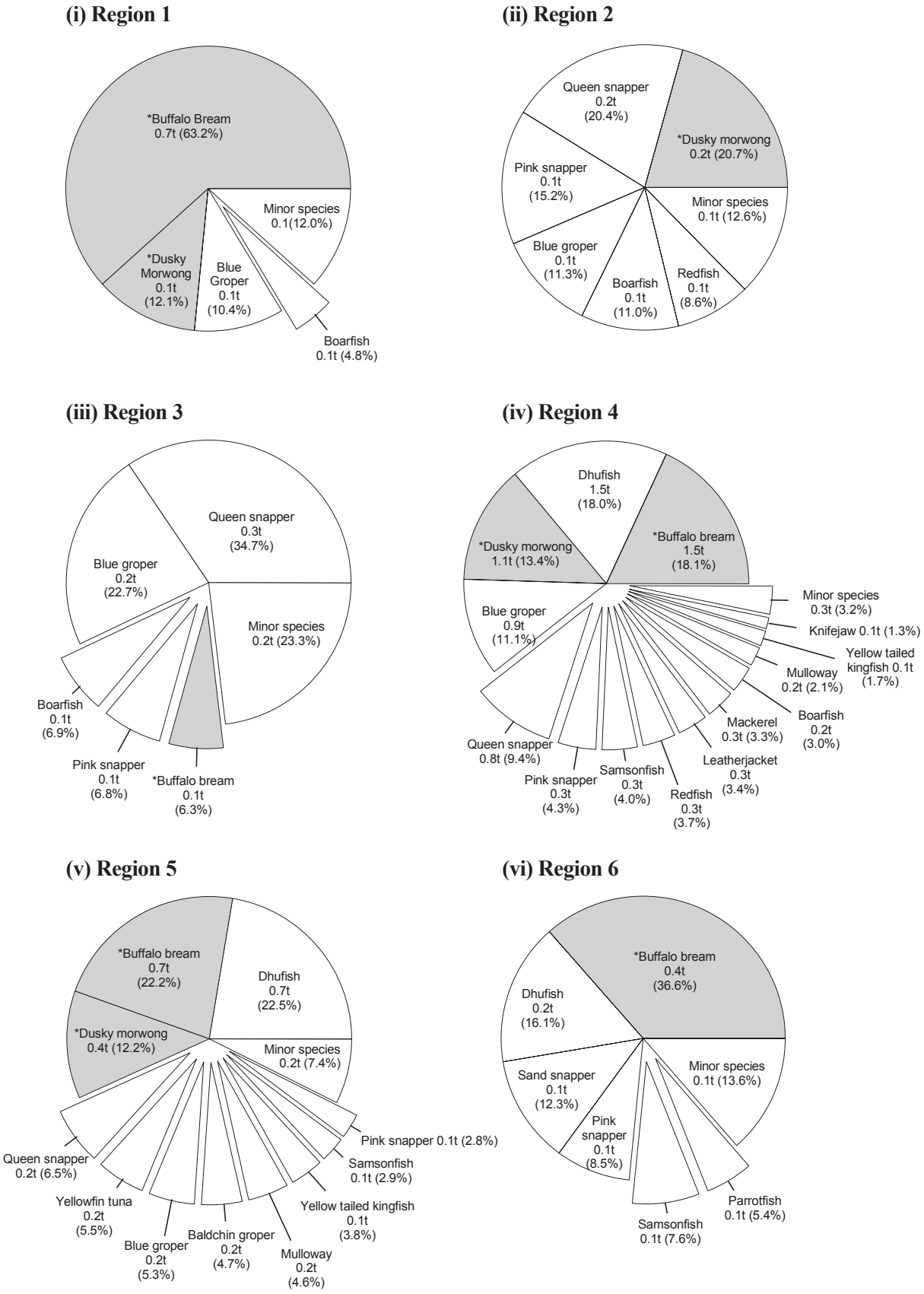


Figure 13. Regional research observed mean annual scalefish catches, July 1994 to June 1999. Shaded species indicate discarded catch.

3.2.5 Species diversity

In total, 16 elasmobranch species[2] were reported by gillnet and longline fishers in their monthly catch returns between 1994 and 1999 (Table 2). The highest commercially reported diversity occurred in regions 3 and 5, where 14 individual species were recorded. Fishers in regions 4 and 6 reported catching 12 species; Region 2 fishers reported 11 and Region 1 fishers reported 10.

Observers recorded a total of 34 elasmobranch categories, 23 of which were identified to individual species (Appendix IV). The greatest observed elasmobranch diversity occurred in region 4 (28 species), followed by region 5, with 25 and region 3, with 24. The lowest elasmobranch diversity (18 species) was observed in region 1, however this was also where the least amount of research coverage occurred. Fishers in regions 1, 2, 3, 5 and 6 reported between 55% and 60% of the elasmobranchs diversity recorded by observers. However, less than 43% of the observed diversity was reported in Region 4, which also reported, by far, the largest proportion of unidentified shark (14.6%).

Table 2. Regional species diversity.

	Elasmobranchs					Teleosts				
Region	# spp. CAESS	# spp. observed	% of observed diversity reported	unspecified (kg)	unspecified (%)	# spp. CAESS	# spp. observed	% of observed diversity reported	unspecified (kg)	unspecified (%)
1	10	18	55.6	1,733	0.8	13	13	100.0	1,437	11.6
2	11	20	55.0	1,361	0.7	19	24	79.2	1,518	7.7
3	14	24	58.3	10,829	4.4	25	26	96.2	3,027	7.0
4	12	28	42.9	38,357	14.6	18	37	48.6	15,042	33.5
5	14	25	56.0	17,986	7.4	31	40	77.5	10,051	20.7
6	12	20	60.0	2,395	1.7	29	17	170.6	2,139	7.7
All	16	34	47.1	72,660	5.6	43	44	97.7	33,214	16.9

Demersal gillnet and longline fishers reported a total of 43 teleost species between 1994 and 1999. Highest diversity was reported in Region 5 (31 species), followed by Region 6 (29 species), the lowest diversity was reported in region 1 (13 species). Research staff also observed the highest teleost diversity in region 5 (40 species) and lowest in region 1 (13 species).

The reported level of teleost diversity in region 1 was the same as the observed level of diversity (although different species); very similar in region 3 and similar in regions 2 and 5. Fishers in Region 4, however reported far fewer teleost species than were observed (48.6% agreement) and also, the highest proportion of unidentified catch. Only fishers in region 6 reported catching more species than were recorded by observers.

3.3 Catch per unit effort (CPUE)

The total (all regions) catch per unit effort of the 18 elasmobranch and 14 scalefish species for which there were five-year datasets are illustrated in Figure 14 and Figure 15, respectively. Regional CPUE data were calculated for species where 5 years of catch and effort data were available. As research sampling was only conducted between 1994 and 1996 in region 1 and between 1994 and 1997 in region 6, no CPUE data were available for these regions and they were excluded. The remaining CPUE data, were used to generate bootstrapped estimated catches.

[2] In some cases, species were reported at a group level (eg. 'blacktip', 'hammerhead', 'rays', etc)

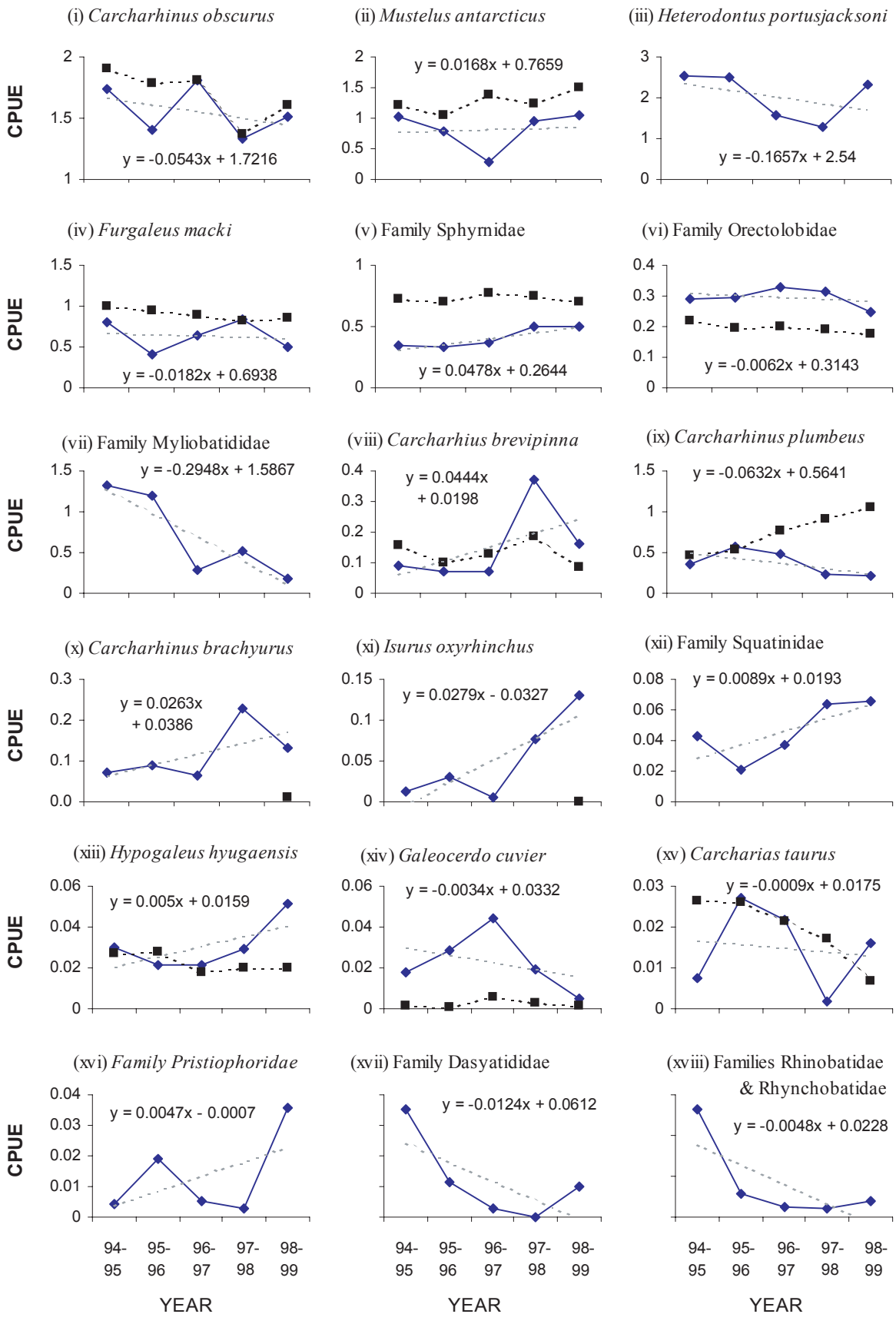


Figure 14. Research observed and commercially reported CPUE (kg/km gillnet hr) of 18 species of elasmobranchs (—◆— = Research; ---■--- = CAESS; ------ = Est CPUE).

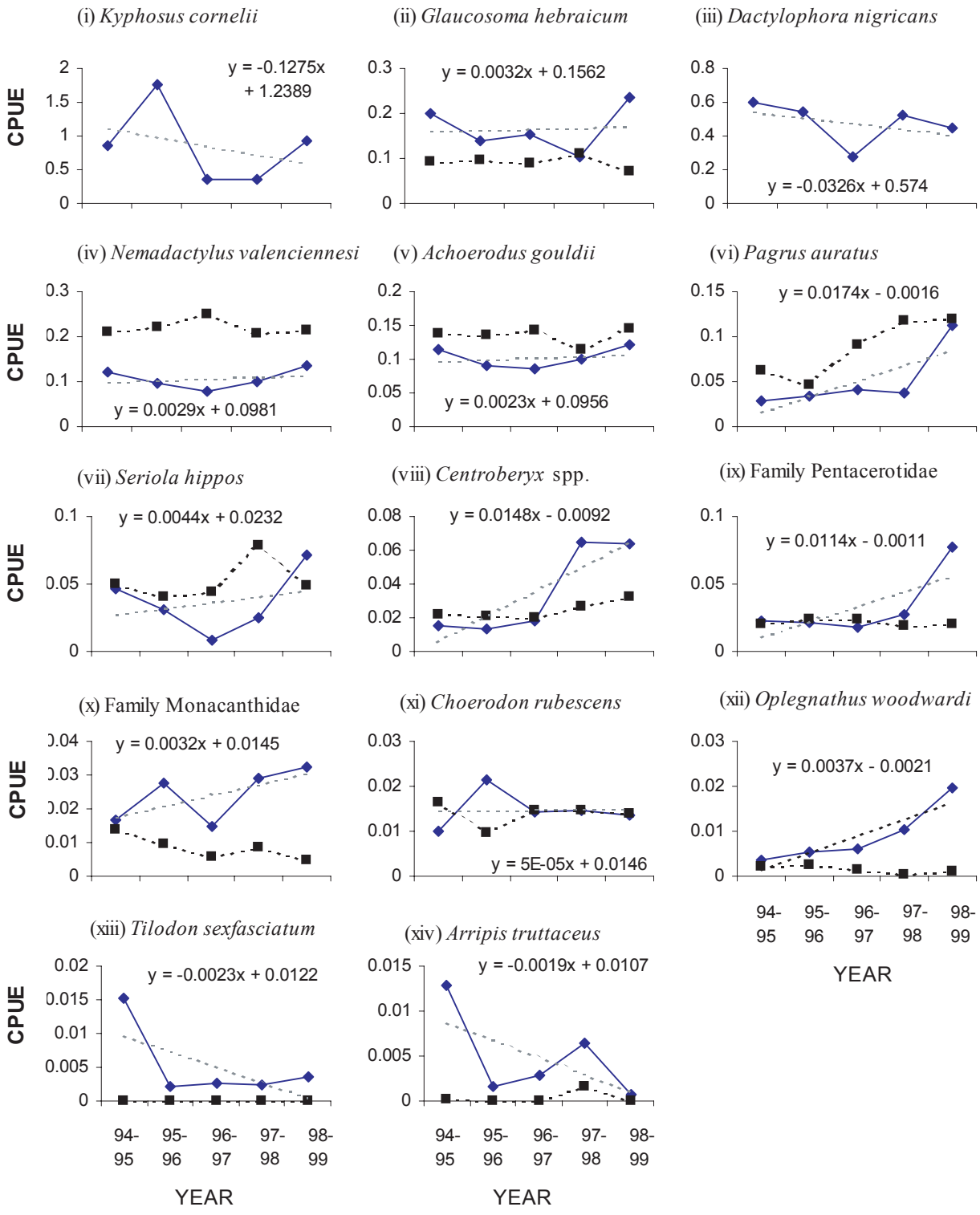


Figure 15. Research observed and commercially reported CPUE (kg/km gillnet hr) of 18 species of elasmobranchs (—◆— = Research; ---■--- = CAESS; ------ = Est CPUE).

3.4 Estimated commercial catch

3.4.1 Elasmobranchs

The best estimate of the total (i.e. all regions) mean annual elasmobranch catch from bootstrapped CPUE data was 1186.6 tonnes (Table 3), 112.0 tonnes less than was reported by the fishery (Table 4). The upper 95% confidence interval also underestimated the total catch by 28.5 tonnes.

Table 3. Annual mean estimated commercial elasmobranch catches from 'bootstrapped' observer CPUE data.

		Estimated mean annual catch (tonnes) and 95% CIs in parentheses				
Name	**Species**	**Region 2**	**Region 3**	**Region 4**	**Region 5**	**Total**
Dusky	*Carcharhinus obscurus*	28.7 (1.2-71.0)	115.8 (25.3-201.5)	82.3 (56.3-103.2)	45.2 (24.6-62.0)	295.2 (61.7-347.8)
Gummy	*Mustelus antarcticus*	101.3 (56.0-186.0)	159.1 (66.0-336.7)	7.9 (4.9-10.5)	1.8 (0.2-6.0)	180.4 (79.6-235.1)
Port Jackson*	*Heterodontus portusjacksoni*	47.5 (11.2-77.5)	74.2 (48.0-124.0)	148.8 (108.5-200.2)	120.8 (70.7-176.5)	122.2 (48.9-246.8)
Whiskery	*Furgaleus macki*	18.7 (9.1-24.0)	34.9 (3.8-60.7)	33.5 (18.9-53.6)	23.5 (8.4-38.9)	120.3 (25.3-177.4)
Hammerheads	Sphyrnidae	15.1 (5.3-38.8)	25.2 (9.2-35.3)	15.4 (5.8-28.3)	15.5 (10.0-23.0)	88.6 (52.3-132.5)
Wobbegongs	Orectolobidae	n/a	3.0 (0.4-6.2)	34.0 (20.8-48.8)	24.0 (3.2-49.2)	65.4 (57.9-72.9)
Eagle Rays*	Myliobatididae	55.0 (21.3-113.2)	24.5 (3.5-82.5)	12.2 (5.6-27.5)	19.8 (11.3-29.6)	49.9 (5.4-141.1)
Longnose grey/Spinner	*Carcharhinus brevipinna*	n/a	n/a	5.4 (2.2-10.2)	6.1 (0.9-11.8)	44.9 (19.8-111.2)
Sandbar	*Carcharhinus plumbeus*	n/a	20.9 (2.4-59.3)	8.3 (0.2-16.0)	21.3 (14.2-31.5)	41.6 (16.7-58.2)
Copper	*Carcharhinus brachyurus*	n/a	n/a	n/a	n/a	26.0 (14.2-44.9)
SF Mako	*Isurus oxyrinchus*	n/a	n/a	n/a	n/a	11.6 (4.5-16.4)
Angel sharks*	Squatinidae	n/a	n/a	n/a	n/a	10.1 (6.6-13.3)
Pencil	*Hypogaleus galeus*	n/a	n/a	n/a	n/a	6.8 (4.8-9.2)
Tiger	*Galeocerdo cuvier*	n/a	n/a	n/a	n/a	5.1 (2.4-9.8)
Grey Nurse	*Carcharias taurus*	n/a	n/a	n/a	n/a	3.1 (0.6-5.8)
Sawsharks*	Pristiophoridae	n/a	n/a	n/a	n/a	3.0 (0.5-5.8)
Sting Rays*	Dasyatididae & Urolophidae	n/a	n/a	n/a	n/a	2.6 (0.9-6.5)
Shovelnose Rays*	Rhinobatidae & Rhynchobatidae	n/a	n/a	n/a	n/a	1.9 (0.8-3.8)
All sharks and rays		101.2 (56.0-186.0)	408.3 (300.6-523.1)	218.5 (205.7-230.1)	227.4 (200.4-259.4)	1186.6 (1,068.1-1,270.1)

Catches of the three main target species, *C. obscurus*, *M. antarcticus*, *F. macki* were also underestimated by 79.0 tonnes (21.1%), 101.7 tonnes (36.1%) and 76.6 tonnes (38.5%), respectively. Commercial catches of *C. obscurus*, *M. antarcticus*, *F. macki* were also greater than the upper 95% confidence limits of the estimated catches by, 26.4 tonnes, 47.0 tonnes and 21.4 tonnes, respectively. Estimated catches of 'secondary' species were generally higher than reported catches. The best estimates of catches of hammerheads (mainly *Sphyrna*

zygaena), wobbegongs (Orectolobidae) and 'blacktip' sharks (*Carcharhinus brevipinna*) were, respectively, 35.5 tonnes (66.9%), 21.9 tonnes (50.5%) and 15.4 tonnes (52.2%) higher than commercially reported. Suitable five-year datasets were not available for school shark, *C. galeus* or dogfish (Squalidae). The mean annual catches of *H. portusjacksoni*, which were commercially unmarketable and discarded and eagle rays, which were only retained to a very minor extent, were estimated to be 122.2 tonnes and 49.9 tonnes, respectively. Discarded bycatch of Port Jackson sharks was estimated to be highest in regions 4 and 5, at 148.8 tonnes and 120.8 tonnes respectively. At 54.9 tonnes, eagle ray bycatch was estimated to be highest in region 2.

Table 4. Differences between estimated and recorded elasmobranch catches.

		Estimated catch above/below reported catch (tonnes live wt.)				
Name	**Species**	**Region 2**	**Region 3**	**Region 4**	**Region 5**	**All regions**
Dusky	*Carcharhinus obscurus*	11.3	39.3	-47.6	-36.9	-79.0
Gummy	*Mustelus antarcticus*	-6.8	99.4	4.6		-101.7
Whiskery	*Furgaleus macki*	-9.6	1.6	-23.4	-16.9	-78.5
Sandbar	*Carcharhinus plumbeus*		13.4	-2.5	-22.2	-78.6
Hammerhead	Family Sphyrnidae	11.2	9.5	8.6	0.7	35.5
Wobbegong	Family Orectolobidae		-2.1	21.6	5.9	22.0
Longnose grey/Spinner	*Carcharhinus brevipinna*			3.5	-8.6	15.4
Skates and Rays*		54.9†	17.1†	10.4†	12.7†	36.2†
Pencil	*Hypogaleus hyugaensis*					1.9
Grey Nurse	*Carcharias taurus*					-1.2
Tiger	*Galeocerdo cuvier*					4.6
Copper	*Carcharhinus brachyurus*					25.6
SF Mako	*Isurus oxyrinchus*					11.6
Sawshark*	Family Pristiophoridae					3.0
Port Jackson*	*Heterodontus portusjacksoni*	47.5	74.2	148.8	120.8	122.2
Angel shark*	Family Squatinidae					10.1

* Discarded;
† Eagle rays (family Myliobatididae) only.

3.4.2 Teleosts

The estimated total teleost catch was 223.6 tonnes (Table 5), 27.0 tonnes (13.7%) more than reported (Table 6). *K. cornelii*, which was always discarded, was estimated to be the largest component of the teleost catch, with a mean annual catch of 44.1 tonnes. *G. hebraicum,* which was generally retained, was estimated to be the second largest scalefish component at 36.9t (16.4t more than reported) followed by *D. nigricans*, another discarded species at 29.6 tonnes. At 23.6 tonnes and 22.6 tonnes, respectively, *N. valenciennesi* and *A. gouldii* were underestimated overall and in all regions for which there were bootstrapped data. *P. auratus* and *S. hippos* were also slightly underestimated while all other species were overestimated. Bootstrapping results indicated that the highest level of discarded teleost bycatch occurred in region 5, where 60.4 tonnes of buffalo bream and 23.4 tonnes of dusky morwong were estimated to have been caught, followed by region 4, where catches were estimated at 46.3 tonnes and 34.2 tonnes respectively.

Table 5. Estimated commercial teleost catches from 'bootstrapped' observer CPUE data.

		Estimated mean annual catch (tonnes) and 95% CIs in parentheses				
Name	**Species**	**Region 2**	**Region 3**	**Region 4**	**Region 5**	**Total**
Buffalo Bream*	*Kyphosus cornelii*	4.7 (0.8-10.2)	13.1 (5.0-20.3)	46.3 (13.9-81.5)	60.4 (11.6-115.1)	44.1 (10.0-98.2)
Dhufish	*Glaucosoma hebraicum*					36.9 (21.8-50.4)
Dusky Morwong*	*Dactylophora nigricans*	30.6 (0.0-48.4)	10.0 (4.8-15.6)	34.2 (20.7-43.1)	23.4 (21.1-25.0)	29.6 (16.6-52.7)
Queen Snapper	*Nemadactylus valenciennesi*	4.5 (1.9-7.6)	12.3 (3.5-18.9)	5.0 (2.6-5.9)	2.7 (1.5-3.4)	23.6 (17.5-28.9)
Blue Groper	*Achoerodus gouldii*	2.7 (1.7-4.1)	8.4 (5.0-15.1)	6.0 (4.4-7.8)	2.5 (1.0-3.5)	22.6 (19.0-26.2)
Pink Snapper	*Pagrus auratus*					11.3 (5.0-17.4)
Samsonfish	*Seriola hippos*					8.1 (1.8-13.8)
Red Snapper	*Centroberyx* spp.					7.8 (4.5-11.1)
Boarfish	Family Pentacerotidae					7.2 (3.8-12.0)
Leatherjacket	Family Monacanthidae					5.3 (3.3-6.8)
Baldchin Groper	*Choerodon rubescens*					3.3 (2.2-4.7)
Knifejaw	*Oplegnathus woodwardi*					2.0 (1.4-2.7)
Moonlighter	*Tilodon sexfasciatum*					1.2 (0.3-2.4)
Aus. Salmon	*Arripis truttaceus*					1.1 (0.2-2.0)
All Scalefish		20.6 (8.3-34.8)	34.8 (19.6-45.5)	51.8 (30.1-62.8)	45.5 (25.7-63.6)	223.6 (156.3-285.2)

* Discarded

Table 6. Differences between estimated and reported teleost catches.

	Estimated catch above/below reported catch (tonnes live wt.)				
Species	**Region 2**	**Region 3**	**Region 4**	**Region 5**	**All regions**
Buffalo Bream	4.7	13.1	46.3	60.4	44
Dusky Morwong	30.5	9.8	34.2	23.4	29.4
Queen Snapper	-5	-4.8	-4.4	-6.1	-25.3
Dhufish					16.4
Pink Snapper					-8.2
Blue Groper	-1.7	-1.4	-2.4	-2.3	-7.1
Samsonfish					-3.7
Leatherjacket					3.4
Red Snapper					2.4
Boarfish					2.4
Knifejaw					1.7
Moonlighter					1.2
Aus. Salmon					1.0
Baldchin Groper					0.2

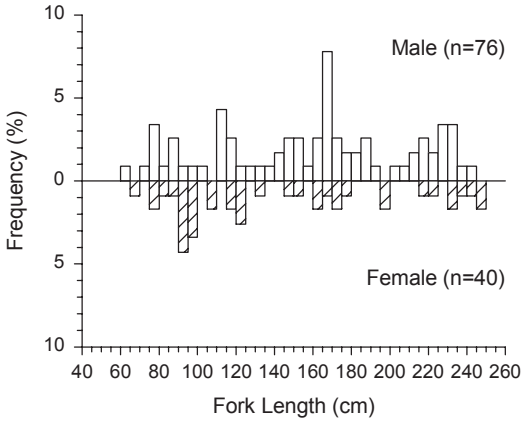
* Discarded

3.5 Shark catch size composition

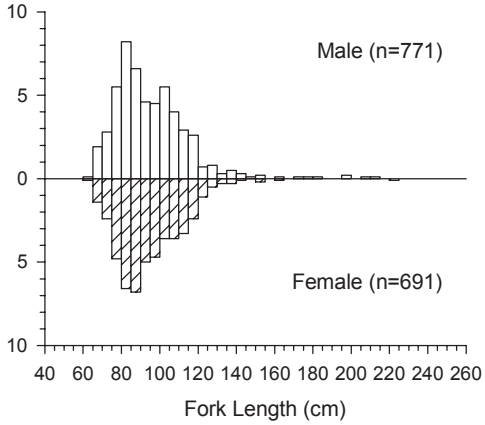
Statistical summaries of the data presented in Figures 16–24 are given in Appendix IV.

3.5.1 Whaler sharks (family Carcharhinidae)

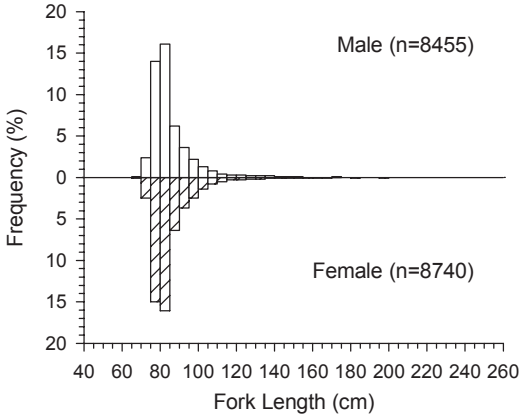
(i) Copper shark, *Carcharhinus brachyurus*



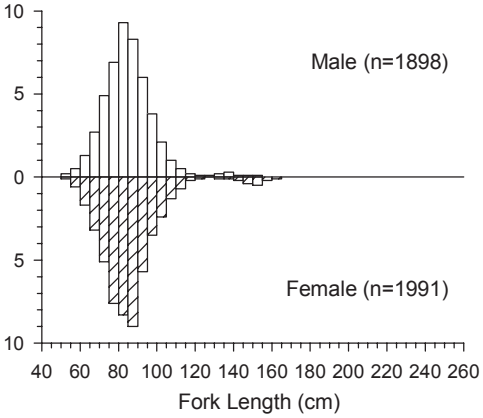
(ii) Spinner shark, *Carcharhinus brevipinna*



(iii) Dusky shark, *Carcharhinus obscurus*



(iv) Sandbar shark, *Carcharhinus plumbeus*



(v) Tiger shark, *Galeocerdo cuvier*

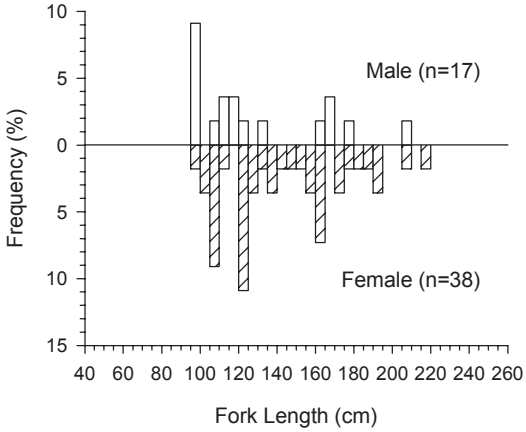


Figure 16. Whaler shark, family Carcharhinidae, size distribution (all zones).

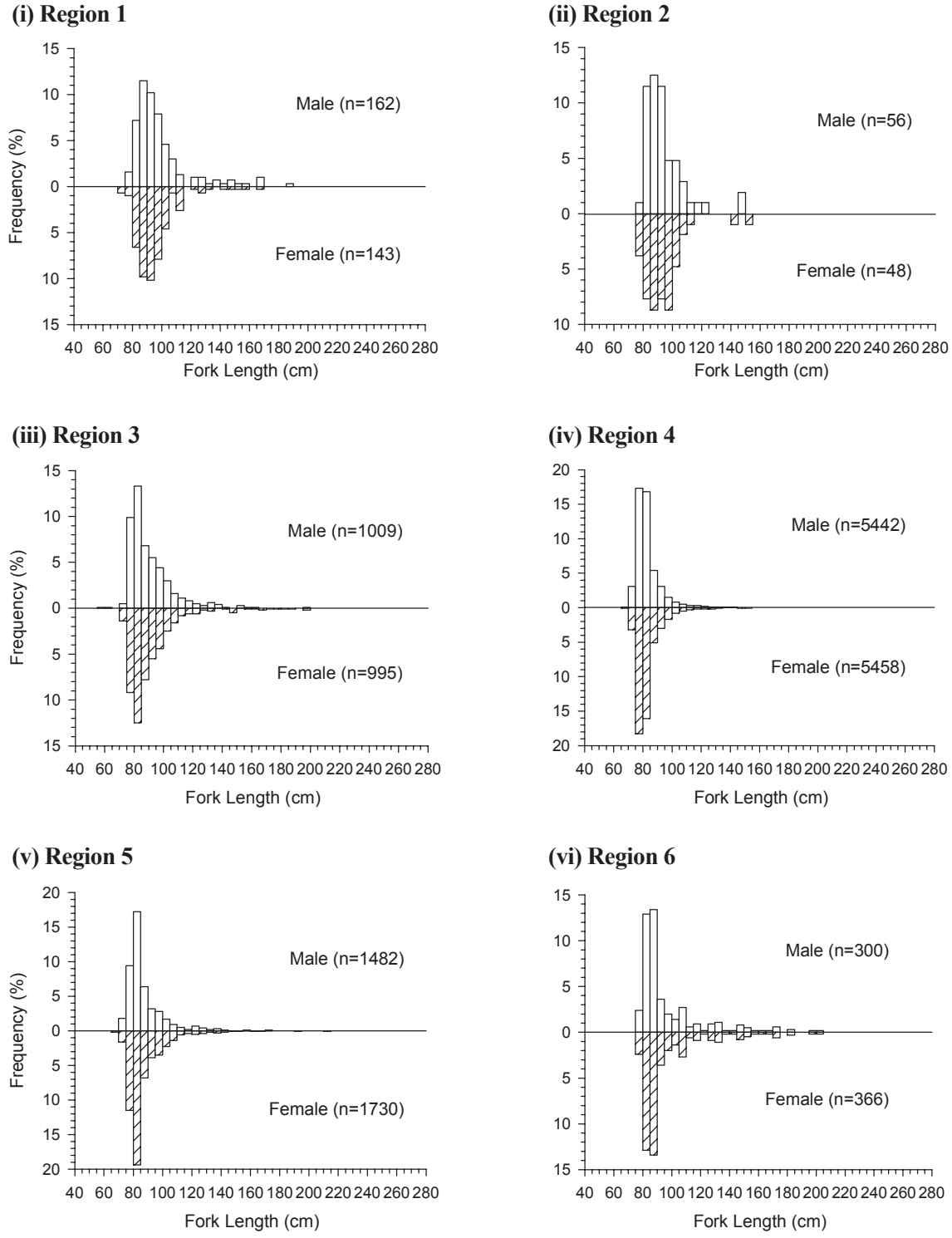


Figure 17. Regional dusky shark, *Carcharhinus obscurus*, size distribution.

The gillnet catch of carcharhinid species was generally restricted to smaller sharks, under 120cm fork length (Figure 16). Larger proportions of intermediate-sized and large individuals were observed in the catches of the copper shark, *Carcharhinus brachyurus*, ($\overline{FL}$ of males=155cm, standard deviation=50cm; $\overline{FL}$ of females=140cm, standard deviation=7cm) and the tiger shark, *Galeocerdo cuvier*, ($\overline{FL}$ of males=125cm, standard deviation=34cm; $\overline{FL}$ of females=139cm, standard deviation=32cm). However, it should be noted that relatively small numbers of both of these species were caught. The catch of *C. obscurus* was highly

skewed to the smaller size-classes ($\overline{FL}$ of males=82cm, standard deviation=14cm; $\overline{FL}$ of females=82cm, standard deviation=15cm), with 91% of observed dusky sharks measuring less than 100cm FL.

The average size of *C. obscurus* (Appendix IV) was slightly higher on the south coast (regions 1, 2 and 3) and in the north west of the fishery (region 6) than in the south-west and lower west coast (regions 4 and 5, respectively). Similarly, the proportion of sharks longer than 100cm FL was also higher in regions 1 (26%), 2 (22%), 3 (18%) and 6 (20%) than in regions 4 (5%) and 5 (12%). The smallest dusky sharks were observed in region 4 ($\overline{FL}$ of males=79cm, standard deviation=11cm; $\overline{FL}$ of females=79cm, standard deviation=12cm), where 79% of the observed catch consisted of sharks measuring between 75cm and 90cm FL. Dusky sharks observed in region 5 were slightly larger ($\overline{FL}$ of males=83cm, standard deviation=14cm; $\overline{FL}$ of females=84cm, standard deviation=16cm) but 71% of the catch was comprised of sharks measuring between 75cm and 90cm FL. The largest mean size was observed in region 1 ($\overline{FL}$ of males=94cm, standard deviation=19cm; $\overline{FL}$ of females=91cm, standard deviation=15cm), followed by region 6 ($\overline{FL}$ of males=92cm, standard deviation=22cm; $\overline{FL}$ of females=90cm, standard deviation=24cm).

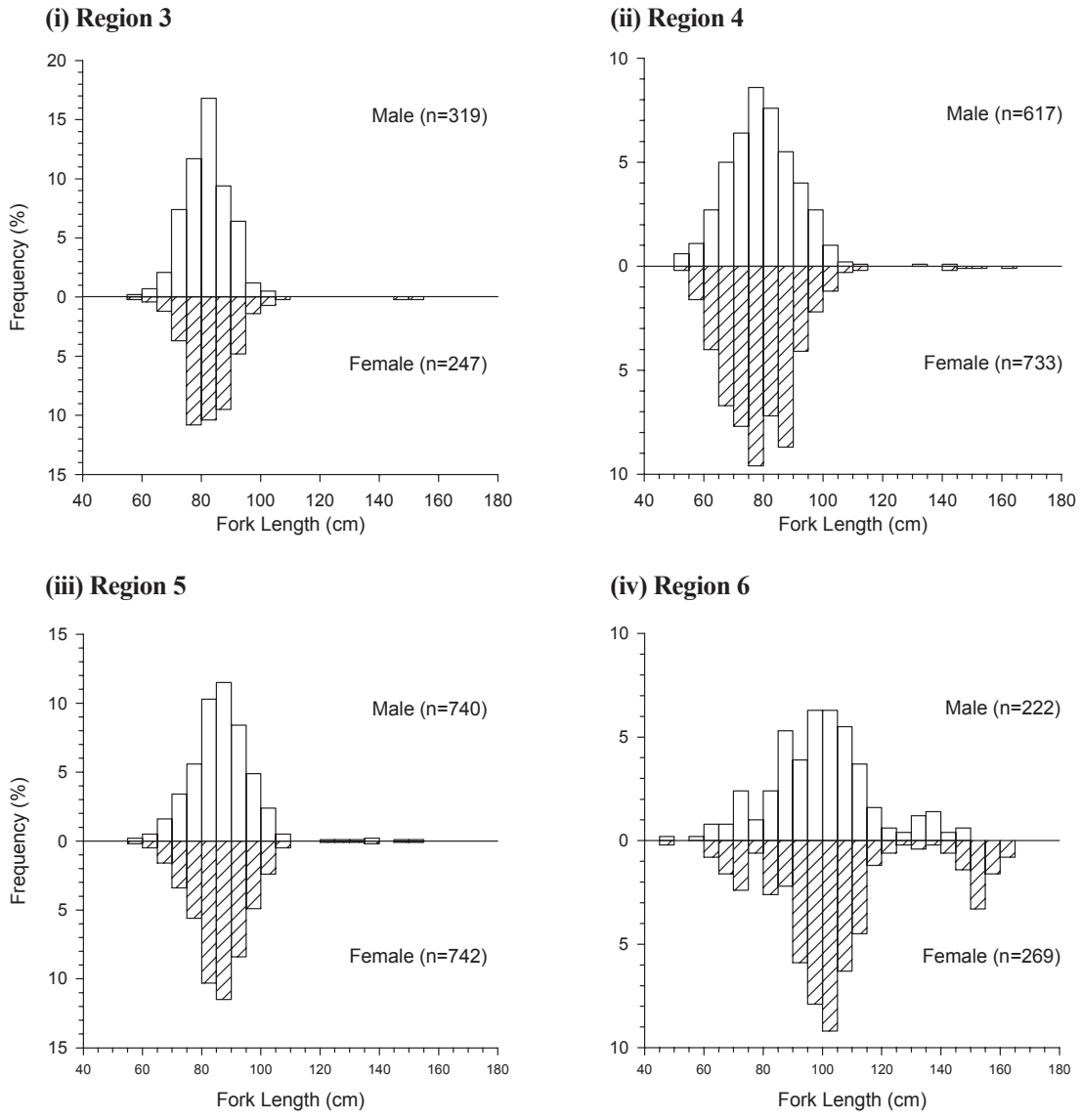
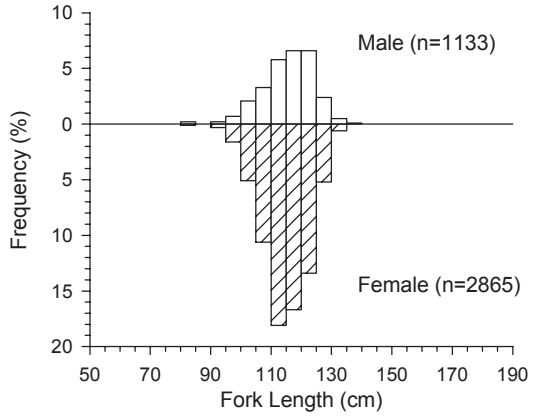


Figure 18. Regional sandbar shark, *Carcharhinus plumbeus*, size distribution.

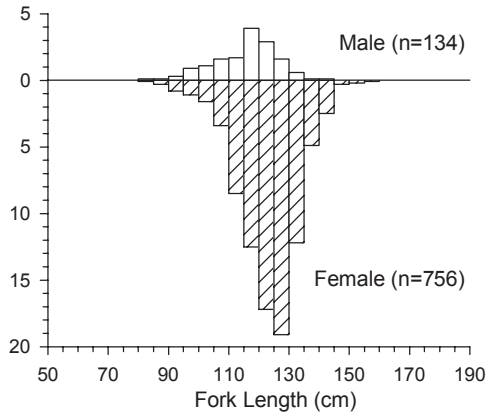
The average size of *C. plumbeus* was noticeably higher in region 6 ($\overline{FL}$ of males=95cm, $\overline{FL}$ of females=101cm), than in all other regions. This was particularly apparent for female sharks larger than 120cm FL, with the proportion highest in region 6 at 13.8% (Figure 18), compared to 0.4% in region 3, 0.8% in region 4 and 1.5% in region 5.

3.5.2 Hound sharks (family Triakidae)

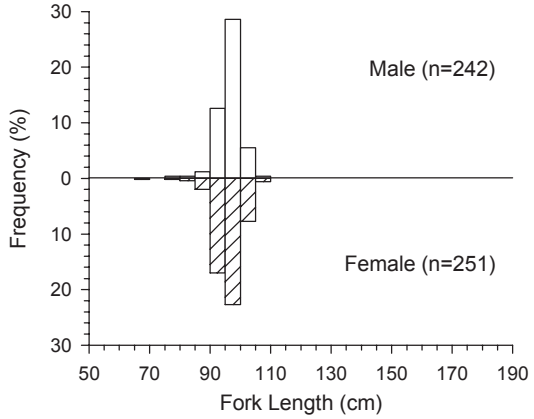
(i) Whiskery shark, *Furgaleus macki*



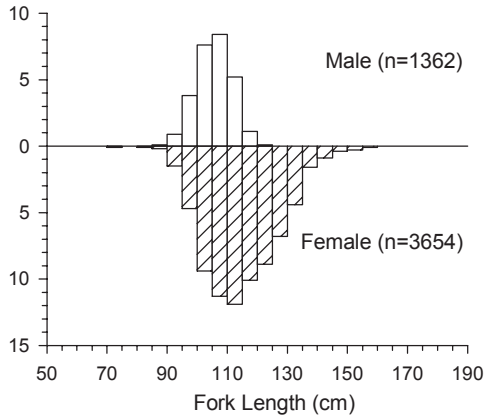
(ii) School shark, *Galeorhinus galeus*



(iii) Pencil shark *Hypogaleus hyugaensis*



(iv) Gummy shark, *Mustelus antarcticus*



(v) Grey gummy, *Mustelus* sp.

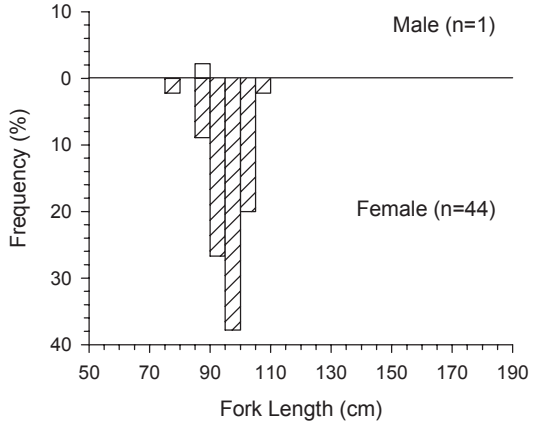


Figure 19. Hound shark, family Triakidae, size distribution (all zones).

Catches of most triakid species, were strongly female-biased (Figure 19). Female whiskery sharks outnumbered males in the observed catch by 2.5 to 1, school sharks by 5.6 to 1 and grey gummy sharks by 2.7 to 1. Pencil sharks, however, were caught in almost equal numbers. Female *G. Galeorhinus* ($\overline{FL}$ =119cm, standard deviation=10cm) and *M. antarcticus* ($\overline{FL}$ =110cm, standard deviation=12cm) in the catch were, on average, larger than males of the same species ($\overline{FL}$ =111cm, standard deviation=11cm and ($\overline{FL}$ =101cm, standard deviation = 6cm, respectively). Male and female whiskery sharks were approximately equal in length (male $\overline{FL}$ =111cm, standard deviation=8cm; female $\overline{FL}$ = 110cm, standard deviation =8cm). The mean lengths of these 3 species were higher than those of the target carcharhinid species *C. obscurus* and *C. plumbeus*.

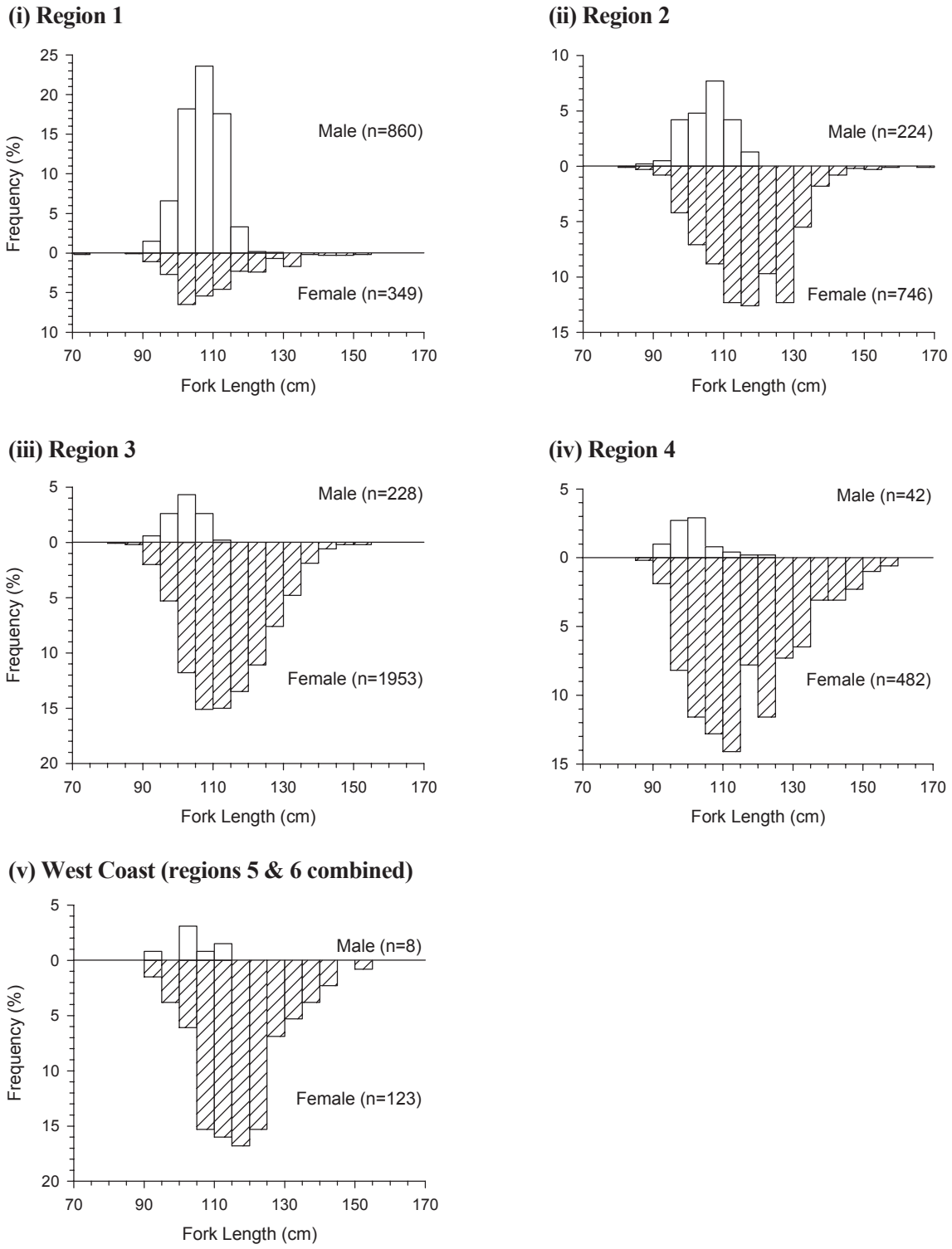


Figure 20. Regional gummy shark, *Mustelus antarcticus*, size distribution.

Regionally, the size composition of *M. antarcticus* did not vary greatly (Figure 20). However, the sex composition did vary significantly. Whilst females outnumbered males in the observed catch by nearly 6:1 overall, the sex ratio shifted steadily from a heavy female bias in the catch from the west coast (15 females to every male) in Regions 5 and 6 to a male bias (2 males to every female) in the catch from the south-eastern corner of the State in Region 1.

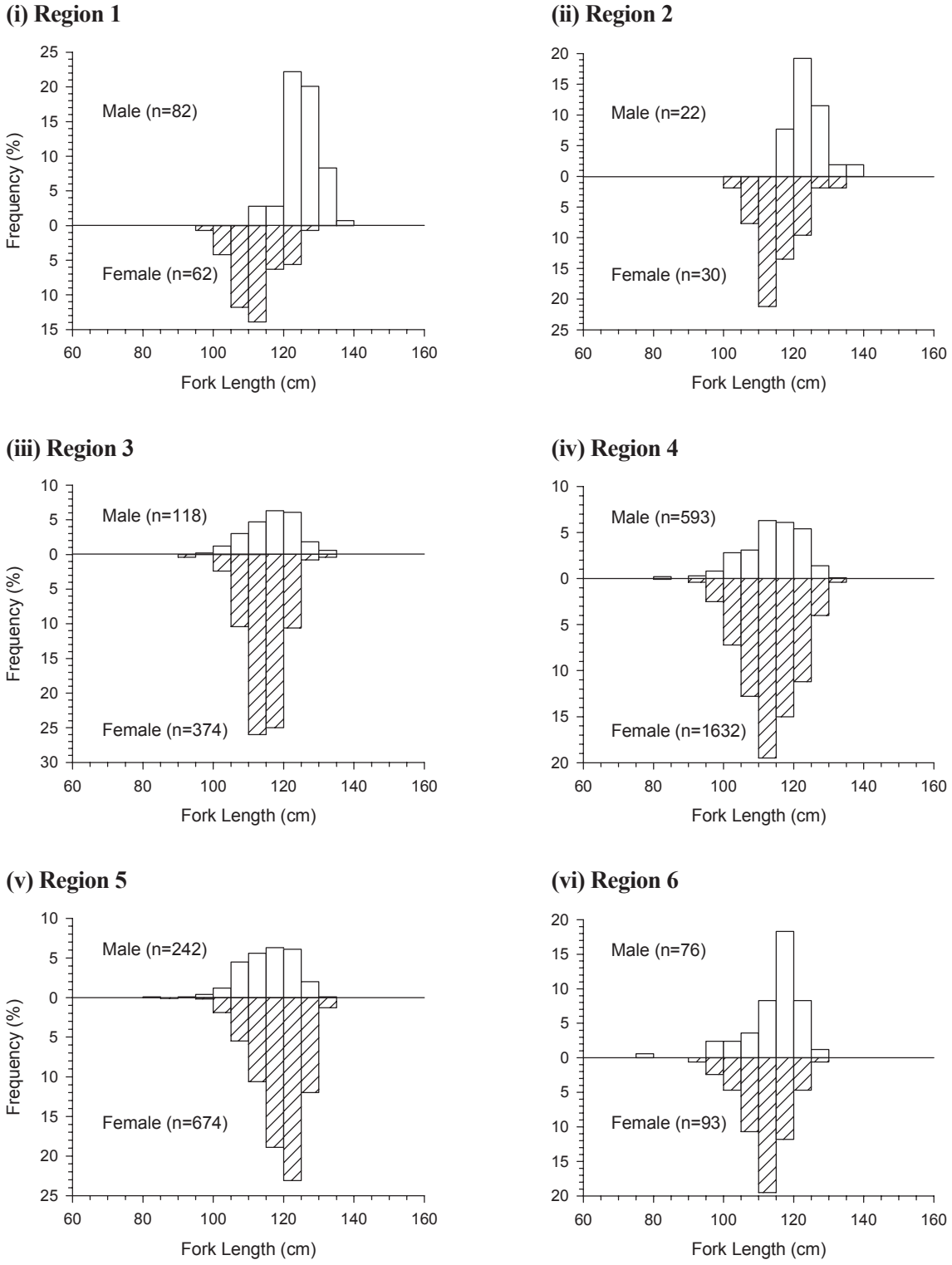


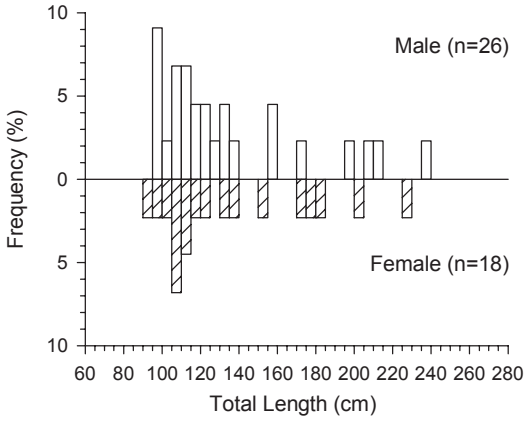
Figure 21. Regional whiskery shark, *Furgaleus macki*, size distribution.

Although in regions 3, 4, 5 and 6 and overall, the mean lengths of male and female *Furgaleus macki* were almost identical, males in regions 1 ($\overline{FL}$ =121cm, standard deviation=5cm) and 2 ($\overline{FL}$ =20cm, standard deviation=4cm) were significantly larger than females ($\overline{FL}$ =108cm, standard deviation=6cm and $\overline{FL}$ =111cm, standard deviation=6cm,

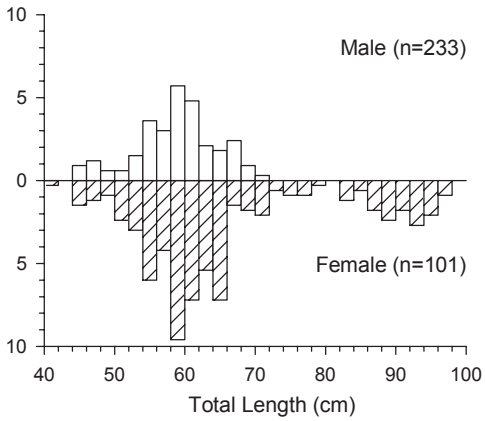
respectively). The sex composition of the *F. macki* catch also varied regionally. Females outnumbered males by approximately 3:1 in regions 3, 4 and 5 but the ratio of females to males was close to 1:1 in regions 1, 2 and 6.

3.5.3 Other sharks

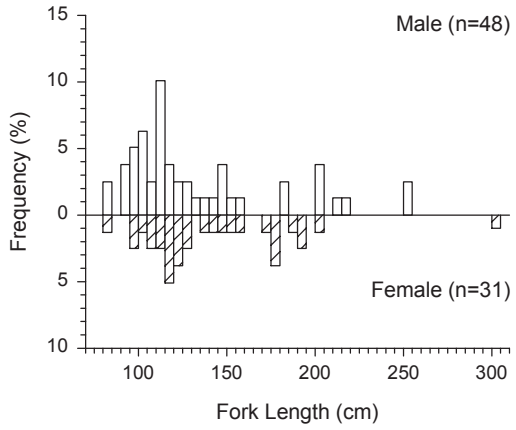
(i) Grey nurse shark, *Carcharias taurus*



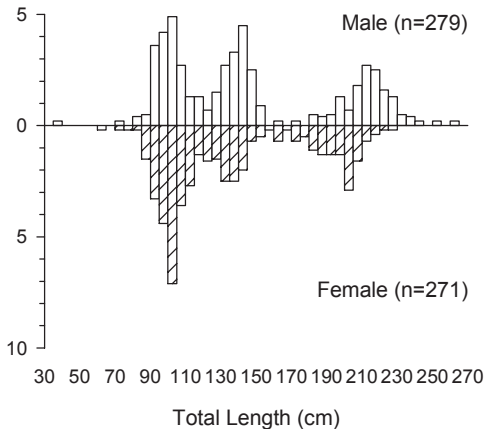
(ii) Port Jackson shark, *Heterodontus portusjacksoni*



(iii) Shortfin mako, *Isurus oxyrinchus*



(iv) Wobbegongs, family Orectolobidae



(v) Smooth hammerhead, *Sphyrna zygaena*

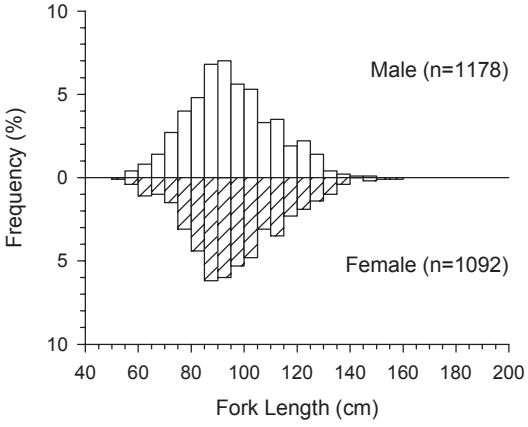


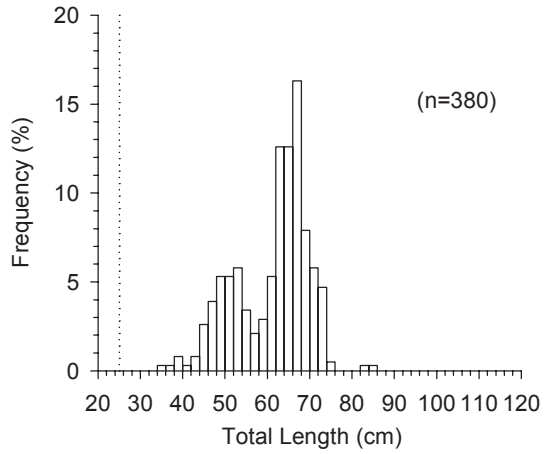
Figure 22. Other shark size distributions (all zones).

The overall size frequency distributions for other shark species are illustrated in Figure 22. Grey nurse sharks, *Carcharias taurus*, ranged in length from 86cm to 231cm TL. The mean length of male grey nurse sharks was 130cm TL and females was 132cm TL. The majority (75%) of observed Port Jackson sharks, *Heterodontus portusjacksoni*, were between 50cm TL and 70cm TL, although there was also a secondary smaller length mode of larger females of 92cm-94cm TL. Shortfin mako sharks, *Isurus oxyrinchus*, ranged in length from 76cm to 300cm FL. The mean length of male makos was 128cm FL and females was 139cm FL. The tri-modal wobbegong size frequency distribution indicates the presence of multiple species in the dataset. The smallest mode (male and female) is mainly due to the cobbler wobbegong, *Sutorectus tentaculatus*, the secondary mode mainly comprises a complex of the western wobbegong, Orectolobus sp. A and the as yet unnamed species, Orectolobus sp. B. The third mode is due mainly to the banded wobbegong, *Orectolobus ornatus* with a smaller number of spotted wobbegongs, *Orectolobus maculatus*. The fishery caught primarily small and intermediate-sized smooth hammerhead sharks, *Sphyrna zygaena* (male $\overline{FL}$ =91cm, standard deviation=17cm, female $\overline{FL}$ =93cm, standard deviation=18cm). There was no clear difference between the size frequencies of male and female smooth hammerheads.

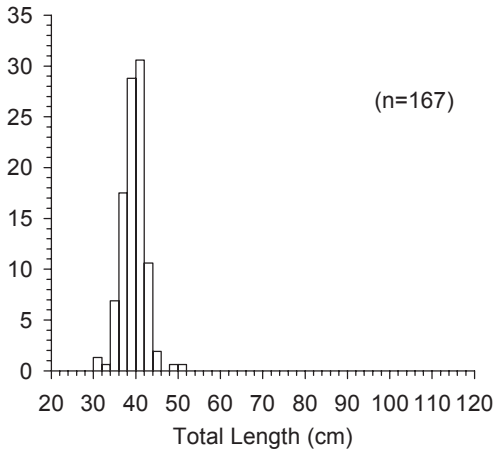
3.6 Scalefish catch size composition

Size frequency distributions of the fisheries' major scalefish species are illustrated in Figure 23. Dotted lines indicate minimum legal sizes where applicable. Size frequency statistics are given in Appendix IV.

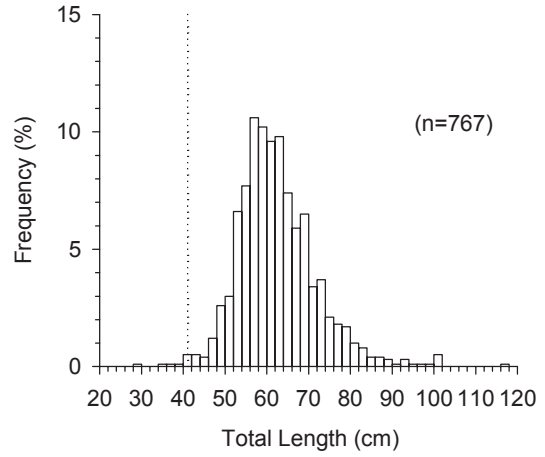
(vii) Leatherjacket, family Monacanthidae



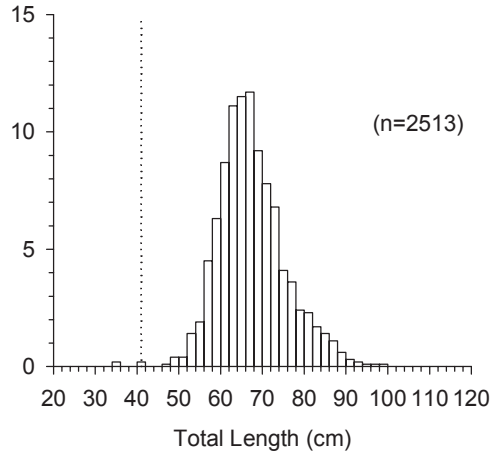
(viii) Moonlighter, *Tilodon sexfasciatum*



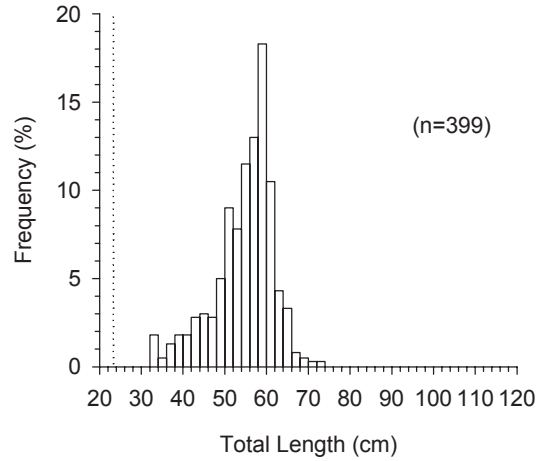
(ix) Pink snapper, *Pagrus auratus*



(x) Queen snapper, *Nemadactylus valenciennesi*



(xi) Redfish, *Centroberyx* spp.



(xii) Samsonfish, *Seriola hippos*

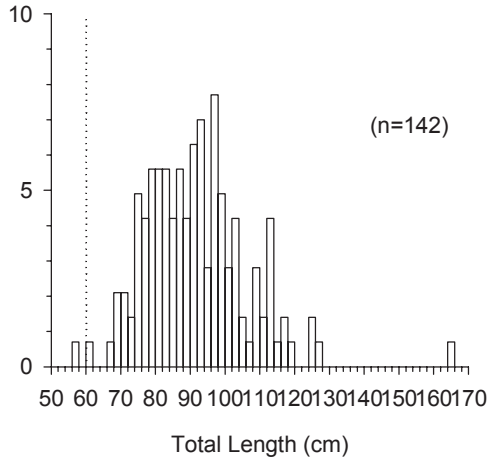


Figure 23. Scalefish size distribution (all zones). *(continued next page)*

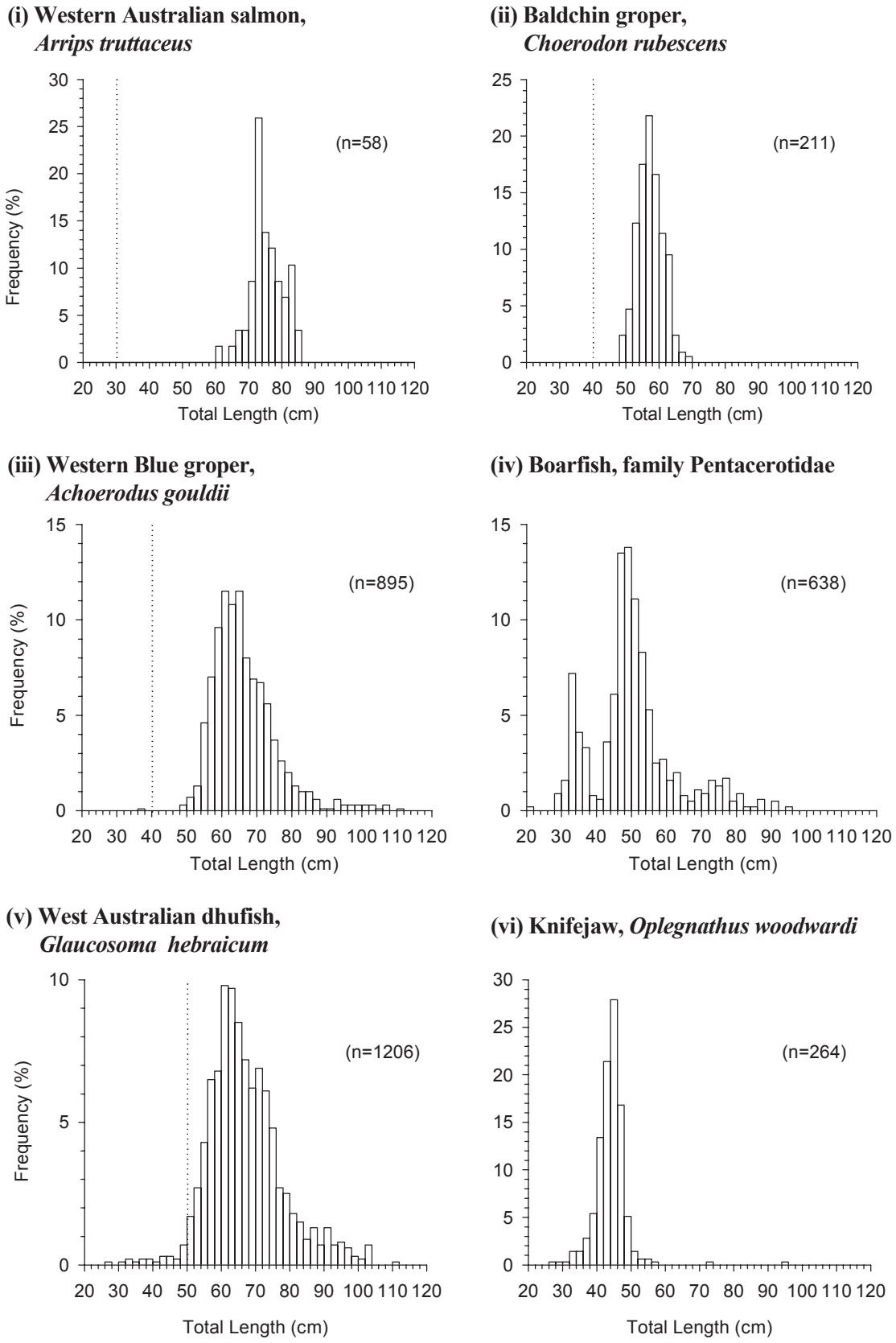


Figure 23 cont. Scalefish size distribution (all zones).

Minimum size limits exist for some species of teleosts in Western Australia, as indicated by dotted lines in Figure 23. The number of undersized fish in the demersal gillnet catch was found to be negligible.

3.7 Non-fish bycatch

Non-fish bycatch was reported infrequently during gillnet fishing observations, with a total occurrence of less than one capture per 1000 kilometre gillnet hours (Table 5). Region 5 had the highest rate of bycatch (2.3 animals/1000 km.gn.hr) and region 6 the lowest (0 captures). The vast majority of incidents involved invertebrate species, particularly the western rock lobster, *Panulirus cygnus*, cuttlefish (order Sepioidea) and baler shells (family Volutidae). All lobsters were caught in regions 4 and 5. Marine mammals were caught at a rate of just over 1 capture per 10,000 km gn.hours; seabirds at 4 captures per 100,000 km gn.hours and turtles at 1 capture per 100,000 km gn.hours.

Table 5. Observed regional non-fish bycatch.

	Region						All
Description	**1**	**2**	**3**	**4**	**5**	**6**	**regions**
Rock lobster				9	34		43
Cuttlefish		1	1	1	4		7
Baler Shell				4	1		5
Dolphin (common)	2	2					4
Dolphin (unspecified)					2		2
Dolphin (bottlenose)				1	1		2
Sea Hare				1	1		2
Cormorants					1		1
Fairy penguin	1						1
Mutton bird				1			1
Sea Lion		1					1
Seal		1					1
Turtle (unspecified)					1		1
Total bycatch occurrence	3	5	1	17	45		71
Catch rate (no. animals/ 000 km.gn.hr)	0.8	1.8	0.1	0.4	2.3	0.0	0.9

4.0 Discussion

The Western Australian temperate demersal gillnet and demersal longline fisheries, operate across an area encompassing subtropical and temperate waters of the Indian and Southern oceans and covering 1,560 km of coastline. Unsurprisingly, the fishery's catch consists of a wide variety of elasmobranch and teleost (scalefish) fauna and shows noticeable regional variation in its composition. Despite the diversity of the catch, between 1994 and 1999, these fisheries remained highly targeted towards catching a small number of shark species, with the majority of landings (57%, by weight) consisting of only three species of sharks: 'bronze whaler' (primarily dusky shark, *Carcharhinus obscurus*), gummy shark, *Mustelus antarcticus* and whiskery shark, *Furgaleus macki*. Examination of catches on a finer geographic scale, however, highlights how the fishery has evolved regionally to exploit a variety of locally abundant species.

As a means of validating the accuracy of commercial catch records of the main target shark species, bootstrapping research observed catch rates proved to be of limited use as the total catches of dusky, gummy, whiskery and sandbar catches were all underestimated. It is highly unlikely that underestimation of the catches of these high-value species was caused by widespread over-reporting of commercial landings, as this would result in higher license fees for the fishery and higher rates of income tax for individual fishers. It is more likely that, because research sampling was not designed to collect data specifically for this purpose, observed catch rates were unrepresentative of commercial CPUE due to temporal and spatial biases in the sampling program. Specifically, the relatively low levels of research effort in regions 1 and 6, respectively, were likely to have caused under representation of commercial catches of gummy and sandbar sharks. However, the reasons for the underestimates of dusky and whiskery shark catches are less clear as relatively high proportions of commercial effort were observed in regions 4 and 5, where the majority of these species' landings were reported. In these cases, commercial catch rates may simply have been higher during unobserved times, in unobserved areas or on unobserved vessels. Alternatively but less likely, fishing behaviour might have been changed by the presence of observers on vessels. However, from the authors' understanding of individual vessels' fishing strategies and observations of skippers' personal fishing records (e.g. vessel 'logbooks', marks on GPS plotters, etc.), there was no indication that vessel behaviour was affected by the presence of observers. It is also considered highly unlikely that fishers would risk lower catch rates and, therefore financial penalty by changing their fishing strategies in order to voluntarily take observers to sea. It is apparent from these results that in order to accurately estimate commercial catches using observer data in a geographically large, multi-species fishery such as this, the level of observer coverage needs to be high. Based on the results from region 4, where target catches were underestimated despite 19.8% of commercial effort being observed, it is suggested that the required level of observer coverage needs to be greater than 20% of commercial effort. Further, to account for regional, temporal and inter-vessel variations in CPUE, observer effort must be applied more uniformly than was possible during this study.

In terms of percentages of the fishery's total elasmobranch catch, the commercial and research data agree that the three traditional target species 'bronze whaler' (primarily dusky shark, *Carcharhinus obscurus*), remained the dominant component of the fishery's catch during the late 1990s. Although the descriptive name of 'bronze whaler' is commonly used to refer to multiple species of carcharhinid (whaler) sharks, *C. obscurus* were found to account

for 98% of the 'bronze whaler' catch observed during this study. The only other species of 'bronze whaler' identified from the research data was *Carcharhinus brachyurus*, also known as the copper shark. Although *C. bracyurus* were observed in all regions of the fishery, they were slightly more common in catches from the south-east of the State.

Research observed length frequencies show that, 97.5% of the observed JASDGDLF and WCDGDLF gillnet dusky shark catch consisted of sharks with a fork length of less than 125cm (i.e. less than 6 years old according to Simpfendorfer et al, 2002). These data confirm that the 16.5cm (6½") and 17.8cm (7") gillnet mesh sizes permitted in these fisheries are highly selective in catching only the youngest age-classes of dusky sharks (Simpfendorfer and Unsworth, 1998a), which is believed to be critical to the ongoing sustainability of this stock (Stevens et al, 1997; Simpfendorfer, 1999a; Simpfendorfer, 1999b). Examination of these size frequency data regionally is believed to provide some important insight into aspects of the early life history of *C. obscurus* in Western Australia. Dusky sharks in region 4 were, on average, smaller than anywhere else and the range of size classes caught there was narrower than in other regions. The mean size and range of size classes both increased in adjacent regions and continued to progressively increase in regions to the north and east, suggesting that the south west corner of the State is the principal area for dusky shark parturition ('pupping'), with juvenile *C. obscurus* gradually spreading to adjacent south and west coast waters as they grow.

Gummy sharks, *M. antarcticus*, continued to be an important component of the demersal gillnet catch in south coast regions whilst remaining only a minor component of the catch in south-western and western regions. The observed size composition was very similar to that reported by Lenanton et al, 1990 and consisted primarily of large adult females. The regional research data indicate an apparent sexual segregation of the gummy shark stock in Western Australia. Whilst females outnumbered males in the observed catch by 6:1 overall, the sex ratio shifted steadily from a heavy female bias in the catch from the west coast (15 females to every male) to a male bias (2 males to every female) in the catch from the south-eastern corner of the State. Similar segregation has been noticed in the south-eastern Australian Southern Shark Fishery (SSF), where females are more common in the catch from Victorian and Tasmanian waters and males are proportionately more significant in catches from the western Great Australian Bight (Walker, personal communication[3]). The segregation of sexes implies that some form of breeding migration must occur, however the details of such movements are poorly understood.

Whiskery sharks also remained a significant component of the fisheries' catch in all six regions, despite the results of recent population modeling suggesting that their biomass has fallen to 32% of its unexploited level (McAuley and Gaughan, In Press). Whilst *F. macki* was actively targeted during the early development of the WA 'shark' fisheries, as catch rates began to decline in the 1980s, the fishery redirected fishing effort towards catching the more abundant species, such as *C. obscurus* and *M. antarcticus* (Simpfendorfer et al, 2000) and these data clearly indicate that by the late 1990s whiskery sharks were no longer as important as catches of these other species. Small whiskery sharks were almost entirely excluded from the catch due to the size-selectivity of the permitted gillnet mesh-sizes, as described by Simpfendorfer and Unsworth, 1998a. Females were approximately 3 times more common than males in catches from the south-west and lower west coasts; males slightly outnumbered females in the far south east of the State and catches of males and females were roughly equal elsewhere. The regional sex ratios indicate that the whiskery shark stock is sexually segregated and that some form of reproductive migration must therefore occur, as was suggested by Simpfendorfer and Unsworth, 1998b.

[3] T. Walker, Marine and Freshwater Resources Institute. Queenscliff, Victoria. Australia.

Whilst the fishery for these traditional 'target' shark species has been well reported, the secondary, but regionally important, components of the fisheries' catch have been less well described. Sandbar sharks have been an important component of the catch in the northern region of the WCDGDLF for a number of years, partly because the Abrolhos Islands have provided a safe offshore anchorage for accessing the deeper continental shelf waters where they occur. Catches only began to increase in lower West Coast and south-western regions during the mid to late 1990s as operators began upgrading to larger and more powerful vessels and could access the deeper offshore waters. Until the late 1990s, *C. plumbeus* was seen as a low value product compared to traditional target species and there was little incentive for fishers to target them. However, increases in the price of shark fins on international markets, together with declines in the catch of traditional target species, have generated increased fishing pressure on sandbar sharks, which have large fins relative to their body-size. The effects of this increased level of exploitation is currently being studied as part of a 3-year research project, part funded by the Fisheries Research and Development corporation. Estimated sandbar catches were very close to commercially reported catches in regions 3 and 4, where *C. plumbeus* was not heavily targeted and in region 5 where they only became a target of the fishery in the latter years of this study.

Significant regional variations were also apparent in JASDGDLF catches. Although they may occasionally occur as far up the west coast as Perth (Last and Stevens, 1994), school sharks, *Galeorhinus galeus*, were only an important component of the catch in Region 1. Like other species of hound sharks (family Triakidae) caught in these fisheries, the catch of *G. galeus* is apparently distinctly female-biased, suggesting a strong sexual segregation of the stock. Because only 2 years of research CPUE data were available for region 1, the commercial catch could not be estimated from research observed catch rates. Dogfish were only landed in significant quantities in region 2, where a handful of Esperance-based vessels began targeting squalene-rich species (mainly *Centrophorus uyato* and *Squalus mitsukurii*, Daley et al 2002) during the mid 1990s. This fishery was short-lived as, according to fishers who were involved at the time, catch rates began to decline dramatically and the fishery for these species had all but ceased by 1999 (McAuley, unpublished data). Because dogfish occur in deep continental slope waters, which are outside the current range of the demersal gillnet and demersal longline fleet, they are unlikely to be subject to continued exploitation by these fisheries.

As was the case with the primary shark species, the estimated catches of the principal teleost species were lower than their commercially reported catches. The notable exception was Dhufish, *Glaucosoma hebraicum.* The underestimation of catches of queen snapper, *Nemadactylus valenciennesi*, blue groper, *Achoerodus gouldii*, and pink snapper, *Pagrus auratus*, may be explained by high commercial catch rates at unobserved times and locations. This is particularly likely for these species, which probably aggregate to spawn for relatively short periods at discreet locations within demersal gillnet fishing grounds. However, dhufish, *Glaucosoma hebraicum* are also known to form spawning aggregations, yet research CPUE was consistently higher than commercial CPUE. As the highest value teleost species caught in the demersal gillnet fishery (valued at $8.50-$9.50 between 94/95 and 98/99), there may have been some incentive for operators to underreport their catches.

Despite the limitations of bootstrapping our research observed catch rates in validating commercially reported catches of the principal target species, the estimated catches offer a useful indication of which secondary, minor and bycatch species might have

been underreported in commercial fishing returns data. Catches of hammerhead sharks, wobbegongs, 'blacktip' sharks (mainly *Carcharhinus brevipinna*), shortfin mako sharks, pencil and tiger sharks were all estimated to be higher than commercially reported, strongly suggesting that a portion of the catch of these species were either undescribed in monthly fishing returns or selectively discarded. Additionally, as these data were found to underestimate catches of the main target species, the same might be true for these other catches and their true catches might be even higher than we have estimated. As fishers are not required to report their discarded bycatch, these estimates offer the best available indication of the magnitude of these catches, however they do not provide any information on the mortality of bycatch species. From the authors' own observations, rates of bycatch mortality varied significantly between each species but in general, survival rates of elasmobranchs captured by gillnets were higher than for teleosts.

This technique may also prove useful in monitoring the level of bycatch of the protected grey nurse shark, *Carcharias taurus*. Since it's protection in 1997 under the Environment Protection and Biodiversity Conservation (EPBC) Act and the State administered Wildlife Conservation Act, commercial catches of this species have ceased. These data, therefore, now represent the only available means of estimating their bycatch in these fisheries. Research observed CPUE data are, however, likely to be of less use in determining catches of great white sharks, *Carcharodon carcharias*, due to the rarity of their capture and the high level of monitoring that would be required to provide a meaningful dataset.

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6.0 References

Al Sakaff, H. and Esseen, M. 1999. Length-weight relationship of fishes from Yemen waters (Gulf of Aden and Red Sea). NAGA. ICLARM Q., **22** (1): 41-42

Branstetter, S. and Musick, J. A. 1994. Age and growth for the sand tiger in the northwestern Atlantic Ocean. Transactions of the American Fisheries Society. Washington D.C.; Vol. 123, **no. 2**: 242-254

Bridge, N. F.; Mackay, D. and Newton, G. 1999. Biology of the ornate angel shark (*Squatina tergocellata)* from the Great Australian Bight. Mar. Freshwater Res. **49**: 679-86

Campbell, G. and Collins, R. A. 1975. The age and growth of the Pacific Bonito, *Sarda chiliensis*, in the eastern North Pacific. California Fish & Game **61** (4): 181 - 200

Cliff, G. and Dudley, S. F. J., 1992. Sharks caught in the protective gill nets off Natal, South Africa. **6**. The copper shark, *Carcharhinus brachyurus* (Guenther). South African Journal of Marine Science. Vol. **12**: 663-674

Daley, R., Stevens, J. and Graham, K. 2002. Catch analysis and productivity of the deepwater dogfish resource in southern Australia. Final Report to the Fisheries Research and Development Corporation for Project 1998/108, June 2002.

Dulcic, J. and Kralijevic, M., 1996. Weight-length relationship for 40 fish species in the eastern Adriatic (Croatian waters). Fish. Res. **28** (3): 243-251

Chidlow, J., 2003. Biology of wobbegong sharks from south-west Western Australian waters. Unpublished Msc Thesis, James Cook University, Queensland, Australia.

Claro, R. and J.P. García-Arteaga, 1994. Crecimiento. p. 321-402. In R. Claro (ed.) Ecología de los peces marinos de Cuba. Inst. Oceanol. Acad. Cienc. Cuba. and Cen. Invest. Quintana Roo (CIQRO) México.

Garcia-Arteaga, J.P.; Claro, R. and Valle, S., 1997. Length-weight relationships of Cuban marine fishes. NAGA ICLARM Q., **20** (1): 38-43

Graham, K. J., 1999. Trawl fish length-weight relationships from data collected during FRV Kapala surveys. Fisheries Research Report Series: 2. New South Wales Fisheries. ISSN 1442-0147

Hancock, D. A. and Edmonds, J.S., 1977. Mercury in shark in Western Australia. A preliminary report. Fish. Res. Bull. Dep. Fish. Wildl. (West. Aust.); no. **18**, 22 pp

Heald, D. I. , 1987. The commercial shark fishery in temperate waters of Western Australia. Fisheries Department of Western Australia Research Report No. **75**, 71pp.

Kailola, P. J.; Williams, M. J.; Stewart, P. C.; Reichelt, R. E.; McNee, A. and Grieve, C. 1993. Australian Fisheries Resources**.** Bureau of Resource Sciences, Department of Primary Industries and the Fisheries Research & Development Corporation. Canberra, Australia, 422pp.

Kohler, N. E.; Casey, J. G. and Turner, P. A., 1995. Length-weight relationships for 13 species of sharks from the western North Atlantic. Fishery Bulletin. **93** (2): 412-418

Last, P. R and Stevens, J. D., 1994. Sharks and Rays of Australia. CSIRO, Melbourne, Australia, 513pp.

Lenanton, R. C. J., Heald, D. I., Platell, M., Cliff, M. and Shaw, J., 1990. Aspects of the Reproductive Biology of the Gummy Shark, Mustelus antarcticus Günther, from Waters off the South Coast of Western Australia. Aust. J. Mar. Freshwater Res., 1990, 41, 807-22

Letourneur, Y.; Kulbicki, M. and Labrosse, P., 1998. Length-weight relationship of fish from coral reefs and lagoons of New Caledonia, southwestern Pacific Ocean: an update. NAGA. ICLARM Q., **21** (4): 39-46

Magnusson, J. and Magnusson, J. V. V., 1987. ICEIDA/Cape Verde Islands Fisheries Project. Survey of demersal fish resources in the waters off Cape Verde Islands. IV. Report: summary of information on species. Icelandic International Development Agency/ Marine Research Institute. 114 pp.

McAuley, R. and Gaughan, D. In Press. Demersal Gillnet and Demersal Longline Fisheries; in State of the Fisheries, 2001-2002, Editor, J.W. Penn. Fisheries Western Australia.

Merella, P.; Quetglas, A.; Alemany, F. and Carbonell, A., 1997. Length-weight relationship of fishes and cephalopods from the Balearic Islands (western Mediterranean). NAGA. ICLARM Q., **20** (3/4): 66-68

Moran, M. J. and Burton, C., 1990. Relationships among and whole lengths and weights for Western Australian pink snapper *Chrysophrys auratus* (Sparidae), Fisheries Research Report No. **89**, Fisheries Department of Western Australia.

Pauly, D.; Cabanban, A. and Torres, F. S. B. Jr., 1996. Fishery biology of 40 trawl-caught teleosts of western Indonesia. P. 135-216. In D. Pauly and P. Martosubroto (eds.). Baseline studies of biodiversity: the fish resource of western Indonesia. ICLARM studies and Reviews **23**.

Simpfendorfer, C., Lenanton, R. and Unsworth, P. 1996. Stock assessment of large coastal and demersal sharks. Final Report to the Fisheries Research and Development Corporation for Project 93/067, 59pp., September 1996.

Simpfendorfer, C. A. and Donohue, K. 1998. Keeping the fish in fish'n'chips: research and management of the Western Australian shark fishery. Aust. J. Mar. Freshwater Res. **49**: 593-600.

Simpfendorfer, C. A. and Unsworth, P., 1998a. Gillnet mesh selectivity of dusky (*Carcharhinus obscurus*) and whiskery, (*Furgaleus macki*) sharks from south-western Australia. Aust. J. Mar. Freshwater Res. **49**: 713-718.

Simpfendorfer, C. A. and Unsworth, P., 1998b. Reproductive biology of the whiskery shark, *Furgaleus macki*, from south-western Australia. Marine and Freshwater Research, **49**: 687-693.

Simpfendorfer, CA. 1999a. Demographic analysis of the dusky shark fishery in south-western Australia. In, Musick, J. A. (ed), "Life in the Slow Lane: Ecology and Conservation of Long-Lived Marine Animals." pp 149-160. American Fisheries Society Symposium No 23, Bethesda, Maryland

Simpfendorfer, C., 1999b. Management of shark fisheries in western Australia. Case studies of the management of elasmobranch fisheries. FAO Fisheries Technical Paper. Shotton, R. (ed.) No. 378/1, Rome, FAO. pp. 425-455.

Simpfendorfer, C. A.; McAuley, R..; Chidlow, J.; Lenanton, R.; Hall, N. and Bastow, T. 1999. Biology and stock assessment of Western Australia's commercially important shark species. Final report to the Fisheries Research and Development Corporation for project 96/130, 99 pp. December 1999. ISBN 0 7309 8448 6

Simpfendorfer, C. A.; Donohue, K. and Hall, N. G., 2000. Stock assessment and risk analysis for the whiskery shark (*Furgaleus macki* (Whiteley)) in south-western Australia. Fisheries Research. **47**: 1-17

Steffe, A. S.; Murphy J. J.; Chapman, D. J.; Tarlinton, B. E.; Gordon, G. N. G. and Grinberg, A., 1996. An assessment of the impact of offshore recreational fishing in New South Wales waters on the management of commercial fisheries. Final report to the Fisheries Research and Development Corporation. ISBN 0 7310 9405 0

Stevens, J. D. and McLoughlin, K. J., 1991. Distribution, size and sex composition, reproductive biology and diet of sharks from northern Australia. Aust. J. Mar. Freshwater Res. **42**: 151-99

Stevens, JD, Walker, TI and Simpfendorfer, CA. 1997. Are southern Australian shark fisheries sustainable? In, Hancock, DA, Smith,DC, Grant, A and Beumer, JP. (Eds.) "Developing and Sustaining World Fisheries Resources. The State of Science and Managment. 2nd World Fisheries Congress." pp62-66. CSIRO, Melbourne.

Sumner, N. R. and Williamson, P.C., 1999. A 12-month survey of coastal recreational boat fishing between Augusta and Kalbarri on the west coast of Western Austraila during 1996-97. Fisheries Research Report No. **117**. Western Australian Marine Research Laboratories, Fisheries Western Australia.

Taylor, R. B. and Willis, T. J. 1998. Relationships amongst length, weight and growth of north-eastern New Zealand reef fishes. Mar. Freshwater Res. **49** (3): 255-260

Torres, F. S. B., Jr., 1991. Tabular data on marine fishes from southern Africa. Part 1. Length-weight relationships. Fishbyte. **9** (1): 50-53

Walker, T. I. 1999. Southern Australian shark fishery management. Case studies of the management of elasmobranch fisheries. FAO Fisheries Technical Paper. Shotton, R. (ed.) No. 378/2, Rome, FAO. pp. 480-514

Whitely, G. P., 1943. Preliminary report on the long line fishery at Bunbury WA. Unpublished report, 9 pp (available from Western Australian Marine Research Laboratories: North Beach, WA)

Willing, R. S. and Pender, P. J., 1989. Length-weight relationships for 45 species of fish and three invertebrates from Australia's northern prawn fishery. Northern Territory Dept. Primary Industry and Fish., Australia, Tech. Bull., 142. 57 pp.

Yanagawa, H. 1994. Length-weight relationships of Gulf of Thailand fishes. NAGA ICLARM Q., **17** (4): 48-52

7.0 Appendices

Appendix I. Commercial demersal gillnet & longline catch and effort, July 1994 – June 1999

1. Elasmobranchs

(i) All regions

	1994-1995			1995-1996			1996-1997			1997-1998			1998-1999			Annual mean		
	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total
Gillnet equivalent Effort (km gn.hr)	218,974	3,870	222,844	208,114	1,170	209,284	218,359	4,019	222,378	226,712	15,445	242,157	204,315	4,612	208,927	215,295	5,823	221,118
Catch (kg live weight)																		
'Bronze whaler'	421,076	4,480	425,556	373,466	701	374,167	400,667	2,156	402,823	320,457	11,342	331,799	332,177	4,702	336,879	369,569	4,676	374,245
Gummy	270,969	166	271,135	220,298	102	220,400	305,186	448	305,634	298,699	100	298,799	313,439	914	314,353	281,718	346	282,064
Whiskery	219,876	1,861	221,737	197,953	356	198,309	196,320	1,076	197,396	194,223	2,762	196,985	179,162	210	179,372	197,507	1,253	198,760
Sandbar	73,999	2,973	76,972	80,979		80,979	124,405	45	124,450	159,663	5,089	164,752	152,466	1,288	153,754	118,302	1,879	120,181
Hammerhead	54,250	11	54,261	54,953	44	54,997	55,350	79	55,429	55,439	569	56,008	44,659	134	44,793	52,930	167	53,098
School	50,845	175	51,020	69,532		69,532	51,692		51,692	54,289		54,289	23,684		23,684	50,008	35	50,043
Dogfish	88,194		88,194	101,576	954	102,530	13,320		13,320	22,166		22,166	2,501		2,501	45,551	191	45,742
Wobbegong	47,909	1,356	49,265	40,063	865	40,928	42,425	2,092	44,517	43,208	2,864	46,072	35,404	1,081	36,485	41,802	1,652	43,453
'Blacktip'	35,122	156	35,278	21,234	29	21,263	28,868	102	28,970	40,864	3,654	44,518	16,186	1,478	17,664	28,455	1,084	29,539
Skates and Rays	13,668	66	13,734	19,247	43	19,290	21,251	51	21,302	19,520	1,727	21,247	14,379	963	15,342	17,613	570	18,183
Pencil	5,798	175	5,973	5,719	159	5,878	3,716	301	4,017	4,701	150	4,851	4,077	126	4,203	4,802	182	4,984
Grey nurse	5,368	552	5,920	5,434	51	5,485	4,690	75	4,765	4,088	49	4,137	1,355	83	1,438	4,187	162	4,349
Tiger		331	331	151		151	1,091	180	1,271	659		659	159	81	240	412	118	530
'Copper whaler'													1,956		1,956	391	0	391
Great white	53	239	292	477		477	19		19	833		833				276	48	324
Mako (shortfin)													41		41	8	0	8
Unspecified	70,921	105	71,026	65,528	291	65,819	72,064		72,064	67,183	299	67,482	86,577	331	86,908	72,455	205	72,660
Total	1,358,048	12,646	1,370,694	1,256,610	3,595	1,260,205	1,321,064	6,605	1,327,669	1,285,992	28,605	1,314,597	1,208,222	11,391	1,219,613	1,285,987	12,568	1,298,556

(ii) Region 1

	1994-1995			1995-1996			1996-1997			1997-1998			1998-1999			Annual mean		
	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total
Gillnet equivalent Effort (km gn.hr)	32,272		32,272	27,687		27,687	24,030		24,030	37,044		37,044	34,013	3	34,022	31,009	1	31,011
Catch (kg live weight)																		
Gummy	105,800		105,800	69,909		69,909	85,364		85,364	127,208		127,208	148,032	464	148,496	107,263	93	107,355
School	41,354		41,354	64,509		64,509	46,889		46,889	45,048		45,048	22,961		22,961	44,152	0	44,152
Whiskery	32,360		32,360	15,312		15,312	24,912		24,912	50,054		50,054	23,653		23,653	29,258	0	29,258
'Bronze whaler'	27,734		27,734	23,028		23,028	26,173		26,173	24,117		24,117	17,690	1,164	18,854	23,748	233	23,981
Hammerhead	9,433		9,433	6,958		6,958	7,247		7,247	9,667		9,667	1,467		1,467	6,954	0	6,954
Dogfish				4,341		4,341				1,200		1,200				1,108	0	1,108
Wobbegong	426		426	372		372	1,479		1,479	1,957		1,957	413		413	929	0	929
Sandbar	24		24							1,286		1,286				262	0	262
Skates and Rays	784		784													157	0	157
Pencil	105		105	64		64	159		159	186		186	16		16	106	0	106
Unspecified	602		602	2,713		2,713	1,462		1,462	2,522		2,522	1,366		1,366	1,733	0	1,733
Total	218,622		218,622	187,206		187,206	193,685		193,685	263,245		263,245	215,598	1,628	217,226	215,671	326	215,997

(iii) Region 2

	1994-1995			1995-1996			1996-1997			1997-1998			1998-1999			Annual mean		
	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total
Gillnet equivalent Effort (km gn.hr)	27,608		27,608	32,811		32,811	37,769		37,769	24,864	68	25,067	28,563		28,563	30,323	14	30,363.8
Catch (kg live weight)																		
Gummy	93,067		93,067	89,492		89,492	144,386		144,386	106,646		106,646	106,891		106,891	108,096	0	108,096
Whiskery	21,041		21,041	22,896		22,896	38,424		38,424	26,838		26,838	32,668		32,668	28,373	0	28,373
Dogfish	45,723		45,723	37,053		37,053	5,754		5,754	15,306		15,306			0	20,767	0	20,767
'Bronze whaler'	16,860		16,860	16,638		16,638	20,128		20,128	13,493	65	13,558	19,728		19,728	17,369	13	17,382
School	8,677		8,677	1,911		1,911	4,676		4,676	8,780		8,780	469		469	4,903	0	4,903
Hammerhead	2,239		2,239	3,275		3,275	4,589		4,589	3,423		3,423	5,627		5,627	3,831	0	3,831
Wobbegong	867		867	266		266	997		997	116		116	1,180		1,180	685	0	685
Pencil	577		577	881		881	472		472	33		33	843		843	561	0	561
Grey nurse	103		103	137		137	127		127							73	0	73
Skates and Rays				169		169										34	0	34
'Blacktip'													16		16	3	0	3
Unspecified	528		528	1739		1,739	1,524		1,524	1,482	280	1,762	1,252		1,252	1,305	56	1,361
Total	189,682		189,682	174,457		174,457	221,077		221,077	176,117	345	176,462	168,674		168,674	186,001	69	186,070

Appendix I cont.

(iv) Region 3

	1994-1995			1995-1996			1996-1997			1997-1998			1998-1999			Annual mean		
	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total
Gillnet equivalent Effort (km gn.hr)	43,918	6	43,936	32,271	190	32,842	35,425	199	36,023	30,555	676	32,584	25,968	202	26,573	33,628	255	34,391.4
Catch (kg live weight)																		
'Bronze whaler'	72,349	286	72,635	61,650	264	61,914	90,553	377	90,930	84,927	512	85,439	71,250	163	71,413	76,146	320	76,466
Gummy	62,583	118	62,701	54,112	38	54,150	66,284	448	66,732	58,667	76	58,743	55,743	48	55,791	59,478	146	59,623
Whiskery	46,972	20	46,992	29,053	96	29,149	32,475	248	32,723	31,225	162	31,387	26,220	147	26,367	33,189	135	33,324
Dogfish	42,369		42,369	60,182		60,182	7,566		7,566	5,660		5,660	2,501		2,501	23,656	0	23,656
Hammerhead	15,938	11	15,949	14,827	33	14,860	15,031	56	15,087	15,337	138	15,475	16,856	43	16,899	15,598	56	15,654
Sandbar	2,576		2,576	5,437		5,437	13,547		13,547	10,693		10,693	5,306	29	5,335	7,512	6	7,518
Skates and Rays	4,261		4,261	7,945	43	7,988	10,673		10,673	6,299		6,299	7,999		7,999	7,435	9	7,444
Wobbegong	5,920		5,920	4,283	452	4,735	3,652	646	4,298	4,473	576	5,049	4,587	749	5,336	4,583	485	5,068
Pencil	4,027		4,027	3,778	159	3,937	2,398	301	2,699	2,483	142	2,625	2,867	107	2,974	3,111	142	3,252
'Blacktip'	399		399	359		359	1,218		1,218	8,987		8,987	801		801	2,353	0	2,353
School	814	175	989	3,112		3,112	127		127	461		461	254		254	954	35	989
Grey nurse	682		682	520		520	491	75	566	874		874	169		169	547	15	562
Great white				477		477	19		19	833		833				266	0	266
Tiger							159		159							32	0	32
Unspecified	11,369	30	11,399	7,477	262	7,739	7,935		7,935	10,963		10,963	16,108		16,108	10,770	58	10,829
Total	270,259	640	270,899	253,212	1,347	254,559	252,128	2,151	254,279	241,882	1,606	243,488	210,661	1,286	211,947	245,628	1,406	247,034

(v) Region 4

	1994-1995			1995-1996			1996-1997			1997-1998			1998-1999			Annual mean		
	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total
Gillnet equivalent Effort (km gn.hr)	43,271	89	43,537	42,211	80	42,451	45,509	45	45,643	42,020	36	42,128	50,420	17	50,470	44,686	53	44,845.8
Catch (kg live weight)																		
'Bronze whaler'	137,517	2,445	139,962	131,677	437	132,114	130,782	1,361	132,143	103,698	1,425	105,123	138,747	1,504	140,251	128,484	1,434	129,919
Whiskery	61,616	11	61,627	65,768	35	65,803	48,807		48,807	40,910		40,910	67,819		67,819	56,984	9	56,993
Wobbegong	12,504	1,356	13,860	11,421	413	11,834	11,701	940	12,641	10,809	89	10,898	12,829		12,829	11,853	560	12,412
Sandbar	1,399		1,399	4,299		4,299	19,293		19,293	9,925		9,925	19,180		19,180	10,819	0	10,819
Hammerhead	4,285		4,285	7,665	11	7,676	5,420	23	5,443	7,672		7,672	9,087		9,087	6,826	7	6,833
Gummy	4,107		4,107	3,702		3,702	4,220		4,220	3,294		3,294	790		790	3,223	0	3,223
'Blacktip'	946	156	1,102	971	29	1,000	1,372	97	1,469	2,937	67	3,004	2,604	214	2,818	1,766	113	1,879
Skates and Rays		66	66	1,930		1,930	2,091		2,091	4,667		4,667	515		515	1,841	13	1,854
Pencil	157	16	173	207		207	321		321	272	8	280	100		100	211	5	216
Grey nurse	81	552	633	72	51	123					49	49				31	130	161
Tiger		331	331				180	180						81	81	0	118	118
Great white		239	239													0	48	48
Unspecified	39,120	75	39,195	36,330	29	36,359	37,317		37,317	32,137		32,137	46,775		46,775	38,336	21	38,357
Total	261,732	5,247	266,979	264,042	1005	265,047	261,324	2,601	263,925	216,321	1,638	217,959	298,446	1,799	300,245	260,373	2,458	262,831

(vi) Region 5

	1994-1995			1995-1996			1996-1997			1997-1998			1998-1999			Annual mean		
	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total
Gillnet equivalent Effort (km gn.hr)	47,230		47,230	51,473		51,473	48,378	344	49,410	49,910	1,771	55,223	32,793	118	33,146	45,957	447	47,296.4
Catch (kg live weight)																		
'Bronze whaler'	116,611		116,611	87,343		87,343	91,212	418	91,630	58,652	9,073	67,725	45,064	1,868	46,932	79,776	2,272	82,048
Sandbar	22,909		22,909	27,819		27,819	38,685	45	38,730	70,211	4,504	74,715	51,968	1,059	53,027	42,318	1,122	43,440
Whiskery	46,830		46,830	55,220		55,220	39,651	828	40,479	34,046	2,238	36,284	23,345	36	23,381	39,818	620	40,439
Wobbegong	21,263		21,263	18,248		18,248	19,037	506	19,543	19,008	2,199	21,207	10,014	332	10,346	17,514	607	18,121
Hammerhead	17,399		17,399	17,380		17,380	17,563		17,563	13,622	431	14,053	7,960	91	8,051	14,785	104	14,889
'Blacktip'	20,656		20,656	12,485		12,485	11,489	5	11,494	16,921	3,587	20,508	7,004	1,264	8,268	13,711	971	14,682
Skates and Rays	7,488		7,488	8,193		8,193	7,281	51	7,332	7,846	1,727	9,573	2,100	963	3,063	6,582	548	7,130
Gummy	5,115		5,115	2,406		2,406	2,859		2,859	2,396	24	2,420	1,318	402	1,720	2,819	85	2,904
Grey nurse	1,953		1,953	2,614		2,614	2,236		2,236	1,374		1,374	116	83	199	1,659	17	1,675
Copper													1,956		1,956	391	0	391
Tiger				151		151	932		932	517		517	159		159	352	0	352
Pencil	65		65	113		113	24		24	83		83	173	19	192	92	4	95
Mako (shortfin)													41		41	8	0	8
Dogfish	32		32													6	0	6
Unspecified	18,452		18,452	17,186		17,186	23,533		23,533	14,872	13	14,885	15,873		15,873	17,983	3	17,986
Total	278,773		278,773	249,158		249,158	254,502	1,853	256,355	239,548	23,796	263,344	167,091	6,117	173,208	237,814	6,353	244,168

(vii) Region 6

	1994-1995			1995-1996			1996-1997			1997-1998			1998-1999			Annual mean		
	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total
Gillnet equivalent Effort (km gn.hr)	24,675	1,196	28,262	21,660	120	22,020	27,248	752	29,503	42,320	2,597	50,111	32,557	1,198	36,152	29,692	1,173	33,209.6
Catch (kg live weight)																		
Sandbar	47,091	2,973	50,064	43,424		43,424	52,880		52,880	67,548	585	68,133	76,012	200	76,212	57,391	752	58,143
Bronze whaler'	50,005	1,749	51,754	53,130		53,130	41,819		41,819	35,570	267	35,837	39,698	3	39,701	44,044	404	44,448
'Blacktip'	13,121		13,121	7,419		7,419	14,789		14,789	12,019		12,019	5,761		5,761	10,622	0	10,622
Whiskery	11,057	1,830	12,887	9,704	225	9,929	12,051		12,051	11,150	362	11,512	5,457	27	5,484	9,884	489	10,373
Wobbegong	6,929		6,929	5,473		5,473	5,559		5,559	6,845		6,845	6,381		6,381	6,237	0	6,237
Hammerhead	4,956		4,956	4,848		4,848	5,500		5,500	5,718		5,718	3,662		3,662	4,937	0	4,937
Grey nurse	2,549		2,549	2,091		2,091	1,836		1,836	1,840		1,840	1,070		1,070	1,877	0	1,877
Skates and Rays	1,135		1,135	1,010		1,010	1,206		1,206	708		708	3,765		3,765	1,565	0	1,565
Gummy	297	48	345	677	64	741	2,073		2,073	488		488	665		665	840	22	862
Pencil	867	159	1,026	676		676	342		342	1,644		1,644	78		78	721	32	753
Dogfish	70		70		954	954										14	191	205
Tiger										142		142				28	0	28
Unspecified	850		850	83		83	293		293	5,207	6	5,213	5,203	331	5,534	2,327	67	2,395
Total	138,927	6,759	145,686	128,535	1,243	129,778	138,348		138,348	148,879	1,220	150,099	147,752	561	148,313	140,488	1,957	142,445

2. Teleosts

(i) All regions

	1994-1995			1995-1996			1996-1997			1997-1998			1998-1999			Annual mean		
	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total
Gillnet equivalent Effort (km gn.hr)	218,974	3,870	222,844	208,114	1,170	209,284	218,359	4,019	222,378	226,712	15,445	242,157	204,315	4,612	208,927	215,295	5,823	221,118
Catch (kg live weight)																		
Queen snapper	46,722	96	46,818	46,595	71	46,666	55,684	222	55,906	49,857	681	50,538	44,257	483	44,740	48,623	311	48,934
Blue groper	30,720	25	30,745	28,393		28,393	31,519	13	31,532	27,509	20	27,529	30,260	3	30,263	29,680	12	29,692
Dhufish	18,438	2,564	21,002	19,739	367	20,106	18,836	963	19,799	19,738	6,734	26,472	13,827	1,168	14,995	18,116	2,359	20,475
Pink snapper	6,384	7,433	13,817	6,905	2,845	9,750	15,630	4,516	20,146	20,024	8,381	28,405	17,951	7,077	25,028	13,379	6,050	19,429
Samsonfish	10,440	697	11,137	8,486	92	8,578	8,872	945	9,817	12,486	6,594	19,080	8,226	2,063	10,289	9,702	2,078	11,780
Mulloway	7,674		7,674	4,301		4,301	6,522		6,522	7,697		7,697	4,291	65	4,356	6,097	13	6,110
Red snapper, redfish	4,934		4,934	4,300	96	4,396	4,366	69	4,435	6,159	222	6,381	6,685	139	6,824	5,289	105	5,394
Boarfish	4,567		4,567	4,994		4,994	5,424		5,424	4,540		4,540	4,344		4,344	4,774	0	4,774
Baldchin groper	2,771	871	3,642	1,896	120	2,016	3,034	216	3,250	3,074	467	3,541	2,609	325	2,934	2,677	400	3,077
Sweetlip	3,105		3,105	3,494		3,494	2,063		2,063	1,660	215	1,875	2,021	26	2,047	2,469	48	2,517
Emperor sweetlip							100	2,533	2,633	706	2,239	2,945	369	5,171	5,540	235	1989	2,224
Leatherjacket	3,117		3,117	2,043		2,043	1,284		1,284	2,071		2,071	997	9	1,006	1,902	2	1,904
Deep sea trevally	1,062		1,062	1,883		1,883	271		271	296		296	534		534	809	0	809
Tuna	568		568	254		254	426		426	1,761		1,761	596		596	721	0	721
Hapuku	357		357	2,101		2,101	268		268	371		371	152		152	650	0	650
Trevally	384	700	1,084	430	15	445	193		193	341	39	380	407	16	423	351	154	505
Spangled emperor	180	511	691	276		276	149	865	1,014		453	453		20	20	121	370	491
Yellowfin tuna	254		254	891		891	752		752	231		231	295		295	485	0	485
Cod	121	474	595	147	236	383	309	86	395	210	333	543	84	86	170	174	243	417
Footballer	145		145	661	50	711	496		496	587	5	592	101	38	139	398	19	417
Parrotfish	283		283	113		113	152		152	119		119	1,042		1,042	342	0	342
Knifejaw	439		439	494		494	314		314	75		75	243	8	251	313	2	315

Appendix I cont.

Sweep	259		259	153		153	243	11	254	529		529	364		364	310	2	312
Mackerel, general	237		237	322		322	151		151	220		220	332		332	252	0	252
Black kingfish (cobia)	228		228	186		186	58		58	311		311	434		434	243	0	243
Groper							77		77				1,032		1,032	222	0	222
Bonito	94		94	72		72	147		147	131		131	431		431	175	0	175
Yellowtail kingfish	17	14	31	389		389	51		51					18	18	91	6	98
Morwong	238		238	221		221										92	0	92
Australian salmon	22		22	5		5	16		16	409		409				90	0	90
Rosy jobfish											314	314		108	108	0	84	84
Spanish mackerel	124		124	101		101	22		22	98		98	19		19	73	0	73
Northwest snapper		300	300													0	60	60
Bream														216	216	0	43	43
Bigeye tuna	75		75	10		10					90	90	12		12	19	18	37
Gurnard	63		63	61		61	63		63							37	0	37
Coral trout		21	21					4	4	52	24	76	28		28	16	10	26
Southern bluefin tuna							54		54							11	0	11
Grey banded cod	29		29	18		18	5		5							10	0	10
Buffalo bream	28		28													6	0	6
John Dory	18		18	1		1	1		1							4	0	4
Skipjack or striped tuna								18	18							0	4	4
Red emperor											1	1				0	0	0
Unspecified scalefish	25,493		25,493	25,583	30	25,613	26,091	327	26,418	34,049	3,148	37,197	50,004	1,344	51,348	32,244	970	33,214
Total scalefish	169,590	13,706	183,296	165,518	3,922	169,440	183,643	10,788	194,431	195,311	29,960	225,271	191,947	18,383	210,330	181,202	15,352	196,554

(ii) Region 1

	1994-1995			1995-1996			1996-1997			1997-1998			1998-1999			Annual mean		
	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total
Gillnet equivalent Effort (km gn.hr)	32,272		32,272	27,687		27,687	24,030		24,030	37,044		37,044	34,013	3	34,022	31,009	1	31,011
Catch (kg live weight)																		
Queen snapper	2,490		2,490	3,032		3,032	4,208		4,208	4,466		4,466	5,494		5,494	3,938		3,938
Blue groper	1,196		1,196	1,401		1,401	2,418		2,418	2,025		2,025	3,062		3,062	2,020		2,020
Mulloway	850		850	1,499		1,499	3,360		3,360	2,234		2,234		49	49	1,589	10	1,598
Red snapper, redfish	1,865		1,865	967		967	1,249		1,249	2,256		2,256	1,524		1,524	1,572		1,572
Pink snapper	158		158	134		134	1,105		1,105	1,718		1,718	1,938	45	1,983	1,011	9	1,020
Boarfish	421		421	712		712	584		584	870		870	523		523	622		622
Trevally, general	3		3	7		7				253		253	274		274	107		107
Morwong	238		238	120		120										72		72
Samsonfish	105		105	9		9				19		19	43		43	35		35
Hapuku										15		15				3		3
Leatherjacket	8		8													2		2
Sweep	6		6													1		1
Knifejaw	1		1													0		0
Unspecified scalefish	28		28	186		186	1,020		1,020	1,006		1,006	4,944		4,944	1,437		1,437
Total scalefish	7,369		7,369	8,067		8,067	13,944		13,944	14,862		14,862	17,802	94	17,896	12,409	19	12,428

(iii) Region 2

	1994-1995			1995-1996			1996-1997			1997-1998			1998-1999			Annual mean		
	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total
Gillnet equivalent Effort (km gn.hr)	27,608		27,608	32,811		32,811	37,769		37,769	24,864	68	25,067	28,563		28,563	30,323	14	30,363.8
Catch (kg live weight)																		
Queen snapper	7,725		7,725	8,574		8,574	11,710		11,710	9,916		9,916	9,338		9,338	9,453	0	9,453
Blue groper	4,615		4,615	4,488		4,488	5,011		5,011	3,458		3,458	4,578		4,578	4,430	0	4,430
Boarfish	1,470		1,470	1,709		1,709	1,650		1,650	1,045		1,045	1,112		1,112	1,397	0	1,397
Red snapper, redfish	1,186		1,186	1,147		1,147	917		917	1,261		1,261	1,674		1,674	1,237	0	1,237
Deep sea trevally	677		677	998		998	168		168	184		184				405	0	405
Pink snapper	406		406	25		25	909		909	88		88	564		564	398	0	398
Hapuku	245		245	1,327		1,327	218		218	71		71				372	0	372
Samsonfish	262		262	57		57	44		44	74		74	329		329	153	0	153
Sweep										313		313	12		12	65	0	65
Trevally, general				47		47	57		57	50		50	91		91	49	0	49
Mulloway	83		83				63		63				11		11	31	0	31
Cod	1		1	57		57				96		96				31	0	31
Leatherjacket	138		138	7		7										29	0	29
Knifejaw	22		22	80		80	5		5							21	0	21
Morwong				101		101										20	0	20
Bigeye tuna											90	90				0	18	18
Groper													53		53	11	0	11
Dhufish													19		19	4	0	4
Gurnard							10		10							2	0	2
Unspecified scalefish	53		53	1,246		1,246	1,855		1,855	1,772	2,450	4,222	215		215	1,028	490	1,518
Total Scalefish	16,883		16,883	19,863		19,863	22,617		22,617	18,328	2,540	20,868	17,996		17,996	19,137	508	19,645

Appendix I cont.

(iv) Region 3

	1994-1995			1995-1996			1996-1997			1997-1998			1998-1999			Annual mean		
	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total
Gillnet equivalent Effort (km gn.hr)	43,918	6	43,936	32,271	190	32,842	35,425	199	36,023	30,555	676	32,584	25,968	202	26,573	33,628	255	34,391.4
Catch (kg live weight)																		
Queen snapper	17,649		17,649	16,238	67	16,305	19,781	105	19,886	16,770	50	16,820	14,805	43	14,848	17,049	53	17,102
Blue groper	11,401		11,401	8,690		8,690	8,494		8,494	9,306		9,306	10,722	3	10,725	9,723	1	9,723
Pink snapper	687		687	1,190	2,162	3,352	3,010	2,493	5,503	4,041	1,840	5,881	4,224	2,617	6,841	2,630	1,822	4,453
Boarfish	2,178		2,178	2,253		2,253	2,805		2,805	2,435		2,435	2,471		2,471	2,428	0	2,428
Red snapper, redfish	1,166		1,166	1,295	82	1,377	1,585	58	1,643	1,861	48	1,909	3,194	98	3,292	1,820	57	1,877
Samsonfish	2,158		2,158	1,516	79	1,595	710	38	748	809	31	840	770	89	859	1,193	47	1,240
Dhufish	801		801	671	36	707	1,131	41	1,172	914	44	958	731	125	856	850	49	899
Leatherjacket	1,387		1,387	594		594	686		686	564		564	547		547	756	0	756
Deep sea trevally	347		347	885		885	103		103	112		112	534		534	396	0	396
Hapuku	112		112	774		774	50		50	285		285	152		152	275	0	275
Footballer	2		2	373	50	423	397		397	373	5	378	46		46	238	11	249
Knifejaw	289		289	307		307	304		304	70		70	237	8	245	241	2	243
Groper													979		979	196	0	196
Mulloway	477		477	36		36				159		159	64		64	147	0	147
Trevally, general	341		341	162	15	177	129		129	24		24	18		18	135	3	138
Sweep	118		118	64		64	61		61	59		59	282		282	117	0	117
Mackerel, general													293		293	59	0	59
Bonito													210		210	42	0	42
Gurnard	63		63	61		61	53		53							35	0	35
Grey banded cod	29		29	18		18										9	0	9
Buffalo bream	28		28													6	0	6
Australian salmon	5		5				16		16							4	0	4
Yellowtail Kingfish														18	18	0	4	4
John Dory	8		8				1		1							2	0	2
Parrotfish							9		9							2	0	2
Unspecified scalefish	2,381		2,381	3,328	27	3,355	2,475		2,475	2,866	31	2,897	4,029		4,029	3,016	12	3,027
Total scalefish	41,627		41,627	38,455	2,518	40,973	41,800	2,735	44,535	40,648	2049	42,697	44,308	3,001	47,309	41,368	2,061	43,428

(v) Region 4

	1994-1995			1995-1996			1996-1997			1997-1998			1998-1999			Annual mean		
	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total
Gillnet equivalent Effort (km gn.hr)	43,271	89	43,537	42,211	80	42,451	45,509	45	45,643	42,020	36	42,128	50,420	17	50,470	44,686	53	44,845.8
Catch (kg live weight)																		
Queen snapper	8,834	69	8,903	9,456	4	9,460	11,437	111	11,548	8,614		8,614	8,224		8,224	9,313	37	9,350
Blue groper	7,813		7,813	8,074		8,074	9,385		9,385	7,051	12	7,063	9,553		9,553	8,375	2	8,378
Dhufish	6,889	759	7,648	6,421	281	6,702	6,197	204	6,401	4,964	24	4,988	5,172	3	5,175	5,929	254	6,183
Samsonfish	2,751	38	2,789	2,246	13	2,259	2,839	8	2,847	1,228	65	1,293	1,811	47	1,858	2,175	34	2,209
Pink snapper	1,583	142	1,725	1,620	233	1,853	2,625	119	2,744	2,256	28	2,284	2,028	8	2,036	2,022	106	2,128
Mulloway	78		78	1,759		1,759	353		353	63		63	78		78	466	0	466
Red snapper, redfish	431		431	558	14	572	341	2	343	692		692	176		176	440	3	443
Leatherjacket	120		120	482		482	461		461	85		85				230	0	230
Cod		314	314		236	236	24	31	55		24	24				5	121	126
Footballer				227		227	57		57	176		176	25		25	97	0	97
Boarfish	71		71	66		66	236		236	5		5	18		18	79	0	79
Baldchin groper	56	3	59	104		104				63		63				45	1	45
Tuna	53		53	81		81	28		28							32	0	32
Trevally, general				151		151										30	0	30
Sweep	40		40	20		20	44	11	55	34		34				28	2	30
Knifejaw	113		113	7		7	5		5				6		6	26	0	26
Black kingfish (cobia)			0			0	14		14							3	0	3
Yellowtail kingfish	4		4			0										1	0	1
						0												
Unspecified scalefish	12,617		12,617	12,277	3	12,280	11,606		11,606	14,078		14,078	24,627		24,627	15,041	1	15,042
Total scalefish	41,453	1,325	42,778	43,549	784	44,333	45,652	486	46,138	39,309	153	39,462	51,718	58	51,776	44,336	561	44,897

(vi) Region 5

	1994-1995			1995-1996			1996-1997			1997-1998			1998-1999			Annual mean		
	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total
Gillnet equivalent Effort (km gn.hr)	47,230		47,230	51,473		51,473	48,378	344	49,410	49,910	1,771	55,223	32,793	118	33,146	45,957	447	47,296.4
Catch (kg live weight)																		
Queen snapper	9,905		9,905	9,169		9,169	8,447	4	8,451	9,687	629	10,316	5,601	440	6,041	8,562	215	8,776
Dhufish	8,091		8,091	9,416		9,416	8,318	232	8,550	8,267	3,273	11,540	3,932	9	3,941	7,605	703	8,308
Samsonfish	4,350		4,350	3,359		3,359	3,013	185	3,198	6,429	2,900	9,329	3,367	1,300	4,667	4,104	877	4,981
Blue groper	5,366		5,366	5,574		5,574	5,873	13	5,886	4,928		4,928	2,042		2,042	4,757	3	4,759
Pink snapper	2,367		2,367	2,537		2,537	4,857	160	5,017	4,204	2,978	7,182	3,761	1,478	5,239	3,545	923	4,468
Mulloway	3,781		3,781	531		531	2,205		2,205	3,742		3,742	1,960	16	1,976	2,444	3	2,447
Baldchin groper	1,698		1,698	1,312		1,312	2,134		2,134	2,119		2,119	1,601	24	1,625	1,773	5	1,778
Leatherjacket	1,454		1,454	960		960	137		137	1,411		1,411	416	9	425	876	2	877
Tuna, other	118		118	126		126	382		382	1,236		1,236	182		182	409	0	409
Yellowfin tuna	62		62	115		115	691		691	147		147	295		295	262	0	262
Red snapper, redfish	286		286	333		333	274	9	283	89	174	263	88	41	129	214	45	259
Boarfish	427		427	254		254	149		149	185		185	220		220	247	0	247
Cod	39		39	90		90	201	2	203	10	141	151	46	66	112	77	42	119
Bonito	94		94	48		48	145		145	115		115	71		71	95	0	95
Sweep	66		66	60		60	116		116	123		123	70		70	87	0	87
Australian salmon	17		17	5		5				409		409				86	0	86
Yellowtail kingfish	13		13	389		389										80	0	80
Footballer	143		143	61		61	42		42	38		38	30	38	68	63	8	70
Sweetlip													340		340	68	0	68
Mackerel, general	59		59	18		18	53		53	25		25	25		25	36	0	36
Spanish mackerel	54		54				22		22	71		71	14		14	32	0	32
Trevally, general	34		34	63		63	7		7	14		14	24		24	28	0	28
Knifejaw	14		14	100		100				5		5				24	0	24
Bigeye tuna	75		75	10		10							12		12	19	0	19
Groper							77		77							15	0	15
Black kingfish (cobia)										10		10	59		59	14	0	14
Grey banded cod	53		53				5		5							12	0	12
Parrotfish										43		43	11		11	11	0	11
Southern bluefin tuna							54		54							11	0	11
Deep sea trevally	38		38													8	0	8
John Dory	10		10	1		1										2	0	2
Unspecified scalefish	10,404		10,404	8,546		8,546	8,374	17	8,391	11,684	169	11,853	10,678	383	11,061	9,937	114	10,051
Total	49,018		49,018	43,077		43,077	45,576	622	46,198	54,991	10,264	65,255	34,845	3,804	38,649	45,501	2,938	48,439

(vii) Region 6

	1994-1995			1995-1996			1996-1997			1997-1998			1998-1999			Annual mean		
	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total	Gillnet	Longline	Total
Gillnet equivalent Effort (km gn.hr)	24,675	1,196	28,262	21,660	120	22,020	27,248	752	29,503	42,320	2,597	50,111	32,557	1,198	36,152	29,692	1,173	33,209.6
Catch (kg live weight)																		
Pink snapper	1,183	7,291	8,474	1,399	450	1,849	3,124	1,744	4,868	7,717	3,535	11,252	5,436	2,929	8,365	3,772	3,190	6,962
Dhufish	2,657	1,805	4,462	3,231	50	3,281	3,190	486	3,676	5,593	3,393	8,986	3,973	1,031	5,004	3,729	1,353	5,082
Samsonfish	814	659	1,473	1,299		1,299	2,266	714	2,980	3,927	3,598	7,525	1,906	627	2,533	2,042	1,120	3,162
Sweetlip	3,105		3,105	3,494		3,494	2,063		2,063	1,660	215	1,875	1,681	26	1,707	2,401	48	2,449
Emperor sweetlip							100	2,533	2,633	706	2,239	2,945	369	5,171	5,540	235	1,989	2,224
Mulloway	2,405		2,405	476		476	541		541	1,499		1,499	2,178		2,178	1,420	0	1,420
Baldchin groper	1,017	868	1,885	480	120	600	900	216	1,116	892	467	1,359	1,008	301	1,309	859	394	1,254
Spangled emperor	180	511	691	276		276	149	865	1,014		453	453		20	20	121	370	491
Blue groper	329	25	354	166		166	338		338	741	8	749	303		303	375	7	382
Parrotfish	283		283	113		113	143		143	76		76	1,031		1,031	329	0	329
Queen snapper	119	27	146	126		126	101	2	103	404	2	406	795		795	309	6	315
Tuna, other	397		397	47		47	16		16	525		525	414		414	280	0	280
Black kingfish (cobia)	228		228	186		186	44		44	301		301	375		375	227	0	227
Yellowfin tuna	192		192	776		776	61		61	84		84				223	0	223
Mackerel, general	178		178	304		304	98		98	195		195	14		14	158	0	158
Trevally, general	6	700	706								39	39		16	16	1	151	152
Cod	81	160	241				84	53	137	104	168	272	38	20	58	61	80	142
Rosy jobfish											314	314		108	108	0	84	84
Northwest snapper		300	300													0	60	60
Bream, mixed														216	216	0	43	43
Spanish mackerel	70		70	101		101				27		27	5		5	41	0	41
Bonito				24		24	2		2	16		16	150		150	38	0	38
Coral trout		21	21					4	4	52	24	76	28		28	16	10	26
Yellowtail kingfish		14	14				51		51							10	3	13
Sweep	29		29	9		9	22		22							12	0	12
Leatherjacket	10		10							11		11	34		34	11	0	11
Red snapper, redfish													29		29	6	0	6
Skipjack or striped tuna								18	18							0	4	4
Red emperor											1	1				0	0	0
Unspecified scalefish	10		10				761	310	1,071	2,643	498	3,141	5,511	961	6,472	1,785	354	2,139
Total scalefish	13,293	12,381	25,674	12,507	620	13,127	14,054	6,945	20,999	27,173	14,954	42,127	25,278	11,426	36,704	18,461	9,265	27,726

Appendix II. Total length – fork length relationships

Common name	Species	TL(cm) = a*FL(cm) + b				FL (cm)	
		a	b	r2	n	min	max
Angel shark (unspecified)	Family Squatinidae	1.0039	5.4232	0.9894	4	72	92
Dusky shark (♂)	*Carcharhinus obscurus*	1.1762	3.6568	0.9838	1,196	66	264
Dusky shark (♀)	" "	1.2073	1.3613	0.9859	1,157	59	347
Dusky shark (combined)	" "	1.1851	3.0321	0.9844	2,359	59	282
Copper shark	*Carcharhinus brachyurus*	1.2206	5.3633	0.9963	20	74	229
School shark	*Galeorhinus galeus*	1.1385	3.3111	0.9800	748	80	151
Gummy shark	*Mustelus antarcticus*	1.0837	4.6424	0.9590	360	63	185
Grey nurse	*Carcharias taurus*	1.185x	10.669	0.9671	9	93	127
Smooth hammerhead	*Sphyrna zygaena*	1.2977	1.7551	0.9846	135	52	142
Spinner shark	*Carcharhinus brevipinna*	1.2026	2.8155	0.9945	61	67	132
Port Jackson	*Heterodontus portusjacksoni*	1.0666	2.5650	0.9760	73	39	95
Pencil shark	*Hypogaleus hyugaensis*	0.8159	31.212	0.3613	25	87	98
Tiger shark	*Galeocerdo cuvier*	1.0748	23.452	0.9476	225	95	361
Sandbar shark	*Carcharhinus plumbeus*	1.2185	0.2133	0.9631	273	52	121
Whiskery shark	*Furgaleus macki*	1.0044	13.171	0.8955	502	92	129
Western wobbegong	*Orectolobus* sp.	0.8148	61.044	0.5316	74	44	122

Appendix III. Length - Weight Relationships

1. Elasmobranchs

Common name	Species	L	Weight (kg) = a*L^b, where L equals length (cm) a	b	r^2	n	Size (cm)	Source
Angel shark (unspecified)	Family Squatinidae	TL	$2.76x10^{-6}$	3.16	0.96	134		Bridge et al. (1999) for *Squatina tergocellata*
Banded wobbegong	*Orectolobus ornatus*	TL	$3.645 x10^{-3}$	1.767	0.641	16	145 - 250	Chidlow (2003)
Blue shark	*Prionace glauca*	FL	$3.1841 x10^{-6}$	3.1313	0.9521	4,529	52 - 288	Kohler et al. (1995)
Broadnose sevengill	*Notorynchus cepedianus*	TL	$1.62 x10^{-6}$	3.15	0.89	69		Bransetter and Musick (1994) for *Carcharias taurus*
Cobbler wobbegong	*Sutorectus tentaculatus*	TL	$2.19 x10^{-6}$	3.23	0.9486	81	47 - 143	Chidlow (2003) for *Orectolobus sp* A. (Last and Stevens, 1994)
Copper shark (♂)	*Carcharhinus brachyurus*	PCL	$7.49 x10^{-6}$	3.11	0.9972	945		Cliff and Dudley (1992)
Copper shark (♀)		PCL	$6.71 x10^{-6}$	3.14	0.9973	770		Cliff and Dudley (1992)
Dogfish, spurdog	*Squalus* spp.	TL	$1.47 x10^{-6}$	3.22			< 80	Torres (1991) for *Squalus acanthias*
Dusky shark	*Carcharhinus obscurus*	TL	$3.469x10^{-6}$	3.100	0.964	351	81 - 240	Unpublished data, Shark Research Section, Fisheries WA
Grey gummy	*Mustelus* sp.	TL	$2.353x10^{-6}$	3.113	0.926	136	40 -126	Unpublished data, Shark Research Section, Fisheries WA, for male *Mustelus antarcticus*
Grey nurse shark	*Carcharias taurus*	TL	$1.62 x10^{-6}$	3.15	0.89	69		Bransetter and Musick (1994) for *Carcharias taurus*
Gummy shark (♂)	*Mustelus antarcticus*	TL	$2.353x10^{-6}$	3.113	0.926	136	40 –126	Unpublished data, Shark Research Section, Fisheries WA
Gummy shark (♀)		TL	$6.098x10^{-7}$	3.423	0.904	661	39 – 164	
Hammerhead (unspecified)	*Sphyrna* spp.	TL	$1.619x10^{-5}$	2.721	0.948	69	68 - 176	Unpublished data, Shark Research Section, Fisheries WA for *S. zygaena*
Pencil shark	*Hypogaleus hyugaensis*	TL	$2.286x10^{-5}$	2.612	0.287	93	102 - 122	Unpublished data, Shark Research Section, Fisheries WA
Port Jackson shark	*Heterodontus portusjacksoni*	TL	$1.630x10^{-7}$	3.900	0.9385	178	46.5 - 108	Unpublished data, Shark Research Section, Fisheries WA

Appendix III cont.

Appendix III cont.

Sandbar (thickskin) shark	*Carcharhinus plumbeus*	FL	1.0885×10^{-5}	3.0124	0.9385	1,548	44 - 201	Kohler et al. (1995)
Sawshark (unspecified)	Family Pristiophoridae	TL	2.0×10^{-7}	3.4617	0.9745	323	36 - 116	Graham (1999) for *Pristiophorus sp.*A (Last and Stevens, 1994)
Scalloped hammerhead	*Sphyrna lewini*	FL	7.745×10^{-6}	3.0669	0.9255	390	79 - 243	Kohler et al. (1995)
School (tope) shark	*Galeorhinus galeus*	TL	2.186×10^{-6}	3.190	0.807	81	117 - 158	Unpublished data, Shark Research Section, Fisheries WA
Shortfin mako	*Isurus oxyrinchus*	FL	5.2432×10^{-6}	3.1407	0.9587	2,081	65 - 338	Kohler et al. (1995)
Shovelnose/fiddler ray (unspecified)	*Families Rhinobatidae and Rhynchobatidae*	TL	1.3×10^{-6}	3.2097	0.9812	200	21 - 103	Graham, K.J. (1999) for *Aptychotrema rostrata*
Smooth hammerhead	*Sphyrna zygaena*	TL	1.619×10^{-5}	2.721	0.948	69	68 - 176	Unpublished data, Shark Research Section, Fisheries WA
Spinner (longnose grey) shark	*Carcharhinus brevipinna*	TL	1.13×10^{-6}	3.33	0.988	35		Stevens and McLoughlin (1991)
Spotted wobbegong	**Orectolobus maculatus**	TL	3.645×10^{-3}	1.767	0.641	16	145 - 250	Chidlow (2003) for *O. ornatus*
Thresher shark (unspecified)	Family Alopiidae	FL	1.8821×10^{-4}	2.5188	0.8795	88	154 - 262	Kohler et al. (1995) for *Alopias vulpinus*
Tiger shark	*Galeocerdo cuvier*	TL	2.62×10^{-6}	3.57	0.993	86		Stevens and McLoughlin (1991)
Western wobbegong	*Orectolobus sp* A. (Last and Stevens)	TL	2.19×10^{-6}	3.23	0.9486	81	47 - 143	Unpublished data, Shark Research Section, Fisheries WA
Whiskery shark	*Furgaleus macki*	TL	2.75×10^{-6}	3.081	0.770	479	104 - 145	Unpublished data, Shark Research Section, Fisheries WA
White shark (white pointer)	*Carcharodon carcharias*	FL	7.5763×10^{-6}	3.0848	0.9802	125	112 - 493	Kohler et al. (1995)
Wobbegong (unspecified)	Family Orectolobidae	TL	3.645×10^{-3}	1.767	0.641	16	145 - 250	Chidlow (2003) for *O. ornatus*

2. Teleosts

Common name	Species	L	Weight (kg) = a*L^b, where L equals length (cm) a	b	r^2	n	Size (cm)	Source
Australian salmon	*Arripis truttaceus*	TL	7.45 x10^{-6}	3.111		8,232	4.0 – 77.0	Steffe et al. (1996)
Baldchin groper	*Choerodon rubescens*	TL	1.3 x10^{-5}	3.139				Unpublished data, Recreational Fishing Section, Fisheries WA
Banded sweep	*Scorpis georgianus*	TL	7.626 x10^{-6}	3.136	0.993	46	3.6-18.0	Taylor & Willis (1998) for *Scorpis lineolatus*
Blue groper	*Achoerodus gouldii*	TL	2.28 x10^{-5}	2.995				Unpublished data, Recreational Fishing Section, Fisheries WA
Boarfish (unspecified)	Family Pentacerotidae	TL	3.92 x10^{-5}	2.95		219	5.0 - 20.0	Magnusson and Magnusson (1987)
Bonito	*Sarda australis*	FL	7.627 x10^{-6}	3.090	0.99	2,824	29.0-77.0	Campbell & Collins (1975) for *Sarda chiliensis*
Boxfish (unspecified)	Family Ostraciidae	TL	1.53 x10^{-5}	2.25		181	5.0-32.0	Claro and Garcia-Arteaga, (1994) for *Lactophrys quadricornis*
Breaksea cod	*Epinephelides armatus*	TL	8.9 x10^{-6}	3.126	0.988	11	14.2-26.9	Yanagawa (1994) for *Epinephelus bleekeri*
Buffalo bream	*Kyphosus cornelii*	FL	2.261 x10^{-5}	3.055	0.955	32	25.0-57.5	Taylor & Willis (1998) for *Kyphosus sydneyanus*
Cobbler, estuary catfish	*Cnidoglanis macrocephalus*	TL	1.56 x10^{-6}	3.2				Unpublished data, Estuarine Section, Fisheries WA
Coral trout	*Plectropomus leopardus*	TL	8.9 x10^{-6}	3.126	0.988	11	14.2-26.9	Yanagawa (1994) for *Epinephelus bleekeri*
Dory (unspecified)	Family Zeidae	TL	5.6 x10^{-6}	3.313	0.9613	225	10.0-53.0	Graham (1999) for *Zeus faber*
Flathead	Family Platycephalidae	TL	9.22 x10^{-5}	2.33				Unpublished data, Estuarine Section, Fisheries WA
Flounder (unspecified)	Families Bothidae & Pleuronectidae	TL	6.8 x10^{-6}	3.076	0.986	90	8.5-25.0	Willing and Pender (1989) for *Pseudorhombus arsius*
Gurnard perch	*Neosebastes spp.*	TL	9.135 x10^{-6}	3.137	0.995	82	2.3-19.6	Taylor & Willis (1998) for *Scorpaena papillosus*
Knifejaw	*Oplegnathus woodwardi*	TL	7.626 x10^{-6}	3.136	0.993	46	3.6-18.0	Taylor & Willis (1998) for *Scorpis lineolatus*
Leatherjacket (unspecified)	Family Monacanthidae	TL	3.09 x10^{-5}	2.8153	0.9773	88	8.0-32.0	Graham (1999) for *Meuschenia scaber*
Mackerel (unspecified)	Family Scombridae	TL	5.0 x10^{-6}	3.247	0.979	460	13.3-35.6	Al Sakaff and Esseen for *Scomber australasicus*
Moonlighter	*Tilodon sexfasciatum*	TL	7.626 x10^{-6}	3.136	0.993	46	3.6-18.0	Taylor & Willis (1998) for *Scorpis lineolatus*
Mulloway	*Argyrosomus hololepidotus*	TL	3.01 x10^{-5}	2.76	n/a	n/a	<200.0	Torres (1991)

Appendix III cont.

Narrow-barred spanish mackerel	*Scomberomorus commerson*	FL	1.0×10^{-5}	2.9092	0.9847	1,238		M. Mackie, Fisheries W.A. Unpublished data
North west blowfish	*Lagocephalus scleratus*	FL	1.94×10^{-5}	2.904	0.996	67	9.0-71.5	Letourneur et al. (1998)
Parrotfish (unspecified)	Family Scaridae	FL	1.35×10^{-5}	3.1		275	7.0-31.0	Garcia-Arteaga et al. (1997) for *Scarus chrysopterum*
Pink snapper	*Pagrus auratus*	FL	4.67727×10^{-5}	2.781	0.99	2,646	6.5 – 82.0	Moran and Burton (1990)
Queen snapper	*Nemadactylus valenciennesi*	TL	3.808×10^{-6}	3.1375	0.94	7	45.1-65.0	Taylor & Willis (1998) for *Nemadactylus douglasii*
Redfish, red snapper, nannygai, bight redfish	*Centroberyx* spp.	FL	6.99×10^{-5}	2.6905	0.9926	187	4.0-34.0	Graham (1999)
Red-lipped morwong	*Cheilodactylus rubrolabiatus*	TL	1.600×10^{-5}	2.989	0.987	140	11.6-55.8	Taylor & Willis (1998) for *Cheilodactylus spectabilis*
Samsonfish	*Seriola hippos*	FL	3.515×10^{-5}	2.845		100s	30.0-166.0	Taylor & Willis (1998) for *Seriola lalandi*
Sand snapper (Painted sweetlips)	*Diagramma pictum*	TL	7.7×10^{-6}	3.131	0.993		10.0-84.0	Pauly et al. (1996)
Sea carp, cale	Family Aplodactylidae	TL	5.260×10^{-6}	3.207	0.972	100	19.4-52.0	Taylor & Willis (1998) for *Aplodactylus arctidens*
Sea sweep	*Scorpis aequipinnis*	TL	7.626×10^{-6}	3.136	0.993	46	3.6-18.0	Taylor & Willis (1998) for *Scorpis lineolatus*
Sergeant baker	*Aulopus purpurissatus*	TL	1.264×10^{-5}	3.012	0.984	97	22.5 – 52.0	Steffe et al. (1996)
Southern blue-fin tuna	*Thunnus maccoyii*							
Spangled emperor	*Lethrinus nebulosus*	TL	9.50×10^{-5}	2.619	0.987	120	23.0-73.5	Al Sakaff and Esseen (1999)
Stargazer (unspecified)	Family Uranoscopidae	TL	7.0×10^{-6}	3.004	0.963	36	15.2-34.1	Dulcic and Kralijevic (1996) for *Uranoscopus scaber*
Swallowtail	*Centroberyx lineatus*	FL	6.99×10^{-5}	2.6905	0.9926	187	4.0-34.0	Graham (1999)
Sweetlip	Family Haemulidae	TL	3.96×10^{-5}	2.761	0.968	19	7.0 – 38.0	Letourneur et al. (1998)
Tailor	*Pomatomus saltatrix*	TL	5.15×10^{-5}	2.714				Unpublished data, Recreational Fishing Section, Fisheries WA
Trevally	Family Scombridae	TL	4.0×10^{-5}	2.6748				Unpublished data, Recreational Fishing Section, Fisheries WA for *Pseudocaranx dentex*
West Australian dhufish	*Glaucosoma hebraicum*	TL	4.83×10^{-5}	2.837				Unpublished data, Recreational Fishing Section, Fisheries WA
Yellow fin tuna	*Thunnus albacares*	FL	1.391×10^{-5}	3.086		196	30.0-168.0	Steffe et al. (1996)
Yellow tailed kingfish	*Seriola lalandi*	TL	3.515×10^{-5}	2.845		100s	30.0-166.0	Taylor & Willis (1998)

Appendix III cont.

Appendix IV. Size frequency statistics

1. Elasmobranch

Name	Species	Sex	Location	n	Mean ($\overline{FL}$)	Standard Dev. (σ)	Fork Length (cm) min.	Fork Length (cm) max.
Copper shark	*Carcharhinus brachyurus*	Male	all regions	76	155	50	60	238
		Female		40	140	57	65	245
Spinner shark	*Carcharhinus brevipinna*	Male	all regions	771	91	19	58	210
		Female		691	90	16	60	220
Dusky shark	*Carcharhinus obscurus*	Male	region 1	162	94	19	72	183
		Female		143	91	15	68	163
"	"	Male	region 2	56	90	14	75	143
		Female		48	90	14	74	149
"	"	Male	region 3	1,009	87	17	53	210
		Female		995	87	20	59	224
"	"	Male	region 4	5,442	79	11	64	253
		Female		5,458	79	12	65	205
"	"	Male	region 5	1,482	83	14	67	219
		Female		1,730	84	16	67	273
"	"	Male	region 6	300	92	22	74	196
		Female		366	90	24	72	222
"	"	Male	all regions	8,455	82	14	53	253
		Female		8,740	82	15	59	273
Sandbar shark	*Carcharhinus plumbeus*	Male	region 3	319	77	7	52	98
		Female		247	79	10	54	150
"	"	Male	region 4	617	75	12	47	140
		Female		733	75	13	46	156
"	"	Male	region 5	740	82	11	52	147
		Female		742	82	12	52	155
"	"	Male	region 6	222	95	18	45	143
		Female		269	101	23	44	160
"	"	Male	all regions	1,898	81	13	45	147
		Female		1,991	82	16	44	160
Tiger shark	*Galeocerdo cuvier*	Male	all regions	17	125	34	92	204
		Female		38	139	32	92	214
Whiskery shark	*Furgaleus macki*	Male	region 1	82	121	5	109	132
		Female		62	108	6	91	123
"	"	Male	region 2	22	120	4	114	131
		Female		30	111	6	100	126
"	"	Male	region 3	118	112	7	95	127
		Female		374	110	5	88	128
"	"	Male	region 4	593	110	8	76	128
		Female		1,632	109	8	75	150
"	"	Male	region 5	242	111	8	80	128
		Female		674	115	7	84	130
"	"	Male	region 6	76	110	8	72	123
		Female		93	107	6	90	122
"	"	Male	all regions	1,133	111	8	72	132
		Female		2,865	110	8	75	150
School shark	*Galeorhinus galeus*	Male	all regions	134	111	11	80	140
		Female		756	119	10	80	151

Pencil shark	*Hypogaleus hyugaensis*	Male	all regions	242	92	4	74	102
		Female		251	92	5	63	105
Gummy shark	*Mustelus antarcticus*	Male	region 1	860	102	6	87	121
		Female		349	106	13	57	185
"	"	Male	region 2	224	101	6	84	115
		Female		746	113	11	80	163
"	"	Male	region 3	228	98	5	84	119
		Female		1,953	110	11	63	148
"	"	Male	region 4	42	97	6	86	117
		Female		482	112	14	84	155
"	"	Male	west coast (regions 5 & 6)	8	100	5	90	106
		Female		123	113	13	88	190
"	"	Male	all regions	1,362	101	6	84	121
		Female		3,654	110	12	57	190
Grey gummy	*Mustelus sp.*	Male	all regions	1			85	
		Female		44	91	5	74	101
Grey nurse	*Carcharias taurus*	Male	all regions	26	130	40	91.0	231.0
		Female		18	132	40	86.0	222.0
Port Jackson	*Heterodontus portusjacksoni*	Male	all regions	98	57	6	43	70
		Female		236	65	14	40	99
Mako	*Isurus oxyrinchus*	Male	all regions	48	128	43	76	247
		Female		31	139	45	80	300
Wobbegongs	Family Orectolobidae	Male	all regions	279	142	48	14	260
		Female		271	130	41	60	225
Hammerhead	*Sphyrna zygaena*	Male	all regions	1,178	91	17	48	187
		Female		1,092	93	18	48	232

2. Teleosts

Name	Species	n	Mean ($\overline{FL}$)	Standard Dev. (σ)	fork length (cm) min.	fork length (cm) max.
Australian salmon	*Arripis truttaceus*	58	74	5	60	84
Baldchin groper	*Choerodon rubescens*	211	56	4	48	67
Blue groper	*Achoerodus gouldii*	895	65	9	35	109
Boarfish (unspecified)	Family Pentacerotidae	638	49	12	18	94
West Australian dhufish	*Glaucosoma hebraicum*	1,206	66	11	25	110
Knifejaw	*Oplegnathus woodwardi*	351	43	5	26	94
Leatherjacket (unspecified)	Family Monacanthidae	380	60	9	34	83
Moonlighter	*Tilodon sexfasciatum*	160	42	16	29	123
Pink snapper	*Pagrus auratus*	767	61	10	28	115
Queen snapper	*Nemadactylus valenciennesi*	2,513	66	8	32	98
Redfish, red snapper, nannygai, bight redfish	*Centroberyx* spp.	399	53	7	31	71
Samsonfish	*Seriola hippos*	142	90	15	55	164

Appendix V. Research Observed Catch, July 1994 – June 1999

(a) Elasmobranchs (i) All regions

Common Name	Species Name	Observed Catch (no)					Observed Catch (kg whole wt)					Mean annual catch	
		94/95	95/96	96/97	97/98	98/99	94/95	95/96	96/97	97/98	98/99	(no)	(kg)
Dusky Shark	*Carcharhinus obscurus*	4,486	5,102	4,272	2,796	3,990	25,751	24,990	21,768	16,471	19,403	4,129	21,677
Gummy Shark	*Mustelus antarcticus*	1,777	2,066	424	1,230	1,811	15,215	14,087	3,359	11,686	13,349	1,462	11,539
Whiskery Shark	*Furgaleus macki*	463	651	265	461	237	11,913	7,283	7,749	10,316	6,472	415	8,746
*Port Jackson Shark	*Heterodontus portusjacksoni*	2,609	3,204	1,826	1,952	3,380	7,801	9,580	5,460	5,836	10,106	2,594	7,757
Smooth Hammerhead	*Sphyrna zygaena*	553	808	956	631	413	5,103	5,837	4,439	6,156	6,429	672	5,593
Sandbar Shark	*Carcharhinus plumbeus*	749	355	266	499	569	4,468	8,169	5,631	2,612	2,491	488	4,674
School Shark	*Galeorhinus galeus*	1	988	0	0	1	13	8,580	0	0	0	330	4,297
Longnose Grey/Spinner Shark	*Carcharhinus brevipinna*	593	140	116	479	227	4,906	1,089	847	4,584	2,086	311	2,702
Wobbegong (unspecified)	Family Orectolobidae	197	211	30	1	0	3,677	4,140	580	19	0	88	1,683
Copper Shark	*Carcharhinus brachyurus*	18	45	11	40	16	1,042	1,615	771	2,837	1,709	26	1,595
*Eagle Ray	Family Myliobatididae	450	410	172	424	161	1,800	1,640	688	1,696	644	323	1,294
Banded Wobbegong	*Orectolobus ornatus*	3	8	43	41	37	84	247	1,612	1,556	1,542	26	1,008
Tiger Shark	*Galeocerdo cuvier*	10	17	26	5	2	655	1,302	1,394	594	173	12	823
Western Wobbegong	*Orectolobus sp.*	10	0	62	109	79	153	0	976	1,692	1,166	52	797
Shortfin Mako	*Isurus oxyrinchus*	9	11	5	22	39	197	533	74	941	1,671	17	683
*Angel Shark (unspecified)	Family Squatinidae	107	60	75	134	143	628	370	452	791	842	104	617
Spotted Wobbegong	*Orectolobus maculatus*	11	37	29	14	9	317	885	702	405	324	20	527
Pencil Shark	*Hypogaleus hyugaensis*	112	98	66	95	170	447	386	261	364	661	108	424
Grey Nurse Shark	*Carcharias taurus*	10	15	12	2	13	113	486	263	22	208	10	218
*Saw Shark (unspecified)	Family *Pristiophoridae*	23	125	25	16	187	62	336	64	37	459	75	192
Hammerhead (unspecified)	Family Sphyrnidae	0	0	59	0	0	0	0	690	0	0	12	138
Blue Shark	*Prionace glauca*	0	0	0	1	2	0	0	0	53	207	<1	52
*Shovelnose/Fiddler Ray	Families Rhinobatidae & Rhynchobatidae	41	67	22	3	36	393	103	30	29	53	34	121
*Cobbler Wobbegong	*Sutorectus tentaculatus*	4	1	9	23	18	39	10	97	212	181	11	108
*Stingray (unspecified)	*Family Dasyatididae*	123	25	9	1	20	369	75	27	3	60	36	107
Thresher Shark (unspecified)	Family *Alopiidae*	6	5	0	0	1	117	211	0	0	116	2	89
Scalloped Hammerhead	*Sphyrna lewini*	1	3	8	0	0	9	182	131	0	0	2	64
Grey Gummy	*Mustelus* sp.	0	27	21	0	0	0	100	82	0	0	10	61
* White Shark	*Carcharodon carcharias*	2	2	1	0	1	300	0	0	0	0	1	150

Appendix V cont.

Blacktip (whaler)	*Carcharhinus limbatus/tilstoni*	0	0	2	0	2	0	0	20	0	23	<1	21
*Manta ray/devil ray	Family Mobulidae	0	0	0	0	2	0	0	0	0	100	<1	20
*Broadnose Sevengill	*Notorynchus cepedianus*	0	1	0	0	0	0	9	0	0	0	<1	9
Dogfish (unspecified)	Family Squalidae	10	4	0	5	7	10	2	0	7	8	5	6
*Catshark (unspecified)	Family Scyliorhinidae	0	0	0	0	1	0	0	0	0	1	<1	<1
Total		12,378	14,486	8,812	8,984	11,574	85,584	92,248	58,167	68,920	70,482	11,247	75,080

(ii) Region 1

		Observed catch (no)					Observed catch (kg live wt.)					Mean annual catch	
Common Name	**Species Name**	**94/95**	**95/96**	**96/97**	**97/98**	**98/99**	**94/95**	**95/96**	**96/97**	**97/98**	**98/99**	**(no)**	**(kg)**
School Shark	*Galeorhinus galeus*	0	986	-	-	-	0	9,362	-	-	-	493	4,681
Gummy Shark	*Mustelus antarcticus*	44	1,371	-	-	-	222	8,693	-	-	-	708	4,457
Dusky Shark	*Carcharhinus obscurus*	106	212	-	-	-	623	1,829	-	-	-	159	1,226
*Port Jackson Shark	*Heterodontus portusjacksoni*	34	746	-	-	-	102	2,231	-	-	-	390	1,166
Smooth Hammerhead	*Sphyrna zygaena*	13	218	-	-	-	98	1,811	-	-	-	116	954
Whiskery Shark	*Furgaleus macki*	3	174	-	-	-	35	1,693	-	-	-	89	864
*Eagle Ray	Family Myliobatididae	132	69	-	-	-	528	276	-	-	-	101	402
Copper Shark	*Carcharhinus brachyurus*	1	34	-	-	-	58	664	-	-	-	18	361
* White Shark	*Carcharodon carcharias*	1	2	-	-	-	300	174	-	-	-	2	237
*Saw Shark (unspecified)	Family *Pristiophoridae*	0	90	-	-	-	0	262	-	-	-	45	131
Banded Wobbegong	*Orectolobus ornatus*	0	6	-	-	-	0	214	-	-	-	3	107
Wobbegong (unspecified)	Family Orectolobidae	0	8	-	-	-	0	155	-	-	-	4	77
*Angel Shark (unspecified)	Family Squatinidae	2	10	-	-	-	12	59	-	-	-	6	36
Pencil Shark	*Hypogaleus hyugaensis*	1	15	-	-	-	4	60	-	-	-	8	32
Spotted Wobbegong	*Orectolobus maculatus*	0	2	-	-	-	0	58	-	-	-	1	29
*Shovelnose/Fiddler Ray	Families Rhinobatidae & Rhynchobatidae	5	7	-	-	-	47	11	-	-	-	6	29
Grey Nurse Shark	*Carcharias taurus*	0	1	-	-	-	0	26	-	-	-	<1	13
*Broadnose Sevengill	*Notorynchus cepedianus*	0	1	-	-	-	0	9	-	-	-	<1	5
Total		342	3,952	-	-	-	2,027	27,586	-	-	-	2,147	14,807

Appendix V cont.

(iii) Region 2

Common Name	Species Name	Observed Catch (no)					Observed Catch (kg whole wt)					Mean annual catch	
		94/95	95/96	96/97	97/98	98/99	94/95	95/96	96/97	97/98	98/99	(no)	(kg)
Gummy Shark	*Mustelus antarcticus*	969	145	102	804	682	7,240	963	824	8,235	4,053	540	4,263
Dusky Shark	*Carcharhinus obscurus*	264	7	151	149	100	1,789	38	799	1,150	577	134	871
Whiskery Shark	*Furgaleus macki*	164	21	38	64	84	1,601	207	190	738	825	74	712
Smooth Hammerhead	*Sphyrna zygaena*	101	12	60	40	33	715	104	382	586	452	49	448
*Port Jackson Shark	*Heterodontus portusjacksoni*	122	33	30	35	188	365	99	90	105	562	82	244
*Eagle Ray	Family Myliobatididae	106	90	14	76	14	424	360	56	304	56	60	240
Copper Shark	*Carcharhinus brachyurus*	6	1	0	20	3	97	91	0	561	379	6	226
Pencil Shark	*Hypogaleus hyugaensis*	69	2	8	28	20	275	8	32	106	78	25	100
Longnose Grey/Spinner Shark	*Carcharhinus brevipinna*	24	0	1	7	1	199	0	7	67	12	7	57
* White Shark	*Carcharodon carcharias*	1	0	0	0	0	229	0	0	0	0	<1	46
*Angel Shark (unspecified)	Family Squatinidae	14	4	4	2	14	81	24	25	6	79	8	43
Banded Wobbegong	*Orectolobus ornatus*	0	0	0	1	5	0	0	0	17	191	1	42
Shortfin Mako	*Isurus oxyrinchus*	0	0	0	2	2	0	0	0	62	94	<1	31
Wobbegong (unspecified)	Family Orectolobidae	5	0	0	1	0	71	0	0	19	0	1	18
School Shark	*Galeorhinus galeus*	1	2	0	0	0	13	16	0	0	0	<1	14
Western Wobbegong	*Orectolobus sp.*	3	0	0	0	1	46	0	0	0	15	<1	12
*Saw Shark (unspecified)	Family *Pristiophoridae*	5	2	5	0	0	12	4	11	0	0	2	6
Grey Nurse Shark	*Carcharias taurus*	0	0	0	0	1	0	0	0	0	25	<1	5
Dogfish (unspecified)	Family Squalidae	0	0	0	4	0	0	0	0	6	0	<1	1
*Stingray (unspecified)	*Family Dasyatididae*	0	0	0	0	1	0	0	0	0	3	<1	<1
Total		1,854	319	413	1,233	1,149	13,156	1,914	2,417	11,961	7,403	994	7,370

Appendix V cont.

(iv) Region 3

Common Name	Species Name	Observed Catch (no) 94/95	95/96	96/97	97/98	98/99	Observed Catch (kg whole wt) 94/95	95/96	96/97	97/98	98/99	Mean annual catch (no)	(kg)
Gummy Shark	*Mustelus antarcticus*	611	372	187	296	946	5,995	2,793	1,483	2,447	7,830	482	4,110
Dusky Shark	*Carcharhinus obscurus*	416	151	679	550	232	2,808	872	4,000	4,120	1,933	406	2,747
Sandbar Shark	*Carcharhinus plumbeus*	25	451	45	20	139	210	3,503	402	195	1,451	136	1,152
Whiskery Shark	*Furgaleus macki*	22	76	86	115	0	1,781	183	643	749	984	60	868
Smooth Hammerhead	*Sphyrna zygaena*	100	30	87	55	79	767	201	753	562	994	70	656
Longnose Grey/Spinner Shark	*Carcharhinus brevipinna*	2	3	2	113	5	43	35	21	1,691	81	25	374
*Port Jackson Shark	*Heterodontus portusjacksoni*	180	106	93	50	92	538	317	278	150	275	104	312
*Eagle Ray	Family Myliobatididae	14	118	2	3	14	56	472	8	12	56	30	121
Copper Shark	*Carcharhinus brachyurus*	0	1	0	0	5	0	50	0	0	425	1	95
Wobbegong (unspecified)	Family Orectolobidae	6	13	0	0	0	85	252	0	0	0	4	67
Pencil Shark	*Hypogaleus hyugaensis*	8	27	2	12	11	31	105	8	46	44	12	47
Western Wobbegong	*Orectolobus sp.*	0	0	6	8	1	0	0	94	115	12	3	44
*Angel Shark (unspecified)	Family Squatinidae	8	11	7	2	3	48	65	41	12	14	6	36
Thresher Shark (unspecified)	Family *Alopiidae*	0	2	0	0	0	0	124	0	0	0	<1	25
Tiger Shark	*Galeocerdo cuvier*	0	0	1	0	0	0	0	111	0	0	<1	22
Spotted Wobbegong	*Orectolobus maculatus*	1	0	2	0	1	23	0	52	0	26	<1	20
Banded Wobbegong	*Orectolobus ornatus*	0	0	1	2	0	0	0	22	47	0	<1	14
School Shark	*Galeorhinus galeus*	0	0	0	0	1	0	0	0	0	13	<1	13
*Saw Shark (unspecified)	Family *Pristiophoridae*	2	1	11	3	1	6	3	33	9	3	4	11
*Cobbler Wobbegong	*Sutorectus tentaculatus*	1	0	0	1	1	10	0	0	10	10	<1	6
Grey Nurse Shark	*Carcharias taurus*	0	0	1	0	0	0	0	14	0	0	<1	3
*Stingray (unspecified)	*Family Dasyatididae*	1	3	0	0	0	3	9	0	0	0	<1	2
*Shovelnose/Fiddler Ray	Families Rhinobatidae & Rhynchobatidae	0	2	1	0	2	0	3	1	0	3	1	1
*Catshark (unspecified)	Family Scyliorhinidae	0	0	0	0	1	0	0	0	0	1	<1	<1
Total		1,397	1,367	1,213	1,230	1,534	12,403	8,987	7,965	10,166	14,155	1,348	10,735

Appendix V cont.

(v) Region 4

Common Name	Species Name	Observed Catch (no)					Observed Catch (kg whole wt)					Mean annual catch	
		94/95	95/96	96/97	97/98	98/99	94/95	95/96	96/97	97/98	98/99	(no)	(kg)
Dusky Shark	*Carcharhinus obscurus*	2,006	3,984	2,477	1,533	3,580	10,333	17,210	11,544	7,827	16,239	2,716	12,631
Whiskery Shark	*Furgaleus macki*	671	427	385	904	462	5,795	3,705	3,358	7,178	3,897	570	4,787
*Port Jackson Shark	*Heterodontus portusjacksoni*	1,492	1,180	993	1,417	2,835	4,461	3,528	2,969	4,237	8,477	1,583	4,734
Sandbar Shark	*Carcharhinus plumbeus*	28	451	421	297	289	208	3,352	4,339	1,845	2,774	297	2,503
Smooth Hammerhead	*Sphyrna zygaena*	147	204	133	258	446	1,479	2,280	1,244	2,919	4,575	238	2,499
Gummy Shark	*Mustelus antarcticus*	135	131	132	43	181	1,600	1,373	1,042	449	1,442	124	1,181
Longnose Grey/Spinner Shark	*Carcharhinus brevipinna*	28	16	14	173	177	394	198	196	1,727	1,681	82	839
Wobbegong (unspecified)	Family Orectolobidae	92	78	11	0	0	1,725	1,564	213	0	0	36	700
Copper Shark	*Carcharhinus brachyurus*	9	0	8	11	6	672	0	615	1,227	683	7	639
Banded Wobbegong	*Orectolobus ornatus*	3	0	22	19	24	84	0	810	742	1,040	14	535
Western Wobbegong	*Orectolobus sp.*	2	0	27	74	44	31	0	456	1,164	680	29	466
*Eagle Ray	Family Myliobatididae	48	59	38	221	124	192	236	152	884	496	98	392
Spotted Wobbegong	*Orectolobus maculatus*	6	24	7	10	8	157	524	171	358	298	11	302
*Angel Shark (unspecified)	Family Squatinidae	28	16	27	49	86	166	109	167	292	511	41	249
Pencil Shark	*Hypogaleus hyugaensis*	31	32	34	54	138	125	128	133	208	535	58	226
* White Shark	*Carcharodon carcharias*	0	0	1	0	1	0	0	870	0	229	<1	220
Blue Shark	*Prionace glauca*	0	0	0	1	2	0	0	0	53	207	<1	130
*Saw Shark (unspecified)	Family *Pristiophoridae*	5	24	4	13	185	13	52	9	28	455	46	111
Shortfin Mako	*Isurus oxyrinchus*	8	7	4	16	36	116	162	15	223	12	14	106
*Cobbler Wobbegong	*Sutorectus tentaculatus*	3	1	9	22	15	29	10	97	203	154	10	98
Grey Nurse Shark	*Carcharias taurus*	5	1	4	1	8	54	5	175	11	60	4	61
Thresher Shark (unspecified)	Family *Alopiidae*	5	1	0	0	1	98	43	0	0	116	1	51
*Shovelnose/Fiddler Ray	Families Rhinobatidae & Rhynchobatidae	13	20	2	0	19	122	31	3	0	28	11	37
Blacktip (whaler)	*Carcharhinus limbatus/tilstoni*	0	0	0	0	2	0	0	0	0	23	<1	23
*Manta ray/devil ray	Family Mobulidae	0	0	0	0	2	0	0	0	0	100	<1	20
*Stingray (unspecified)	*Family Dasyatididae*	11	2	3	1	14	33	6	9	3	42	6	19
Tiger Shark	*Galeocerdo cuvier*	0	0	0	0	1	0	0	0	0	46	<1	9
Dogfish (unspecified)	Family Squalidae	9	2	0	1	7	9	1	0	1	8	4	4
Total		4,785	6,660	4,756	5,118	8,693	27,896	34,517	28,585	31,576	44,807	6,002	33,476

Appendix V cont.

(vi) Region 5

Common Name	Species Name	Observed Catch (no) 94/95	95/96	96/97	97/98	98/99	Observed Catch (kg whole wt) 94/95	95/96	96/97	97/98	98/99	Mean annual catch (no)	(kg)
Dusky Shark	*Carcharhinus obscurus*	1,561	543	682	564	78	9,388	3,072	3,210	3,374	653	686	3,939
Sandbar Shark	*Carcharhinus plumbeus*	281	403	494	291	59	3,500	4,530	5,137	3,183	712	306	3,412
*Port Jackson Shark	*Heterodontus portusjacksoni*	694	1,121	710	450	265	2,075	3,352	2,123	1,346	792	648	1,938
Whiskery Shark	*Furgaleus macki*	296	57	330	179	91	2,655	509	3,202	1,651	766	191	1,757
Longnose Grey/Spinner Shark	*Carcharhinus brevipinna*	500	85	46	186	44	4,131	653	251	1,099	312	172	1,289
Smooth Hammerhead	*Sphyrna zygaena*	201	86	76	229	37	1,860	905	828	2,089	408	126	1,218
Wobbegong (unspecified)	Family Orectolobidae	86	98	4	0	0	1,693	1,904	77	0	0	38	735
Shortfin Mako	*Isurus oxyrinchus*	1	4	1	4	1	81	371	59	656	1,564	2	546
Copper Shark	*Carcharhinus brachyurus*	2	5	3	9	2	216	560	156	1,050	221	4	441
*Eagle Ray	Family Myliobatididae	150	70	117	124	9	600	280	468	496	36	94	376
Tiger Shark	*Galeocerdo cuvier*	3	5	4	5	1	163	538	399	594	126	4	364
Banded Wobbegong	*Orectolobus ornatus*	0	0	19	19	8	0	0	751	750	311	9	362
Western Wobbegong	*Orectolobus sp.*	5	0	29	27	33	77	0	425	413	458	19	275
*Angel Shark (unspecified)	Family Squatinidae	55	19	37	81	40	321	113	219	481	238	46	274
Spotted Wobbegong	*Orectolobus maculatus*	3	8	18	4	0	111	240	432	47	0	7	166
Gummy Shark	*Mustelus antarcticus*	17	15	3	87	2	121	84	10	554	24	25	159
Grey Nurse Shark	*Carcharias taurus*	5	9	7	1	4	60	249	74	11	123	5	103
*Stingray (unspecified)	*Family Dasyatididae*	111	20	6	0	5	333	60	18	0	15	28	85
*Shovelnose/Fiddler Ray	Families Rhinobatidae & Rhynchobatidae	23	38	19	3	15	215	58	26	29	22	20	70
Thresher Shark (unspecified)	Family *Alopiidae*	1	2	0	0	0	20	44	0	0	0	<1	13
*Saw Shark (unspecified)	Family *Pristiophoridae*	11	8	5	0	1	30	15	10	0	2	5	11
Pencil Shark	*Hypogaleus hyugaensis*	3	5	4	1	1	12	20	15	4	4	3	11
*Cobbler Wobbegong	*Sutorectus tentaculatus*	0	0	0	0	2	0	0	0	0	17	<1	3
Scalloped Hammerhead	*Sphyrna lewini*	0	0	1	0	0	0	0	9	0	0	<1	2
Dogfish (unspecified)	Family Squalidae	1	2	0	0	0	<1	1	0	0	0	<1	<1
Total		4,010	2,603	2,615	2,264	698	27,662	17,559	17,899	17,828	6,804	2,438	17,551

Appendix V cont.

(vii) Region 6

Common Name	Species Name	Observed Catch (no) 94/95	95/96	96/97	97/98	98/99	Observed Catch (kg whole wt) 94/95	95/96	96/97	97/98	98/99	Mean annual catch (no)	(kg)
Sandbar Shark	*Carcharhinus plumbeus*	280	186	52	-	-	4,831	4,071	1,371	-	-	173	3,425
Dusky Shark	*Carcharhinus obscurus*	133	205	283	-	-	811	1,969	2,216	-	-	207	1,665
Tiger Shark	*Galeocerdo cuvier*	7	12	21	-	-	492	764	884	-	-	13	713
Hammerhead (unspecified)	Family Sphyrnidae	0	0	59	-	-	0	0	690	-	-	20	690
Smooth Hammerhead	*Sphyrna zygaena*	2	36	0	-	-	184	536	1,232	-	-	13	651
Whiskery Shark	*Furgaleus macki*	6	123	41	-	-	46	986	356	-	-	57	462
Longnose Grey/Spinner Shark	*Carcharhinus brevipinna*	39	36	53	-	-	141	202	371	-	-	43	238
Wobbegong (unspecified)	Family Orectolobidae	8	14	15	-	-	103	265	290	-	-	12	219
Gummy Shark	*Mustelus antarcticus*	1	32	0	-	-	38	179	0	-	-	11	109
*Port Jackson Shark	*Heterodontus portusjacksoni*	87	18	0	-	-	260	54	0	-	-	35	105
Scalloped Hammerhead	*Sphyrna lewini*	1	3	7	-	-	9	182	122	-	-	4	104
Copper Shark	*Carcharhinus brachyurus*	0	4	0	-	-	0	250	0	-	-	1	83
Grey Nurse Shark	*Carcharias taurus*	0	4	0	-	-	0	206	0	-	-	1	69
Grey Gummy	*Mustelus* sp.	0	27	21	-	-	0	100	82	-	-	16	61
Pencil Shark	*Hypogaleus hyugaensis*	0	17	18	-	-	0	65	74	-	-	12	46
Spotted Wobbegong	*Orectolobus maculatus*	1	3	2	-	-	26	62	46	-	-	2	45
Banded Wobbegong	*Orectolobus ornatus*	0	2	1	-	-	0	33	30	-	-	1	21
*Eagle Ray	Family Myliobatididae	0	4	1	-	-	0	16	4	-	-	2	7
Blacktip (whaler)	*Carcharhinus limbatus/tilstoni*	0	0	2	-	-	0	0	20	-	-	<1	7
*Shovelnose/Fiddler Ray	Families Rhinobatidae & Rhynchobatidae	1	1	0	-	-	9	0	0	-	-	1	5
Total		566	727	576	-	-	6,949	9,943	7,787	-	-	623	8,226

Appendix V cont.

Research Observed Scalefish Catch, July 1994 – June 1999

(i) All regions

Common Name	Species Name	Observed Catch (no)					Observed Catch (kg whole wt)					Mean annual catch	
		94/95	95/96	96/97	97/98	98/99	94/95	95/96	96/97	97/98	98/99	(no)	(kg)
*Buffalo Bream	*Kyphosus cornelii*	384	866	186	258	358	2617	5901	1267	1758	2440	410	2797
West Australian Dhufish	*Glaucosoma hebraicum*	379	349	255	174	404	2947	2487	1909	1291	3016	312	2330
*Dusky Morwong	*Dactylophora nigricans*	304	288	155	234	312	2072	1963	1056	1595	2126	259	1762
Queen Snapper	*Nemadactylus valenciennesi*	490	750	419	478	376	1820	1720	951	1227	1756	503	1495
Blue Groper	*Achoerodus gouldii*	268	231	166	197	239	1681	1623	1033	1247	1548	220	1426
Pink Snapper	*Pagrus auratus*	167	225	182	158	471	425	591	491	444	1475	241	685
Samson Fish	*Seriola hippos*	48	52	8	19	71	763	576	98	312	917	40	533
Red snapper, Redfish, Nannygai	*Centroberyx spp.*	93	72	60	215	259	249	242	215	719	820	140	449
Boarfish (unspecified)	Family Pentacerotidae	207	247	114	142	484	346	384	217	279	980	239	441
Mulloway	*Argyrosomus hololepidotus*	71	31	10	29	13	794	329	162	385	190	31	372
Leatherjacket (unspecified)	Family Monacanthidae	73	142	62	115	132	253	492	183	370	416	105	343
Mackerel (unspecified)	Family Scombridae	2	19	5	13	551	5	23	12	60	1347	118	289
Yellow tailed kingfish	*Seriola lalandi*	28	24	16	17	3	426	393	194	310	110	18	287
Baldchin Groper	*Choerodon rubescens*	37	106	45	43	43	149	423	170	182	175	55	220
Yellowfin Tuna	*Thunnus albacares*	5	9	2	9	3	179	314	45	312	127	6	195
Painted sweetlips, sand snapper	*Diagramma pictum*	16	79	50	0	2	72	340	224	0	2	29	128
Knife Jaw	*Oplegnathus woodwardi*	49	106	75	126	226	53	99	74	129	253	116	122
Australian Salmon	*Arripis truttaceus*	41	7	7	14	2	190	33	35	79	10	14	69
Moonlighter	*Tilodon sexfasciatum*	36	51	46	45	62	187	37	31	32	44	48	66
Parrotfish (unspecified)	Family Scaridae	2	38	3	0	2	9	175	14	0	<1	9	50
Sea sweep	*Scorpis aequipinnis*	10	3	3	49	59	12	4	4	58	70	25	30
Southern Blue-fin Tuna	*Thunnus maccoyii*	7	2	4	5	4	33	11	26	25	24	4	24
Bonito	*Sarda australis*	0	4	7	10	30	0	10	11	15	70	10	21
Dory (unspecified)	Family Zeidae	6	14	5	5	44	8	22	7	5	62	15	21
Banded Sweep	*Scorpis georgianus*	21	22	14	25	41	17	16	8	30	27	25	20
Spanish mackerel	*Scomberomorus commerson*	0	3	5	6	0	0	16	34	38	0	3	18
Trevally (unspecified)	Family Carangidae	5	1	1	8	18	19	5	3	13	41	7	16
Spangled Emperor	*Lethrinus nebulosus*	1	9	0	0	0	6	56	0	0	0	2	12

Appendix V cont.

Breaksea Cod	*Epinephelides armatus*	6	9	1	1	9	12	18	2	2	19	5	11
*Sergeant Baker	*Aulopus purpurissatus*	9	5	3	2	6	11	5	3	2	6	5	5
Swallow Tail	*Centroberyx lineatus*	9	4	0	0	1	11	6	0	0	4	3	4
Sweetlip (unspecified)	*Family Haemulidae*	1	2	5	0	1	2	4	10	0	2	2	4
Flounder (unspecified)	Families Bothidae & Pleuronectidae	2	2	5	0	2	3	2	4	0	6	2	3
*Red-lipped Morwong	*Cheilodactylus rubrolabiatus*	0	6	0	0	1	0	14	0	0	1	1	3
Flathead	Family Platycephalidae	0	0	3	3	3	0	0	4	4	5	2	3
*North West Blowfish	*Lagocephalus scleratus*	0	14	3	0	0	0	11	2	0	0	3	3
*Gurnard Perch	*Neosebastes spp.*	1	9	1	0	0	<1	6	<1	0	0	2	2
Tailor	*Pomatomus saltatrix*	0	0	2	4	0	0	0	3	6	0	1	2
*Sea Carp, Cale	Family Aplodactylidae	0	2	0	1	3	0	2	0	3	1	1	1
Cobbler, Estuary Catfish	*Cnidoglanis macrocephalus*	0	1	4	0	3	0	1	2	0	2	2	1
Coral Trout	*Plectropomus leopardus* or *Cephalopholis miniata*	0	1	1	0	0	0	<1	4	0	0	<1	<1
*Gurnard	Family Triglidae	0	0	0	0	1	0	0	0	0	3	<1	<1
*Stargazer (unspecified)	Family Uranoscopidae	1	1	0	0	0	<1	<1	0	0	0	<1	<1
*Boxfish	Family Ostraciidae	1	3	0	1	2	<1	<1	0	<1	0	1	<1
Total Scalefish		2780	3809	1933	2406	4241	15371	18354	8508	10932	18095	3034	14252

(ii) Region 1

		Observed catch (no)					Observed catch (kg live wt.)					Mean annual catch	
Common Name	**Species Name**	**94/95**	**95/96**	**96/97**	**97/98**	**98/99**	**94/95**	**95/96**	**96/97**	**97/98**	**98/99**	**(no)**	**(kg)**
*Buffalo Bream	*Kyphosus cornelii*	0	215	-	-	-	0	1465	-	-	-	108	733
*Dusky Morwong	*Dactylophora nigricans*	4	37	-	-	-	27	252	-	-	-	21	140
Blue Groper	*Achoerodus gouldii*	0	35	-	-	-	0	243	-	-	-	18	122
Boarfish (unspecified)	Family Pentacerotidae	10	56	-	-	-	16	96	-	-	-	33	56
Queen Snapper	*Nemadactylus valenciennesi*	2	36	-	-	-	3	86	-	-	-	19	45
Mulloway	*Argyrosomus hololepidotus*	1	7	-	-	-	11	74	-	-	-	4	43
Red snapper, Redfish, Nannygai	*Centroberyx spp.*	0	18	-	-	-	0	66	-	-	-	9	33
Samson Fish	*Seriola hipos*	0	2	-	-	-	0	22	-	-	-	1	11
Knife Jaw	*Oplegnathus woodwardi*	0	10	-	-	-	0	9	-	-	-	5	5
Pink Snapper	*Pagrus auratus*	0	2	-	-	-	0	5	-	-	-	1	3
Banded Sweep	*Scorpis georgianus*	0	1	-	-	-	0	<1	-	-	-	1	0
Moonlighter	*Tilodon sexfasciatum*	0	1	-	-	-	0	<1	-	-	-	1	0
*Gurnard Perch	*Neosebastes spp.*	0	1	-	-	-	0	<1	-	-	-	1	0
Total		17	421	-	-	-	57	2318	-	-	-	219	1188

Appendix V cont.

(iii) Region 2

Common Name	Species Name	Observed Catch (no) 94/95	95/96	96/97	97/98	98/99	Observed Catch (kg whole wt) 94/95	95/96	96/97	97/98	98/99	Mean annual catch (no)	(kg)
*Dusky Morwong	*Dactylophora nigricans*	45.0	15.0	0.0	41.0	27.0	307.0	102.0	0.0	279.0	184.0	25.6	174.4
Queen Snapper	*Nemadactylus valenciennesi*	58.0	28.0	23.0	57.0	248.0	104.0	64.0	47.0	139.0	506.0	82.8	172.0
Pink Snapper	*Pagrus auratus*	5.0	0.0	1.0	17.0	184.0	13.0	0.0	3.0	47.0	576.0	41.4	127.8
Blue Groper	*Achoerodus gouldii*	6.0	11.0	4.0	25.0	24.0	30.0	68.0	26.0	193.0	156.0	14.0	94.6
Boarfish (unspecified)	Family Pentacerotidae	31.0	8.0	5.0	38.0	160.0	45.0	14.0	10.0	73.0	324.0	48.4	93.2
Red Snapper, Redfish, Nannygai	*Centroberyx spp.*	26.0	1.0	0.0	16.0	79.0	54.0	2.0	0.0	53.0	250.0	24.4	71.8
Samson Fish	*Seriola hipos*	4.0	0.0	0.0	0.0	4.0	64.0	0.0	0.0	0.0	52.0	1.6	23.2
*Buffalo Bream	*Kyphosus cornelii*	2.0	4.0	1.0	1.0	7.0	14.0	27.0	7.0	7.0	48.0	3.0	20.6
Leatherjacket (unspecified)	Family Monacanthidae	2.0	0.0	0.0	0.0	22.0	6.0	0.0	0.0	0.0	69.0	4.8	15.0
Australian Salmon	*Arripis truttaceus*	11.0	0.0	0.0	0.0	0.0	51.0	0.0	0.0	0.0	0.0	2.2	10.2
Southern Blue-fin Tuna	*Thunnus maccoyii*	6.0	0.0	0.0	1.0	2.0	30.0	0.0	0.0	6.0	11.0	1.8	9.4
Trevally (unspecified)	Family Carangidae	1.0	1.0	0.0	0.0	15.0	4.0	4.0	0.0	0.0	34.0	3.4	8.4
West Australian Dhufish	*Glaucosoma hebracium*	4.0	0.0	0.0	0.0	0.0	31.0	0.0	0.0	0.0	0.0	0.8	6.2
Mulloway	*Argyrosomus hololepidotus*	2.0	0.0	0.0	0.0	0.0	22.0	0.0	0.0	0.0	0.0	0.4	4.4
Knife Jaw	*Oplegnathus woodwardi*	3.0	0.0	0.0	0.0	8.0	3.0	0.0	0.0	0.0	9.0	2.2	2.4
Moonlighter	*Tilodon sexfasciatum*	2.0	0.0	0.0	0.0	11.0	1.0	0.0	0.0	0.0	8.0	2.6	1.8
Bonito	*Sarda australis*	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	8.0	0.8	1.6
Dory (unspecified)	Family Zeidae	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	5.0	<1	1.0
*Gurnard	Family Triglidae	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	3.0	<1	0.6
*Sergeant Baker	*Aulopus purpurissatus*	2.0	0.0	0.0	2.0	0.0	2.0	0.0	0.0	2.0	0.0	<1	<1
Mackerel (unspecified)	Family Scombridae	2.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	<1	<1
Swallow Tail	*Centroberyx lineatus*	2.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	<1	<1
Banded Sweep	*Scorpis georgianus*	1.0	0.0	0.0	0.0	0.0	<1	0.0	0.0	0.0	0.0	<1	<1
*Gurnard Perch	*Neosebastes spp.*	1.0	0.0	0.0	0.0	0.0	<1	0.0	0.0	0.0	0.0	<1	<1
Total Scalefish		216	68	34	198	800	788	281	93	799	2243	263	841

Appendix V cont.

(iv) Region 3

Common Name	Species Name	Observed Catch (no) 94/95	95/96	96/97	97/98	98/99	Observed Catch (kg whole wt) 94/95	95/96	96/97	97/98	98/99	Mean annual catch (no)	(kg)
Queen Snapper	*Nemadactylus valenciennesi*	212	53	202	56	159	462	116	451	152	400	136	316
Blue Groper	*Achoerodus gouldii*	54	31	53	7	5	362	236	345	60	32	30	207
Boarfish (unspecified)	Family Pentacerotidae	21	42	13	4	73	48	85	28	8	147	31	63
Pink Snapper	*Pagrus auratus*	5	13	22	6	48	12	35	62	17	184	19	62
*Buffalo Bream	*Kyphosus cornelii*	13	19	2	6	2	89	129	14	41	14	8	57
Red Snapper, Redfish, Nannygai	*Centroberyx spp.*	9	6	4	3	51	25	16	14	11	158	15	45
*Dusky Morwong	*Dactylophora nigricans*	7	5	8	7	2	48	34	55	48	14	6	40
West Australian Dhufish	*Glaucosoma hebracium*	4	1	1	3	4	44	17	7	26	28	3	25
Samson Fish	*Seriola hipos*	7	2	0	0	0	143	43	0	0	0	2	37
Leatherjacket (unspecified)	Family Monacanthidae	2	0	0	1	23	6	0	0	3	73	5	16
Yellow tailed kingfish	*Seriola lalandi*	1	2	0	0	0	17	33	0	0	0	<1	10
Knife Jaw	*Oplegnathus woodwardi*	5	9	2	0	25	7	7	2	0	28	8	9
Mulloway	*Argyrosomus hololepidotus*	0	0	2	0	0	0	0	37	0	0	<1	7
Trevally (unspecified)	Family Carangidae	2	0	0	0	8	8	0	0	0	18	2	5
Mackerel (unspecified)	Family Scombridae	0	0	0	0	10	0	0	0	0	25	2	5
Moonlighter	*Tilodon sexfasciatum*	10	2	0	0	2	7	1	0	0	1	3	2
Southern Blue-fin Tuna	*Thunnus maccoyii*	0	2	0	0	0	0	11	0	0	0	<1	2
Australian Salmon	*Arripis truttaceus*	0	1	0	0	0	0	5	0	0	0	<1	<1
*Sergeant Baker	*Aulopus purpurissatus*	2	0	0	0	0	2	0	0	0	0	<1	<1
*Gurnard Perch	*Neosebastes spp.*	0	3	0	0	0	0	2	0	0	0	<1	<1
Bonito	*Sarda australis*	0	0	0	1	0	0	0	0	2	0	<1	<1
Breaksea Cod	*Epinephelides armatus*	0	1	0	0	0	0	2	0	0	0	<1	<1
Banded Sweep	*Scorpis georgianus*	0	0	0	0	0	0	0	2	0	0	0	<1
Swallow Tail	*Centroberyx lineatus*	1	0	0	0	0	<1	0	0	0	0	<1	<1
*Gurnard	Family Triglidae	0	0	0	0	4	0	0	0	0	<1	<1	<1
*Boxfish	Family Ostraciidae	0	1	0	0	0	<1	0	0	0	0	<1	<1
Total		355	193	309	94	416	1279	772	1015	368	1122	273	911

Appendix V cont.

(v) Region 4

Common Name	Species Name	Observed Catch (no)					Observed Catch (kg whole wt)					Mean annual catch	
		94/95	95/96	96/97	97/98	98/99	94/95	95/96	96/97	97/98	98/99	(no)	(kg)
*Buffalo Bream	*Kyphosus cornelii*	159	427	56	201	229	1,083	2,910	382	1,370	1,560	214	1,461
West Australian Dhufish	*Glaucosoma hebracium*	214	156	126	99	348	1,690	1,208	1,007	765	2,600	189	1,454
*Dusky Morwong	*Dactylophora nigricans*	149	166	83	131	266	1,015	1,131	566	893	1,813	159	1,083
Blue Groper	*Achoerodus gouldii*	172	117	99	134	193	1,064	831	630	787	1,187	143	900
Queen Snapper	*Nemadactylus valenciennesi*	441	608	175	372	371	885	1,119	359	711	710	393	757
Pink Snapper	*Pagrus auratus*	69	93	116	116	236	184	225	309	317	707	126	348
Samson Fish	*Seriola hipos*	30	15	2	14	66	421	142	24	189	852	25	326
Red Snapper, Redfish, Nannygai	*Centroberyx spp.*	34	40	53	196	128	104	134	192	654	409	90	299
Leatherjacket (unspecified)	Family Monacanthidae	59	109	47	93	81	212	406	160	329	260	78	273
Mackerel (unspecified)	Family Scombridae	0	11	0	8	537	0	20	0	15	1,315	111	270
Boarfish (unspecified)	Family Pentacerotidae	107	124	86	96	250	177	164	168	186	508	133	240
Mulloway	*Argyrosomus hololepidotus*	9	11	3	29	13	103	131	46	385	190	13	171
Yellow tailed kingfish	*Seriola lalandi*	18	1	1	17	3	261	13	14	310	110	8	141
Knife Jaw	*Oplegnathus woodwardi*	40	81	70	124	191	42	77	70	127	214	101	106
Baldchin Groper	*Choerodon rubescens*	10	6	7	3	33	39	19	32	11	134	12	47
Moonlighter	*Tilodon sexfasciatum*	17	22	30	36	47	77	16	19	25	33	30	34
Australian Salmon	*Arripis truttaceus*	30	3	7	2	2	139	17	35	10	10	9	42
Sea sweep	*Scorpis aequipinnis*	10	1	3	49	58	12	1	4	58	69	24	29
Dory (unspecified)	Family Zeidae	5	10	5	4	39	7	15	7	4	54	13	17
Bonito	*Sarda australis*	0	2	0	3	26	0	6	0	7	62	6	15
Banded Sweep	*Scorpis georgianus*	16	14	10	25	40	12	9	6	13	27	21	13
Southern Blue-fin Tuna	*Thunnus maccoyii*	0	0	4	1	2	0	0	26	7	14	1	9
Painted sweetlips, sand snapper	*Diagramma pictum*	0	10	0	0	2	0	43	0	0	2	2	9
Trevally (unspecified)	Family Carangidae	2	1	1	8	7	7	5	3	13	16	4	9
Spanish mackerel	*Scomberomorus commerson*	0	0	0	6	0	0	0	0	38	0	1	8
Breaksea Cod	*Epinephelides armatus*	4	4	1	1	8	8	6	2	2	17	4	7
Parrotfish (unspecified)	Family Scaridae	2	0	0	0	2	9	0	0	0	<1	<1	2
Flathead	Family Platycephalidae	0	0	3	2	2	0	0	4	4	4	2	2
*Sergeant Baker	*Aulopus purpurissatus*	3	1	2	0	4	3	1	2	0	5	2	2
*Sea Carp, Cale	Family Aplodactylidae	0	2	0	1	3	0	2	0	3	1	1	2
Flounder (unspecified)	Families Bothidae & Pleuronectidae	1	1	0	0	2	1	1	0	0	6	<1	2
*Red-lipped Morwong	*Cheilodactylus rubrolabiatus*	0	3	0	0	1	0	7	0	0	1	<1	2
Spangled Emperor	*Lethrinus nebulosus*	1	0	0	0	0	6	0	0	0	0	1	1
Cobbler, Estuary Catfish	*Cnidoglanis macrocephalus*	0	1	4	0	3	0	1	2	0	2	3	1

Appendix V cont.

Swallow Tail	*Centroberyx lineatus*	0	0	0	0	0	0	1	0	0	3	0	<1
*Gurnard Perch	*Neosebastes spp.*	0	2	0	0	0	0	1	0	0	0	<1	<1
*Boxfish	Family Ostraciidae	1	1	0	0	2	<1	0	0	<1	0	<1	<1
Total		1603	2043	994	1771	3195	7562	8662	4068	7230	12894	1921	8083

(vi) Region 5

		Observed Catch (no)					Observed Catch (kg whole wt)					Mean annual catch	
Common Name	**Species Name**	**94/95**	**95/96**	**96/97**	**97/98**	**98/99**	**94/95**	**95/96**	**96/97**	**97/98**	**98/99**	**(no)**	**(kg)**
West Australian Dhufish	*Glaucosoma hebracium*	141	156	109	72	52	1,061	1,007	763	499	387	106	744
*Buffalo Bream	*Kyphosus cornelii*	175	75	119	50	120	1,193	511	811	341	818	108	735
*Dusky Morwong	*Dactylophora nigricans*	97	63	64	55	17	661	429	436	375	116	59	403
Queen Snapper	*Nemadactylus valenciennesi*	194	155	54	83	25	388	333	123	170	63	102	215
Yellowfin Tuna	*Thunnus albacares*	3	9	2	9	3	109	314	45	312	127	5	181
Blue Groper	*Achoerodus gouldii*	36	36	10	31	17	200	260	85	212	113	26	174
Baldchin Groper	*Choerodon rubescens*	24	83	33	40	10	98	340	120	171	41	38	154
Mulloway	*Argyrosomus hololepidotus*	59	2	5	0	0	657	21	80	0	0	13	152
Yellow tailed kingfish	*Seriola lalandi*	9	19	14	0	0	149	314	163	0	0	8	125
Samson Fish	*Seriola hippos*	7	14	3	5	1	136	165	37	123	13	6	95
Pink Snapper	*Pagrus auratus*	81	35	37	19	3	201	92	102	62	8	35	93
Painted sweetlips, sand snapper	*Diagramma pictum*	0	43	4	0	0	0	187	20	0	0	9	41
Leatherjacket (unspecified)	Family Monacanthidae	10	33	15	21	6	30	87	24	38	14	17	38
Moonlighter	*Tilodon sexfasciatum*	7	26	16	9	2	102	19	12	7	2	12	28
Boarfish (unspecified)	Family Pentacerotidae	38	17	10	4	1	61	25	11	13	1	14	22
Red snapper, Redfish, Nannygai	*Centroberyx spp.*	24	7	3	0	1	66	24	9	0	3	7	21
Australian Salmon	*Arripis truttaceus*	0	3	0	12	0	0	11	0	69	0	3	16
Mackerel (unspecified)	Family Scombridae	0	8	5	5	4	0	3	12	45	7	4	14
Trevally (unspecified)	Family Carangidae	2	3	1	15	2	6	14	3	24	5	5	10
Spanish mackerel	*Scomberomorus commerson*	0	3	5	0	0	0	16	34	0	0	2	10
Banded Sweep	*Scorpis georgianus*	4	6	4	0	1	3	6	0	17	0	3	5
Tailor	*Pomatomus saltatrix*	0	0	2	4	0	0	0	3	6	0	1	5
Bonito	*Sarda australis*	0	2	7	6	0	0	4	11	6	0	3	4
Sweetlip (unspecified)	*Family Haemulidae*	1	2	5	0	1	2	4	10	0	2	2	3
Parrotfish (unspecified)	Family Scaridae	0	2	1	0	0	0	11	6	0	0	<1	3
Breaksea Cod	*Epinephelides armatus*	2	4	0	0	1	4	10	0	0	2	1	3
Southern Blue-fin Tuna	*Thunnus maccoyii*	1	0	0	3	0	3	0	0	13	0	<1	3
Knife Jaw	*Oplegnathus woodwardi*	1	6	3	2	2	1	6	3	2	2	3	3
Swallow Tail	*Centroberyx lineatus*	6	4	0	0	1	7	5	0	0	<1	2	3

Dory (unspecified)	Family Zeidae	1	4	0	1	1	1	7	0	2	2	1	2
*Sergeant Baker	*Aulopus purpurissatus*	2	4	1	0	2	3	4	1	0	1	2	2
*Red-lipped Morwong	*Cheilodactylus rubrolabiatus*	0	3	0	0	0	0	7	0	0	0	<1	1
Flounder (unspecified)	Families Bothidae & Pleuronectidae	1	1	5	0	0	1	<1	4	0	0	1	1
*North West Blowfish	*Lagocephalus scleratus*	0	7	1	0	0	0	5	<1	0	0	2	1
Sea sweep	*Scorpis aequipinnis*	0	1	0	0	1	0	2	0	0	1	<1	<1
*Gurnard Perch	*Neosebastes spp.*	0	3	1	0	0	0	1	<1	0	0	<1	<1
Flathead	Family Platycephalidae	0	0	0	1	1	0	0	0	<1	1	1	<1
Coral Trout	*Plectropomus leopardus* or *Cephalopholis miniata*	0	1	0	0	0	0	<1	0	0	0	1	<1
*Stargazer (unspecified)	Family Uranoscopidae	1	1	0	0	0	<1	<1	0	0	0	<1	<1
*Boxfish	Family Ostraciidae	0	1	0	1	0	0	<1	0	<1	0	<1	<1
Total		927	842	539	448	275	5143	4247	2928	2506	1730	606	3311

(vii) Region 6

		Observed Catch (no)					Observed Catch (kg whole wt)					Mean annual catch	
Common Name	**Species Name**	**94/95**	**95/96**	**96/97**	**97/98**	**98/99**	**94/95**	**95/96**	**96/97**	**97/98**	**98/99**	**(no)**	**(kg)**
*Buffalo Bream	*Kyphosus cornelii*	35	126	8	-	-	239	859	55	-	-	56	384
West Australian Dhufish	*Glaucosoma hebracium*	16	36	19	-	-	120	255	131	-	-	24	169
Painted sweetlips, sand snapper	*Diagramma pictum*	16	26	46	-	-	72	110	204	-	-	29	129
Pink Snapper	*Pagrus auratus*	7	82	6	-	-	17	234	16	-	-	32	89
Samson Fish	*Seriola hipos*	0	19	3	-	-	0	204	37	-	-	7	80
Parrotfish (unspecified)	Family Scaridae	0	36	2	-	-	0	164	8	-	-	13	57
Mulloway	*Argyrosomus hololepidotus*	0	11	0	-	-	0	104	0	-	-	4	35
Baldchin Groper	*Choerodon rubescens*	3	16	5	-	-	11	65	18	-	-	8	32
Yellowfin Tuna	*Thunnus albacares*	2	0	0	-	-	70	0	0	-	-	<1	23
Spangled Emperor	*Lethrinus nebulosus*	0	9	0	-	-	0	56	0	-	-	9	19
Yellow tailed kingfish	*Seriola lalandi*	0	2	1	-	-	0	33	17	-	-	1	17
*Dusky Morwong	*Dactylophora nigricans*	2	2	0	-	-	14	14	0	-	-	1	9
Blue Groper	*Achoerodus gouldii*	0	1	0	-	-	0	9	0	-	-	<1	3
Queen Snapper	*Nemadactylus valenciennesi*	0	3	0	-	-	0	7	0	-	-	1	2
Coral Trout	*Plectropomus leopardus* or *Cephalopholis miniata*	0	0	1	-	-	0	0	4	-	-	1	1
Banded Sweep	*Scorpis georgianus*	0	1	0	-	-	<1	0	0	-	-	<1	<1
Sea sweep	*Scorpis aequipinnis*	0	1	0	-	-	0	1	0	-	-	<1	<1
Total		81	371	91	-	-	543	2114	490	-	-	181	1049

List of Fisheries Research Reports

Not all have been listed here, a complete list is available online at http://www.fish.wa.gov.au/res

83 The Western Rock Lobster fishery 1985/86. Brown, R.S. and Barker, E.H. (1990.)

84 The Marine open shelf environment: review of human influences. Hancock, D.A. (1990.)

85 A Description of the British United Trawlers / Southern Ocean Trawlers operation in the Great Australian Bight during the period 19.11.77 to 28.5.79. Walker, M.H., Blight, S.J. and Clarke, D.P. (1989.)

86 The Demersal trawl resources of the Great Australian Bight as indicated by the fishing operations of the stern trawlers Othello, Orsino and Cassio in the period 19.11.77 to 28.5.79. Walker, M.H. and Clarke, D.P. (1990.)

87 The recreational marron fishery in Western Australia summarised research statistics, 1971–1987. Morrissy, N.M. and Fellows, C.J. (1990.)

88 A synopsis of the biology and the exploitation of the Australasian pilchard, *Sardinops neopilchardus* (Steindachner). Part 1: Biology. Fletcher, W.J. (1990.)

89 Relationships among partial and whole lengths and weights for Western Australian pink snapper *Chrysophrys auratus* (Sparidae). Moran, M.J. and Burton, C. (1990.)

90 A Summary of projects financed by the Fisheries Research and Development Fund 1965–1983. (1991.)

91 A synopsis of the biology and the exploitation of the Australasian pilchard, *Sardinops neopilchardus* (Steindachner) Part II : History of stock assessment and exploitation. Fletcher, W.J. (1991.)

92 Spread of the introduced yabbie *Cherax albidus* Clark, 1936 in Western Australia. Morrissy, N.M. and Cassells, G. (1992.)

93 Biological synopsis of the black bream, *Acanthopagrus butcheri* (Munro) (Teleostei: Sparidae). Norriss, J.V., Tregonning, J.E., Lenanton, R.C.J. and Sarre, G.A. (2002.)

94 to 98 No reports were published under these numbers.

99 An Investigation of weight loss of marron *(Cherax tenuimanus)* during live transport to market. Morrissy, N.; Walker, P.; Fellows, C.; Moore, W. (1993.)

100 The Impact of trawling for saucer scallops and western king prawns on the benthic communities in coastal waters off south-western Australia. (FRDC final report 90/019) Laurenson, L.B.J., Unsworth, P., Penn, J.W. and Lenanton, R.C.J. (1993.)

101 The Big Bank region of the limited entry fishery for the western rock lobster *Panulirus cygnus*. Chubb, C.F., Barker, E.H. and Dibden, C.J. (1994.)

102 A Review of international aquaculture development and selected species in environments relevant to Western Australia. Lawrence, C.S. (1995.)

103 Identifying the developmental stages for eggs of the Australian pilchard, *Sardinops sagax*. White, K.V. and Fletcher, W.J. (Warrick Jeffrey) (1998.)

104 Assessment of the effects of a trial period of unattended recreational netting in selected estuaries of temperate Western Australia. Lenanton, R.C., Allison, R. and Ayvazian, S.G. (1996.)

105 The western rock lobster fishery 1986/7 to 1990/91. Chubb, C.F., Barker, E.H.and Brown, R.S. (1996.)

106 Environmental and biological aspects of the mass mortality of pilchards (Autumn 1995) in Western Australia. Fletcher, W.J., Jones, B., Pearce, A.F. and Hosja, W. (1997.)

107 Chemical composition of yabbies, *Cherax albidus* Clark 1936 from Western Australian farm dams. Francesconi, K.A. and Morrissy, N.M. (1996.)

108 Aspects of the biology and stock assessment of the whitebait, *Hyperlophus vittatus*, in south western Australia. Gaughan, D.J., Fletcher, W.J., Tregonning, R.J. and Goh, J. (1996.)

109 The western rock lobster fishery 1991/92 to 1992/93. Chubb, C.F. and Barker, E.H. (1998.)

110 A Research vessel survey of bottom types in the area of the Abrolhos Islands and mid-west trawl fishery. Dibden, C.J. and Joll, L.M. (1998.)

111 Sea temperature variability off Western Australia 1990 to 1994. Pearce, A., Rossbach, M., Tait, M. and Brown, R. (1999.)

112 Final report, FRDC project 94/075: enhancement of yabbie production from Western Australian farm dams. Lawrence, C., Morrissy, N., Bellanger, J. and Cheng, Y. W. (1998.)

113 Catch, effort and the conversion from gill nets to traps in the Peel-Harvey and Cockburn Sound blue swimmer crab *(Portunus pelagicus)* fisheries. Melville-Smith, R., Cliff, M. and Anderton, S.M. (1999.)

114 The Western Australian scallop industry. Harris, D.C., Joll, L.M. and Watson, R.A. (1999.)

115 Statistical analysis of Gascoyne region recreational fishing study July 1996. Sumner, N.R. and Steckis, R.A. (1999.)

116 The western rock lobster fishery 1993/94 to 1994/95 Chubb, C.F. and Barker, E.H. (2000.)

117 A 12-month survey of coastal recreational boat fishing between Augusta and Kalbarri on the west coast of Western Australia during 1996-97. Sumner, N.R. and Williamson, P.C. (1999.)

118 A study into Western Australia's open access and wetline fisheries. Crowe, F., Lehre, W. and Lenanton, R.J.C. (1999.)

119 Final report : FRDC project 95/037 : The biology and stock assessment of the tropical sardine, *Sardinella lemuru*, off the mid-west coast of Western Australia. Gaughan, D.J. and Mitchell, R.W.D. (2000.)

120 A 12 month survey of recreational fishing in the Leschenault Estuary of Western Australia during 1998. Malseed, B. E., Sumner, N.R. and Williamson, P.C. (2000.)

121 Synopsis of the biology and exploitation of the blue swimmer crab, *Portunus pelagicus* Linnaeus, in Western Australia. Kangas, M.I. (2000.)

122 Western rock lobster mail surveys of licensed recreational fishers 1986/87 to 1998/99. Melville-Smith, R. and Anderton, S.M. (2000.)

123 Review of productivity levels of Western Australian coastal and estuarine waters for mariculture planning purposes. CDRom in back pocket has title "Chlorophyll-a concentration in Western Australian coastal waters - a source document. by S. Helleren and A. Pearce" (document in PDF format) Pearce, A., Helleren, S. and Marinelli, M. (2000.)

124 The Evaluation of a recreational fishing stock enhancement trial of black bream *(Acanthopagrus butcheri)* in the Swan River, Western Australia. Dibden, C.J., Jenkins, G., Sarre, G.A., Lenanton, R.C.J. and Ayvazian, S.G. (2000.)

125 A history of foreign fishing activities and fishery-independent surveys of the demersal finfish resources in the Kimberley region of Western Australia. [Part funded by Fisheries Research and Development Corporation Project 94/026] Nowara, G.B. and Newman, S.J. (2001.)

126 A 12 month survey of recreational fishing in the Swan-Canning Estuary Basin of Western Australia during 1998-99. Malseed, B.E. and Sumner, N.R. (2001.)

127 A 12 month survey of recreational fishing in the Peel-Harvey Estuary of Western Australia during 1998-99. Malseed, B.E. and Sumner, N.R. (2001.)

128 Aquaculture and related biological attributes of abalone species in Australia - a review. Freeman, K.A. (2001.)

129 Morpholgy and incidence of yabby *(Cherax albidus)* burrows in Western Australia. Lawrence, C.S., Brown, J.I. and Bellanger, J.E. (2001.)

130 Environmental requirements and tolerences of rainbow trout *(Oncorhynchus mykiss)* and brown trout *(Salmo trutta)* with special reference to Western Australia : a review. Molony, B. (2001.)

131 Pilchard *(Sardinops sagax)* nursery areas and recruitment process assessment between different regions in southern Western Australia. Gaughan, D.J., Baudains, G.A., Mitchell, R.W.D. and Leary, T.I. (2002.)

132 A review of food availability, sea water characteristics and bivalve growth performance occuring at coastal culture sites in temperate and warm temperate regions of the world. Saxby, S.A. (2002.)

133 Preliminary assessment and seasonal fluctuations in the fish biota inhabiting the concentrator ponds of Dampier Salt, Port Hedland, with options for the potential application of results. Molony, B. and Parry, G. (2002.)

134 Towards an assessment of the natural and human use impacts on the marine environment of the Abrolhos Islands. Volume 1, Summary of existing information and current levels of human use. CDRom in back pocket has the title "Abrolhos Habitat Survey". Webster, F.J., Dibden, C.J., Weir, K.E. and Chubb, C.F. (2002.) Volume 2, Strategic research and develoment plan. Chubb, C.F., Webster, F.J., Dibden, C.J. and Weir, K.E. (2002.)

135 The western rock lobster fishery 1995/96 to 1996/97. Chubb, C.F. and Barker, E.H. (2002.)

136 Assessment of gonad staging systems and other methods used in the study of the reproductive biology of narrow-barred Spanish mackerel , *Scomberomorus commerson*, in Western Australia. Mackie, M. and Lewis, P. (2001.)

137 Annual report on the monitoring of the recreational marron fishery in 2000, with an analysis of long-term data and changes within this fishery. Molony, B. and Bird, C. (2002.)

138 Historical diving profiles for pearl oyster divers in Western Australia. Lulofs, H.M.A. and Sumner, N.R. (2002.)

139 A 12-month survey of recreational fishing in the Gascoyne bioregion of Western Australia during 1998-99. Sumner, N.R., Willimson, P.C. and Malseed, B.E. (2002.)

140 The western rock lobster fishery 1997/98 to 1998/99. Chubb, C.F. and Barker, E.H. (2003.)

141 A guide to good otolith cutting. Jenke, J. (2002.)

142 Identifying the developmental stages of preserved eggs of snapper, Pagrus auratus, from Shark Bay, Western Australia. Norriss, J. V. and Jackson G. (2002.)

143 Methods used in the collection, preparation and interpretation of narrow-barred Spanish mackerel (Scomberomorus commerson) otoliths for a study of age and growth in Western Australia. Lewis P. D. and Mackie, M. (2003.)

144 FRDC Project 1998/302 – Rock Lobster Enhancement and Aquaculture Subprogram: Towards establishing techniques for large scale harvesting of pueruli and obtaining a better understanding of mortality rates. Phillips B. F. (2003.)