Shark and other chondrichthyan byproduct and bycatch estimation in the Southern and Eastern Scalefish and Shark Fishery

Terence I. Walker and Anne S. Gason

State Government Victoria
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NON-TECHNICAL SUMMARY

2001/007 Shark & other chondrichthyan byproduct & bycatch estimation in the Southern and Eastern Scalefish and Shark Fishery

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Objectives

1. Summarise retained and discarded catches and length-frequency data on sharks, rays and holocephalans from the Integrated Scientific Monitoring Program (ISMP) database.
2. Estimate spatial and temporal trends in catches and abundance of sharks, rays and holocephalans using data from the ISMP database and from the SEF catch and effort database.
3. Identify implications and requirements for species management, fishery bycatch action plans, and FAO's International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks).
4. Evaluate impact on the ISMP data and catch and effort data collection following adoption of the shark field guide to sharks and rays caught in Australian waters.

Non-Technical Summary

The project met all four objectives completely and the outputs from the project are important inputs for the management of byproduct and bycatch.

Data from the Integrated Scientific Monitoring Program (ISMP) and from fisher logbooks were analysed for the South Eastern Trawl Fishery (SETF) during 1994–06, the Great Australian Bight Trawl Fishery (GABTF) during 2000–06, and, where available, the Gillnet Hook and Trap Fishery (GHATF) during 2000–06. The project delivered several important outputs.

1. The project provides mean annual estimates of retained catches (byproduct) and discarded catches (bycatch) for all species of sharks, rays and holocephalans in the SETF, GABTF and GHATF for the period 2000–06. These results complement estimates of retained and discarded catches made for the GHATF shark gillnet method and GHATF longline method as part of FRDC Project 1999/103 (Sawshark and elephant fish assessment and bycatch evaluation in the Southern Shark Fishery) cover all chondrichthyan species caught in the Southern and Eastern Scalefish and Shark Fishery (SESSF).
2. The project provides trends in standardised catch per unit effort (CPUE) for the SETF during 1994–06 and the GABTF during 2000–06 for interpretation as trends in relative abundance of species of sharks, rays and holocephalans or trends in changing fishing practices such as re-targeting.
3. The project provides distributional maps displaying spatial variation in standardised CPUE from the SETF and GABTF mostly the period 2000–06 for interpretation as spatial variation in relative abundance of species of sharks, rays and holocephalans or spatial variation in fishing practices such as targeting.
4. The complex process for data management and analysis developed to produce these outputs provides a basis for future ready update of the results for sharks, rays and holocephalans and for processing similar data available for non-chondrichthyan species.

5. The project provides a basis for classing the abundance of chondrichthyan species as 'abundant', 'common', 'sparse' or 'rare'. This is an important input to FRDC Project 2002/033 (Rapid assessment of ecological risk for chondrichthyan species from the effects of fishing).
6. The project provides a basis for classing trend in standardised CPUE as 'increasing', 'decreasing', 'no trend', or 'indeterminable' also an important input to FRDC Project 2002/033.

Estimates of mean annual CPUE and catch are provided for 131 chondrichthyan species (72 shark, 47 ray and 12 holocephalan species) identified mostly to species with some identified to genus or family; the list includes both species distributed predominantly in southern and eastern Australian waters and species distributed predominantly outside this region but sampled by the ISMP within this region.

The overall mean annual chondrichthyan catch estimate during 2000–06 for southern and eastern Australia from eight fishing methods is at 6467 tonnes: 3731 t of shark species (58%), 2641 t of ray species (41%), and 95 t of holocephalan species (1%). The highest chondrichthyan catch was provided by SETF otter trawl (4377 t, 66%) followed by GABTF otter trawl (1468 t, 22%), SETF Danish seine (560 t, 9%), GHATF scalefish longline (112 t, 2%), and GHATF automatic longline (72 t, 1%). The three other methods of GHATF trap, GHATF dropline, GHATF scalefish longline, and GHATF scalefish gillnet together provided a negligible catch (7 t, 0%).

About two-thirds of the overall chondrichthyan catch comprises only 14 species. Spikey spurdog (*Squalus megalops*) (11%), greenback stingaree (*Urolophus viridis*) (7%), whitefin swell shark (*Cephaloscyllium* sp A) (6%), wide stingaree (*Urolophus expansus*) (5%), Australian angel shark (*Squatina australis*) (5%), ornate angel shark (*Squatina tergocellata*) (4%), common sawshark (*Pristiophorus cirratus*) (5%), brier shark (*Deania calcea*) (4%), and draughtboard shark (*Cephaloscyllium laticeps*) (4%) provided 51% of catch. The remaining 15% for the top two-thirds of catch was provided by the five species of green-eyed dogfish (*Squalus mitsukuri*) (3%), Port Jackson shark (*Heterodontus portusjacksoni*) (3%), gummy shark (*Mustelus antarcticus*) (3%), southern fiddler ray (*Trygonorrhina fasciata*) (3%), and Melbourne skate (*Dipturus whitleyi*) (3%).

Excluding species detected by the ISMP that are mainly distributed outside the range of the SESSF and adding species not detected by the ISMP, but known from the literature to be mainly distributed within the range of the SESSF, gives a total of 121 chondrichthyan species (77 shark, 36 ray, and 8 holocephalan species). Based on mean annual catch during 2000–06, these species are arbitrarily classed as 'rare' where mean annual catch is <1 t, 'sparse' where catch is 1–19 t, 'common' where catch is 20–99 t, and abundant where catch is ≥100 t. The 77 shark species were classed as 33 rare, 25 sparse, 8 common, and 11 abundant; the 36 ray species were classed as 8 rare, 9 sparse, 13 common, and 6 abundant; and the 8 holocephalan species were classed as 2 rare, 5 sparse, and 1 abundant.

As part of trend analysis of each species for the effects of year, month, depth of fishing, and longitude west of the meridian 148° E and latitude east of this meridian, initial data screening was undertaken to exclude broad regions and broad depth-ranges of zero catch for a selected period. Initially, four separate data selection criteria were applied sequentially for each species in each of the SETF and GABTF separately or in these two fisheries combined for the period after 2000, the year when ISMP monitoring of the GABTF began. The data were selected for each of the four depth-ranges within each of the eight regions if the total catch exceeded 0 kg for >0 tows (Criterion 1), >10 tows (Criterion 2), >50 tows (Criterion 3), and >100 tows (Criterion 4). Initial analyses suggested a need for Criteria 2, 3 and 4 for trend analysis, but it eventually become apparent that these can be abandoned in favour of a more fine-tuned approach, which involves removing zeros or low catches by applying Criterion 1 and then, if required, slightly reducing longitude range, latitude range, or depth range for data selection.

Extensive preliminary statistical testing of alternative probability density functions (pdf), individually or in combination with the binomial pdf (i.e. delta-x) for model formulation, was undertaken with many separate selected data sets. This testing indicated that the log-gamma pdf (for CPUE values >0) combined with the binomial pdf (1 for CPUE values >0 and 0 for CPUE values of 0) (i.e. presence–absence) provided the most appropriate model formulation. Whereas model runs for most formulations failed to converge, the log-gamma pdf–binomial pdf delta-x model formulation usually converged without having to apply data selection criteria to reduce zero CPUE values. However, the model usually failed to converge for species where the mean annual catch was less than ~20 t or where there were less than ~500 trawl tows selected in the data. This is an important finding and has wide application for the analysis of CPUE data. This is because it overcomes the statistically questionable practices commonly adopted to avoid zero CPUE values, such as ignoring data of zero value, transforming data by adding an arbitrary constant, or aggregating data. The disadvantage of data aggregation is that it reduces statistical power.

Based on standardised CPUE by depth, each species is assigned to one of the three depth-categories of continental shelf (<200 m), upper-slope–mid-slope (200–599 m), or lower-slope (≥600 m). For most species classed as 'sparse' or 'rare' and for some species classed as 'common', there were insufficient data for trend analysis and hence provided an indeterminable result. For most species, the results of trend analysis were 'indeterminable' where the mean annual catch was below ~20 t or the number of trawl tows selected for analysis was below ~500. The only exceptions to this pattern were three holocephalan species—blackfin ghostshark (*Hydrolagus lemurs*), Ogilbys ghostshark (*Hydrolagus ogilbyi*), and southern chimaera (*Chimaera* sp a)—where the models converged, but exhibited 'no trend'. Calculated from standardised CPUE trend analysis based on post-2000 decline, risk of future population decline from the effects of fishing was classed as 'high', 'medium', or 'low'.

Shark species distributed on the continental shelf identified at 'medium' risk are school shark (*Galeorhinus galeus*), gummy shark (*Mustelus antarcticus*), common sawshark (*Pristiophorus cirratus*), and Australian angel shark (*Squatina australis*). School shark, gummy shark and common sawshark, which are taken as target or byproduct species by shark gillnet, have undergone extensive ongoing stock assessment and are now effectively carefully managed by a total allowable catch with individual transferable quota, a narrow mesh-size range (6–6½ inches) for shark gillnet, and closed areas (including nursery areas). For Australian angel shark, the region of medium risk from the effects of otter trawl is restricted to waters off New South Wales and, although the species is exposed to shark gillnet throughout the rest of southern Australia on the continental shelf, shark gillnet takes a negligible catch and provides negligible risk.

Shark species distributed predominantly on the upper-slope–mid-slope and lower-slope identified at 'high' or 'medium' risk are whitefin swell shark (*Cephaloscyllium* sp a), greeneye spurdog (*Squalus mitsukurii*), gulper sharks (*Centrophorus* spp), brier shark (*Deania calcea*), and black shark (*Dalatias licha*). Analyses for the gulper sharks—mostly endeavour dogfish (*Centrophorus moluccensis*) and southern dogfish (*C. uyato*), with negligible quantities of Harrisons dogfish (*C. harrissoni*), and leafscale gulper shark (*C. squamosus*)—are at higher risk in the western region than in the eastern region of the SETF.

Ray species distributed predominantly on the continental shelf are mostly at 'low' risk from the effects of otter trawl. Three species are at 'medium risk': greenback stingaree (*Urolophus viridis*), sandyback stingaree (*U. bucculentus*), and sparsely spotted stingaree (*U. paucimaculatus*). None of seven ray species distributed on the continental slope are at risk.

Holocephalan species are mostly on the continental slope, with only elephant fish (*Callorhinchus milii*) distributed on the continental shelf. Catches of all holocephalan species by otter trawl are low and insufficient to detect statistically significant trends.

In summary, species identified as requiring stock rehabilitation are the gulper sharks (*Centrophorus* spp) and the greeneye spurdog (*Squalus mitsukurii*). Catch and retention of these species and the other deepwater byproduct species of dogfish *Centroscymnus owstoni*, *Deania calcea*, and *Dalatias licha* are monitored and controlled by basket trip limits to discourage targeting these species. A temporary closed area for gulper sharks and school shark established on the continental slope off Kangaroo Island in South Australia, was moved further west off South Australia, following a survey of the waters off South Australia and Western Australia by automatic longline fishing to assess the presence of gulper sharks, greeneye spurdog, and school shark. Given risk cannot be evaluated for sparse (<20 t) and rare (<1 t) species from the ISMP, management of these species and several bycatch species of stingaree and the whitefin swellshark require a precautionary approach.

It is too early to assess the full impact the Field Guide to Australian Sharks and Rays on ease of species identifications for the ISMP. Both scientific observers and fishers find that the diagrams with clear labels make the guide easy to use and find the compact size and waterproof pages much more convenient to use in the field than the other available texts for species identification. Observers report that they would like to see additional species included.

The results presented present report and a separate report on scalefish have provided an important input to the decision making processes associated with setting basket quotas for dogfish and holocephalans, and for establishing spatial closures during June 2007. Many of these spatial closures are for protection of school shark, greeneye spurdog, and of gulper sharks through four gulper shark closures. Deepwater dogfish and holocephalans will receive additional protection through the closure of all waters of depth greater than 700 m in the SETF.

OUTCOMES ACHIEVED

In response to presentations of preliminary results from the present FRDC project on sharks, rays and holocephalans, AFMA requested similar data analyses for teleosts, cephalopods, and crustaceans. As a result, the present report, together with the report for a similar AFMA project (Walker *et al.* 2007), where the AFMA report applies the methods developed by the present project, provide the most comprehensive analysis of data from the Integrated Scientific Monitoring Program yet undertaken.

Results from the FRDC project and AFMA Project together have been presented variously to AFMA, industry, SharkRAG, GHATMAC, SETMAC, CSIRO, and various scientific forums. The results provided key data inputs to development of Management Plans and extensive legislation on the SESSF for quota baskets, trip limits, closed areas and depth exclusions, implemented in response to the Ministerial Direction to AFMA of December 2005 to eliminate overfishing and halve bycatch.

Evaluation of byproduct and bycatch and CPUE trend analysis for species impacted by the GABTF, SETF, and GHATF are part of documentation requirements for several important processes prescribed in legislation and national policies.

(a) Strategic assessment of fisheries prescribed under the Australian Environment Protection and Biodiversity Conservation Act 1999. AFMA has previously used other data sets for this purpose, but the outputs from the present project will serve to refine the documentation.

(b) AFMA's documentation requirements for bycatch action plans prescribed under the Australian Fisheries Act 1991.

(c) Prescribed action in Australia's National Plan of Action for the Conservation and Management of Sharks launched 26 May 2004. The present FRDC report will provide required information to the Shark Plan Implementation Committee for updating the Shark Assessment Report, submitted periodically to the FAO Committee of Fisheries.

Methods developed as part of the present project provide a basis for periodic update of the ISMP data, refinement of the monitoring design of the ISMP, and a new approach to analysis of fisheries catch and effort data in Australia and other parts of the world.

There has been growing demand from the SESSF Fishery Assessment Groups to provide time series of standardised CPUE from ISMP from SESSF quota species for direct input into stock assessment. Because the ISMP data provide a basis for standardising CPUE from retained and discarded catches combined, for some species, the ISMP CPUE data provide a better indication of abundance than fisher logbook data, which contain only retained catches known often to vary depending on market and legislative requirements.

The results also provide an essential input to FRDC Project 2002/033 (Rapid assessment of ecological risk for chondrichthyan species in the SESSF).

Keywords: SESSF, SETF, GABTF, GHATF, standardised CPUE, byproduct, bycatch, retain and discards

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Acknowledgment is due to the many people who have variously contributed to provision of data from the Southern and Eastern Shark and Scalefish Fishery through the successful conduct of the Integrated Scientific Monitoring Program during 1992–06. In all, 23 scientifically trained observers contributed to the data set during this period, three of whom deserve special mention because of their long period of service and provision of most of the data. These are Jeff Nemec (1992–06), Paul McCoy (1994–06), and Glen Richardson (1998–06). Former members of Primary Industries Research Victoria (PIRVic) Dr Ian A. Knuckey (presently Fishwell Pty Ltd), Dr David C. Smith (presently CSIRO Marine and Atmospheric Research), Dr Sonia Talman (presently Fisheries Victoria, Department of Primary Industries), and Dr Matthew Koopman (PIRVic) are acknowledged for their contributions to the design and management of the ISMP. Thérèse Stokie presently of PIRVic is acknowledged for her recent work associated with management of the data. Many professional fishers who accommodated the observers on-board their vessels are acknowledged for facilitating the operations of the observers at sea. The Australian Fisheries Management Authority is acknowledged for funding the ISMP, 80% of which is raised by industry licence levies, and the Fisheries Research and Development Corporation is acknowledged for funding the project..

FINAL REPORT

2001/007	**Shark & other chondrichthyan byproduct & bycatch estimation in the Southern and Eastern Scalefish and Shark Fishery**

Background

Acronyms

AFMA	Australian Fisheries Management Authority
COFI	FAO Committee of Fisheries
CSIRO	CSIRO Marine and Atmospheric Research
DAFF	Department of Agriculture Fisheries and Forests
DEH	Department of Environment and Heritage
FAO	United Nations Food and Agricultural Organisation
FIRTA	Fishing Industry Research Trust Account
FRDC	Fisheries Research and Development Corporation
GABTF	Great Australian Bight Trawl Fishery
GHATF	Gillnet Hook and Trap Fishery
GHATMAC	Gillnet Hook and Trap Management Advisory Committee
IPOA-Sharks	International Plan of Action for the Conservation and Management of Sharks
ISMP	Integrated Scientific Monitoring Program
NPOA-Sharks	National Plan of Action for the Conservation and Management of Sharks
PIRVic	Primary Industries Research Victoria
SEF	South East Fishery (former name)
SESSF	Southern and Eastern Scalefish and Shark Fishery
SETF	South East Trawl Fishery
SAG	Shark Assessment Group
SCFA	Standing Committee on Fisheries and Aquaculture (former committee)
SETMAC	South East Trawl Management Advisory Committee
SharkRAG	Shark Resource Assessment Group

Background

Since commencement of the present project, the former South East Fishery (SEF) has been amalgamated with the former Southern Shark Fishery (SSF) and other fisheries to form the Southern and Eastern Scalefish and Shark Fishery (SESSF). The project evaluates byproduct catch and bycatch of sharks, rays and holocephalans (class chondrichthyes) by analysing data for each of three fishing methods from the South East Trawl Fishery (SETF) and Great Australia Bight Trawl Fishery (GABTF), which are now sectors of the SESSF. The three fishing methods are GABTF otter trawl, SETF otter trawl, and SETF Danish seine. The project also analyses data for five fishing methods used in the Gillnet Hook and Trap Fishery (GHATF), which is also now a sector of the SESSF. The five methods analysed are referred to as GHATF trap, GHATF dropline, GHATF automatic longline, GHATF scalefish hook, and GHATF scalefish gillnet. Chondrichthyan catch evaluation was undertaken as part of FRDC Project 1999/103 for GHATF shark gillnet and GHATF shark hook, which are two other fishing methods deployed in the GHATF (Walker *et al.* 2005).

Globally, there have been concerns since the early 1990s that targeted catch, byproduct (retained non-targeted catch), and bycatch (discarded catch), are markedly depleting the populations of sharks, rays and holocephalans. Chondrichthyan species are among the least biologically productive fish resources and some species are particularly prone to overexploitation by fishing.

In Australia, species such as gummy shark (*Mustelus antarcticus*) are harvested sustainably and rationally (Pribac *et al.* 2005; Walker 1998), but populations of several species of dogfish (family squalidae) and holocephalan (order holocephalii) on the continental slope off New South Wales are severely depleted (Andrew *et al.* 1997; Graham *et al.* 2001). The population of school shark (*Galeorhinus galeus*) harvested from on the continental shelf throughout southern Australia is another example of a markedly depleted species (Punt *et al.* 2000a; Punt and Walker 1998).

Target species of shark in Australia have been monitored and extensive biological studies have been undertaken to provide a basis for sound stock assessment. Results from the monitoring, research and assessment have been well documented for the shark fisheries of south-eastern Australia (Walker 1999), Western Australia (Simpfendorfer 1999), and northern Australia (Stevens 1999).

Byproduct and bycatch of species of sharks, rays and holocephalans, however, have not been so extensively investigated. In southern and eastern Australia, fishing methods presently providing the highest byproduct and bycatch of these fish include the GABTF otter trawl, SETF otter trawl, GHATF shark gillnet, and GHATF automatic longline. Data are available or currently being collected for these fisheries. Data on byproduct and bycatch are much less extensive for the State-managed inshore species, but the catches are low compared with those for the offshore fisheries.

The present project uses data on catch mass of sharks, rays and holocephalans with information on spatial position, depth, year, season and vessel for tows, line-lifts or sets of the fishing gear from the Integrated Scientific Monitoring Program (ISMP) and from available fisher logbook data submitted to various fisheries agencies. The principal objective of the ISMP is to provide information on the quantity, size and age composition of the retained and discarded catch of quota and non-quota species caught by the SESSF. To meet this objective, scientifically trained on-board field observers sample the retained and discarded catches. Through the ISMP, which includes its pre-cursors (the Scientific Monitoring Program and a NSW project on fish trawling); an extensive database has been developed since 1992 with details of the species composition from a large region of southern and eastern Australia.

The present report is structured to address each of the four project objectives, addressed through a set of four sub-headings recurring through the report. Addressing Objective 2 was complex. It required evaluating new methods to standardise CPUE for trends in relative abundance and developing an innovative approach to interface outputs from the statistical package SAS with the Geographic Information Systems software ARCINFO and ARCVIEW (GIS) and then to display spatial variation in abundance on maps.

Previous research

Analysis and recent collection of byproduct and bycatch data for the GHATF shark gillnet and GHATF shark hook were undertaken as part of FRDC Project 1999/103 (Sawshark and elephant fish assessment and bycatch evaluation in the Southern Shark Fishery) (Walker *et al.* 2005). Deepwater dogfish (family Squalidae) taken in several fisheries were investigated by FRDC Project 1998/108 (Daley *et al.* 2002b). Byproduct species such as whiskery shark (*Furgaleus macki*) and dusky shark (*Carcharhinus obsurus*) were investigated in Western Australia as part of FRDC Project 1996/130 (Simpfendorfer *et al.* 1999). Data on shark species taken by pelagic long-line in the EEZ were collated by FRDC project 98/107 (Stevens and Wayte 1999). Improvement of field identification of chondrichthyan species has been facilitated by recent preparation of a field guide to sharks and rays as part of FRDC project 2000/105 (Daley *et al.* 2002a).

Collection of data from the ISMP occurred for the SETF during 1992–present, GABTF during 2000–present, and GHATF trap, GHATF dropline, GHATF automatic longline, GHATF scalefish longline, and GHATF scalefish gillnet during various periods during 2000–present. The present project is the first attempt to provide a thorough synthesis of the chondrichthyan data. The ISMP catch and effort data are merged with fisher logbook data to provide estimates of total catch of chondrichthyan byproduct and bycatch species.

Need

The present project addresses two items listed as high priority in various updates of the Southern Shark Fishery Five Year Strategic Research Plan; these items are under the key area 'resource status' of FRDC's program 'resources sustainability'. The two items are (1) investigation of non-quota species and (2) analysis of bycatch. There are also international and national priorities for the work.

Several initiatives taken in recent years have created requirements to evaluate catches better and determine trends in abundance in Australian fisheries. The requirement applies to both targeted and non-targeted species, and, of the non-targeted species, to both the retained (byproduct) and discarded (bycatch) species.

Australia's *Fisheries Management Act 1991* requires management arrangements to "ensure that the exploitation of fisheries resources and the carrying on of related activities are conducted in a manner consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle, in particular the need to have regard to the impact of fishing activities on non-target species and the long-term sustainability of the marine environment". Hence, in accordance with these legislative obligations and Commonwealth Government policy prescribed under Australia's Ocean Policy regarding the impact of fishing activities on non-target species and the environment, the Australian Fisheries Management Authority is required to update periodically bycatch action plans for major Australian fisheries.

In addition, through the former Standing Committee on Fisheries and Aquaculture (SCFA), all Australian Commonwealth and State fisheries ministers endorsed the National Policy on Fisheries Bycatch, which includes sharks, rays and holocephalans. The Australian government released its bycatch policy, which builds on the endorsed National Policy on Fisheries Bycatch and committed the Commonwealth to develop and periodically update a Bycatch Action Plan for each major Commonwealth fishery.

More recently, the Australian *Environment Protection and Biodiversity Conservation Act (EPBC) 1999* requires fisheries managed under Commonwealth jurisdiction or fisheries producing products for export to be 'strategically assessed'. This process involves assessing each fishery for ecological impacts on (a) target and byproduct species, (b) bycatch species, (c) threatened, endangered and protected species, (d) marine habitats, and (e) marine food chains. The process requires collection of appropriate data, risk assessment, and appropriate management responses.

At the world level, concern for the condition of the stocks of chondrichthyan species led to the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks), developed by the Food and Agriculture Organisation of the United Nations (FAO). Ratified by the FAO Committee of Fisheries (COFI) during February 1999, the IPOA-Sharks recognises that the life-history characteristics of chondrichthyan species provide low 'biological productivity' and cause these animals to be generally more susceptible to overexploitation from fishing than teleost and invertebrate species. The IPOA-Sharks also recognises that these species require special management, research, and monitoring if they are to be harvested sustainably (Anon. 2000).

As a signatory to FAO's IPOA-Sharks, Australia was obliged to develop a National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks). Australia's Department of Agriculture Fisheries and Forests (DAFF) established a national Shark Advisory Group (SAG) to prepare a Shark Assessment Report and develop a Shark Plan, which together formed the Australian NPOA-Sharks. The SAG included representatives from all key government and non-government stakeholder groups, including shark research specialists. Following endorsement of all appropriate Commonwealth, State and Territory fisheries ministers and environment ministers, Australia's NPOA-Sharks was launched 26 May 2004. The FAO Committee of Fisheries has endorsed Australia's NPOA-Sharks.

Globally, the catches of most chondrichthyan species have not been reported and it is likely that many species, particularly those taken as bycatch, are already at high risk without it being recognised (Walker 1998). 'Critical bycatches' are bycatches of species or populations that are in danger of extinction, and 'unsustainable bycatches' are bycatches of species or populations that are not currently at risk, but will decline at current levels of bycatch (Hall 1996).

In the SESSF, the catches of sharks, rays and holocephalans have been evaluated for the GHATF shark gillnet and the GHATF shark hook (Walker *et al.* 2005). The present study is designed to evaluate the catch and catch rates for each chondrichthyan species for GABTF otter trawl, SETF otter trawl, SETF Danish seine, GHATF trap, GHATF dropline, GHATF automatic longline, GHATF scalefish longline, and GHATF scalefish gillnet. Each species is evaluated in terms of 'retained catch' and 'discarded catch' using data available from the ISMP and fish logbooks.

Objectives

1. Summarise retained and discarded catches and length-frequency data on sharks, rays and holocephalans from the Integrated Scientific Monitoring Program (ISMP) database.
2. Estimate spatial and temporal trends in catches and abundance of sharks, skates, rays and holocephalans using data from the ISMP database and from the SESSF catch and effort database.
3. Identify implications and requirements for species management, fishery bycatch action plans, and FAO's International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks).
4. Evaluate impact on the ISMP data and catch and effort data collection following adoption of the shark field guide to sharks and rays caught in Australian waters.

Methods

The geographic range of the present study includes the Great Australian Bight and south-eastern Australia. For the purpose of this report, south-eastern Australia is the region of the SETF, which is separated from the Great Australian Bight Trawl fishery at longitude 138°E (eastern end of Kangaroo Island). The report adopts the terms western region and eastern region to distinguish regions of the SETF west and east of longitude 148°E. The report also refers to the regions of South Australia (SA), Bass Strait (BS) (waters south of Victoria and north of latitude 41° South, which aligns approximately with the north coast of Tasmania), Tasmania (Tas) (south of 41° South), and New South Wales defined as waters adjacent to the states.

Data are available from the Integrated Scientific Monitoring Program (ISMP) for the SETF during 1992–present, but only data for the period 1994–06 are used. Because sampling intensity and fishery coverage were low for the years 1992 and 1993, data for these two years were rejected from the data analyses. Expansion of the ISMP to cover the GABTF and parts of the GHATF began in 2000. The most comprehensive data are for the SETF otter trawl and GABTF otter trawl; data for SETF Danish seine and GHATF are limited. All data were collected under normal fishing operations and the sampling by the ISMP is designed to provide for representative coverage of vessels and regions. The scientifically trained observers apply strict sampling protocols when estimating and sampling catches, and recording data.

Available ISMP and fisher logbook data were combined and analysed to provide four different types of information.

1. Estimates of mean catch rate (with standard error) and mean-annual total catch mass (with percentage discarded) during 2000–06 for each chondrichthyan species for GABTF otter trawl, SETF otter trawl, SETF Danish seine, GHATF trap, GHATF dropline, GHATF automatic longline, GHATF scalefish longline, and GHATF scalefish gillnet.
2. Estimates of annual retained catch, discarded catch, and total catch (each with a standard error) for each chondrichthyan species taken in significant quantities by SETF otter trawl during 1994–06 and GABTF otter trawl during 2000–06. There are insufficient data to provide time series of estimates of these quantities for SETF Danish seine and each fishing method used the GHATF.
3. Trends in CPUE standardised for year, month, longitude or latitude, depth, and vessel for the each species where generalised linear models converged SETF otter trawl data for 1994–06. Where early data

were missing or where the model failed to converge or provide all summary statistics, trends are presented for a reduced period (mostly 1996–06, 1998–06, or 2000–06). There were insufficient data available to provide trends in standardised CPUE for methods other than SEFT otter trawl and GABTF trawl fishery. Some analyses combine SETF otter trawl and GABTF otter trawl for the period 2000–06.

4. Maps of CPUE standardised for the effects of year and longitude-depth or latitude-depth for each species where generalised linear models converged using combined data for GABTF otter trawl and SETF otter trawl during 2000–06. The maps are based on five arbitrary CPUE ranges represented by a five-tone colour-scale prepared using the Geographic Information Systems package ARCVIEW.

Species names adopted are based mostly on the books 'Australian Seafood Handbook an identification guide to domestic species' (Andrew *et al.* 1999), Sharks and Rays of Australia (Last and Stevens 1994), and 'The fishes of Australia's South Coast' (Goman *et al.* 1994), and on the Codes for Australian Aquatic Biota (www.marine.csiro.au/caab/caabsearch) administered by CSIRO Marine and Atmospheric Research.

Estimation of retained and discarded catches

The mean annual total-catch mass for each species during 2000–06, within each fishery sector of the SESSF, was estimated in two steps. The first step was to estimate mean CPUE for total catch mass (kg per tow, kg per line-lift, or kg per set depending on sector) from ISMP data. The second step was to weight the mean CPUE for each species within each sector by the mean annual number of shots of the gear (tows, line-lifts or sets) reported on fisher logbooks to determine total catch. The term 'shot' refers to 'tow' of otter trawl or Danish seine; to 'line-lift' of trap or dropline; or to 'set' of automatic longline, scalefish longline, or scalefish gillnet. Also determined for each species is percentage of shots producing catch >0 kg and percentage of total-catch discarded.

Estimates of mean annual retained-catch and mean annual discarded-catch were estimated from the estimate of mean annual total-catch combined with percentage of total-catch discarded for each teleost species separately for GABTF otter trawl, SETF otter trawl, SETF Danish seine, GHATF trap, GHATF dropline, GHATF automatic longline, GHATF scalefish longline, and GHATF scalefish gillnet. These catch masses were determined separately within each of three bathometric depth ranges (0–199 m, 200–599 m, and ≥600 m) and for all depths combined during 2000–05.

Determination of spatial and temporal trends in abundance

ISMP

The ISMP monitors the GABTF from Cape Leeuwin (34° 22′ South, 115° 08′ East) in Western Australia to Cape Jervis (35° 37′ South, 138° 05′ East) in South Australia. The ISMP also monitors the SETF from Cape Jervis in South Australia to Barranjoey Head (33° 35′ South, 151° 20′ East) in New South Wales. The data are distinguished between the two fishery sectors by the meridian of longitude 138° East. Data are available since 2000 from the GABTF and since 1992 from the SETF. Because of large differences in the periods of the time series of data and limited overlap in the vessels between the GABTF and SETF, data from the two fishery sectors were mostly analysed separately, but were combined for some species.

Rationale for standardisation

Standardisation of CPUE data as an indicator of abundance of populations of teleost species is widely practiced. Examples include demersal otter trawl (Chatterton 1996; Goñi *et al.* 1999; Kulka *et al.* 1996; Salthaug and Godø 2001), beam trawl (Large 1992), long-line (Fonteneau and Richard 2003; Goodyear 2003; Hinton and Nakano 1996; Kimura 1981), and purse seine (CPUE associated with spotter planes) (Lo *et al.* 1992). However, there are few examples of standardization of CPUE data for abundance of populations of chondrichthyan species; these are for gillnet (Punt *et al.* 2000b) and longline (Bradford 2001; Nakano 1997).

The present study explores standardising the available observer CPUE data from the ISMP for temporal and spatial trends in relative abundance and for distributional abundance to prepare maps for each chondrichthyan species. Catches resulting from fishing operations from either survey or commercial fishing vessels depend largely on three factors. These factors are (a) vessel and characteristics such as skill of operators, fishing gear and technological equipment; (b) characteristics of the fished population such as abundance level, spatial distribution and availability to the fishing gear; and (c) environmental and physiographic conditions such as weather, hydrology, depth and substrate. It is necessary to identify and, if possible, separate the effects of these factors to correctly interpret catch rate (Pelletier 1998).

Demersal otter trawling in the GABTF and SETF is over a wide geographic range and wide depth-range, well beyond the spatial distribution of many of the species caught. Fishing outside a species' distributional range, combined with the naturally occurring low abundance of many chondrichthyan species gives numerous records of zero catch. Large proportions of zero CPUE values in the data create statistical complexities that are addressed by two processes applied to each species and usually to each fishery separately. The first of the two processes is to undertake a "data selection process" designed to reduce the proportion of zero records by excluding records from localities outside of the distributional range of each species. The second process is to explore alternative probability distribution functions (pdfs) for data structures in the generalised linear models for each selected data set.

Several alternative approaches are not explored here. One such approach sometimes taken to reduce the proportion of zero CPUE values is to aggregate data over larger units of fishing effort (Punt *et al.* 2000b) from say length of tow to a larger unit such as total length of all tows during each month. This approach can reduce the standard errors on parameter estimates, which can have the advantage of reducing noise if the standardised CPUE trends are used as inputs to stochastic fishery assessment models. However, this approach reduces the resolution of the data and reduces statistical power. In the present study, we chose to work with the resolution at which the data were collected to explore the variance in the actual data. Models involving log-normal (Kimura 1981; Large 1992), gamma (Goñi *et al.* 1999), and log-gamma (Punt *et al.* 2000b) pdfs cannot include zero CPUE values and are often adjusted by the addition of a small constant γ (Bradford 2001; Punt *et al.* 2000b). However, because standardised trends can be affected by the magnitude γ, this approach is also avoided in the present study. Other pdfs adopted as model data-structures, such as normal, inverse Gaussian, Poisson (Dong and Restrepo 1995) and negative binomial (Punt *et al.* 2000b), can include zero CPUEs in the data. The "delta-x" modelling approach (Lo *et al.* 1992; Punt *et al.* 2000b; Vignaux 1994), which can incorporate the log-normal, gamma, log-gamma, as well as other pdfs, paired with the binomial pdf, is also applied as part of the present study.

Data

The observers recorded, *inter alia*, the start and finish dates, times and positions of each trawl tow and the mass of the catch for each species. The mass of the catch was categorised as retained and discarded and, each of these, were further categorised as live and dead. For the purpose of the present study, CPUE for each species was computed for each trawl tow from total catch measured in kilograms and from fishing effort expressed in nautical miles as length of tow calculated from the start and finish positions.

Relevant data were transferred from a Microsoft ACCESS database to the statistical package SAS Version 9.1 (SAS Institute, North Carolina, USA) for manipulation, selection and analysis. The ARCINFO Geographic Information System, together with ARCVIEW, was adopted for processing bathometric data to generate isobaths on maps and for calculating the area of locality-cells. ARCVIEW was used for spatial display of relative abundance estimates produced by SAS.

The data associated with each observed trawl tow were assigned to one or more "locality-cells" based on start and finish positions and depth of fishing. Where a trawl tow crossed the boundaries of cells, the catch and effort from that tow were distributed between cells in proportion to the length of tow in each cell; this assumes catch is uniform over the full length of the tow. The locality-cell boundaries were defined by depth-intervals and by intervals of longitude west of the meridian of longitude 148° East or intervals of latitude east of this meridian. Adopted were 40-m depth-interval in the range 0–39 m, 20-m depth-intervals in the range 40–199 m, 100-m depth-intervals in the range 200–999 m, and 1000-m depth-intervals in the range 1000–3000 m. Longitude-intervals of 1 degree were adopted for the range 127°–148° East. East of the meridian of longitude 148° East, eight latitude-intervals were adopted for the range 33°–46° South (33° 00′–35° 59′, 36° 00′–37° 29′, 37° 30′–38° 12′, 38° 13′–38° 59′, 39° 00′–39° 59′, 40° 00′–40° 59′, 41° 00′–41° 59′, 42° 00′–46° 00′) (Figure 1).

Data selection

Data selection criteria were adopted to exclude fishing grounds where a species was absent or rare and to reduce the number of zero observations in the data used for an analysis. Initially four separate data selection criteria were applied sequentially for each species in each of the SETF and GABTF separately or in these two fisheries combined for the period after 2000 when monitoring of the GABTF began. As a first step each locality-cell was assigned to one of four depth-ranges (0–199, 200–599, 600–1199, and ≥1200 m) within one of eight broad regions (Figure 2). The data were selected for each of the four depth-ranges within each of the eight regions if the total catch exceeded 0 kg for >0 tows (Criterion 1), >10 tows (Criterion 2), >50 tows (Criterion 3), and >100 tows (Criterion 4). Initial analyses suggested a need for Criteria 2, 3 and 4 for trend analysis, but it become apparent that these could be abandoned in favour of a more fine-tuned approach, which involved removing zeros or low catches by applying Criterion 1 and then, if required, slightly reducing longitude range, latitude range, or depth range for data selection data. Occasionally, a combination of ranges was applied. Where every model continued to fail to converge for a species, the data were split west and east of the meridian of longitude 148° E to provide the western and eastern regions. The data were also split into the two regions where the statistical package used to analyse the data indicated that the results were uncertain or it failed to provide all of the requested statistics after initial data selection. The data were also split into these two regions, where there is evidence or a body of opinion indicating separate stocks. The data selection process was then repeated for each sub-stock separately.

Depending on species, the additional selection criterion of y years was applied to the data so that only data after a particular year were selected. There were two reasons for this. Firstly, coverage of the SETF by the observer program tended to monitor the western regions and deeper depths of the fishery less intensively during the early years than during the later years. Secondly, there was uncertainty associated with identification of several species. Hence, the early years were variously excluded from certain analyses and several species were grouped (see results).

Data analysis
Each data set selected as part of the "data selection process" was analysed using the GENMOD procedure of the statistical package SAS/STAT. The GENMOD procedure fits generalised linear models (Nelder and Wedderburn 1972) to data by maximum likelihood estimation of parameters through an iterative fitting process. The GENMOD Type 3 Analysis was adopted because design of the data is non-orthogonal and because the results do not depend on the order in which the explanatory variable terms in the model were fitted to the data.

Standardising CPUE data for various effects was undertaken by applying generalised linear models (Gavaris 1980; Hilborn and Walters 1992). This modelling involved using nominal CPUE or the natural logarithm of CPUE as a response variable and using several variables as explanatory variables. For depicting temporal and spatial trends in relative abundance, the explanatory variables included year, month, locality, bathometric depth-interval, and vessel, where locality is treated as a longitude-interval or latitude-interval ('long-lat'). For determining distributional relative abundance for display on maps, the explanatory variables included year, month, locality, and vessel, where locality is defined by a longitude-interval or latitude-interval combined with a depth-interval (as defined above) to compute a 'locality-cell'. For trend analysis, CPUE standardisation was undertaken separately for the SETF and the GABTF separately because of differences in the duration of the monitoring programs between the two fishery sectors.

CPUE standardisation for temporal and spatial trends in abundance was applied by estimating values of the constant β_0 and the coefficients of each of the five vectors β_1, β_2, β_3, β_4, and β_5 associated with the five explanatory variables. Constant β_0 is the CPUE for the final "year", "month", "depth", "long-lat", and "vessel". Vector β_1 denotes the $y-1$ coefficients associated with $y-1$ of y selected fishing years ("year"). Vector β_2 denotes the 11 coefficients associated with $m-1$ of m (usually 12) fishing months ("month") to include seasonal effects in the model. Vector β_3 denotes the $d-1$ coefficients associated with $d-1$ of d selected depth-intervals ("depth"); this is included as a categorical variable rather than as a continuous variable (covariate) because CPUE is unlikely to vary linearly with depth. Vector β_4 denotes the $l-1$ coefficients associated with $l-1$ of l selected longitude-intervals or latitude-intervals ("long-lat"). Vector β_5 denotes coefficients associated with $v-1$ of v selected vessels ("vessel"). CPUE standardisation for depicting distributional abundance on maps was undertaken by applying an almost identical approach, except depth-intervals and longitude-intervals or latitude-intervals were combined to compute "locality-cells". Standard errors and associated p-values were computed by SAS for the parameter estimates based on asymptotic normality of the maximum likelihood estimators.

The GENMOD procedure uses a ridge-stabilised Newton–Raphson algorithm (McCullagh and Nelder 1983) to maximise the log-likelihood function. It automatically fits a sequence of models, beginning with a simple model with only an intercept term, to include one additional explanatory variable in each successive model until all explanatory variables in the specified model are included. These asymptotic tests allow the statistical significance of each additional explanatory variable to be assessed from the value of χ^2 / degrees of freedom produced for each explanatory variable.

To address statistical complexities associated with large proportions of zero catch rates, a range of possible response probability distribution functions (pdfs) were tested for each of the alternative data sets selected using criteria designed to include only data from the distributional range of each species. In addition, non-zero CPUE values modelled with each of seven alternative pdfs (normal, log-normal, inverse Guassian, gamma, log-gamma, Poisson or negative binomial) was combined with the binomial pdf where CPUE=0 was assigned a value of 0 and CPUE>0 a value of 1. These seven pairs of pdfs (delta-x model formulation) plus four pdfs that could be fitted directly to the data with zero values (normal, inverse Gaussian, Poisson, and negative binomial) gave a total of 11 model formulations each fitted by maximum likelihood to each data set.

The GENMOD procedure has facility for applying eight response pdfs to the structure of data: normal, log-normal, inverse Guassian, Poisson, gamma, log-gamma, negative-binomial and binomial. Three of the seven pdfs could not be applied directly to the data available for the present study; the log-normal, gamma, and log-gamma pdfs cannot include values of CPUE=0 and the binomial pdf can only include values of CPUE=0 and CPUE=1. All seven pdfs were tested with the delta-x formulation where non-zero CPUE values modelled alternatively with each of the seven pdfs (normal, log-normal, inverse Guassian, gamma, log-gamma, Poisson or negative binomial) were each separately combined with the eighth pdf (binomial). For the binomial pdf, CPUE=0 was assigned a value of 0 and CPUE>0 was assigned a value of 1. In each of the delta-x formulations, a coefficient for a particular variable is calculated by multiplying together the corresponding coefficients determined for each of the two component pdfs. The seven pairs of pdfs associated with the delta-x option, and the four pdfs that could be applied directly to the data (normal, inverse Gaussian, Poisson and negative binomial) gave 11 separate analyses for each data set.

Selection of the most appropriate pdf model formulation for each data set was based on, firstly, whether or not the model converged and, then secondly, if the model did converge, on the goodness of fit of the data to the model. Goodness of fit was examined from the scaled Pearson's χ^2 value (i.e. Pearson's χ^2 / degrees of freedom); the pdf giving the scaled Pearson's χ^2 value closest to 1.0 was accepted as the most appropriate for the data set in question (SAS Institute Inc. 1997). Where the value lay outside the range 0.5–2.0, the deviance value was compared with tables of asymptotic values to determine whether probability > 0.05.

Standardisation of CPUE is usually undertaken to determine inter-annual trends in abundance of target species involving standardisation for differences in the fishing power of vessels (Goñi *et al.* 1999; Salthaug and Godø 2001). In these instances, the vessels tend to operate in regions where the fish are most abundant resulting in data that give good coverage in regions of high abundance, but, often, inadequate coverage in regions of low abundance. An advantage with target species is that the proportion of zero-CPUE values in the data is low, but the tendency for fleets to operate on fish aggregations biases CPUE as an indicator of abundance. Where stocks are declining this often leads to hyperstability where the fish re-aggregate as abundance declines or to hypostability where initial aggregations in an unfished population are depleted. Attempts to reduce these biases are often addressed by weighting nominal CPUE (Gulland 1956) or standardised CPUE (Punt *et al.* 2000b) in locality-cells by the "habitat area" in each cell.

To achieve this, the estimates of the parameters associated with each of the variables in the model, and the associated standard errors, were weighted by A_c / A_T ('habitat area ratio'). A_c is the size of the 'habitat area' in locality-cell c and A_T is the sum of the 'habitat areas' over all locality-cells included in the analysis. These 'habitat area ratio' weighted standardised CPUEs were then be summed over any region or the entire fishery using the formula

$$I_\tau = \sum_c I_{\tau,c}(A_c / A_T) \ .$$

I_τ is the relative abundance index ('habitat area ratio weighted standardised CPUE') for year τ . $I_{\tau,c}$ is the relative abundance index (standardised CPUE) for year τ , or any other variable such as month, depth-interval or long-lat-interval, in the 'locality-cell' c . A_c / A_T is the value of the 'habitat area ratio' of 'cell' c (Quinn II and Deriso 1999). A limitation of this approach is the need to have data from all locality-cells in all years; missing CPUE data for any of the factors in the model create the need for establishing rules for filling in for missing data (Punt *et al.* 2000b). This is a lesser problem for byproduct and bycatch species than for target species.

For displaying distributional abundance on maps, standardised CPUE values determined for each locality-cell within SAS were transferred to the Geographic Information Systems software ARCVIEW. In ARCVIEW, the standardised CPUE values were categorised into three ranges to represent three relative abundance intervals (high, medium, and low) which is displayed on a map using five-step colour tones, where the darker the tone the higher the relative abundance. Absence of CPUE data is displayed as white. Standardised CPUE values used for the maps were not weighted by 'habitat ratio area'.

Identification requirements for species management

In the SETF, GABTF and GHATF, evaluation of catch with trends in catch and trends in abundance based on CPUE are usually the first information used for identifying the need for fishery management or conservation measures for any species. These trends can be readily determined for target and some byproduct species from fisher logbook data provided there is not significant discarding or other forms of cryptic fishing mortality. However, fisher logbook data do not include bycatch species or byproduct species where significant discarding occurs for these fisheries.

For the present study, catch and CPUE for shark, ray and holocephalan bycatch species were evaluated from on-board observer data available for the SETF during 1994–06 and in the GABTF during 2000–06. Catch is identified for scalefish gillnet and automatic longline but there are insufficient data for evaluating CPUE trends for these fishing methods. Relative catches between species and evaluation of trends in CPUE were evaluated for shark gillnets and shark longline by FRDC Project 199/103 (Sawshark and elephant fish assessment and bycatch evaluation in the Southern Shark Fishery') (Walker *et al.* 2005).

Results on trends in catch provided in addressing Objective 1 of the present study in conjunction with published information were used for classing each species as 'abundant', 'common', 'sparse' or 'rare'. Results on trends in CPUE provided in addressing Objective 2 of the present study in conjunction with published information were used for classing the population of each species as 'increasing', 'decreasing', or 'no trend'.

Evaluation of shark field guide for ISMP and logbook data

The scientifically trained on-board observers encounter several hundred species of fish as part of their work associated with the ISMP. The ability of an observer to identify accurately the species of a fish at sea depends on the observer's experience and the availability of taxonomic guides. When examining data from the ISMP databases, in most instances, it is not possible to determine whether the identification is correct. While it is clear that the quality of the data has improved, it is not possible to distinguish whether the improvement is a result of observer experience or availability of taxonomic guides. Hence a qualitative approach was adopted to assess the value the shark field guide (Daley *et al.* 2002a). Each of five experienced observers was interviewed to discuss the value of the guide. Four of the observers were experienced in the SETF, GABTF or both and a fifth was experienced in New Zealand trawl fisheries and had operated in the SETF for only several months.

Results and Discussion

Estimation of retained and discarded catches

The total number of tows, lifts or sets for each of eight fishing sectors of the SESSF monitored by the ISMP during 2000–06 and the mean annual number of tows, lifts or sets for each of the eight sectors reported on fisher logbooks during 2000–05 are presented in Table 1. The onboard observer coverage was 4.06% annually for GABTF otter trawl tows, 2.54% for SETF otter trawl tows, 0.85% for SETF Danish seine tows, 12.09% for GHATF trap lifts, 16.89% for GHATF dropline lifts, 17.62% for GHATF automatic longline sets, 1.54% for GHATF scalefish longline sets, and 0.04% (200–599 m depth) for GHATF scalefish gillnet sets. The GHATF gillnet set in depth-range 0–199 m was all assumed to be GHATF shark gillnet and excluded from the analysis.

The mean annual overall catch estimate across all species was 45,171 tonnes, comprising 611 species (identified mostly to species with some identified to genus or family) across all eight sectors of the SESSF monitored by the ISMP during 2000–06 (Tables 2 and 3). The overall catch mass comprised teleosts (80.1%), sharks (8.3%), rays (5.8%), holocephalans (0.2%), hagfish (0.0%), cephalopods (2.8%), crustaceans (1.2%), and other invertebrates (1.5%). Of the overall catch, 49% came from 0–199 m depth, 37% from 200–599 m depth, and 14% from ≥600 m depth.

For summary purposes, the species are divided into eight taxonomic groups: 'sharks' (72 species or higher taxon), 'rays' (47), 'holocephalans' (12), 'scalefish' (409), 'hagfish' (3), cephalopods (15), crustaceans (30), and other invertebrates (23). Of the overall catch estimate of 45,171 t, the largest component was taken by SETF otter trawl (33,764 t, 74.7%) (Table 2). This was followed by GABTF otter trawl (6880 t, 15.2%), SETF Danish seine (3369 t, 7.5%), GHATF scalefish longline (781 t, 1.7%), GHATF automatic longline (266 t, 0.6%), GHATF trap (42 t, 0.1%), GHATF scalefish gillnet (45 t, 0.1%), and GHATF dropline (23t, 0.1%).

The overall mean annual chondrichthyan catch during 2000–06 from the SESSF by eight fishing methods is estimated at 6467 tonnes: 3731 t of shark species (58%), 2641 t of ray species (41%), and 95 t of holocephalan species (1%). The highest chondrichthyan catch was by SETF otter trawl (4377 t, 66%) followed by GABTF otter trawl (1468 t, 22%), SETF Danish seine (560 t, 9%), GHATF scalefish longline (112 t, 2%), and GHATF automatic longline (72 t, 1%). The three other methods of GHATF trap, GHATF dropline, GHATF scalefish longline, and GHATF scalefish gillnet together provided a negligible catch (7 t, 0%) (Table 2).

About two-thirds of the overall chondrichthyan catch comprises only 14 species. Spikey spurdog (*Squalus megalops*) (11%), greenback stingaree (*Urolophus viridis*) (7%), white finned swell shark (*Cephaloscyllium* sp A) (6%), wide stingaree (*Urolophus expansus*) (5%), Australian angel shark (*Squatina australis*) (5%), ornate angel shark (*Squatina tergocellata*) (4%), common sawshark (*Pristiophorus cirratus*) (5%), brier shark (*Deania calcea*) (4%), and draughtboard shark (*Cephaloscyllium laticeps*) (4%) provided 51% of catch. The remaining 15% for the top two-thirds of catch was provided by the five species of green-eyed dogfish (*Squalus mitsukuri*) (3%), Port Jackson shark (*Heterodontus portusjacksoni*) (3%), gummy shark (*Mustelus antarcticus*) (3%), southern fiddler ray (*Trygonorrhina fasciata*) (3%), and Melbourne skate (*Dipturus whitleyi*) (3%) (Table 4a).

Of the overall mean annual chondrichthyan catch estimate of 6467 tonnes, retained catch was highest for shark species (1993 t , 53%), followed by ray species (262 t , 10%) and holocephalan species (85 t, 89%) (Table 4a). Higher proportions of the catch were retained for quota and basket species (Table 4b). The chondrichthyan mass values reported above are whole mass, whereas the landed form of sharks and holocephalans is about two-thirds (headed and eviscerated carcass) and rays (margins of disc only) is about one-tenth.

Mean annual catch mass (retained and discarded) and catch rate (with standard error) (kg per shot), for each chondrichthyan species during 2000–06, are presented for each method. Also presented for each species by fishing method are percentages of shots with a catch exceeding 0 kg and percent of catch discarded (Tables 5a and 5b).

Determination of spatial and temporal trends in abundance

Extensive testing of various probability density functions (pdf), with and without the delta-x model formulation, against four different data selection criteria related to the number of zero CPUE observations in the data, indicated that the log-gamma pdf combined with the binomial pdf most often fit the data to provide results. Models fitted to the data when applying most other pdfs usually failed to converge. Models applying normal and log-normal pdfs often converged but these were rejected for two reasons. One reason is that they impose the assumption of homogeneous variance in the data, and the other reason is that use of these pdfs often predicts negative values either for mean values or for part of the range of the 95% confidence limits.

In addition to applying a standard method based on the delta-x formulation, with log-gamma pdf and binomial pdf, it was found that data selection could be simplified to Criterion 1 (>0 tows), which occasionally required minor constraints. These constraints included period (by excluding years at the beginning of the time series), longitude range, latitude range, or depth range (or a combination of these). Available ISMP data for 1992–1993 were rejected from all analyses and, for some species, it was necessary to reject data from some of the other early years because of uncertainty with species identification or missing data on depth of fishing.

Success of the delta-x model formulation combining log-gamma and binomial pdfs with data selection Criterion 1 for analysing ISMP data is not only highly statistically defensible, but simplifies the data selection and analysis procedures. The model formulation works for species of low abundance as well as species of high abundance, except data selected from a low number of tows causes the confidence limits to widen. Hence, all results presented in the present report are based on this model formulation with minimal data exclusion and without initial transformation or alteration to the resolution of the data. This remarkable discovery simplifies standardisation of ISMP CPUE data and, possibly, of fisher logbook CPUE data.

CPUE standardisation was undertaken for all species where there were more than ~500 otter trawl tows (less for several species) throughout the time series after applying data selection; the 95% confidence limits on the inter-annual trend become very wide with fewer tows. For some species it was necessary to analyse data within a western or eastern region (or both); these regions were normally divided at longitude 147° E or 149° E, depending on species. Analyses of several species were confined to the region off NSW. Details of the data selection criteria along with summary statistics for the standardisation analyses for each species are provided in Table 6.

A standard output for the CPUE standardisation analyses is provided for each species based variously on data from the SETF (1994–06) or GABTF (2000–06) or from the two SETF and GABTF combined (2000–06). Results are presented for each of 15 species of shark (Figures 3.01–3.15b), 18 species of rays (Figures 4.01a–4.18a), and 3 species of holocephalans (Figures 5.01a–5.03a). Because of difficulties encountered by observers distinguishing between species of gulper shark, the species were bulked for analysis, such that *Centrophorus* spp comprises four species. These species are mostly endeavour dogfish (*C. moluccensis*) and southern dogfish (*C. uyato*), with negligible quantities of Harrisons dogfish (*C. harrissoni*), and leafscale gulper shark (*C. squamosus*) for the western region of the SETF (Figure 3.16a) and for the eastern region of the SETF (Figure 3.16b). In addition to the figures, tables of the time series of raw CPUE and standardised CPUE adjusted against the mean raw CPUE are presented in tables along with the figures. The tables of adjusted standardised CPUE can be applied in species assessments. The 95% confidence limits on standardised CPUE for month, longitude-latitude and depth are variously suppressed for some species because they were wide and obscured the trend in mean standardised CPUE. The 95% confidence limits on standardised CPUE were retained for the annual trends of all species.

Inter-annual standardised CPUE trends for chondrichthyan species, where models converge, exhibited four distinct trend-patterns: rise–peak–decline, continual decline, continual rise, and no-trend. These patterns where inferred from regression analysis to test for 'increasing trend', 'decreasing trend' or 'no trend', and, where there was no trend, the time period was truncated to test whether or not there was a trend during 2000–06 or similar period. The continual-decline pattern is a special case of the rise–peak–decline pattern, where peaking occurred during 1992–94 or before commencement of the ISMP. The rise–peak–decline pattern and continual-decline pattern occurred more frequently than the continual-rise pattern and no-trend pattern in all three depth-categories. Where a model failed to converge to provide standardised CPUE, the trend was classed as 'indeterminable'.

Based on the results of the trend analyses, the chondrichthyan species are grouped within three depth-categories: continental-shelf depth-category (predominantly <200 m depth), the upper-slope–mid-slope category (predominantly 200–599 m depth), and the lower-slope category (predominantly ≥600 m depth). Of the species with sufficient data to undertake trend analyses, the 15 species of shark were distributed in all three depth-categories, whereas the 18 species of rays were predominantly distributed in the continental-shelf category, and the 3 species of holocephalans were distributed across the upper-slope–mid-slope category and the lower-slope category. The shark species in the continental-shelf category were taxonomically diverse, whereas the shark species in the two continental-slope depth-categories were either dogfish (family *Squalidae*) or catsharks. The continental shelf category included two species of angel shark (genus *Squatina*), two species of catshark (family *Scyliorhinidae*), two species of smoothhound (family *Triakidae*), common sawshark (*Pristiophorus cirratus*), and Port Jackson shark (*Heterodontus portusjacksoni*). The upper-slope–mid-slope category included two species of catshark—whitefin swell shark (*Cephaloscyllium* sp A) and sawtail shark (*Galeus boardmani*)—and two species of dogfish of genus *Squalus*, whereas the lower-slope depth-category included three species of dogfish of the genera *Dalatias*, *Deania*, and *Centroscymnus*. Whereas the data from trawl catches recorded by the ISMP for school shark (*Galeorhinus galeus*) are predominantly from the upper-slope–mid-slope category, data from gillnet and longline shark fishing in the GHATF indicate that school shark (Walker *et al.* 2005) are distributed predominantly in the continental-shelf depth-category (Table 7).

For the continental-shelf depth-category, eight species exhibited the rise–peak–decline pattern: Australian angel shark (*Squatina australis*) (peaked 1998), common sawshark (*Pristiophorus cirratus*) (2000), gummy shark (*Mustelus antarcticus*) (2000), ornate angel shark (*Squatina tergocellata*) (2003 in Great Australian Bight), Port Jackson shark (*Heterodontus portusjacksoni*) (1998 off eastern Australia), sandyback stingaree (*Urolophus bucculentus*) (2000), school shark (*Galeorhinus galeus*), and Sydney skate (*Dipterus australis*) off eastern Australia (2003). Three species exhibited the continual-decline pattern: longnose skate (*Raja* sp A), southern fiddler ray (*Trygonorrhina fasciata*), and sparsely spotted stingaree (*Urolophus paucimaculatus*). Five species in the continental-shelf depth-category exhibited the continual-rise pattern: the Bight skate (*Raja gudgeri*), eastern shovelnose ray (*Aptychotrema rostrata*), greenback stingaree (*Urolophus viridis*), Melbourne skate (*Raja whitleyi*), and Tasmanian numbfish (*Narcine tasmaniensis*). Ten species exhibited the no-trend pattern: draughtboard shark (*Cephaloscyllium laticeps*), grey spotted catshark (*Asymbolis analis*), banded stingaree (*Urolophus cruciatus*), black stingray (*Dasyatis thetidis*), common stingaree (*Trygonoptera testacea*), peacock skate (*Pavoraja nitida*), smooth stingray (*Dasyatis brevicaudata*), southern eagle ray (*Myliobatis australis*), short-tail torpedo ray (*Torpedo macneilli*), and wide stingaree (*Urolophus expansus*) in Great Australian Bight.

For the upper-slope–mid-slope depth-category, two species exhibited the rise–peak–decline pattern: greeneye spurdog (*Squalus mitsukurii*) (peaked 2001 in eastern SETF region and 1999 western SETF region) and whitefin swell shark (*Cephaloscyllium* sp A) (peaking 1997; both species exhibited severe decline after peaking. Only sawtail shark (*Galeus boardmani*) exhibited the continual-decline pattern, with minor change in CPUE, and only spikey spurdog (*Squalus megalops*) exhibited the continual-rise pattern, with major increase in CPUE. *Centrophorus* spp in the upper-slope–mid-slope category exhibited the no-trend pattern.

For the lower-slope depth-category, three species exhibited the continual-decline pattern: black shark (*Dalatias licha*), brier shark (*Deania calcea*), and Owstons dogfish (*Centroscymnus owstoni*). Three holocephalan species inhabit both mid-slope and lower-slope—blackfin ghostshark (*Hydrolagus lemurs*), Ogilbys ghostshark (*Hydrolagus ogilbyi*), and southern chimaera (*Chimaera* sp a)—of which all exhibited no trend.

In a complex multi-species fishery such as the SETF, it is difficult to distinguish between changes in fish abundance and changes in targeting, which are affected by catch rates and market forces. Of the species predominantly inhabiting depths ≥600 m, five had the continuous-decline pattern and one had the no-trend pattern, while fishing effort declined, suggesting an overall decline in abundance. The lack of the continual-rise pattern for any lower-slope species suggests that declining trends are more likely to be caused by declining stock abundance than by retargeting. For upper-slope–mid-slope species, 17 had the rise–peak–decline pattern or decline pattern, whereas 9 had the continual-rise pattern or no-trend pattern. On balance, more species exhibiting decline patterns than rise patterns suggests an overall decline in stock abundance, particularly as there has been a gradual decline in the number of tows since about 2003. Similarly, for shelf species, 13 had the rise–peak–decline pattern or continual-decline pattern, whereas 7 had the continual-rise pattern or no-trend pattern, suggesting some overall decline in stock abundance.

Interpreting the standardised CPUE time series is complex and outside the scope of the present study. Such an interpretation requires invoking several competing hypotheses to explain the observed patterns.

1. Change in standardised CPUE reflects a temporal change in relative abundance of fish on the fishing grounds from the effects of fishing mortality.
2. Change in standardised CPUE reflects a temporal change in relative abundance of fish on the fishing grounds from the effects of fishing altering habitats such that species are either attracted or repelled from an area because of changes in food availability or habitat suitability or both.
3. Change in standardised CPUE reflects a temporal change in relative abundance of fish on the fishing grounds from the effects of fishing altering the abundance of competitor species.
4. Change in standardised CPUE reflects a temporal change in the accuracy of species identification by on-board scientific observers.
5. Change in standardised CPUE reflects a temporal change in the targeting practices of fishers.

Interpreting the standardised CPUE patterns against these hypotheses requires examination of patterns of fishing effort by region and fishing depth during 1994–06. Of the seven SharkRAG regions (Figure 1), the highest levels of effort were in New South Wales and Eastern Bass Strait at 6000–13,000 trawl tows per year, whereas levels were low in Eastern Tasmania, Western Tasmania, Eastern South Australia, and South Australia–Victoria at 2000–4000 tows per year. Western Bass Strait was <1000 tows per year (Figure 6.01). East of longitude 146° East (eastern region), effort has been stable at ~20,000–27,000 tows per annum, whereas, west of longitude 146°E (western region), effort steadily rose to half this peak level at ~14,000 tows during 2002–04, which declined by ~50% during 2005–06 (Figure 6.01).

Depth of fishing has tended to remain fairly constant except during 1994, 1995 and 1997 when gemfish (*Rexea solandri*) recruitment failed and fishing in depths 200–599 m was markedly reduced in New South Wales and Eastern Tasmania (Figure 6.02). Most of the fishing effort was in depths of 0–199 m east of longitude 146° East and, until recently, in depths of 200–599 m west of longitude 146° East (Figure 6.03). In other words, most of the fishing was on top of the continental shelf off New South Wales, in eastern Bass Strait, and off eastern Tasmania. From southern Tasmania to the Great Australia Bight, most trawling was on the upper-slope and mid-slope, but during 2004–06, there was a shift in effort from the slope to the shelf, particularly in the Great Australian Bight.

Seasonal variation in catch rates of key quota teleost species suggest a tendency to vary targeting through the year successively from the shelf to deeper water on the slope: tiger flathead (*Neoplatycephalus richardsoni*) (May–June), eastern gemfish (June–August), blue warehou (*Seriolella brama*) (July–October), spotted warehou (*Seriolella punctata*) (July–October), orange roughy (September–November).

Following the mid-1990s, targeting on the upper-slope and mid-slope shifted from gemfish to a range of other species, including deepwater dogfish (family *Squalidae*) and blue grenadier (*Macruronus novaezelandiae*). Targeting for tiger flathead (*Neoplatycephalus richardsoni*) and other flatheads increased at this time on the continental shelf. This re-targeting, largely explains the initial increase in standardised CPUE for a number of species during 1997–2000, but the subsequent declines are likely to be a result of reduced abundance or further retargeting (Walker *et al.* 2007).

Some of the steepness of the major long-term decline of the upper-slope–mid-slope species *Squalus mitsukurii* may be partly attributable to misidentification of *Squalus megalops* as *S. mitsukurii* during the earlier years of the 1994–06 period. Conversely, *Squalus megalops* abundance appears not to have been markedly impacted by fishing off New South Wales (Andrew *et al.* 1997; Graham *et al.* 2001). There is a large population of *S. megalops* on the continental shelf, largely unaffected by gillnet of 6–6½-inch mesh-size adopted by the shark fishery (Walker *et al.* 2005), the most widespread fishing method on the shelf, that can sustainably support the large bycatch of this species by otter trawl.

In the eastern region on the continental shelf, increased targeting of tiger flathead during 2000–06 probably contributed to decreasing CPUE for *Heterodontus portusjacksoni*, *Mustelus antarcticus*, *Pristiophorus cirratus*, *Squatina australis*, *Trygonorrhina fasciata*, *Urolophus paucimaculatus*, and *U. viridis*. For some species, immigration to trawled regions from large populations distributed throughout south-eastern Australia might explain the increasing trend and no trend in standardised CPUE found for many species.

The standardised CPUE trends for *Galeorhinus australis* from the ISMP suggests abundance of mature males in the western region is continuing to decline. The switch from effort controls to quota management caused changed targeting practices, which created high uncertainty in interpretation of the fisher logbook CPUE for GHATF shark gillnet. It is likely that otter-trawl non-targeted CPUE provides a less biased indication of abundance than shark-gillnet targeted CPUE.

Squatina tergocellata and *Urolophus expansus*, which exhibit no trend in standardised CPUE, occur predominantly in the Great Australian Bight. Catches of both these species have risen rapidly in recent years.

During most of the period of the ISMP, scientific observers had difficulty distinguishing between the four species of gulper shark (*Centrophorus* spp): *C. uyato*, *C. moluccensis*, *C. harrissoni*, and *C. squamosus*. There is also a view among taxonomists that *C. uyato* needs to be divided into two separate species. Consequently, results of standardised CPUE trends are pooled rather than split by species. Independent survey data indicate that these species have been severely depleted (Andrew *et al.* 1997; Graham *et al.* 2001). Pooling ISMP data across all species indicates that the total population of *Centrophorus* spp is relatively stable at a low level. This suggests that most of the depletion occurred before the ISMP began and small populations persist in areas inaccessible to trawls. However, there is no information on whether the least abundant species (*C. harrissoni* and *C. squamosus*) are continuing to decline.

Mapping standardised CPUE for the GABTF and SETF on a single-page map is problematic. Because most of the trawl catch is taken on the continental slope and on the east coast where the continental shelf is very narrow, the isobaths are close together compared with those on top of the continental shelf throughout southern Australia. The implication of this is that a map of the entire region of the GABTF and SETF provides little clear visual definition of variation in CPUE and that a series of maps needs to be produced for each species to be useful. Hence, more than one map for each species of shark (Maps 1.01a–1.15c), ray (Maps 2.01a–2.14a), and holocephalan (Maps 3.01a–3.03a).

Identification of requirements for species management

Table 8a shows the number of separate species identified by the ISMP, the number of species identified by the ISMP but have their distribution mostly outside the range of the SESSF, and the number of species known from the scientific literature to occur predominantly within the range of the SESSF, yet not identified by the ISMP during 2000–06. Table 8b is a simplified version of Table 8a, where species distributed mostly outside the range of the SESSF are excluded. This gives a total of 77 shark species, 36 ray species, and 8 holocephalan species. In these two tables, based on mean annual catch during 2000–06, species are arbitrarily classed as 'rare' where mean annual catch is <1 t, 'sparse' where catch is 1–19 t, 'common' where catch is 20–99 t, and abundant where catch is ≥100 t. The 77 shark species were classed as 33 rare, 25 sparse, 8 common, and 11 abundant; the 36 ray species were classed as 8 rare, 9 sparse, 13 common, and 6 abundant; and the 8 holocephalan species were classed as 2 rare, 5 sparse, and 1 abundant.

Tables 9a (sharks), 9b (rays), and 9c (holocephalans) combine information from Table 8b and Tables 6 and 7. These tables attempt to simplify and create a framework for representing the vast volume of information of information provided in Tables 1–9. Within each of the three depth-categories of continental shelf (<200 m), upper-slope–mid-slope (200–599 m), and lower-slope (≥600 m), the tables identify individually the abundant and common species. Percentage of catch retained by fishers and a measure of risk, based on trend analysis, are presented for each of these species. For most species classed as 'sparse' or 'rare' and for some species classed as 'common', there were insufficient data for trend analysis; models applied using GENMOD in the statistical package SAS did not converge and hence provided an indeterminable result. For most species, the results of trend analysis were 'indeterminable' where the mean annual catch was below ~20 t or below ~500 trawl tows selected for analysis. The only exceptions to this pattern were three holocephalan species—blackfin ghostshark (*Hydrolagus lemurs*), Ogilbys ghostshark (*Hydrolagus ogilbyi*), and southern chimaera (*Chimaera* sp a)—where the models converged but exhibited 'no trend'.

Risk of population decline into the future classed as 'high', 'medium', or 'low' was calculated from standardised CPUE based on post-2000 decline (=mean CPUE 2004–06/mean CPUE 2000–02). Post-2000 decline to ≥0.667 was classed as 'low' risk, post-2000 decline to 0.334–0.666 was classed as 'medium' risk, and post-2000 decline to ≤0.333 was classed as 'high' risk. Post-2000 decline was 'indeterminable' for all rare species, most sparse species, and several 'common' species. For these species, greater coverage of otter trawl in the SESSF by the ISMP or change to the design of the ISMP would be required to provide sufficient statistical power to detect trends in standardised CPUE.

Species of shark on the continental shelf identified at 'medium' risk are school shark (*Galeorhinus galeus*), gummy shark (*Mustelus antarcticus*), common sawshark (*Pristiophorus cirratus*), and Australian angel shark (*Squatina australis*) (Table 9a). School shark, gummy shark and common sawshark, which are taken as target or byproduct species by shark gillnet, have undergone extensive ongoing stock assessment through SharkRAG and are now effectively carefully managed by a total allowable catch with individual transferable quota, a narrow mesh-size range (6–6½ inches) for shark gillnet, and closed areas (including nursery areas). For Australian angel shark, the region of medium risk from the effects of otter trawl is restricted to waters off New South Wales (Table 9a; Figures 3.01a, b and c). Although the species is exposed to shark gillnet throughout the rest of southern Australia on the continental shelf, shark gillnet takes a negligible catch (Walker and Gason 2005) and provide negligible risk.

Species of shark on the upper-slope–mid-slope and lower-slope identified at 'high' or 'medium' risk are whitefin swell shark (*Cephaloscyllium* sp a), greeneye spurdog (*Squalus megalops*), gulper sharks (*Centrophorus* spp), brier shark (*Deania calcea*), and black shark (*Dalatias licha*) (Table 9a). Analyses for the gulper sharks—mostly *Centrophorus moluccensis* and *C. uyato*, with negligible quantities of *C. harrissoni*, and *C. squamosus*—are at higher risk in the western region than in the eastern region of the SETF.

The rays are distributed mostly on the continental shelf and at 'low' risk from the effects of otter trawl. Three species are at 'medium risk': greenback stingaree (*Urolophus viridis*), sandyback stingaree (*U. bucculentus*), and sparsely spotted stingaree (*U. paucimaculatus*) (Table 9b).

Species of holocephalan are mostly distributed on the continental slope, with only the elephant fish (*Callorhinchus milii*) distributed on the continental shelf. Catches are low and insufficient to detect statistically significant trends (Table 9c).

In summary, species identified as having their populations markedly reduced from the effects of fishing and requiring special rehabilitation are the gulper sharks (*Centrophorus* spp) and the greeneye spurdog (*Squalus mitsukurii*). Catches of these species and the other deepwater species of dogfish *Centroscymnus owstoni*, *Deania calcea*, and *Dalatias licha* are now carefully monitored and controlled by trip limits. The species are partly controlled by a basket trip limit for dogfish to prevent fishers from targeting these species. A temporary closed area for gulper sharks and *Galeorhinus galeus* was presently established on the continental slope off Kangaroo Island in South Australia. However, following survey of the waters off South Australia and Western Australia by automatic longline fishing to assess their suitability for closed areas for gulper sharks and *Galeorhinus galeus* resulted in dismantling this closure and establishing one further west.

Various updates of the results of the analyses presented in this report and a separate report on scalefish (Walker *et al.* 2007) have been presented to AFMA. The results have provided an important input to the decision making processes associated with setting basket quotas for dogfish and holocephalans, and for establishing spatial closures during June 2007. Many of these spatial closures are targeted at improved management of school shark through protection of breeding animals and of gulper sharks through four gulper shark closures. Deepwater dogfish and holocephalans will receive additional protection through the closure of all waters of depth greater than 700 m in the SETF.

Evaluation of shark field guide for ISMP and logbook data

An important feature of the ISMP is that the accuracy of species identification of sharks, rays and holocephalans in the database has improved with time, which can be attributed to several factors. The most important factor is improved stability in staffing of the ISMP with time; observers are confronted with several hundred different species to identify and it takes time to learn to distinguish the species. The recent staff can all be characterised as highly trained and experienced in species identification. During 1992–04, there have been 24 different observers with rapid turn over in staffing during the early phases of the ISMP. At present, the five on-board scientific observers all have 8–14 years experience undertaking this at-sea work. Another feature is that taxonomic uncertainties are being gradually resolved and the observers are regularly advised of these developments.

Both scientific observers and fishers find the diagrams with clear labels make the guide easy to use and find the compact size and waterproof pages much more convenient to use than the other available texts for taxonomic identification of species. Observers report that they would like to see additional species included.

The Field Guide to Australian Sharks and Rays (Daley *et al.* 2002a) very clearly identifies key taxonomic features pictorially with clear labels for distinguishing between closely related species. The waterproof pages provide for a durable guide. The guide was only recently published, whereas the most useful guides used previously were published in 1994 (Goman *et al.* 1994; Last and Stevens 1994), so the guide has only the recent developments. It will take some time before the influence of the guide can be detected.

Benefits and Adoption

Benefits from the present project are allocated as 58% to the Commercial Sector (25% SETF, 10% GABTF, 15% GHATF, 2% NSW, 2% South Australia, 2% Tasmania, and 2% Victoria) and 2% Recreational Sector (½% NSW, ½% South Australia, ½% Tasmania, and ½% Victoria). The remaining 40% consists of 20% national ecological interests through the Department of Environment and Heritage (DEH) and 20% international commitments through the Department of Agriculture, Fisheries and Forests (DAFF).

Catches and catch rates of byproduct catch and bycatch species are not adequately monitored by fisher logbooks and therefore need to be monitored either by fishery-independent survey or by on-board observer programs. The results from synthesis of ISMP data for sharks, rays and holocephalans are available for the for management of these species.

Documentation of the results from the present project, and the capacity developed during the project to update readily the results, provides a basis for catch evaluation and determining trends in abundance and spatial distribution of chondrichthyan byproduct and bycatch species. As the data sets are updated, summarised and analysed, the results can be presented periodically to SharkRAG, GHATMAC, SESSMAC, and other resource assessment groups and management advisory committees. The results are now available to the Commonwealth and State agencies connected with fisheries management for input into various ongoing consultative and management processes (see Planned Outcomes).

Further Development

Conduct of the present project required development of improved data management and data analysis processes for the ISMP data and required integration of these data with fisher logbook data. The understanding and processes developed as part of this project will facilitate periodic update of analyses for species of sharks, rays and holocephalans and has already enabled cost-effective analysis of similar data from the ISMP for species of teleosts, hagfishes, cephalopods, crustaceans, and other invertebrates. Increasingly various Fishery Resource Assessment Groups are requesting standardisation of CPUE. For example, the standardised CPUE trends for school shark using ISMP data are now being used routinely as an index of abundance for stock assessment.

There is scope for additional work with the ISMP data. Further work might show that certain trends are a result of incorrect species identification or certain artefacts of the data.

The results from the present project are of wide scientific interest and to ensure the scientific defensibility of the results and the defensibility of ecological risk assessments based on the methods developed by the project, the results are being prepared for publication in internationally recognised scientific journals.

Planned Outcomes

Results from the present project provide fundamental information required for several regional, national, and international fishery-management processes. (1) AFMA's requirement for provision of data and data synthesis to resource assessment groups and fishery management committees involving industry, scientist, and fishery managers associated with the SESSF. (2) Department of Environment and Heritage (DEH) requirement under the Commonwealth Environmental Protection and Biodiversity Conservation (EPBC) Act 1999 for a Strategic Environmental Impact Assessment for each Commonwealth managed fishery and each export State-managed fishery. (3) DEH's requirement under the EPBC Act 1999 to identify threatened and potentially threatened marine and estuarine fishes. (4) AFMA's requirement to develop a Bycatch Action Plan for each major Commonwealth managed fishery under Australia's Fisheries Management Act 1991. (5)

Commonwealth Fisheries Minister's direction of December 2005 for AFMA to cease overfishing and to halve bycatch. (6) Department of Agriculture Fisheries and Forests (DAFF) international obligation to update periodically the Shark Assessment Report and Shark Plan, which form Australia's National Plan of Action for the Management and Conservation of Sharks (NPOA-Sharks). As a signatory nation to the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks), developed by the United Nations Food and Agriculture Organisation (FAO), Australia is required to report periodically these documents to the FAO Committee of Fisheries (COFI).

Relative catches between species and trends in catch and standardised CPUE determined by the present project serve as sustainability indicators for byproduct and bycatch species, consistent with the ESD reporting and assessment framework developed through the former Standing Committee on Fisheries and Aquaculture (SCFA). Each species in the SETF, GABTF or both is classed as having standardised CPUE during 2000–06 'declining', 'increasing', 'no trend', or 'indeterminable' from available ISMP data. Each species identified as taken in the GABTF, SETF or GHATF is classed into one of four abundance categories: 'abundant', 'common', 'sparse', or 'rare'. In addition, based on spatial distribution and inhabited water depth, each species is classed into one of three depth ranges: 'continental shelf', 'upper-slope–mid-slope', or 'lower-slope'. Maps and graphs indicating spatial distribution and relative abundance serve to indicate sensitive areas for threatened and potentially threatened species. These outputs serve as an important input to FRDC Project 2002/033 ('Rapid assessment of sustainability for ecological risk of shark and other chondrichthyan bycatch in the SESSF').

In addition to providing results immediately applicable for ecological risk assessment and fishery management, the present project provides facility for rapid data access and update of statistical analyses as required. Data and specific analyses can be provided readily to other scientists and fisheries mangers as required. Results from the project will also be made available to scientists, fishery managers, industry personnel, and other beneficiaries in the form of the present report final to FRDC and scientific papers and other reports as they are published.

The present project focused on analysis of available data on sharks, rays and holocephalans, but the new data management and analysis processes can cost-effectively process available ISMP and fisher logbook data to provide updated evaluation of byproduct catch and bycatch and trends in abundance of any species. These systems and methods developed as part of the present project were applied recently to teleost, hagfish, cephalopod, crustacean, and other invertebrate species as part of AFMA Project R05/1096 using National Heritage Trust funds provided by DEH (Walker *et al.* 2007). The results from the present report and AFMA Project R05/1096 have been an essential input to AFMA's decision processes in establishing closed areas, fishing depth limits, and species trip limits.

A major outcome from the project was to develop appropriate methods to analyse data from the ISMP. The present report focussing on sharks, rays and holocephalans, together with the report focussing on other groups (Walker *et al.* 2007), provide the most comprehensive analysis of the data collected by the ISMP since it began in 1992. To apply the most scientifically defensible methods and provide up-to-date information, components of the data have been variously reanalysed several times and presented to AFMA, CSIRO, SharkRAG, and several industry forums. The results of these analyses have been a major input to the decision-making processes associated with setting basket quotas for dogfish and holocephalans, and for establishing spatial closures during June 2007. Many of these spatial closures improve management of school shark through protection of breeding animals and of gulper shark and greeneye spurdog through four gulper shark closures. Deepwater dogfish and holocephalans will receive additional protection through the closure of all waters of depth greater than 700 m in the SETF.

Conclusion

Excluding species detected by the ISMP that are mainly distributed outside the range of the SESSF and adding species not detected by the ISMP, but known from the literature to be mainly distributed within the range of the SESSF, gives a total of 121 chondrichthyan species (77 shark, 36 ray, and 8 holocephalan species). The 77 shark species were classed as 33 rare, 25 sparse, 8 common, and 11 abundant; the 36 ray species were classed as 8 rare, 9 sparse, 13 common, and 6 abundant; and the 8 holocephalan species were classed as 2 rare, 5 sparse, and 1 abundant.

The overall mean annual chondrichthyan catch estimate during 2000–06 for southern and eastern Australia from eight fishing methods is at 6467 tonnes: 3731 t of shark species (58%), 2641 t of ray species (41%), and 95 t of holocephalan species (1%). The highest chondrichthyan catch was provided by SETF otter trawl (4377 t, 66%) followed by GABTF otter trawl (1468 t, 22%), SETF Danish seine (560 t, 9%), GHATF scalefish longline (112 t, 2%), and GHATF automatic longline (72 t, 1%). The three other methods of GHATF trap, GHATF dropline, GHATF scalefish longline, and GHATF scalefish gillnet together provided a negligible catch (7 t, 0%). About two-thirds of the overall catch comprises only 14 species.

As part of trend analysis of each species for the effects of year, month, depth of fishing, and location, the log-gamma pdf–binomial pdf delta-x model formulation usually converged without having to apply data selection criteria to reduce zero CPUE values. However, all model formulations usually failed to converge for rare (mean annual catch was <1 t) and sparse (<20 t) species and for datasets where there were less than ~500 trawl tows. This is an important finding and has wide application for the analysis of CPUE data. This is because it overcomes the statistically questionable practices commonly adopted to avoid zero CPUE values.

Species identified as requiring stock rehabilitation are the gulper sharks (*Centrophorus* spp) and the greeneye spurdog (*Squalus mitsukurii*), and several byproduct dogfish species (*Centroscymnus owstoni*), (*Deania calcea*), and (*Dalatias licha*) require careful monitoring and management. Several bycatch species of stingaree, the whitefin swellshark (*Cephaloscyllium* sp a), and the rare and sparse require a precautionary approach to management.

The standardised CPUE trends for *Galeorhinus australis* from the ISMP for otter trawl are now used for stock assessment. This is because the switch from effort controls to quota management caused changed targeting practices, which created high uncertainty in interpretation of the fisher logbook CPUE for GHATF shark gillnet. It is likely that for shark otter trawl non-targeted CPUE provides a less biased indication of abundance than gillnet targeted CPUE.

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Appendix 1: Intellectual Property

No intellectual property has arisen from the research that is likely to lead to significant commercial benefits, patents or licences. Intellectual property associated with information produced from the project will be shared equally by the Fisheries Research and Development Corporation and by the Victorian Department of Primary Industries.

Appendix 2: Staff

Organisation, position, period on the project and percentage of time each year on the project are listed for each staff member at the Department of Primary Industries.

Terence Walker	Principal Investigator	1 Jul 01–30 Jun 02	45%
Anne Gason	Biometrician	1 Jul 99–30 Jun 00	35%

Table 1. Fishing effort observed by ISMP during 2000–06 and reported by fishers on logbooks during 2000–05

Fishing effort monitored by onboard scientific observers was recorded as part of the Integrated Scientific Monitoring Program (ISMP) and fishing effort for the fishery was determined from AFMA fisher logbooks for each SESSF sector, except the Shark Gillnet Sector.

Data source	Depth range (m)	Number of tows, lifts or sets for each fishing method							
		GABTF Otter trawl (tows)	SETF Otter trawl (tows)	SETF Danish Seine (tows)	GHATF Trap (trap-lifts)	GHATF Dropline (line-lifts)	GHATF ALL (sets)	GHATF Longline (sets)	GHATF Gill net (sets)
ISMP observed	0–199	875	2743	471	0	55	9	23	4 [A]
fishing effort	200–599	129	2503	0	56	627	565	40	29
during 2000–06	≥600	145	495	0	1	137	3	23	0
	Total	1149	5741	471	57	819	577	86	33
Fishery reported	0–199	3454	15332	7945	2	15	4	595	12040
mean annual	200–599	320	13014	0	65	670	419	200	167
fishing effort	≥600	272	3956	0	0	8	45	2	2
during 2000–05	Total	4045	32302	7945	67	693	468	797	12209
Annual	0–199	3.62	2.56	0.85	0.00	53.57	30.86	0.55	0.00
per cent	200–599	5.76	2.75		12.31	13.36	19.29	2.85	2.48
sampled	≥600	7.62	1.79			249.85 [B]	0.95	219.05 [B]	0.00
	Total	4.06	2.54	0.85	12.09	16.89	17.62	1.54	0.04

[A]GHATF gillnet for the 0–199 m depth range was excluded from the analysis because of the very small number number of sets monitored by the ISMP (4 sets during 7 years) compared with the large number of sets reported by commercial fishers (12,040 sets as mean annual effort) (most sets of GHATF gillnet in this depth range are targeted at gummy shark and catch evaluation for the SESSF Shark Gillnet Sector is reported from a separate survey (Walker et al. 2005). [B]Anomalies where the number of line-lifts or sets monitored by the ISMP exceeds that reported for the SESSF Sector is a result of differences in the depth ranges of fishing reported independently by ISMP observers on data sheets and by commercial fishers on logbook returns.

Table 2. Estimates of mean annual catch mass for each sector of the SESSF by depth category during 2000–06

Shark longline and shark gillnet sectors of the SESSF were not monitored by the ISMP during 2000–06.

Depth category (metres)	Species category	Catch mass (tonnes) for each fishing method								
		GABTF Otter trawl	SETF Otter trawl	SETF Danish seine	GHATF Trap	GHATF Dropline	GHATF Automatic longline	GHATF Scalefish longline	GHATF Scalefish gillnet	Total
0–199	Sharks	612	1029	202	0	0	0	52	0	1896
	Rays	708	1207	317	0	0	0	23	0	2254
	Holocephalans	3	8	41	0	0	0	0	0	52
	Scale fish	4248	9929	2658	0	0	1	26	0	16863
	Hagfish	0	0	0	0	0	0	0	0	0
	Cephalopods	106	392	20	0	0	0	0	0	518
	Crustaceans	7	82	9	0	0	0	0	0	97
	Other Invertebrates	414	98	123	0	0	0	0	0	635
	Total	6098	12745	3369	0	0	2	102	0	22315
200–599	Sharks	67	1108	0	0	1	50	32	6	1263
	Rays	41	352	0	0	0	6	4	0	402
	Holocephalans	2	27	0	0	0	2	0	1	31
	Scale fish	411	12953	0	41	21	181	177	39	13823
	Hagfish	0	1	0	0	0	0	0	0	1
	Cephalopods	20	661	0	0	0	0	0	0	681
	Crustaceans	2	394	0	0	0	0	0	0	397
	Other Invertebrates	16	43	0	0	0	0	0	0	60
	Total	559	15539	0	42	22	239	213	45	16658
≥600	Sharks	33	620	0	0	0	15	0	0	668
	Rays	1	16	0	0	0	0	0	0	18
	Holocephalans	1	11	0	0	0	0	0	0	12
	Scale fish	304	5131	0	0	0	19	2	0	5456
	Hagfish	0	0	0	0	0	0	0	0	0
	Cephalopods	2	14	0	0	0	0	0	0	16
	Crustaceans	0	36	0	0	0	0	0	0	36
	Other Invertebrates	3	21	0	0	0	0	0	0	24
	Total	344	5849	0	0	0	34	2	0	6230
Total (Sum of above)	Sharks	713	2757	202	0	1	65	85	6	3828
	Rays	750	1575	317	0	0	6	26	0	2674
	Holocephalans	5	45	41	0	0	2	1	1	94
	Scale fish	4962	28013	2658	41	22	202	205	39	36142
	Hagfish	0	1	0	0	0	0	0	0	1
	Cephalopods	128	1068	20	0	0	0	0	0	1215
	Crustaceans	9	511	9	0	0	0	0	0	530
	Other Invertebrates	434	163	123	0	0	0	0	0	719
	Total	7001	34133	3369	42	23	274	317	45	45204
Total (Estimated independently of above)	Sharks	704	2671	202	0	1	56	91	6	3731
	Rays	691	1607	317	0	0	6	20	0	2641
	Holocephalans	7	45	41	0	0	2	1	1	95
	Scale fish	4943	27625	2658	42	22	202	669 [A]	39	36200
	Hagfish	0	1	0	0	0	0	0	0	1
	Cephalopods	126	1120	20	0	0	0	0	0	1266
	Crustaceans	9	534	9	0	0	0	0	0	552
	Other Invertebrates	399	161	123	0	0	0	0	0	683
	Total	6880	33764	3369	42	23	266	781	45	45171

[A]Catches of species on the continental slope overestimated by large number of shark longline sets in the data.

Table 3. Number of species captured for each sector of the SESSF by depth during 2000–06

Shark longline and shark gillnet sectors of the SESSF were not monitored by the ISMP during 2000–06.

Depth category (metres)	Species category	Number of species for each fishing method								
		GABTF Otter trawl	SETF Otter trawl	SETF Danish seine	GHATF Trap	GHATF Dropline	GHATF Automatic longline	GHATF Scalefish longline	GHATF Scalefish gillnet	Total
0–199	Sharks	30	44	24	0	1	9	13	0	51
	Rays	27	35	30	0	0	3	10	0	41
	Holocephalans	4	7	2	0	0	0	1	0	7
	Scale fish	115	238	134	0	8	15	13	0	282
	Hagfish	0	0	0	0	0	0	0	0	0
	Cephalopods	5	7	9	0	0	0	1	0	11
	Crustaceans	7	20	8	0	0	0	0	0	21
	Other Invertebrates	14	14	11	0	0	0	1	0	21
	Total	202	365	218	0	9	27	39	0	434
200–599	Sharks	25	50	0	1	15	37	13	12	59
	Rays	20	35	0	0	3	11	4	1	38
	Holocephalans	4	9	0	0	0	5	2	1	9
	Scale fish	82	211	0	14	25	76	22	21	241
	Hagfish	0	2	0	0	1	2	0	0	3
	Cephalopods	4	12	0	1	0	2	0	0	12
	Crustaceans	6	19	0	4	0	5	2	0	20
	Other Invertebrates	9	13	0	7	0	2	0	0	17
	Total	150	351	0	27	44	140	43	35	399
≥600	Sharks	19	29	0	0	2	6	7	0	36
	Rays	4	12	0	0	1	1	2	0	14
	Holocephalans	6	11	0	0	0	0	1	0	11
	Scale fish	68	163	0	0	6	11	11	0	174
	Hagfish	0	1	0	0	0	0	0	0	1
	Cephalopods	3	5	0	0	0	0	0	0	5
	Crustaceans	3	13	0	0	0	1	0	0	13
	Other Invertebrates	5	6	0	0	0	1	0	0	7
	Total	108	240	0	0	9	20	21	0	261
Total (Estimated independently of above)	Sharks	41	63	24	1	16	37	20	12	72
	Rays	30	39	30	0	4	11	12	1	47
	Holocephalans	7	12	2	0	0	5	2	1	12
	Scale fish	172	360	134	14	28	76	35	21	409
	Hagfish	0	2	0	0	1	2	0	0	3
	Cephalopods	5	13	9	1	0	2	1	0	15
	Crustaceans	7	28	8	4	0	5	2	0	30
	Other Invertebrates	14	16	11	7	0	2	1	0	23
	Total	276	533	218	27	49	140	73	35	611

Table 4a. Estimates of mean annual catch mass of each species in the SESSF during 2000–06

Catch is determined as (CPUE for onboard observations) x (mean annual fishing effort reported on fisher logbooks); GHATF gillnet at depths of 0–199 m (4 sets) is all assumed to be targeted at shark excluded from the analysis; se, standard error; cum, cummulative catch. Sorted in descending order of annual total catch estimate for each major taxonomic group.

Table 4a. Continued

Common name	Scientific name	Annual catch estimate			Total annual catch estimate				
		Retained		Discarded	Estimate	se	se	(%)	Cum
		(kg)	(%)	(kg)	(kg)	(kg)	(%)		(%)
Sharks (Selachii)									
Spikey spurdog	*Squalus megalops*	198122	28	521075	719197	48906	7	19.3	19
Whitefin swell shark	*Cephaloscyllium sp A*	39611	10	345590	385201	17993	5	10.3	30
Australian angelshark	*Squatina australis*	301855	97	9470	311325	12932	4	8.3	38
Ornate angelshark	*Squatina tergocellata*	217016	75	72411	289427	11217	4	7.8	46
Common sawshark	*Pristiophorus cirratus*	256960	93	19005	275965	14396	5	7.4	53
Brier shark	*Deania calcea*	208586	81	48065	256651	31257	12	6.9	60
Draughtboard shark	*Cephaloscyllium laticeps*	107194	47	119670	226864	10650	5	6.1	66
Greeneye dogfish	*Squalus mitsukurii*	51172	24	161021	212193	15656	7	5.7	72
Port Jackson shark	*Heterodontus portusjacksoni*	0	0	210653	210653	9944	5	5.6	77
Gummy shark	*Mustelus antarcticus*	174822	94	10636	185458	7438	4	5.0	82
Platypus shark	*Deania spp*	89709	93	7109	96818	22972	24	2.6	85
Black shark	*Dalatias licha*	36262	45	44907	81169	10370	13	2.2	87
Owston dogfish	*Centroscymnus owstoni*	65509	93	5260	70769	9458	13	1.9	89
Golden dogfish	*Centroscymnus crepidater*	51509	93	4098	55607	11945	21	1.5	91
School shark	*Galeorhinus galeus*	33049	94	2095	35144	3696	11	0.9	91
Southern sawshark	*Pristiophorus nudipinnis*	30899	96	1148	32047	6198	19	0.9	92
Endeavour dogfish	*Centrophorus moluccensis*	19269	64	10928	30197	5649	19	0.8	93
Grey spotted catshark	*Asymbolus analis*	0	0	25884	25884	2170	8	0.7	94
Spotted wobbegong	*Orectolobus maculatus*	21672	89	2800	24472	2416	10	0.7	94
Sawtail catshark	*Galeus boardmani*	0	0	23076	23076	1832	8	0.6	95
Sharpnose sevengill shark	*Heptranchias perlo*	3449	18	15803	19252	2456	13	0.5	96
Rusty carpetshark	*Parascyllium ferrugineum*	0	0	18689	18689	3329	18	0.5	96
Bronze whaler	*Carcharhinus brachyurus*	15294	90	1788	17082	3264	19	0.5	97
Thresher shark	*Alopias vulpinus*	14576	94	926	15502	3348	22	0.4	97
Southern lanternshark	*Etmopterus granulosus*	7905	54	6826	14731	3147	21	0.4	97
Gulper shark (unspecified)	*Centrophorus spp*	9778	70	4217	13995	2847	20	0.4	98
Southern dogfish	*Centrophorus uyato*	10355	88	1471	11826	2095	18	0.3	98
Unspecified & other sharks	*Selachii*	276	3	10533	10809	2674	25	0.3	98
Collar carpetshark	*Parascyllium collare*	168	2	9778	9946	895	9	0.3	99
Blackbelly lanternshark	*Etmopterus lucifer*	38	1	4701	4739	608	13	0.1	99
Longsnout dogfish	*Deania quadrispinosa*	2209	52	2037	4246	1677	39	0.1	99
Slender lanternshark	*Etmopterus pusillus*	2559	63	1472	4031	922	23	0.1	99
Whitespotted dogfish	*Squalus acanthias*	3024	81	688	3712	986	27	0.1	99
Sandtiger shark	*Odontaspis ferox*	2979	85	526	3505	1043	30	0.1	99
Broadnose sevengill shark	*Notorynchus cepedianus*	2618	91	258	2876	502	17	0.1	99
Smooth hammerhead	*Sphyrna zygaena*	2740	96	118	2858	438	15	0.1	99
Tiger shark	*Galeocerdo cuvier*	2759	100	0	2759	1392	50	0.1	99
Grey nurse shark	*Carcharias taurus*	91	3	2601	2692	1292	48	0.1	99
Scalloped hammerhead	*Sphyrna lewini*	2580	100	0	2580	1054	41	0.1	100
Shortfin mako	*Isurus oxyrinchus*	2321	98	38	2359	1007	43	0.1	100
Southern sleeper shark	*Somniosus antarcticus*	0	0	1912	1912	1247	65	0.1	100
White shark	*Carcharodon carcharias*	228	14	1403	1631	1182	72	0.0	100
Basking shark	*Cetorhinus maximus*	0	0	1405	1405	1405	100	0.0	100
Portuguese dogfish	*Centroscymnus coelolepis*	0	0	1383	1383	423	31	0.0	100
Prickly dogfish	*Oxynotus bruniensis*	21	2	1075	1096	146	13	0.0	100
Whiskery shark	*Furgaleus macki*	939	99	9	948	325	34	0.0	100
Blue shark	*Prionace glauca*	873	97	28	901	262	29	0.0	100
Smooth lanternshark	*Etmopterus bigelowi*	155	19	653	808	300	37	0.0	100
Orange spotted catshark	*Asymbolus rubiginosus*	0	0	696	696	547	79	0.0	100
Gulf catshark	*Asymbolus vincenti*	0	0	632	632	117	19	0.0	100
Banded wobbegong	*Orectolobus ornatus*	563	99	6	569	411	72	0.0	100
White-spotted gummy shark	*Mustelus sp B*	381	99	3	384	181	47	0.0	100
Dwarf catshark	*Asymbolus parvus*	0	0	371	371	119	32	0.0	100
Plunket dogfish	*Centroscymnus plunketi*	181	70	77	258	136	53	0.0	100
Bluntnose sixgill shark	*Hexanchus griseus*	254	100	0	254	246	97	0.0	100
Harrisson dogfish	*Centrophorus harrissoni*	110	65	59	169	70	41	0.0	100
Smalltooth cookiecutter shark	*Isistius brasiliensis*	16	10	141	157	114	73	0.0	100
Porbeagle	*Lamna nasus*	25	19	105	130	66	51	0.0	100
Frill shark	*Chlamydoselachus anguineus*	3	3	107	110	58	53	0.0	100
Eastern angel shark	*Squatina sp A*	100	100	0	100	100	100	0.0	100
Fleshynose catshark	*Apristurus sp C*	0	0	100	100	29	29	0.0	100
Variegated catshark	*Asymbolus submaculatus*	0	0	83	83	36	43	0.0	100
Western spotted catshark	*Asymbolus occiduus*	0	0	69	69	31	44	0.0	100
Crested hornshark	*Heterodontus galeatus*	0	0	68	68	29	43	0.0	100
Velvet dogfish	*Zameus squamulosus*	0	0	55	55	55	100	0.0	100
Leafscale gulper shark	*Centrophorus squamosus*	1	3	32	33	32	97	0.0	100
Zebra shark	*Stegostoma fasciatum*	0	0	32	32	29	91	0.0	100

Table 4a. Continued

Common name	Scientific name	Annual catch estimate			Total annual catch estimate				
		Retained		Discarded	Estimate	se	se	(%)	Cum
		(kg)	(%)	(kg)	(kg)	(kg)	(%)		(%)
Reticulate swellshark	*Cephaloscyllium fasciatum*	0	0	29	29	29	100	0.0	100
Fossil shark	*Hemipristis elongata*	18	100	0	18	18	100	0.0	100
Crocodile shark	*Pseudocarcharias kamoharai*	0	0	14	14	14	100	0.0	100
Blind shark	*Brachaelurus waddi*	0	0	13	13	13	100	0.0	100
Pinocchio catshark	*Apristurus sp G*	0	0	6	6	6	100	0.0	100
Mandarin shark	*Cirrhigaleus barbifer*	0	0	0	0	0	100	0.0	100
Total	*Selachii*	1992804		1737936	3730740	75885	2	100.0	
Rays (Batoidea)									
Greenback stingaree	*Urolophus viridis*	0	0	454679	454679	31128	7	17.2	17
Wide stingaree	*Urolophus expansus*	0	0	351084	351084	29785	8	13.3	31
Southern fiddler ray	*Trygonorrhina fasciata*	57140	26	162099	219239	11838	5	8.3	39
Melbourne skate	*Dipturus whitleyi*	52108	30	124145	176253	8794	5	6.7	45
Sydney skate	*Dipturus australis*	0	0	157239	157239	5683	4	6.0	51
Sandyback stingaree	*Urolophus bucculentus*	23202	19	100655	123857	6698	5	4.7	56
Unspecified & other rays	*Batoidea*	3778	3	110339	114117	10215	9	4.3	60
Skate (unspecified)	*Rajidae*	6981	7	97762	104743	8007	8	4.0	64
Black stingray	*Dasyatis thetidis*	24909	26	70834	95743	6237	7	3.6	68
Sparsely-spotted stingaree	*Urolophus paucimaculatus*	1260	1	88606	89866	8834	10	3.4	71
Smooth stingray	*Dasyatis brevicaudata*	4289	5	84216	88505	5520	6	3.4	75
Southern eagle ray	*Myliobatis australis*	48303	55	39958	88260	9131	10	3.3	78
Bight skate	*Dipturus gudgeri*	2611	3	85524	88135	4546	5	3.3	81
Short-tail torpedo ray	*Torpedo macneilli*	0	0	71912	71912	3615	5	2.7	84
Banded stingaree	*Urolophus cruciatus*	0	0	70322	70322	3974	6	2.7	87
Peacock skate	*Pavoraja nitida*	0	0	69717	69717	4034	6	2.6	89
Tasmanian numbfish	*Narcine tasmaniensis*	0	0	55989	55989	3701	7	2.1	92
Whitespotted skate	*Dipturus cerva*	98	0	37242	37340	3912	10	1.4	93
Common stingaree	*Trygonoptera testacea*	0	0	30766	30766	2944	10	1.2	94
Longnose skate	*Dipturus sp A*	16582	67	8093	24675	2522	10	0.9	95
Eastern shovelnose ray	*Aptychotrema rostrata*	17527	77	5359	22886	1902	8	0.9	96
Thornback skate	*Dipturus lemprieri*	73	0	19816	19889	7254	36	0.8	97
Deepwater skate	*Dipturus sp J*	3022	19	12884	15906	2264	14	0.6	97
Grey skate	*Dipturus sp B*	76	1	13182	13258	2083	16	0.5	98
Stingaree (unspecified)	*Urolophidae*	0	0	10454	10454	3628	35	0.4	98
Coffin ray	*Hypnos monopterygium*	0	0	9296	9296	1304	14	0.4	99
Stingray (unspecified)	*Dasyatidae*	42	1	7308	7350	1939	26	0.3	99
Western shovelnose ray	*Aptychotrema vincentiana*	11	0	7287	7298	903	12	0.3	99
Yellowback stingaree	*Urolophus sufflavus*	0	0	4776	4776	1134	24	0.2	99
Pink whipray	*Himantura fai*	0	0	4572	4572	1142	25	0.2	100
Spotted stingaree	*Urolophus gigas*	0	0	2578	2578	2265	88	0.1	100
Brown stingaree	*Urolophus westraliensis*	0	0	2536	2536	413	16	0.1	100
Electric ray (unspecified)	*Torpedinidae*	0	0	2289	2289	538	24	0.1	100
Western shovelnose stingaree	*Trygonoptera mucosa*	0	0	1560	1560	442	28	0.1	100
Kapala stingaree	*Urolophus kapalensis*	0	0	1169	1169	339	29	0.0	100
Guitarfish (unspecified)	*Rhinobatidae*	227	24	719	946	342	36	0.0	100
Eastern shovelnose stingaree	*Trygonoptera sp B*	0	0	720	720	263	36	0.0	100
Blue skate	*Notoraja sp A*	0	0	653	653	226	35	0.0	100
Bluespotted maskray	*Dasyatis kuhlii*	0	0	141	141	141	100	0.0	100
Eastern fiddler ray	*Trygonorrhina sp A*	0	0	130	130	96	74	0.0	100
Pygmy devilray	*Mobula eregoodootenkee*	0	0	110	110	55	50	0.0	100
Australian butterfly ray	*Gymnura australis*	0	0	101	101	101	100	0.0	100
Sawfish (unspecified)	*Pristidae*	0	0	68	68	68	100	0.0	100
Boreal skate	*Amblyraja hyperborea*	0	0	57	57	37	65	0.0	100
Western numbfish	*Narcine lasti*	0	0	39	39	19	49	0.0	100
Longtail torpedo ray	*Torpedo sp A*	0	0	29	29	29	100	0.0	100
Whitespotted guitarfish	*Rhynchobatus australiae*	0	0	21	21	21	100	0.0	100
Total	*Batoidea*	262238		2379035	2641273	52476	2	100.0	
Holocephalans (*Holocephalii*)									
Elephantfish	*Callorhinchus milii*	45201	94	2759	47960	14717	31	50.3	50
Southern chimaera	*Chimaera sp A*	10959	89	1419	12378	1232	10	13.0	63
Blackfin ghostshark	*Hydrolagus lemures*	7912	74	2733	10645	1080	10	11.2	74
Ogilby ghostshark	*Hydrolagus ogilbyi*	9147	89	1139	10286	854	8	10.8	85
Shortnose chimaera (unspecified)	*Chimaeridae*	8304	86	1341	9645	1341	14	10.1	95
Bigspine spookfish	*Harriotta raleighana*	1717	85	293	2010	381	19	2.1	97
Pacific spookfish	*Rhinochimaera pacifica*	577	48	623	1200	335	28	1.3	99
Black ghostshark	*Hydrolagus sp A*	798	83	160	958	245	26	1.0	100
Giant chimaera	*Chimaera lignaria*	0	0	97	97	48	49	0.1	100
Marbled ghostshark	*Hydrolagus sp B*	0	0	68	68	42	62	0.1	100
Shortspine chimaera	*Chimaera sp B*	0	0	45	45	32	71	0.0	100
Spookfish (unspecified)	*Rhinochimaeridae*	23	100	0	23	16	70	0.0	100
Total	*Holcephalii*	84639		10676	95315	14904	16	100.0	

Table 4b. Estimates of mean annual catch mass of each quota or basket species in the SESSF during 2000–06

Catch is determined as (CPUE for onboard observations) x (mean annual fishing effort reported on fisher logbooks); GHATF gillnet at depths of 0–199 m is all assumed to be targeted at shark excluded from the analysis; se, standard error. Sorted in descending order of annual total catch estimate for each major taxonomic group.

Table 4b. Continued

Common name	Scientific name	Annual catch estimate			Total annual catch estimate		
		Retained		Discarded	Estimate	se	se
		(kg)	(%)	(kg)	(kg)	(kg)	(%)
Sharks (Selachii)–continental shelf							
Common sawshark	*Pristiophorus cirratus*	256960	93	19005	275965	14396	5
Gummy shark	*Mustelus antarcticus*	174822	94	10636	185458	7438	4
School shark	*Galeorhinus galeus*	33049	94	2095	35144	3696	11
Southern sawshark	*Pristiophorus nudipinnis*	30899	96	1148	32047	6198	19
Total		495730	94	32884	528614	17739	3
Sharks (Selachii)–deepwater							
Brier shark	*Deania calcea*	208586	81	48065	256651	31257	12
Platypus shark	*Deania spp*	89709	93	7109	96818	22972	24
Black shark	*Dalatias licha*	36262	45	44907	81169	10370	13
Owston dogfish	*Centroscymnus owstoni*	65509	93	5260	70769	9458	13
Golden dogfish	*Centroscymnus crepidater*	51509	93	4098	55607	11945	21
Southern lanternshark	*Etmopterus granulosus*	7905	54	6826	14731	3147	21
Blackbelly lanternshark	*Etmopterus lucifer*	38	1	4701	4739	608	13
Longsnout dogfish	*Deania quadrispinosa*	2209	52	2037	4246	1677	39
Slender lanternshark	*Etmopterus pusillus*	2559	63	1472	4031	922	23
Portuguese dogfish	*Centroscymnus coelolepis*	0	0	1383	1383	423	31
Smooth lanternshark	*Etmopterus bigelowi*	155	19	653	808	300	37
Plunket dogfish	*Centroscymnus plunketi*	181	70	77	258	136	53
Total		464623	79	126587	591210	43111	7
Sharks (Selachii)–gulper sharks							
Endeavour dogfish	*Centrophorus moluccensis*	19269	64	10928	30197	5649	19
Gulper shark (unspecified)	*Centrophorus spp*	9778	70	4217	13995	2847	20
Southern dogfish	*Centrophorus uyato*	10355	88	1471	11826	2095	18
Harrisson dogfish	*Centrophorus harrissoni*	110	65	59	169	70	41
Leafscale gulper shark	*Centrophorus squamosus*	1	3	32	33	32	97
Total		39513	70	16707	56220	6664	12
Holocephalans (*Holocephalii*)							
Elephantfish	*Callorhinchus milii*	45201	94	2759	47960	14717	31
Southern chimaera	*Chimaera sp A*	10959	89	1419	12378	1232	10
Blackfin ghostshark	*Hydrolagus lemures*	7912	74	2733	10645	1080	10
Ogilby ghostshark	*Hydrolagus ogilbyi*	9147	89	1139	10286	854	8
Shortnose chimaera (unspecified)	*Chimaeridae*	8304	86	1341	9645	1341	14
Bigspine spookfish	*Harriotta raleighana*	1717	85	293	2010	381	19
Pacific spookfish	*Rhinochimaera pacifica*	577	48	623	1200	335	28
Black ghostshark	*Hydrolagus sp A*	798	83	160	958	245	26
Giant chimaera	*Chimaera lignaria*	0	0	97	97	48	49
Marbled ghostshark	*Hydrolagus sp B*	0	0	68	68	42	62
Shortspine chimaera	*Chimaera sp B*	0	0	45	45	32	71
Spookfish (unspecified)	*Rhinochimaeridae*	23	100	0	23	16	70
Total		84639	89	10676	95315	14904	16

Table 5a. Mean annual catch rate for each species in the GABTF otter trawl, SETF otter trawl, SETF Danish seine, and GHATF trap during 2000–06

For each species and method, '% of tows, lifts or sets >0 kg' is the percent of observed tows, lifts or sets in the ISMP database during 2000–06 with a greater than zero catch mass. For each species and method, 'catch' is mean annual catch mass estimated from the observer mean catch per unit effort weighted to total effort (tows, lifts or sets) as reported in fisher logbooks during 2000–05. Species with blank fields for any fishing method were not detected by the ISMP during 2000–06.

Table 5a (continued)

Common name	Scientific name	Depth	Total annual	GABTF otter trawl						SETF otter trawl						SETF Danish seine						GHATF trap					
		category	catch (kg)	% tows	kg per tow		% dis-	Annual catch (kg)		% tows	kg per tow		% dis-	Annual catch (kg)		% tows	kg per tow		% dis-	Annual catch (kg)		% tows	kg per trap-lift		% dis-	Annual catch (kg)	
		(metres)	Estimate	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se
Sharks (Selachii)																											
Australian angelshark	*Squatina australis*	0–199	255022							46	16.2012	0.7248	1	248402	11113	14	0.8333	0.1469	51	6620	1167						
		200–599	50507							13	3.8809	0.4075	4	50507	5303												
		≥600	0																								
		Total	311325							28	9.4329	0.3987	2	304705	12879	14	0.8333	0.1469	51	6620	1167						
Banded wobbegong	*Orectolobus ornatus*	0–199	638		0.1829	0.1332		632	460		0.0004	0.0004	100	6	6												
		200–599	0																								
		≥600	0																								
		Total	569		0.1393	0.1015		563	411		0.0002	0.0002	100	6	6												
Basking shark	*Cetorhinus maximus*	0–199	0																								
		200–599	1300								0.0999	0.0999	100	1300	1300												
		≥600	0																								
		Total	1405								0.0435	0.0435	100	1405	1405												
Black shark	*Dalatias licha*	0–199	2293	1	0.0549	0.0264	100	190	91		0.0022	0.0022		34	34												
		200–599	39095	4	0.2868	0.1561	41	92	50	7	2.9271	0.4691	84	38094	6105												
		≥600	52378	9	0.6276	0.1865	96	170	51	40	13.1861	2.7928	25	52162	11048												
		Total	81169	2	0.1532	0.0359	85	620	145	6	2.4179	0.3199	56	78104	10334												
Blackbelly lanternshark	*Etmopterus lucifer*	0–199	53																								
		200–599	523								0.0120	0.0043	100	156	56												
		≥600	5436	5	0.7310	0.3170	100	199	86	11	1.3202	0.2004	99	5222	793												
		Total	4739	1	0.0923	0.0405	100	373	164	1	0.1191	0.0180	99	3847	581												
Blind shark	*Brachaelurus waddi*	0–199	0																								
		200–599	12																								
		≥600	0																								
		Total	13																								
Blue shark	*Prionace glauca*	0–199	15																								
		200–599	588																								
		≥600	2																								
		Total	901																								
Bluntnose sixgill shark	*Hexanchus griseus*	0–199	276		0.0800	0.0800		276	276																		
		200–599	7																								
		≥600	0																								
		Total	254		0.0609	0.0609		246	246																		
Brier shark	*Deania calcea*	0–199	7258								0.0011	0.0011		17	17												
		200–599	31303	10	1.3953	0.4335	2	446	139	5	0.8757	0.1873	8	11397	2438												
		≥600	286691	11	35.0207	10.3040	1	9514	2799	41	66.7533	9.8859	8	264065	39107												
		Total	256651	3	4.5762	1.3416	1	18510	5427	6	6.1379	0.8901	8	198268	28752												
Broadnose sevengill shark	*Notorynchus cepedianus*	0–199	2417		0.0514	0.0383	67	178	132	1	0.1422	0.0290	1	2180	445		0.0074	0.0053	100	59	42						
		200–599	431								0.0240	0.0123	17	312	160												
		≥600	0																								
		Total	2876		0.0392	0.0292	67	159	118	1	0.0784	0.0149	3	2533	481		0.0074	0.0053	100	59	42						
Bronze whaler	*Carcharhinus brachyurus*	0–199	12935	1	1.0457	0.3570		3611	1233	1	0.6081	0.1634	18	9324	2505												
		200–599	4003	2	1.3178	0.9298		421	297		0.2701	0.1209		3515	1573												
		≥600	0																								
		Total	17082	1	0.9443	0.2913		3820	1178	1	0.4083	0.0942	13	13189	3043												
Collar carpetshark	*Parascyllium collare*	0–199	9821							8	0.6296	0.0562	100	9653	862		0.0212	0.0212		168	168						
		200–599	57								0.0044	0.0040	100	57	52												
		≥600	0																								
		Total	9946							4	0.3027	0.0272	100	9778	879		0.0212	0.0212		168	168						

Table 5a (continued)

Common name	Scientific name	Depth category (metres)	Total annual catch (kg) Estimate	GABTF otter trawl % tows >0 kg	GABTF kg per tow Mean	GABTF kg per tow se	GABTF % discard	GABTF Annual catch (kg) Estimate	GABTF Annual catch (kg) se	SETF otter trawl % tows >0 kg	SETF otter trawl kg per tow Mean	SETF otter trawl kg per tow se	SETF otter trawl % discard	SETF otter trawl Annual catch (kg) Estimate	SETF otter trawl Annual catch (kg) se	SETF Danish seine % tows >0 kg	SETF Danish seine kg per tow Mean	SETF Danish seine kg per tow se	SETF Danish seine % discard	SETF Danish seine Annual catch (kg) Estimate	SETF Danish seine Annual catch (kg) se	GHATF trap % tows >0 kg	GHATF trap kg per trap-lift Mean	GHATF trap kg per trap-lift se	GHATF trap % discard	GHATF trap Annual catch (kg) Estimate	GHATF trap Annual catch (kg) se
Sharks (Selachii) (continued)																											
Common sawshark	*Pristiophorus cirratus*	0–199	182548	69	19.5019	2.2160	18	67350	7653	40	6.2989	0.4272	1	96577	6550	31	2.3439	0.3321	11	18621	2638						
		200–599	85472	33	43.6667	15.4013	22	13959	4923	17	5.4912	0.5387	2	71463	7011												
		≥600	4028							2	1.0182	0.5298		4028	2096												
		Total	275965	56	19.7539	2.4321	19	79901	9837	27	5.4915	0.3150	1	177388	10175	31	2.3439	0.3321	11	18621	2638						
Crested hornshark	*Heterodontus galeatus*	0–199	67								0.0044	0.0019	100	67	29												
		200–599	0																								
		≥600	0																								
		Total	68								0.0021	0.0009	100	68	29												
Crocodile shark	*Pseudocarcharias kamoharai*	0–199	0																								
		200–599	0																								
		≥600	7	1	0.0276	0.0276	100	7	7																		
		Total	14		0.0035	0.0035	100	14	14																		
Draughtboard shark	*Cephaloscyllium laticeps*	0–199	190664		0.0343	0.0198	100	118	68	34	10.0503	0.5888	40	154095	9028	48	4.3864	0.3736	81	34848	2968						
		200–599	33349							7	2.1278	0.2988	75	27692	3889												
		≥600	40								0.0101	0.0101	100	40	40												
		Total	226864		0.0261	0.0151	100	106	61	19	5.7305	0.3149	46	185109	10172	48	4.3864	0.3736	81	34848	2968						
Dwarf catshark	*Asymbolus parvus*	0–199	302								0.0142	0.0058	100	218	89		0.0106	0.0076	100	84	60						
		200–599	62								0.0048	0.0036	100	62	47												
		≥600	0																								
		Total	371								0.0089	0.0032	100	287	103		0.0106	0.0076	100	84	60						
Eastern angel shark	*Squatina sp A*	0–199	0																								
		200–599	94								0.0072	0.0072		94	94												
		≥600	0																								
		Total	100								0.0031	0.0031		100	100												
Endeavour dogfish	*Centrophorus moluccensis*	0–199	13099	2	0.6789	0.2302		2345	795		0.2570	0.1721	100	3940	2639	4	0.8577	0.5162	100	6814	4101						
		200–599	14902	9	3.0310	1.0912		969	349	4	1.0020	0.1872		13040	2436												
		≥600	1335							2	0.3374	0.1496		1335	592												
		Total	30197	2	0.8573	0.2149		3468	869	2	0.5887	0.1167	21	19016	3770	4	0.8577	0.5162	100	6814	4101						
Fleshynose catshark	*Apristurus sp C*	0–199	0																								
		200–599	0																								
		≥600	144							3	0.0364	0.0100	100	144	40												
		Total	100								0.0031	0.0009	100	100	29												
Fossil shark	*Hemipristis elongata*	0–199	0																								
		200–599	12	1	0.0388	0.0388		12	12																		
		≥600	0																								
		Total	18		0.0044	0.0044		18	18																		
Frill shark	*Chlamydoselachus anguineus*	0–199	0																								
		200–599	3																								
		≥600	152							1	0.0384	0.0210	100	152	83												
		Total	110								0.0033	0.0018	100	107	58												
Golden dogfish	*Centroscymnus crepidater*	0–199	0																								
		200–599	3237								0.2393	0.2013	43	3114	2620												
		≥600	73564	6	0.6828	0.2735	6	185	74	21	18.5495	4.0925	5	73379	16189												
		Total	55607	1	0.0862	0.0351	6	349	142	2	1.7037	0.3697	7	55033	11942												
Greeneye dogfish	*Squalus mitsukurii*	0–199	72249	28	13.2983	1.4292	73	45926	4936	2	1.5406	0.5452	57	23621	8359	2	0.3248	0.1335	100	2580	1061						
		200–599	122672	66	36.5504	7.5551	78	11684	2415	22	7.1986	0.7617	75	93684	9913												
		≥600	10202	4	0.6828	0.3783	85	185	103	4	2.5313	1.4523	95	10013	5745												
		Total	212193	29	14.3168	1.4037	75	57909	5678	11	4.0928	0.4416	73	132207	14265	2	0.3248	0.1335	100	2580	1061						
Grey nurse shark	*Carcharias taurus*	0–199	2703		0.2857	0.2857	100	987	987		0.1119	0.0611	100	1716	937												
		200–599	78								0.0060	0.0060		78	78												
		≥600	0																								
		Total	2692		0.2176	0.2176	100	880	880		0.0561	0.0293	95	1812	946												

Table 5a (continued)

Common name	Scientific name	Depth category (metres)	Total annual catch (kg) Estimate	GABTF otter trawl % tows >0 kg	GABTF kg per tow Mean	GABTF kg per tow se	GABTF % dis-card	GABTF Annual catch (kg) Estimate	GABTF Annual catch (kg) se	SETF otter trawl % tows >0 kg	SETF otter kg per tow Mean	SETF otter kg per tow se	SETF otter % dis-card	SETF otter Annual catch (kg) Estimate	SETF otter Annual catch (kg) se	SETF Danish seine % tows >0 kg	SETF DS kg per tow Mean	SETF DS kg per tow se	SETF DS % dis-card	SETF DS Annual catch (kg) Estimate	SETF DS Annual catch (kg) se	GHATF trap % tows >0 kg	GHATF kg per trap-lift Mean	GHATF kg per trap-lift se	GHATF % dis-card	GHATF Annual catch (kg) Estimate	GHATF Annual catch (kg) se
Sharks (Selachii) (continued)																											
Grey spotted catshark	*Asymbolus analis*	0–199	25230	12	0.8378	0.1196	100	2893	413	17	1.0454	0.0991	100	16028	1519	8	0.7941	0.1848	100	6309	1468						
		200–599	786	2	0.0698	0.0624	100	22	20	2	0.0587	0.0117	100	764	152												
		≥600	0																								
		Total	25884	9	0.6459	0.0919	100	2613	372	9	0.5251	0.0481	100	16962	1554	8	0.7941	0.1848	100	6309	1468						
Gulf catshark	*Asymbolus vincenti*	0–199	628	5	0.1737	0.0363	100	600	125		0.0018	0.0012	100	28	18												
		200–599	55	2	0.0698	0.0443	100	22	14		0.0016	0.0010	100	21	13												
		≥600	0																								
		Total	632	4	0.1401	0.0282	100	567	114		0.0016	0.0007	100	52	23												
Gulper shark (unspecified)	*Centrophorus spp*	0–199	508		0.0366	0.0344	100	126	119		0.0011	0.0011	100	17	17		0.0425	0.0425	100	338	338						
		200–599	5088							2	0.2115	0.0588	3	2752	765												
		≥600	8073	24	7.0897	4.1224	21	1926	1120	5	1.5539	0.5441	10	6147	2152												
		Total	13995	3	0.9225	0.5239	23	3731	2119	2	0.2267	0.0537	7	7323	1735		0.0425	0.0425	100	338	338						
Gummy shark	*Mustelus antarcticus*	0–199	166934	61	19.1303	1.0751	1	66066	3713	24	2.8489	0.1818	1	43680	2787	34	3.3051	0.3674	31	26257	2919						
		200–599	40248	8	1.1008	0.4189		352	134	16	2.9692	0.3073	1	38642	3999												
		≥600	1999							2	0.5051	0.2506	4	1998	991												
		Total	185458	47	14.6919	0.8527	1	59426	3449	19	2.6993	0.1614	1	87194	5214	34	3.3051	0.3674	31	26257	2919						
Harrisson dogfish	*Centrophorus harrissoni*	0–199	28								0.0018	0.0018		28	28												
		200–599	131								0.0024	0.0018		31	23												
		≥600	0																								
		Total	169								0.0019	0.0012		61	39												
Leafscale gulper shark	*Centrophorus squamosus*	0–199	0																								
		200–599	32								0.0024	0.0024	100	31	31												
		≥600	0																								
		Total	33								0.0010	0.0010	100	32	32												
Longsnout dogfish	*Deania quadrispinosa*	0–199	23								0.0015	0.0015		23	23												
		200–599	837								0.0571	0.0221	21	743	288												
		≥600	4723							2	1.1939	0.5900	56	4723	2334												
		Total	4246								0.1285	0.0519	49	4151	1676												
Mandarin shark	*Cirrhigaleus barbifer*	0–199	0																								
		200–599	0																								
		≥600	0																								
		Total	0																								
Orange spotted catshark	*Asymbolus rubiginosus*	0–199	152								0.0022	0.0013	100	34	20		0.0149	0.0114	100	118	91						
		200–599	505								0.0388	0.0384	100	505	500												
		≥600	0																								
		Total	696								0.0179	0.0167	100	578	539		0.0149	0.0114	100	118	91						
Ornate angelshark	*Squatina tergocellata*	0–199	305381	95	88.4217	3.1618	25	305364	10919								0.0021	0.0021	100	17	17						
		200–599	11989	36	37.3411	9.0662	23	11937	2898		0.0040	0.0040	100	52	52												
		≥600	19	1	0.0690	0.0690	100	19	19																		
		Total	289427	76	71.5370	2.7731	25	289355	11217		0.0017	0.0017	100	55	55		0.0021	0.0021	100	17	17						
Owston dogfish	*Centroscymnus owstoni*	0–199	0																								
		200–599	3758	1	0.4031	0.4031	4	129	129	1	0.1946	0.1297	8	2533	1688												
		≥600	92609	12	4.1172	1.5570	8	1119	423	40	22.9414	3.1609	6	90752	12504												
		Total	70769	2	0.5648	0.2050	8	2285	829	4	2.0629	0.2907	6	66636	9390												
Pinocchio catshark	*Apristurus sp G*	0–199	0																								
		200–599	0																								
		≥600	8								0.0020	0.0020	100	8	8												
		Total	6								0.0002	0.0002	100	6	6												
Platypus shark	*Deania spp*	0–199	84								0.0055	0.0041	67	84	63												
		200–599	5586	1	0.9302	0.9302	100	297	297	2	0.3004	0.0816	15	3909	1062												
		≥600	95711	9	71.5517	30.2913	12	19438	8229	6	19.2808	5.9600	2	76272	23577												
		Total	96818	1	9.1340	3.8763	13	36946	15679	1	1.7960	0.5195	3	58015	16781												

Table 5a (continued)

Common name	Scientific name	Depth category (metres)	Total annual catch (kg) Estimate	GABTF otter trawl % tows >0 kg	GABTF kg per tow Mean	GABTF kg per tow se	GABTF % discard	GABTF Annual catch (kg) Estimate	GABTF Annual catch (kg) se	SETF otter trawl % tows >0 kg	SETF otter kg per tow Mean	SETF otter kg per tow se	SETF otter % discard	SETF otter Annual catch (kg) Estimate	SETF otter Annual catch (kg) se	SETF Danish seine % tows >0 kg	SETF Danish kg per tow Mean	SETF Danish kg per tow se	SETF Danish % discard	SETF Danish Annual catch (kg) Estimate	SETF Danish Annual catch (kg) se	GHATF trap % tows >0 kg	GHATF kg per trap-lift Mean	GHATF kg per trap-lift se	GHATF % discard	GHATF Annual catch (kg) Estimate	GHATF Annual catch (kg) se
Sharks (Selachii) (continued)																											
Plunket dogfish	*Centroscymnus plunketi*	0–199	0																								
		200–599	0																								
		≥600	367							1	0.0929	0.0484	30	367	191												
		Total	258								0.0080	0.0042	30	258	136												
Porbeagle	*Lamna nasus*	0–199	0																								
		200–599	119																								
		≥600	0																								
		Total	130																								
Port Jackson shark	*Heterodontus portusjacksoni*	0–199	185384	40	5.5749	0.4197	100	19253	1449	34	10.1557	0.5156	100	155711	7905	14	0.9469	0.1696	100	7523	1347						
		200–599	25896	8	1.3566	0.4694	100	434	150	4	1.9565	0.3791	100	25462	4934												
		≥600	6	1	0.0207	0.0207	100	6	6																		
		Total	210653	31	4.4003	0.3299	100	17798	1334	18	5.7053	0.3020	100	184295	9755	14	0.9469	0.1696	100	7523	1347						
Portuguese dogfish	*Centroscymnus coelolepis*	0–199	0																								
		200–599	1279							1	0.0983	0.0300	100	1279	390												
		≥600	0																								
		Total	1383								0.0428	0.0131	100	1383	423												
Prickly dogfish	*Oxynotus bruniensis*	0–199	0																								
		200–599	817	1	0.0155	0.0155	100	5	5	2	0.0615	0.0091	98	800	118												
		≥600	287	1	0.0276	0.0194	100	7	5	2	0.0707	0.0229	100	280	91												
		Total	1096		0.0052	0.0030	100	21	12	1	0.0329	0.0045	98	1063	145												
Reticulate swellshark	*Cephaloscyllium fasciatum*	0–199	0																								
		200–599	26								0.0020	0.0020	100	26	26												
		≥600	0																								
		Total	29								0.0009	0.0009	100	29	29												
Rusty carpetshark	*Parascyllium ferrugineum*	0–199	18938	16	1.1246	0.1626	100	3884	562	3	0.4632	0.1924	100	7102	2950	17	0.9977	0.1778	100	7926	1413						
		200–599	128	1	0.0078	0.0078	100	2	2		0.0096	0.0047	100	125	61												
		≥600	0																								
		Total	18689	12	0.8573	0.1246	100	3468	504	2	0.2255	0.0920	100	7284	2972	17	0.9977	0.1778	100	7926	1413						
Sandtiger shark	*Odontaspis ferox*	0–199	44								0.0029	0.0029		44	44												
		200–599	3198							2	0.2457	0.0740	15	3198	963												
		≥600	0																								
		Total	3505							1	0.1085	0.0323	15	3505	1043												
Sawtail catshark	*Galeus boardmani*	0–199	3537	3	0.2851	0.1243	100	985	429	3	0.1646	0.0359	100	2524	550												
		200–599	17699	32	3.4109	0.7394	100	1090	236	19	1.1740	0.1168	100	15279	1520												
		≥600	3	1	0.0103	0.0077	100	3	2																		
		Total	23076	6	0.6014	0.1292	100	2433	523	10	0.5905	0.0542	100	19075	1751												
Scalloped hammerhead	*Sphyrna lewini*	0–199	2893	2	0.8377	0.3418		2893	1180																		
		200–599	0																								
		≥600	0																								
		Total	2580	2	0.6379	0.2605		2580	1054																		
School shark	*Galeorhinus galeus*	0–199	7626	4	0.2869	0.0642		991	222	2	0.4076	0.0775	1	6249	1188		0.0085	0.0060	100	68	48						
		200–599	22851	12	2.0775	0.7276		664	233	8	1.3228	0.1237	5	17215	1610												
		≥600	1351							1	0.3414	0.1695		1351	671												
		Total	35144	4	0.4517	0.0965		1827	390	4	0.8009	0.0673	4	25871	2174		0.0085	0.0060	100	68	48						
Sharpnose sevengill shark	*Heptranchias perlo*	0–199	7231	7	1.5646	0.2793	97	5403	965	1	0.0514	0.0157	70	788	241	1	0.0170	0.0116	25	135	92						
		200–599	10999	22	12.2636	3.6318	92	3920	1161	4	0.4203	0.0863	90	5470	1123												
		≥600	41	1	0.1517	0.1385	91	41	38																		
		Total	19252	8	2.5875	0.4703	94	10466	1902	2	0.2078	0.0384	88	6712	1240	1	0.0170	0.0116	25	135	92						
Shortfin mako	*Isurus oxyrinchus*	0–199	654		0.0114	0.0114	100	39	39		0.0401	0.0366		615	561												
		200–599	1620								0.0360	0.0291		469	379												
		≥600	3																								
		Total	2359		0.0087	0.0087	100	35	35		0.0348	0.0216		1124	698												

Table 5a (continued)

Common name	Scientific name	Depth category (metres)	Total annual catch (kg) Estimate	GABTF otter trawl % tows >0 kg	GABTF kg per tow Mean	GABTF kg per tow se	GABTF % dis-card	GABTF Annual catch (kg) Estimate	GABTF Annual catch (kg) se	SETF otter trawl % tows >0 kg	SETF otter kg per tow Mean	SETF otter kg per tow se	SETF otter % dis-card	SETF otter Annual catch (kg) Estimate	SETF otter Annual catch (kg) se	SETF Danish seine % tows >0 kg	SETF Danish kg per tow Mean	SETF Danish kg per tow se	SETF Danish % dis-card	SETF Danish Annual catch (kg) Estimate	SETF Danish Annual catch (kg) se	GHATF trap % tows >0 kg	GHATF kg per trap-lift Mean	GHATF kg per trap-lift se	GHATF % dis-card	GHATF Annual catch (kg) Estimate	GHATF Annual catch (kg) se
Sharks (Selachii) (continued)																											
Slender lanternshark	*Etmopterus pusillus*	0–199	0																								
		200–599	36								0.0028	0.0022	71	36	29												
		≥600	5468	6	0.4483	0.1895	12	122	51	10	1.3515	0.3243	37	5346	1283												
		Total	4031	1	0.0566	0.0242	12	229	98	1	0.1177	0.0284	38	3802	917												
Smalltooth cookiecutter shark	*Isistius brasiliensis*	0–199	0																								
		200–599	41								0.0016	0.0013	25	21	17												
		≥600	160								0.0404	0.0404	100	160	160												
		Total	157								0.0042	0.0035	88	136	113												
Smooth hammerhead	*Sphyrna zygaena*	0–199	2859	2	0.2891	0.0754		998	260	2	0.1137	0.0223		1743	342		0.0149	0.0149	100	118	118						
		200–599	67	2	0.2093	0.1483		67	47																		
		≥600	0																								
		Total	2858	2	0.2437	0.0599		986	242	1	0.0543	0.0107		1754	346		0.0149	0.0149	100	118	118						
Smooth lanternshark	*Etmopterus bigelowi*	0–199	0																								
		200–599	211								0.0016	0.0008	100	21	10												
		≥600	815							2	0.2061	0.1062	73	815	420												
		Total	808								0.0185	0.0092	74	598	297												
Southern dogfish	*Centrophorus uyato*	0–199	514								0.0321	0.0135	15	492	207												
		200–599	7519	5	3.6667	2.6705	13	1172	854	4	0.4387	0.0940	8	5709	1223												
		≥600	3823	2	0.1862	0.1535	7	51	42	3	0.9535	0.3713	1	3772	1469												
		Total	11826	1	0.4352	0.3013	12	1760	1219	2	0.2888	0.0525	6	9329	1696												
Southern lanternshark	*Etmopterus granulosus*	0–199	215								0.0073	0.0073		112	112												
		200–599	4782							1	0.3452	0.1575		4492	2050												
		≥600	12990	3	0.1103	0.0546	100	30	15	13	3.2762	0.7799	67	12960	3085												
		Total	14731		0.0139	0.0070	100	56	28	1	0.4370	0.0969	44	14116	3130												
Southern sawshark	*Pristiophorus nudipinnis*	0–199	30917	7	0.4551	0.1172	45	1572	405	2	0.2264	0.0912		3471	1398	23	3.2569	0.7461	2	25874	5927						
		200–599	1180								0.0907	0.0769		1180	1001												
		≥600	0																								
		Total	32047	5	0.3466	0.0894	45	1402	362	1	0.1477	0.0550		4771	1777	23	3.2569	0.7461	2	25874	5927						
Southern sleeper shark	*Somniosus antarcticus*	0–199	0																								
		200–599	1612								0.1239	0.0876	100	1612	1140												
		≥600	240								0.0606	0.0606	100	240	240												
		Total	1912								0.0592	0.0386	100	1912	1247												
Spikey spurdog	*Squalus megalops*	0–199	310797	44	16.6274	1.7816	100	57423	6153	23	13.4779	2.0669	64	206648	31690	34	5.8790	0.8559	100	46706	6800						
		200–599	377295	40	40.8140	7.6009	99	13047	2430	32	27.8072	2.5310	69	361888	32939												
		≥600	512	1	0.0690	0.0690	100	19	19	1	0.1172	0.0634	29	464	251												
		Total	719197	38	17.2533	1.6280	100	69787	6585	25	18.5733	1.4853	67	599961	47979	34	5.8790	0.8559	100	46706	6800						
Spotted wobbegong	*Orectolobus maculatus*	0–199	23137	12	5.6514	0.5995	6	19517	2070	1	0.1466	0.0404		2248	619		0.0425	0.0425	100	338	338						
		200–599	3737	1	0.4651	0.4651	100	149	149		0.2757	0.0916	32	3588	1192												
		≥600	0																								
		Total	24472	9	4.3560	0.4645	7	17619	1879	1	0.1902	0.0444	20	6144	1434		0.0425	0.0425	100	338	338						
Thresher shark	*Alopias vulpinus*	0–199	419								0.0273	0.0273		419	419												
		200–599	13956							1	1.0659	0.2353	6	13872	3062												
		≥600	0																								
		Total	15502								0.4778	0.1036	6	15434	3347												
Tiger shark	*Galeocerdo cuvier*	0–199	2738								0.1786	0.0902		2738	1383												
		200–599	0																								
		≥600	0																								
		Total	2759								0.0854	0.0431		2759	1392												
Unspecified & other sharks	*Selachii*	0–199	10383	7	0.3543	0.0589	100	1224	203	1	0.1458	0.0447	100	2235	685	11	0.8716	0.3223	100	6924	2561						
		200–599	306	2	0.0775	0.0475	100	25	15		0.0216	0.0145	7	281	189												
		≥600	288								0.0727	0.0707	100	288	280												
		Total	10809	6	0.2785	0.0453	100	1126	183	1	0.0854	0.0231	90	2759	746	11	0.8716	0.3223	100	6924	2561						

Table 5a (continued)

Common name	Scientific name	Depth category (metres)	Total annual catch (kg) Estimate	GABTF otter trawl % tows >0 kg	GABTF kg per tow Mean	GABTF kg per tow se	GABTF % discard	GABTF Annual catch (kg) Estimate	GABTF Annual catch (kg) se	SETF otter trawl % tows >0 kg	SETF OT kg per tow Mean	SETF OT kg per tow se	SETF OT % discard	SETF OT Annual catch (kg) Estimate	SETF OT Annual catch (kg) se	SETF Danish seine % tows >0 kg	SETF DS kg per tow Mean	SETF DS kg per tow se	SETF DS % discard	SETF DS Annual catch (kg) Estimate	SETF DS Annual catch (kg) se	GHATF trap % tows >0 kg	GHATF kg per trap-lift Mean	GHATF kg per trap-lift se	GHATF % discard	GHATF Annual catch (kg) Estimate	GHATF Annual catch (kg) se
Sharks (Selachii) (continued)																											
Variegated catshark	*Asymbolus submaculatus*	0–199	93	1	0.0269	0.0116	100	93	40																		
		200–599	0																								
		≥600	0																								
		Total	83	1	0.0205	0.0088	100	83	36																		
Velvet dogfish	*Zameus squamulosus*	0–199	0																								
		200–599	0																								
		≥600	80								0.0202	0.0202	100	80	80												
		Total	55								0.0017	0.0017	100	55	55												
Western spotted catshark	*Asymbolus occiduus*	0–199	70								0.0007	0.0005	100	11	8	1	0.0074	0.0038	100	59	30						
		200–599	0																								
		≥600	0																								
		Total	69								0.0003	0.0002	100	10	6	1	0.0074	0.0038	100	59	30						
Whiskery shark	*Furgaleus macki*	0–199	1054	2	0.3051	0.1055	1	1054	364																		
		200–599	7																								
		≥600	0																								
		Total	948	2	0.2324	0.0804	1	940	325																		
White shark	*Carcharodon carcharias*	0–199	1621								0.1057	0.0765	86	1621	1173												
		200–599	0																								
		≥600	0																								
		Total	1631								0.0505	0.0366	86	1631	1182												
Whitefin swell shark	*Cephaloscyllium sp A*	0–199	31116	1	0.1383	0.0498	100	478	172	5	1.4340	0.1862	50	21987	2855	3	0.4331	0.1720	100	3441	1366						
		200–599	310243	48	20.1783	2.3519	100	6450	752	50	21.5408	1.1632	91	280336	15138							2	0.0357	0.0357		2	2
		≥600	4209	1	0.3448	0.2479	100	94	67	6	0.8105	0.3713	100	3206	1469												
		Total	385201	7	2.4143	0.3262	100	9765	1319	25	10.1449	0.5324	88	327704	17198	3	0.4331	0.1720	100	3441	1366	2	0.0351	0.0351		2	2
Whitespotted dogfish	*Squalus acanthias*	0–199	2510							1	0.1637	0.0605	5	2510	928												
		200–599	1066							1	0.0643	0.0216	30	837	281												
		≥600	0																								
		Total	3712							1	0.1063	0.0304	12	3434	982												
White-spotted gummy shark	*Mustelus sp B*	0–199	380								0.0248	0.0116		380	178												
		200–599	2																								
		≥600	0																								
		Total	384								0.0118	0.0056		381	181												
Zebra shark	*Stegostoma fasciatum*	0–199	34								0.0022	0.0019	100	34	29												
		200–599	0																								
		≥600	0																								
		Total	32								0.0010	0.0009	100	32	29												
Rays (Batoidea)																											
Australian butterfly ray	*Gymnura australis*	0–199	101														0.0127	0.0127	100	101	101						
		200–599	0																								
		≥600	0																								
		Total	101														0.0127	0.0127	100	101	101						
Banded stingaree	*Urolophus cruciatus*	0–199	60448							24	2.6140	0.1953	100	40079	2994	36	2.5639	0.2473	100	20369	1965						
		200–599	8853	3	0.2636	0.1696	100	84	54	6	0.6738	0.1155	100	8769	1503												
		≥600	0																								
		Total	70322		0.0296	0.0191	100	120	77	14	1.5427	0.1069	100	49833	3453	36	2.5639	0.2473	100	20369	1965						
Bight skate	*Dipturus gudgeri*	0–199	6000	3	0.2720	0.1235	100	939	427		0.0633	0.0263	100	971	403	2	0.2038	0.0836	100	1619	664						
		200–599	70312	28	7.8605	1.4374	98	2513	459	22	4.6264	0.2787	98	60209	3627												
		≥600	5081	8	2.0345	0.7745	100	553	210	6	1.0869	0.2976	78	4300	1177												
		Total	88135	6	1.3464	0.2218	99	5446	897	10	2.1410	0.1282	97	69159	4141	2	0.2038	0.0836	100	1619	664						
Black stingray	*Dasyatis thetidis*	0–199	88181	7	3.8069	0.5885	100	13147	2032	13	4.5498	0.3514	69	69759	5388	4	0.3482	0.1118	100	2766	888						
		200–599	9364							2	0.7195	0.1511	74	9364	1966												
		≥600	0																								
		Total	95743	6	2.8990	0.4507	100	11726	1823	7	2.4875	0.1822	69	80352	5885	4	0.3482	0.1118	100	2766	888						

Table 5a (continued)

Common name	Scientific name	Depth	Total annual	GABTF otter trawl						SETF otter trawl						SETF Danish seine						GHATF trap					
		category	catch (kg)	% tows	kg per tow		% dis-	Annual catch (kg)		% tows	kg per tow		% dis-	Annual catch (kg)		% tows	kg per tow		% dis-	Annual catch (kg)		% tows	kg per trap-lift		% dis-	Annual catch (kg)	
		(metres)	Estimate	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se
Rays (Batoidea) (continued)																											
Blue skate	*Notoraja sp A*	0–199	0																								
		200–599	442								0.0340	0.0138	100	442	180												
		≥600	248							1	0.0626	0.0426	100	248	169												
		Total	653								0.0202	0.0070	100	653	226												
Bluespotted maskray	*Dasyatis kuhlii*	0–199	0																								
		200–599	99	1	0.3101	0.3101	100	99	99																		
		≥600	0																								
		Total	141		0.0348	0.0348	100	141	141																		
Boreal skate	*Amblyraja hyperborea*	0–199	0																								
		200–599	52																								
		≥600	0																								
		Total	57																								
Brown stingaree	*Urolophus westraliensis*	0–199	1867							2	0.1218	0.0235	100	1867	360												
		200–599	605								0.0451	0.0142	100	587	185												
		≥600	0																								
		Total	2536							1	0.0779	0.0128	100	2516	413												
Coffin ray	*Hypnos monopterygium*	0–199	8013	1	0.0960	0.0405	100	332	140	3	0.3657	0.0761	100	5607	1167	7	0.2611	0.0524	100	2074	416						
		200–599	1133	2	0.2093	0.1594	100	67	51	1	0.0819	0.0249	100	1066	324												
		≥600	19	1	0.0690	0.0690	100	19	19																		
		Total	9296	1	0.1053	0.0367	100	426	148	2	0.2104	0.0380	100	6796	1227	7	0.2611	0.0524	100	2074	416						
Common stingaree	*Trygonoptera testacea*	0–199	29720							12	1.8757	0.1840	100	28759	2821	2	0.1210	0.0610	100	961	485						
		200–599	790								0.0607	0.0331	100	790	431												
		≥600	0																								
		Total	30766							6	0.9227	0.0899	100	29805	2904	2	0.1210	0.0610	100	961	485						
Deepwater skate	*Dipturus sp J*	0–199	0																								
		200–599	12952							4	0.9952	0.1421	86	12952	1849												
		≥600	2685							1	0.6788	0.3748	46	2685	1483												
		Total	15906							2	0.4924	0.0701	81	15906	2264												
Eastern fiddler ray	*Trygonorrhina sp A*	0–199	213														0.0106	0.0106	100	84	84						
		200–599	0																								
		≥600	0																								
		Total	130														0.0106	0.0106	100	84	84						
Eastern shovelnose ray	*Aptychotrema rostrata*	0–199	23322	9	1.5029	0.2400	100	5190	829	8	1.1826	0.1122	4	18132	1720												
		200–599	5								0.0004	0.0004		5	5												
		≥600	0																								
		Total	22886	7	1.1445	0.1837	100	4629	743	4	0.5652	0.0542	4	18257	1751												
Eastern shovelnose stingaree	*Trygonoptera sp B*	0–199	719								0.0073	0.0052	100	112	80	2	0.0764	0.0315	100	607	250						
		200–599	0																								
		≥600	0																								
		Total	720								0.0035	0.0025	100	113	81	2	0.0764	0.0315	100	607	250						
Electric ray (unspecified)	*Torpedinidae*	0–199	317	1	0.0869	0.0338	100	300	117		0.0011	0.0011	100	17	17												
		200–599	1662	1	0.0620	0.0620	100	20	20	1	0.1262	0.0358	100	1642	466												
		≥600	280								0.0707	0.0544	100	280	215												
		Total	2289	1	0.0731	0.0266	100	296	108	1	0.0617	0.0163	100	1993	527												
Greenback stingaree	*Urolophus viridis*	0–199	377369							45	24.2166	1.5820	100	371297	24256	11	0.7643	0.1441	100	6072	1145						
		200–599	69155	1	0.1550	0.1550	100	50	50	7	5.3100	1.3350	100	69105	17374												
		≥600	0																								
		Total	454679		0.0174	0.0174	100	70	70	24	13.8856	0.9630	100	448537	31107	11	0.7643	0.1441	100	6072	1145						
Grey skate	*Dipturus sp B*	0–199	174		0.0343	0.0343	100	118	118		0.0036	0.0036	100	55	55												
		200–599	9511	5	1.5659	0.7687	100	501	246	4	0.6364	0.1400	100	8282	1822												
		≥600	2956	5	1.1724	0.4538	100	319	123	5	0.6667	0.1568	100	2637	620												
		Total	13258	1	0.3499	0.1078	100	1415	436	2	0.3367	0.0627	100	10876	2025												

Table 5a (continued)

Common name	Scientific name	Depth	Total annual	GABTF otter trawl						SETF otter trawl						SETF Danish seine						GHATF trap					
		category	catch (kg)	% tows	kg per tow		% dis-	Annual catch (kg)		% tows	kg per tow		% dis-	Annual catch (kg)		% tows	kg per tow		% dis-	Annual catch (kg)		% tows	kg per trap-lift		% dis-	Annual catch (kg)	
		(metres)	Estimate	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se
Rays (Batoidea) (continued)																											
Guitarfish (unspecified)	*Rhinobatidae*	0–199	547								0.0357	0.0174	59	547	267												
		200–599	364								0.0280	0.0150	100	364	195												
		≥600	0																								
		Total	946								0.0293	0.0106	76	946	342												
Kapala stingaree	*Urolophus kapalensis*	0–199	1162							1	0.0758	0.0219	100	1162	336												
		200–599	0																								
		≥600	0																								
		Total	1169								0.0362	0.0105	100	1169	339												
Longnose skate	*Dipturus sp A*	0–199	22356		0.1714	0.1714	100	592	592	7	1.3587	0.1525	21	20832	2338	1	0.0913	0.0556	100	725	442						
		200–599	2035							1	0.1167	0.0319	100	1519	415												
		≥600	144							1	0.0364	0.0232	100	144	92												
		Total	24675		0.1305	0.1305	100	528	528	4	0.7032	0.0747	27	22715	2413	1	0.0913	0.0556	100	725	442						
Longtail torpedo ray	*Torpedo sp A*	0–199	0																								
		200–599	26								0.0020	0.0020	100	26	26												
		≥600	0																								
		Total	29								0.0009	0.0009	100	29	29												
Melbourne skate	*Dipturus whitleyi*	0–199	133942	8	3.2320	0.4781	94	11162	1651	16	6.8370	0.4124	62	104827	6323	11	2.2367	0.4023	96	17769	3196						
		200–599	36731	16	24.4186	7.2884	100	7806	2330	5	2.2117	0.2423	65	28783	3153												
		≥600	759							1	0.1919	0.0971	100	759	384												
		Total	176253	8	5.2028	0.9161	97	21044	3705	10	4.2475	0.2262	63	137204	7307	11	2.2367	0.4023	96	17769	3196						
Peacock skate	*Pavoraja nitida*	0–199	64157	1	0.1851	0.0965	100	639	333	10	1.7251	0.1649	100	26450	2528	39	4.6561	0.3753	100	36990	2982						
		200–599	5075	1	0.1163	0.1163	100	37	37	6	0.3871	0.0605	100	5038	787												
		≥600	0																								
		Total	69717	1	0.1540	0.0747	100	623	302	7	0.9930	0.0836	100	32076	2700	39	4.6561	0.3753	100	36990	2982						
Pink whipray	*Himantura fai*	0–199	4555							2	0.1761	0.0327	100	2700	501	1	0.2335	0.1288	100	1855	1023						
		200–599	0																								
		≥600	0																								
		Total	4572							1	0.0841	0.0157	100	2717	507	1	0.2335	0.1288	100	1855	1023						
Pygmy devilray	*Mobula eregoodootenkee*	0–199	109								0.0071	0.0037	100	109	57												
		200–599	0																								
		≥600	0																								
		Total	110								0.0034	0.0017	100	110	55												
Sandyback stingaree	*Urolophus bucculentus*	0–199	121876	7	7.1154	1.1772	100	24573	4065	23	4.4265	0.2775	67	67869	4255	23	3.7049	0.4360	100	29434	3464						
		200–599	3765							3	0.2893	0.0470	74	3765	612												
		≥600	160								0.0404	0.0404	100	160	160												
		Total	123857	5	5.4186	0.9008	100	21917	3644	12	2.2446	0.1370	68	72506	4425	23	3.7049	0.4360	100	29434	3464						
Sawfish (unspecified)	*Pristidae*	0–199	68														0.0085	0.0085	100	68	68						
		200–599	0																								
		≥600	0																								
		Total	68														0.0085	0.0085	100	68	68						
Short-tail torpedo ray	*Torpedo macneilli*	0–199	21959	3	0.2126	0.0547	100	734	189	7	1.3755	0.1363	100	21090	2090		0.0170	0.0170	100	135	135						
		200–599	45512	2	0.0543	0.0386	100	17	12	22	3.4958	0.2038	100	45495	2652												
		≥600	903							2	0.2283	0.1096	100	903	434												
		Total	71912	3	0.1680	0.0420	100	680	170	13	2.2010	0.1117	100	71097	3608		0.0170	0.0170	100	135	135						
Skate (unspecified)	*Rajidae*	0–199	54150	5	0.6034	0.1684	100	2084	582	3	1.8491	0.2757	94	28351	4227	13	2.9851	0.6175	80	23715	4906						
		200–599	40621	14	4.0775	1.1552	100	1303	369	8	3.0088	0.3113	99	39157	4051												
		≥600	2194	1	0.0690	0.0690	100	19	19	6	0.5414	0.1210	100	2142	479												
		Total	104743	5	0.9260	0.1853	100	3746	750	5	2.2419	0.1897	97	72419	6128	13	2.9851	0.6175	80	23715	4906						
Smooth stingray	*Dasyatis brevicaudata*	0–199	96926	36	22.1760	1.5552	100	76585	5371	5	0.8990	0.1027	69	13784	1575	4	0.2166	0.0671	100	1721	533						
		200–599	2596	2	0.5426	0.3861	100	173	123		0.1862	0.0861	100	2423	1121												
		≥600	0																								
		Total	88505	28	16.9487	1.2166	100	68555	4921	2	0.5107	0.0620	74	16497	2003	4	0.2166	0.0671	100	1721	533						

Table 5a (continued)

Common name	Scientific name	Depth category (metres)	Total annual catch (kg) Estimate	GABTF otter trawl % tows >0 kg	GABTF kg per tow Mean	GABTF kg per tow se	GABTF % discard	GABTF Annual catch (kg) Estimate	GABTF Annual catch (kg) se	SETF otter trawl % tows >0 kg	SETF otter kg per tow Mean	SETF otter kg per tow se	SETF otter % discard	SETF otter Annual catch (kg) Estimate	SETF otter Annual catch (kg) se	SETF Danish seine % tows >0 kg	SETF Danish kg per tow Mean	SETF Danish kg per tow se	SETF Danish % discard	SETF Danish Annual catch (kg) Estimate	SETF Danish Annual catch (kg) se	GHATF trap % tows >0 kg	GHATF kg per trap-lift Mean	GHATF kg per trap-lift se	GHATF % discard	GHATF Annual catch (kg) Estimate	GHATF Annual catch (kg) se
Rays (Batoidea) (continued)																											
Southern eagle ray	*Myliobatis australis*	0–199	96022	14	6.6114	0.9404	94	22832	3248	15	3.3547	0.5314	17	51435	8148	14	1.1953	0.2264	100	9496	1799						
		200–599	2039	1	0.2326	0.2326	100	74	74	1	0.1510	0.0499	96	1965	649												
		≥600	0																								
		Total	88260	11	5.0609	0.7212	94	20470	2917	7	1.6687	0.2557	20	53903	8260	14	1.1953	0.2264	100	9496	1799						
Southern fiddler ray	*Trygonorrhina fasciata*	0–199	234494	55	44.4263	3.3369	100	153426	11524	18	4.3376	0.3097	15	66506	4748	17	1.8036	0.3006	98	14329	2388						
		200–599	892	4	0.6589	0.3131	100	211	100	1	0.0523	0.0185	85	681	241												
		≥600	0																								
		Total	219239	42	33.9060	2.6009	100	137144	10520	9	2.0953	0.1509	16	67683	4874	17	1.8036	0.3006	98	14329	2388						
Sparsely-spotted stingaree	*Urolophus paucimaculatus*	0–199	86923	3	2.7257	0.6995	100	9413	2416	8	1.7969	0.3002	98	27551	4603	35	6.2885	0.8966	100	49959	7123						
		200–599	2924							1	0.2247	0.0712	82	2924	927												
		≥600	871							2	0.2202	0.0906	100	871	358												
		Total	89866	3	2.0757	0.5337	100	8396	2159	5	0.9755	0.1473	96	31511	4758	35	6.2885	0.8966	100	49959	7123						
Spotted stingaree	*Urolophus gigas*	0–199	2610		0.7314	0.7314	100	2526	2526								0.0106	0.0076	100	84	60						
		200–599	175	1	0.4961	0.4961	100	159	159		0.0012	0.0012	100	16	16												
		≥600	0																								
		Total	2578		0.6127	0.5597	100	2478	2264		0.0005	0.0005	100	16	16		0.0106	0.0076	100	84	60						
Stingaree (unspecified)	*Urolophidae*	0–199	10234		0.0057	0.0057	100	20	20	1	0.4725	0.2196	100	7245	3367	2	0.3737	0.1620	100	2969	1287						
		200–599	163								0.0124	0.0063	100	161	82												
		≥600	0																								
		Total	10454		0.0044	0.0044	100	18	18		0.2311	0.1050	100	7465	3392	2	0.3737	0.1620	100	2969	1287						
Stingray (unspecified)	*Dasyatidae*	0–199	6230	2	0.7783	0.5266	100	2688	1819	1	0.1947	0.0601	98	2985	921	1	0.0701	0.0454	100	557	361						
		200–599	1246	2	0.4031	0.3230	100	129	103	1	0.0851	0.0244	100	1108	318												
		≥600	0																								
		Total	7350	1	0.6379	0.4027	100	2580	1629	1	0.1301	0.0306	99	4203	988	1	0.0701	0.0454	100	557	361						
Sydney skate	*Dipturus australis*	0–199	142736							53	9.2435	0.3358	100	141724	5149	1	0.1274	0.0558	100	1012	443						
		200–599	12535							7	0.9632	0.1007	100	12535	1311												
		≥600	0																								
		Total	157239							28	4.8364	0.1754	100	156227	5666	1	0.1274	0.0558	100	1012	443						
Tasmanian numbfish	*Narcine tasmaniensis*	0–199	42299		0.0491	0.0354	100	170	122	23	2.2125	0.1908	100	33923	2925	29	1.0329	0.1073	100	8206	852						
		200–599	12439	1	0.2326	0.2326	100	74	74	7	0.9501	0.1452	100	12365	1890												
		≥600	0																								
		Total	55989		0.0635	0.0375	100	257	152	14	1.4713	0.1114	100	47526	3598	29	1.0329	0.1073	100	8206	852						
Thornback skate	*Dipturus lemprieri*	0–199	9049	2	0.4503	0.1538	100	1555	531	1	0.2049	0.0466	97	3142	714	3	0.5478	0.1552	100	4352	1233						
		200–599	7819	17	23.3721	15.5572	100	7471	4973		0.0260	0.0151	100	338	197												
		≥600	0																								
		Total	19889	3	2.9669	1.7576	100	12001	7109	1	0.1092	0.0232	98	3527	749	3	0.5478	0.1552	100	4352	1233						
Unspecified & other rays	*Batoidea*	0–199	104804	2	0.4686	0.2451	100	1618	846	5	2.4615	0.3287	92	37741	5040	20	8.2378	1.0852	100	65445	8621						
		200–599	7695							3	0.5913	0.1305	92	7695	1698												
		≥600	1295							1	0.3273	0.1496	100	1295	592												
		Total	114117	2	0.3568	0.1867	100	1443	755	4	1.4621	0.1680	92	47229	5427	20	8.2378	1.0852	100	65445	8621						
Western numbfish	*Narcine lasti*	0–199	11								0.0007	0.0007	100	11	11												
		200–599	26								0.0020	0.0012	100	26	16												
		≥600	0																								
		Total	39								0.0012	0.0006	100	39	19												
Western shovelnose ray	*Aptychotrema vincentiana*	0–199	8118	11	2.3440	0.2900	100	8095	1002		0.0015	0.0010	50	23	15												
		200–599	52								0.0040	0.0040	100	52	52												
		≥600	0																								
		Total	7298	8	1.7850	0.2228	100	7220	901		0.0024	0.0018	86	78	58												
Western shovelnose stingaree	*Trygonoptera mucosa*	0–199	1749	2	0.5063	0.1432	100	1749	495																		
		200–599	0																								
		≥600	0																								
		Total	1560	2	0.3856	0.1092	100	1560	442																		

Table 5a (continued)

Common name	Scientific name	Depth	Total annual	GABTF otter trawl						SETF otter trawl						SETF Danish seine						GHATF trap					
		category	catch (kg)	% tows	kg per tow		% dis-	Annual catch (kg)		% tows	kg per tow		% dis-	Annual catch (kg)		% tows	kg per tow		% dis-	Annual catch (kg)		% tows	kg per trap-lift		% dis-	Annual catch (kg)	
		(metres)	Estimate	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se
Rays (Batoidea) (continued)																											
Whitespotted guitarfish	*Rhynchobatus australiae*	0–199	0										100														
		200–599	0																								
		≥600	1																								
		Total	21										100														
Whitespotted skate	*Dipturus cerva*	0–199	21649	4	0.7634	0.2156	100	2636	745	2	0.6201	0.0994	100	9508	1524	6	1.1932	0.2447	100	9479	1944						
		200–599	14109	3	6.0930	4.1195	100	1948	1317	4	0.9261	0.1619	100	12052	2107												
		≥600	0																								
		Total	37340	3	1.2654	0.4919	100	5118	1990	3	0.7001	0.0851	100	22615	2749	6	1.1932	0.2447	100	9479	1944						
Wide stingaree	*Urolophus expansus*	0–199	364733	60	#######	9.3504	100	364733	32292																		
		200–599	18139	31	56.7442	13.7998	100	18139	4411																		
		≥600	0																								
		Total	351084	49	86.7981	7.3637	100	351084	29785																		
Yellowback stingaree	*Urolophus sufflavus*	0–199	4576		0.0103	0.0103	100	36	36		0.0343	0.0191	100	526	293	4	0.5053	0.1366	100	4014	1085						
		200–599	187								0.0144	0.0105	100	187	137												
		≥600	0																								
		Total	4776		0.0078	0.0078	100	32	32		0.0226	0.0102	100	730	329	4	0.5053	0.1366	100	4014	1085						
Holocephalans (Holocephalii)																											
Bigspine spookfish	*Harriotta raleighana*	0–199	11								0.0007	0.0007		11	11												
		200–599	198								0.0152	0.0091	16	198	118												
		≥600	2524	1	0.0276	0.0194	100	7	5	11	0.6364	0.1262	13	2517	499												
		Total	2010		0.0035	0.0025	100	14	10	1	0.0618	0.0118	14	1996	381												
Black ghostshark	*Hydrolagus sp A*	0–199	29		0.0034	0.0034		12	12		0.0011	0.0008		17	12												
		200–599	474							1	0.0364	0.0136	18	474	177												
		≥600	587	1	0.0138	0.0138		4	4	3	0.1475	0.0541	16	583	214												
		Total	958		0.0044	0.0031		18	13		0.0291	0.0076	17	940	245												
Blackfin ghostshark	*Hydrolagus lemures*	0–199	1711	3	0.3097	0.0918	23	1070	317		0.0317	0.0174	40	486	267												
		200–599	6810	17	4.4806	1.2494	13	1432	399	4	0.3160	0.0452	43	4112	588												
		≥600	759	6	1.7931	0.9057	5	487	246	1	0.0687	0.0425		272	168												
		Total	10645	5	0.9652	0.1974	14	3904	798	2	0.1589	0.0218	41	5133	704												
Elephantfish	*Callorhinchus milii*	0–199	47005	6	0.5029	0.1980	2	1737	684	3	0.2836	0.0683	2	4348	1047	16	5.1507	1.8456	6	40920	14662						
		200–599	790	3	0.0930	0.0473		30	15	1	0.0575	0.0228	17	748	297												
		≥600	352							1	0.0889	0.0570	9	352	225												
		Total	47960	5	0.3934	0.1510	2	1591	611	2	0.1683	0.0345	5	5436	1114	16	5.1507	1.8456	6	40920	14662						
Giant chimaera	*Chimaera lignaria*	0–199	0																								
		200–599	0																								
		≥600	136							1	0.0343	0.0179	100	136	71												
		Total	97								0.0030	0.0015	100	97	48												
Marbled ghostshark	*Hydrolagus sp B*	0–199	0																								
		200–599	47								0.0036	0.0027	100	47	35												
		≥600	24								0.0061	0.0061	100	24	24												
		Total	68								0.0021	0.0013	100	68	42												
Ogilby ghostshark	*Hydrolagus ogilbyi*	0–199	772		0.0034	0.0026		12	9	1	0.0496	0.0143	1	760	219												
		200–599	7691	5	0.3721	0.1533	8	119	49	11	0.5202	0.0494	14	6770	643												
		≥600	1012	1	0.0690	0.0524		19	14	3	0.2505	0.1075	10	991	425												
		Total	10286	1	0.0531	0.0188	7	215	76	5	0.2721	0.0246	12	8789	795												
Pacific spookfish	*Rhinochimaera pacifica*	0–199	0																								
		200–599	0																								
		≥600	1263	5	0.9724	0.4492	100	264	122	3	0.2525	0.0867	18	999	343												
		Total	1200	1	0.1227	0.0573	100	496	232		0.0218	0.0075	18	704	242												
Shortnose chimaera (unspecified)	*Chimaeridae*	0–199	1191							1	0.0766	0.0404	2	1174	619		0.0021	0.0021		17	17						
		200–599	7071							6	0.5398	0.0806	16	7025	1049												
		≥600	1127							3	0.2848	0.1193	18	1127	472												
		Total	9645							3	0.2965	0.0415	14	9578	1341		0.0021	0.0021		17	17						

Table 5a (continued)

Common name	Scientific name	Depth	Total annual	GABTF otter trawl						SETF otter trawl						SETF Danish seine						GHATF trap					
		category	catch (kg)	% tows	kg per tow		% dis-	Annual catch (kg)		% tows	kg per tow		% dis-	Annual catch (kg)		% tows	kg per tow		% dis-	Annual catch (kg)		% tows	kg per trap-lift		% dis-	Annual catch (kg)	
		(metres)	Estimate	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se
Holocephalans (Holocephalii) (continued)																											
Shortspine chimaera	*Chimaera sp B*	0–199	0																								
		200–599	42								0.0032	0.0023	100	42	30												
		≥600	0																								
		Total	45								0.0014	0.0010	100	45	32												
Southern chimaera	*Chimaera sp A*	0–199	860								0.0561	0.0279	2	860	428												
		200–599	8063	6	0.3333	0.1294	2	107	41	6	0.5873	0.0732	8	7643	953												
		≥600	3760	5	0.3103	0.1300	44	84	35	11	0.9293	0.1764	23	3676	698												
		Total	12378	1	0.0766	0.0222	24	310	90	4	0.3630	0.0380	11	11726	1227												
Spookfish (unspecified)	*Rhinochimaeridae*	0–199	0																								
		200–599	0																								
		≥600	32								0.0081	0.0057		32	23												
		Total	23								0.0007	0.0005		23	16												

Table 5b. Mean annual catch rate for each species in the SESSF GHATF dropline, GHATF automatic longline, GHATF scalefish longline, and GHATF gillnet (excluding GHATF shark gillnet) sectors during 2000–06

For each species and method, '% of tows, lifts or sets >0 kg' is the percent of observed tows, lifts or sets in the ISMP database during 2000–06 with a greater than zero catch mass. For each species and method, 'catch' is mean annual catch mass estimated from the observer mean catch per unit effort weighted to total effort (tows, lifts or sets) as reported in fisher logbooks during 2000–05. Species with blank fields for any fishing method were not detected by the ISMP during 2000–06.

Table 5b (continued)

Common name	Scientific name	Depth	Total annual	GHATF dropline						GHATF automatic longline						GHATF scalefish longline						GHATF scalefish gillnet					
		category	catch (kg)	% tows	kg per line-lift		% dis-	Annual catch (kg)		% tows	kg per set		% dis-	Annual catch (kg)		% tows	kg per set		% dis-	Annual catch (kg)		% tows	kg per set		% dis-	Annual catch (kg)	
		(metres)	Estimate	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se
Sharks (Selachii)																											
Australian angelshark	*Squatina australis*	0–199	255022																								
		200–599	50507																								
		≥600	0																								
		Total	311325																								
Banded wobbegong	*Orectolobus ornatus*	0–199	638																								
		200–599	0																								
		≥600	0																								
		Total	569																								
Basking shark	*Cetorhinus maximus*	0–199	0																								
		200–599	1300																								
		≥600	0																								
		Total	1405																								
Black shark	*Dalatias licha*	0–199	2293													4	3.4783	3.4783		2069	2069						
		200–599	39095		0.0016	0.0016	100	1	1	9	0.5009	0.0886	49	210	37	28	3.4000	1.0918	36	681	219	3	0.1034	0.1034		17	17
		≥600	52378							33	1.0000	1.0000	100	45	45	13	0.9130	0.6125	43	1	1						
		Total	81169		0.0012	0.0012	100	1	1	9	0.4957	0.0869	49	232	41	17	2.7558	1.0641	24	2195	848	3	0.1034	0.1034		17	17
Blackbelly lanternshark	*Etmopterus lucifer*	0–199	53							11	0.2222	0.2222	100	1	1	4	0.0870	0.0870	100	52	52						
		200–599	523							17	0.7342	0.1213	100	307	51	25	0.3000	0.0892	100	60	18						
		≥600	5436							33	0.3333	0.3333	100	15	15	17	0.2348	0.1177	100								
		Total	4739							17	0.7241	0.1189	100	339	56	17	0.2256	0.0572	100	180	46						
Blind shark	*Brachaelurus waddi*	0–199	0																								
		200–599	12								0.0283	0.0283	100	12	12												
		≥600	0																								
		Total	13								0.0277	0.0277	100	13	13												
Blue shark	*Prionace glauca*	0–199	15							22	3.6667	3.3082		15	14												
		200–599	588		0.0080	0.0057	40	5	4	11	1.3942	0.2593	4	583	109												
		≥600	2													4	1.0870	1.0870		2	2						
		Total	901		0.0061	0.0044	40	4	3	11	1.4224	0.2588	4	665	121	1	0.2907	0.2907		232	232						
Bluntnose sixgill shark	*Hexanchus griseus*	0–199	276																								
		200–599	7								0.0177	0.0177		7	7												
		≥600	0																								
		Total	254								0.0173	0.0173		8	8												
Brier shark	*Deania calcea*	0–199	7258													4	12.1739	12.1739	100	7241	7241						
		200–599	31303							15	4.4832	1.1177	40	1876	468	50	87.7750	27.3428	80	17584	5478						
		≥600	286691							100	#######	#######	54	13098	6564	17	9.3696	5.9346	100	14	9						
		Total	256651							15	5.8977	1.5205	44	2759	711	29	46.5872	13.7700	83	37114	10970						
Broadnose sevengill shark	*Notorynchus cepedianus*	0–199	2417																								
		200–599	431		0.0080	0.0080	100	5	5	1	0.1770	0.1179	15	74	49							3	0.2414	0.2414		40	40
		≥600	0																								
		Total	2876		0.0061	0.0061	100	4	4	1	0.1733	0.1155	15	81	54							3	0.2414	0.2414		40	40
Bronze whaler	*Carcharhinus brachyurus*	0–199	12935																								
		200–599	4003								0.1593	0.1593	100	67	67												
		≥600	0																								
		Total	17082								0.1560	0.1560	100	73	73												
Collar carpetshark	*Parascyllium collare*	0–199	9821																								
		200–599	57																								
		≥600	0																								
		Total	9946																								

Table 5b (continued)

Common name	Scientific name	Depth category (metres)	Total annual catch (kg) Estimate	GHATF dropline % tows >0 kg	kg per line-lift Mean	kg per line-lift se	% discard	Annual catch (kg) Estimate	Annual catch (kg) se	GHATF automatic longline % tows >0 kg	kg per set Mean	kg per set se	% discard	Annual catch (kg) Estimate	Annual catch (kg) se	GHATF scalefish longline % tows >0 kg	kg per set Mean	kg per set se	% discard	Annual catch (kg) Estimate	Annual catch (kg) se	GHATF scalefish gillnet % tows >0 kg	kg per set Mean	kg per set se	% discard	Annual catch (kg) Estimate	Annual catch (kg) se
Sharks (Selachii) (continued)																											
Common sawshark	*Pristiophorus cirratus*	0–199	182548																								
		200–599	85472							3	0.1195	0.0360	3	50	15												
		≥600	4028																								
		Total	275965							3	0.1170	0.0353	3	55	17												
Crested hornshark	*Heterodontus galeatus*	0–199	67																								
		200–599	0																								
		≥600	0																								
		Total	68																								
Crocodile shark	*Pseudocarcharias kamoharai*	0–199	0																								
		200–599	0																								
		≥600	7																								
		Total	14																								
Draughtboard shark	*Cephaloscyllium laticeps*	0–199	190664													22	2.6957	1.5972	100	1603	950						
		200–599	33349							19	13.4094	2.1967	90	5612	919	5	0.2250	0.1660	100	45	33						
		≥600	40																								
		Total	226864							18	13.1305	2.1525	90	6143	1007	8	0.8256	0.4445	100	658	354						
Dwarf catshark	*Asymbolus parvus*	0–199	302																								
		200–599	62																								
		≥600	0																								
		Total	371																								
Eastern angel shark	*Squatina sp A*	0–199	0																								
		200–599	94																								
		≥600	0																								
		Total	100																								
Endeavour dogfish	*Centrophorus moluccensis*	0–199	13099																								
		200–599	14902	2	0.0789	0.0275	100	53	18	5	0.4389	0.1119	26	184	47							31	3.9310	2.1085	4	656	352
		≥600	1335																								
		Total	30197	1	0.0604	0.0211	100	42	15	5	0.4298	0.1096	26	201	51							31	3.9310	2.1085	4	656	352
Fleshynose catshark	*Apristurus sp C*	0–199	0																								
		200–599	0																								
		≥600	144																								
		Total	100																								
Fossil shark	*Hemipristis elongata*	0–199	0																								
		200–599	12																								
		≥600	0																								
		Total	18																								
Frill shark	*Chlamydoselachus anguineus*	0–199	0																								
		200–599	3								0.0071	0.0071		3	3												
		≥600	152																								
		Total	110								0.0069	0.0069		3	3												
Golden dogfish	*Centroscymnus crepidater*	0–199	0																								
		200–599	3237								0.0071	0.0071	100	3	3	3	0.6000	0.6000	100	120	120						
		≥600	73564																								
		Total	55607								0.0069	0.0069	100	3	3	1	0.2791	0.2791	100	222	222						
Greeneye dogfish	*Squalus mitsukurii*	0–199	72249							22	29.3333	26.4659	100	122	110												
		200–599	122672	6	0.2089	0.0464	89	140	31	22	37.5779	6.0026	95	15726	2512							69	8.6207	4.4780	92	1438	747
		≥600	10202													30	2.4348	1.5564	100	4	2						
		Total	212193	4	0.1600	0.0356	89	111	25	22	37.2539	5.8917	95	17429	2756	8	0.6512	0.4258	100	519	339	69	8.6207	4.4780	92	1438	747
Grey nurse shark	*Carcharias taurus*	0–199	2703																								
		200–599	78																								
		≥600	0																								
		Total	2692																								

Table 5b (continued)

Common name	Scientific name	Depth category (metres)	Total annual catch (kg) Estimate	GHATF dropline % tows >0 kg	kg per line-lift Mean	kg per line-lift se	% dis-card	Annual catch (kg) Estimate	Annual catch (kg) se	GHATF automatic longline % tows >0 kg	kg per set Mean	kg per set se	% dis-card	Annual catch (kg) Estimate	Annual catch (kg) se	GHATF scalefish longline % tows >0 kg	kg per set Mean	kg per set se	% dis-card	Annual catch (kg) Estimate	Annual catch (kg) se	GHATF scalefish gillnet % tows >0 kg	kg per set Mean	kg per set se	% dis-card	Annual catch (kg) Estimate	Annual catch (kg) se
Sharks (Selachii) (continued)																											
Grey spotted catshark	*Asymbolus analis*	0–199	25230																								
		200–599	786																								
		≥600	0																								
		Total	25884																								
Gulf catshark	*Asymbolus vincenti*	0–199	628																								
		200–599	55								0.0283	0.0283	100	12	12												
		≥600	0																								
		Total	632								0.0277	0.0277	100	13	13												
Gulper shark (unspecified)	*Centrophorus spp*	0–199	508							11	6.4444	6.4444	100	27	27												
		200–599	5088							5	5.5416	1.5299	97	2319	640							3	0.1034	0.1034		17	17
		≥600	8073																								
		Total	13995							5	5.5269	1.5011	97	2586	702							3	0.1034	0.1034		17	17
Gummy shark	*Mustelus antarcticus*	0–199	166934													87	52.0000	9.1100	3	30931	5419						
		200–599	40248							8	2.7611	0.8201	46	1156	343							10	0.5862	0.3421		98	57
		≥600	1999													9	0.6522	0.4772	100	1	1						
		Total	185458							8	2.7036	0.8032	46	1265	376	26	14.0814	3.4550	4	11218	2752	10	0.5862	0.3421		98	57
Harrisson dogfish	*Centrophorus harrissoni*	0–199	28																								
		200–599	131		0.0064	0.0064	100	4	4	1	0.2283	0.1270	53	96	53												
		≥600	0																								
		Total	169		0.0049	0.0049	100	3	3	1	0.2236	0.1244	53	105	58												
Leafscale gulper shark	*Centrophorus squamosus*	0–199	0																								
		200–599	32								0.0018	0.0018		1	1												
		≥600	0																								
		Total	33								0.0017	0.0017		1	1												
Longsnout dogfish	*Deania quadrispinosa*	0–199	23																								
		200–599	837		0.0016	0.0016	100	1	1		0.0035	0.0025	100	1	1							10	0.5517	0.3083		92	51
		≥600	4723																								
		Total	4246		0.0012	0.0012	100	1	1		0.0035	0.0024	100	2	1							10	0.5517	0.3083		92	51
Mandarin shark	*Cirrhigaleus barbifer*	0–199	0																								
		200–599	0																								
		≥600	0																								
		Total	0																								
Orange spotted catshark	*Asymbolus rubiginosus*	0–199	152																								
		200–599	505																								
		≥600	0																								
		Total	696																								
Ornate angelshark	*Squatina tergocellata*	0–199	305381																								
		200–599	11989																								
		≥600	19																								
		Total	289427																								
Owston dogfish	*Centroscymnus owstoni*	0–199	0																								
		200–599	3758							4	0.6920	0.2592	37	290	108	20	4.0250	2.0075	63	806	402						
		≥600	92609							33	16.3333	16.3333	51	738	738												
		Total	70769							4	0.7626	0.2673	39	357	125	9	1.8721	0.9526	63	1491	759						
Pinocchio catshark	*Apristurus* sp G	0–199	0																								
		200–599	0																								
		≥600	8																								
		Total	6																								
Platypus shark	*Deania* spp	0–199	84																								
		200–599	5586							8	2.4354	0.6087	48	1019	255	8	1.8000	1.2337		361	247						
		≥600	95711													13	0.3478	0.1949	38	1							
		Total	96818							8	2.3847	0.5962	48	1116	279	7	0.9302	0.5791	4	741	461						

Table 5b (continued)

Common name	Scientific name	Depth category (metres)	Total annual catch (kg) Estimate	GHATF dropline % tows >0 kg	kg per line-lift Mean	kg per line-lift se	% discard	Annual catch (kg) Estimate	Annual catch (kg) se	GHATF automatic longline % tows >0 kg	kg per set Mean	kg per set se	% discard	Annual catch (kg) Estimate	Annual catch (kg) se	GHATF scalefish longline % tows >0 kg	kg per set Mean	kg per set se	% discard	Annual catch (kg) Estimate	Annual catch (kg) se	GHATF scalefish gillnet % tows >0 kg	kg per set Mean	kg per set se	% discard	Annual catch (kg) Estimate	Annual catch (kg) se
Sharks (Selachii) (continued)																											
Plunket dogfish	*Centroscymnus plunketi*	0–199	0																								
		200–599	0																								
		≥600	367																								
		Total	258																								
Porbeagle	*Lamna nasus*	0–199	0																								
		200–599	119							1	0.2832	0.1440	81	119	60												
		≥600	0																								
		Total	130							1	0.2773	0.1410	81	130	66												
Port Jackson shark	*Heterodontus portusjacksoni*	0–199	185384													43	4.8696	1.4505	100	2897	863						
		200–599	25896																								
		≥600	6																								
		Total	210653													12	1.3023	0.4475	100	1037	357						
Portuguese dogfish	*Centroscymnus coelolepis*	0–199	0																								
		200–599	1279																								
		≥600	0																								
		Total	1383																								
Prickly dogfish	*Oxynotus bruniensis*	0–199	0																								
		200–599	817																			3	0.0690	0.0690	100	12	12
		≥600	287																								
		Total	1096																			3	0.0690	0.0690	100	12	12
Reticulate swellshark	*Cephaloscyllium fasciatum*	0–199	0																								
		200–599	26																								
		≥600	0																								
		Total	29																								
Rusty carpetshark	*Parascyllium ferrugineum*	0–199	18938													4	0.0435	0.0435	100	26	26						
		200–599	128								0.0035	0.0035	100	1	1												
		≥600	0																								
		Total	18689								0.0035	0.0035	100	2	2	1	0.0116	0.0116	100	9	9						
Sandtiger shark	*Odontaspis ferox*	0–199	44																								
		200–599	3198																								
		≥600	0																								
		Total	3505																								
Sawtail catshark	*Galeus boardmani*	0–199	3537							22	0.4444	0.3379	100	2	1	4	0.0435	0.0435	100	26	26						
		200–599	17699		0.0032	0.0032	100	2	2	52	2.9998	0.2797	100	1255	117	33	0.3625	0.0913	100	73	18						
		≥600	3													26	0.2130	0.0816	100								
		Total	23076		0.0024	0.0024	100	2	2	51	2.9444	0.2744	100	1377	128	23	0.2372	0.0507	100	189	40						
Scalloped hammerhead	*Sphyrna lewini*	0–199	2893																								
		200–599	0																								
		≥600	0																								
		Total	2580																								
School shark	*Galeorhinus galeus*	0–199	7626							11	2.0000	2.0000		8	8	4	0.5217	0.5217		310	310						
		200–599	22851		0.0431	0.0306		29	21	15	6.0549	1.2497	11	2534	523	13	12.0250	7.7713	16	2409	1557						
		≥600	1351																								
		Total	35144		0.0330	0.0234		23	16	15	5.9601	1.2243	11	2788	573	7	5.7326	3.6486	15	4567	2907						
Sharpnose sevengill shark	*Heptranchias perlo*	0–199	7231													4	1.5217	1.5217		905	905						
		200–599	10999		0.0032	0.0032	100	2	2	3	0.1416	0.0394	35	59	16							21	9.2759	5.2391		1548	874
		≥600	41																								
		Total	19252		0.0024	0.0024	100	2	2	3	0.1386	0.0386	35	65	18	1	0.4070	0.4070		324	324	21	9.2759	5.2391		1548	874
Shortfin mako	*Isurus oxyrinchus*	0–199	654																								
		200–599	1620							1	0.2743	0.1833	2	115	77							7	6.2069	4.3099		1036	719
		≥600	3	1	0.3285	0.3285		3	3																		
		Total	2359		0.0549	0.0549		38	38	1	0.2686	0.1795	2	126	84							7	6.2069	4.3099		1036	719

Table 5b (continued)

Common name	Scientific name	Depth category (metres)	Total annual catch (kg) Estimate	GHATF dropline % tows >0 kg	kg per line-lift Mean	kg per line-lift se	% discard	Annual catch (kg) Estimate	Annual catch (kg) se	GHATF automatic longline % tows >0 kg	kg per set Mean	kg per set se	% discard	Annual catch (kg) Estimate	Annual catch (kg) se	GHATF scalefish longline % tows >0 kg	kg per set Mean	kg per set se	% discard	Annual catch (kg) Estimate	Annual catch (kg) se	GHATF scalefish gillnet % tows >0 kg	kg per set Mean	kg per set se	% discard	Annual catch (kg) Estimate	Annual catch (kg) se
Sharks (Selachii) (continued)																											
Slender lanternshark	*Etmopterus pusillus*	0–199	0																								
		200–599	36																								
		≥600	5468																								
		Total	4031																								
Smalltooth cookiecutter shark	*Isistius brasiliensis*	0–199	0																								
		200–599	41							1	0.0080	0.0044	100	3	2							3	0.1034	0.1034	100	17	17
		≥600	160																								
		Total	157							1	0.0078	0.0043	100	4	2							3	0.1034	0.1034	100	17	17
Smooth hammerhead	*Sphyrna zygaena*	0–199	2859																								
		200–599	67																								
		≥600	0																								
		Total	2858																								
Smooth lanternshark	*Etmopterus bigelowi*	0–199	0																								
		200–599	211							8	0.4496	0.0845	100	188	35	5	0.0100	0.0070	100	2	1						
		≥600	815																								
		Total	808							8	0.4402	0.0828	100	206	39	2	0.0047	0.0033	100	4	3						
Southern dogfish	*Centrophorus uyato*	0–199	514							11	5.3333	5.3333	100	22	22												
		200–599	7519							6	1.5250	0.3443	94	638	144												
		≥600	3823																								
		Total	11826							6	1.5764	0.3467	95	737	162												
Southern lanternshark	*Etmopterus granulosus*	0–199	215													4	0.1739	0.1739	100	103	103						
		200–599	4782							2	0.0474	0.0241	100	20	10	8	1.3500	0.8745	100	270	175						
		≥600	12990																								
		Total	14731							2	0.0464	0.0236	100	22	11	5	0.6744	0.4123	100	537	328						
Southern sawshark	*Pristiophorus nudipinnis*	0–199	30917																								
		200–599	1180																								
		≥600	0																								
		Total	32047																								
Southern sleeper shark	*Somniosus antarcticus*	0–199	0																								
		200–599	1612																								
		≥600	240																								
		Total	1912																								
Spikey spurdog	*Squalus megalops*	0–199	310797	11	0.8364	0.3770	71	12	6	11	1.8889	1.8889	100	8	8												
		200–599	377295	7	0.5175	0.1163	79	347	78	22	4.8112	0.8838	97	2013	370												
		≥600	512	21	1.8139	0.4295	100	14	3	33	0.3333	0.3333	100	15	15												
		Total	719197	10	0.7558	0.1182	87	524	82	22	4.7423	0.8660	97	2219	405												
Spotted wobbegong	*Orectolobus maculatus*	0–199	23137													4	1.7391	1.7391		1034	1034						
		200–599	3737																								
		≥600	0																								
		Total	24472													1	0.4651	0.4651		371	371						
Thresher shark	*Alopias vulpinus*	0–199	419																								
		200–599	13956		0.1196	0.1196		80	80		0.0106	0.0106		4	4												
		≥600	0																								
		Total	15502		0.0916	0.0916		63	63		0.0104	0.0104		5	5												
Tiger shark	*Galeocerdo cuvier*	0–199	2738																								
		200–599	0																								
		≥600	0																								
		Total	2759																								
Unspecified & other sharks	*Selachii*	0–199	10383																								
		200–599	306																								
		≥600	288																								
		Total	10809																								

Table 5b (continued)

Common name	Scientific name	Depth category (metres)	Total annual catch (kg) Estimate	GHATF dropline % tows >0 kg	kg per line-lift Mean	kg per line-lift se	% dis-card	Annual catch (kg) Estimate	Annual catch (kg) se	GHATF automatic longline % tows >0 kg	kg per set Mean	kg per set se	% dis-card	Annual catch (kg) Estimate	Annual catch (kg) se	GHATF scalefish longline % tows >0 kg	kg per set Mean	kg per set se	% dis-card	Annual catch (kg) Estimate	Annual catch (kg) se	GHATF scalefish gillnet % tows >0 kg	kg per set Mean	kg per set se	% dis-card	Annual catch (kg) Estimate	Annual catch (kg) se
Sharks (Selachii) (continued)																											
Variegated catshark	*Asymbolus submaculatus*	0–199	93																								
		200–599	0																								
		≥600	0																								
		Total	83																								
Velvet dogfish	*Zameus squamulosus*	0–199	0																								
		200–599	0																								
		≥600	80																								
		Total	55																								
Western spotted catshark	*Asymbolus occiduus*	0–199	70																								
		200–599	0																								
		≥600	0																								
		Total	69																								
Whiskery shark	*Furgaleus macki*	0–199	1054																								
		200–599	7								0.0177	0.0177		7	7												
		≥600	0																								
		Total	948								0.0173	0.0173		8	8												
White shark	*Carcharodon carcharias*	0–199	1621																								
		200–599	0																								
		≥600	0																								
		Total	1631																								
Whitefin swell shark	*Cephaloscyllium sp A*	0–199	31116							44	9.1111	4.4890	100	38	19	4	8.6957	8.6957	100	5172	5172						
		200–599	310243	3	0.3509	0.1259	100	235	84	50	30.8000	3.1839	98	12890	1332	70	48.8625	9.2837	100	9789	1860	34	3.2414	1.4261	100	541	238
		≥600	4209	1	0.0292	0.0292	100			33	18.6667	18.6667	100	843	843	96	44.0217	10.6790	100	66	16						
		Total	385201	2	0.2735	0.0966	100	189	67	50	30.3986	3.1215	98	14221	1460	59	36.8256	5.9132	100	29338	4711	34	3.2414	1.4261	100	541	238
Whitespotted dogfish	*Squalus acanthias*	0–199	2510																								
		200–599	1066		0.0048	0.0048	100	3	3	4	0.4531	0.1758	99	190	74	8	0.1800	0.1078	100	36	22						
		≥600	0																								
		Total	3712		0.0037	0.0037	100	3	3	4	0.4437	0.1722	99	208	81	3	0.0837	0.0508	100	67	40						
White-spotted gummy shark	*Mustelus sp B*	0–199	380																								
		200–599	2		0.0024	0.0024	100	2	2																		
		≥600	0	1	0.0109	0.0109	100																				
		Total	384		0.0037	0.0026	100	3	2																		
Zebra shark	*Stegostoma fasciatum*	0–199	34																								
		200–599	0																								
		≥600	0																								
		Total	32																								
Rays (Batoidea)																											
Australian butterfly ray	*Gymnura australis*	0–199	101																								
		200–599	0																								
		≥600	0																								
		Total	101																								
Banded stingaree	*Urolophus cruciatus*	0–199	60448																								
		200–599	8853																								
		≥600	0																								
		Total	70322																								
Bight skate	*Dipturus gudgeri*	0–199	6000							22	3.4444	2.4558	100	14	10	4	4.1304	4.1304	100	2457	2457						
		200–599	70312							53	10.5430	0.7696	93	4412	322	75	15.8650	2.8510	98	3178	571						
		≥600	5081							33	5.0000	5.0000	100	226	226	29	1.6500	0.7252	97	2	1						
		Total	88135							52	10.4035	0.7558	93	4867	354	44	8.8414	1.8399	98	7044	1466						
Black stingray	*Dasyatis thetidis*	0–199	88181													26	4.2174	1.6986	100	2509	1010						
		200–599	9364																								
		≥600	0																								
		Total	95743													7	1.1279	0.4906	100	899	391						

Table 5b (continued)

Common name	Scientific name	Depth	Total annual	GHATF dropline						GHATF automatic longline						GHATF scalefish longline						GHATF scalefish gillnet					
		category	catch (kg)	% tows	kg per line-lift		% dis-	Annual catch (kg)		% tows	kg per set		% dis-	Annual catch (kg)		% tows	kg per set		% dis-	Annual catch (kg)		% tows	kg per set		% dis-	Annual catch (kg)	
		(metres)	Estimate	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se
Rays (Batoidea) (continued)																											
Blue skate	*Notoraja sp A*	0–199	0																								
		200–599	442																								
		≥600	248																								
		Total	653																								
Bluespotted maskray	*Dasyatis kuhlii*	0–199	0																								
		200–599	99																								
		≥600	0																								
		Total	141																								
Boreal skate	*Amblyraja hyperborea*	0–199	0																								
		200–599	52							1	0.1239	0.0800	100	52	33												
		≥600	0																								
		Total	57							1	0.1213	0.0784	100	57	37												
Brown stingaree	*Urolophus westraliensis*	0–199	1867																								
		200–599	605								0.0442	0.0442	100	18	18												
		≥600	0																								
		Total	2536								0.0433	0.0433	100	20	20												
Coffin ray	*Hypnos monopterygium*	0–199	8013																								
		200–599	1133																								
		≥600	19																								
		Total	9296																								
Common stingaree	*Trygonoptera testacea*	0–199	29720																								
		200–599	790																								
		≥600	0																								
		Total	30766																								
Deepwater skate	*Dipturus sp J*	0–199	0																								
		200–599	12952																								
		≥600	2685																								
		Total	15906																								
Eastern fiddler ray	*Trygonorrhina sp A*	0–199	213													4	0.2174	0.2174	100	129	129						
		200–599	0																								
		≥600	0																								
		Total	130													1	0.0581	0.0581	100	46	46						
Eastern shovelnose ray	*Aptychotrema rostrata*	0–199	23322																								
		200–599	5																								
		≥600	0																								
		Total	22886																								
Eastern shovelnose stingaree	*Trygonoptera sp B*	0–199	719																								
		200–599	0																								
		≥600	0																								
		Total	720																								
Electric ray (unspecified)	*Torpedinidae*	0–199	317																								
		200–599	1662																								
		≥600	280																								
		Total	2289																								
Greenback stingaree	*Urolophus viridis*	0–199	377369																								
		200–599	69155																								
		≥600	0																								
		Total	454679																								
Grey skate	*Dipturus sp B*	0–199	174							11	0.2222	0.2222	100	1	1												
		200–599	9511		0.0064	0.0064		4	4	12	1.1913	0.2362	95	499	99	15	1.1250	0.4990	89	225	100						
		≥600	2956																								
		Total	13258		0.0049	0.0049		3	3	12	1.1701	0.2314	95	547	108	7	0.5233	0.2384	89	417	190						

Table 5b (continued)

Common name	Scientific name	Depth category (metres)	Total annual catch (kg) Estimate	GHATF dropline % tows >0 kg	GHATF dropline kg per line-lift Mean	GHATF dropline kg per line-lift se	GHATF dropline % discard	GHATF dropline Annual catch (kg) Estimate	GHATF dropline Annual catch (kg) se	GHATF automatic longline % tows >0 kg	GHATF automatic longline kg per set Mean	GHATF automatic longline kg per set se	GHATF automatic longline % discard	GHATF automatic longline Annual catch (kg) Estimate	GHATF automatic longline Annual catch (kg) se	GHATF scalefish longline % tows >0 kg	GHATF scalefish longline kg per set Mean	GHATF scalefish longline kg per set se	GHATF scalefish longline % discard	GHATF scalefish longline Annual catch (kg) Estimate	GHATF scalefish longline Annual catch (kg) se	GHATF scalefish gillnet % tows >0 kg	GHATF scalefish gillnet kg per set Mean	GHATF scalefish gillnet kg per set se	GHATF scalefish gillnet % discard	GHATF scalefish gillnet Annual catch (kg) Estimate	GHATF scalefish gillnet Annual catch (kg) se
Rays (Batoidea) (continued)																											
Guitarfish (unspecified)	*Rhinobatidae*	0–199	547																								
		200–599	364																								
		≥600	0																								
		Total	946																								
Kapala stingaree	*Urolophus kapalensis*	0–199	1162																								
		200–599	0																								
		≥600	0																								
		Total	1169																								
Longnose skate	*Dipturus sp A*	0–199	22356													4	0.3478	0.3478	100	207	207						
		200–599	2035							1	1.0177	0.4794	100	426	201	8	0.4500	0.2841	100	90	57						
		≥600	144																								
		Total	24675							1	0.9965	0.4695	100	466	220	5	0.3023	0.1613	100	241	129						
Longtail torpedo ray	*Torpedo sp A*	0–199	0																								
		200–599	26																								
		≥600	0																								
		Total	29																								
Melbourne skate	*Dipturus whitleyi*	0–199	133942							11	0.6667	0.6667	100	3	3	4	0.3043	0.3043	100	181	181						
		200–599	36731		0.0096	0.0096	100	6	6	2	0.2080	0.0999	100	87	42	3	0.1000	0.1000	100	20	20	3	0.1724	0.1724	100	29	29
		≥600	759																								
		Total	176253		0.0073	0.0073	100	5	5	2	0.2140	0.0984	100	100	46	2	0.1279	0.0933	100	102	74	3	0.1724	0.1724	100	29	29
Peacock skate	*Pavoraja nitida*	0–199	64157													9	0.1304	0.0954	100	78	57						
		200–599	5075																								
		≥600	0																								
		Total	69717													2	0.0349	0.0259	100	28	21						
Pink whipray	*Himantura fai*	0–199	4555																								
		200–599	0																								
		≥600	0																								
		Total	4572																								
Pygmy devilray	*Mobula eregoodootenkee*	0–199	109																								
		200–599	0																								
		≥600	0																								
		Total	110																								
Sandyback stingaree	*Urolophus bucculentus*	0–199	121876																								
		200–599	3765																								
		≥600	160																								
		Total	123857																								
Sawfish (unspecified)	*Pristidae*	0–199	68																								
		200–599	0																								
		≥600	0																								
		Total	68																								
Short-tail torpedo ray	*Torpedo macneilli*	0–199	21959																								
		200–599	45512																								
		≥600	903																								
		Total	71912																								
Skate (unspecified)	*Rajidae*	0–199	54150																								
		200–599	40621							4	0.3841	0.1245	63	161	52												
		≥600	2194													61	22.0000	5.2803	100	33	8						
		Total	104743							4	0.3761	0.1219	63	176	57	16	5.8837	1.7451	100	4687	1390						
Smooth stingray	*Dasyatis brevicaudata*	0–199	96926													17	8.1304	6.5106	100	4836	3873						
		200–599	2596																								
		≥600	0																								
		Total	88505													5	2.1744	1.7568	100	1732	1400						

Table 5b (continued)

Common name	Scientific name	Depth	Total annual	GHATF dropline						GHATF automatic longline						GHATF scalefish longline						GHATF scalefish gillnet					
		category	catch (kg)	% tows	kg per line-lift		% dis-	Annual catch (kg)		% tows	kg per set		% dis-	Annual catch (kg)		% tows	kg per set		% dis-	Annual catch (kg)		% tows	kg per set		% dis-	Annual catch (kg)	
		(metres)	Estimate	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se
Rays (Batoidea) (continued)																											
Southern eagle ray	*Myliobatis australis*	0–199	96022													48	20.6087	7.9653	10	12259	4738						
		200–599	2039																								
		≥600	0																								
		Total	88260													13	5.5116	2.3175	10	4391	1846						
Southern fiddler ray	*Trygonorrhina fasciata*	0–199	234494													9	0.3913	0.2863	100	233	170						
		200–599	892																								
		≥600	0																								
		Total	219239													2	0.1047	0.0776	100	83	62						
Sparsely-spotted stingaree	*Urolophus paucimaculatus*	0–199	86923																								
		200–599	2924																								
		≥600	871																								
		Total	89866																								
Spotted stingaree	*Urolophus gigas*	0–199	2610																								
		200–599	175																								
		≥600	0																								
		Total	2578																								
Stingaree (unspecified)	*Urolophidae*	0–199	10234																								
		200–599	163								0.0053	0.0053	100	2	2												
		≥600	0																								
		Total	10454								0.0052	0.0052	100	2	2												
Stingray (unspecified)	*Dasyatidae*	0–199	6230																								
		200–599	1246							1	0.0212	0.0106	100	9	4												
		≥600	0																								
		Total	7350							1	0.0208	0.0104	100	10	5												
Sydney skate	*Dipturus australis*	0–199	142736																								
		200–599	12535																								
		≥600	0																								
		Total	157239																								
Tasmanian numbfish	*Narcine tasmaniensis*	0–199	42299																								
		200–599	12439																								
		≥600	0																								
		Total	55989																								
Thornback skate	*Dipturus lemprieri*	0–199	9049																								
		200–599	7819		0.0128	0.0128	100	9	9		0.0035	0.0035		1	1	3											
		≥600	0																								
		Total	19889		0.0098	0.0098	100	7	7		0.0035	0.0035		2	2	1											
Unspecified & other rays	*Batoidea*	0–199	104804																								
		200–599	7695																								
		≥600	1295																								
		Total	114117																								
Western numbfish	*Narcine lasti*	0–199	11																								
		200–599	26																								
		≥600	0																								
		Total	39																								
Western shovelnose ray	*Aptychotrema vincentiana*	0–199	8118																								
		200–599	52																								
		≥600	0																								
		Total	7298																								
Western shovelnose stingaree	*Trygonoptera mucosa*	0–199	1749																								
		200–599	0																								
		≥600	0																								
		Total	1560																								

Table 5b (continued)

Common name	Scientific name	Depth category (metres)	Total annual catch (kg)	GHATF dropline						GHATF automatic longline						GHATF scalefish longline						GHATF scalefish gillnet					
				% tows	kg per line-lift		% dis-	Annual catch (kg)		% tows	kg per set		% dis-	Annual catch (kg)		% tows	kg per set		% dis-	Annual catch (kg)		% tows	kg per set		% dis-	Annual catch (kg)	
			Estimate	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se
Rays (Batoidea) (continued)																											
Whitespotted guitarfish	*Rhynchobatus australiae*	0–199	0																								
		200–599	0																								
		≥600	1	1	0.1825	0.1825	100	1	1																		
		Total	21		0.0305	0.0305	100	21	21																		
Whitespotted skate	*Dipturus cerva*	0–199	21649													4	0.0435	0.0435	100	26	26						
		200–599	14109							2	0.2602	0.2133	18	109	89												
		≥600	0																								
		Total	37340							2	0.2548	0.2089	18	119	98	1	0.0116	0.0116	100	9	9						
Wide stingaree	*Urolophus expansus*	0–199	364733																								
		200–599	18139																								
		≥600	0																								
		Total	351084																								
Yellowback stingaree	*Urolophus sufflavus*	0–199	4576																								
		200–599	187																								
		≥600	0																								
		Total	4776																								
Holocephalans (Holocephalii)																											
Bigspine spookfish	*Harriotta raleighana*	0–199	11																								
		200–599	198																								
		≥600	2524																								
		Total	2010																								
Black ghostshark	*Hydrolagus sp A*	0–199	29																								
		200–599	474																								
		≥600	587																								
		Total	958																								
Blackfin ghostshark	*Hydrolagus lemures*	0–199	1711													4	0.2609	0.2609		155	155						
		200–599	6810							25	2.5522	0.3204	7	1068	134	38	0.9900	0.2483		198	50						
		≥600	759													9	0.0783	0.0573									
		Total	10645							24	2.4991	0.3141	7	1169	147	21	0.5512	0.1418		439	113						
Elephantfish	*Callorhinchus milii*	0–199	47005																								
		200–599	790								0.0283	0.0206		12	9												
		≥600	352																								
		Total	47960								0.0277	0.0202		13	9												
Giant chimaera	*Chimaera lignaria*	0–199	0																								
		200–599	0																								
		≥600	136																								
		Total	97																								
Marbled ghostshark	*Hydrolagus sp B*	0–199	0																								
		200–599	47																								
		≥600	24																								
		Total	68																								
Ogilby ghostshark	*Hydrolagus ogilbyi*	0–199	772																								
		200–599	7691							5	0.2301	0.0490		96	21	15	1.0250	0.5633	10	205	113	45	3.0000	0.9687	7	501	162
		≥600	1012													22	1.3913	0.6556		2	1						
		Total	10286							5	0.2253	0.0480		105	22	13	0.8488	0.3175	5	676	253	45	3.0000	0.9687	7	501	162
Pacific spookfish	*Rhinochimaera pacifica*	0–199	0																								
		200–599	0																								
		≥600	1263																								
		Total	1200																								
Shortnose chimaera (unspecified)	*Chimaeridae*	0–199	1191																								
		200–599	7071							2	0.1097	0.0394		46	16												
		≥600	1127																								
		Total	9645							2	0.1075	0.0386		50	18												

Table 5b (continued)

Common name	Scientific name	Depth	Total annual	GHATF dropline						GHATF automatic longline						GHATF scalefish longline						GHATF scalefish gillnet					
		category	catch (kg)	% tows	kg per line-lift		% dis-	Annual catch (kg)		% tows	kg per set		% dis-	Annual catch (kg)		% tows	kg per set		% dis-	Annual catch (kg)		% tows	kg per set		% dis-	Annual catch (kg)	
		(metres)	Estimate	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se	>0 kg	Mean	se	card	Estimate	se
Holocephalans (Holocephalii) (continued)																											
Shortspine chimaera	*Chimaera sp B*	0–199	0																								
		200–599	42																								
		≥600	0																								
		Total	45																								
Southern chimaera	*Chimaera sp A*	0–199	860																								
		200–599	8063							13	0.7469	0.1266	16	313	53												
		≥600	3760																								
		Total	12378							12	0.7314	0.1240	16	342	58												
Spookfish (unspecified)	*Rhinochimaeridae*	0–199	0																								
		200–599	0																								
		≥600	32																								
		Total	23																								

Table 6. Summary statistics and data selection criteria for CPUE standardisation

Summary statistics include values of scaled Pearson $\chi 2$ and regression gradient. CPUE standardisations are from ISMP data for various periods during 1994–06 for SETF and during 2000–06 for GABTF. Sthn Aus, southern Australia predominantly longitude range 127–151°E; SE Aus, south-eastern Australia predominantly longitude range 138–151°E; GAB, Great Australian Bight predominantly longitude range 127–138°E; Western, predominantly longitude range 138–148°E; Eastern, predominantly longitude range 148–152°E.

Table 6 (continued)

Common name	Scientific name	Region	Data selection criteria					Mean annual catch & effort for selected data					Scaled Pearson χ^2		Trend in abundance		Figure
			Period	Longitude		Latitude	Depth	Hauls	Catch	Tow dist	CPUE	Hauls (%)	Log-	Binomial	Trend	P	
				Min	Max		(m)	(no.)	(kg)	(km)	(kg/km)	>0 catch	gamma				
Sharks (Selachii)																	
Australian angel shark	*Squatina australis*	Eastern	1994–06	148°E	151°E	<38°S	0– 500	316	5001	2776	1.801	40	1.52	1.01	No trend	ns	3.01a
Australian angel shark	*Squatina australis*	Eastern	1998–06	148°E	151°E	<38°S	0– 500	419	7167	3586	1.999	49	1.58	1.01	Decreasing	0.0005	3.01b
Australian angel shark	*Squatina australis*	Eastern	2000–06	148°E	151°E	<38°S	0– 500	442	7653	3754	2.039	49	1.48	1.01	No trend	ns	3.01c
Black shark	*Dalatias licha*	SE Aus	1994–06	137°E	151°E		600–1000	106	829	321	2.584	27	1.09	1.15	Decreasing	0.0026	3.02a
Black shark	*Dalatias licha*	SE Aus	2000–06	137°E	151°E		600–1000	130	1905	1008	1.890	241	1.24	1.56	Decreasing	0.0200	3.02b
Brier shark	*Denia calcea*	Sthn Aus	2000–06	136°E	148°E		600–1000	131	5626	1012	5.562	30	1.00	1.08	Decreasing	0.0159	3.03a
Brier shark	*Denia calcea*	Western	1996–06	137°E	148°E		600–1000	61	3208	554	5.789	58	0.74	1.10	Decreasing	0.0111	3.03b
Common sawshark	*Pristiophorus cirratus*	Sthn Aus	2000–06	127°E	151°E		0– 800	859	6819	8177	0.834	32	1.52	1.04	Decreasing	0.0044	3.04a
Common sawshark	*Pristiophorus cirratus*	SE Aus	1994–06	136°E	151°E		0– 800	601	2866	5558	0.516	22	1.56	1.21	Increasing	0.0135	3.04b
Common sawshark	*Pristiophorus cirratus*	Western	2000–06	127°E	145°E		0– 800	229	3977	2754	1.444	40	1.14	1.07	No trend	ns	3.04c
Common sawshark	*Pristiophorus cirratus*	Eastern	2000–06	148°E	151°E		0– 500	499	2656	4219	0.629	34	1.62	1.10	Decreasing	0.0099	3.04d
Draughtboard shark	*Cephaloscyllium laticeps*	SE Aus	1996–06	143°E	151°E		0– 200	315	4122	2781	1.482	40	1.20	1.07	No trend	ns	3.05a
Draughtboard shark	*Cephaloscyllium laticeps*	SE Aus	2000–06	143°E	151°E		0– 200	382	4052	3287	1.233	34	1.18	1.07	No trend	ns	3.05b
Greeneye spurdog	*Squalus mitsukurii*	Sthn Aus	2000–06	127°E	151°E		120– 800	650	4547	6335	0.718	17	1.56	1.13	Decreasing	<0.0001	3.06a
Greeneye spurdog	*Squalus mitsukurii*	Western	1996–06	137°E	148°E		200– 800	169	3948	1786	2.211	47	1.73	1.14	Decreasing	<0.0001	3.06b
Greeneye spurdog	*Squalus mitsukurii*	Eastern	1996–06	148°E	151°E	<39°S	120– 600	304	767	2752	0.279	8	1.63	1.06	Decreasing	0.0108	3.06c
Grey spotted catshark	*Asymbolis analis*	Sthn Aus	2000–06	127°E	151°E		0– 300	497	440	4523	0.097	15	1.10	1.03	No trend	ns	3.07a
Grey spotted catshark	*Asymbolis analis*	SE Aus	1998–06	137°E	151°E		0– 300	450	404	3927	0.103	15	1.09	1.03	No trend	ns	3.07b
Gummy shark	*Mustelus antarcticus*	Sthn Aus	2000–06	127°E	151°E		0– 500	806	2669	7929	0.337	25	1.08	1.00	Decreasing	0.0013	3.08a
Gummy shark	*Mustelus antarcticus*	SE Aus	1994–05	139°E	151°E		0– 600	828	2077	7430	0.280	19	1.13	0.99	No trend	ns	3.08b
Ornate angel shark	*Squatina tergocellata*	GAB	2000–06	127°E	133°E		0– 300	121	11122	1691	6.576	93	1.08	0.77	No trend	ns	3.09a
Owstons dogfish	*Centroscymnus owstoni*	SE Aus	1996–06	137°E	151°E		600–1000	126	1924	931	2.067	32	0.79	1.15	Decreasing	0.0072	3.10a
Owstons dogfish	*Centroscymnus owstoni*	SE Aus	2000–06	136°E	151°E		600–1000	120	1731	902	1.920	26	1.02	1.21	No trend	ns	3.10b
Port Jackson shark	*Heterodontus portusjacksoni*	Sthn Aus	2000–06	127°E	151°E		0– 300	542	4952	5149	0.962	32	1.98	1.00	Decreasing	0.0415	3.11a
Port Jackson shark	*Heterodontus portusjacksoni*	GAB	2000–06	127°E	132°E		0– 300	92	387	1272	0.305	33	1.06	1.03	No trend	ns	3.11b
Port Jackson shark	*Heterodontus portusjacksoni*	Eastern	1994–06	148°E	151°E		0– 400	326	3357	2864	1.172	25	1.76	0.94	No trend	ns	3.11c
Sawtail shark	*Galeus boardmani*	Sthn Aus	2000–06	127°E	151°E		140– 600	615	542	6060	0.089	14	1.80	1.05	No trend	ns	3.12a
Sawtail shark	*Galeus boardmani*	SE Aus	1998–06	136°E	151°E		140– 600	524	509	4834	0.105	16	1.81	1.05	Decreasing	0.0301	3.12b
School shark	*Galeorhinus galeus*	Sthn Aus	2000–06	127°E	151°E		120– 600	672	586	6601	0.089	5	1.07	0.94	Decreasing	0.0115	3.13a
School shark	*Galeorhinus galeus*	SE Aus	1994–06	136°E	151°E		100– 600	520	922	5044	0.183	12	1.17	1.00	Decreasing	<0.0001	3.13b
School shark	*Galeorhinus galeus*	Western	1994–06	136°E	148°E		200– 600	154	726	1649	0.440	21	1.09	1.04	Decreasing	<0.0001	3.13c
School shark	*Galeorhinus galeus*	Eastern	1994–06	148°E	151°E		100– 500	374	183	3369	0.054	7	1.31	0.95	Decreasing	0.0045	3.13d

Table 6 (continued)

Common name	Scientific name	Region	Data selection criteria: Period	Longitude Min	Longitude Max	Latitude	Depth (m)	Mean annual catch & effort for selected data: Hauls (no.)	Catch (kg)	Tow dist (km)	CPUE (kg/km)	Hauls (%) >0 catch	Scaled Pearson χ^2: Log-gamma	Binomial	Trend in abundance: Trend	P	Figure
Sharks (Selachii) (continued)																	
Spikey spurdog	*Squalus megalops*	Sthn Aus	2000–06	127°E	151°E		0– 600	842	17326	8038	2.156	29	2.38	0.98	Increasing	<0.0001	3.14a
Spikey spurdog	*Squalus megalops*	GAB	2001–06	127°E	132°E		0– 300	98	2346	1335	1.757	53	1.39	1.05	No trend	ns	3.14b
Spikey spurdog	*Squalus megalops*	Western	2002–06	139°E	148°E		140– 600	161	3606	1837	1.963	30	1.24	0.94	No trend	ns	3.14c
Spikey spurdog	*Squalus megalops*	Eastern	1998–06	148°E	151°E	<41°S	0– 600	534	11747	4500	2.611	29	2.33	0.99	Increasing	0.0019	3.14d
Whitefin swell shark	*Cephaloscyllium sp a*	SE Aus	1994–06	137°E	151°E		200– 700	354	7905	3369	2.346	51	1.34	1.01	Decreasing	<0.0001	3.15a
Whitefin swell shark	*Cephaloscyllium sp a*	SE Aus	2000–06	137°E	151°E		200– 700	417	8136	3878	2.098	47	1.33	0.99	Decreasing	<0.0001	3.15b
Gulper shark	*Centrophorus spp*	Western	1996–06	136°E	144°E		200–1000	160	313	1578	0.199	9	1.55	1.42	No trend	ns	3.16a
Gulper shark	*Centrophorus spp*	Eastern	1998–06	148°E	151°E	<38°S	200– 900	214	434	1726	0.252	12	1.67	1.03	No trend	ns	3.16b
Rays (Batoidea)																	
Banded stingaree	*Urolophus cruciatus*	Sthn Aus	2000–06	136°E	151°E		0– 400	563	1264	4975	0.254	20	1.22	0.99	No trend	ns	4.01a
Bight skate	*Dipturus gudgeri*	Sthn Aus	2000–06	127°E	151°E		160–1000	496	1940	4816	0.403	19	1.01	1.02	Increasing	0.0029	4.02a
Black stingray	*Dasyatis thetidis*	GAB	2001–06	127°E	132°E		120– 200	80	304	1099	0.277	7	1.27	0.52	No trend	ns	4.03a
Black stingray	*Dasyatis thetidis*	Eastern	1998–06	148°E	151°E	<38°S	0– 400	385	1573	3279	0.480	11	1.14	1.00	No trend	ns	4.03b
Common stingaree	*Trygonoptera testacea*	Eastern	2001–06	148°E	151°E	<38°S	0– 300	326	882	2742	0.322	17	2.00	0.93	No trend	ns	4.04a
Eastern shovelnose ray	*Aptychotrema rostrata*	Eastern	1998–06	148°E	151°E	<38°S	0– 160	241	427	1967	0.217	12	0.71	0.82	Increasing	<0.0001	4.05a
Greenback stingaree	*Urolophus viridis*	Eastern	1998–06	149°E	151°E	<38°S	0– 300	351	9162	2991	3.064	44	1.82	1.02	Decreasing	0.0026	4.06a
Longnose skate	*Dipturus* sp A	Eastern	1998–06	148°E	151°E	<38°S	0– 140	250	393	2106	0.187	8	0.81	0.79	Decreasing	0.0438	4.07a
Melbourne skate	*Dipturus whitleyi*	GAB	2001–06	127°E	131°E		160– 400	93	761	1268	0.600	11	1.33	1.34	Increasing	0.0071	4.08a
Melbourne skate	*Dipturus whitleyi*	Western	2002–06	138°E	147°E		0– 400	91	272	945	0.287	8	1.93	0.91	No trend	ns	4.08b
Melbourne skate	*Dipturus whitleyi*	Eastern	1998–06	145°E	151°E	>35°S	0– 600	609	2950	5270	0.560	11	1.14	0.99	Increasing	0.0034	4.08c
Peacock skate	*Pavoraja nitida*	Eastern	2001–06	148°E	151°E		0– 600	588	795	5018	0.158	10	0.94	1.06	No trend	ns	4.09a
Sandyback stingaree	*Urolophus bucculentus*	Eastern	1998–06	148°E	151°E		0– 300	407	1510	3533	0.427	19	1.23	1.14	No trend	ns	4.10a
Smooth stingray	*Dasyatis brevicaudata*	GAB	2001–06	127°E	132°E		0– 200	90	2216	1228	1.805	34	0.99	1.71	No trend	ns	4.11a
Smooth stingray	*Dasyatis brevicaudata*	Eastern	2002–06	149°E	151°E	<38°S	0– 300	368	526	3135	0.168	7	1.68	1.03	No trend	ns	4.11b
Southern eagle ray	*Myliobatis australis*	Eastern	1998–06	148°E	151°E	<38°S	0– 300	380	1358	3255	0.417	13	2.11	1.19	No trend	ns	4.12a
Southern fiddler ray	*Trygonorrhina fasciata*	GAB	2000–06	127°E	132°E		0– 200	86	2699	1181	2.285	49	0.88	1.07	No trend	ns	4.13a
Southern fiddler ray	*Trygonorrhina fasciata*	Eastern	1998–06	148°E	151°E	<38°S	0– 200	327	1540	2776	0.554	17	0.86	1.27	Decreasing	0.0435	4.13b
Sparsely spotted stingaree	*Urolophus paucimaculatus*	Eastern	1998–06	148°E	151°E		0– 300	407	792	3533	0.224	8	1.21	1.35	Decreasing	0.0125	4.14a
Short-tail torpedo ray	*Torpedo macneilli*	Sthn Aus	2000–06	127°E	151°E		60– 600	830	1819	7973	0.228	13	1.22	1.05	No trend	ns	4.15a
Sydney skate	*Dipturus australis*	Eastern	1998–06	148°E	151°E		0– 600	567	3570	4855	0.735	35	1.35	1.04	No trend	ns	4.16a
Tasmanian numbfish	*Narcine tasmaniensis*	Sthn Aus	2000–06	127°E	151°E		0– 600	736	1216	6739	0.180	16	1.16	1.26	Increasing	<0.0001	4.17a
Wide stingaraee	*Urolophus expansus*	GAB	2000–06	127°E	133°E		120– 400	85	6563	1173	5.594	55	1.44	1.18	No trend	ns	4.18a
Holocephalans (Holocephalii)																	
Blackfin ghostshark	*Hydrolagus lemures*	Eastern	2002–06	148°E	151°E	<38°S	140– 900	324	184	2763	0.067	7	1.46	1.00	No trend	ns	5.01a
Ogilbys ghostshark	*Hydrolagus ogilbyi*	SE Aus	1994–06	141°E	151°E		140–1000	425	209	3759	0.056	8	1.39	0.90	No trend	ns	5.02a
Southern chimaera	*Chimaera* sp a	SE Aus	1994–06	137°E	151°E		200–1000	383	283	3400	0.083	10	1.05	0.87	No trend	ns	5.03a

Table 7. Depth range distribution from results of standardisation for each species

CPUE standardisations are from ISMP data for various periods during 1994–06 for SETF and during 2000–06 for GABTF. Sthn Aus, southern Australia predominantly longitude range 127–151°E; SE Aus, south-eastern Australia predominantly longitude range 138–151°E; GAB, Great Australian Bight predominantly longitude range 127–138°E; Western, western region of SETF predominantly longitude range 138–148°E; Eastern, eastern reion of predominantly longitude range 148–152°E. ▒ , present; ■ , highest abundance.

Table 7 (continued)

Common name	Scientific name	Region	Period	Longitude Min	Longitude Max	Lat.	Depth (m)	0–99	100–199	200–299	300–399	400–499	500–599	600–699	700–799	800–899	900–999	1000–1099
Sharks (Selachii)																		
Australian angel shark	*Squatina australis*	Eastern	1994–06	148°E	151°E	<38°S	0– 500	▒	■	▒	▒	▒						
Australian angel shark	*Squatina australis*	Eastern	1998–06	148°E	151°E	<38°S	0– 500	▒	■	▒	▒	▒						
Australian angel shark	*Squatina australis*	Eastern	2000–06	148°E	151°E	<38°S	0– 500	▒	■	▒	▒	▒						
Black shark	*Dalatias licha*	SE Aus	1994–06	137°E	151°E		600–1000							▒	▒	▒	■	▒
Black shark	*Dalatias licha*	SE Aus	2000–06	137°E	151°E		600–1000							▒	▒	▒	■	▒
Brier shark	*Denia calcea*	Sthn Aus	2000–06	136°E	148°E		600–1000							▒	▒	▒	■	▒
Brier shark	*Denia calcea*	Western	1996–06	137°E	148°E		600–1000							▒	▒	▒	■	▒
Common sawshark	*Pristiophorus cirratus*	Sthn Aus	2000–06	127°E	151°E		0– 800	▒	■	■	■	▒	▒	▒	▒	▒		
Common sawshark	*Pristiophorus cirratus*	SE Aus	1994–06	136°E	151°E		0– 800	▒	■	■	■	▒	▒	▒	▒	▒		
Common sawshark	*Pristiophorus cirratus*	Western	2000–06	127°E	145°E		0– 800	▒	■	▒	▒	▒	▒	▒	▒	▒		
Common sawshark	*Pristiophorus cirratus*	Eastern	2000–06	148°E	151°E		0– 500	▒	■	■	■	▒	▒					
Draughtboard shark	*Cephaloscyllium laticeps*	SE Aus	1996–06	143°E	151°E		0– 200	▒	■	▒								
Draughtboard shark	*Cephaloscyllium laticeps*	SE Aus	2000–06	143°E	151°E		0– 200	▒	■	▒								
Greeneye spurdog	*Squalus mitsukurii*	Sthn Aus	2000–06	127°E	151°E		120– 800		▒	▒	■	■	■	▒	▒	▒		
Greeneye spurdog	*Squalus mitsukurii*	Western	1996–06	137°E	148°E		200– 800			■	■	■	■	▒	▒	▒		
Greeneye spurdog	*Squalus mitsukurii*	Eastern	1996–06	148°E	151°E	<39°S	120– 600		■	■	■	■	▒	▒				
Grey spotted catshark	*Asymbolis analis*	Sthn Aus	2000–06	127°E	151°E		0– 300	▒	■	▒	▒							
Grey spotted catshark	*Asymbolis analis*	SE Aus	1998–06	137°E	151°E		0– 300	■	■	▒	▒							
Gummy shark	*Mustelus antarcticus*	Sthn Aus	2000–06	127°E	151°E		0– 500	■	▒	▒	▒	▒	▒					
Gummy shark	*Mustelus antarcticus*	SE Aus	1994–05	139°E	151°E		0– 600	▒	■	▒	▒	▒	▒	▒				
Ornate angel shark	*Squatina tergocellata*	GAB	2000–06	127°E	133°E		0– 300	▒	■	▒	▒							
Owstons dogfish	*Centroscymnus owstoni*	SE Aus	1996–06	137°E	151°E		600–1000							▒	▒	▒	■	▒
Owstons dogfish	*Centroscymnus owstoni*	SE Aus	2000–06	136°E	151°E		600–1000							▒	▒	▒	■	▒
Port Jackson shark	*Heterodontus portusjacksoni*	Sthn Aus	2000–06	127°E	151°E		0– 300	■	▒	▒	▒							
Port Jackson shark	*Heterodontus portusjacksoni*	GAB	2000–06	127°E	132°E		0– 300	▒	■	▒	▒							
Port Jackson shark	*Heterodontus portusjacksoni*	Eastern	1994–06	148°E	151°E		0– 400	■	▒	▒	▒	▒						
Sawtail shark	*Galeus boardmani*	Sthn Aus	2000–06	127°E	151°E		140– 600		▒	▒	■	▒	▒	▒				
Sawtail shark	*Galeus boardmani*	SE Aus	1998–06	136°E	151°E		140– 600		▒	▒	■	▒	▒	▒				
School shark	*Galeorhinus galeus*	Sthn Aus	2000–06	127°E	151°E		120– 600		▒	▒	■	▒	▒	▒				
School shark	*Galeorhinus galeus*	SE Aus	1994–06	136°E	151°E		100– 600		■	■	■	■	▒	▒				
School shark	*Galeorhinus galeus*	Western	1994–06	136°E	148°E		200– 600			■	■	■	▒	▒				
School shark	*Galeorhinus galeus*	Eastern	1994–06	148°E	151°E		100– 500		■	▒	▒	▒	▒					

Table 7 (continued)

Common name	Scientific name	Region	Period	Longitude Min	Longitude Max	Lat.	Depth (m)	0–99	100–199	200–299	300–399	400–499	500–599	600–699	700–799	800–899	900–999	1000–1099
Sharks (Selachii) (continued)																		
Spikey spurdog	*Squalus megalops*	Sthn Aus	2000–06	127°E	151°E		0– 600											
Spikey spurdog	*Squalus megalops*	GAB	2001–06	127°E	132°E		0– 300											
Spikey spurdog	*Squalus megalops*	Western	2002–06	139°E	148°E		140– 600											
Spikey spurdog	*Squalus megalops*	Eastern	1998–06	148°E	151°E		0– 600											
Whitefin swell shark	*Cephaloscyllium sp a*	SE Aus	1994–06	137°E	151°E		200– 700											
Whitefin swell shark	*Cephaloscyllium sp a*	SE Aus	2000–06	137°E	151°E		200– 700											
Gulper shark	*Centrophorus spp*	Western	1996–06	136°E	144°E		200–1000											
Gulper shark	*Centrophorus spp*	Eastern	1998–06	148°E	151°E	<38°S	200– 900											
Rays (Batoidea)																		
Banded stingaree	*Urolophus cruciatus*	Sthn Aus	2000–06	136°E	151°E		0– 400											
Bight skate	*Dipturus gudgeri*	Sthn Aus	2000–06	127°E	151°E		160–1000											
Black stingray	*Dasyatis thetidis*	GAB	2001–06	127°E	132°E		120– 200											
Black stingray	*Dasyatis thetidis*	Eastern	1998–06	148°E	151°E	<38°S	0– 400											
Common stingaree	*Trygonoptera testacea*	Eastern	2001–06	148°E	151°E	<38°S	0– 300											
Eastern shovelnose ray	*Aptychotrema rostrata*	Eastern	1998–06	148°E	151°E	<38°S	0– 160											
Greenback stingaree	*Urolophus viridis*	Eastern	1998–06	149°E	151°E	<38°S	0– 300											
Longnose skate	*Dipturus sp A*	Eastern	1998–06	148°E	151°E	<38°S	0– 140											
Melbourne skate	*Dipturus whitleyi*	GAB	2001–06	127°E	131°E		160– 400											
Melbourne skate	*Dipturus whitleyi*	Western	2002–06	138°E	147°E		0– 400											
Melbourne skate	*Dipturus whitleyi*	Eastern	1998–06	145°E	151°E	>35°S	0– 600											
Peacock skate	*Pavoraja nitida*	Eastern	2001–06	148°E	151°E		0– 600											
Sandyback stingaree	*Urolophus bucculentus*	Eastern	1998–06	148°E	151°E		0– 300											
Smooth stingray	*Dasyatis brevicaudata*	GAB	2001–06	127°E	132°E		0– 200											
Smooth stingray	*Dasyatis brevicaudata*	Eastern	2002–06	149°E	151°E	<38°S	0– 300											
Southern eagle ray	*Myliobatis australis*	Eastern	1998–06	148°E	151°E	<38°S	0– 300											
Southern fiddler ray	*Trygonorrhina fasciata*	GAB	2000–06	127°E	132°E		0– 200											
Southern fiddler ray	*Trygonorrhina fasciata*	Eastern	1998–06	148°E	151°E	<38°S	0– 200											
Sparsely spotted stingaree	*Urolophus paucimaculatus*	Eastern	1998–06	148°E	151°E		0– 300											
Short-tail torpedo ray	*Torpedo macneilli*	Sthn Aus	2000–06	127°E	151°E		60– 600											
Sydney skate	*Dipturus australis*	Eastern	1998–06	148°E	151°E		0– 600											
Tasmanian numbfish	*Narcine tasmaniensis*	Sthn Aus	2000–06	127°E	151°E		0– 600											
Wide stingaraee	*Urolophus expansus*	GAB	2000–06	127°E	133°E		120– 400											
Holocephalans (Holocephalii)																		
Blackfin ghostshark	*Hydrolagus lemures*	Eastern	2002–06	148°E	151°E	<38°S	140– 900											
Ogilbys ghostshark	*Hydrolagus ogilbyi*	SE Aus	1994–06	141°E	151°E		140–1000											
Southern chimaera	*Chimaera sp a*	SE Aus	1994–06	137°E	151°E		200–1000											

Table 8a. Number of species by abundance category and depth range

Abundance category is mostly total catch in the SESSF: rare <1 t; sparse, 1–19 t; common 20–99 t; abundant, ≥100 t.

Category	Mean annual catch (t) estimate from ISMP	Number of species			
		Shelf <200 m	Upper-mid slope 200–599 m	Deep-water ≥600 m	Total
Sharks (Selachii)					
Rare	0	3	4	2	9
	<1	8	9	7	24
	Outside range	2	1		3
	Sub-total	13	14	9	36
Sparse	0	4			4
	1–19	7	9	5	21
	Outside range	2			2
	Sub-total	13	9	5	27
Common	20–99	3	2	3	8
Abundant	≥100	7	3	1	11
Total		36	28	18	82
Rays (Batoidea)					
Rare	0	3		1	4
	<1	2	2		4
	Outside range	3	3	1	7
	Sub-total	8	5	2	15
Sparse	0				0
	1–19	7	2		9
	Outside range	2			2
	Sub-total	9	2	0	11
Common	20–99	11	2	0	13
Abundant	≥100	6	0	0	6
Total		34	9	2	45
Holocephalans (Holocephalii)					
Rare	0				0
	<1			2	2
	Outside range		2		2
	Sub-total	0	2	2	4
Sparse	1–19		3	2	5
	Outside range				0
	Sub-total	0	3	2	5
Common	20–99	0	0	0	0
Abundant	≥100	1	0	0	1
Total		1	5	4	10
Grand total		71	42	24	137

Table 8b. Number of species by abundance category and depth range

Abundance category is mostly total catch in the SESSF: rare <1 t; sparse, 1–19 t; common 20–99 t; abundant, ≥100 t.

Abundance category	Number of species			
	Shelf <200 m	Upper-mid slope 200–599 m	Deep-water ≥600 m	Total
Sharks (Selachii)				
Rare	11	13	9	33
Sparse	11	9	5	25
Common	3	2	3	8
Abundant	7	3	1	11
Total	32	27	18	77
Rays (Batoidea)				
Rare	5	2	1	8
Sparse	7	2	0	9
Common	11	2	0	13
Abundant	6	0	0	6
Total	29	6	1	36
Holocephalans (Holocephalii)				
Rare	0	0	2	2
Sparse	0	3	2	5
Common	0	0	0	0
Abundant	1	0	0	1
Total	1	3	4	8
Grand total	62	36	23	121

Table 9a. Number of species of shark (selachii) by abundance category and depth range

Shark gillnet and shark longling catch is included in SESSF quota, but not included in ISMP catch estimate. Abundance category is based on mostly total catch in the SESSF: rare <1 t; sparse, 1–19 t; common 20–99 t; abundant, ≥100 t; risk category is derived from standardised CPUE based on post-2000 decline (=mean cpue 2004–06/mean cpue 2000–02): low, ≥0.667; medium, 0.334–0.666; high, ≤0.333.

Common name	Scientific name	ISMP[A] catch estimate (t)	Per cent retained	Abundance category	Trend	Post-2000 decline	Risk	Management mitgation
Continental shelf (<200 m)								
School shark	*Galeorhinus galeus*	35		Abundant	Decline only	0.426	Medium	Quota (257 t)[B]
Gummy shark	*Mustelus antarcticus*	185	94	Abundant	Rise-peak-decline	0.520	Medium	Quota (1800 t)
Australian angel shark	*Squatina australis*	313	97	Abundant	Rise-peak-decline	0.657	Medium	
Ornate angel shark	*Squatina tergocellata*	289	75	Abundant	Rise-peak-decline	1.643	Low	
Common sawshark	*Pristiophorus cirratus*	280	93	Abundant	Rise-peak-decline	0.556	Medium	Quota (434 t)[C]
Port Jackson shark	*Heterodontus portusjacksoni*	211	0	Abundant	Rise-peak-decline	0.687	Low	
Draughtboard shark	*Cephaloscyllium laticeps*	227	47	Abundant	No trend	0.864	Low	
Grey-spotted catshark	*Asymbolis analis*	26	0	Common	No trend	0.675	Low	
Southern sawshark	*Pristiophorus nudipinnis*	32	96	Common	Indeterminable			Quota[C]
Spotted wobbegong	*Orectolobus maculatus*	24	89	Common	Indeterminable			
11 sparse species (4 included from inshore fisheries)		1–19		Sparse	Indeterminable			
11 rare species (3 from literature)		<1		Rare	Indeterminable			
Upper-slope–mid-slope (200–599 m)								
Spikey spurdog	*Squalus megalops*	719	28	Abundant	Rise only	2.643	Low	Spatial closure
Whitefin swellshark	*Cephaloscyllium* sp a	385	10	Abundant	Rise-peak-decline	0.508	Medium	Spatial closure
Greeneye spurdog	*Squalus mitsukurii*	112	24	Abundant	Rise-peak-decline	0.123	High	Spatial closure
Gulper shark	*Centrophorus spp* [D]	56	75	Common	No trend	0.273	High[E]	Spatial closure
Sawtail shark	*Galeus boardmani*	23	0	Common	Decline	0.903	Low	
9 sparse species		1–19		Sparse	Indeterminable			
13 rare species (4 from literature)		<1		Rare	Indeterminable			
Lower-slope (≥600 m)								
Brier shark	*Deania calcea*	257	81	Abundant	Decline	0.476	Medium	Closure >700 m
Platypus shark	*Deania* spp	97	93	Common	Indeterminable			Closure >700 m
Black shark	*Dalatias licha*	81	45	Common	Decline	0.204	High	Closure >700 m
Owstons shark	*Centroscymnus owstoni*	71	93	Common	Decline	1.578	Low	Closure >700 m
Golden dogfish	*Centroscymnus crepidator*	56	93	Common	Indeterminable			Closure >700 m
5 sparse species		1–19		Sparse	Indeterminable			Closure >700 m
9 rare species (2 from literature)		<1		Rare	Indeterminable			Closure >700 m

[A]Excludes shark gillnet and shark longline fishing catch; [B]SESSF quota includes shark gillnet and shark longline fishing catch; [C]sawshark quota; [D]mostly *Centrophorus moluccensis* and *C. uyato*, with negligible quantities of *C. harrissoni*, and *C. squamosus*; [E]post-2000 decline in western region is 0.273 (high risk), whereas eastern region is 1.667 (low risk).

Table 9b. Number of species of rays (batoidea) by abundance category and depth range

Shark gillnet and shark longling catch is included in SESSF quota, but not included in ISMP catch estimate. Abundance category is based on mostly total catch in the SESSF: rare <1 t; sparse, 1–19 t; common 20–99 t; abundant, ≥100 t; risk category is derived from standardised CPUE based on post-2000 decline (=mean cpue 2004–06/mean cpue 2000–02): low, ≥0.667; medium, 0.334–0.666; high, ≤0.333.

Common name	Scientific name	ISMP[A] catch estimate (t)	Per cent retained	Abundance category	Trend	Post-2000 decline	Risk	Management mitigation
Continental shelf (<200 m)								
Greenback stingaree	*Urolophus viridis*	455	0	Abundant	Decline only	0.337	Medium	
Wide stingaree	*Urolophus expansus*	351	0	Abundant	No trend	1.067	Low	
Southern fiddler ray	*Trygonorrhina fasciata*	219	26	Abundant	No trend	1.252	Low	
Melbourne skate	*Dipturus whitleyi*	176	30	Abundant	Rise only	2.233	Low	
Sydney skate	*Dipturus australis*	157	0	Abundant	Rise-peak-decline	0.721	Low	
Sandyback stingaree	*Urolophus bucculentus*	124	19	Abundant	Rise-peak-decline	0.405	Medium	
Black stingray	*Dasyatis thetidis*	96	26	Common	Rise only	2.232	Low	
Sparsely spotted stingaree	*Urolophus paucimaculatus*	90	1	Common	Decline only	0.615	Medium	
Smooth stingray	*Dasyatis brevicaudata*	89	5	Common	Rise-peak-decline	2.123	Low	
Southern eagle ray	*Myliobatis australis*	88	55	Common	No trend	2.077	Low	
Banded stingaree	*Urolophus cruciatus*	70	0	Common	Rise-peak-decline	0.861	Low	
Peacock skate	*Pavoraja nitida*	70	0	Common	No trend	0.873	Low	
Tasmanian numbfish	*Narcine tasmaniensis*	56	0	Common	Rise only	4.715	Low	
Whitespotted skate	*Dipturus cerva*	37	0	Common	Indeterminable			
Common stingaree	*Trygonoptera testacea*	31	0	Common	Indeterminable			
Longnose skate	*Dipturus* sp A	25	67	Common	Indeterminable			
Eastern shovelnose	*Aptychotrema rostrata*	23	77	Common	Rise only	9.555	Low	
7 sparse species		1–19		Sparse	Indeterminable			
5 rare species (3 from literature with zero catch)		<1		Rare	Indeterminable			
Upper-slope–mid-slope (200–599 m)								
Bight skate	*Dipturus gudgeri*	88		Common	Rise only	2.232	Low	
Short-tail torpedo ray	*Torpedo macneilli*	72		Common	Rise-peak-decline	1.067	Low	
2 sparse species		1–19		Sparse	Indeterminable			
2 rare species		<1		Rare	Indeterminable			
Lower-slope (≥600 m)								
0 sparse species		1–19		Sparse	Indeterminable			Closure >700 m
1 rare species (includes 1 from literature with zero catch)		<1		Rare	Indeterminable			Closure >700 m

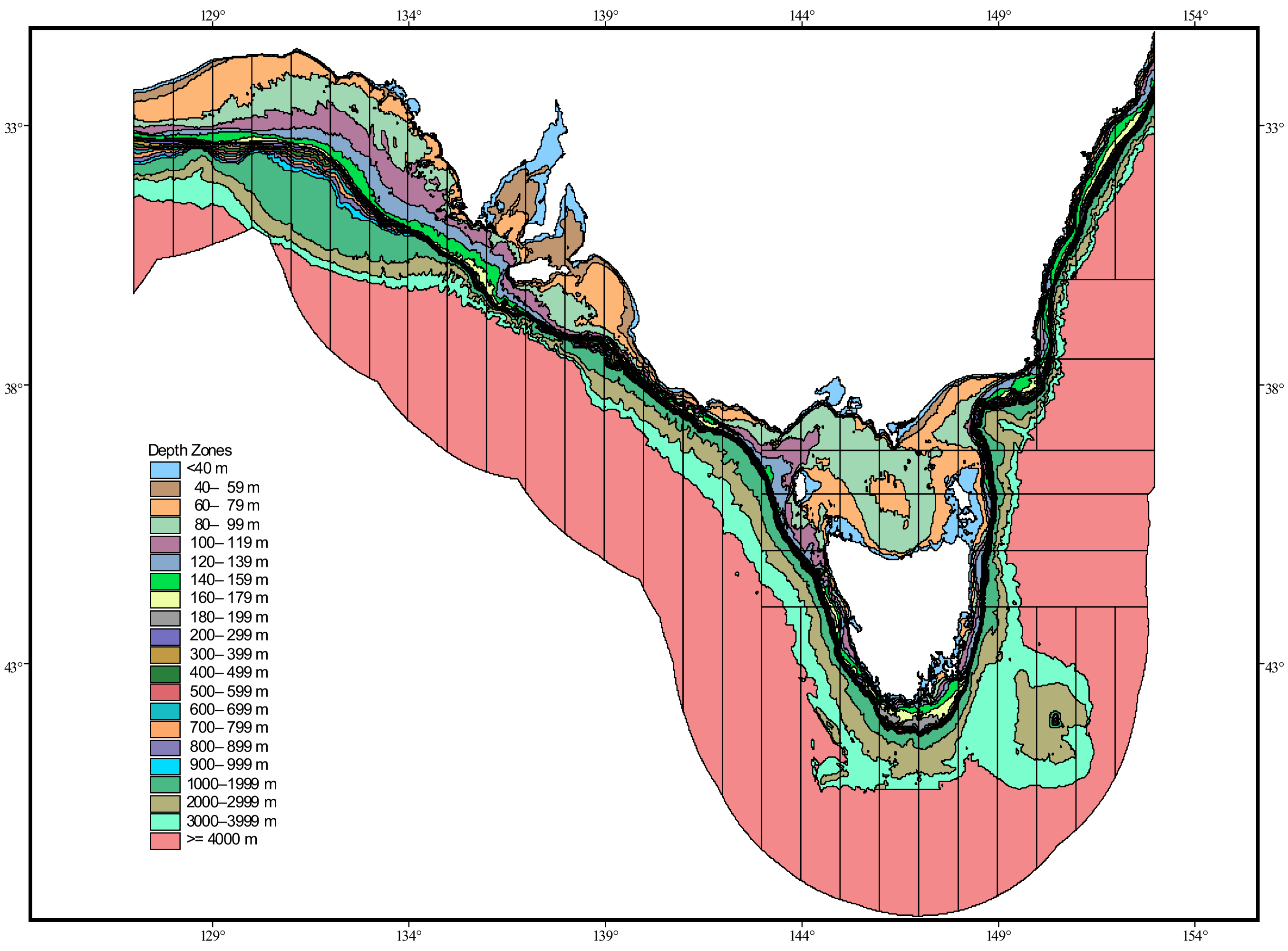
Table 9c. Number of species of holocephalans (holocephalii) by abundance category and depth range

Shark gillnet and shark longling catch is included in SESSF quota, but not included in ISMP catch estimate. Abundance category is based on mostly total catch in the SESSF: rare <1 t; sparse, 1–19 t; common 20–99 t; abundant, ≥100 t; risk category is derived from standardised CPUE based on post-2000 decline (=mean cpue 2004–06/mean cpue 2000–02): low, ≥0.667; medium, 0.334–0.666; high, ≤0.333.

Common name	Scientific name	ISMP[A] catch estimate	Per cent retained	Abundance category	Trend	Post-2000 decline	Risk	Management mitigation
Continental shelf (<200 m)								
Elephant fish	*Callorhinchus milii*	94	94	Abundant	Indeterminable			Quota (130 t)[B]
0 sparse species		1–19		Sparse	Indeterminable			
0 rare species		<1		Rare	Indeterminable			
Upper-slope–mid-slope (200–599 m)								
Southern chimaera	*Chimaera* sp A	12	89	Sparse	No trend	0.204	High	Quota (basket)
Ogilbys ghostshark	*Hydrolagus ogilby*	10	89	Sparse	No trend	1.870	Low	Quota (basket)
1 sparse species		1–19		Sparse	Indeterminable			Quota (basket)
0 rare species		<1		Rare	Indeterminable			
Lower-slope (≥600 m)								
Blackfin ghostshark	*Hydrolagus lemures*	11	74	Sparse	No trend	1.274	Low	Closure >700 m
1 sparse species		1–19		Sparse	Indeterminable			Closure >700 m
2 rare species		<1		Rare	Indeterminable			Closure >700 m

[A]Excludes shark gillnet and shark longline fishing catch; [B]SESSF quota includes shark gillnet and shark longline fishing catch.

Fig. 1. Boundaries of locality-cells



Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Fig. 2. Regions for data selection

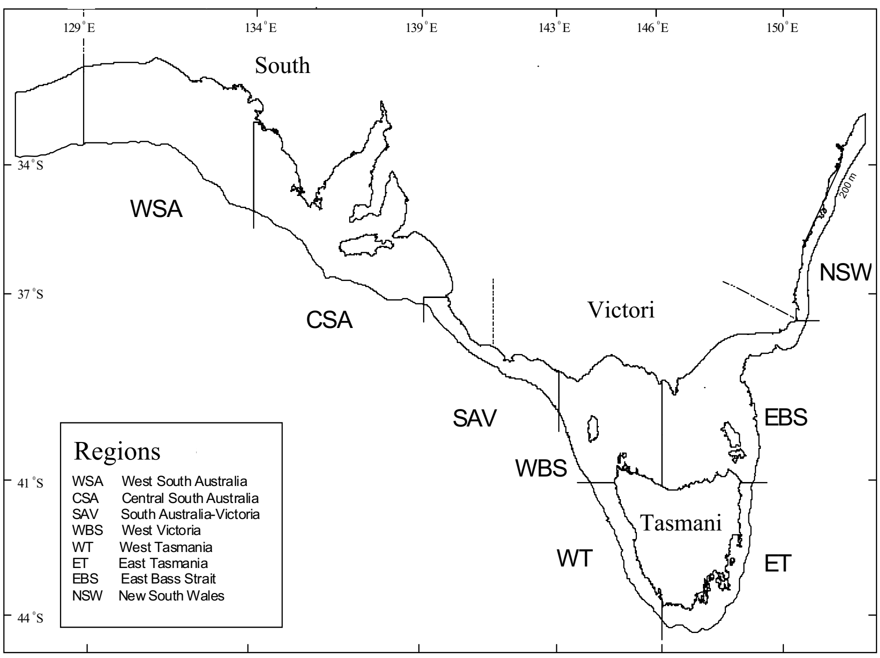
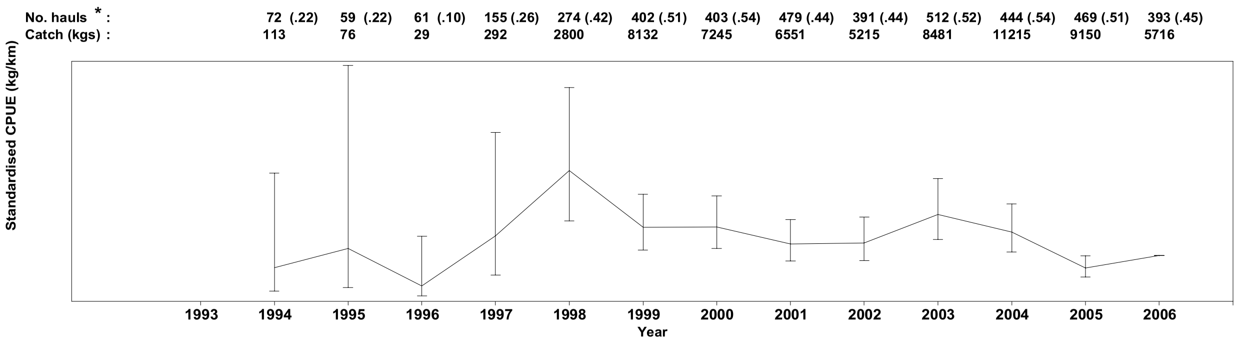
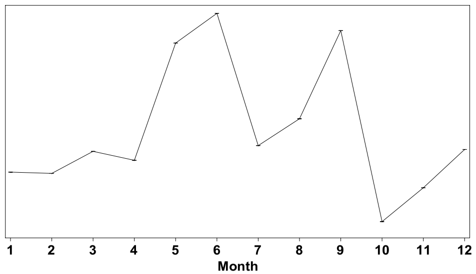
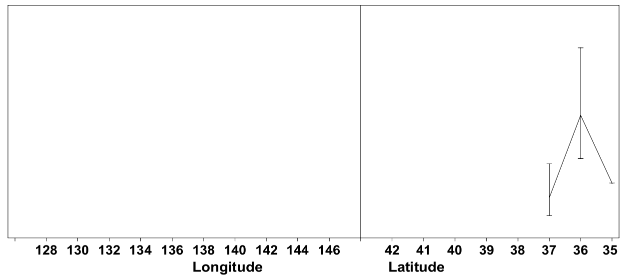
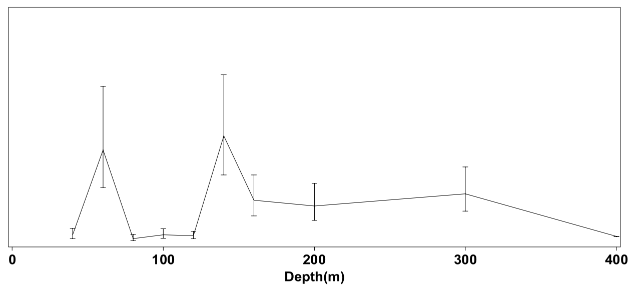


Fig. 3.01a. Australian angel shark (*Squatina australis*) 1994–06 SETF 0–400 m depth eastern region (longitude 148–151° E, latitude <38° S)









Australian angelshark Fishery: SETF

Scientific name: Squatina australis
CAAB code: 37024001

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.01
Model fit criterion: scaled Pearson chisq/df = 1.52
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	12	58.71	<.0001	15.42	ns
Month	11	36.93	0.0001	70.45	<.0001
Longitude/latitude	2	85.10	<.0001	724.13	<.0001
Depth	9	308.55	<.0001	181.96	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

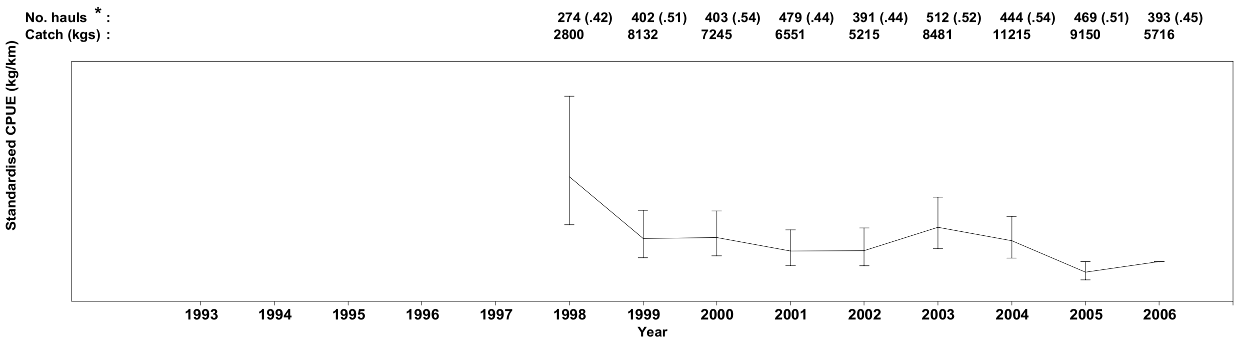
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

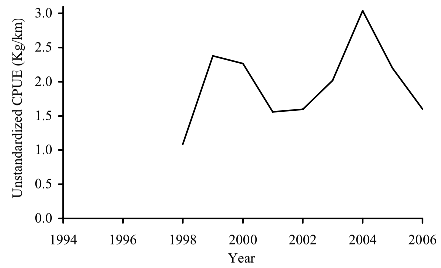
Year	Standardised CPUE (95% CI)		
1994	0.730	0.177	3.016
1995	1.199	0.256	5.622
1996	0.289	0.056	1.493
1997	1.500	0.561	4.006
1998	3.079	1.864	5.086
1999	1.707	1.163	2.504
2000	1.717	1.195	2.466
2001	1.306	0.901	1.892
2002	1.331	0.903	1.962
2003	2.023	1.417	2.888
2004	1.590	1.114	2.271
2005	0.726	0.515	1.023
2006	1.029	1.029	1.029

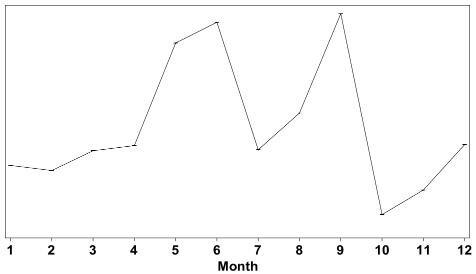
Raw catch and effort

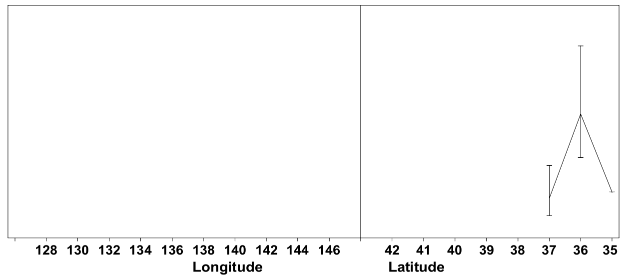
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994	0.222	72	113	767	0.147
1995	0.220	59	76	665	0.114
1996	0.098	61	29	622	0.047
1997	0.265	155	292	1762	0.166
1998	0.420	274	2801	2580	1.086
1999	0.515	402	8132	3417	2.380
2000	0.543	403	7245	3198	2.265
2001	0.438	479	6551	4198	1.561
2002	0.440	391	5215	3262	1.599
2003	0.521	512	8481	4198	2.020
2004	0.543	444	11215	3688	3.041
2005	0.505	469	9150	4159	2.200
2006	0.453	393	5716	3574	1.599
Mean	0.399	316	5001	2776	1.801

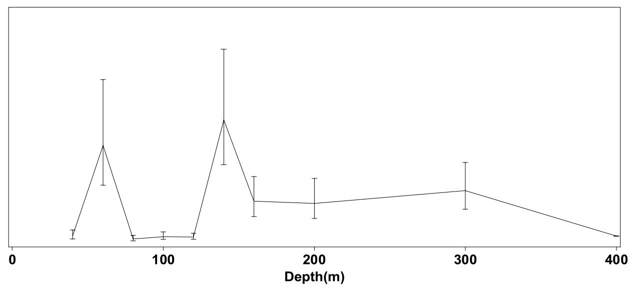
Fig. 3.01b. Australian angel shark (*Squatina australis*) 1998–06 SETF 0–400 m depth eastern region (longitude 148–151° E, latitude <38° S)











Australian angelshark

Fishery: SETF

Scientific name: Squatina australis
CAAB code: 37024001

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.01
Model fit criterion: scaled Pearson chisq/df = 1.58
Interannual trend: decreasing P = 0.0005

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	8	57.16	<.0001	10.03	ns
Month	11	37.67	<.0001	61.00	<.0001
Longitude/latitude	2	98.86	<.0001	725.66	<.0001
Depth	9	352.75	<.0001	164.12	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

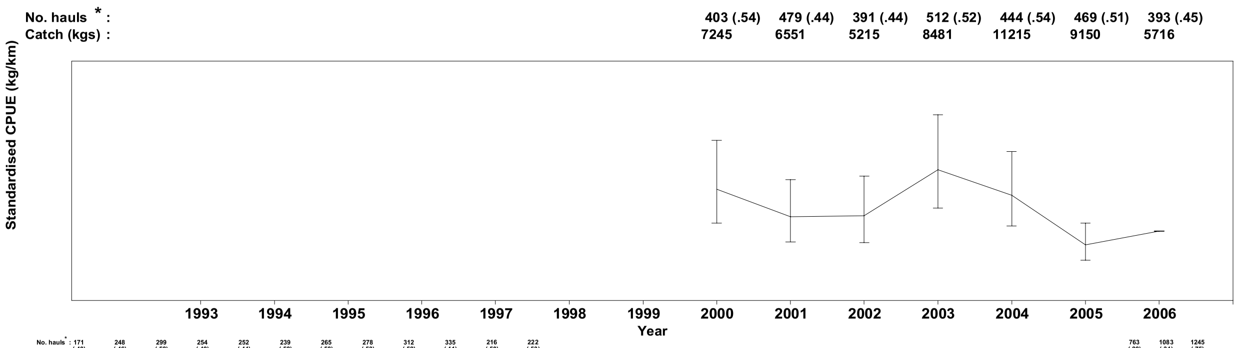
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

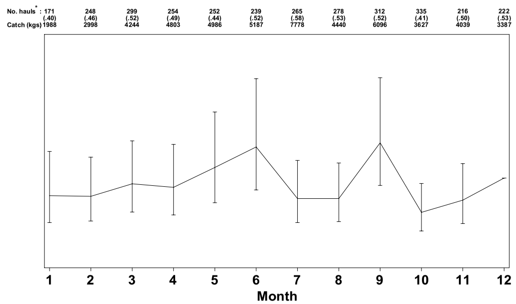
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998	4.100	2.470	6.806
1999	2.007	1.361	2.959
2000	2.043	1.421	2.937
2001	1.590	1.096	2.306
2002	1.600	1.085	2.359
2003	2.381	1.667	3.402
2004	1.926	1.348	2.753
2005	0.877	0.622	1.236
2006	1.227	1.227	1.227

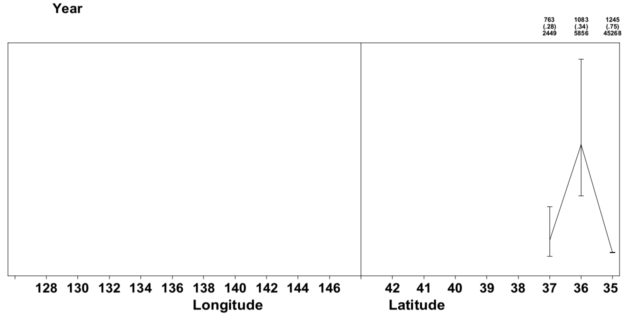
Raw catch and effort

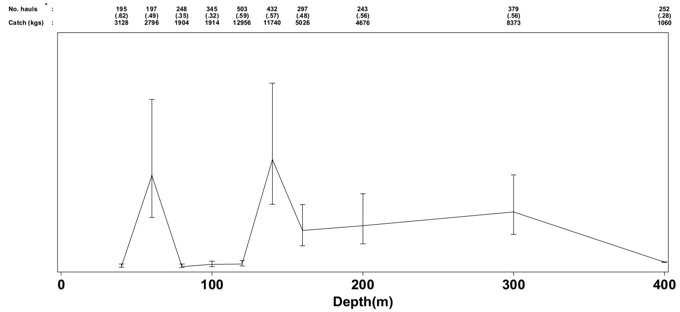
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998	0.420	274	2801	2580	1.086
1999	0.515	402	8132	3417	2.380
2000	0.543	403	7245	3198	2.265
2001	0.438	479	6551	4198	1.561
2002	0.440	391	5215	3262	1.599
2003	0.521	512	8481	4198	2.020
2004	0.543	444	11215	3688	3.041
2005	0.505	469	9150	4159	2.200
2006	0.453	393	5716	3574	1.599
Mean	0.487	419	7167	3586	1.999

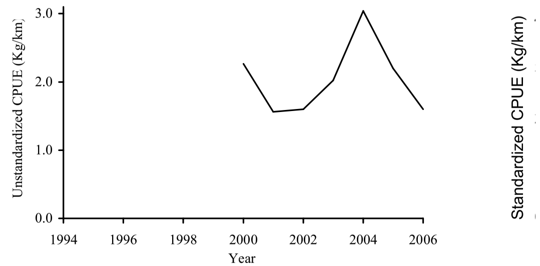
Fig. 3.01c. Australian angel shark (*Squatina australis*) 2000–06 SETF 0–400 m depth eastern region (longitude 148–151° E, latitude <38° S)











Australian angelshark

Fishery: trawl

Scientific name: Squatina australis
CAAB code: 37024001

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.01
Model fit criterion: scaled Pearson chisq/df = 1.48
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	6	29.02	<.0001	10.38	ns
Month	11	29.14	0.0022	51.22	<.0001
Longitude/latitude	2	137.66	<.0001	581.08	<.0001
Depth	9	345.00	<.0001	145.94	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

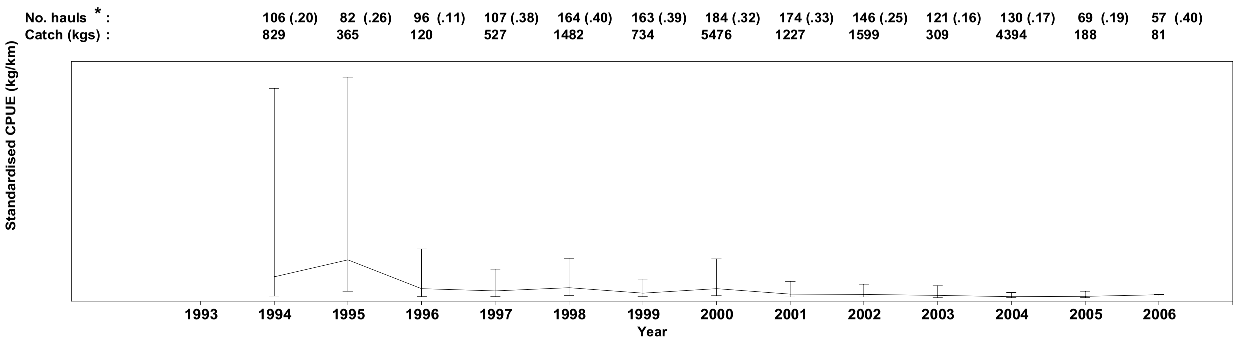
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

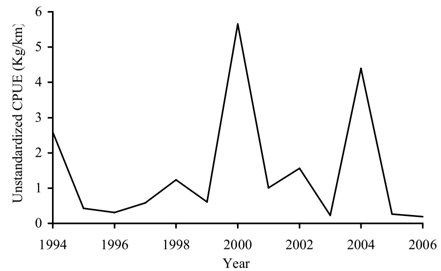
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	2.494	1.714	3.627
2001	1.863	1.277	2.718
2002	1.884	1.268	2.798
2003	2.945	2.057	4.216
2004	2.355	1.646	3.370
2005	1.212	0.857	1.713
2006	1.533	1.533	1.533

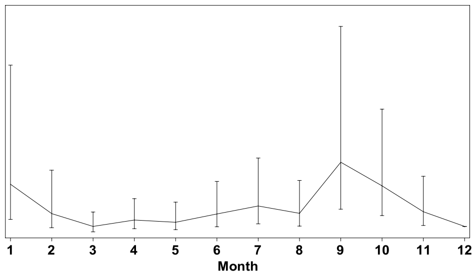
Raw catch and effort

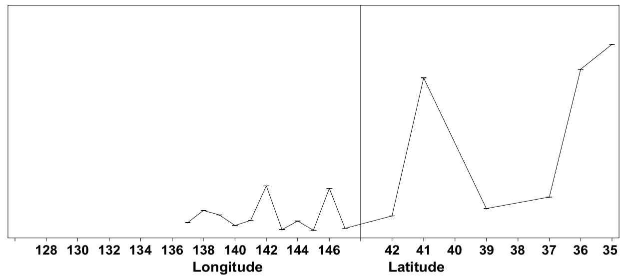
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.543	403	7245	3198	2.265
2001	0.438	479	6551	4198	1.561
2002	0.440	391	5215	3262	1.599
2003	0.521	512	8481	4198	2.020
2004	0.543	444	11215	3688	3.041
2005	0.505	469	9150	4159	2.200
2006	0.453	393	5716	3574	1.599
Mean	0.492	442	7653	3754	2.039

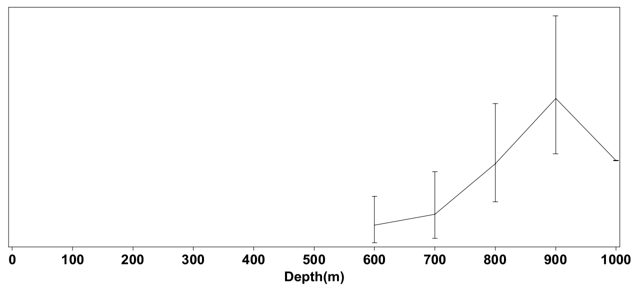
Fig. 3.02a. Black shark (*Dalatias licha*) 1994–06 SETF 600–1000 m depth south-eastern Australia (longitude 137–151° E)











Black shark

Fishery: SETF

Scientific name: Dalatias licha
CAAB code: 37020002

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.15
Model fit criterion: scaled Pearson chisq/df = 1.09
Interannual trend: decreasing P = 0.0026

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	12	33.42	0.0008	74.75	<.0001
Month	11	35.82	0.0002	53.52	<.0001
Longitude/latitude	13	78.93	<.0001	108.54	<.0001
Depth	4	17.34	0.0017	84.14	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

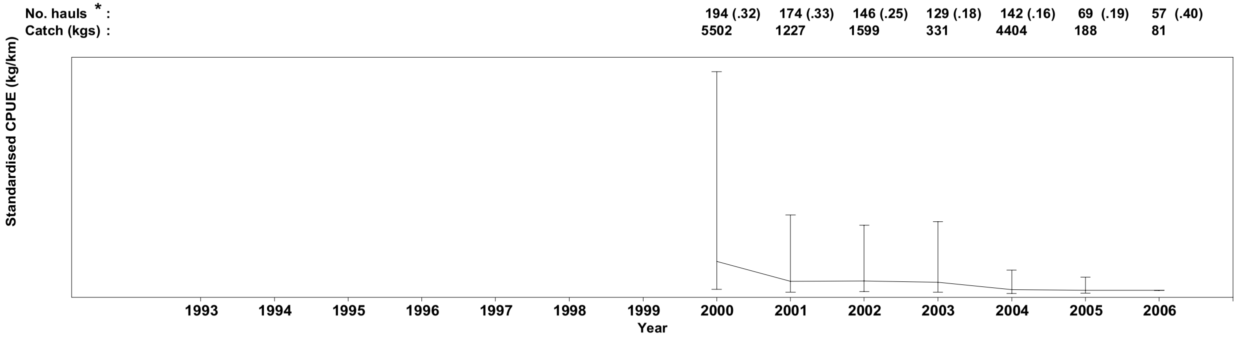
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

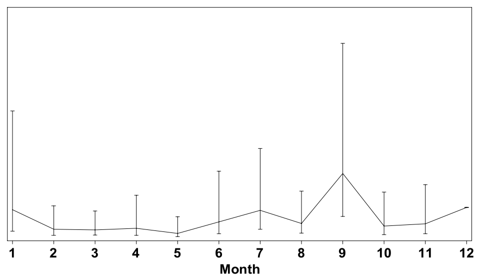
Year	Standardised	CPUE (95% CI)	
1994	3.461	0.348	34.471
1995	6.285	1.086	36.391
1996	1.514	0.283	8.094
1997	1.137	0.272	4.750
1998	1.670	0.424	6.580
1999	0.787	0.201	3.085
2000	1.514	0.355	6.454
2001	0.641	0.154	2.668
2002	0.572	0.144	2.274
2003	0.438	0.097	1.984
2004	0.220	0.054	0.902
2005	0.265	0.065	1.090
2006	0.538	0.538	0.538

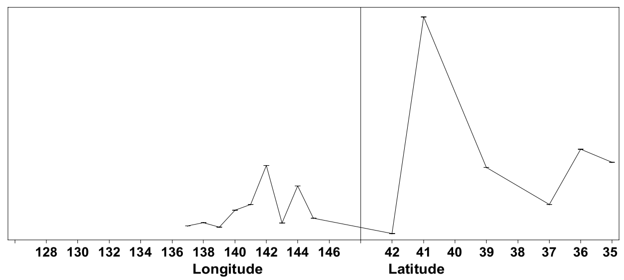
Raw catch and effort

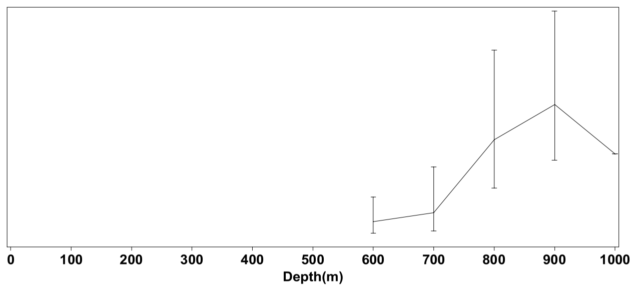
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994	0.198	106	829	321	2.584
1995	0.256	82	365	848	0.431
1996	0.115	96	120	385	0.311
1997	0.383	107	527	911	0.578
1998	0.400	165	1482	1204	1.231
1999	0.387	163	734	1210	0.606
2000	0.315	184	5476	968	5.655
2001	0.333	174	1227	1218	1.008
2002	0.247	146	1600	1026	1.559
2003	0.157	121	309	1345	0.230
2004	0.169	130	4395	1001	4.390
2005	0.188	69	188	713	0.264
2006	0.404	57	81	419	0.193
Mean	0.273	123	1333	890	1.498

Fig. 3.02b. Black shark (*Dalatias licha*) 2000–06 SETF 600–1000 m depth south-eastern Australia (longitude 137–151° E)









Black shark

Fishery: trawl

Scientific name: Dalatias licha
CAAB code: 37020002

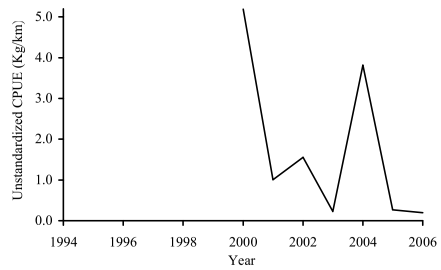
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.56
Model fit criterion: scaled Pearson chisq/df = 1.24
Interannual trend: decreasing P = 0.0200

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	6	15.43	0.0171	33.37	<.0001
Month	11	23.18	0.0167	39.33	<.0001
Longitude/latitude	12	44.95	<.0001	98.89	<.0001
Depth	4	11.38	0.0226	44.59	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



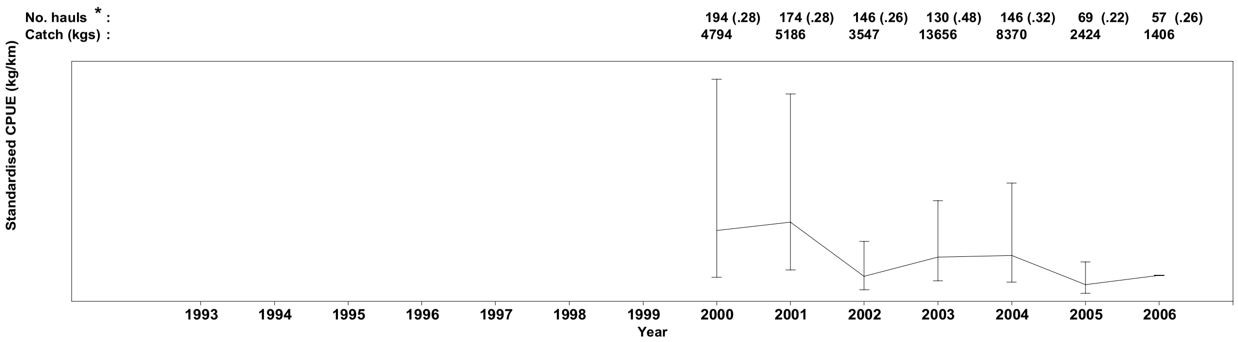
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

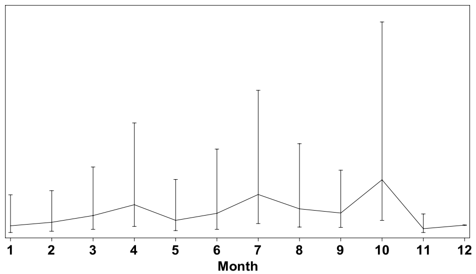
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	4.852	0.709	33.202
2001	1.923	0.313	11.810
2002	1.960	0.374	10.266
2003	1.741	0.280	10.830
2004	0.652	0.118	3.595
2005	0.563	0.125	2.542
2006	0.570	0.570	0.570

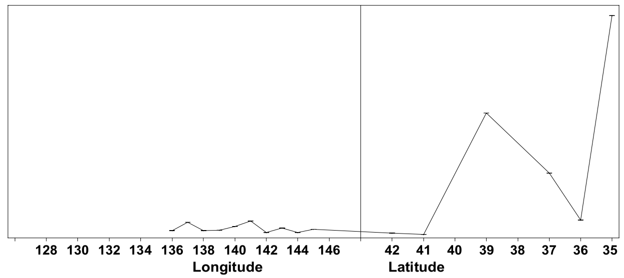
Raw catch and effort

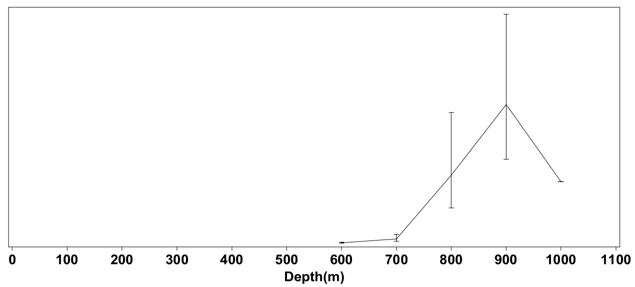
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.325	194	5502	1059	5.196
2001	0.333	174	1227	1218	1.008
2002	0.247	146	1600	1026	1.559
2003	0.178	129	331	1463	0.226
2004	0.162	142	4405	1154	3.816
2005	0.188	69	188	713	0.264
2006	0.404	57	81	419	0.193
Mean	0.262	130	1905	1008	1.890

Fig. 3.03a. Brier shark (*Deania calcea*) 2000–06 SETF 600–1000 m depth south-eastern Australia (longitude 136–151° E)









Brier shark

Fishery: trawl

Scientific name: Deania calcea
CAAB code: 37020003

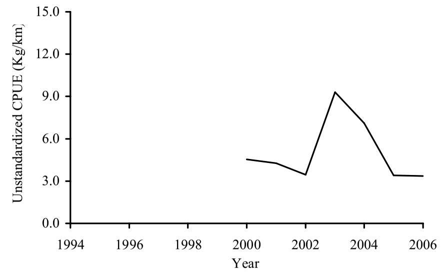
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.08
Model fit criterion: scaled Pearson chisq/df = 1.00
Interannual trend: decreasing P = 0.0159

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	6	8.63	ns	22.31	0.0011
Month	11	16.30	ns	51.64	<.0001
Longitude/latitude	13	10.62	ns	207.13	<.0001
Depth	4	85.53	<.0001	117.95	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



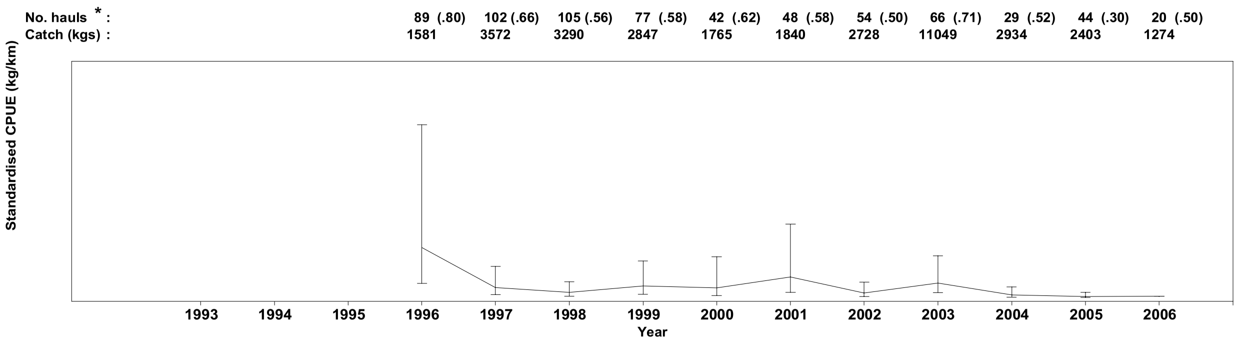
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

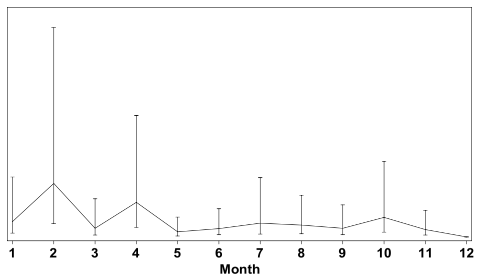
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	8.396	2.595	27.168
2001	9.424	3.504	25.346
2002	2.723	1.053	7.041
2003	5.085	2.133	12.120
2004	5.295	1.966	14.262
2005	1.674	0.622	4.500
2006	2.807	2.807	2.807

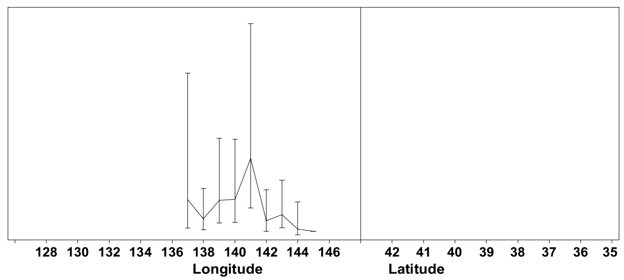
Raw catch and effort

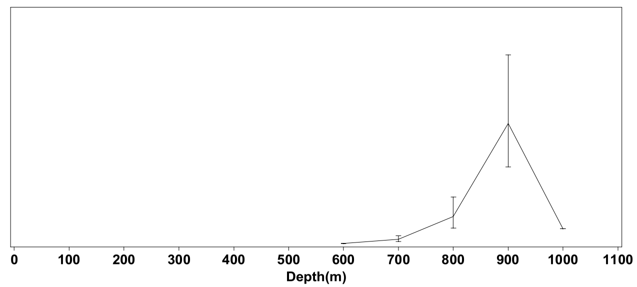
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.278	194	4794	1059	4.528
2001	0.282	174	5186	1218	4.259
2002	0.260	146	3548	1026	3.457
2003	0.485	130	13656	1469	9.297
2004	0.315	146	8370	1177	7.109
2005	0.217	69	2424	713	3.399
2006	0.263	57	1406	419	3.355
Mean	0.300	131	5626	1012	5.562

Fig. 3.03b. Brier shark (*Deania calcea*) 1994–06 SETF 600–1000 m depth western region (longitude 137–147° E)









Brier shark Fishery: SETF

Scientific name: Deania calcea
CAAB code: 37020003

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.10
Model fit criterion: scaled Pearson chisq/df = 0.74
Interannual trend: decreasing P = 0.0111

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	10	10.23	ns	53.68	<.0001
Month	11	12.59	ns	62.12	<.0001
Longitude/latitude	8	11.33	ns	37.41	<.0001
Depth	4	116.74	<.0001	210.22	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

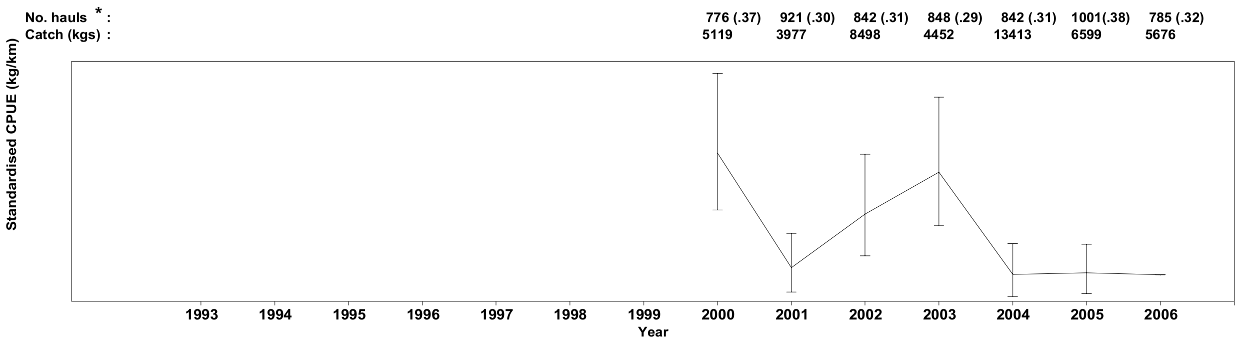
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

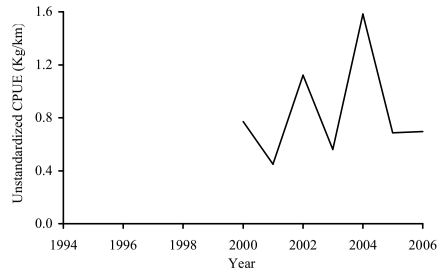
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996	22.695	6.606	77.967
1997	4.741	1.579	14.238
1998	2.556	0.888	7.359
1999	5.512	1.816	16.733
2000	4.671	1.169	18.674
2001	9.469	2.689	33.342
2002	2.316	0.753	7.127
2003	6.726	2.387	18.954
2004	1.421	0.406	4.970
2005	0.783	0.237	2.581
2006	0.887	0.887	0.887

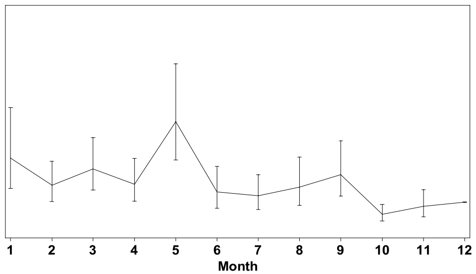
Raw catch and effort

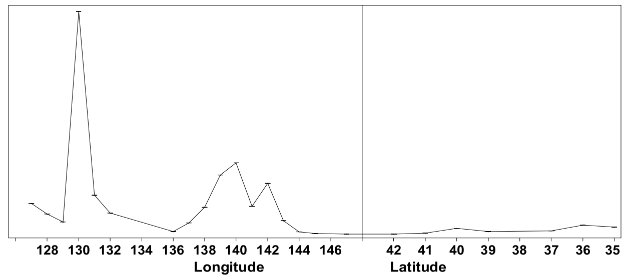
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996	0.798	89	1581	328	4.827
1997	0.657	102	3572	876	4.078
1998	0.562	105	3290	722	4.557
1999	0.584	77	2847	741	3.844
2000	0.619	42	1765	329	5.361
2001	0.583	48	1840	518	3.550
2002	0.500	54	2728	641	4.259
2003	0.712	66	11049	874	12.638
2004	0.517	29	2934	371	7.904
2005	0.295	44	2403	468	5.129
2006	0.500	20	1274	226	5.627
Mean	0.575	61	3208	554	5.789

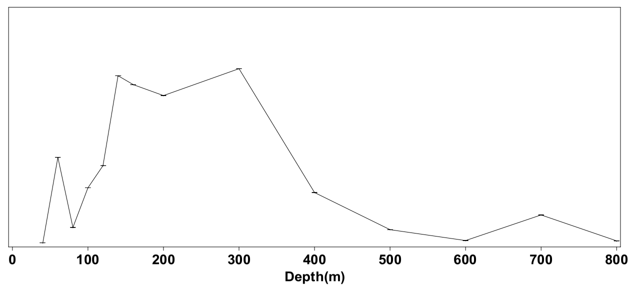
Fig. 3.04a. Common sawshark (*Pristiophorus cirratus*) 2000–06 otter trawl 0–800 m depth southern Australia (longitude 127–151° E)











Common sawshark

Fishery: trawl

Scientific name: Pristiophorus cirratus
CAAB code: 37023002

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.04
Model fit criterion: scaled Pearson chisq/df = 1.52
Interannual trend: decreasing P = 0.0044

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	6	42.90	<.0001	22.05	0.0012
Month	11	78.04	<.0001	42.42	<.0001
Longitude/latitude	23	134.45	<.0001	516.59	<.0001
Depth	13	93.01	<.0001	1116.95	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

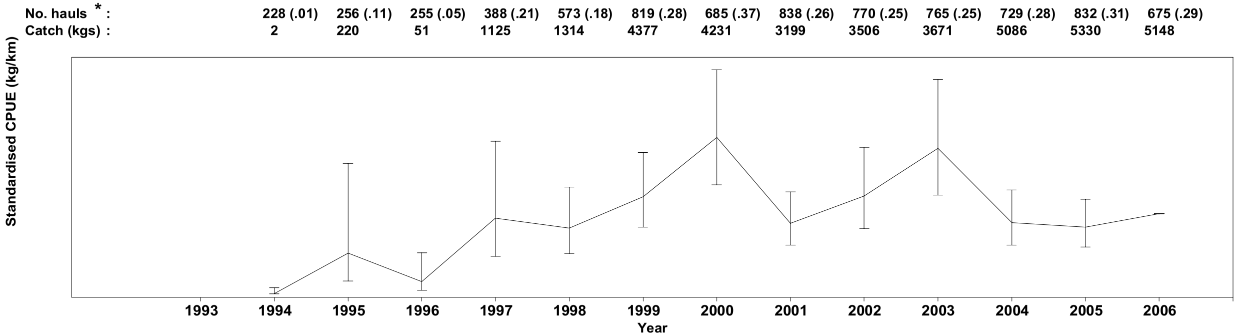
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

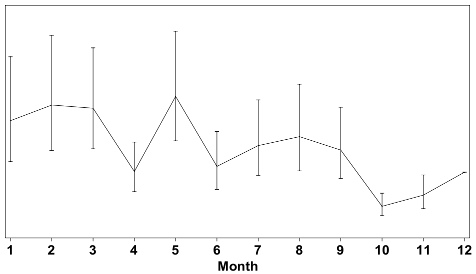
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	1.399	0.999	1.959
2001	0.592	0.421	0.833
2002	0.969	0.676	1.390
2003	1.263	0.891	1.792
2004	0.545	0.390	0.761
2005	0.556	0.408	0.758
2006	0.544	0.544	0.544

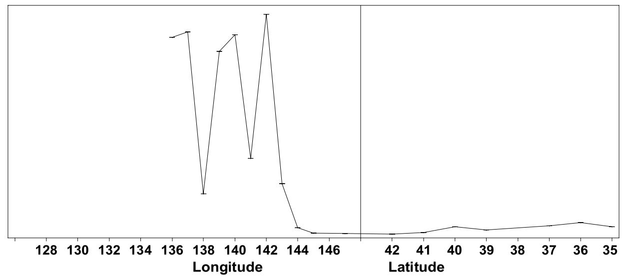
Raw catch and effort

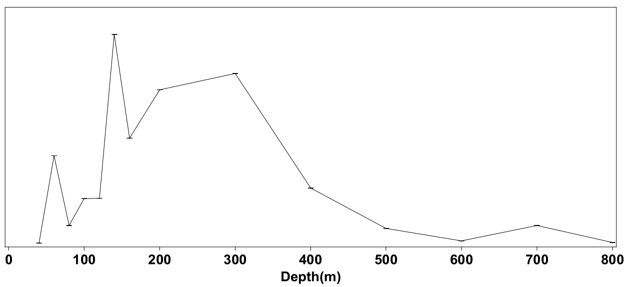
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.369	776	5119	6631	0.772
2001	0.301	921	3977	8837	0.450
2002	0.305	842	8499	7580	1.121
2003	0.287	848	4453	7950	0.560
2004	0.305	842	13413	8474	1.583
2005	0.380	1001	6599	9599	0.687
2006	0.318	785	5677	8165	0.695
Mean	0.323	859	6819	8177	0.834

Fig. 3.04b. Common sawshark (*Pristiophorus cirratus*) 1994–06 SETF 0–800 m depth south-eastern Australia (longitude 136–151° E)









Common sawshark Fishery: SETF

Scientific name: Pristiophorus cirratus
CAAB code: 37023002

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.21
Model fit criterion: scaled Pearson chisq/df = 1.56
Interannual trend: increasing P = 0.0135

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	12	37.08	0.0002	205.05	<.0001
Month	11	85.42	<.0001	62.20	<.0001
Longitude/latitude	17	109.27	<.0001	557.96	<.0001
Depth	13	155.99	<.0001	1442.76	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

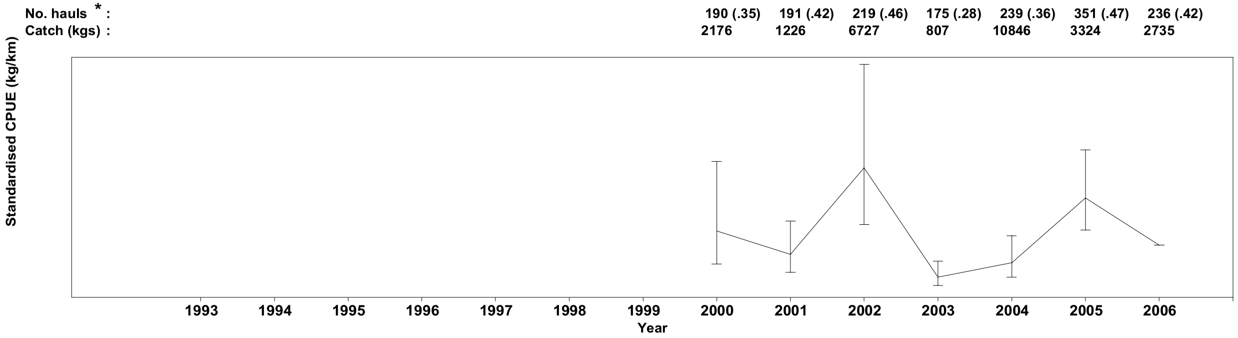
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

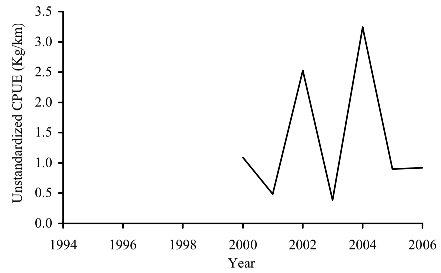
Year	Standardised CPUE	(95% CI)	
1994	0.004	0.000	0.038
1995	0.238	0.075	0.756
1996	0.073	0.023	0.239
1997	0.438	0.218	0.881
1998	0.381	0.235	0.619
1999	0.562	0.387	0.818
2000	0.904	0.632	1.295
2001	0.409	0.284	0.591
2002	0.566	0.379	0.846
2003	0.842	0.572	1.241
2004	0.412	0.283	0.601
2005	0.386	0.272	0.547
2006	0.465	0.465	0.465

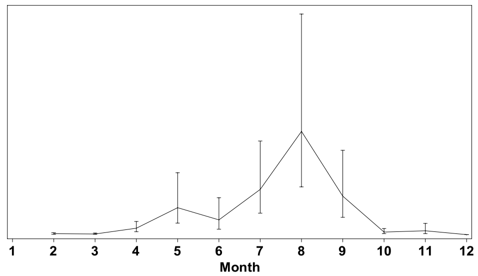
Raw catch and effort

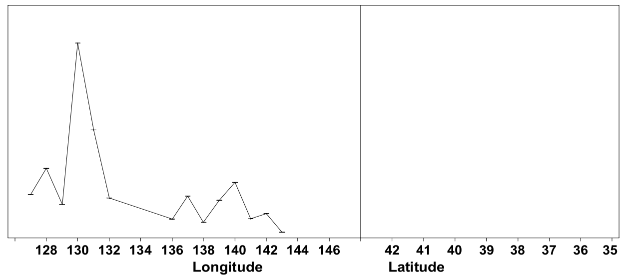
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994	0.009	228	2	2399	0.001
1995	0.109	256	220	2653	0.083
1996	0.055	255	51	2694	0.019
1997	0.214	388	1125	4191	0.268
1998	0.180	573	1314	5276	0.249
1999	0.278	819	4377	7301	0.600
2000	0.368	685	4231	5533	0.765
2001	0.264	838	3199	7533	0.425
2002	0.248	770	3507	6620	0.530
2003	0.254	765	3672	6852	0.536
2004	0.281	729	5086	6745	0.754
2005	0.305	832	5330	7680	0.694
2006	0.286	675	5149	6776	0.760
Mean	0.219	601	2866	5558	0.516

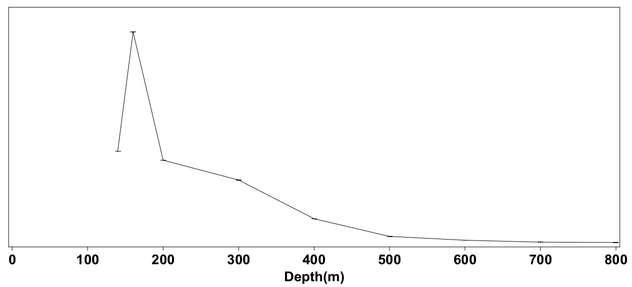
Fig. 3.04c. Common sawshark (*Pristiophorus cirratus*) 2000–06 otter trawl 0–800 m depth South Australia (longitude 127–145° E)











Common sawshark Fishery: trawl

Scientific name: Pristiophorus cirratus
CAAB code: 37023002

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.07
Model fit criterion: scaled Pearson chisq/df = 1.14
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	6	11.47	ns	35.65	<.0001
Month	10	59.86	<.0001	335.76	<.0001
Longitude/latitude	13	58.38	<.0001	70.09	<.0001
Depth	8	28.32	0.0004	101.62	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

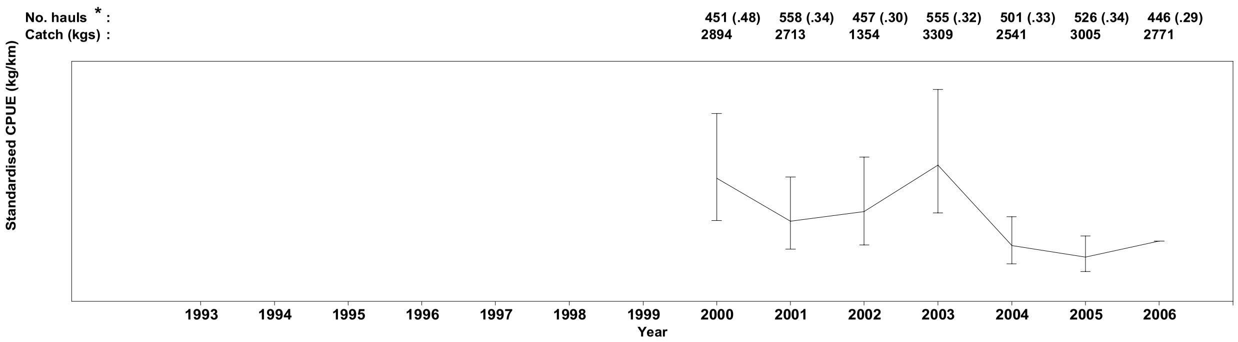
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

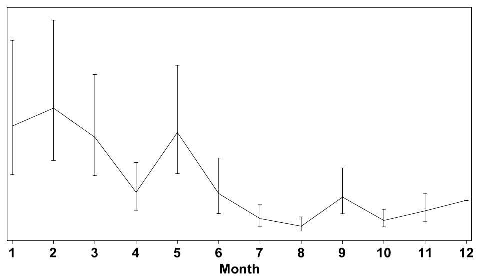
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	1.427	0.680	2.995
2001	0.897	0.488	1.647
2002	2.853	1.569	5.189
2003	0.383	0.197	0.745
2004	0.711	0.383	1.318
2005	2.171	1.448	3.255
2006	1.110	1.110	1.110

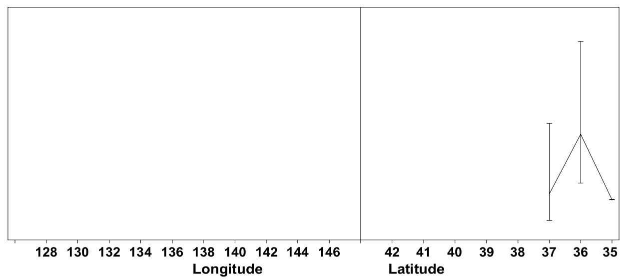
Raw catch and effort

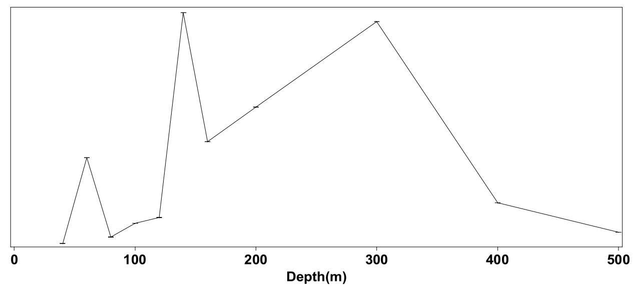
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.347	190	2176	1996	1.090
2001	0.424	191	1226	2516	0.487
2002	0.461	219	6727	2663	2.526
2003	0.280	175	807	2078	0.388
2004	0.364	239	10846	3344	3.243
2005	0.470	351	3324	3709	0.896
2006	0.419	236	2735	2971	0.921
Mean	0.395	229	3977	2754	1.444

Fig. 3.04d. Common sawshark (*Pristiophorus cirratus*) 2000–06 SETF 0–500 m depth eastern region (longitude 148–151° E)









Common sawshark

Fishery: trawl

Scientific name: Pristiophorus cirratus
CAAB code: 37023002

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.10
Model fit criterion: scaled Pearson chisq/df = 1.62
Interannual trend: decreasing P = 0.0099

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	6	32.11	<.0001	20.54	0.0022
Month	11	82.88	<.0001	84.80	<.0001
Longitude/latitude	2	57.03	<.0001	287.46	<.0001
Depth	10	149.08	<.0001	735.80	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

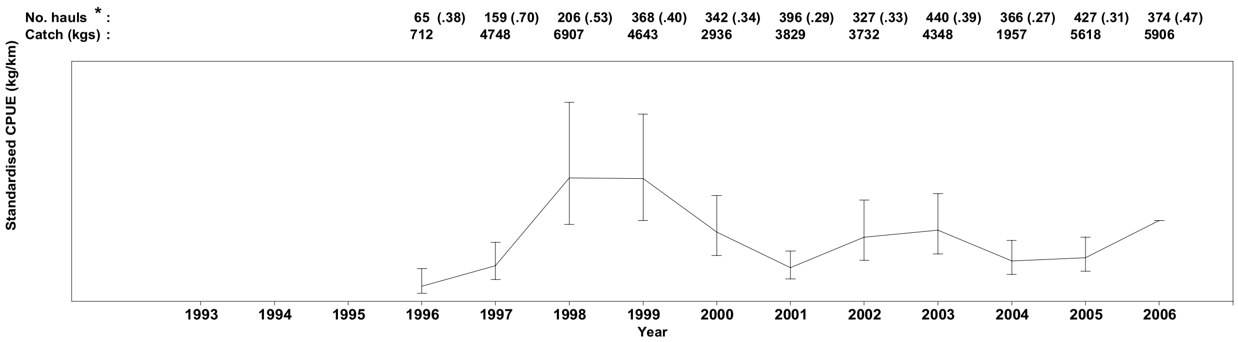
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

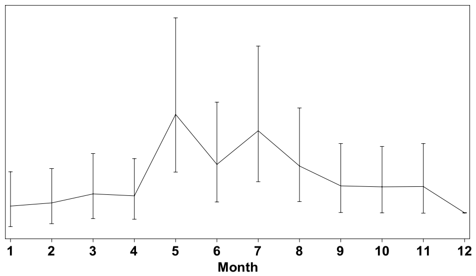
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	0.929	0.603	1.433
2001	0.598	0.381	0.940
2002	0.672	0.413	1.094
2003	1.034	0.660	1.620
2004	0.409	0.265	0.633
2005	0.317	0.207	0.484
2006	0.443	0.443	0.443

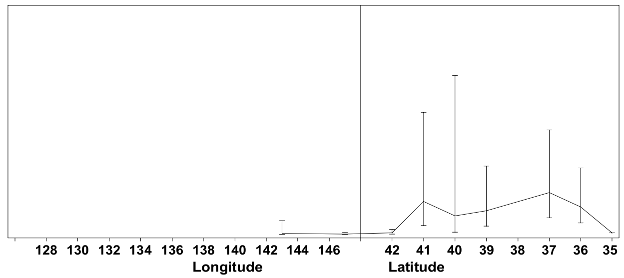
Raw catch and effort

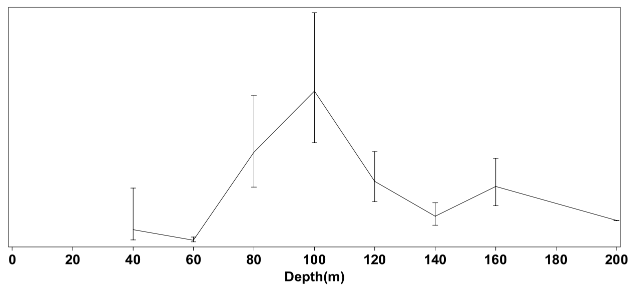
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.477	451	2894	3545	0.816
2001	0.339	558	2713	4839	0.561
2002	0.295	457	1355	3642	0.372
2003	0.323	555	3310	4560	0.726
2004	0.325	501	2541	4214	0.603
2005	0.338	526	3005	4655	0.646
2006	0.294	446	2772	4079	0.680
Mean	0.342	499	2656	4219	0.629

Fig. 3.05a. Draughtboard shark (*Cephaloscyllium latisceps*) 1996–06 SETF 0–200 m depth south-eastern Australia (longitude 143–151° E)









Draughtboard shark Fishery: SETF

Scientific name: Cephaloscyllium laticeps
CAAB code: 37015001

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.07
Model fit criterion: scaled Pearson chisq/df = 1.20
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	10	39.17	<.0001	107.55	<.0001
Month	11	18.41	ns	30.48	0.0013
Longitude/latitude	8	61.50	<.0001	907.55	<.0001
Depth	7	112.09	<.0001	166.51	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

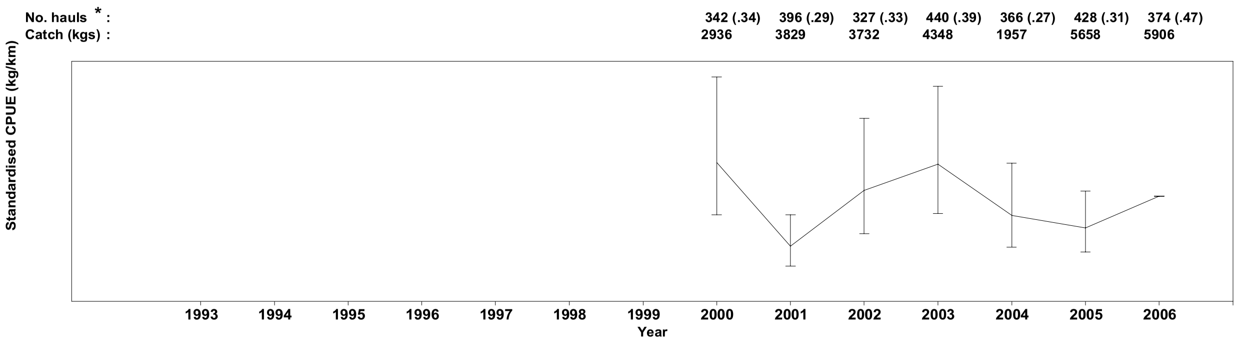
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

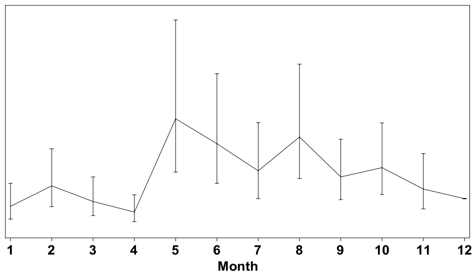
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996	0.311	0.125	0.771
1997	0.837	0.484	1.447
1998	3.127	1.920	5.093
1999	3.110	2.020	4.790
2000	1.719	1.106	2.669
2001	0.787	0.505	1.227
2002	1.583	0.982	2.552
2003	1.767	1.150	2.713
2004	0.964	0.618	1.504
2005	1.054	0.702	1.582
2006	2.018	2.018	2.018

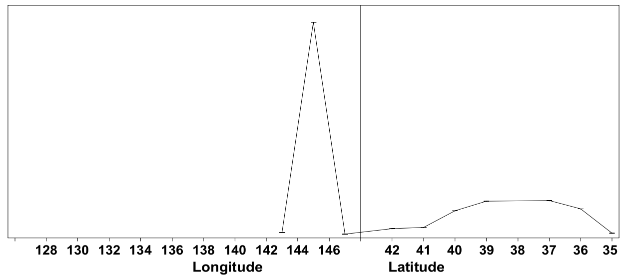
Raw catch and effort

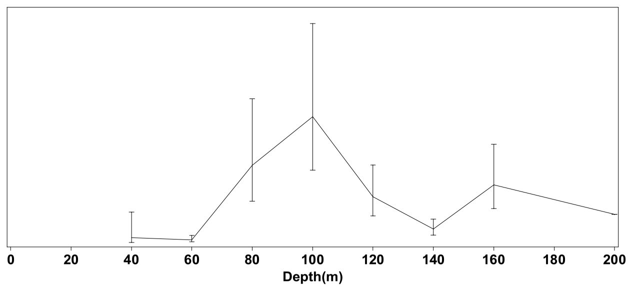
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996	0.385	65	712	682	1.043
1997	0.698	159	4748	1771	2.681
1998	0.529	206	6908	1937	3.567
1999	0.405	368	4643	3192	1.455
2000	0.342	342	2936	2746	1.069
2001	0.288	396	3829	3589	1.067
2002	0.330	327	3732	2759	1.353
2003	0.386	440	4349	3559	1.222
2004	0.273	366	1957	3114	0.628
2005	0.311	427	5618	3758	1.495
2006	0.473	374	5906	3481	1.696
Mean	0.402	315	4122	2781	1.482

Fig. 3.05b. Draughtboard shark (*Cephaloscyllium latisceps*) 2000–06 SETF 0–200 m depth south-eastern Australia (longitude 143–151° E)









Draughtboard shark Fishery: trawl

Scientific name: Cephaloscyllium laticeps
CAAB code: 37015001

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.07
Model fit criterion: scaled Pearson chisq/df = 1.18
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	6	17.94	0.0064	65.78	<.0001
Month	11	34.54	0.0003	25.79	0.0070
Longitude/latitude	9	31.10	0.0003	704.22	<.0001
Depth	7	110.78	<.0001	137.60	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

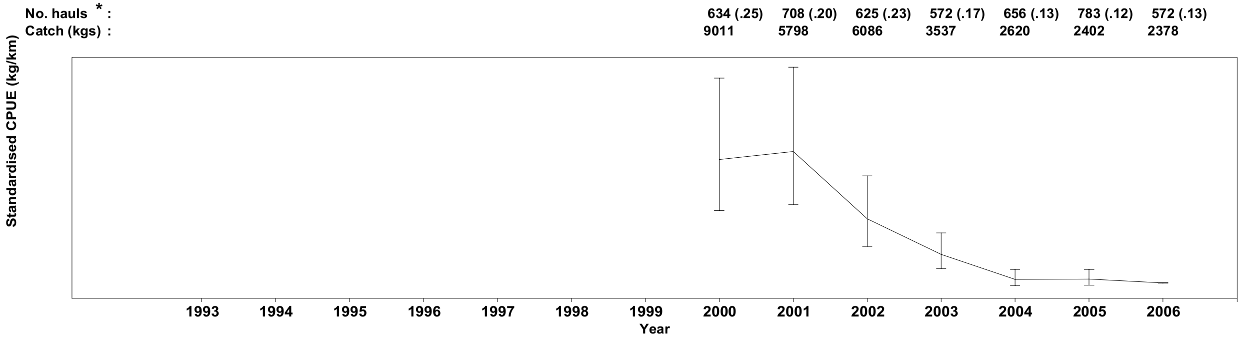
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

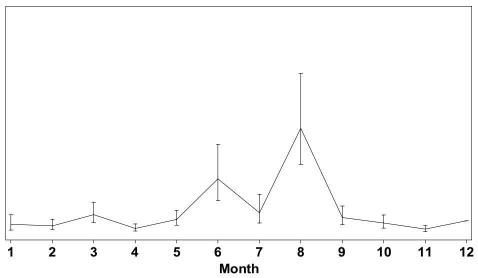
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	1.694	1.040	2.758
2001	0.646	0.401	1.041
2002	1.344	0.804	2.246
2003	1.671	1.057	2.643
2004	1.034	0.634	1.686
2005	0.877	0.577	1.335
2006	1.273	1.273	1.273

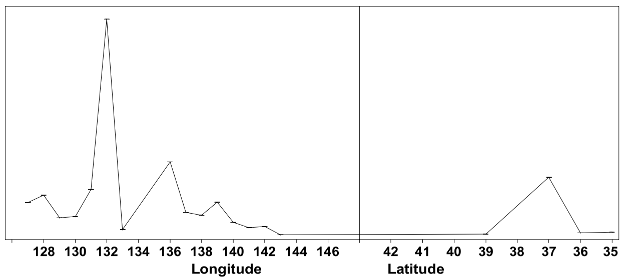
Raw catch and effort

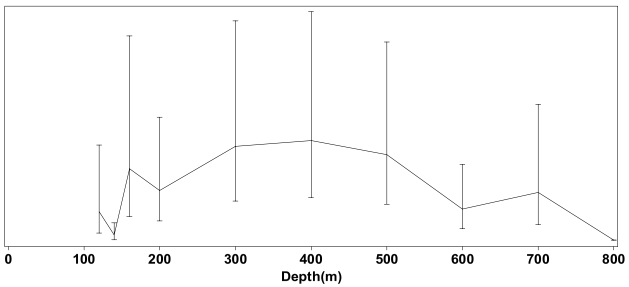
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.342	342	2936	2746	1.069
2001	0.288	396	3829	3589	1.067
2002	0.330	327	3732	2759	1.353
2003	0.386	440	4349	3559	1.222
2004	0.273	366	1957	3114	0.628
2005	0.313	428	5658	3762	1.504
2006	0.473	374	5906	3481	1.696
Mean	0.344	382	4052	3287	1.233

Fig. 3.06a. Greeneye spurdog (*Squalus mitsukurii*) 2000–06 GABTF SETF 120–800 m depth southern Australia (longitude 127–151° E)









Greeneye dogfish

Fishery: trawl

Scientific name: Squalus mitsukurii
CAAB code: 37020007

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.13
Model fit criterion: scaled Pearson chisq/df = 1.56
Interannual trend: decreasing P = <.0001

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	6	31.77	<.0001	168.05	<.0001
Month	11	144.34	<.0001	35.37	0.0002
Longitude/latitude	17	82.78	<.0001	1034.51	<.0001
Depth	9	150.07	<.0001	219.15	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

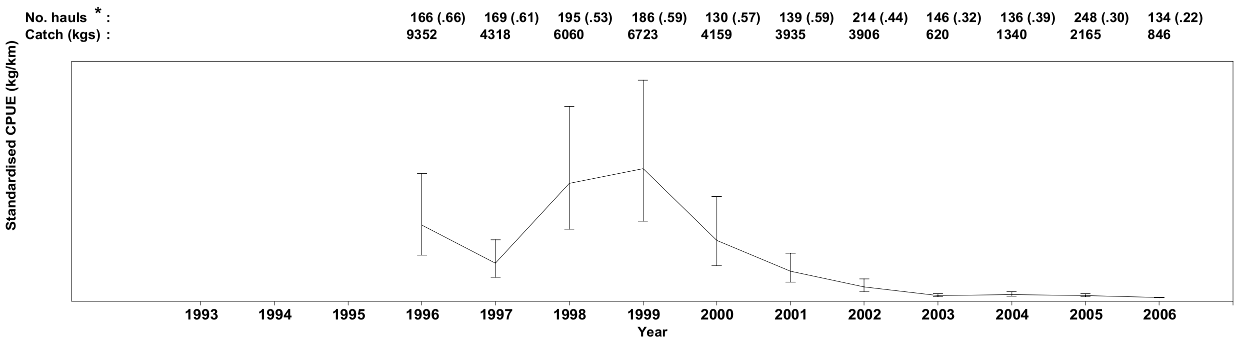
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

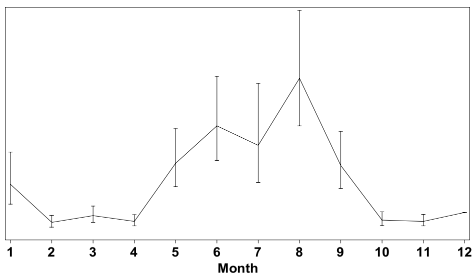
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	1.647	1.027	2.641
2001	1.746	1.101	2.768
2002	0.927	0.593	1.449
2003	0.495	0.323	0.757
2004	0.190	0.117	0.309
2005	0.193	0.120	0.312
2006	0.147	0.147	0.147

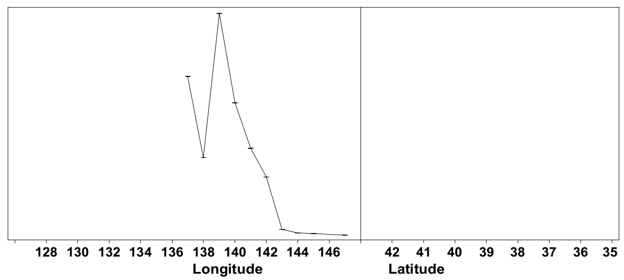
Raw catch and effort

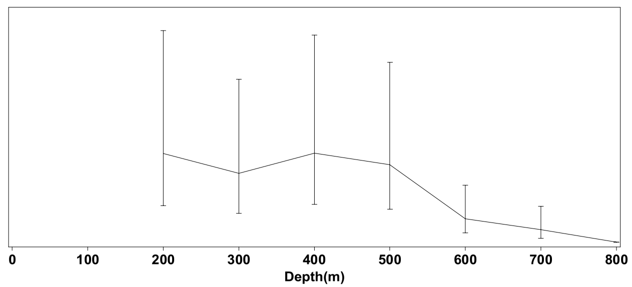
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.252	634	9011	5214	1.728
2001	0.202	708	5798	6828	0.849
2002	0.227	625	6086	5724	1.063
2003	0.173	572	3537	5509	0.642
2004	0.127	656	2620	6983	0.375
2005	0.116	783	2402	7827	0.307
2006	0.126	572	2378	6257	0.380
Mean	0.175	650	4547	6335	0.718

Fig. 3.06b. Greeneye spurdog (*Squalus mitsukurii*) 1996–06 SETF 200–800 m depth western region (longitude 137–148° E)









Greeneye dogfish

Fishery: SETF

Scientific name: Squalus mitsukurii
CAAB code: 37020007

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.14
Model fit criterion: scaled Pearson chisq/df = 1.73
Interannual trend: decreasing P = <.0001

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	10	170.10	<.0001	270.72	<.0001
Month	11	330.55	<.0001	19.40	ns
Longitude/latitude	9	111.53	<.0001	378.35	<.0001
Depth	6	117.49	<.0001	196.82	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

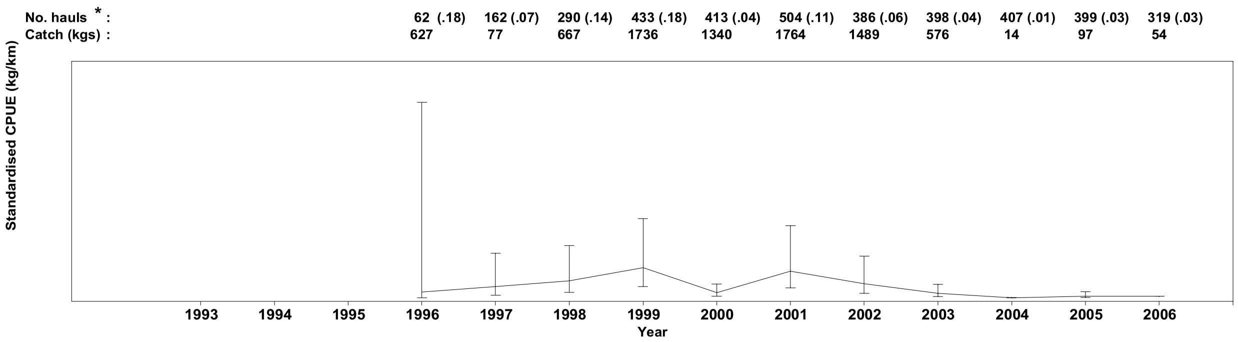
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

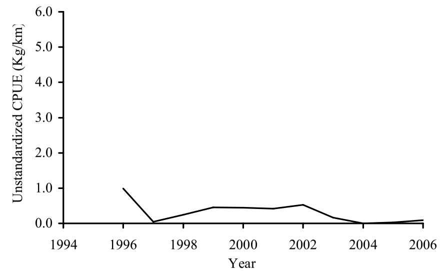
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996	4.098	2.404	6.987
1997	1.959	1.172	3.276
1998	6.429	3.849	10.738
1999	7.259	4.316	12.209
2000	3.231	1.834	5.693
2001	1.503	0.900	2.512
2002	0.636	0.377	1.074
2003	0.147	0.086	0.252
2004	0.200	0.113	0.356
2005	0.145	0.086	0.244
2006	0.045	0.045	0.045

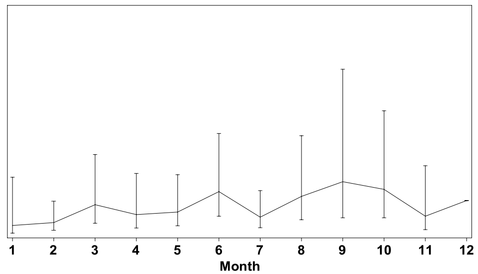
Raw catch and effort

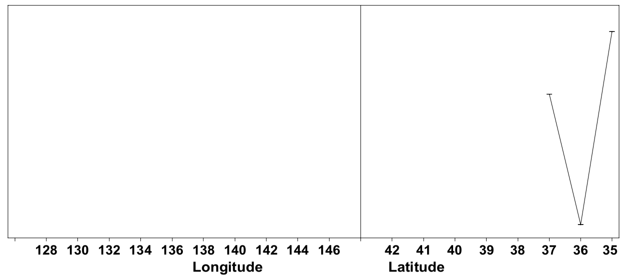
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996	0.663	166	9352	1662	5.627
1997	0.609	169	4318	1814	2.380
1998	0.533	195	6061	1695	3.576
1999	0.591	186	6723	1720	3.909
2000	0.569	130	4159	1190	3.494
2001	0.590	139	3935	1569	2.507
2002	0.439	214	3906	2343	1.667
2003	0.315	146	620	1695	0.366
2004	0.390	136	1340	1755	0.764
2005	0.298	248	2165	2497	0.867
2006	0.216	134	846	1702	0.497
Mean	0.474	169	3948	1786	2.211

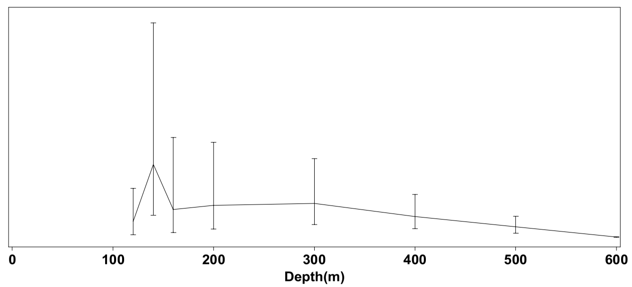
Fig. 3.06c. Greeneye spurdog (*Squalus mitsukurii*) 1996–06 SETF 120–600 m depth eastern region (longitude 148–151° E, latitude <39°S)











Greeneye dogfish

Fishery: SETF

Scientific name: Squalus mitsukurii
CAAB code: 37020007

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.06
Model fit criterion: scaled Pearson chisq/df = 1.63
Interannual trend: decreasing P = 0.0108

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	9	30.81	0.0003	158.49	<.0001
Month	11	20.26	0.0419	22.99	0.0177
Longitude/latitude	2	1.22	ns	119.92	<.0001
Depth	7	71.44	<.0001	108.57	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

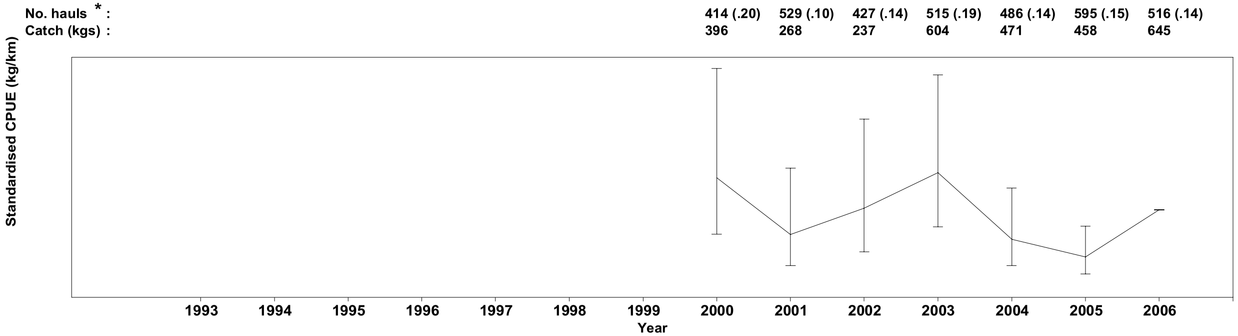
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

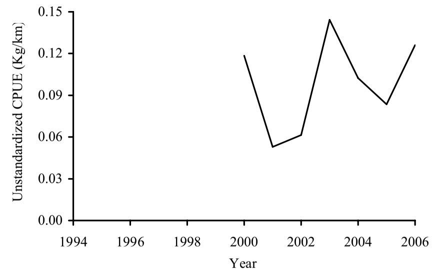
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996	0.159	0.004	5.994
1997	0.272	0.046	1.606
1998	0.394	0.081	1.910
1999	0.692	0.160	2.994
2000	0.164	0.038	0.716
2001	0.741	0.168	3.269
2002	0.562	0.122	2.591
2003	0.115	0.025	0.527
2004	0.004	0.001	0.027
2005	0.047	0.009	0.245
2006	0.191	0.191	0.191

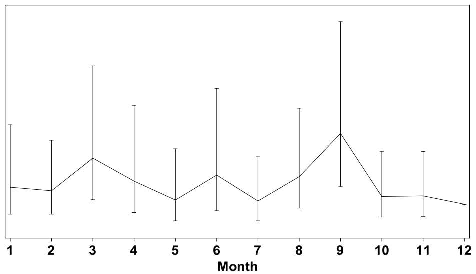
Raw catch and effort

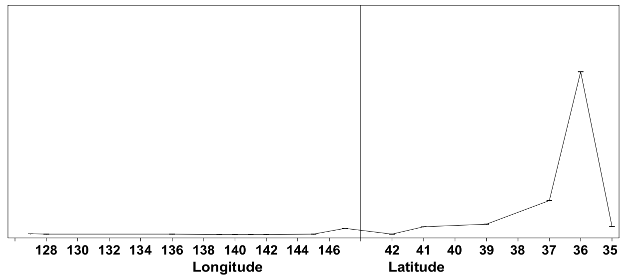
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996	0.177	62	627	636	0.986
1997	0.068	161	77	1816	0.042
1998	0.141	290	667	2699	0.247
1999	0.176	433	1736	3828	0.454
2000	0.040	374	1340	3032	0.442
2001	0.123	465	1764	4206	0.419
2002	0.078	320	1489	2850	0.522
2003	0.043	398	576	3483	0.165
2004	0.010	381	14	3444	0.004
2005	0.028	399	97	3702	0.026
2006	0.045	66	54	574	0.094
Mean	0.085	304	767	2752	0.279

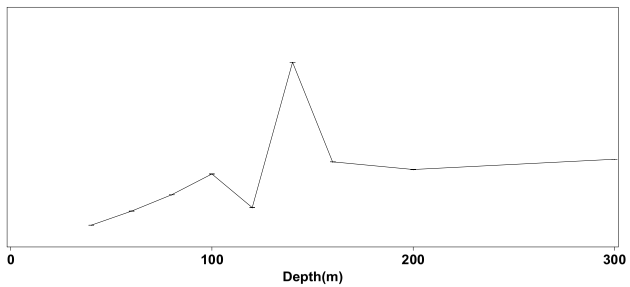
Fig. 3.07a. Grey spotted catshark (*Asymbolis analis*) 2000–06 otter trawl 0–300 m depth southern Australia (longitude 127–151° E)











Grey spotted catshark

Fishery: trawl

Scientific name: Asymbolus analis
CAAB code: 37015027

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.03
Model fit criterion: scaled Pearson chisq/df = 1.10
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	6	15.18	0.0189	20.01	0.0028
Month	11	12.82	ns	10.71	ns
Longitude/latitude	12	56.91	<.0001	65.94	<.0001
Depth	8	23.51	0.0028	67.47	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

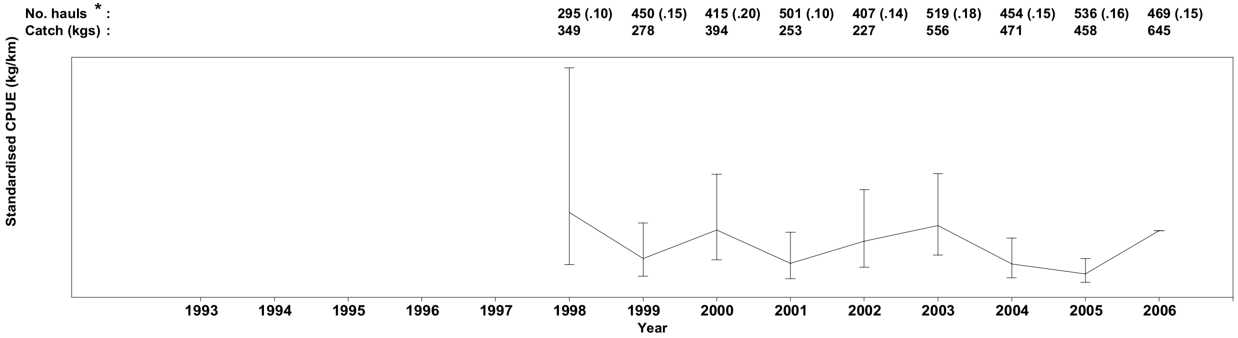
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

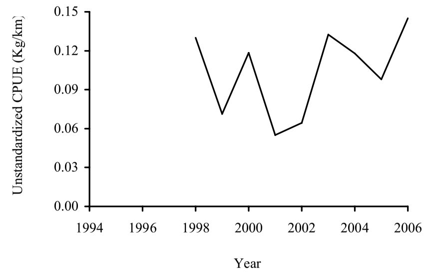
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	0.143	0.074	0.278
2001	0.074	0.035	0.155
2002	0.106	0.052	0.215
2003	0.150	0.083	0.270
2004	0.068	0.035	0.130
2005	0.046	0.025	0.084
2006	0.104	0.104	0.104

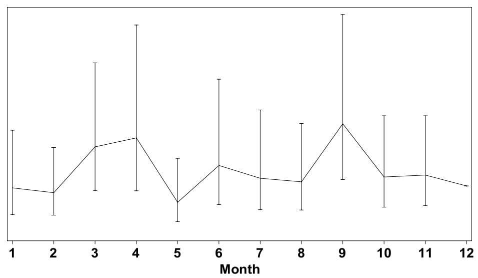
Raw catch and effort

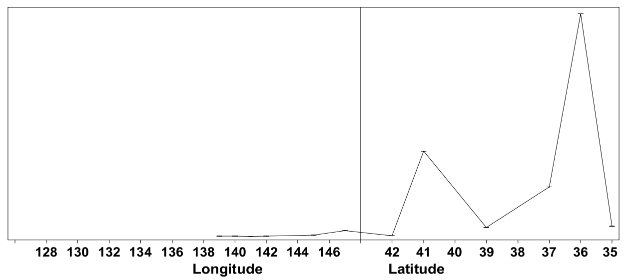
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.203	414	396	3339	0.119
2001	0.102	529	268	5064	0.053
2002	0.141	427	238	3869	0.061
2003	0.186	515	604	4187	0.144
2004	0.136	486	472	4606	0.102
2005	0.146	595	458	5481	0.084
2006	0.136	516	646	5118	0.126
Mean	0.150	497	440	4523	0.097

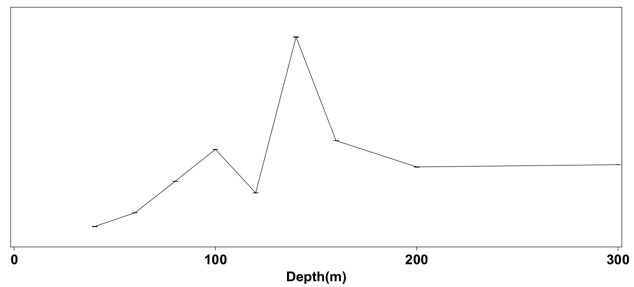
Fig. 3.07b. Grey spotted catshark (*Asymbolis analis*) 2000–06 SETF 0–300 m depth south-eastern Australia (longitude 138–151°E)











Grey spotted catshark Fishery: SETF

Scientific name: Asymbolus analis
CAAB code: 37015027

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.03
Model fit criterion: scaled Pearson chisq/df = 1.09
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	8	32.67	<.0001	26.00	0.0011
Month	11	12.48	ns	11.62	ns
Longitude/latitude	10	84.74	<.0001	37.34	0.0007
Depth	8	23.60	0.0027	102.88	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

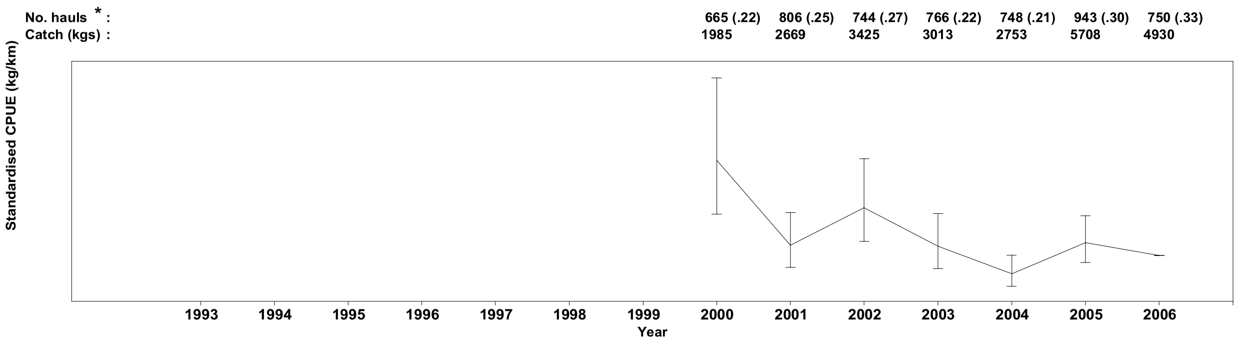
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998	0.170	0.062	0.472
1999	0.074	0.037	0.148
2000	0.134	0.071	0.249
2001	0.064	0.032	0.129
2002	0.111	0.056	0.217
2003	0.143	0.082	0.251
2004	0.063	0.034	0.117
2005	0.042	0.024	0.074
2006	0.132	0.132	0.132

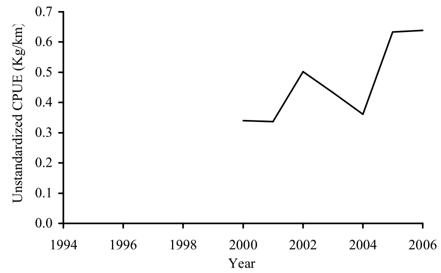
Raw catch and effort

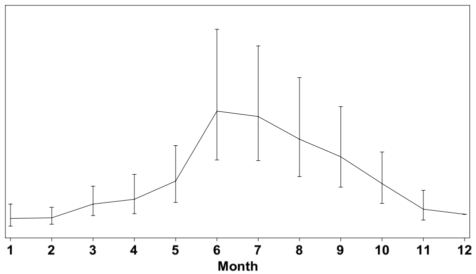
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998	0.102	295	349	2682	0.130
1999	0.153	450	278	3895	0.071
2000	0.200	415	394	3327	0.118
2001	0.096	501	253	4590	0.055
2002	0.138	407	228	3533	0.064
2003	0.179	519	556	4193	0.133
2004	0.145	454	472	3998	0.118
2005	0.162	536	458	4677	0.098
2006	0.149	469	646	4447	0.145
Mean	0.147	450	404	3927	0.103

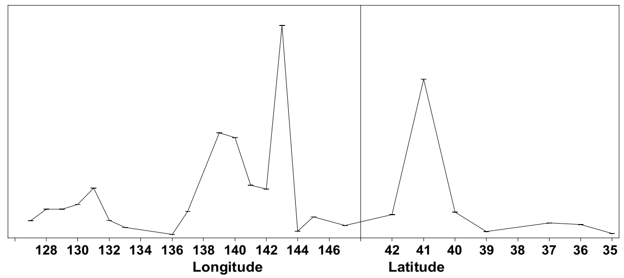
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

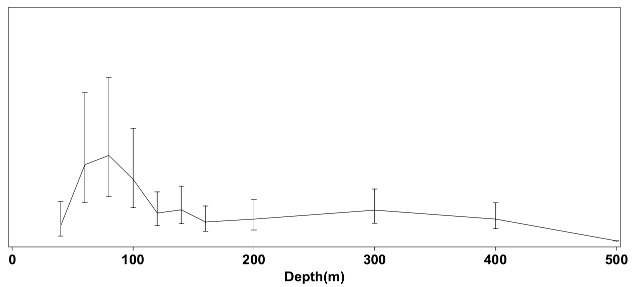
Fig. 3.08a. Gummy shark (*Mustelus antarcticus*) 2000–06 otter trawl 0–500 m depth southern Australia (longitude 127–151°E)











Gummy shark Fishery: trawl

Scientific name: Mustelus antarcticus
CAAB code: 37017001

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.00
Model fit criterion: scaled Pearson chisq/df = 1.08
Interannual trend: decreasing P = 0.0013

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	6	31.66	<.0001	19.69	0.0031
Month	11	22.21	0.0228	252.73	<.0001
Longitude/latitude	22	126.37	<.0001	445.87	<.0001
Depth	10	23.76	0.0083	343.63	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

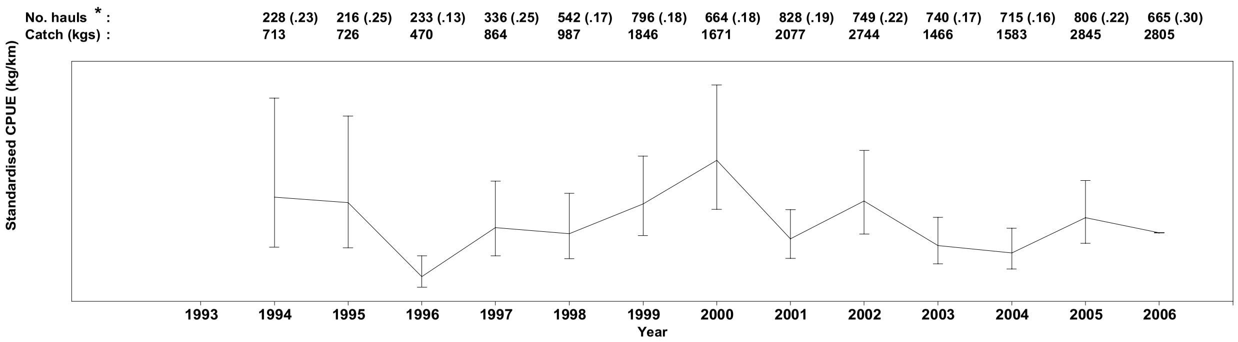
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

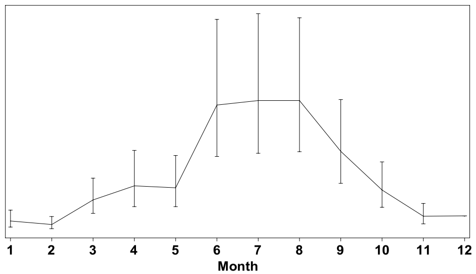
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	0.877	0.572	1.344
2001	0.395	0.269	0.580
2002	0.607	0.416	0.886
2003	0.388	0.263	0.575
2004	0.232	0.160	0.337
2005	0.408	0.296	0.562
2006	0.337	0.337	0.337

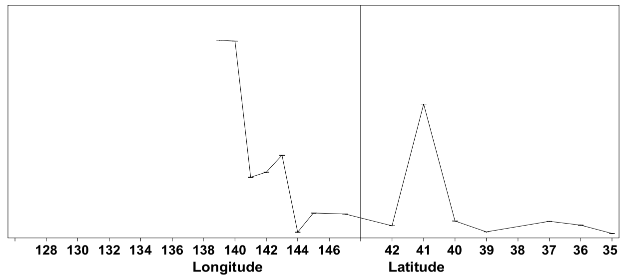
Raw catch and effort

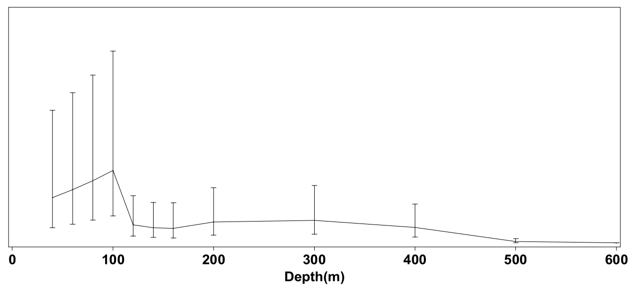
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.224	665	1985	5840	0.340
2001	0.253	806	2669	7929	0.337
2002	0.272	744	3425	6822	0.502
2003	0.219	766	3014	6957	0.433
2004	0.214	748	2753	7627	0.361
2005	0.302	943	5708	9007	0.634
2006	0.335	750	4930	7720	0.639
Mean	0.260	775	3498	7415	0.472

Fig. 3.08b. Gummy shark (*Mustelus antarcticus*) 1994–06 SETF 0–600 m depth south-eastern Australia (longitude 139–151°E)









Gummy shark

Fishery: SETF

Scientific name: Mustelus antarcticus
CAAB code: 37017001

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.99
Model fit criterion: scaled Pearson chisq/df = 1.13
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	12	28.01	0.0055	45.76	<.0001
Month	11	48.00	<.0001	331.56	<.0001
Longitude/latitude	14	115.30	<.0001	225.95	<.0001
Depth	11	51.09	<.0001	625.41	<.0001

*** Proportion of hauls with catch in parentheses**
*** Minimum hauls in selected depth category and zone = 0**

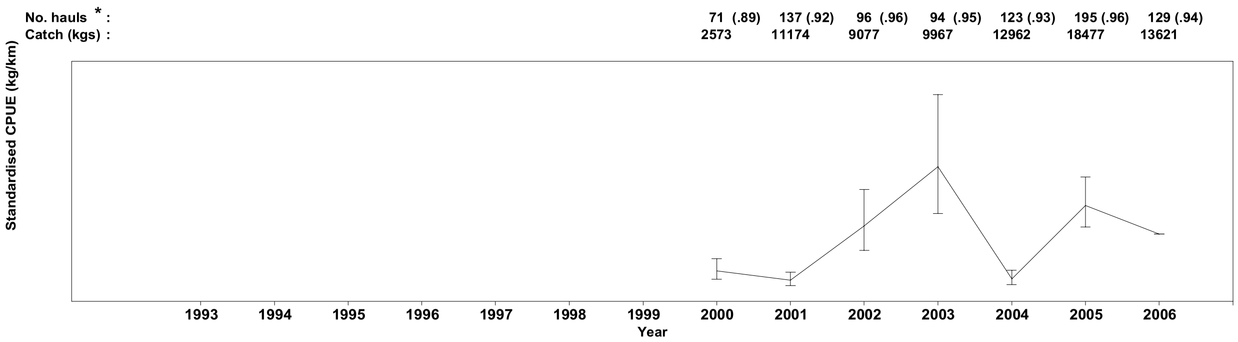
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

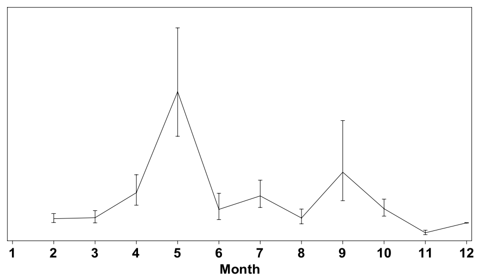
Year	Standardised CPUE (95% CI)		
1994	0.389	0.196	0.770
1995	0.369	0.194	0.701
1996	0.083	0.042	0.162
1997	0.271	0.163	0.450
1998	0.248	0.152	0.404
1999	0.363	0.241	0.547
2000	0.530	0.343	0.821
2001	0.228	0.153	0.340
2002	0.375	0.247	0.569
2003	0.203	0.133	0.310
2004	0.174	0.112	0.269
2005	0.309	0.211	0.453
2006	0.252	0.252	0.252

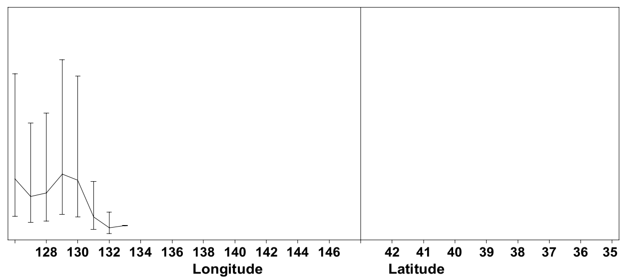
Raw catch and effort

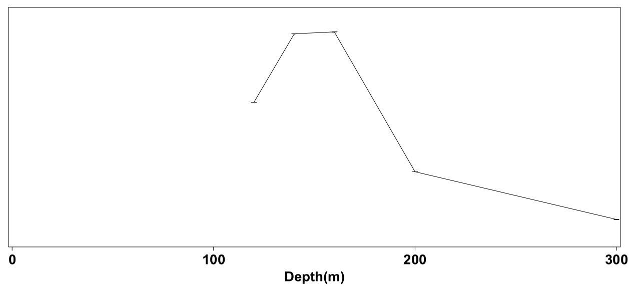
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994	0.228	228	713	2399	0.297
1995	0.255	216	726	2233	0.325
1996	0.133	233	470	2483	0.189
1997	0.253	336	864	3714	0.233
1998	0.173	542	987	4984	0.198
1999	0.182	796	1847	7094	0.260
2000	0.181	664	1671	5412	0.309
2001	0.193	828	2077	7430	0.280
2002	0.223	749	2744	6389	0.430
2003	0.174	740	1467	6480	0.226
2004	0.162	715	1583	6553	0.242
2005	0.220	806	2845	7417	0.384
2006	0.299	665	2805	6646	0.422
Mean	0.206	578	1600	5326	0.300

Fig. 3.09a. Ornate angel shark (*Squatina tergocellata*) 2000–06 GABTF 80–300 m depth Great Australian Bight (longitude 126–133° E)









Ornate angelshark

Fishery: GABTF

Scientific name: Squatina tergocellata
CAAB code: 37024002

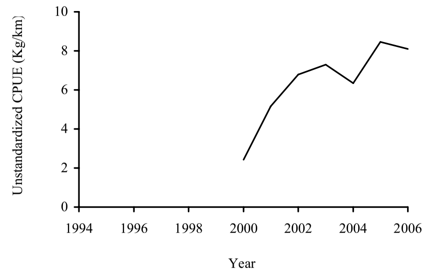
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.77
Model fit criterion: scaled Pearson chisq/df = 1.08
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	6	42.55	<.0001		
Month	10	142.67	<.0001		
Longitude/latitude	7	45.16	<.0001		
Depth	4	20.62	0.0004		

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



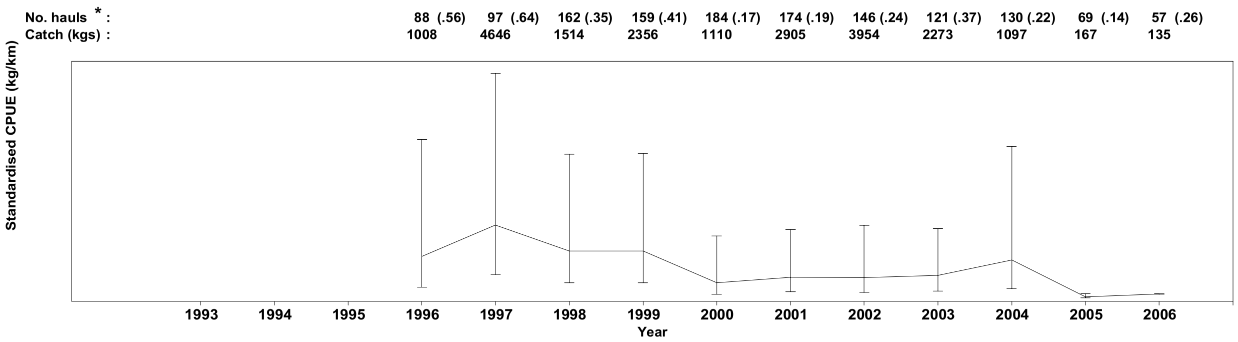
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

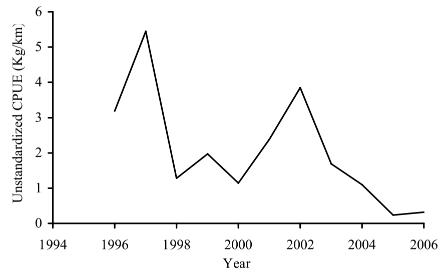
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	0.961	0.169	5.468
2001	2.911	0.918	9.234
2002	5.904	2.306	15.116
2003	13.027	5.252	32.317
2004	1.394	0.290	6.708
2005	9.414	6.444	13.755
2006	5.254	5.254	5.254

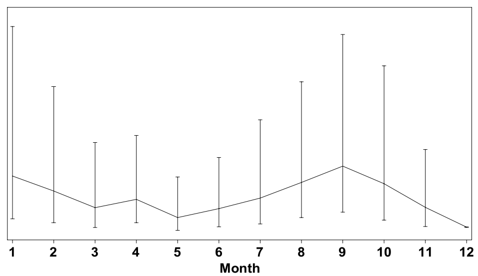
Raw catch and effort

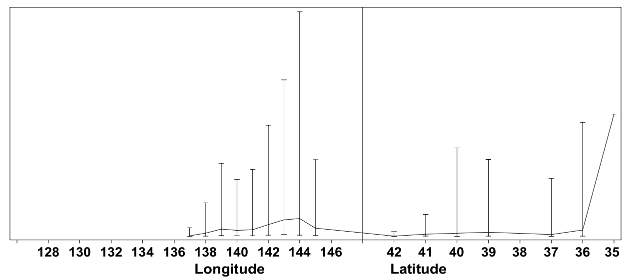
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.887	71	2573	1062	2.423
2001	0.920	137	11174	2163	5.165
2002	0.958	96	9077	1336	6.793
2003	0.947	94	9967	1366	7.298
2004	0.927	123	12962	2045	6.338
2005	0.964	195	18477	2186	8.453
2006	0.938	129	13621	1681	8.103
Mean	0.934	121	11122	1691	6.576

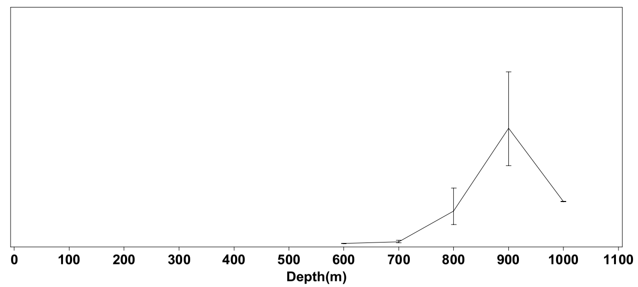
Fig. 3.10a. Owstons dogfish (*Centroscymnus owstoni*) 1996–06 SETF 600–1000 m depth south-eastern Australia (longitude 137–151°E)











Owston dogfish

Fishery: SETF

Scientific name: Centroscymnus owstoni
CAAB code: 37020019

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.15
Model fit criterion: scaled Pearson chisq/df = 0.79
Interannual trend: decreasing P = 0.0072

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	10	38.51	<.0001	51.81	<.0001
Month	11	33.68	0.0004	32.13	0.0007
Longitude/latitude	12	43.68	<.0001	135.54	<.0001
Depth	4	51.48	<.0001	334.48	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

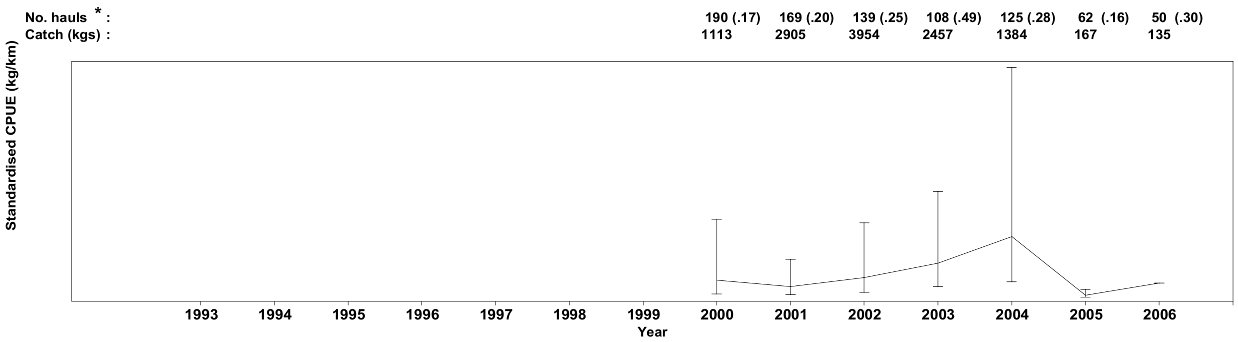
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

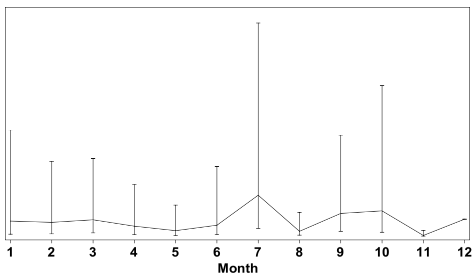
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996	2.841	0.747	10.807
1997	4.974	1.617	15.304
1998	3.220	1.057	9.803
1999	3.206	1.044	9.841
2000	1.041	0.257	4.220
2001	1.416	0.430	4.663
2002	1.402	0.396	4.958
2003	1.537	0.498	4.742
2004	2.603	0.656	10.325
2005	0.084	0.022	0.316
2006	0.287	0.287	0.287

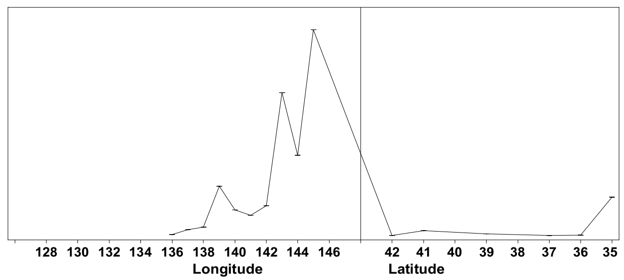
Raw catch and effort

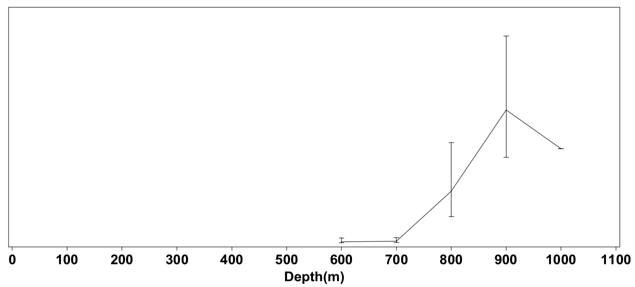
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996	0.557	88	1008	316	3.187
1997	0.639	97	4646	853	5.445
1998	0.346	162	1514	1183	1.280
1999	0.409	159	2356	1196	1.970
2000	0.168	184	1110	968	1.146
2001	0.190	174	2905	1218	2.385
2002	0.240	146	3954	1026	3.853
2003	0.372	121	2273	1345	1.689
2004	0.223	130	1097	1001	1.096
2005	0.145	69	167	713	0.234
2006	0.263	57	135	419	0.322
Mean	0.323	126	1924	931	2.067

Fig. 3.10b. Owstons dogfish (*Centroscymnus owstoni*) 1996–06 SETF 600–1000 m depth south-eastern Australia (longitude 136–151°E)









Owston dogfish

Fishery: trawl

Scientific name: Centroscymnus owstoni
CAAB code: 37020019

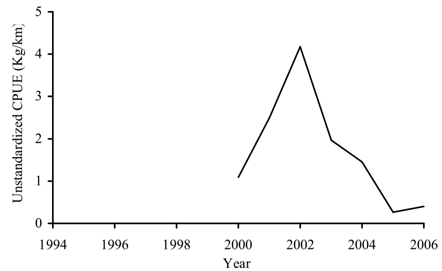
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.21
Model fit criterion: scaled Pearson chisq/df = 1.02
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	6	21.53	0.0015	19.79	0.0030
Month	11	57.02	<.0001	28.75	0.0025
Longitude/latitude	12	50.06	<.0001	88.15	<.0001
Depth	4	13.02	0.0112	207.53	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



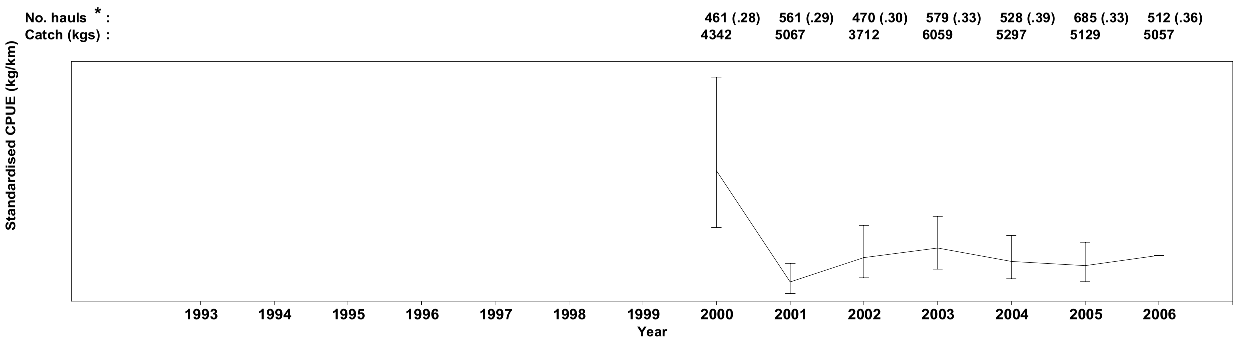
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

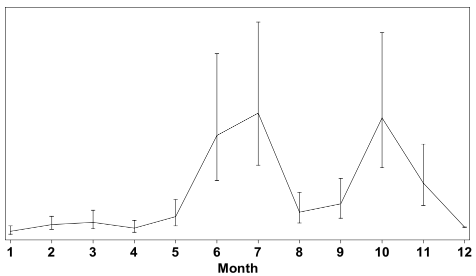
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	1.303	0.299	5.673
2001	0.831	0.247	2.800
2002	1.482	0.405	5.431
2003	2.518	0.826	7.677
2004	4.424	1.178	16.621
2005	0.202	0.064	0.635
2006	1.080	1.080	1.080

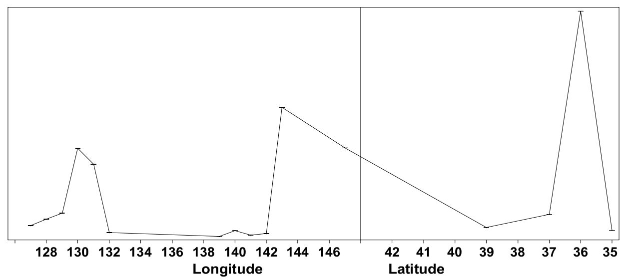
Raw catch and effort

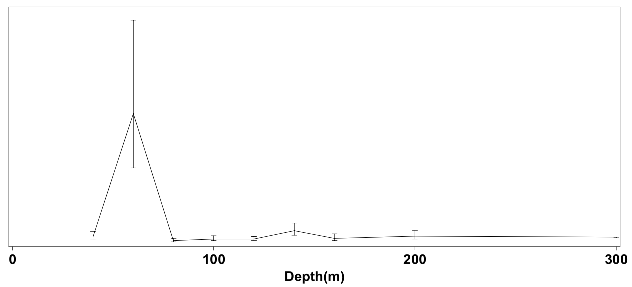
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.168	190	1113	1018	1.093
2001	0.195	169	2905	1165	2.493
2002	0.252	139	3954	947	4.177
2003	0.491	108	2457	1250	1.966
2004	0.280	125	1384	955	1.449
2005	0.161	62	167	640	0.261
2006	0.300	50	135	336	0.402
Mean	0.264	120	1731	902	1.920

Fig. 3.11a. Port Jackson shark (*Heterodontus portusjacksoni*) 2000–06 otter trawl 0–300 m depth southern Australia (longitude 127–151°E)









Port jackson shark Fishery: trawl

Scientific name: Heterodontus portusjacksoni
CAAB code: 37007001

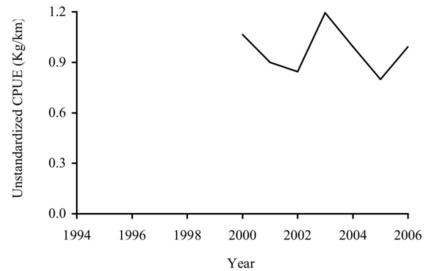
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.00
Model fit criterion: scaled Pearson chisq/df = 1.98
Interannual trend: decreasing P = 0.0415

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	6	35.06	<.0001	6.21	ns
Month	11	35.41	0.0002	500.73	<.0001
Longitude/latitude	12	144.42	<.0001	171.47	<.0001
Depth	8	208.82	<.0001	540.77	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



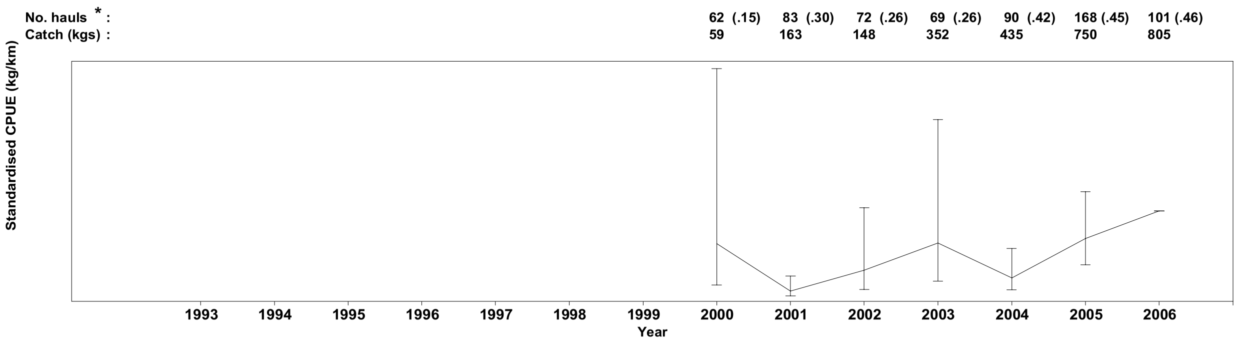
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

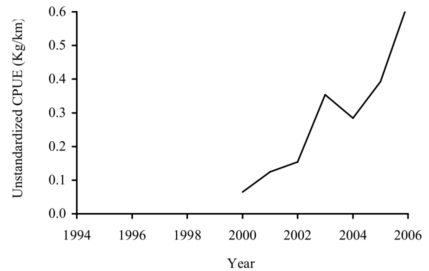
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	2.130	1.285	3.532
2001	0.473	0.298	0.751
2002	0.837	0.532	1.316
2003	0.981	0.664	1.450
2004	0.780	0.521	1.168
2005	0.716	0.481	1.067
2006	0.868	0.868	0.868

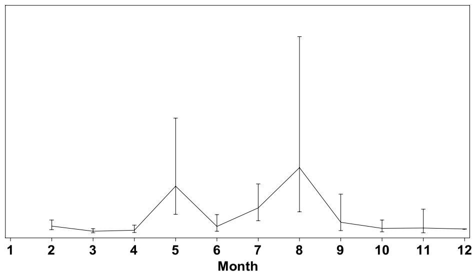
Raw catch and effort

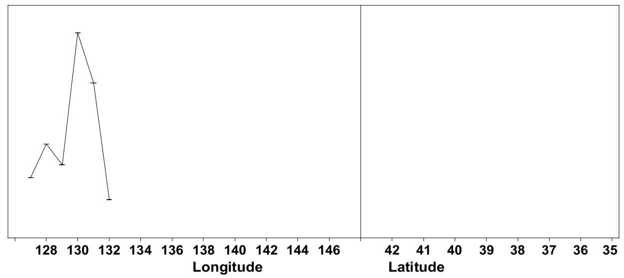
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.280	461	4342	4076	1.065
2001	0.289	561	5067	5637	0.899
2002	0.300	470	3712	4399	0.844
2003	0.326	579	6059	5073	1.194
2004	0.386	528	5297	5334	0.993
2005	0.328	685	5129	6429	0.798
2006	0.355	512	5057	5091	0.993
Mean	0.324	542	4952	5149	0.962

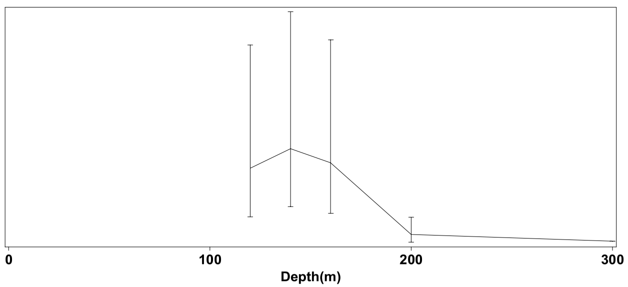
Fig. 3.11b. Port Jackson shark (*Heterodontus portusjacksoni*) 2000–06 GABTF 0–300 m depth Great Australian Bight (longitude 127–132°E)











Port jackson shark Fishery: SETF

Scientific name: Heterodontus portusjacksoni
CAAB code: 37007001

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.03
Model fit criterion: scaled Pearson chisq/df = 1.06
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	6	8.66	ns	16.18	0.0128
Month	10	19.43	0.0351	40.50	<.0001
Longitude/latitude	5	41.69	<.0001	11.63	ns
Depth	4	27.62	<.0001	23.19	0.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

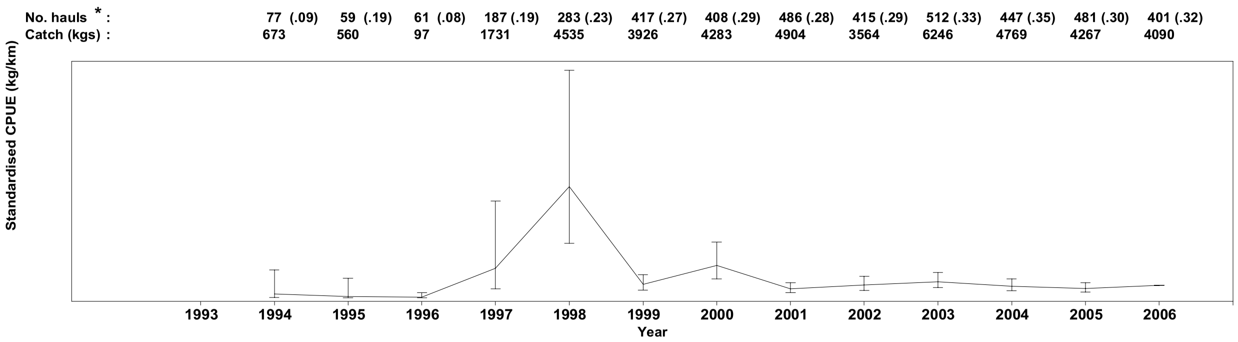
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

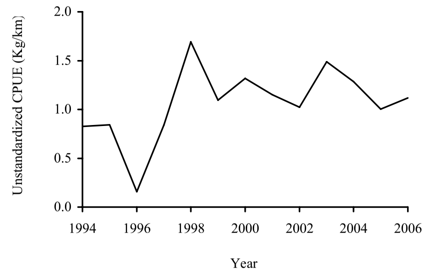
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	0.350	0.083	1.474
2001	0.046	0.015	0.143
2002	0.180	0.056	0.579
2003	0.354	0.109	1.146
2004	0.129	0.053	0.318
2005	0.382	0.214	0.683
2006	0.560	0.560	0.560

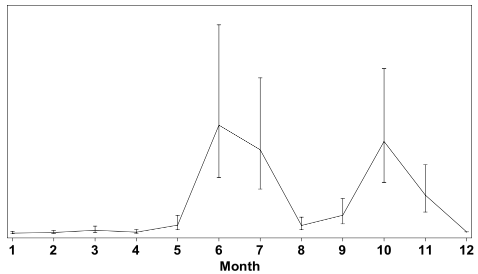
Raw catch and effort

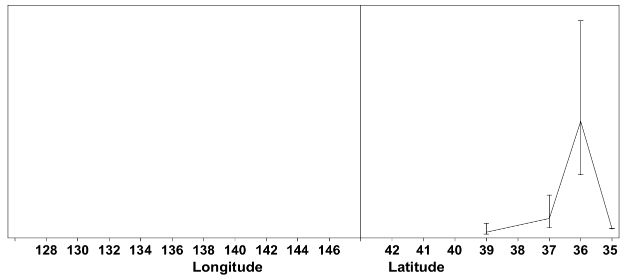
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.145	62	59	918	0.064
2001	0.301	83	163	1304	0.125
2002	0.264	72	148	960	0.154
2003	0.261	69	352	994	0.354
2004	0.422	90	435	1530	0.284
2005	0.446	168	750	1911	0.393
2006	0.455	101	805	1284	0.627
Mean	0.328	92	387	1272	0.305

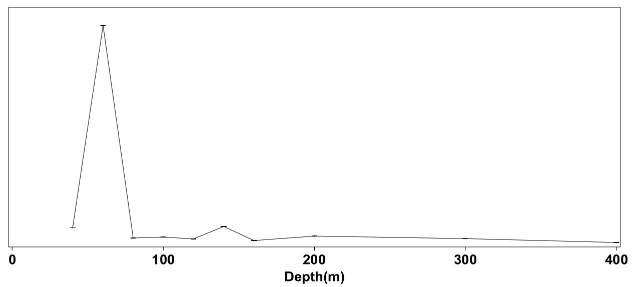
Fig. 3.11c. Port Jackson shark (*Heterodontus portusjacksoni*) 1994–06 SETF 0–400 m depth eastern region (longitude 148–151°E)











Port jackson shark Fishery: SETF

Scientific name: Heterodontus portusjacksoni
CAAB code: 37007001

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.94
Model fit criterion: scaled Pearson chisq/df = 1.76
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	12	87.77	<.0001	16.18	ns
Month	11	35.88	0.0002	700.40	<.0001
Longitude/latitude	3	95.11	<.0001	70.31	<.0001
Depth	9	185.70	<.0001	1008.49	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

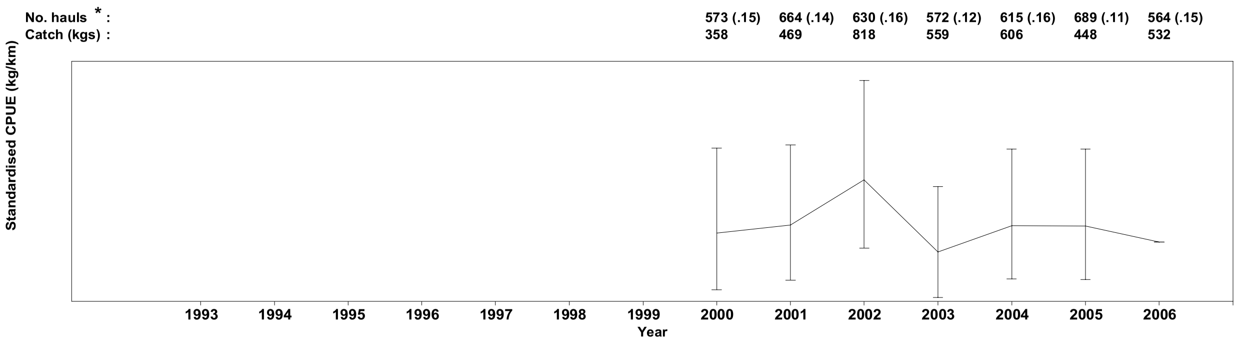
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

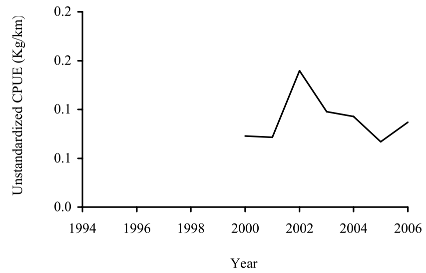
Year	Standardised CPUE (95% CI)		
1994	0.215	0.032	1.463
1995	0.078	0.006	1.031
1996	0.049	0.009	0.273
1997	1.538	0.470	5.034
1998	5.779	2.831	11.797
1999	0.712	0.415	1.220
2000	1.698	0.989	2.917
2001	0.481	0.290	0.798
2002	0.677	0.409	1.121
2003	0.843	0.539	1.319
2004	0.615	0.383	0.988
2005	0.498	0.311	0.799
2006	0.660	0.660	0.660

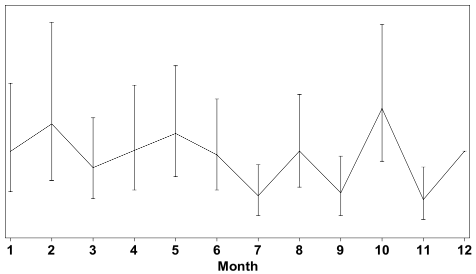
Raw catch and effort

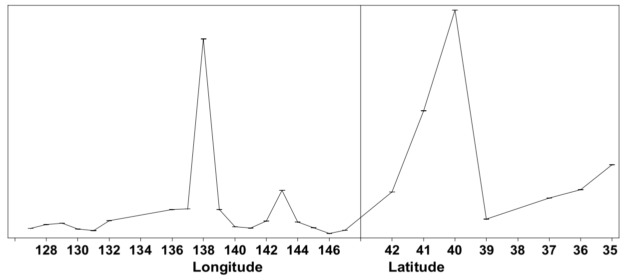
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994	0.091	77	673	814	0.827
1995	0.186	59	560	665	0.842
1996	0.082	61	97	622	0.156
1997	0.187	187	1731	2057	0.842
1998	0.233	283	4535	2679	1.693
1999	0.271	417	3926	3583	1.096
2000	0.294	408	4283	3251	1.317
2001	0.282	486	4904	4262	1.151
2002	0.294	415	3564	3479	1.025
2003	0.334	512	6246	4198	1.488
2004	0.351	447	4769	3706	1.287
2005	0.299	481	4267	4255	1.003
2006	0.322	401	4090	3658	1.118
Mean	0.248	326	3357	2864	1.172

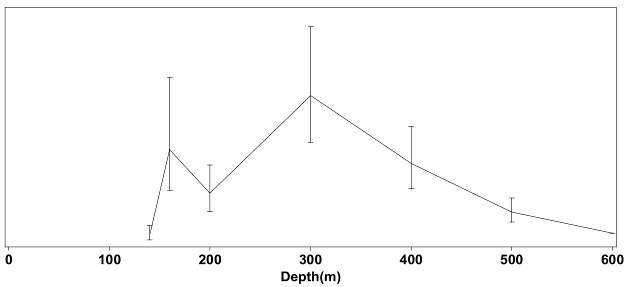
Fig. 3.12a. Sawtail shark (*Galeus boardmani*) 1998–06 otter trawl 140–600 m depth southern Australia (longitude 127–151°E)











Sawtail catshark Fishery: trawl

Scientific name: Galeus boardmani
CAAB code: 37015009

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.05
Model fit criterion: scaled Pearson chisq/df = 1.80
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	6	6.42	ns	5.53	ns
Month	11	29.84	0.0017	10.63	ns
Longitude/latitude	23	35.83	0.0430	164.12	<.0001
Depth	6	92.72	<.0001	336.82	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

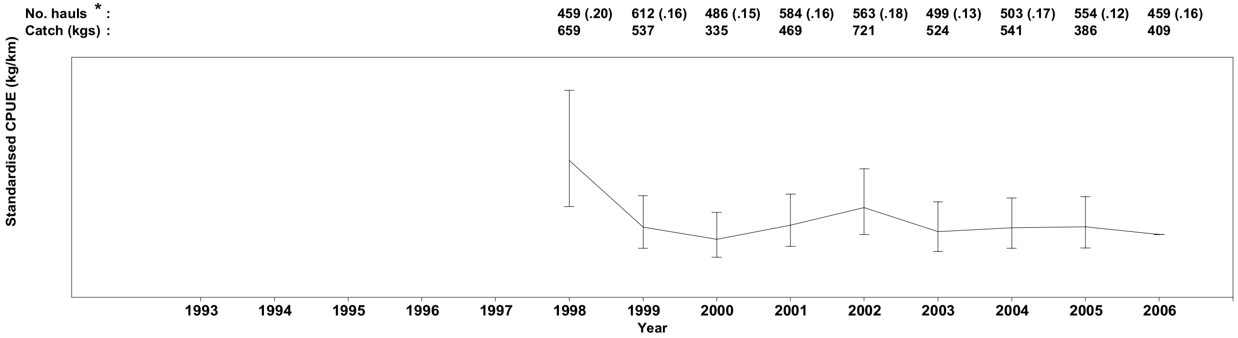
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

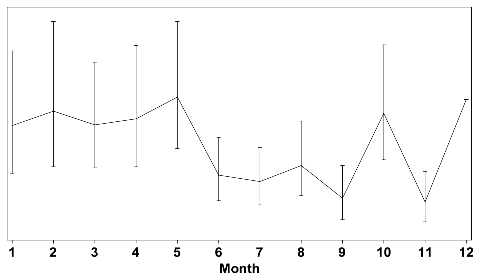
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	0.086	0.057	0.130
2001	0.090	0.062	0.131
2002	0.114	0.079	0.164
2003	0.077	0.053	0.110
2004	0.090	0.063	0.129
2005	0.090	0.062	0.129
2006	0.082	0.082	0.082

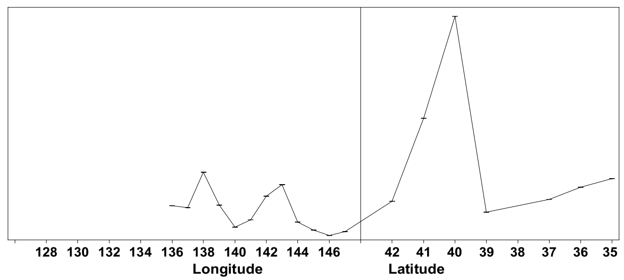
Raw catch and effort

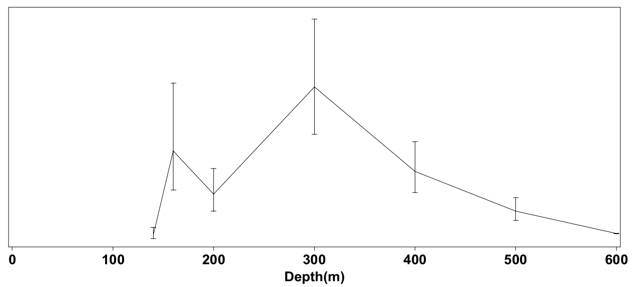
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.154	573	359	4929	0.073
2001	0.143	664	469	6552	0.072
2002	0.160	630	818	5850	0.140
2003	0.122	572	559	5727	0.098
2004	0.164	615	606	6524	0.093
2005	0.106	689	449	6714	0.067
2006	0.147	564	532	6122	0.087
Mean	0.142	615	542	6060	0.089

Fig. 3.12b. Sawtail shark (*Galeus boardmani*) 1998–06 SETF 120–600 m depth south-eastern Australia (longitude 136–151° E)









Sawtail catshark

Fishery: SETF

Scientific name: Galeus boardmani
CAAB code: 37015009

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.05
Model fit criterion: scaled Pearson chisq/df = 1.81
Interannual trend: decreasing P = 0.0301

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	8	16.91	0.0311	10.89	ns
Month	11	31.05	0.0011	19.54	ns
Longitude/latitude	18	42.87	0.0008	163.54	<.0001
Depth	6	124.74	<.0001	337.62	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

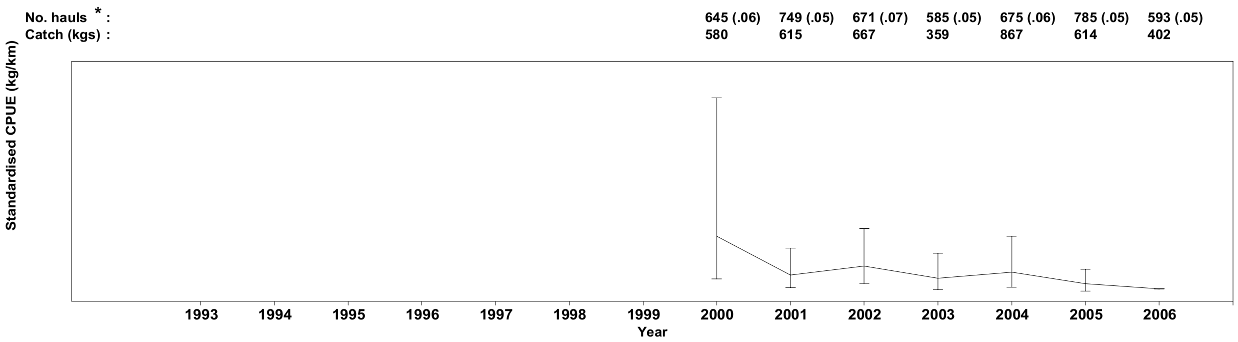
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

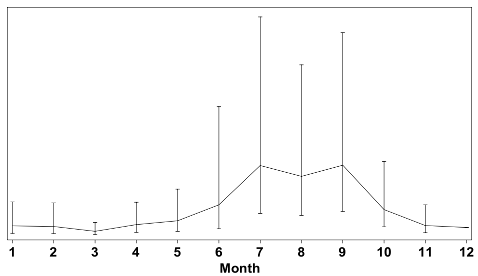
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998	0.191	0.125	0.292
1999	0.096	0.065	0.141
2000	0.079	0.053	0.117
2001	0.099	0.068	0.143
2002	0.124	0.086	0.180
2003	0.090	0.061	0.132
2004	0.095	0.066	0.138
2005	0.096	0.066	0.139
2006	0.085	0.085	0.085

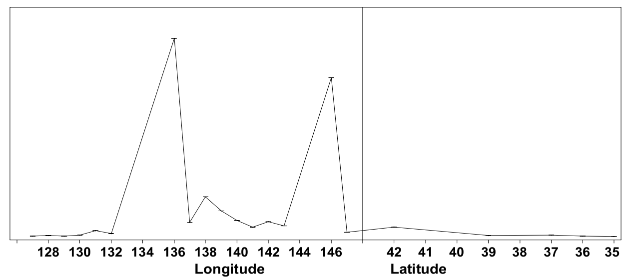
Raw catch and effort

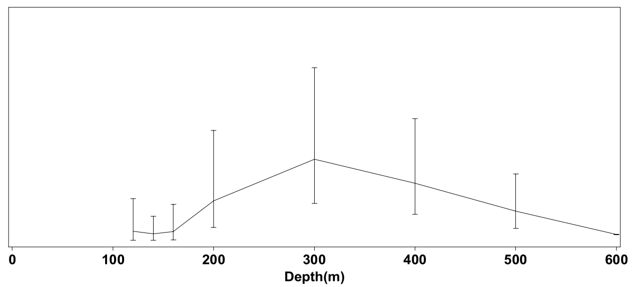
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998	0.196	459	659	4199	0.157
1999	0.162	612	537	5586	0.096
2000	0.150	486	336	3874	0.087
2001	0.163	584	469	5276	0.089
2002	0.176	563	721	4946	0.146
2003	0.128	499	524	4779	0.110
2004	0.171	503	541	4811	0.112
2005	0.121	554	387	5245	0.074
2006	0.161	459	409	4787	0.085
Mean	0.159	524	509	4834	0.105

Fig. 3.13a. School shark (*Galeorhinus galeus*) 2000–06 otter trawl 120–600 m depth southern Australia (longitude 127–151°E)









School shark Fishery: trawl

Scientific name: Galeorhinus galeus
CAAB code: 37017008

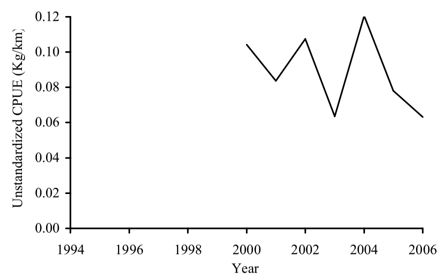
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.94
Model fit criterion: scaled Pearson chisq/df = 1.07
Interannual trend: decreasing P = 0.0115

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	6	6.04	ns	15.56	0.0163
Month	11	6.57	ns	83.41	<.0001
Longitude/latitude	19	74.14	<.0001	287.20	<.0001
Depth	7	21.68	0.0029	24.24	0.0010

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



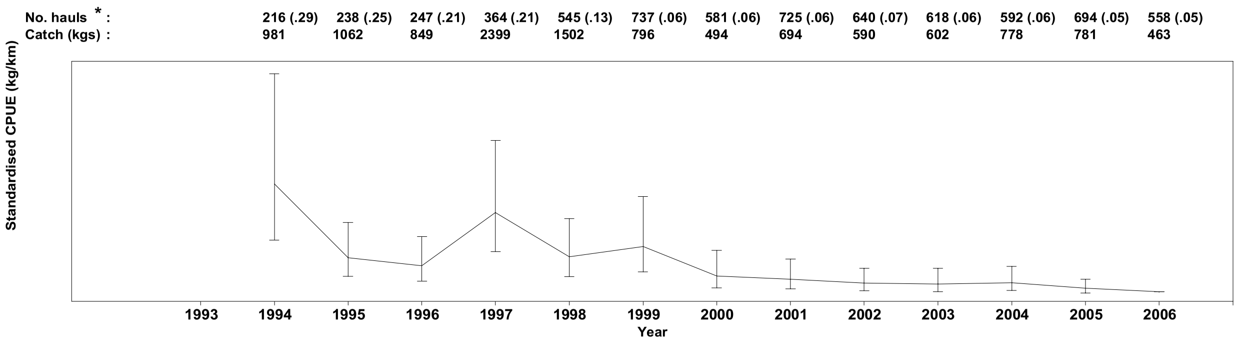
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

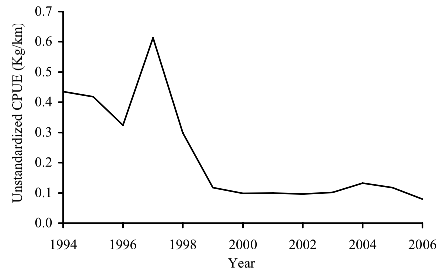
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	0.206	0.064	0.668
2001	0.077	0.035	0.167
2002	0.107	0.049	0.233
2003	0.066	0.029	0.149
2004	0.087	0.036	0.206
2005	0.048	0.024	0.096
2006	0.031	0.031	0.031

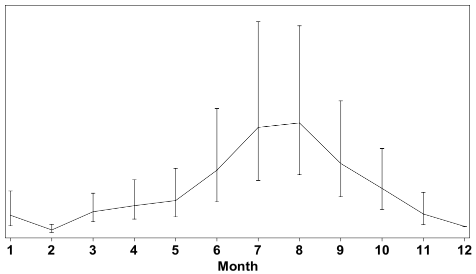
Raw catch and effort

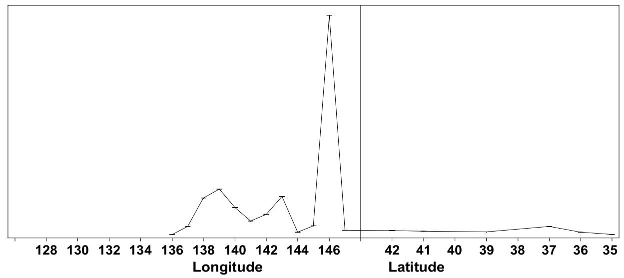
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.0589	645	580	5563	0.104
2001	0.0481	749	615	7353	0.084
2002	0.0745	671	667	6206	0.107
2003	0.0462	585	359	5652	0.064
2004	0.0607	675	867	7195	0.121
2005	0.0459	785	614	7874	0.078
2006	0.0489	593	402	6362	0.063
Mean	0.0547	672	586	6601	0.089

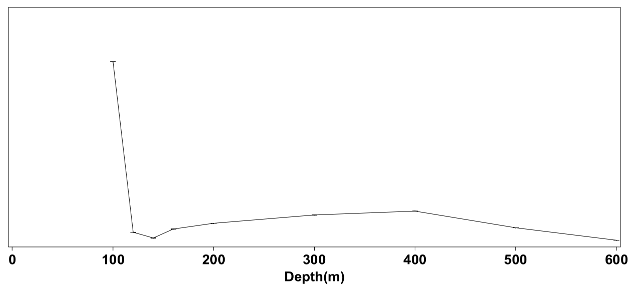
Fig. 3.13b. School shark (*Galeorhinus galeus*) 1994–06 SETF 80–600 m depth longitude south-eastern Australia (136–151°E)











School shark Fishery: SETF

Scientific name: Galeorhinus galeus
CAAB code: 37017008

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.00
Model fit criterion: scaled Pearson chisq/df = 1.17
Interannual trend: decreasing P = <.0001

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	12	30.94	0.0020	171.24	<.0001
Month	11	25.21	0.0085	165.25	<.0001
Longitude/latitude	17	74.59	<.0001	399.35	<.0001
Depth	8	68.46	<.0001	81.49	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

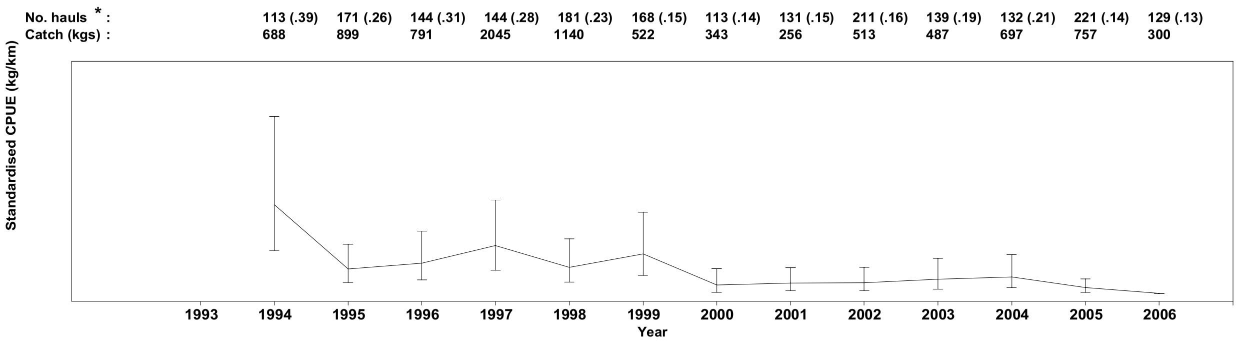
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

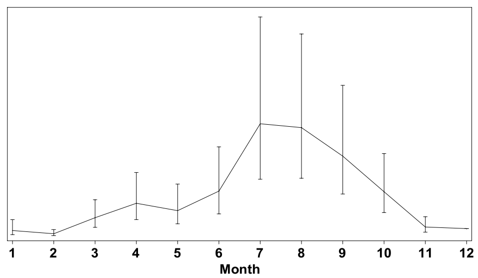
Year	Standardised CPUE (95% CI)		
1994	0.716	0.364	1.409
1995	0.254	0.136	0.475
1996	0.202	0.106	0.385
1997	0.537	0.292	0.989
1998	0.260	0.135	0.499
1999	0.324	0.164	0.638
2000	0.140	0.065	0.299
2001	0.119	0.058	0.246
2002	0.094	0.047	0.188
2003	0.087	0.040	0.188
2004	0.097	0.047	0.199
2005	0.062	0.033	0.118
2006	0.040	0.040	0.040

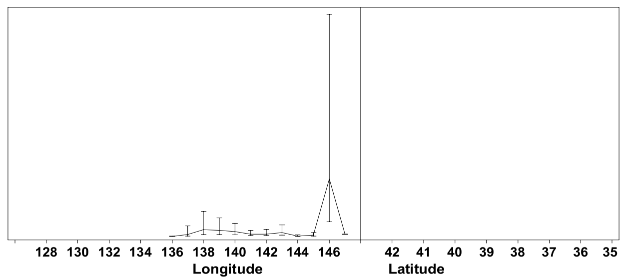
Raw catch and effort

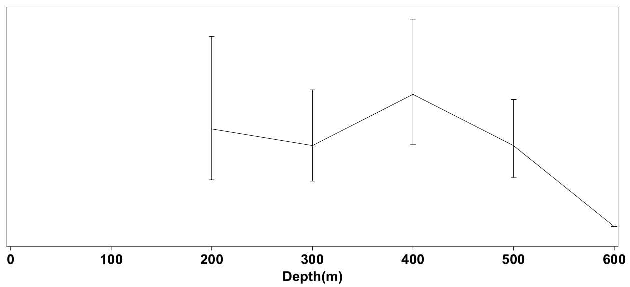
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994	0.287	216	981	2254	0.435
1995	0.248	238	1062	2538	0.419
1996	0.206	247	849	2622	0.324
1997	0.214	364	2399	3911	0.613
1998	0.128	545	1503	5033	0.299
1999	0.062	737	796	6753	0.118
2000	0.055	581	494	5038	0.098
2001	0.055	725	694	6996	0.099
2002	0.067	640	590	6133	0.096
2003	0.055	618	602	5916	0.102
2004	0.059	592	778	5896	0.132
2005	0.049	694	781	6646	0.118
2006	0.048	558	463	5835	0.079
Mean	0.118	520	922	5044	0.183

Fig. 3.13c. School shark (*Galeorhinus galeus*) 1994–06 SETF 80–600 m depth western region (148–151°E)









Adjusted to mean observed annual cpue

Delta-X error (log-gamma/binomial)

Year	Standardised CPUE (95% CI)		
1994	1.428	0.732	2.787
1995	0.446	0.241	0.825
1996	0.537	0.280	1.028
1997	0.804	0.429	1.504
1998	0.474	0.248	0.908
1999	0.677	0.348	1.316
2000	0.201	0.090	0.451
2001	0.232	0.116	0.466
2002	0.239	0.121	0.471
2003	0.290	0.139	0.607
2004	0.327	0.160	0.668
2005	0.160	0.087	0.296
2006	0.077	0.077	0.077

School shark

Fishery: SETF

Scientific name: Galeorhinus galeus
CAAB code: 37017008

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.04
Model fit criterion: scaled Pearson chisq/df = 1.09
Interannual trend: decreasing P = <.0001

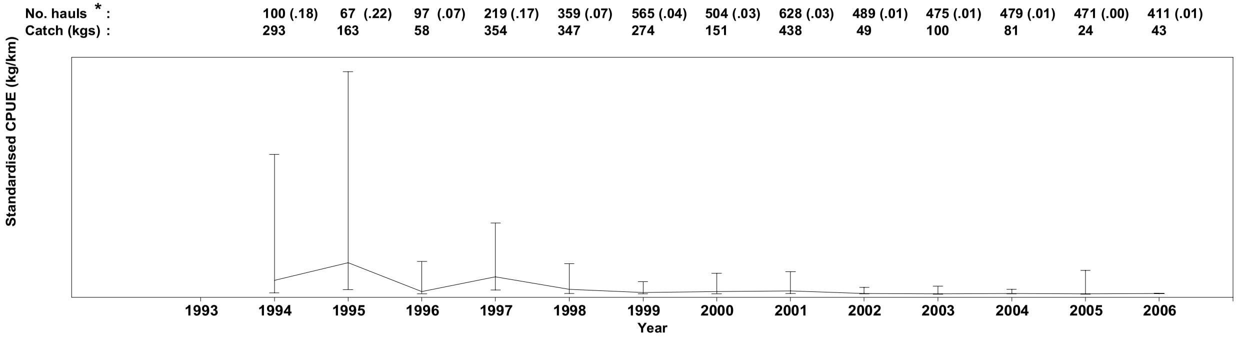
		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	12	31.11	0.0019	88.23	<.0001
Month	11	27.11	0.0044	136.85	<.0001
Longitude/latitude	11	44.80	<.0001	44.35	<.0001
Depth	4	17.60	0.0015	73.16	<.0001

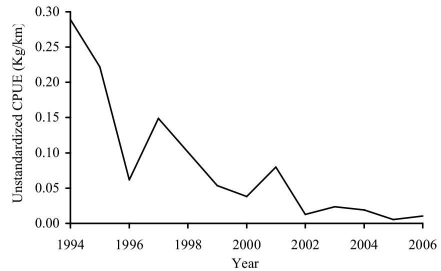
* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

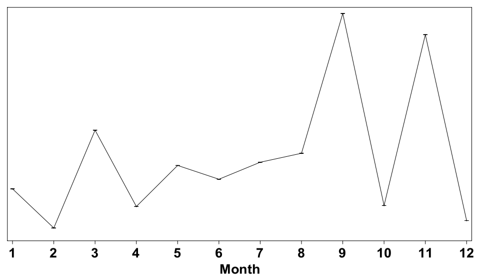
Raw catch and effort

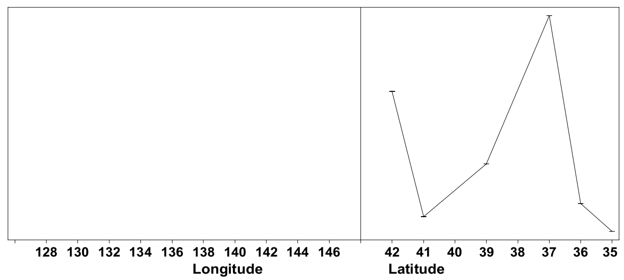
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994	0.389	113	688	1217	0.565
1995	0.257	171	899	1803	0.499
1996	0.306	144	791	1620	0.488
1997	0.285	144	2045	1522	1.343
1998	0.232	181	1141	1553	0.734
1999	0.149	168	522	1578	0.331
2000	0.142	113	343	1118	0.307
2001	0.145	131	256	1501	0.171
2002	0.156	211	513	2322	0.221
2003	0.187	139	487	1615	0.301
2004	0.212	132	697	1690	0.413
2005	0.145	221	757	2256	0.336
2006	0.132	129	300	1640	0.183
Mean	0.211	154	726	1649	0.440

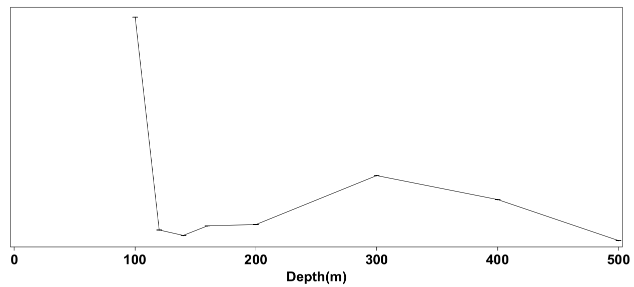
Fig. 3.13d. School shark (*Galeorhinus galeus*) 1994–06 SETF 80–600 m depth eastern region (148–151°E)











School shark

Fishery: SETF

Scientific name: Galeorhinus galeus
CAAB code: 37017008

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.95
Model fit criterion: scaled Pearson chisq/df = 1.31
Interannual trend: decreasing P = 0.0045

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	12	10.43	ns	122.52	<.0001
Month	11	15.37	ns	70.32	<.0001
Longitude/latitude	5	11.87	0.0367	79.68	<.0001
Depth	8	36.74	<.0001	32.51	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

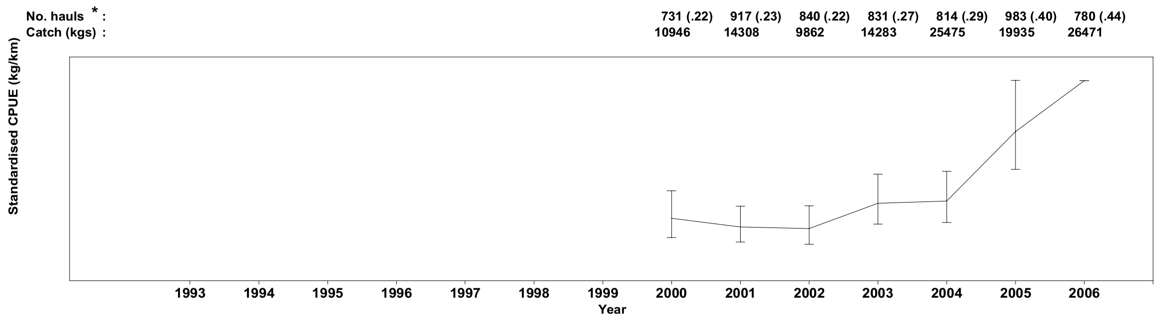
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

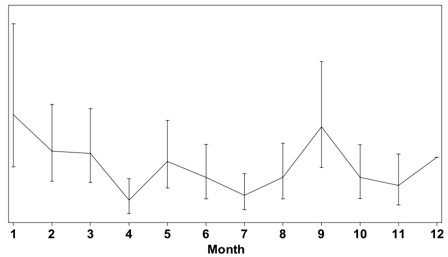
Year	Standardised CPUE (95% CI)		
1994	0.185	0.018	1.873
1995	0.422	0.060	2.985
1996	0.034	0.003	0.441
1997	0.232	0.056	0.955
1998	0.064	0.010	0.408
1999	0.020	0.002	0.169
2000	0.034	0.004	0.281
2001	0.042	0.006	0.300
2002	0.009	0.001	0.089
2003	0.005	0.000	0.107
2004	0.006	0.001	0.062
2005	0.005	0.000	0.319
2006	0.009	0.009	0.009

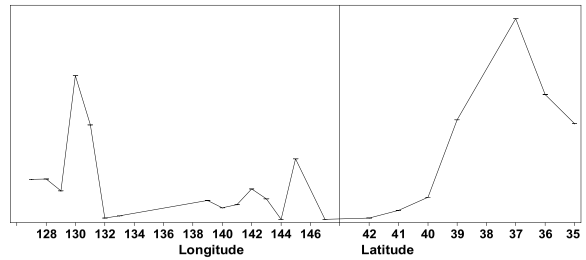
Raw catch and effort

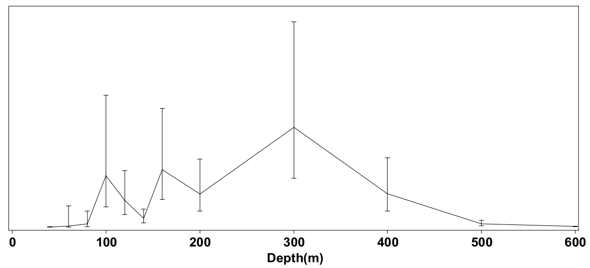
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994	0.180	100	293	1013	0.289
1995	0.224	67	163	735	0.222
1996	0.072	97	58	942	0.062
1997	0.169	219	354	2376	0.149
1998	0.072	359	347	3430	0.101
1999	0.037	565	274	5126	0.053
2000	0.032	504	151	3950	0.038
2001	0.033	628	438	5492	0.080
2002	0.014	489	49	3841	0.013
2003	0.015	475	100	4255	0.024
2004	0.015	479	81	4208	0.019
2005	0.004	471	24	4368	0.005
2006	0.010	411	43	4056	0.011
Mean	0.067	374	183	3369	0.054

Fig. 3.14a. Spikey spurdog (*Squalus megalops*) 1998–06 otter trawl 0–600 m depth southern Australia (longitude 127–151°E)









Spikey dogfish

Fishery: trawl

Scientific name: Squalus megalops
CAAB code: 37020006

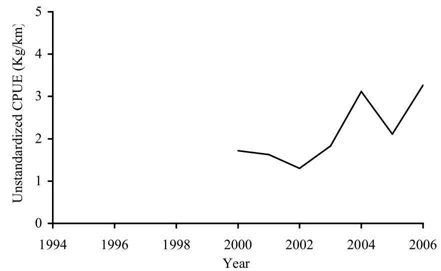
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.98
Model fit criterion: scaled Pearson chisq/df = 2.38
Interannual trend: increasing P = <.0001

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	6	5.64	ns	167.35	<.0001
Month	11	58.32	<.0001	21.86	0.0255
Longitude/latitude	20	164.44	<.0001	397.94	<.0001
Depth	10	308.73	<.0001	1317.00	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



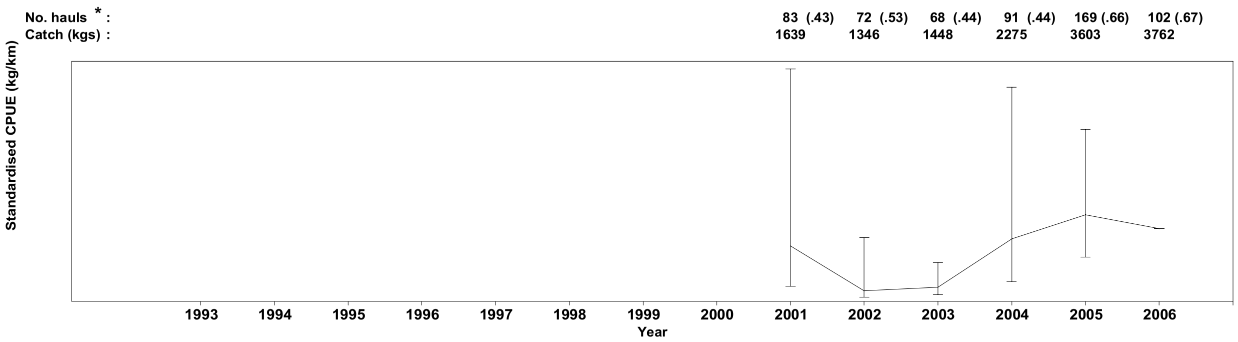
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

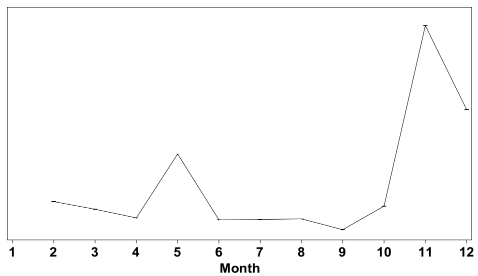
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	1.358	0.924	1.995
2001	1.159	0.818	1.641
2002	1.124	0.765	1.651
2003	1.708	1.228	2.374
2004	1.756	1.263	2.443
2005	3.352	2.483	4.525
2006	4.516	4.516	4.516

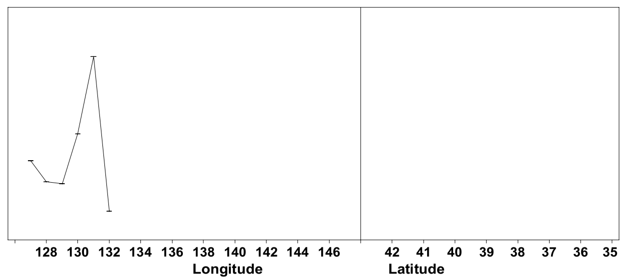
Raw catch and effort

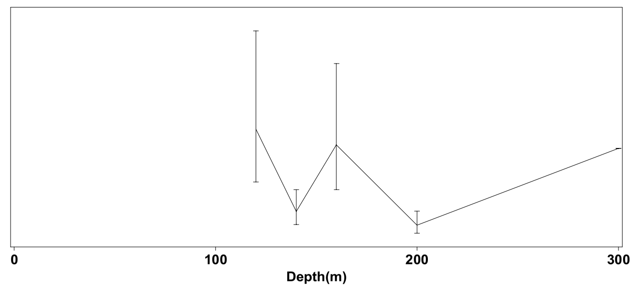
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.216	731	10946	6370	1.718
2001	0.231	917	14308	8803	1.625
2002	0.218	840	9863	7564	1.304
2003	0.272	831	14284	7814	1.828
2004	0.285	814	25475	8169	3.118
2005	0.399	983	19935	9440	2.112
2006	0.440	780	26471	8102	3.267
Mean	0.294	842	17326	8038	2.156

Fig. 3.14b. Spikey spurdog (*Squalus megalops*) 1998–06 GABTF 0–300 m depth Great Australian Bight (longitude 127–132° E)









Spikey dogfish

Fishery: SETF

Scientific name: Squalus megalops
CAAB code: 37020006

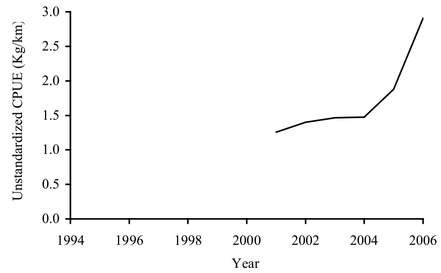
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.05
Model fit criterion: scaled Pearson chisq/df = 1.39
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	5	11.49	0.0424	9.65	ns
Month	10	51.00	<.0001	26.58	0.0030
Longitude/latitude	5	37.94	<.0001	4.56	ns
Depth	4	59.44	<.0001	11.93	0.0179

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



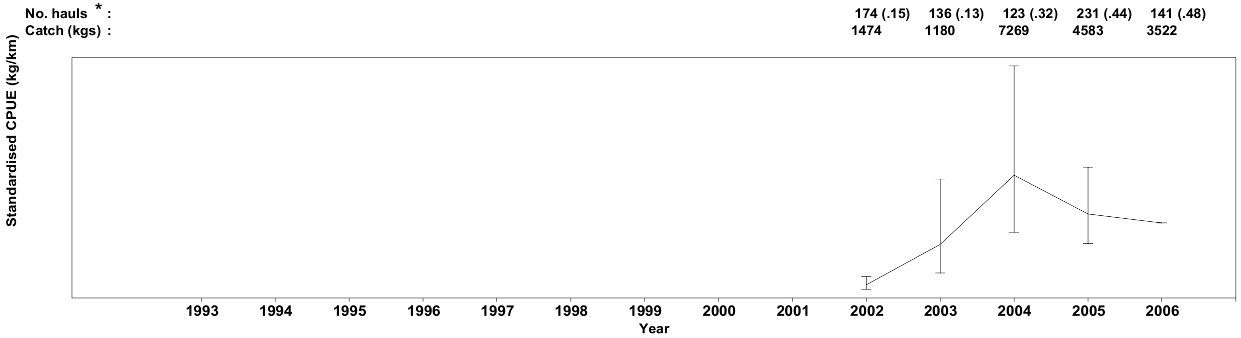
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

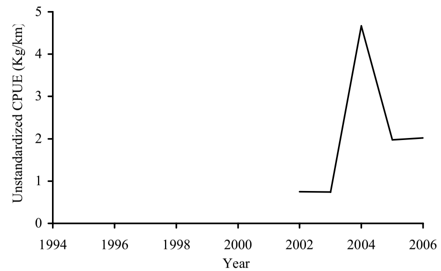
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001	1.918	0.437	8.414
2002	0.271	0.033	2.224
2003	0.401	0.123	1.305
2004	2.176	0.611	7.745
2005	3.056	1.509	6.187
2006	2.561	2.561	2.561

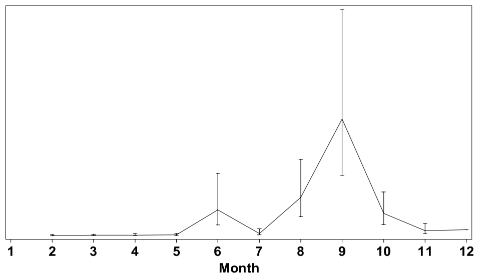
Raw catch and effort

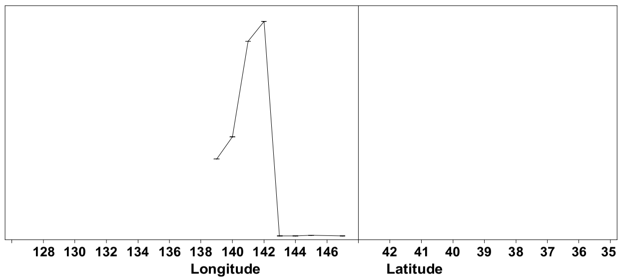
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001	0.434	83	1639	1304	1.257
2002	0.528	72	1346	960	1.402
2003	0.441	68	1448	988	1.466
2004	0.440	91	2275	1544	1.474
2005	0.663	169	3603	1918	1.878
2006	0.667	102	3762	1294	2.906
Mean	0.529	98	2346	1335	1.757

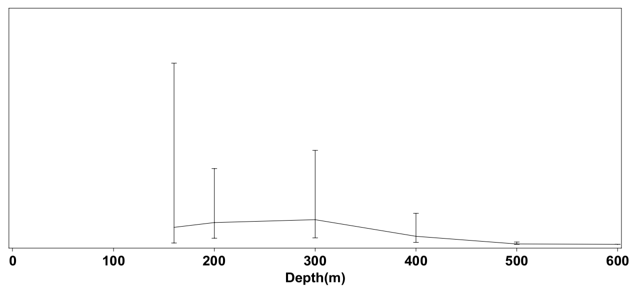
Fig. 3.14c. Spikey spurdog (*Squalus megalops*) 1998–06 SETF 0–600 m depth western region (longitude 139–148° E)











Spikey dogfish Fishery: SETF

Scientific name: Squalus megalops
CAAB code: 37020006

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.94
Model fit criterion: scaled Pearson chisq/df = 1.24
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	4	19.31	0.0007	52.84	<.0001
Month	10	103.08	<.0001	139.52	<.0001
Longitude/latitude	6	16.71	0.0104	66.95	<.0001
Depth	5	34.28	<.0001	140.28	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

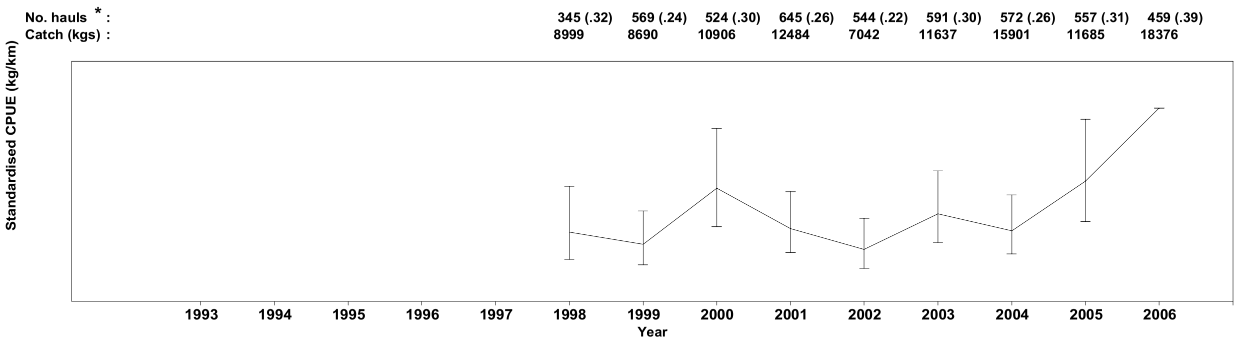
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

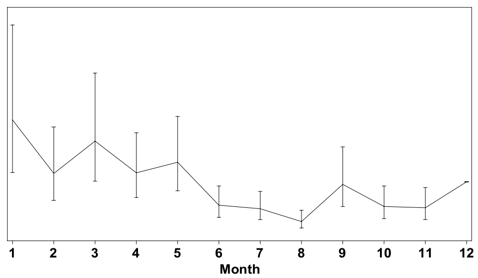
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001			
2002	0.299	0.160	0.558
2003	1.536	0.667	3.539
2004	3.652	1.907	6.997
2005	2.467	1.559	3.904
2006	2.193	2.193	2.193

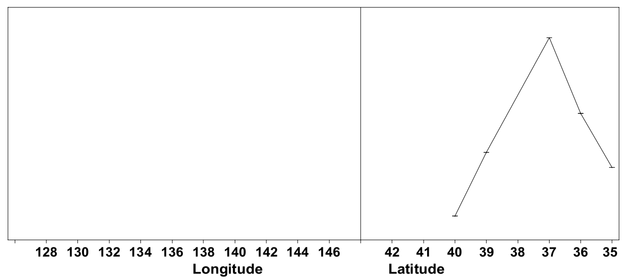
Raw catch and effort

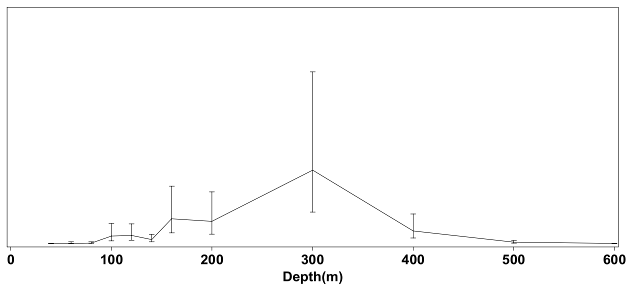
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001					
2002	0.149	174	1474	1975	0.746
2003	0.125	136	1180	1585	0.745
2004	0.317	123	7269	1558	4.665
2005	0.442	231	4583	2321	1.974
2006	0.475	141	3522	1746	2.018
Mean	0.302	161	3606	1837	1.963

Fig. 3.14d. Spikey spurdog (*Squalus megalops*) 1998–06 SETF 0–600 m depth eastern region (longitude 148–151°E)









Spikey dogfish Fishery: SETF

Scientific name: Squalus megalops
CAAB code: 37020006

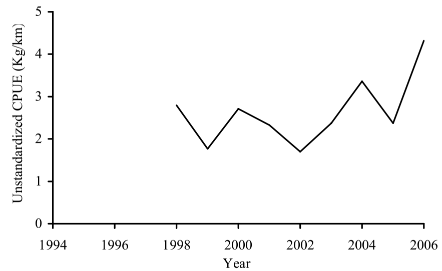
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.99
Model fit criterion: scaled Pearson chisq/df = 2.33
Interannual trend: increasing P = 0.0019

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	8	11.72	ns	49.45	<.0001
Month	11	57.19	<.0001	46.27	<.0001
Longitude/latitude	4	22.62	0.0002	72.27	<.0001
Depth	11	271.59	<.0001	1449.45	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



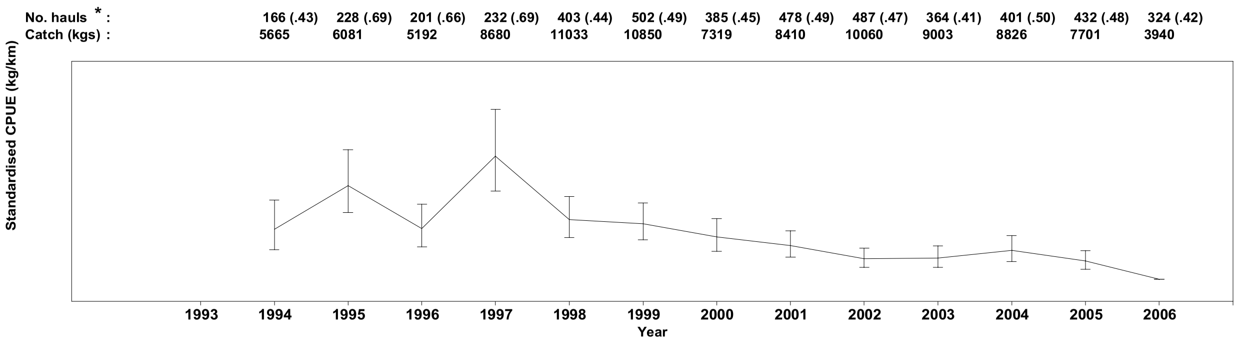
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

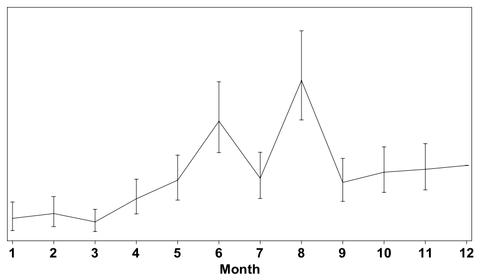
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998	1.935	1.140	3.285
1999	1.581	0.976	2.562
2000	3.232	2.098	4.980
2001	2.047	1.338	3.129
2002	1.434	0.879	2.341
2003	2.477	1.643	3.736
2004	1.983	1.298	3.030
2005	3.437	2.246	5.257
2006	5.588	5.588	5.588

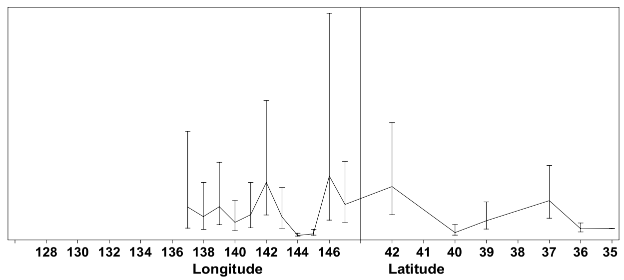
Raw catch and effort

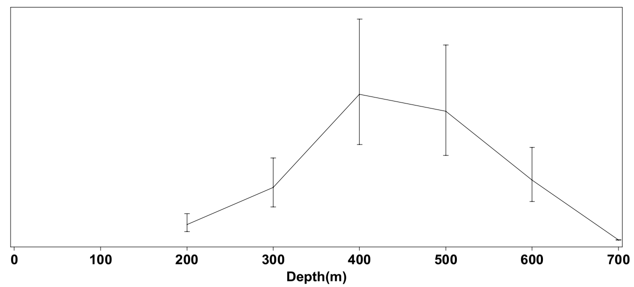
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998	0.325	345	8999	3223	2.792
1999	0.244	569	8691	4916	1.768
2000	0.298	524	10906	4024	2.710
2001	0.262	645	12484	5360	2.329
2002	0.219	544	7043	4146	1.699
2003	0.298	591	11638	4909	2.371
2004	0.257	572	15901	4735	3.358
2005	0.314	557	11685	4930	2.370
2006	0.386	459	18376	4255	4.318
Mean	0.289	534	11747	4500	2.611

Fig. 3.15a. Whitefin swell shark (*Cephaloscyllium* sp A) 1994–06 SETF 200–700 m depth south-eastern Australia (longitude 137–151°E)









Whitefin swell shark Fishery: SETF

Scientific name: Cephaloscyllium sp a
CAAB code: 37015013

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.01
Model fit criterion: scaled Pearson chisq/df = 1.34
Interannual trend: decreasing P = <.0001

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	12	152.79	<.0001	66.92	<.0001
Month	11	96.01	<.0001	46.11	<.0001
Longitude/latitude	16	135.57	<.0001	476.55	<.0001
Depth	5	128.76	<.0001	614.90	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

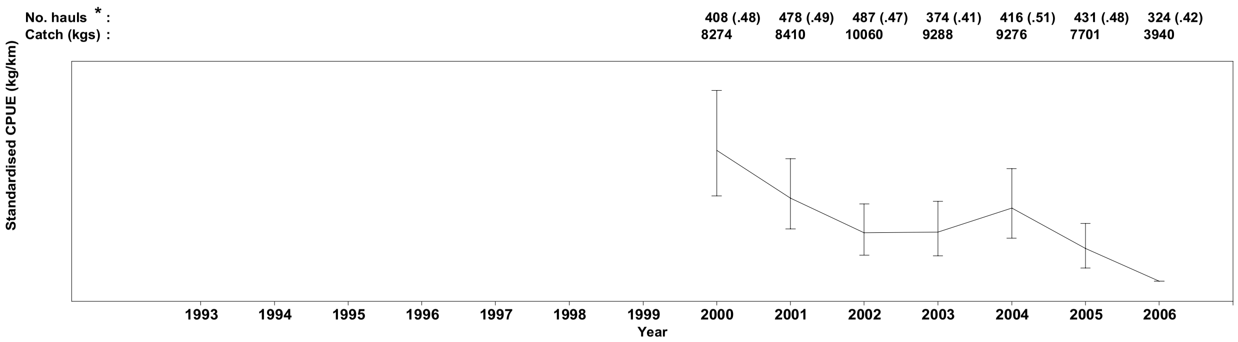
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

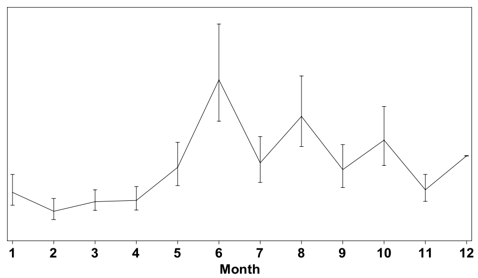
Year	Standardised CPUE (95% CI)		
1994	2.588	1.819	3.683
1995	4.233	3.209	5.582
1996	2.611	1.933	3.527
1997	5.340	4.020	7.094
1998	2.946	2.272	3.821
1999	2.802	2.195	3.577
2000	2.294	1.763	2.985
2001	1.974	1.542	2.526
2002	1.476	1.159	1.880
2003	1.510	1.162	1.961
2004	1.798	1.381	2.342
2005	1.390	1.084	1.783
2006	0.706	0.706	0.706

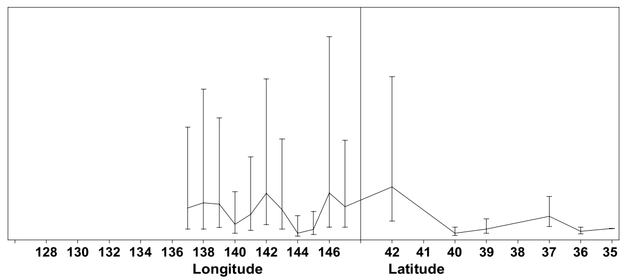
Raw catch and effort

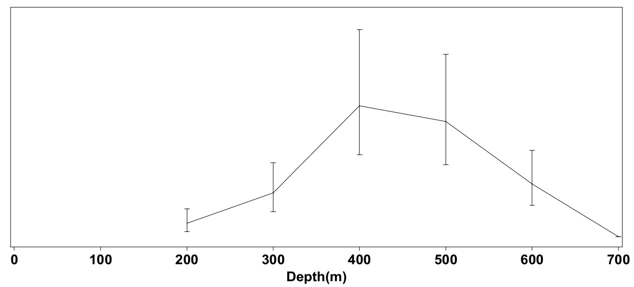
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994	0.428	166	5665	1679	3.373
1995	0.689	228	6081	2456	2.476
1996	0.662	201	5192	2126	2.442
1997	0.690	232	8680	2419	3.589
1998	0.437	403	11034	3689	2.991
1999	0.486	502	10851	4621	2.348
2000	0.452	385	7319	3025	2.419
2001	0.487	478	8410	4244	1.982
2002	0.470	487	10060	4235	2.376
2003	0.409	364	9003	3592	2.506
2004	0.496	401	8827	3966	2.226
2005	0.479	432	7701	4233	1.819
2006	0.423	324	3940	3510	1.122
Mean	0.508	354	7905	3369	2.346

Fig. 3.15b. Whitefin swell shark (*Cephaloscyllium sp A*) 2000–06 SETF 200–700 m depth south-eastern Australia (longitude 137–151°E)









Whitefin swell shark Fishery: trawl

Scientific name: Cephaloscyllium sp a
CAAB code: 37015013

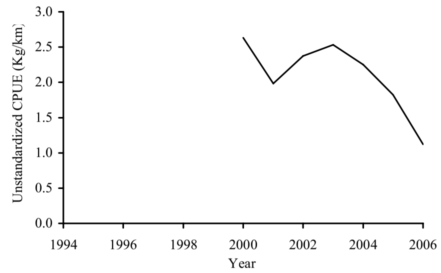
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.99
Model fit criterion: scaled Pearson chisq/df = 1.33
Interannual trend: decreasing P = <.0001

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	6	50.23	<.0001	13.69	0.0333
Month	11	74.75	<.0001	44.55	<.0001
Longitude/latitude	16	90.62	<.0001	354.18	<.0001
Depth	5	123.75	<.0001	387.53	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



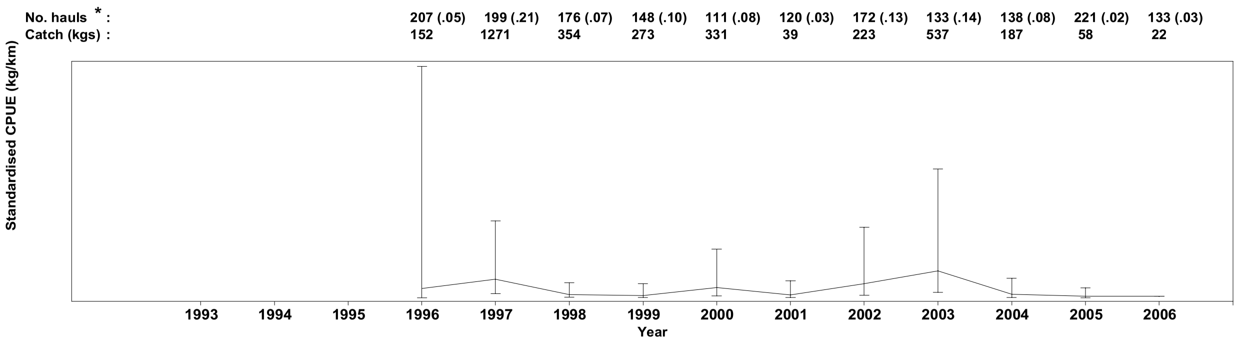
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

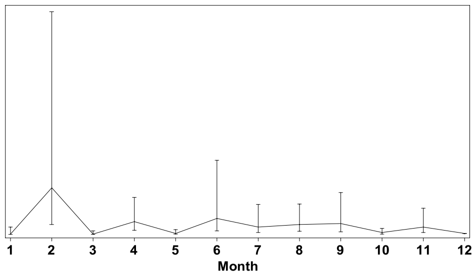
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	3.398	2.569	4.495
2001	2.530	1.969	3.251
2002	1.899	1.487	2.426
2003	1.910	1.476	2.470
2004	2.349	1.801	3.064
2005	1.612	1.256	2.070
2006	1.019	1.019	1.019

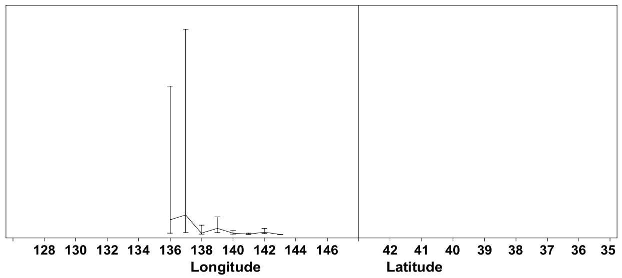
Raw catch and effort

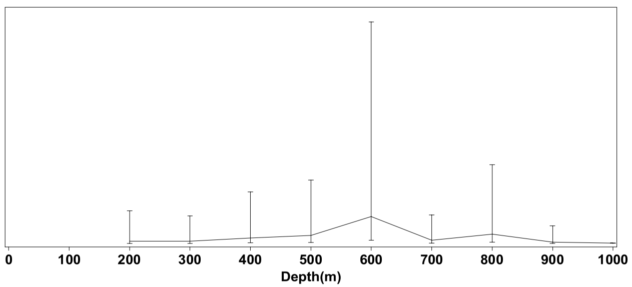
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.480	408	8274	3146	2.630
2001	0.487	478	8410	4244	1.982
2002	0.470	487	10060	4235	2.376
2003	0.414	374	9288	3664	2.535
2004	0.507	416	9277	4122	2.250
2005	0.480	431	7701	4224	1.823
2006	0.423	324	3940	3510	1.122
Mean	0.466	417	8136	3878	2.098

Fig. 3.16a. Gulper shark (*Centrophorus* spp) 1996–06 SETF 200–1100 m depth western region (longitude 136–144°)









Gulper shark (unspecified) Fishery: SETF

Scientific name: Centrophorus spp
CAAB code: 37020001 37020009-11 37020902

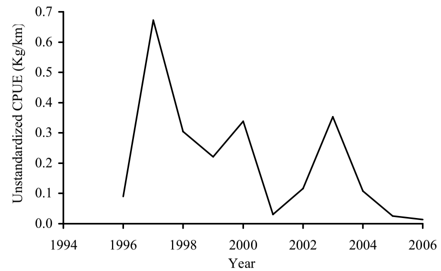
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.42
Model fit criterion: scaled Pearson chisq/df = 1.55
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	9	12.54	ns	43.73	<.0001
Month	10	30.18	0.0008	20.80	0.0355
Longitude/latitude	7	42.43	<.0001	64.62	<.0001
Depth	8	27.05	0.0007	151.62	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



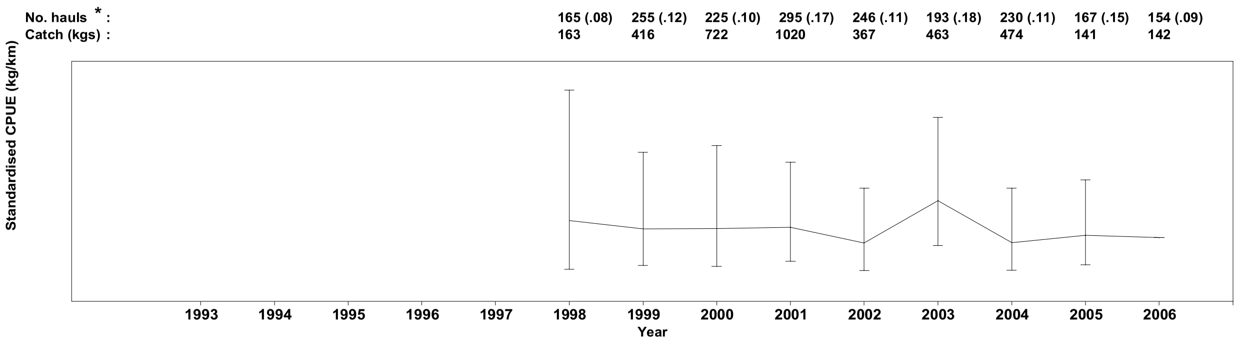
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

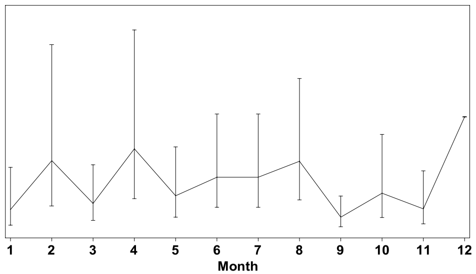
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996	0.224	0.009	5.414
1997	0.440	0.107	1.809
1998	0.085	0.020	0.356
1999	0.060	0.011	0.334
2000	0.244	0.052	1.148
2001	0.073	0.013	0.401
2002	0.334	0.068	1.651
2003	0.635	0.133	3.019
2004	0.089	0.017	0.460
2005	0.044	0.008	0.242
2006	0.045	0.045	0.045

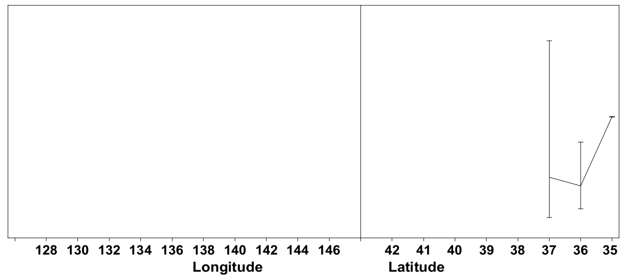
Raw catch and effort

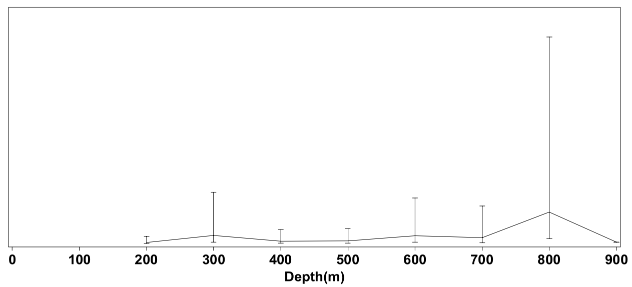
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996	0.048	207	152	1688	0.090
1997	0.211	199	1271	1889	0.673
1998	0.074	176	354	1163	0.304
1999	0.101	148	273	1236	0.221
2000	0.081	111	331	978	0.338
2001	0.033	120	39	1284	0.030
2002	0.134	172	223	1923	0.116
2003	0.143	133	537	1518	0.354
2004	0.080	138	187	1740	0.107
2005	0.018	221	58	2298	0.025
2006	0.030	133	22	1645	0.013
Mean	0.087	160	313	1578	0.199

Fig. 3.16b. Gulper shark (*Centrophorus* spp) 1998–06 SETF 0–1000 m depth eastern region (longitude 148–151° E, latitude <38° S)









Gulper shark (unspecified)

Fishery: SETF

Scientific name: Centrophorus spp
CAAB code: 37020001 37020009-11 37020902

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.03
Model fit criterion: scaled Pearson chisq/df = 1.67
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	8	10.14	ns	21.15	0.0068
Month	11	19.88	0.0470	46.12	<.0001
Longitude/latitude	2	2.01	ns	12.82	0.0016
Depth	7	75.90	<.0001	126.22	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

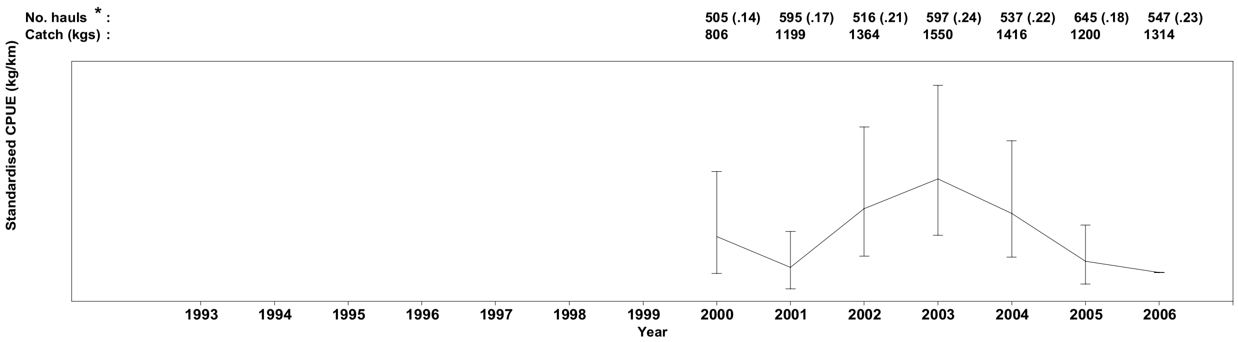
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

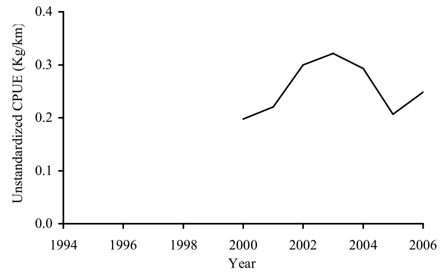
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998	0.275	0.103	0.739
1999	0.246	0.117	0.517
2000	0.248	0.113	0.542
2001	0.251	0.131	0.482
2002	0.196	0.098	0.390
2003	0.346	0.187	0.642
2004	0.196	0.099	0.390
2005	0.223	0.119	0.420
2006	0.216	0.216	0.216

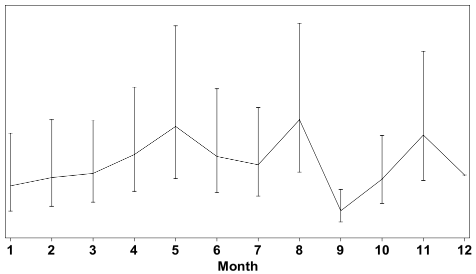
Raw catch and effort

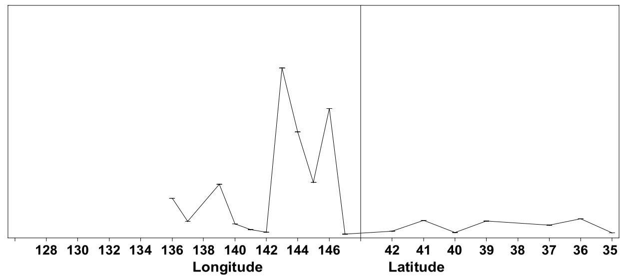
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998	0.085	165	164	1526	0.107
1999	0.118	255	416	2195	0.189
2000	0.102	225	722	1471	0.491
2001	0.173	295	1020	2214	0.461
2002	0.106	246	367	1634	0.225
2003	0.176	193	463	1649	0.281
2004	0.113	230	474	1877	0.253
2005	0.150	167	141	1533	0.092
2006	0.091	154	142	1438	0.099
Mean	0.124	214	434	1726	0.252

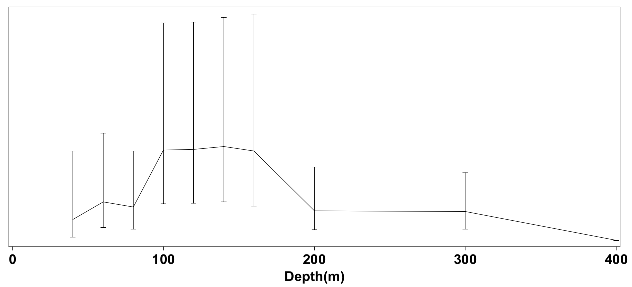
Fig. 4.01a. Banded stingaree (*Urolophus cruciatus*) 2000–06 Otter trawl 0–400 m depth southern Australia (longitude 136–151° E)











Banded stingaree

Fishery: trawl

Scientific name: Urolophus cruciatus
CAAB code: 37038002

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.99
Model fit criterion: scaled Pearson chisq/df = 1.22
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	6	16.91	0.0096	34.12	<.0001
Month	11	26.08	0.0063	92.14	<.0001
Longitude/latitude	17	97.46	<.0001	224.88	<.0001
Depth	9	40.99	<.0001	243.22	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

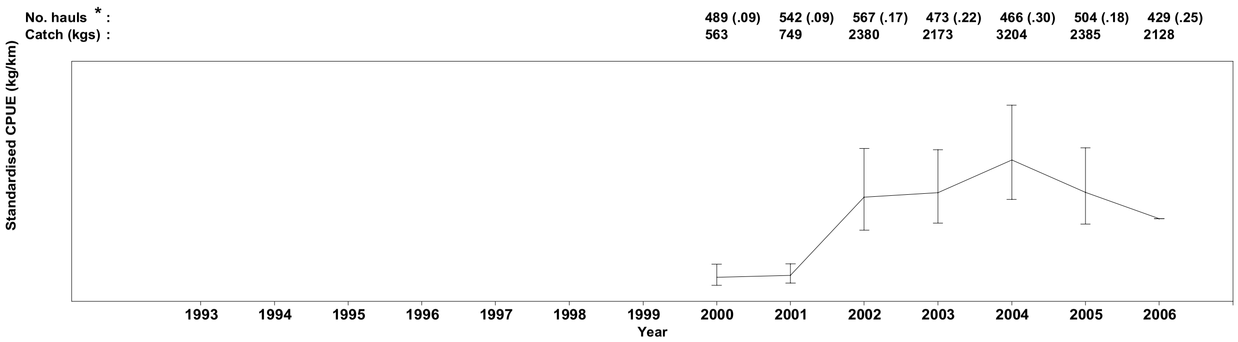
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

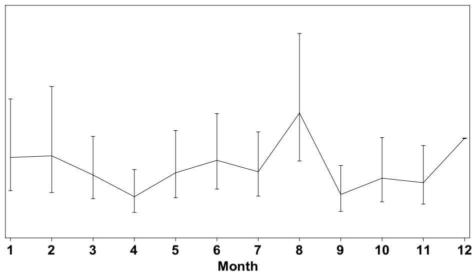
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	0.248	0.140	0.438
2001	0.158	0.095	0.263
2002	0.330	0.191	0.569
2003	0.417	0.252	0.690
2004	0.315	0.188	0.528
2005	0.176	0.110	0.282
2006	0.143	0.143	0.143

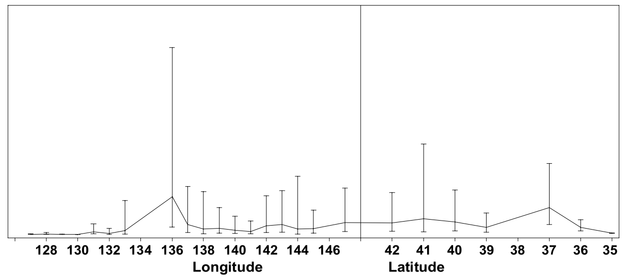
Raw catch and effort

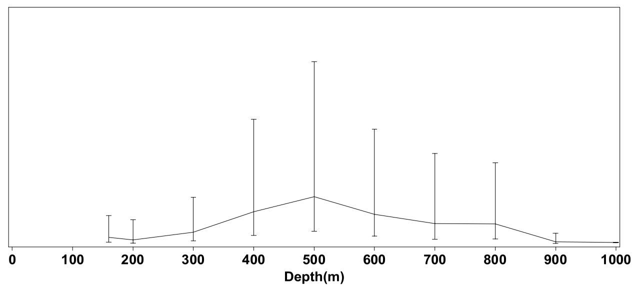
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.137	505	806	4079	0.198
2001	0.168	595	1199	5437	0.221
2002	0.207	516	1364	4556	0.299
2003	0.243	597	1550	4827	0.321
2004	0.220	537	1416	4836	0.293
2005	0.175	645	1200	5803	0.207
2006	0.234	547	1315	5291	0.248
Mean	0.198	563	1264	4975	0.254

Fig. 4.02a. Bight skate (Dipturus *gudgeri*) 2000–06 Otter trawl 160–1000 m depth southern Australia (longitude 126–151° E)









Bight skate

Fishery: trawl

Scientific name: Dipturus gudgeri
CAAB code: 37031010

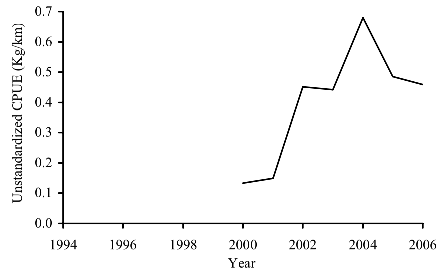
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.02
Model fit criterion: scaled Pearson chisq/df = 1.01
Interannual trend: increasing P = 0.0029

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	6	25.84	0.0002	124.04	<.0001
Month	11	20.94	0.0340	22.79	0.0189
Longitude/latitude	22	74.65	<.0001	179.36	<.0001
Depth	9	64.22	<.0001	397.19	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



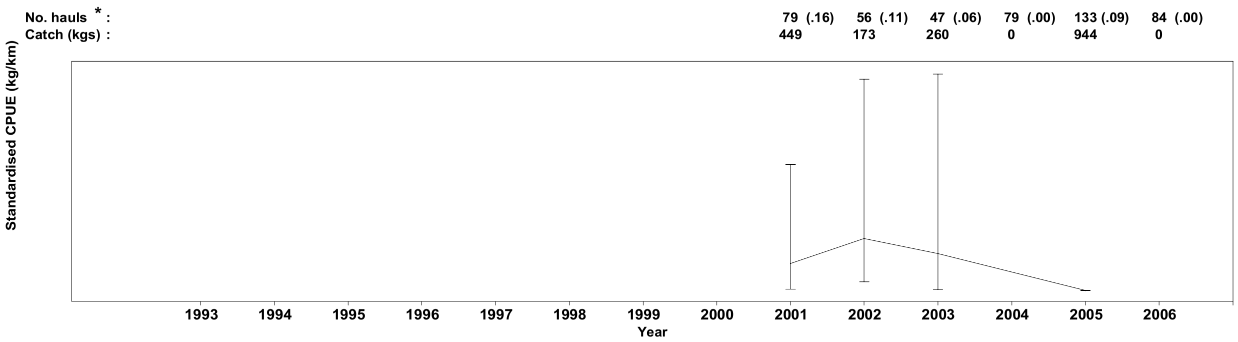
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

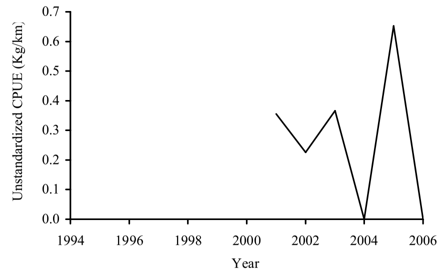
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	0.102	0.062	0.166
2001	0.112	0.074	0.168
2002	0.493	0.332	0.732
2003	0.515	0.366	0.725
2004	0.674	0.482	0.943
2005	0.516	0.362	0.734
2006	0.388	0.388	0.388

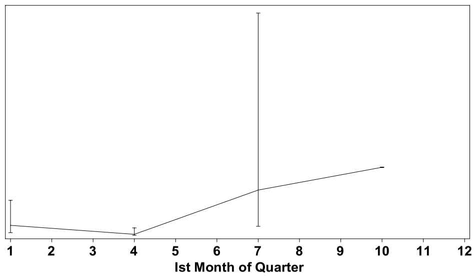
Raw catch and effort

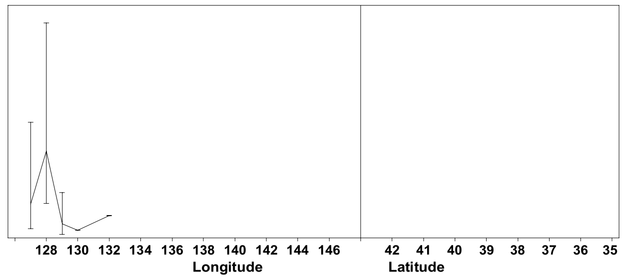
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.094	489	563	4220	0.133
2001	0.094	542	749	5036	0.149
2002	0.175	567	2380	5265	0.452
2003	0.220	473	2173	4920	0.442
2004	0.305	466	3204	4714	0.680
2005	0.183	504	2386	4918	0.485
2006	0.252	429	2128	4636	0.459
Mean	0.189	496	1940	4816	0.403

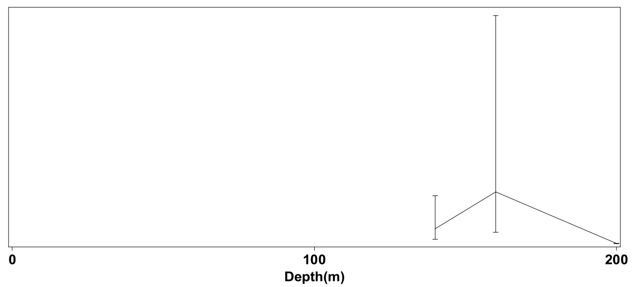
Fig. 4.03a. Black stingray (*Dasyatis thetidis*) 2000–06 GABTF 120–200 m depth Great Australian Bight (longitude 127–132° E)











Black stingray Fishery: trawl

Scientific name: Dasyatis thetidis
CAAB code: 37035002

Model: cpue = year + quarter + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.52
Model fit criterion: scaled Pearson chisq/df = 1.27
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	0	0.00	.	40.48	<.0001
Month	0	0.00	.	10.24	0.0166
Longitude/latitude	3	25.31	<.0001	8.79	ns
Depth	2	19.90	<.0001	4.35	ns

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

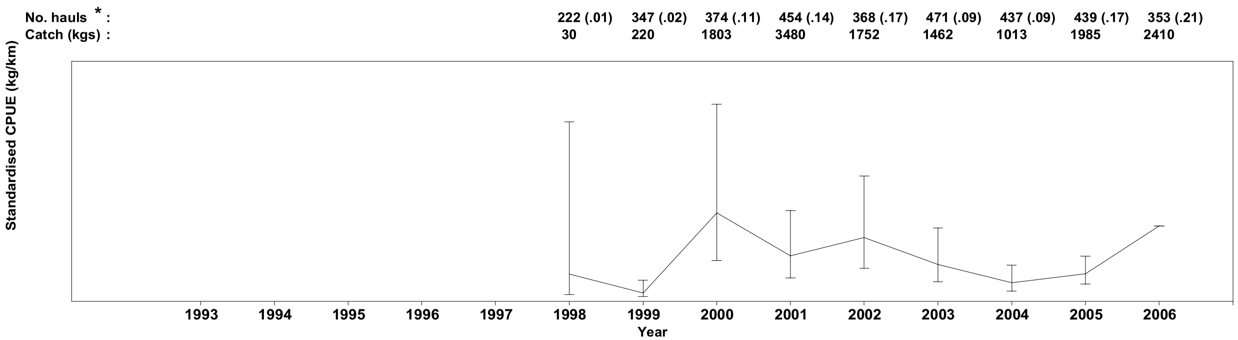
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

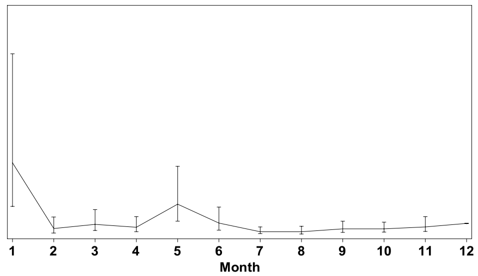
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001	0.251	0.065	0.975
2002	0.435	0.119	1.595
2003	0.324	0.064	1.633
2004			
2005	0.056	0.056	0.056
2006			

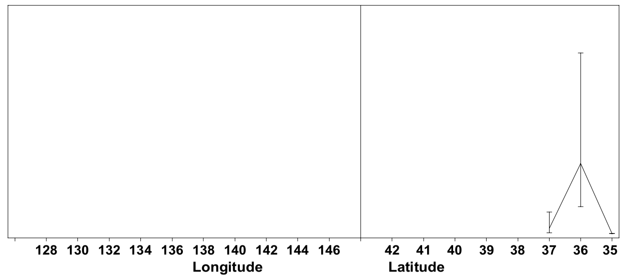
Raw catch and effort

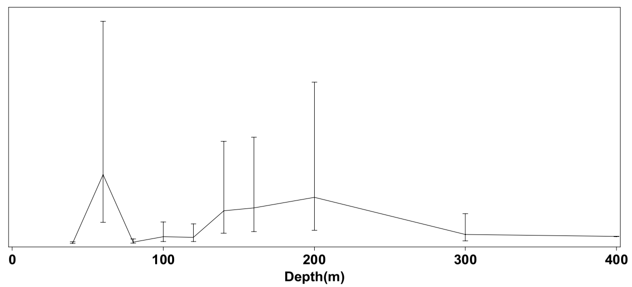
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001	0.165	79	449	1264	0.355
2002	0.107	56	173	767	0.225
2003	0.064	47	260	709	0.367
2004	0.000	79	0	1314	0.000
2005	0.090	133	944	1446	0.653
2006	0.000	84	0	1092	0.000
Mean	0.071	80	304	1099	0.277

Fig. 4.03b. Black stingray (*Dasyatis thetidis*) 1998–06 SETF 0–400 m depth eastern region (longitude 148–151° E, latitude <38°S)









Black stingray

Fishery: SETF

Scientific name: Dasyatis thetidis
CAAB code: 37035002

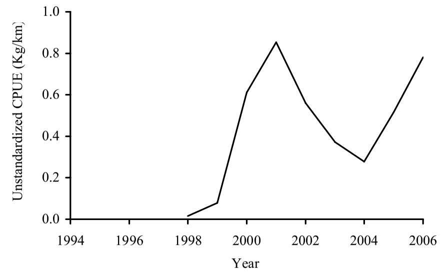
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.00
Model fit criterion: scaled Pearson chisq/df = 1.14
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	8	29.40	0.0003	142.55	<.0001
Month	11	56.42	<.0001	90.10	<.0001
Longitude/latitude	2	84.68	<.0001	21.10	<.0001
Depth	9	137.59	<.0001	76.92	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



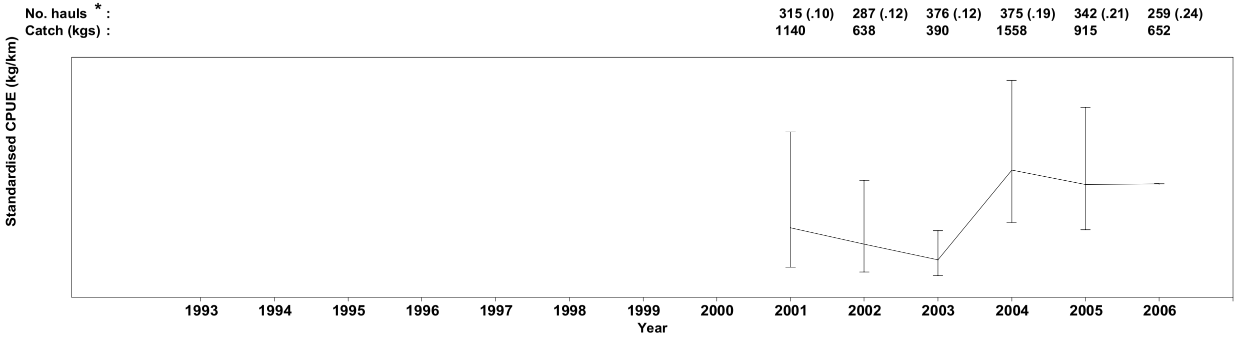
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

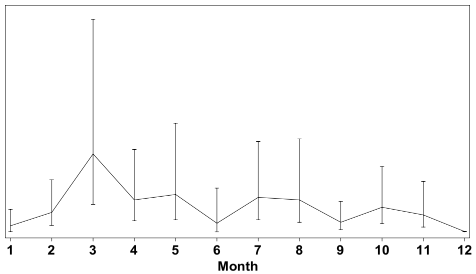
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998	0.270	0.037	1.974
1999	0.057	0.016	0.202
2000	0.953	0.418	2.171
2001	0.472	0.228	0.977
2002	0.676	0.334	1.367
2003	0.378	0.182	0.785
2004	0.172	0.080	0.369
2005	0.273	0.159	0.469
2006	0.809	0.809	0.809

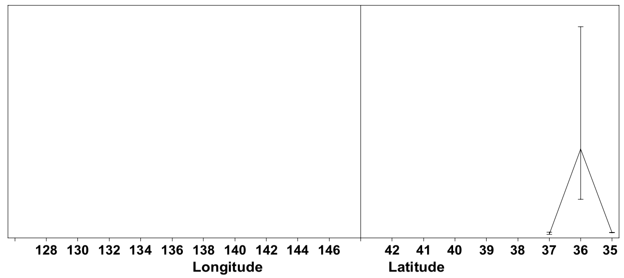
Raw catch and effort

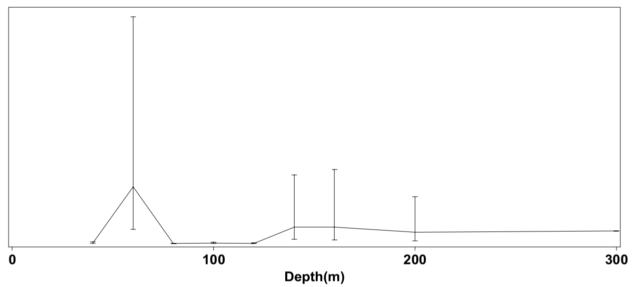
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998	0.014	222	30	2009	0.015
1999	0.023	347	220	2801	0.079
2000	0.112	374	1803	2950	0.611
2001	0.139	454	3480	4079	0.853
2002	0.168	368	1752	3131	0.560
2003	0.093	471	1462	3938	0.371
2004	0.092	437	1013	3657	0.277
2005	0.173	439	1985	3855	0.515
2006	0.210	353	2410	3089	0.780
Mean	0.114	385	1573	3279	0.480

Fig. 4.04a. Common stingaree (*Trygonoptera testacea*) 2001–06 SETF 0–300 m depth eastern region (longitude 148–151° E, latitude <38°S)









Common stingaree

Fishery: SETF

Scientific name: Trygonoptera testacea
CAAB code: 37038006

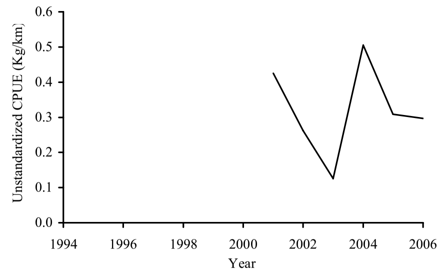
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.93
Model fit criterion: scaled Pearson chisq/df = 2.00
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	5	18.74	0.0022	23.21	0.0003
Month	11	45.10	<.0001	28.58	0.0026
Longitude/latitude	1	150.72	<.0001	220.40	<.0001
Depth	8	446.43	<.0001	193.76	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



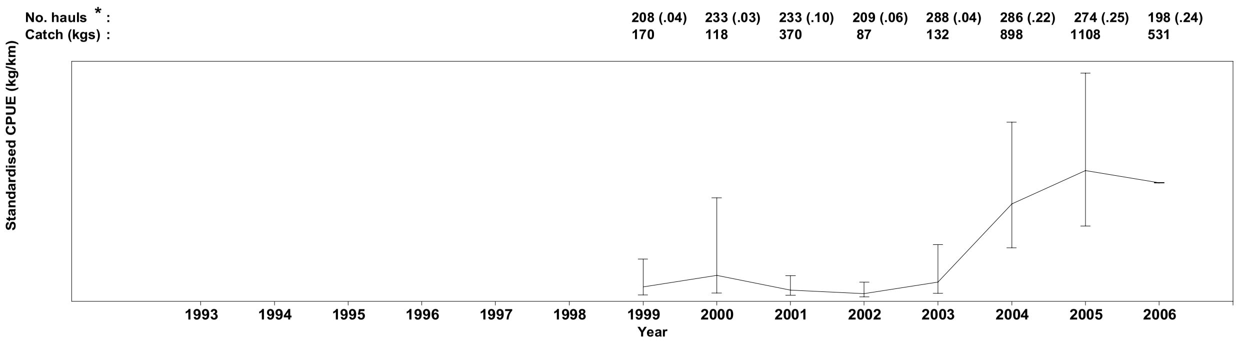
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

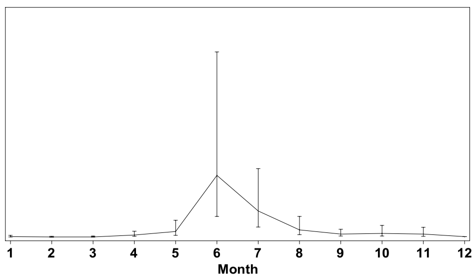
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001	0.258	0.105	0.632
2002	0.195	0.086	0.443
2003	0.134	0.073	0.247
2004	0.482	0.279	0.832
2005	0.427	0.251	0.726
2006	0.429	0.429	0.429

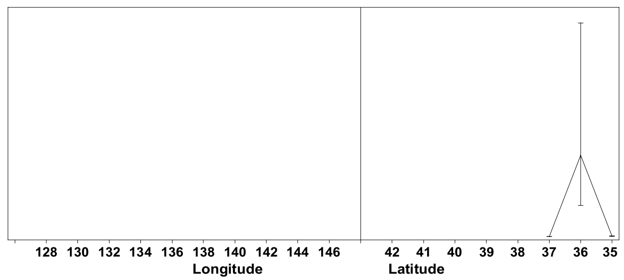
Raw catch and effort

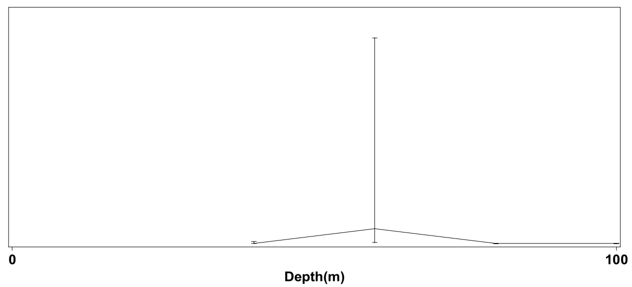
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001	0.098	315	1140	2683	0.425
2002	0.122	287	638	2431	0.262
2003	0.122	376	390	3094	0.126
2004	0.195	375	1558	3082	0.505
2005	0.213	342	915	2967	0.308
2006	0.239	259	652	2194	0.297
Mean	0.165	326	882	2742	0.322

Fig. 4.05a. Eastern shovelnose ray (*Aptychotrema rostrata*) 1999–06 SETF 0–160 m depth eastern region (longitude 148–151° E, latitude <38°S)









Eastern shovelnose ray

Fishery: SETF

Scientific name: Aptychotrema rostrata
CAAB code: 37027009

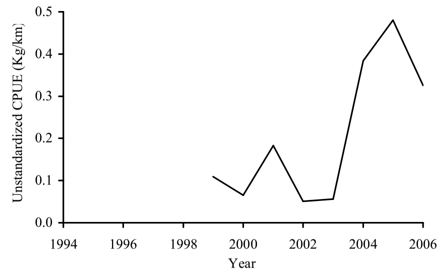
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.82
Model fit criterion: scaled Pearson chisq/df = 0.71
Interannual trend: increasing P = <.0001

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	7	17.67	0.0136	153.53	<.0001
Month	11	30.84	0.0012	159.63	<.0001
Longitude/latitude	2	109.07	<.0001	6.94	0.0312
Depth	6	289.25	<.0001	221.66	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



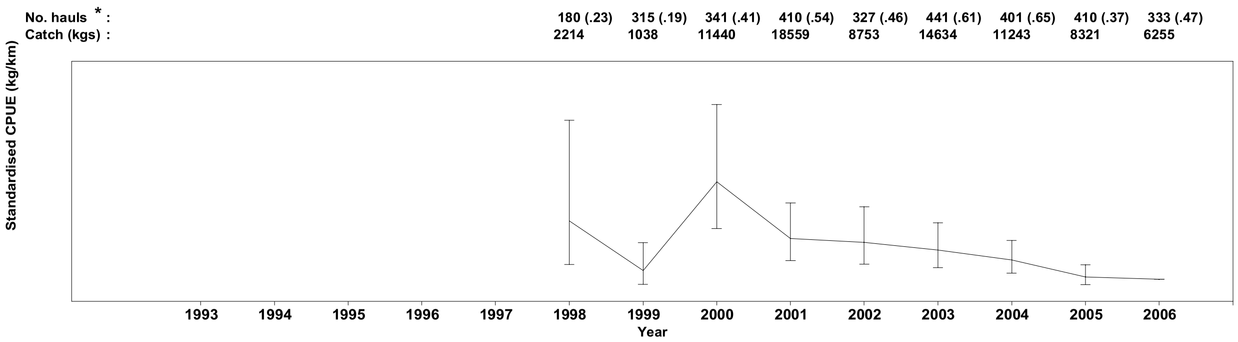
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

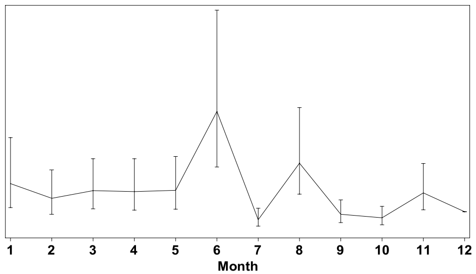
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999	0.047	0.013	0.162
2000	0.094	0.021	0.416
2001	0.033	0.012	0.093
2002	0.019	0.005	0.066
2003	0.066	0.019	0.221
2004	0.390	0.208	0.729
2005	0.527	0.298	0.932
2006	0.478	0.478	0.478

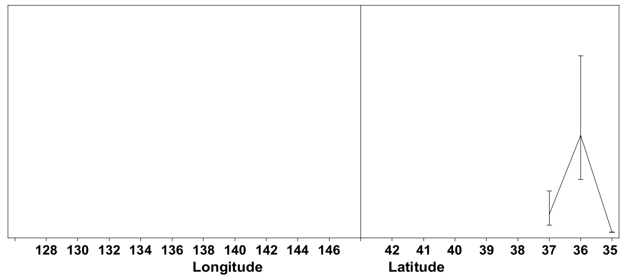
Raw catch and effort

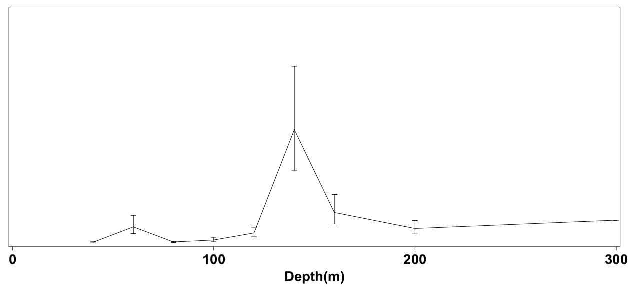
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999	0.043	208	170	1557	0.109
2000	0.026	233	118	1814	0.065
2001	0.099	233	370	2027	0.182
2002	0.057	209	87	1722	0.051
2003	0.038	288	132	2337	0.056
2004	0.224	286	898	2340	0.384
2005	0.252	274	1108	2308	0.480
2006	0.237	198	531	1631	0.326
Mean	0.122	241	427	1967	0.217

Fig. 4.06a. Greenback stingaree (*Urolophus viridis*) 1998–06 SETF 0–300 m depth eastern region (longitude 149–151°E, latitude <38°S)









Greenback stingaree

Fishery: SETF

Scientific name: Urolophus viridis
CAAB code: 37038007

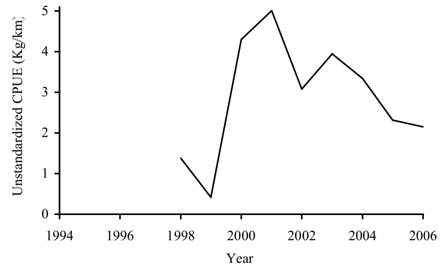
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.02
Model fit criterion: scaled Pearson chisq/df = 1.82
Interannual trend: decreasing P = 0.0026

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	8	115.24	<.0001	291.37	<.0001
Month	11	104.02	<.0001	25.62	0.0074
Longitude/latitude	2	134.98	<.0001	171.84	<.0001
Depth	8	268.03	<.0001	173.03	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



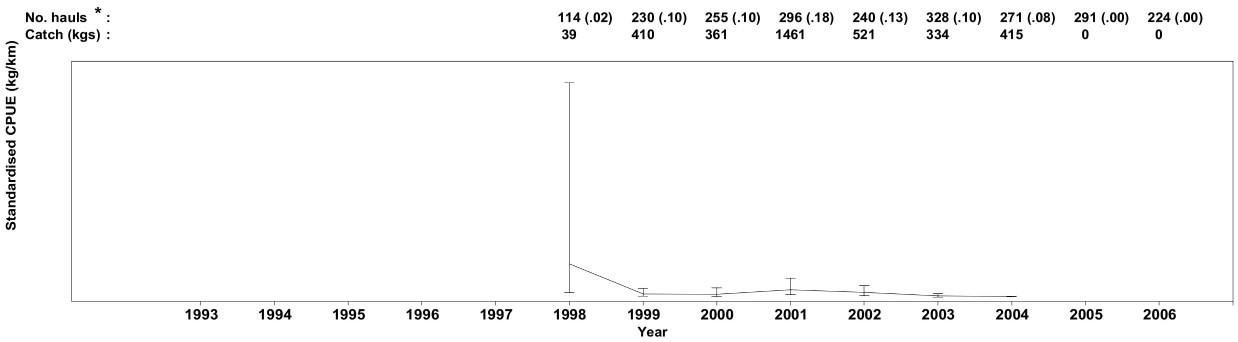
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

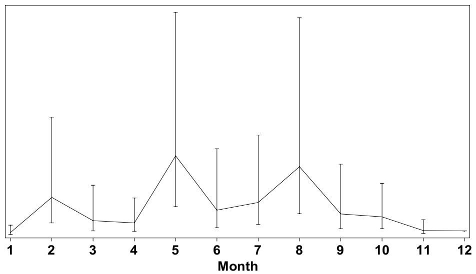
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998	4.339	1.890	9.960
1999	1.549	0.771	3.109
2000	6.507	3.904	10.847
2001	3.348	2.105	5.325
2002	3.121	1.903	5.118
2003	2.686	1.713	4.214
2004	2.130	1.402	3.235
2005	1.192	0.759	1.872
2006	1.047	1.047	1.047

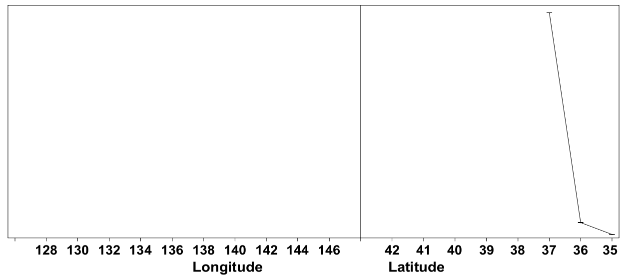
Raw catch and effort

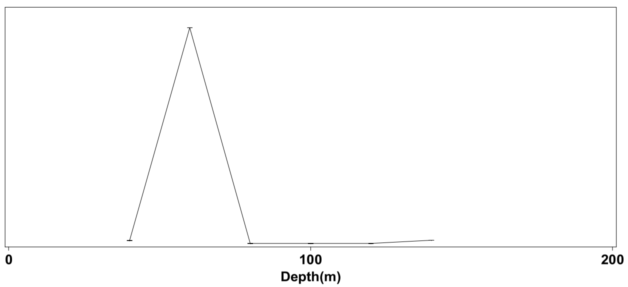
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998	0.228	180	2214	1611	1.375
1999	0.187	315	1039	2508	0.414
2000	0.411	341	11440	2662	4.297
2001	0.537	410	18559	3706	5.007
2002	0.462	327	8753	2842	3.080
2003	0.612	441	14634	3711	3.943
2004	0.648	401	11244	3368	3.339
2005	0.368	410	8322	3593	2.316
2006	0.474	333	6255	2914	2.146
Mean	0.436	351	9162	2991	3.064

Fig. 4.07a. Longnose skate (*Dipturus* sp A) 1998–06 SETF 0–140 m depth eastern region (longitude 148–151°E, latitude <38°S)









Longnose skate

Fishery: SETF

Scientific name: Dipturus sp a
CAAB code: 37031005

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.79
Model fit criterion: scaled Pearson chisq/df = 0.81
Interannual trend: decreasing P = 0.0438

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	6	47.27	<.0001	196.98	<.0001
Month	11	13.14	ns	57.18	<.0001
Longitude/latitude	1	95.55	<.0001	150.80	<.0001
Depth	5	319.70	<.0001	71.44	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

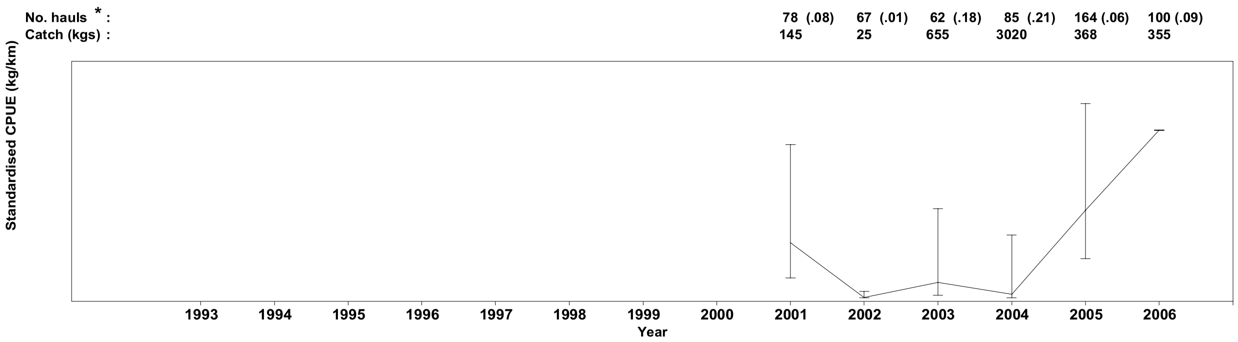
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

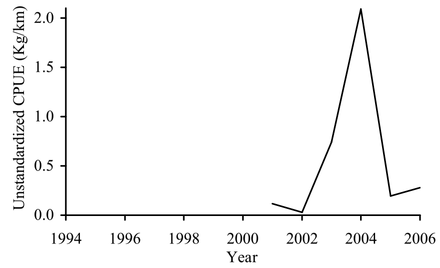
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998	0.689	0.109	4.352
1999	0.085	0.037	0.199
2000	0.078	0.029	0.210
2001	0.170	0.072	0.403
2002	0.115	0.052	0.254
2003	0.046	0.023	0.092
2004	0.029	0.029	0.029
2005			
2006			

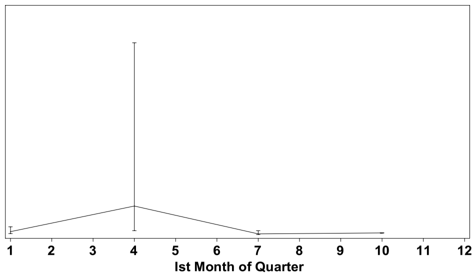
Raw catch and effort

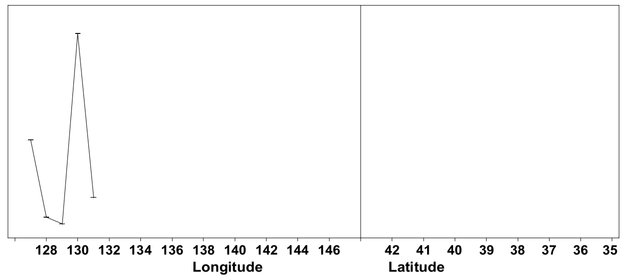
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998	0.018	114	39	1034	0.038
1999	0.104	230	410	1868	0.219
2000	0.102	255	361	2073	0.174
2001	0.179	296	1461	2659	0.549
2002	0.133	240	521	1981	0.263
2003	0.104	328	334	2613	0.128
2004	0.077	271	415	2217	0.187
2005	0.000	291	0	2519	0.000
2006	0.000	224	0	1987	0.000
Mean	0.080	250	393	2106	0.187

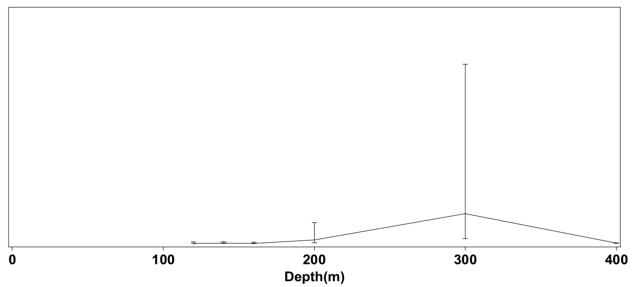
Fig. 4.08a. Melbourne skate (*Dipturus whitleyi*) 2001–06 GABTF 160–400 m Great Australian Bight (longitude 127–131° E)











Melbourne skate

Fishery: trawl

Scientific name: Dipturus whitleyi
CAAB code: 37031006

Model: cpue = year + quarter + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.34
Model fit criterion: scaled Pearson chisq/df = 1.33
Interannual trend: increasing P = 0.0071

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	1	2.99	ns	27.05	<.0001
Month	2	6.14	0.0465	9.41	0.0243
Longitude/latitude	4	14.26	0.0065	3.32	ns
Depth	4	26.76	<.0001	24.96	0.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

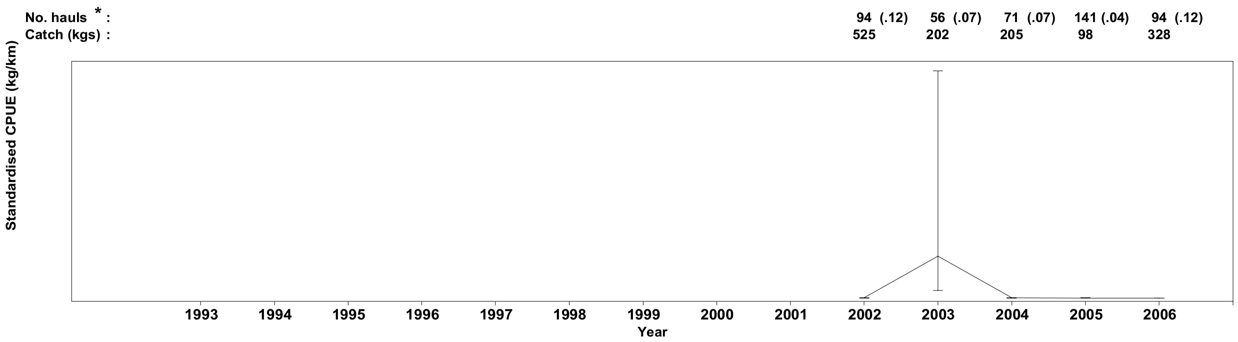
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

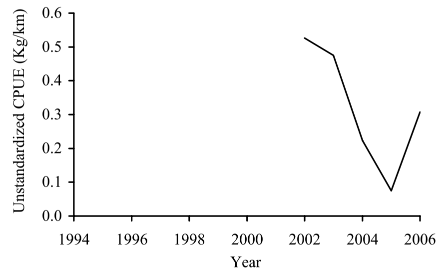
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001	0.578	0.209	1.600
2002	0.005	0.000	0.070
2003	0.164	0.029	0.931
2004	0.040	0.002	0.659
2005	0.914	0.412	2.025
2006	1.750	1.750	1.750

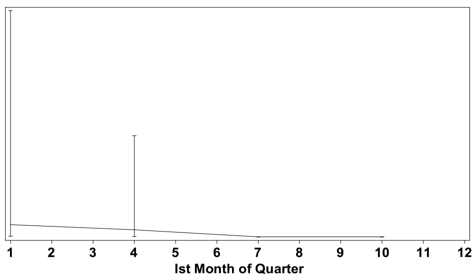
Raw catch and effort

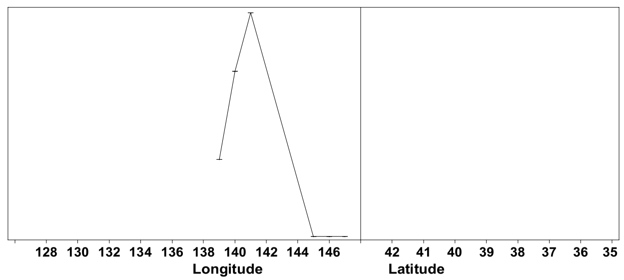
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001	0.077	78	145	1238	0.117
2002	0.015	67	25	899	0.028
2003	0.177	62	655	886	0.739
2004	0.212	85	3020	1444	2.091
2005	0.061	164	368	1878	0.196
2006	0.090	100	355	1265	0.281
Mean	0.105	93	761	1268	0.600

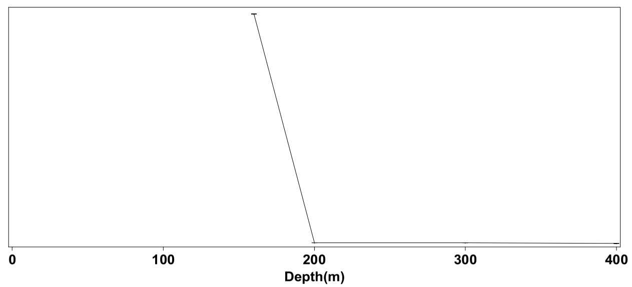
Fig. 4.08b. Melbourne skate (*Dipturus whitleyi*) 2002–06 SETF 0–400 m western region (longitude 138–147° E)











Melbourne skate

Fishery: trawl

Scientific name: Dipturus whitleyi
CAAB code: 37031006

Model: cpue = year + quarter + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.91
Model fit criterion: scaled Pearson chisq/df = 1.93
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	2	50.74	<.0001	1.45	ns
Month	2	2.83	ns	6.17	ns
Longitude/latitude	3	25.47	<.0001	45.00	<.0001
Depth	2	75.33	<.0001	3.74	ns

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

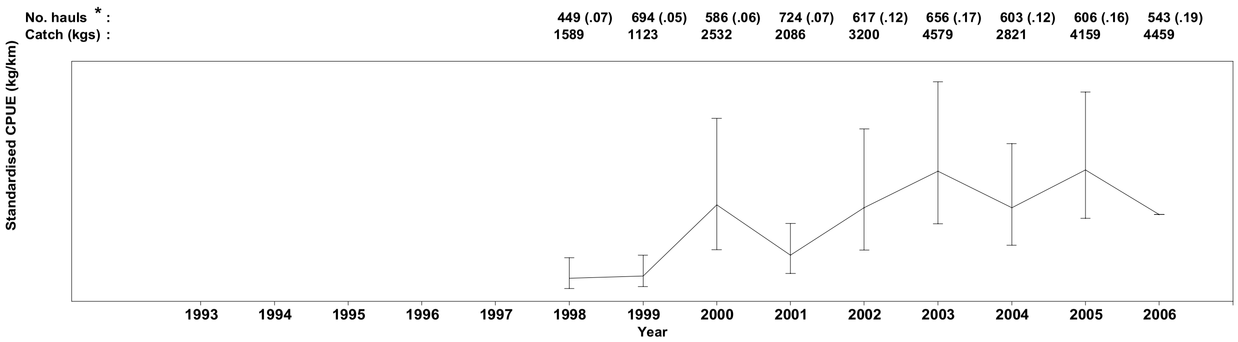
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

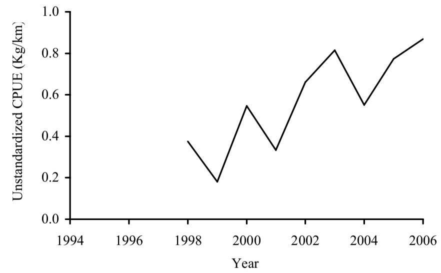
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001			
2002	0.002	0.001	0.008
2003	1.602	0.294	8.714
2004	0.001	0.000	0.008
2005	0.001	0.000	0.005
2006	0.000	0.000	0.000

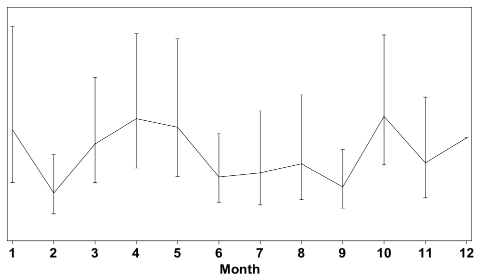
Raw catch and effort

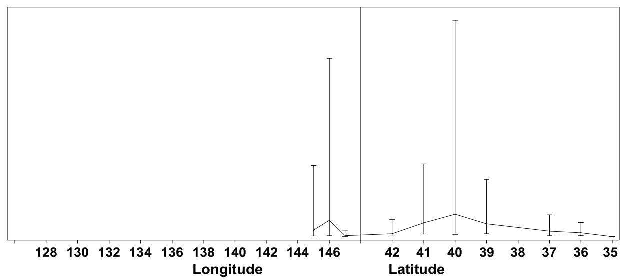
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001					
2002	0.117	94	525	998	0.526
2003	0.071	56	202	426	0.475
2004	0.070	71	205	918	0.223
2005	0.035	141	98	1319	0.074
2006	0.117	94	328	1065	0.308
Mean	0.082	91	272	945	0.287

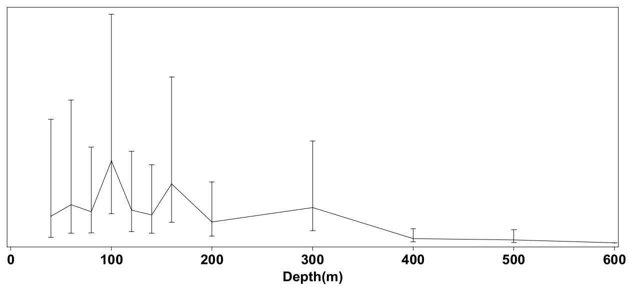
Fig. 4.08c. Melbourne skate (*Dipturus whitleyi*) 1998–06 SETF 0–600 m south-eastern Australia (longitude 145–151° E)











Melbourne skate

Fishery: SETF

Scientific name: Dipturus whitleyi
CAAB code: 37031006

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.99
Model fit criterion: scaled Pearson chisq/df = 1.14
Interannual trend: increasing P = 0.0034

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	8	21.81	0.0053	120.63	<.0001
Month	11	15.45	ns	21.67	0.0271
Longitude/latitude	9	35.28	<.0001	336.05	<.0001
Depth	11	42.82	<.0001	233.12	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

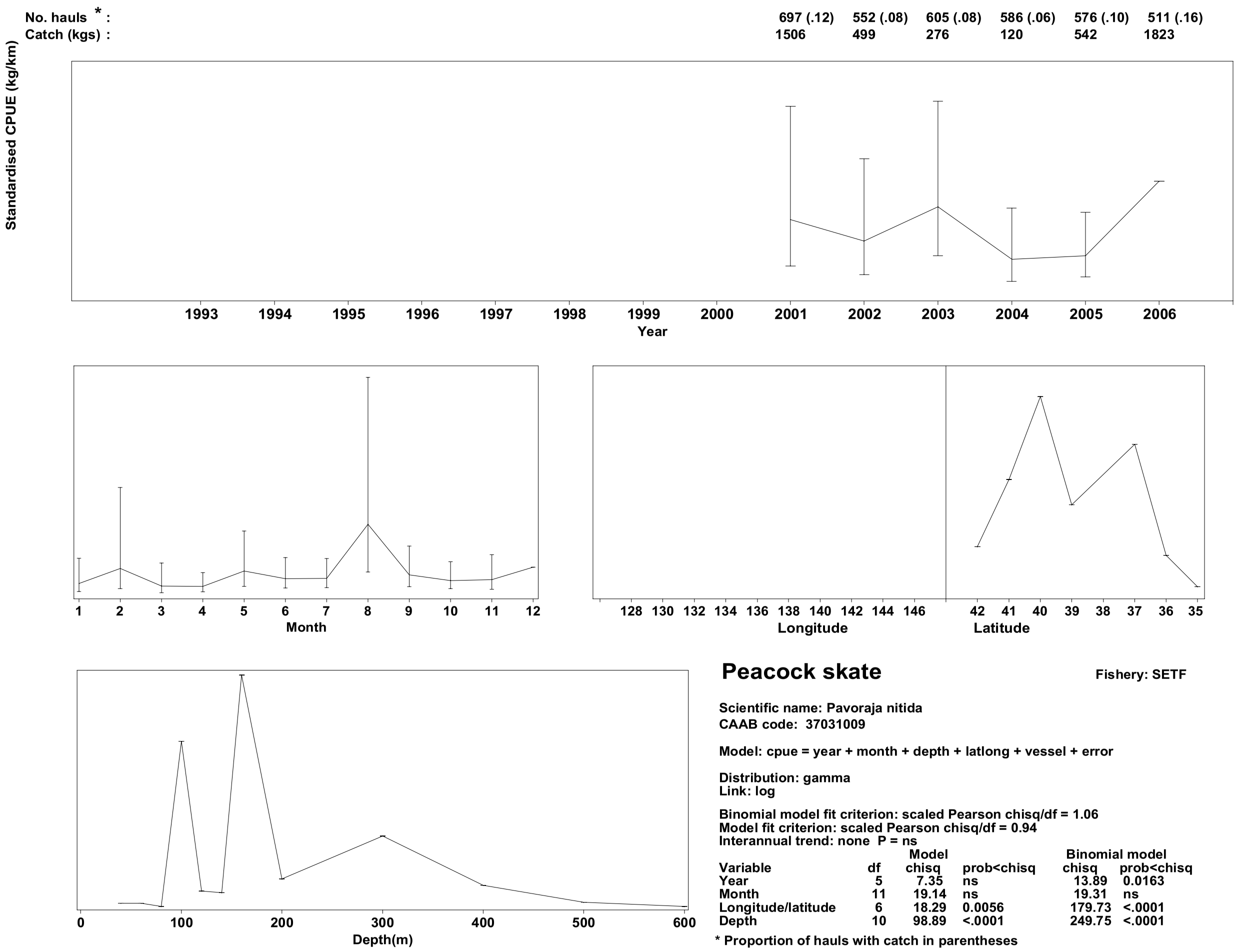
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998	0.146	0.072	0.296
1999	0.162	0.083	0.314
2000	0.682	0.354	1.316
2001	0.314	0.180	0.546
2002	0.660	0.352	1.237
2003	0.929	0.545	1.581
2004	0.661	0.387	1.130
2005	0.938	0.584	1.508
2006	0.612	0.612	0.612

Raw catch and effort

Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998	0.067	449	1589	4241	0.375
1999	0.050	694	1123	6203	0.181
2000	0.063	586	2532	4635	0.546
2001	0.073	724	2086	6264	0.333
2002	0.122	617	3200	4843	0.661
2003	0.172	656	4579	5622	0.815
2004	0.121	603	2821	5116	0.551
2005	0.160	606	4159	5377	0.774
2006	0.192	543	4459	5133	0.869
Mean	0.113	609	2950	5270	0.560

Fig. 4.09a. Peacock skate (*Pavoraja nitida*) 2001–06 SETF 0–600 m depth eastern region (longitude 148–151° E)



Peacock skate

Fishery: SETF

Scientific name: Pavoraja nitida
CAAB code: 37031009

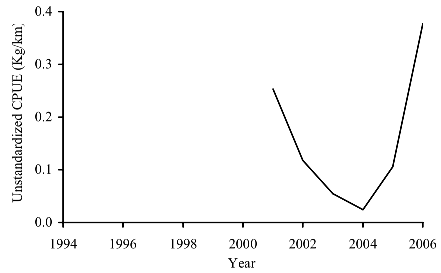
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.06
Model fit criterion: scaled Pearson chisq/df = 0.94
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	5	7.35	ns	13.89	0.0163
Month	11	19.14	ns	19.31	ns
Longitude/latitude	6	18.29	0.0056	179.73	<.0001
Depth	10	98.89	<.0001	249.75	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



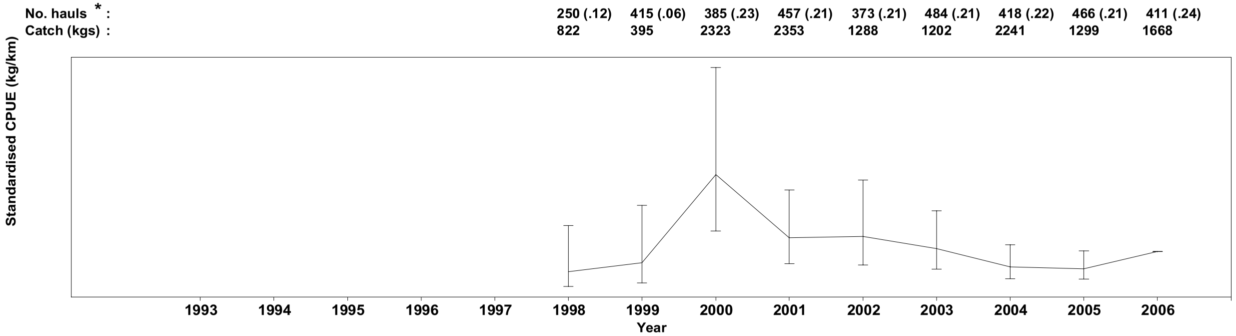
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

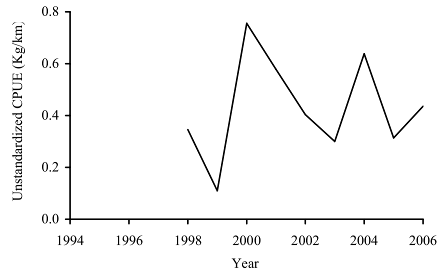
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001	0.172	0.070	0.423
2002	0.125	0.051	0.307
2003	0.201	0.093	0.433
2004	0.085	0.036	0.198
2005	0.093	0.045	0.188
2006	0.257	0.257	0.257

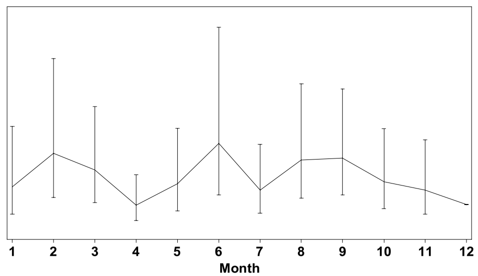
Raw catch and effort

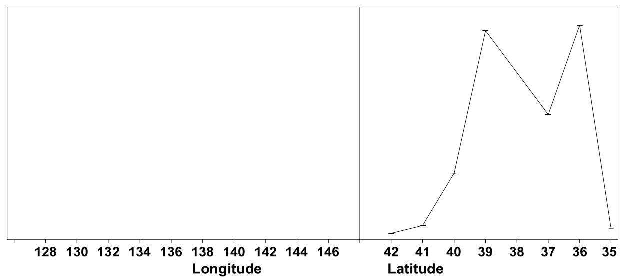
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001	0.119	697	1506	5945	0.253
2002	0.083	552	499	4230	0.118
2003	0.083	605	277	5072	0.055
2004	0.058	586	120	4895	0.025
2005	0.097	576	542	5128	0.106
2006	0.164	511	1824	4837	0.377
Mean	0.101	588	795	5018	0.158

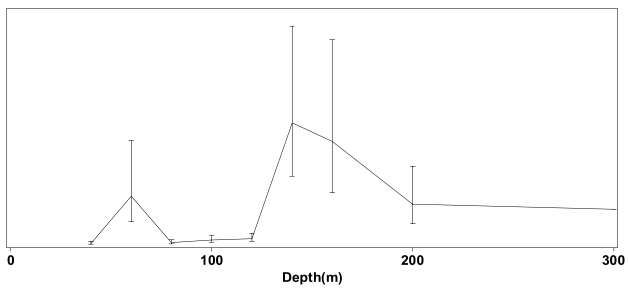
Fig. 4.10a. Sandyback stingaree (*Urolophus bucculentus*) 1998–06 SETF 0–300 m depth eastern region (longitude 148–151° E)











Sandyback stingaree

Fishery: SETF

Scientific name: Urolophus bucculentus
CAAB code: 37038001

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.14
Model fit criterion: scaled Pearson chisq/df = 1.23
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	8	39.56	<.0001	100.08	<.0001
Month	11	17.25	ns	18.94	ns
Longitude/latitude	6	92.24	<.0001	231.66	<.0001
Depth	8	160.53	<.0001	182.06	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

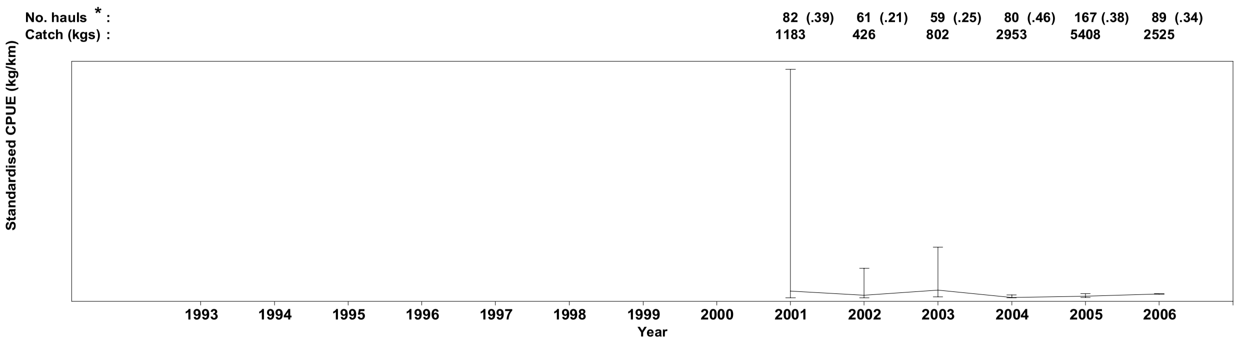
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

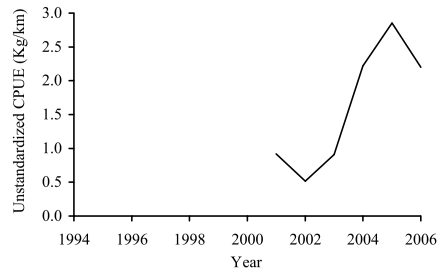
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998	0.203	0.066	0.623
1999	0.281	0.098	0.808
2000	1.089	0.574	2.069
2001	0.511	0.275	0.950
2002	0.523	0.263	1.041
2003	0.413	0.225	0.757
2004	0.246	0.136	0.447
2005	0.228	0.132	0.392
2006	0.386	0.386	0.386

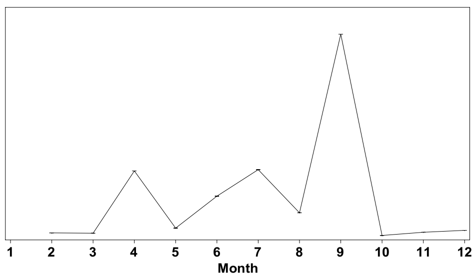
Raw catch and effort

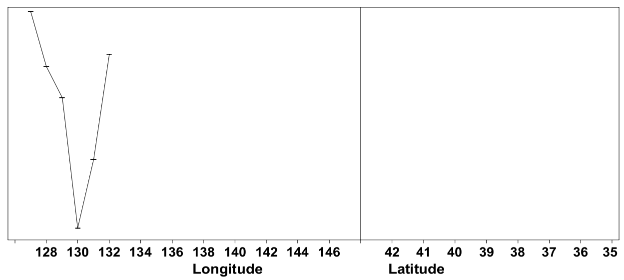
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998	0.116	250	823	2378	0.346
1999	0.055	415	395	3603	0.110
2000	0.226	385	2323	3074	0.756
2001	0.214	457	2353	4064	0.579
2002	0.212	373	1288	3191	0.404
2003	0.207	484	1202	4010	0.300
2004	0.225	418	2241	3511	0.638
2005	0.212	466	1299	4137	0.314
2006	0.243	411	1668	3831	0.435
Mean	0.190	407	1510	3533	0.427

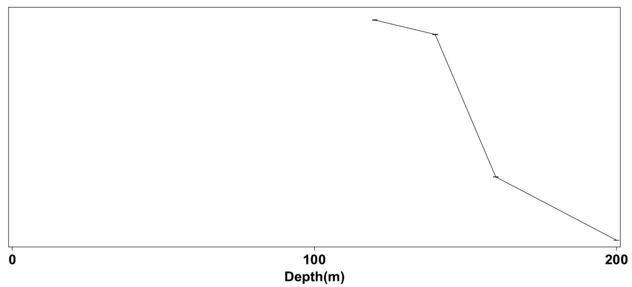
Fig. 4.11a. Smooth stingray (*Dasyatis brevicaudata*) 2001–06 GABTF 0–200 m depth Great Australian Bight (longitude 127–132° E)











Smooth stingray Fishery: trawl

Scientific name: Dasyatis brevicaudata
CAAB code: 37035001

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.71
Model fit criterion: scaled Pearson chisq/df = 0.99
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	5	6.55	ns	4.64	ns
Month	10	13.33	ns	112.94	<.0001
Longitude/latitude	5	24.76	0.0002	37.70	<.0001
Depth	3	13.33	0.0040	31.99	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

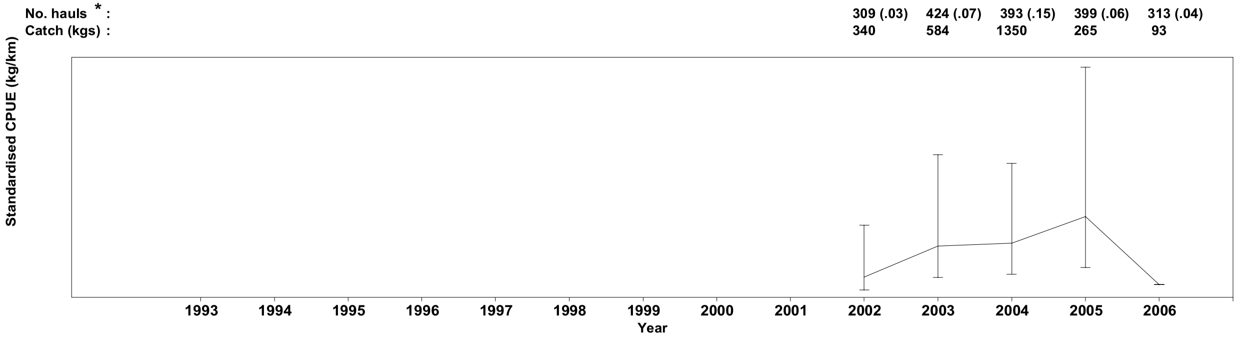
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

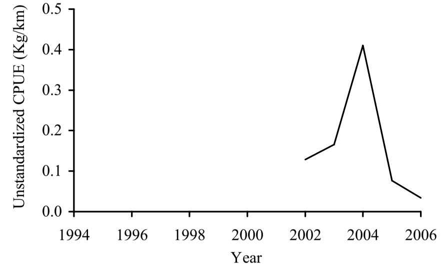
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001	2.764	0.086	88.409
2002	1.132	0.111	11.520
2003	3.126	0.497	19.687
2004	0.297	0.071	1.235
2005	0.708	0.284	1.764
2006	1.592	1.592	1.592

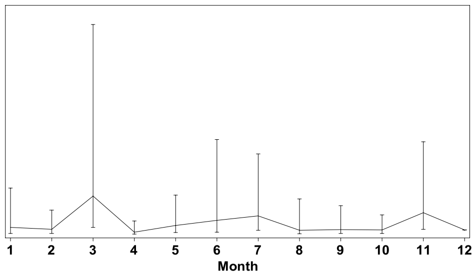
Raw catch and effort

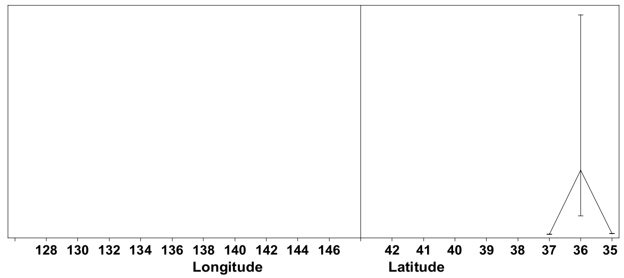
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001	0.390	82	1183	1291	0.916
2002	0.213	61	426	823	0.517
2003	0.254	59	802	881	0.910
2004	0.463	80	2953	1331	2.219
2005	0.383	167	5408	1895	2.854
2006	0.337	89	2525	1147	2.202
Mean	0.340	90	2216	1228	1.805

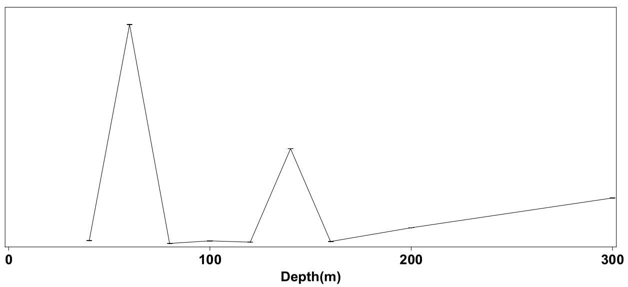
Fig. 4.11b. Smooth stingray (*Dasyatis brevicaudata*) 2002–06 SETF 0–300 m depth eastern region (longitude 149–151° E)











Smooth stingray

Fishery: SETF

Scientific name: Dasyatis brevicaudata
CAAB code: 37035001

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.03
Model fit criterion: scaled Pearson chisq/df = 1.68
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	4	13.27	0.0100	38.93	<.0001
Month	11	18.63	ns	14.96	ns
Longitude/latitude	2	66.94	<.0001	42.66	<.0001
Depth	8	177.46	<.0001	47.68	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

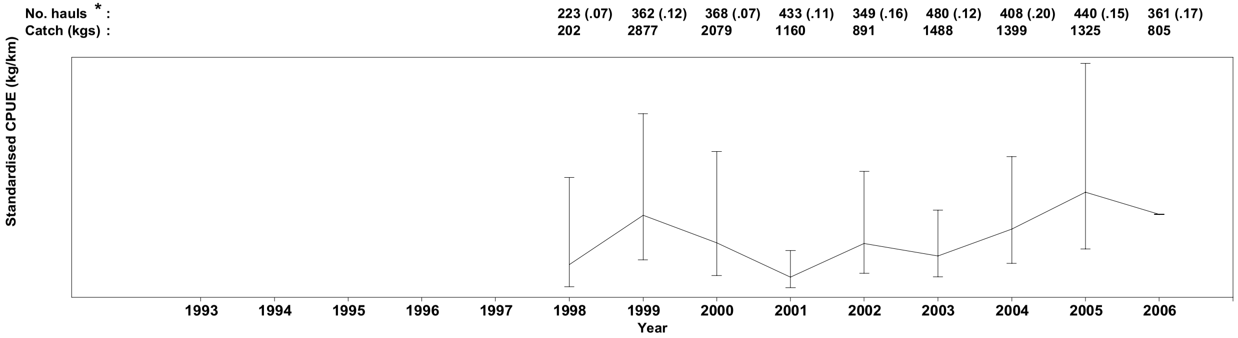
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

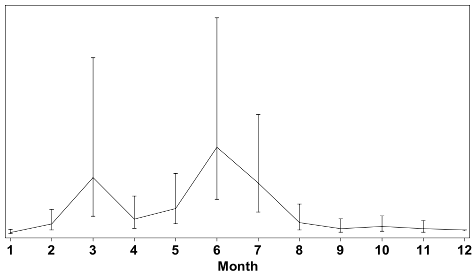
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001			
2002	0.068	0.017	0.275
2003	0.193	0.067	0.558
2004	0.204	0.079	0.523
2005	0.311	0.106	0.907
2006	0.039	0.039	0.039

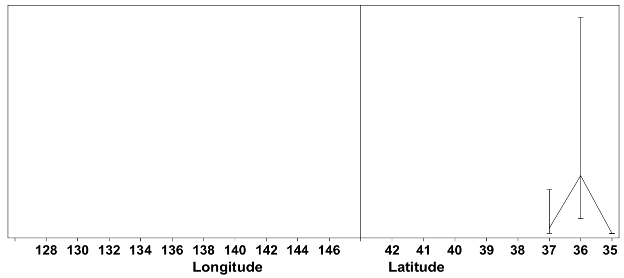
Raw catch and effort

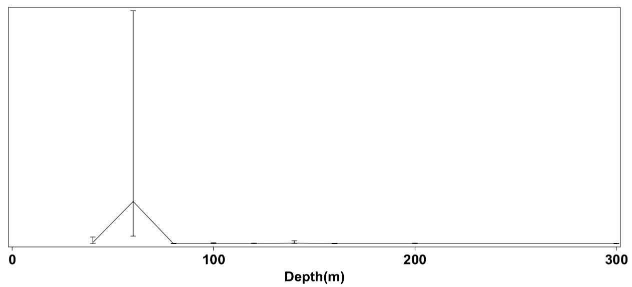
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001					
2002	0.026	309	340	2647	0.128
2003	0.068	424	584	3528	0.166
2004	0.148	393	1350	3289	0.410
2005	0.058	399	265	3480	0.076
2006	0.035	313	93	2730	0.034
Mean	0.067	368	526	3135	0.168

Fig. 4.12a. Southern eagle ray (*Myliobatis australis*) 1998–06 SETF 0–300 m depth eastern region (longitude 148–151°E, latitude <39°S)









Southern eagle ray — Fishery: SETF

Scientific name: Myliobatis australis
CAAB code: 37039001

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.19
Model fit criterion: scaled Pearson chisq/df = 2.11
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	8	13.73	ns	15.36	ns
Month	11	60.75	<.0001	111.22	<.0001
Longitude/latitude	2	50.22	<.0001	47.92	<.0001
Depth	8	290.73	<.0001	608.64	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

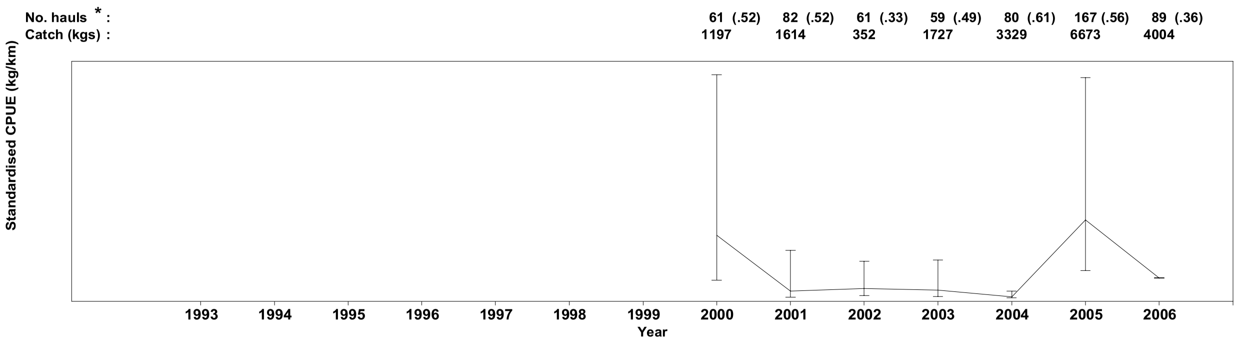
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

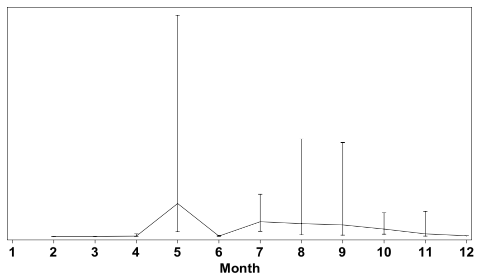
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998	0.216	0.055	0.853
1999	0.576	0.252	1.319
2000	0.377	0.136	1.044
2001	0.123	0.047	0.319
2002	0.369	0.152	0.896
2003	0.279	0.126	0.615
2004	0.476	0.225	1.007
2005	0.746	0.330	1.687
2006	0.583	0.583	0.583

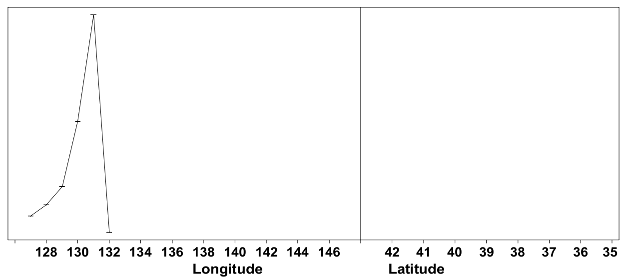
Raw catch and effort

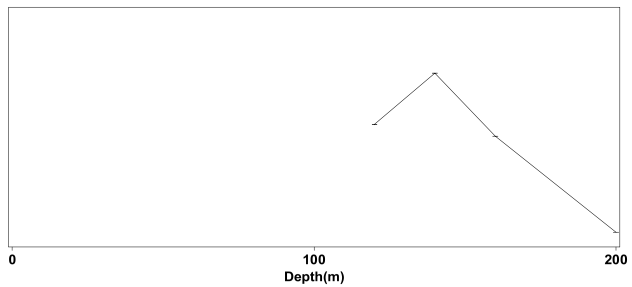
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998	0.067	223	202	2092	0.097
1999	0.124	362	2877	3029	0.950
2000	0.071	368	2079	2893	0.719
2001	0.109	433	1160	3806	0.305
2002	0.158	349	891	2964	0.301
2003	0.117	480	1488	3952	0.377
2004	0.201	408	1399	3399	0.412
2005	0.145	440	1325	3897	0.340
2006	0.172	361	805	3265	0.247
Mean	0.129	380	1358	3255	0.417

Fig. 4.13a. Southern fiddler ray (*Trygonorrhina fasciata*) 2000–06 GABTF 0–200 m depth Great Australian Bight (longitude 127–132° E)









Southern fiddler ray Fishery: trawl

Scientific name: Trygonorrhina fasciata
CAAB code: 37027002

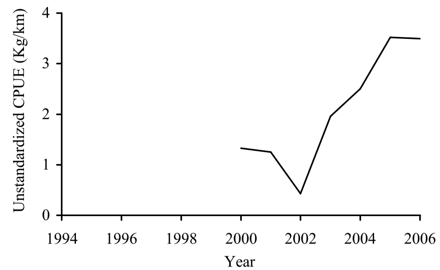
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.88
Model fit criterion: scaled Pearson chisq/df = 1.07
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	6	11.43	ns	20.64	0.0021
Month	10	67.93	<.0001	338.92	<.0001
Longitude/latitude	5	39.87	<.0001	11.50	0.0424
Depth	3	36.56	<.0001	14.01	0.0029

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



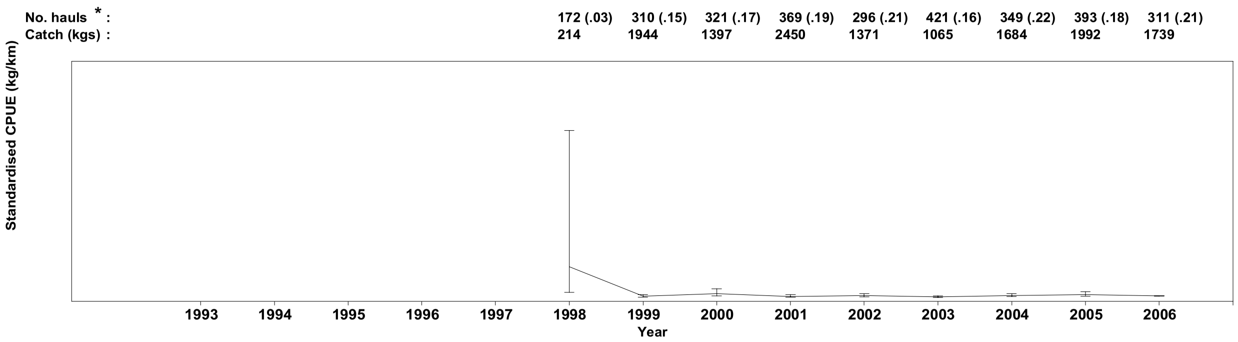
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

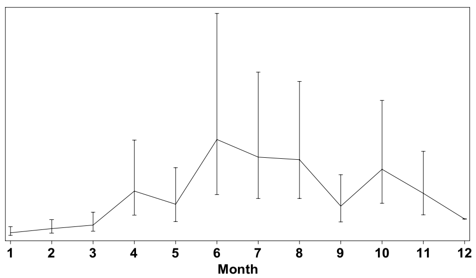
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	4.877	1.378	17.266
2001	0.524	0.074	3.700
2002	0.752	0.198	2.850
2003	0.625	0.132	2.955
2004	0.098	0.018	0.528
2005	6.045	2.141	17.067
2006	1.559	1.559	1.559

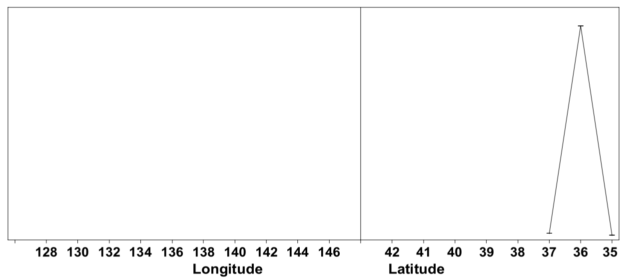
Raw catch and effort

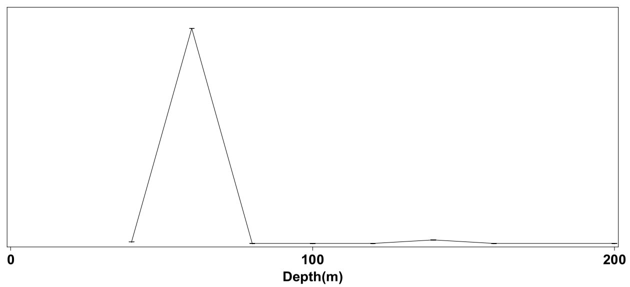
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.525	61	1197	902	1.327
2001	0.524	82	1614	1291	1.250
2002	0.328	61	352	823	0.428
2003	0.492	59	1727	881	1.961
2004	0.613	80	3329	1331	2.502
2005	0.563	167	6673	1895	3.521
2006	0.360	89	4004	1147	3.492
Mean	0.486	86	2699	1181	2.285

Fig. 4.13b. Southern fiddler ray (*Trygonorrhina fasciata*) 2000–06 SETF 0–200 m depth eastern region (longitude 148–151° E, latitude <38° S)









Southern fiddler ray

Fishery: SETF

Scientific name: Trygonorrhina fasciata
CAAB code: 37027002

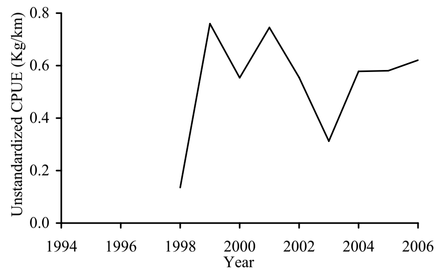
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.27
Model fit criterion: scaled Pearson chisq/df = 0.86
Interannual trend: decreasing P = 0.0435

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	8	79.09	<.0001	48.07	<.0001
Month	11	30.16	0.0015	68.87	<.0001
Longitude/latitude	2	182.54	<.0001	144.10	<.0001
Depth	7	444.60	<.0001	675.95	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



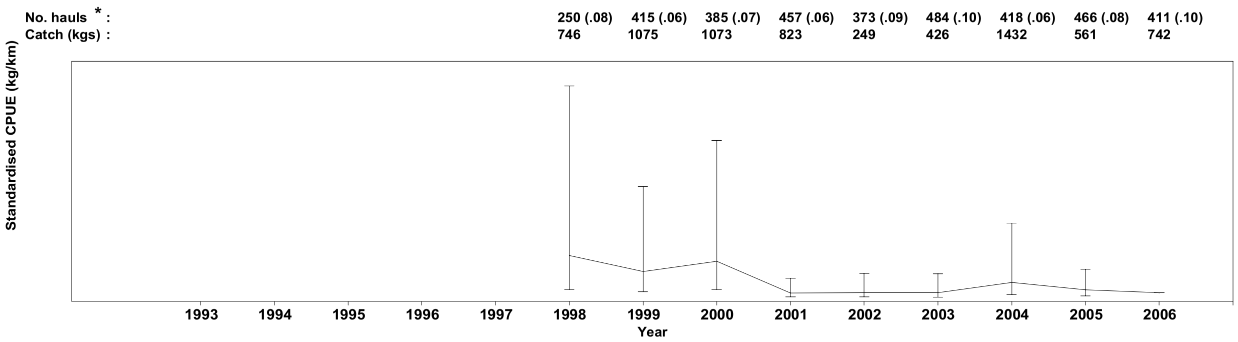
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

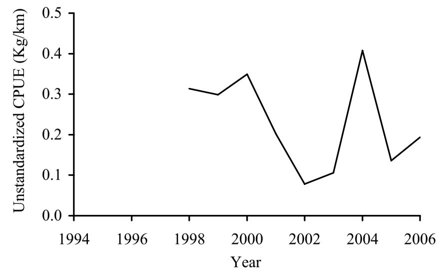
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998	2.959	0.553	15.825
1999	0.171	0.085	0.344
2000	0.435	0.212	0.890
2001	0.160	0.081	0.316
2002	0.221	0.113	0.432
2003	0.112	0.061	0.209
2004	0.238	0.130	0.436
2005	0.324	0.176	0.598
2006	0.218	0.218	0.218

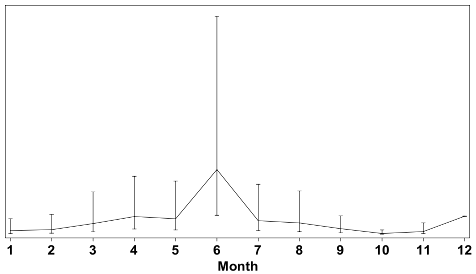
Raw catch and effort

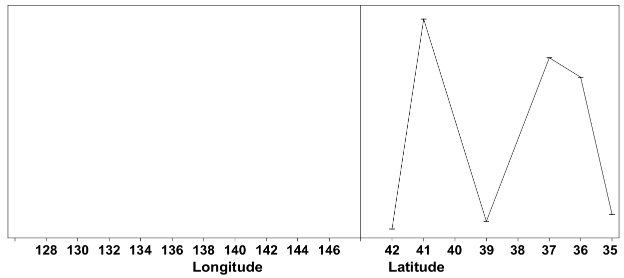
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998	0.029	172	214	1580	0.135
1999	0.148	310	1944	2557	0.760
2000	0.168	321	1397	2525	0.553
2001	0.190	369	2450	3290	0.745
2002	0.213	296	1371	2469	0.555
2003	0.162	421	1065	3414	0.312
2004	0.221	349	1684	2915	0.578
2005	0.178	393	1992	3434	0.580
2006	0.212	311	1739	2804	0.620
Mean	0.169	327	1540	2776	0.554

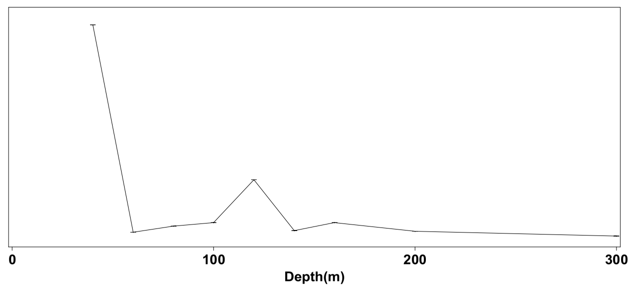
Fig. 4.14a. Sparsely spotted stingaree (*Urolophus paucimaculatus*) 1998–06 SETF 0–300 m depth eastern region (longitude 148–151° E)











Sparsely-spotted stingaree

Fishery: SETF

Scientific name: Urolophus paucimaculatus
CAAB code: 37038004

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.35
Model fit criterion: scaled Pearson chisq/df = 1.21
Interannual trend: decreasing P = 0.0125

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	8	34.16	<.0001	17.95	0.0216
Month	11	31.06	0.0011	86.54	<.0001
Longitude/latitude	5	2.14	ns	160.25	<.0001
Depth	8	29.46	0.0003	165.90	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

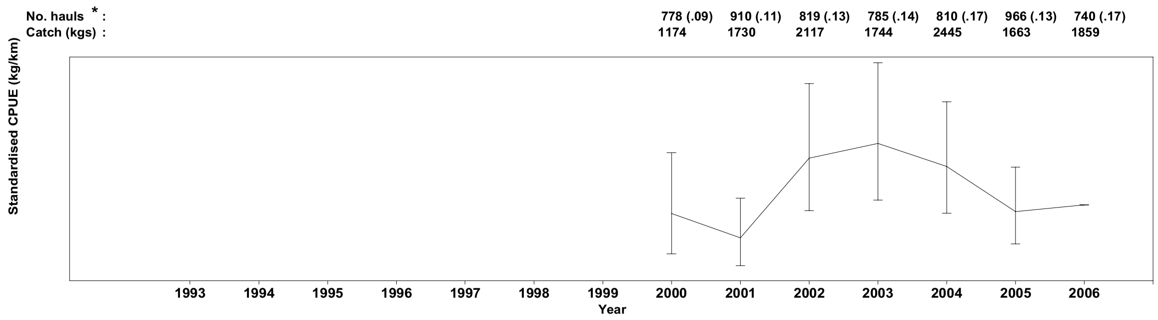
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

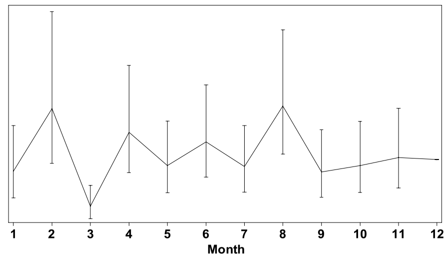
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998	0.589	0.118	2.930
1999	0.365	0.087	1.541
2000	0.510	0.119	2.179
2001	0.070	0.018	0.274
2002	0.075	0.016	0.339
2003	0.073	0.016	0.336
2004	0.218	0.046	1.036
2005	0.112	0.032	0.397
2006	0.073	0.073	0.073

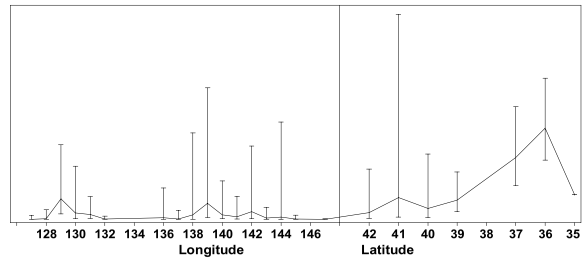
Raw catch and effort

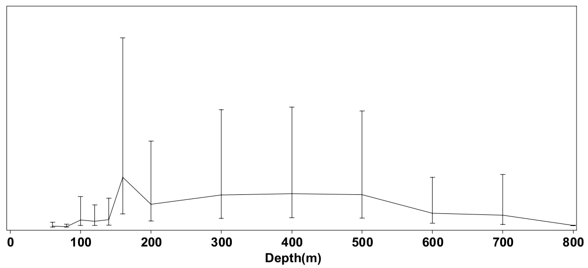
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998	0.084	250	746	2378	0.314
1999	0.055	415	1075	3603	0.298
2000	0.068	385	1073	3074	0.349
2001	0.057	457	823	4064	0.203
2002	0.086	373	250	3191	0.078
2003	0.095	484	426	4010	0.106
2004	0.060	418	1432	3511	0.408
2005	0.082	466	561	4137	0.136
2006	0.102	411	742	3831	0.194
Mean	0.076	407	792	3533	0.224

Fig. 4.15a. Short-tail torpedo ray (*Torpedo macneilli*) 2000–06 otter trawl 60–600 m depth southern Australia (longitude 127–151°E)









Short-tail torpedo ray Fishery: trawl

Scientific name: Torpedo macneilli
CAAB code: 37028003

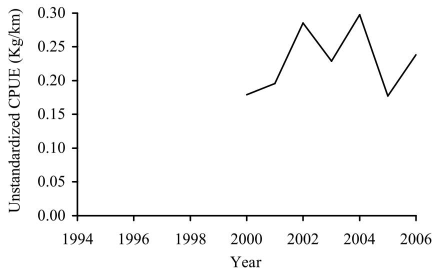
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.05
Model fit criterion: scaled Pearson chisq/df = 1.22
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	6	32.51	<.0001	60.41	<.0001
Month	11	17.68	ns	40.29	<.0001
Longitude/latitude	21	107.37	<.0001	268.40	<.0001
Depth	12	92.01	<.0001	421.99	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



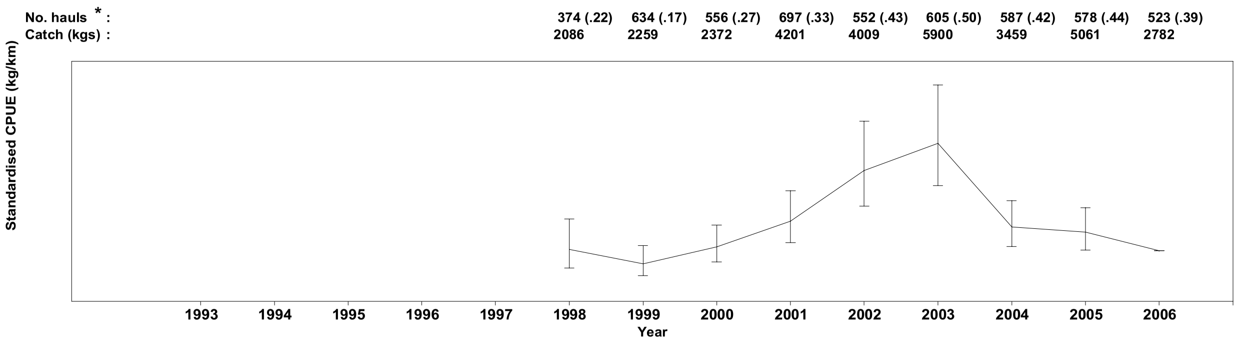
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

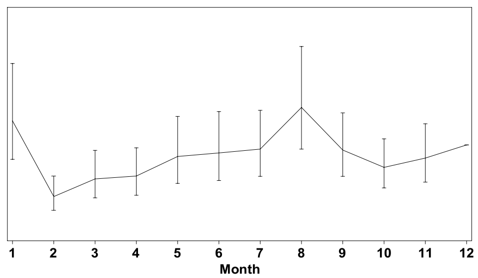
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	0.192	0.127	0.291
2001	0.153	0.108	0.217
2002	0.282	0.197	0.403
2003	0.306	0.214	0.437
2004	0.268	0.193	0.373
2005	0.195	0.143	0.267
2006	0.206	0.206	0.206

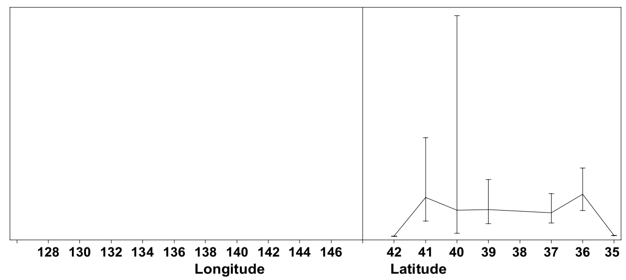
Raw catch and effort

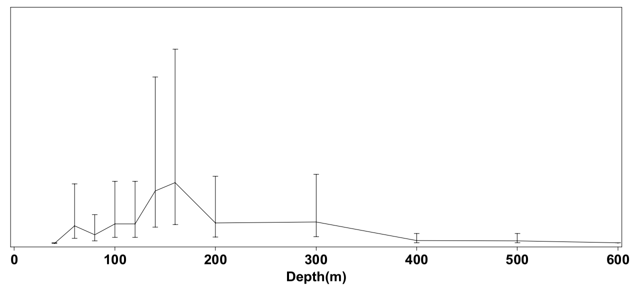
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.089	778	1174	6555	0.179
2001	0.105	910	1730	8842	0.196
2002	0.131	819	2117	7417	0.285
2003	0.138	785	1744	7612	0.229
2004	0.165	810	2445	8213	0.298
2005	0.131	966	1663	9379	0.177
2006	0.174	740	1859	7791	0.239
Mean	0.133	830	1819	7973	0.228

Fig. 4.16a. Sydney skate (*Dipturus australis*) 1998–06 SETF 60–600 m depth eastern region (longitude 148–151° E)









Sydney skate

Fishery: SETF

Scientific name: Dipturus australis
CAAB code: 37031002

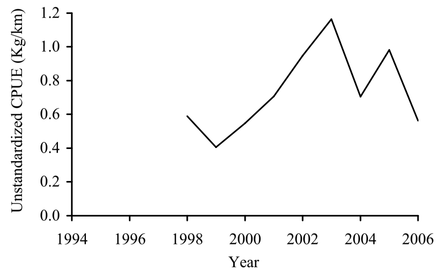
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.04
Model fit criterion: scaled Pearson chisq/df = 1.35
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	8	56.89	<.0001	258.85	<.0001
Month	11	26.09	0.0063	51.67	<.0001
Longitude/latitude	6	194.42	<.0001	119.79	<.0001
Depth	11	172.98	<.0001	1444.11	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



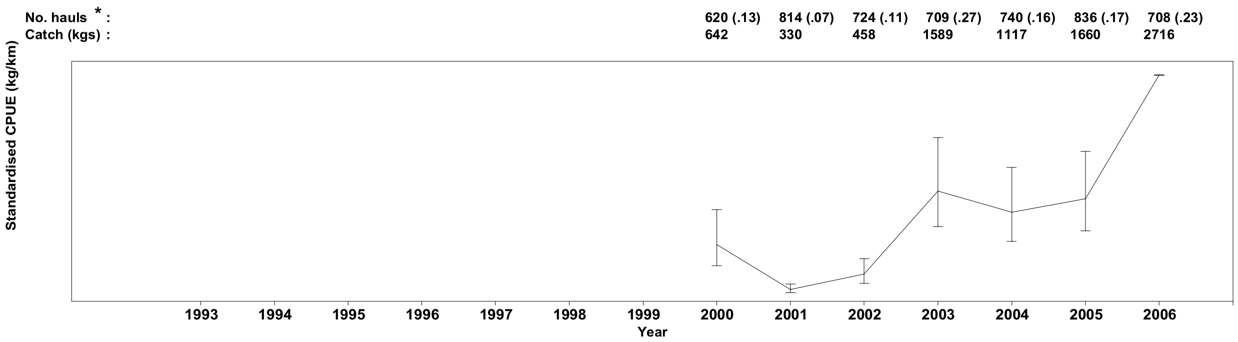
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

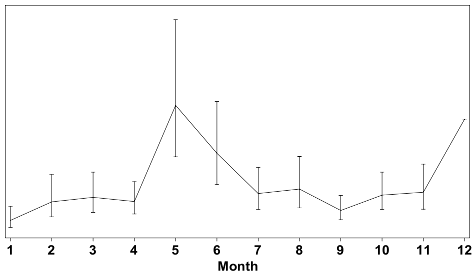
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998	0.476	0.293	0.772
1999	0.335	0.219	0.513
2000	0.500	0.351	0.713
2001	0.751	0.540	1.046
2002	1.242	0.896	1.723
2003	1.509	1.095	2.079
2004	0.692	0.504	0.950
2005	0.642	0.468	0.882
2006	0.463	0.463	0.463

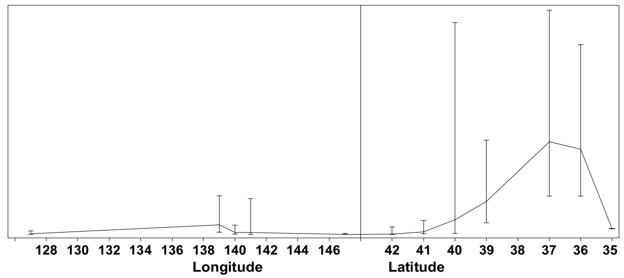
Raw catch and effort

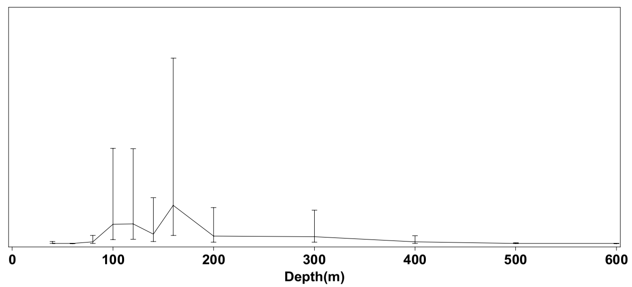
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998	0.219	374	2087	3540	0.589
1999	0.167	634	2259	5580	0.405
2000	0.273	556	2372	4334	0.547
2001	0.331	697	4201	5945	0.707
2002	0.435	552	4009	4230	0.948
2003	0.502	605	5900	5072	1.163
2004	0.421	587	3459	4906	0.705
2005	0.441	578	5061	5151	0.982
2006	0.394	523	2782	4934	0.564
Mean	0.354	567	3570	4855	0.735

Fig. 4.17a. Tasmanian numbfish (*Narcine tasmaniensis*) 2000–06 otter trawl 0–600 m depth southern Australia (longitude 127–151° E)









Tasmanian numbfish Fishery: trawl

Scientific name: Narcine tasmaniensis
CAAB code: 37028002

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.26
Model fit criterion: scaled Pearson chisq/df = 1.16
Interannual trend: increasing P = <.0001

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	6	23.91	0.0005	218.10	<.0001
Month	11	34.74	0.0003	54.06	<.0001
Longitude/latitude	9	51.17	<.0001	825.62	<.0001
Depth	10	160.72	<.0001	573.56	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

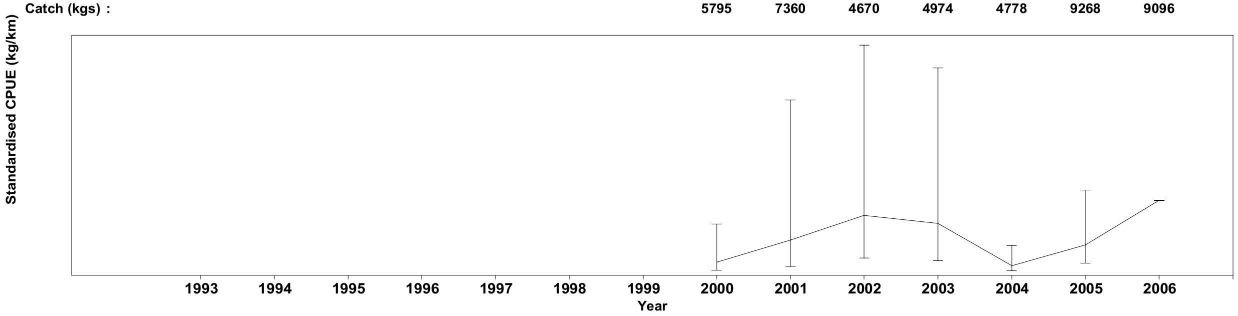
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

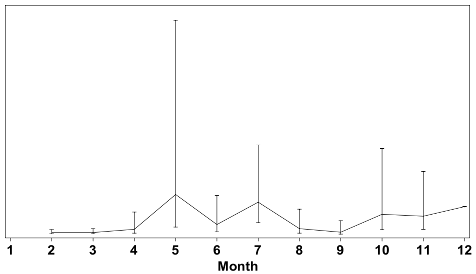
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	0.111	0.067	0.183
2001	0.018	0.011	0.029
2002	0.050	0.030	0.081
2003	0.222	0.148	0.332
2004	0.178	0.117	0.270
2005	0.205	0.139	0.303
2006	0.461	0.461	0.461

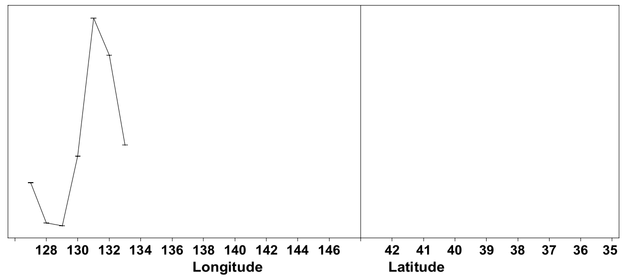
Raw catch and effort

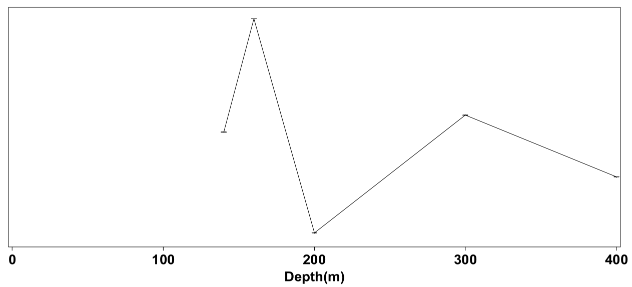
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.126	620	642	5004	0.128
2001	0.071	814	330	7398	0.045
2002	0.106	724	458	6315	0.073
2003	0.265	709	1589	6087	0.261
2004	0.158	740	1118	7052	0.159
2005	0.172	836	1660	8029	0.207
2006	0.233	708	2716	7291	0.373
Mean	0.162	736	1216	6739	0.180

Fig. 4.18a. Wide stingaraee (*Urolophus expansus*) 2000–06 GABTF 120–400 m depth Great Australian Bight (longitude 127–133° E)









Wide stingaree Fishery: trawl

Scientific name: Urolophus expansus
CAAB code: 37038008

Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.18
Model fit criterion: scaled Pearson chisq/df = 1.44
Interannual trend: none P = ns

		Model		Binomial model	
Variable	df	chisq	prob<chisq	chisq	prob<chisq
Year	6	15.49	0.0168	26.29	0.0002
Month	10	54.68	<.0001	104.09	<.0001
Longitude/latitude	6	19.03	0.0041	36.68	<.0001
Depth	4	23.65	<.0001	5.61	ns

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

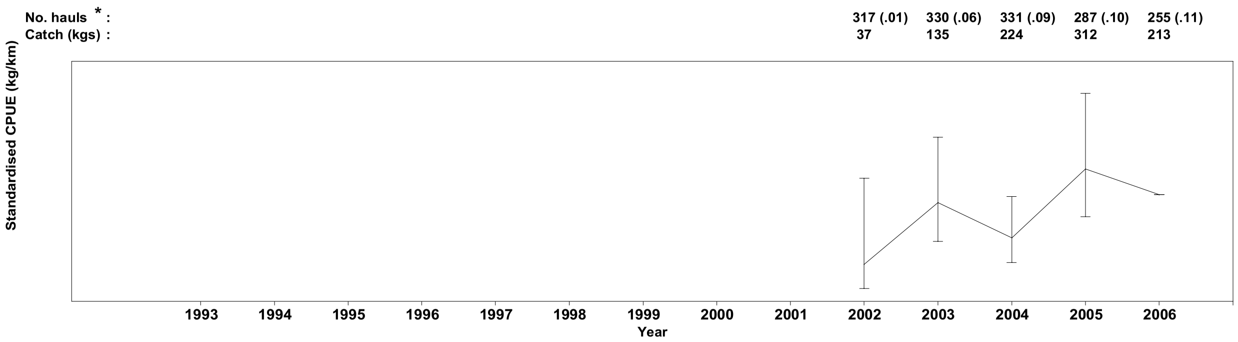
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

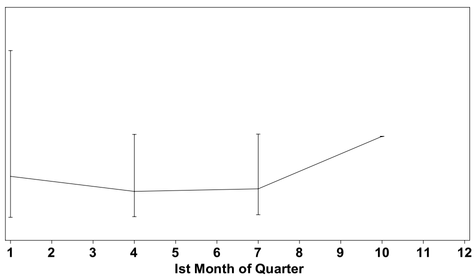
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000	1.569	0.326	7.557
2001	5.031	0.936	27.051
2002	8.924	2.231	35.691
2003	7.629	1.812	32.112
2004	0.988	0.233	4.188
2005	4.282	1.421	12.899
2006	11.288	11.288	11.288

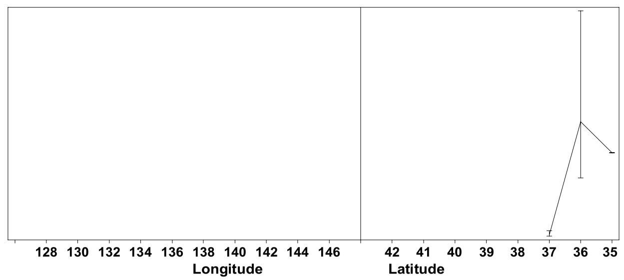
Raw catch and effort

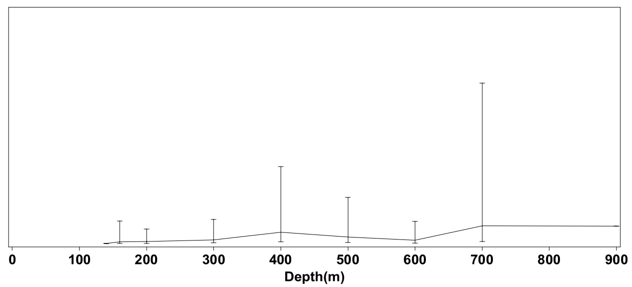
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000	0.726	62	5795	918	6.315
2001	0.563	80	7360	1277	5.765
2002	0.522	67	4670	904	5.165
2003	0.559	59	4974	847	5.873
2004	0.511	90	4778	1527	3.128
2005	0.526	135	9268	1469	6.309
2006	0.460	100	9096	1271	7.157
Mean	0.552	85	6563	1173	5.594

Fig. 5.01a. Blackfin ghostshark (*Hydrolagus lemures*) 2002–06 SETF 140–1000 m depth eastern region (longitude 148–151° E)









Blackfin ghostshark Fishery: SETF

Scientific name: Hydrolagus lemures
CAAB code: 37042003

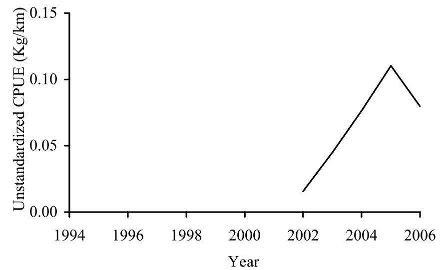
Model: cpue = year + quarter + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 1.00
Model fit criterion: scaled Pearson chisq/df = 1.46
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	4	8.22	ns	80.84	<.0001
Month	3	4.78	ns	8.49	0.0369
Longitude/latitude	1	2.92	ns	90.70	<.0001
Depth	7	37.02	<.0001	140.39	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



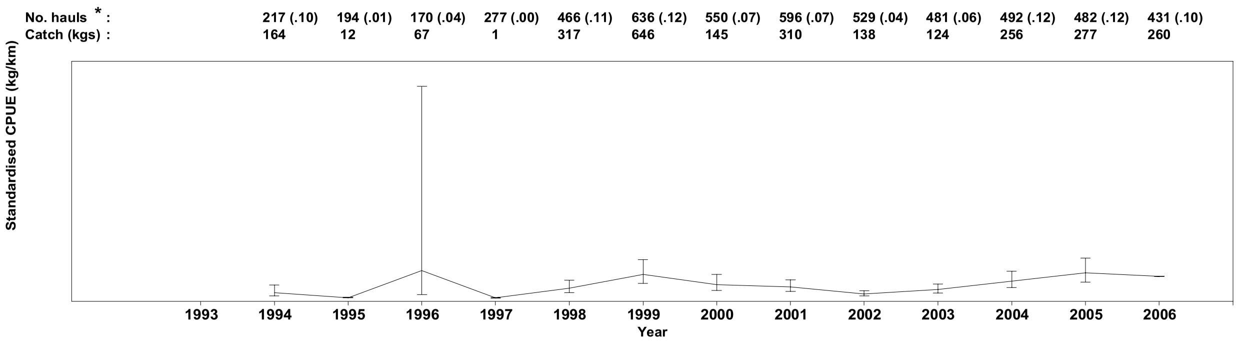
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

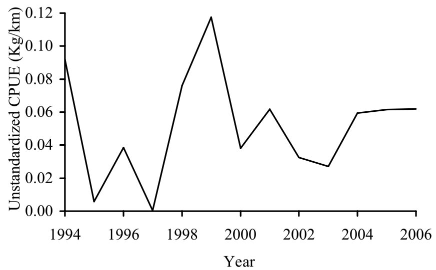
Year	Standardised CPUE (95% CI)		
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001			
2002	0.032	0.009	0.113
2003	0.073	0.044	0.123
2004	0.046	0.027	0.078
2005	0.098	0.062	0.155
2006	0.078	0.078	0.078

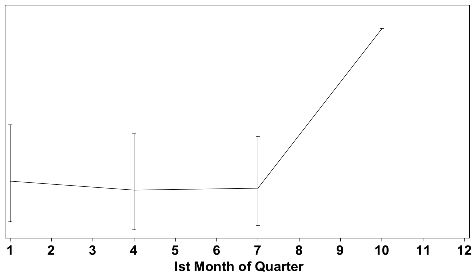
Raw catch and effort

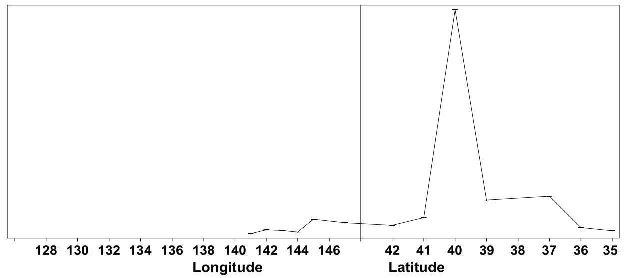
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001					
2002	0.006	327	37	2377	0.016
2003	0.055	346	135	2998	0.045
2004	0.083	350	224	2933	0.076
2005	0.089	314	312	2832	0.110
2006	0.100	281	213	2673	0.080
Mean	0.067	324	184	2763	0.067

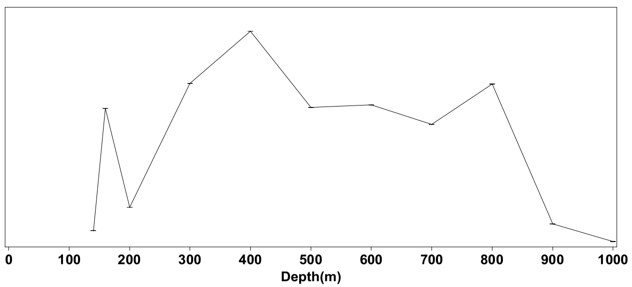
Fig. 5.02a. Ogilbys ghostshark (*Hydrolagus ogilbyi*) 1994–06 SETF 140–1000 m depth south-eastern Australia (longitude 141–151° E)











Ogilby ghostshark Fishery: trawl

Scientific name: Hydrolagus ogilbyi
CAAB code: 37042001

Model: cpue = year + quarter + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.90
Model fit criterion: scaled Pearson chisq/df = 1.39
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	12	18.92	ns	135.96	<.0001
Month	3	10.80	0.0129	11.74	0.0083
Longitude/latitude	11	45.46	<.0001	418.72	<.0001
Depth	10	86.08	<.0001	261.41	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0

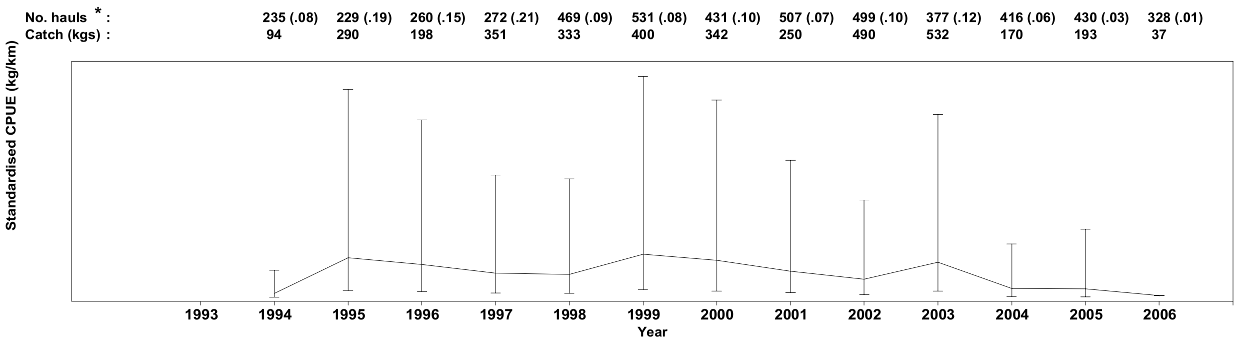
Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

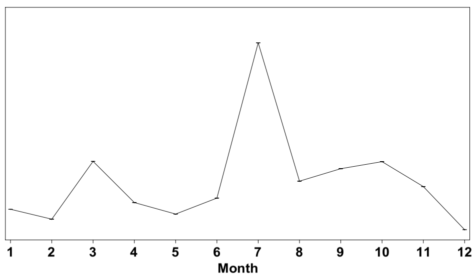
Year	Standardised CPUE (95% CI)		
1994	0.022	0.009	0.053
1995	0.001	0.000	0.004
1996	0.109	0.014	0.847
1997	0.000	0.000	0.003
1998	0.040	0.022	0.071
1999	0.095	0.059	0.154
2000	0.054	0.031	0.095
2001	0.044	0.027	0.073
2002	0.017	0.009	0.030
2003	0.034	0.021	0.056
2004	0.067	0.042	0.107
2005	0.101	0.064	0.161
2006	0.087	0.087	0.087

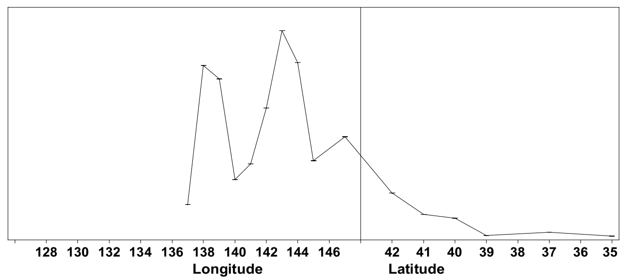
Raw catch and effort

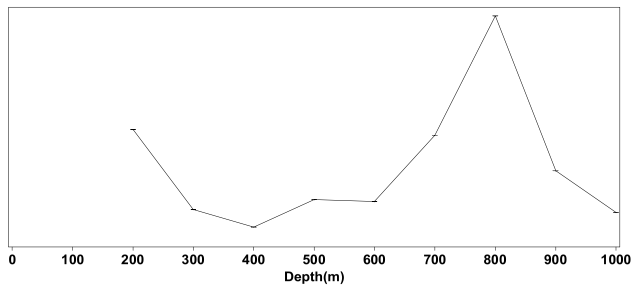
Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994	0.097	217	164	1783	0.092
1995	0.010	194	12	2044	0.006
1996	0.041	170	67	1736	0.039
1997	0.004	277	1	2929	0.000
1998	0.114	466	318	4171	0.076
1999	0.119	636	646	5498	0.118
2000	0.073	550	146	3824	0.038
2001	0.070	596	310	5028	0.062
2002	0.042	529	138	4253	0.032
2003	0.062	481	124	4564	0.027
2004	0.124	492	257	4323	0.059
2005	0.120	482	278	4504	0.062
2006	0.102	431	261	4209	0.062
Mean	0.075	425	209	3759	0.056

Fig. 5.03a. Southern chimaera (*Chimaera sp a*) 1994–06 SETF 200–1000 m depth south-eastern Australia (longitude 136–151° E)









Southern chimaera

Fishery: SETF

Scientific name: Chimaera sp a
CAAB code: 37042005

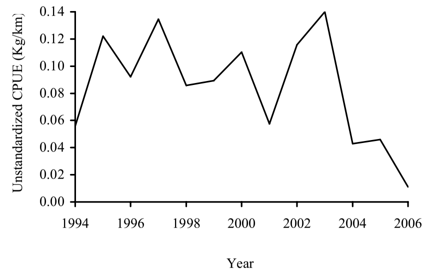
Model: cpue = year + month + depth + latlong + vessel + error

Distribution: gamma
Link: log

Binomial model fit criterion: scaled Pearson chisq/df = 0.87
Model fit criterion: scaled Pearson chisq/df = 1.05
Interannual trend: none P = ns

Variable	df	Model chisq	Model prob<chisq	Binomial model chisq	Binomial model prob<chisq
Year	12	29.71	0.0031	98.73	<.0001
Month	11	27.89	0.0034	72.99	<.0001
Longitude/latitude	13	36.91	0.0004	449.50	<.0001
Depth	8	64.28	<.0001	113.64	<.0001

* Proportion of hauls with catch in parentheses
* Minimum hauls in selected depth category and zone = 0



Adjusted to mean observed annual cpue
Delta-X error (log-gamma/binomial)

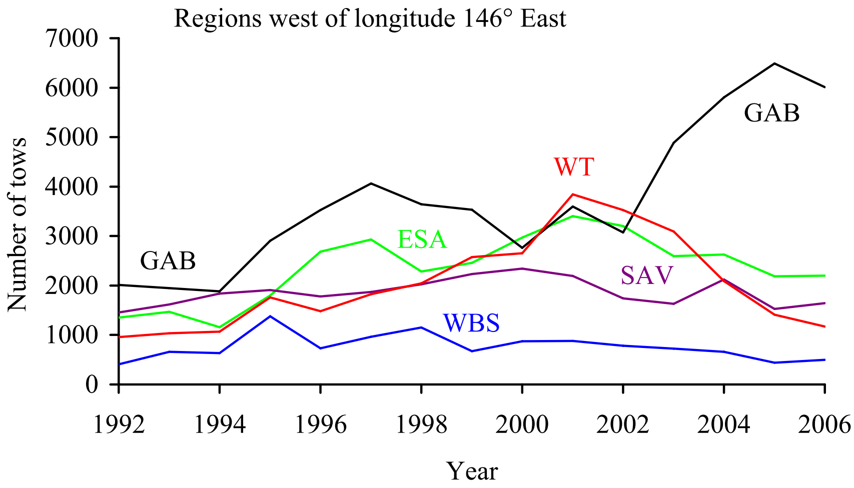
Year	Standardised CPUE (95% CI)		
1994	0.017	0.003	0.099
1995	0.143	0.028	0.737
1996	0.119	0.022	0.629
1997	0.088	0.018	0.435
1998	0.084	0.017	0.421
1999	0.155	0.031	0.783
2000	0.134	0.026	0.700
2001	0.095	0.019	0.486
2002	0.066	0.013	0.347
2003	0.126	0.025	0.648
2004	0.034	0.006	0.191
2005	0.032	0.004	0.243
2006	0.009	0.009	0.009

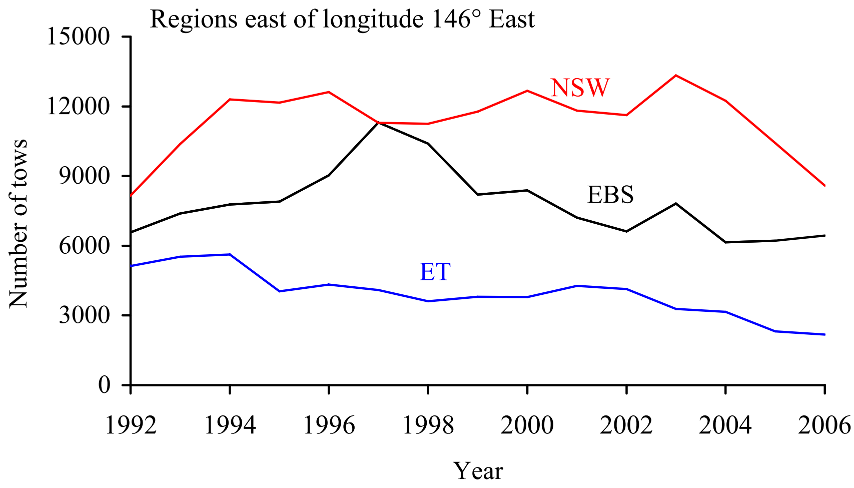
Raw catch and effort

Year	Non-zero hauls	Hauls	Catch (Kg)	Effort (Km)	CPUE (Kg/km)
1994	0.081	235	94	1684	0.056
1995	0.188	229	290	2376	0.122
1996	0.146	260	198	2147	0.092
1997	0.210	272	351	2608	0.135
1998	0.085	469	333	3885	0.086
1999	0.083	531	401	4488	0.089
2000	0.097	431	342	3102	0.110
2001	0.069	507	250	4340	0.058
2002	0.096	499	490	4234	0.116
2003	0.125	377	532	3801	0.140
2004	0.055	416	170	3959	0.043
2005	0.033	430	193	4210	0.046
2006	0.006	328	37	3360	0.011
Mean	0.098	383	283	3400	0.083

Fig. 6.01. Number of otter trawl tows by region in the SETF and GABTF

See Figure 1 for definitions of regions (defined by SharkRAG).





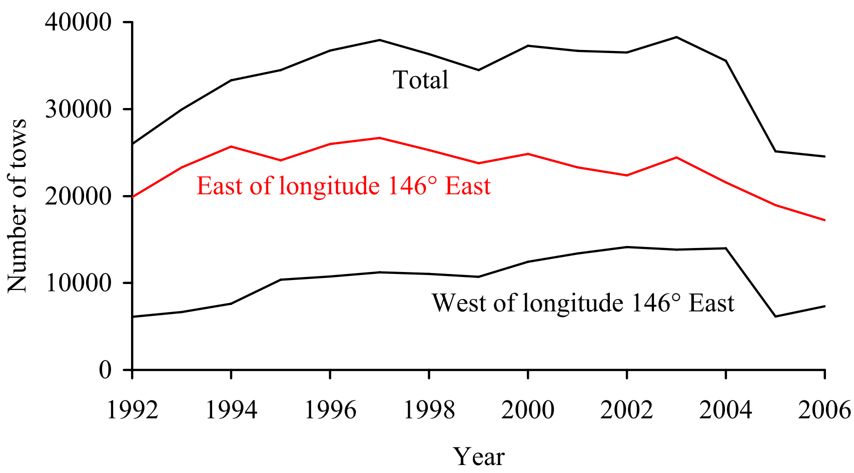
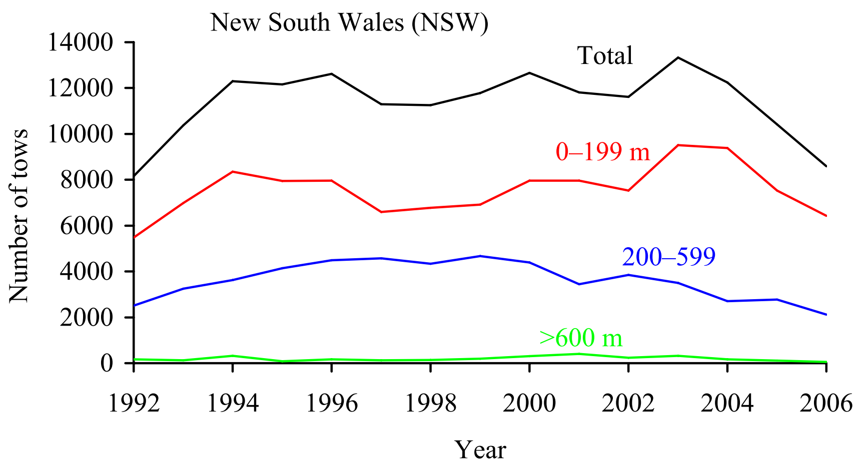
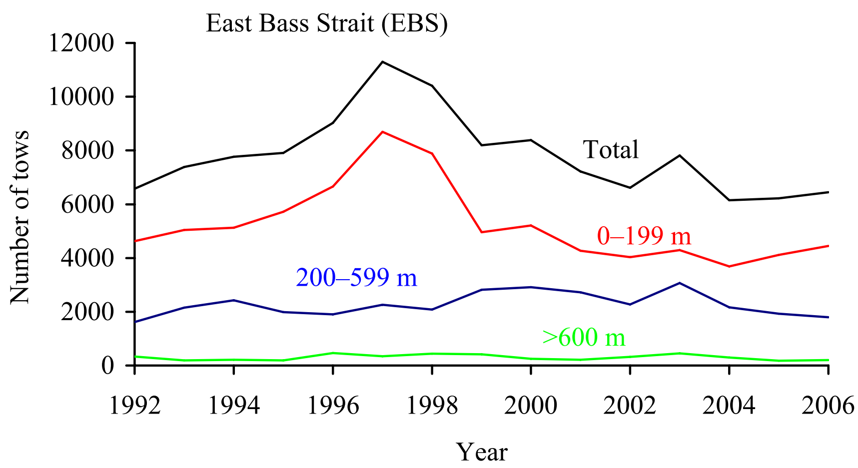


Fig. 6.02. Number of otter trawl tows by depth-class in eastern regions in SETF

See Figure 1 for definitions of regions (defined by SharkRAG).





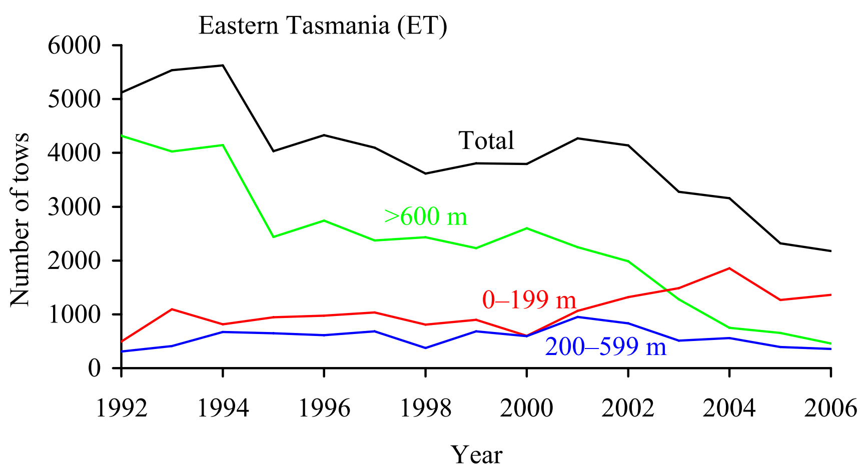
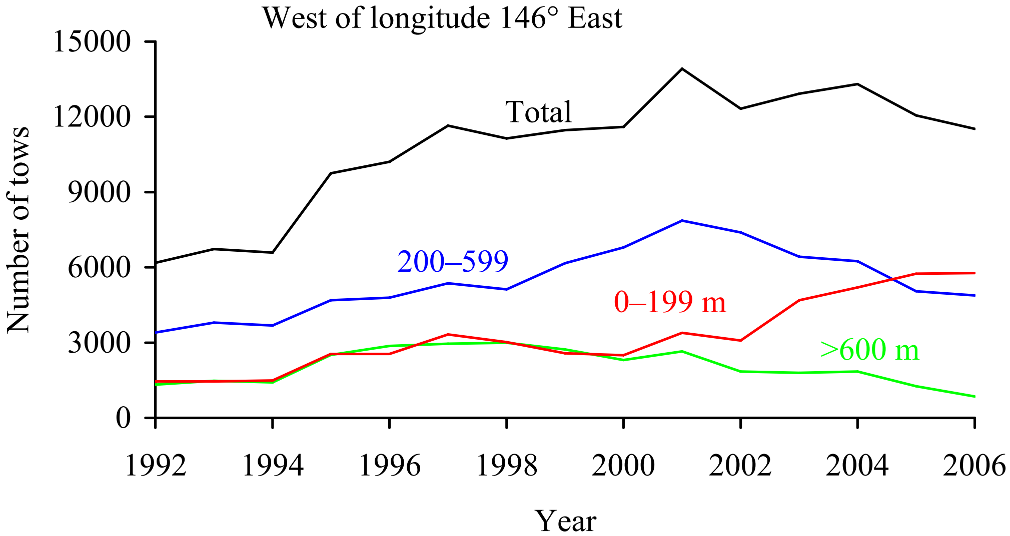
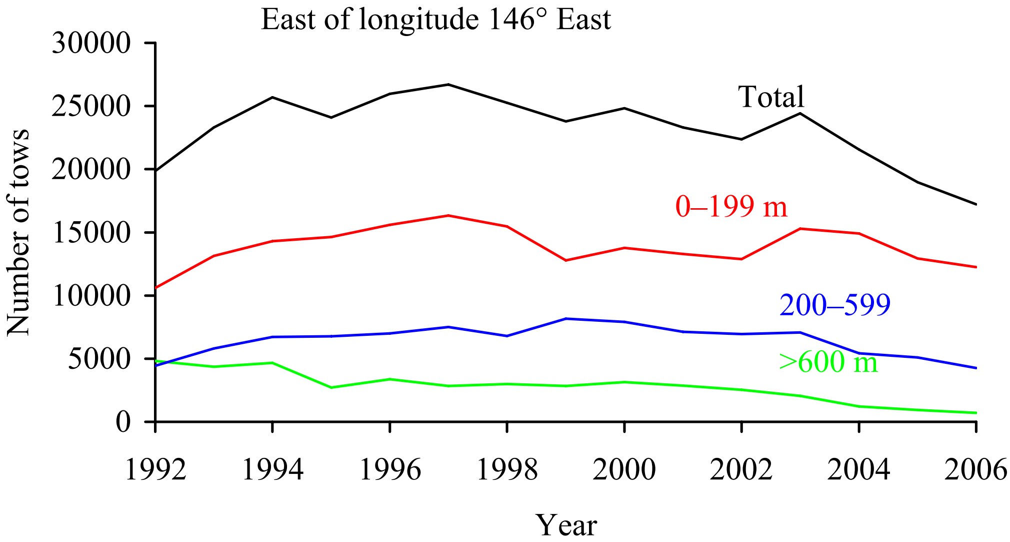
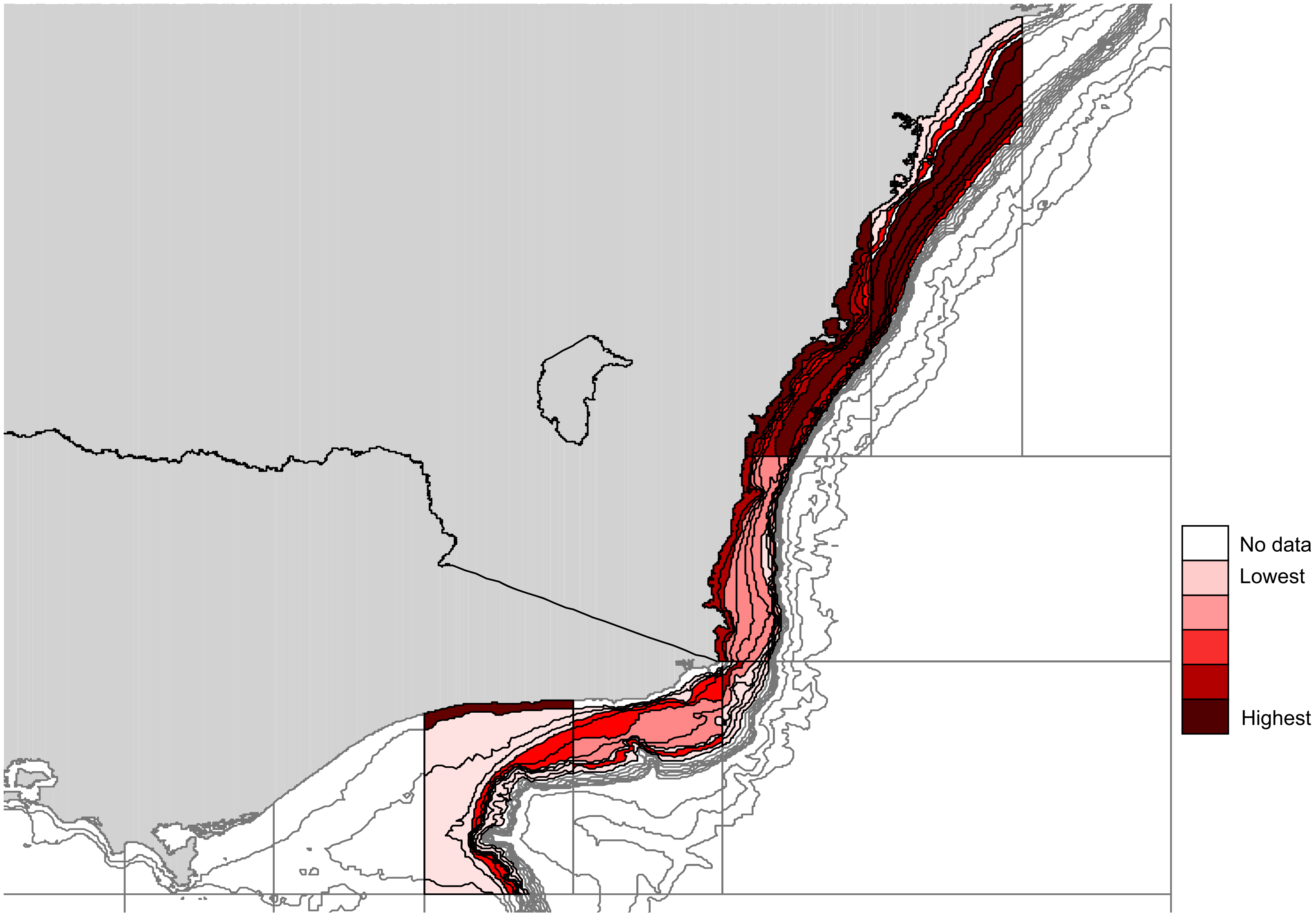


Fig. 6.03. Number otter trawl tows by depth-class each side of 146° East



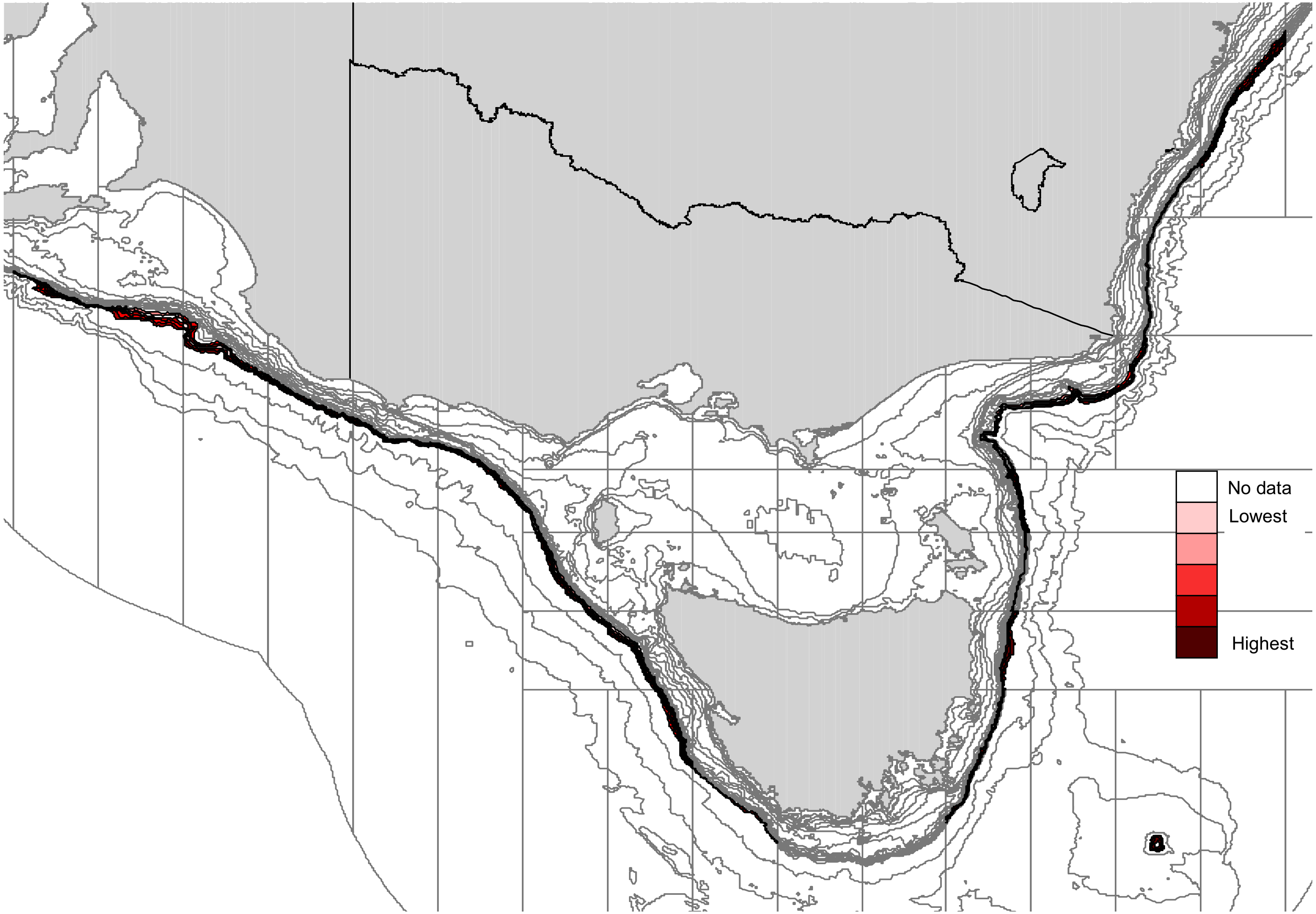


Map 1.01a. Australian angel shark (*Squatina australis*) 1998–06 SETF 0–400 m depth (longitude 137–151° E)



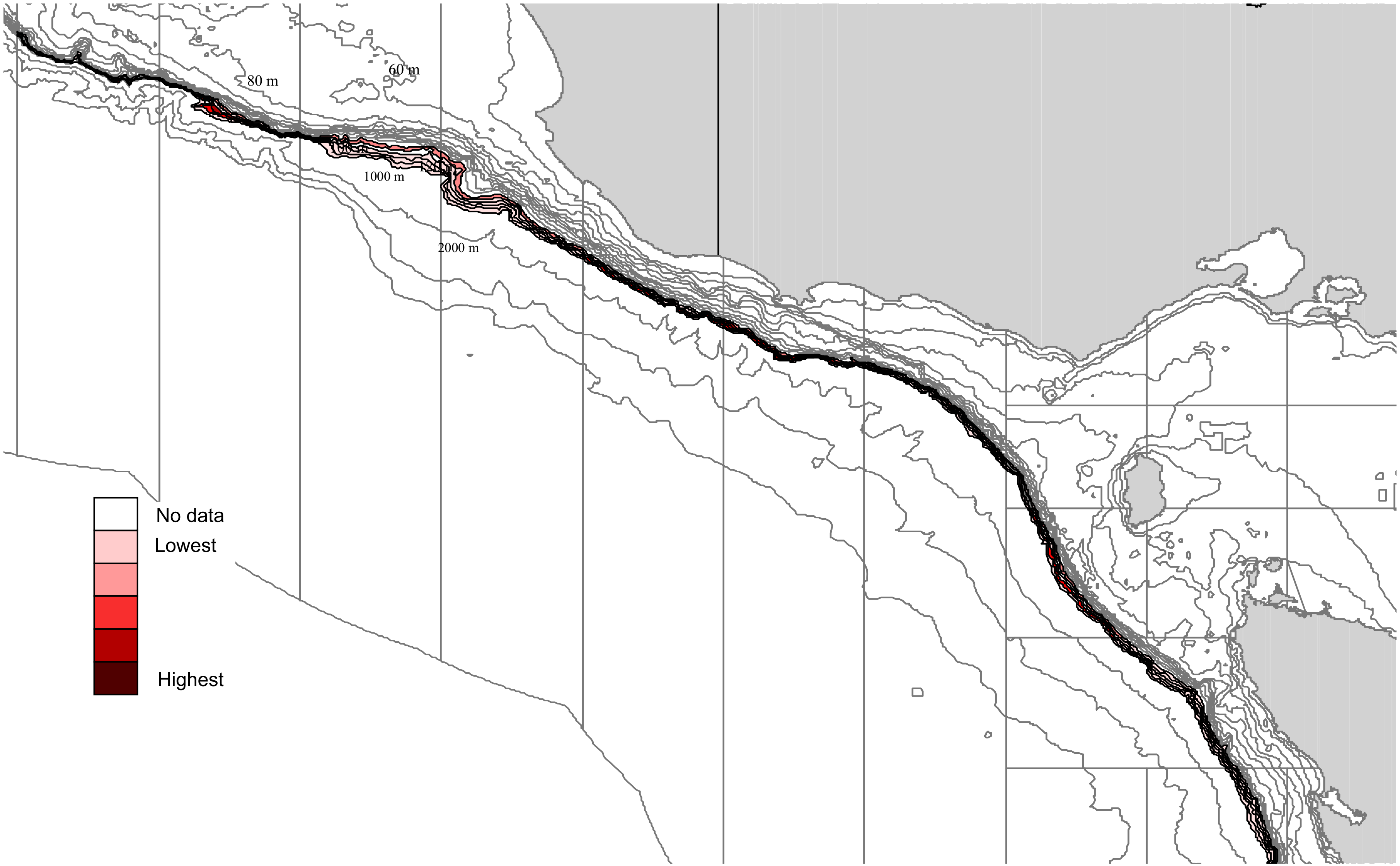
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.01a. Black shark (*Dalatias licha*) 2000–06 SETF 600–1000 m depth (longitude 137–151° E)



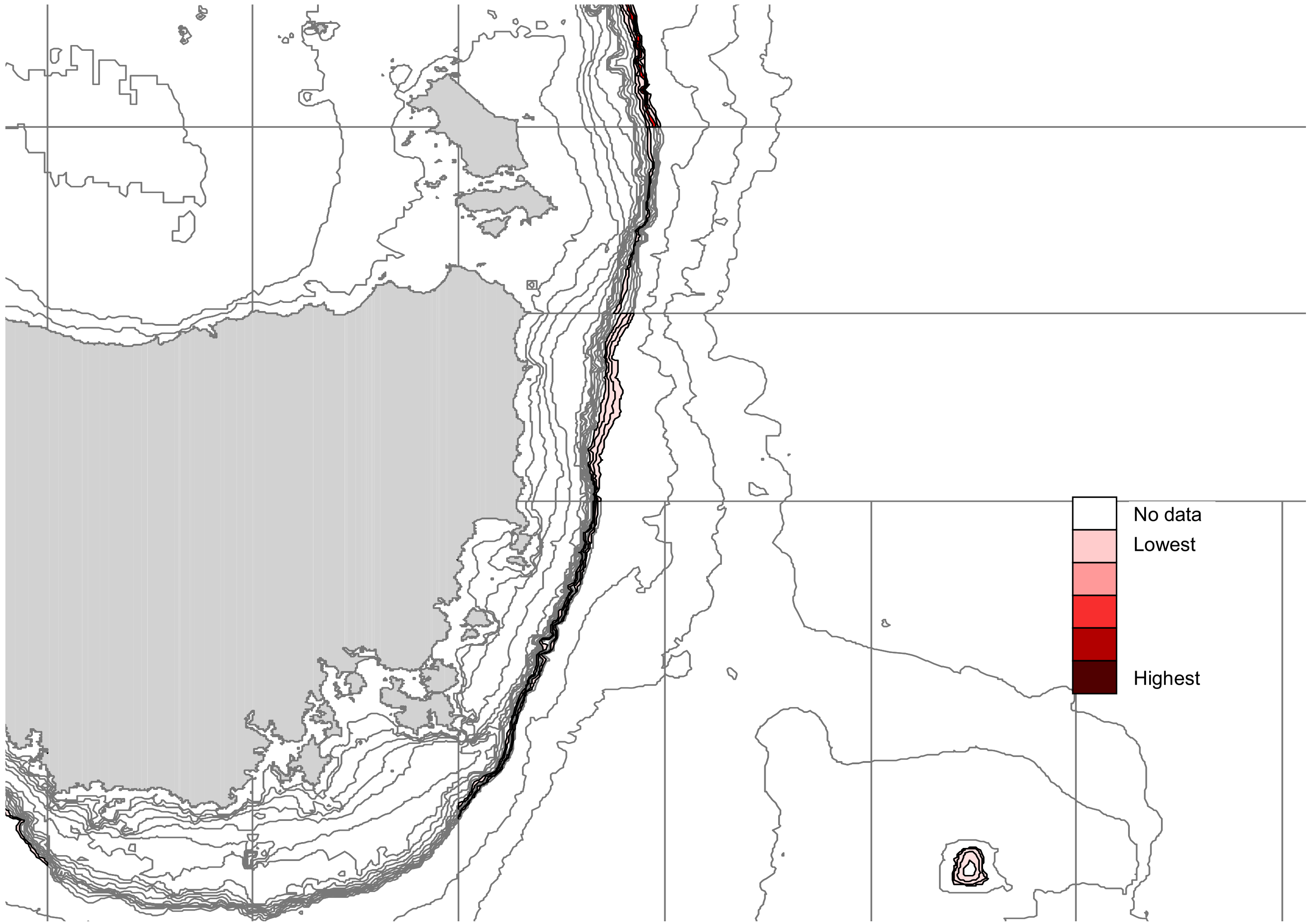
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.03a. Brier shark (*Deania calcea*) 2000–06 SETF 600–1100 m depth western region



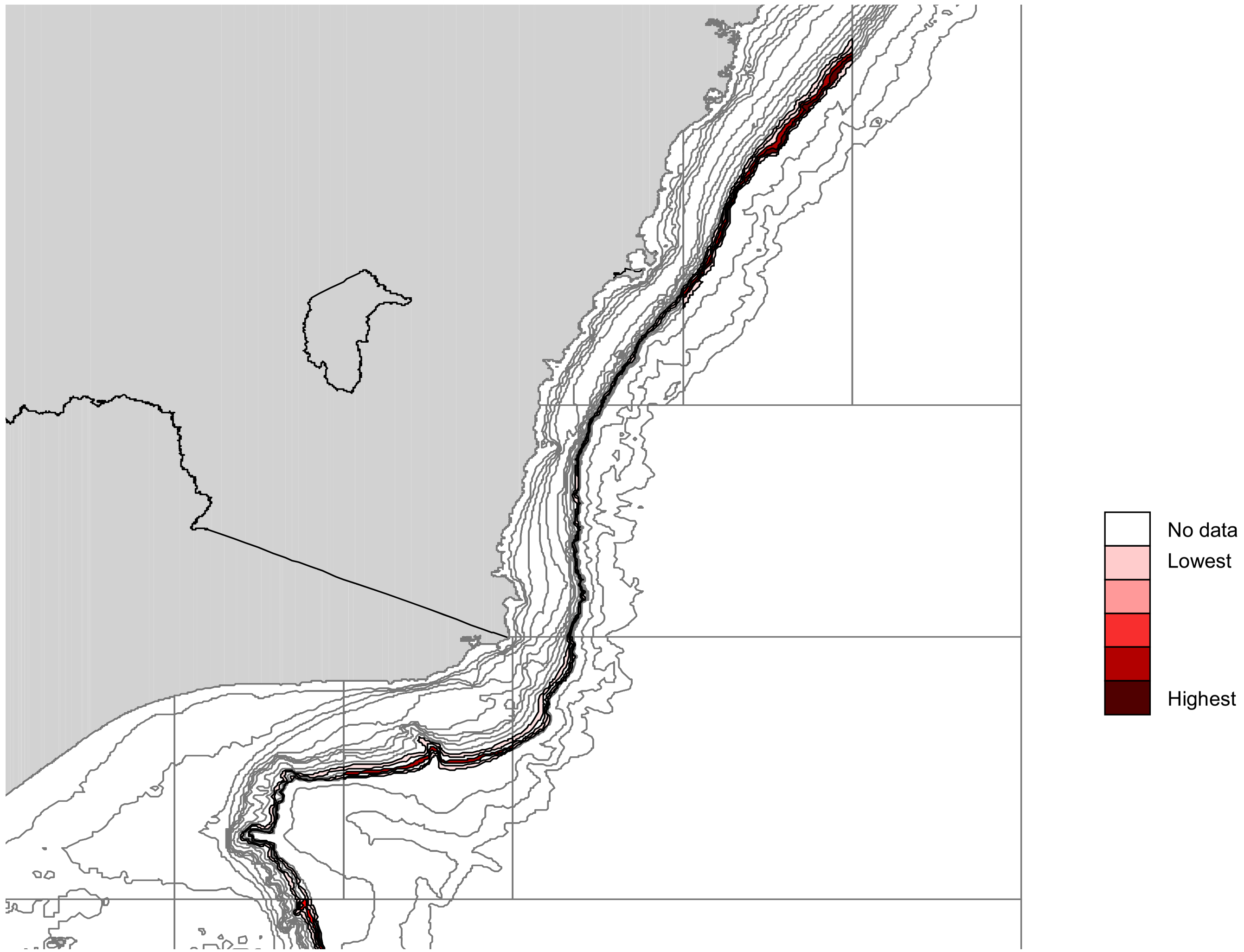
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.03b. Brier shark (*Deania calcea*) 2000–06 SETF 600–1100 m depth eastern Tasmania



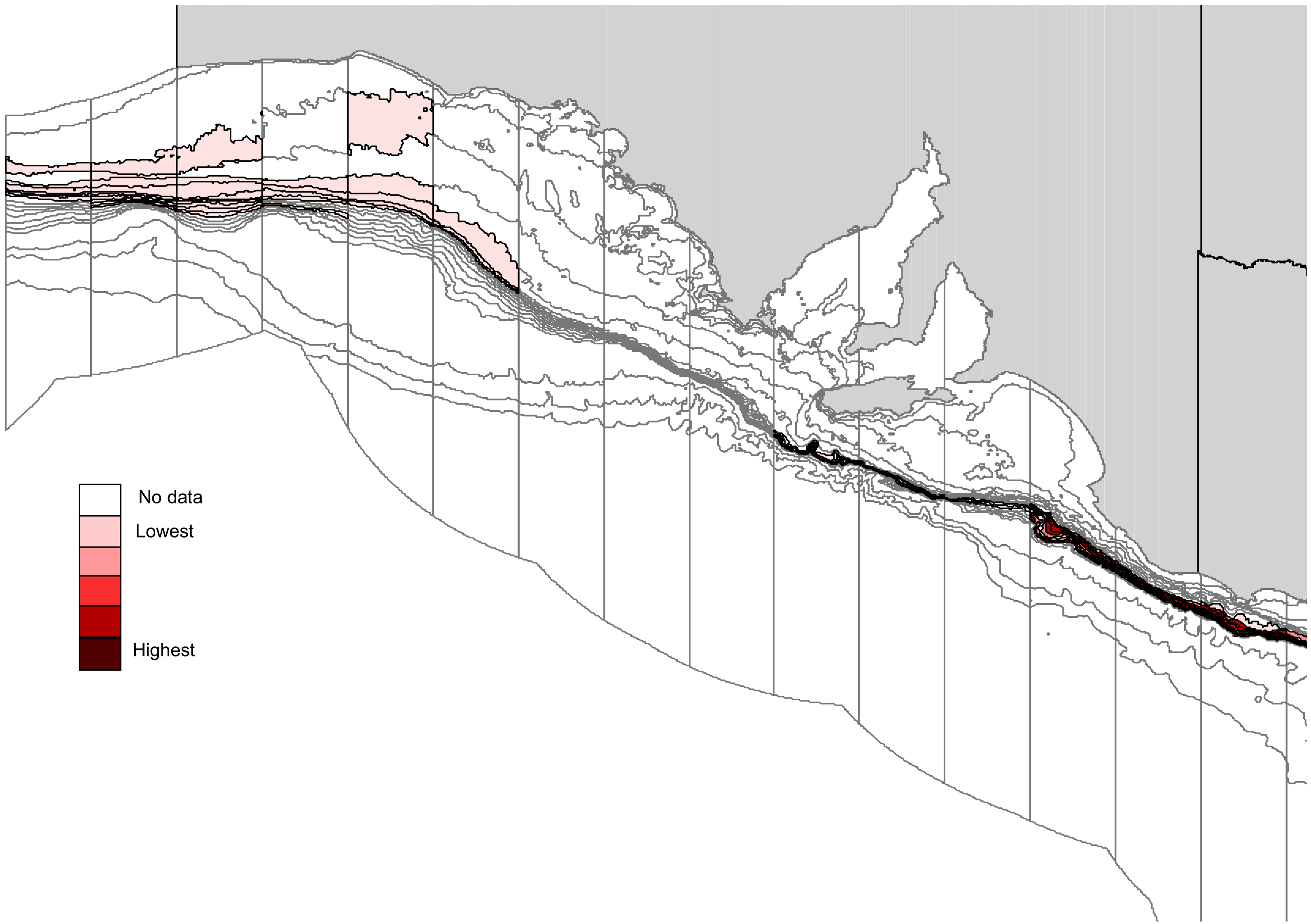
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 Janusry 2007

Map 1.03c. Brier shark (*Deania calcea*) 2000–06 SETF 600–1100 m depth New South Wales



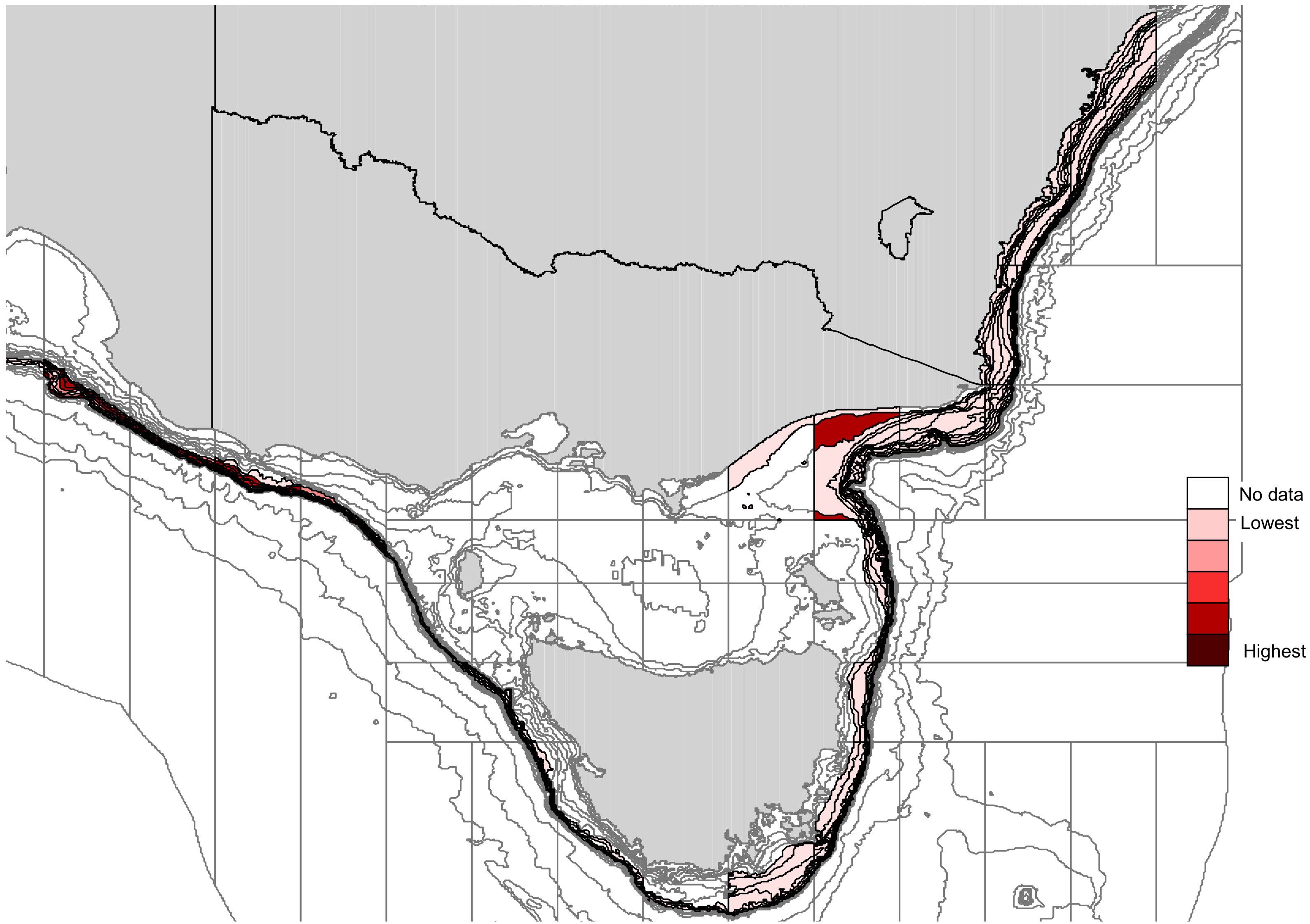
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 Janusry 2007

Map 1.04a. Common sawshark (*Pristiophorus cirratus*) 2000–06 Otter trawl 0–800 m depth (longitude 127–151° E)



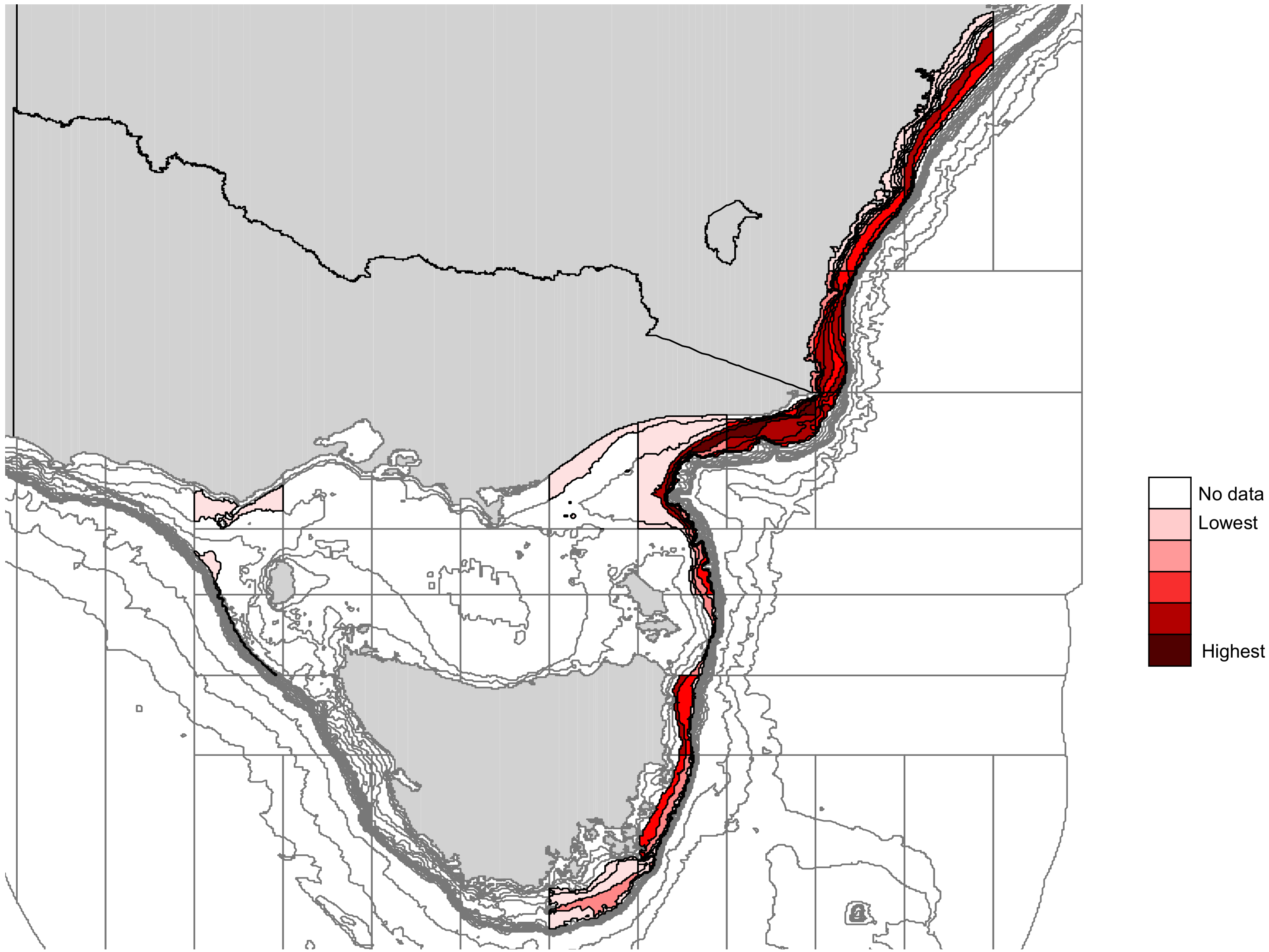
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.04b. Common sawshark (*Pristiophorus cirratus*) 2000–06 Otter trawl 0–800 m depth (longitude 127–151° E)



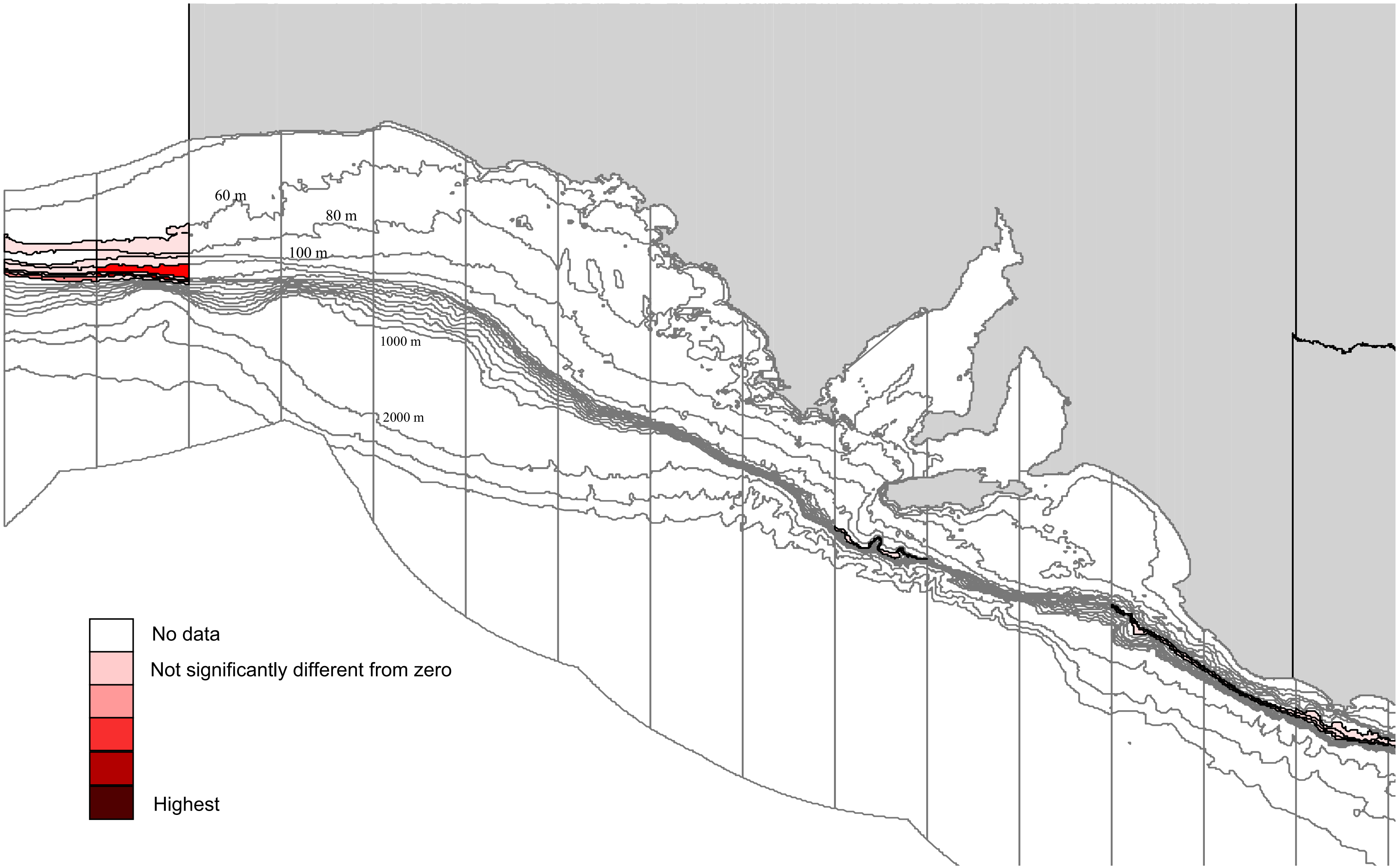
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.05a. Draughtboard shark (*Cephaloscyllium laticeps*) 2000–06 Otter trawl 0–200 m depth



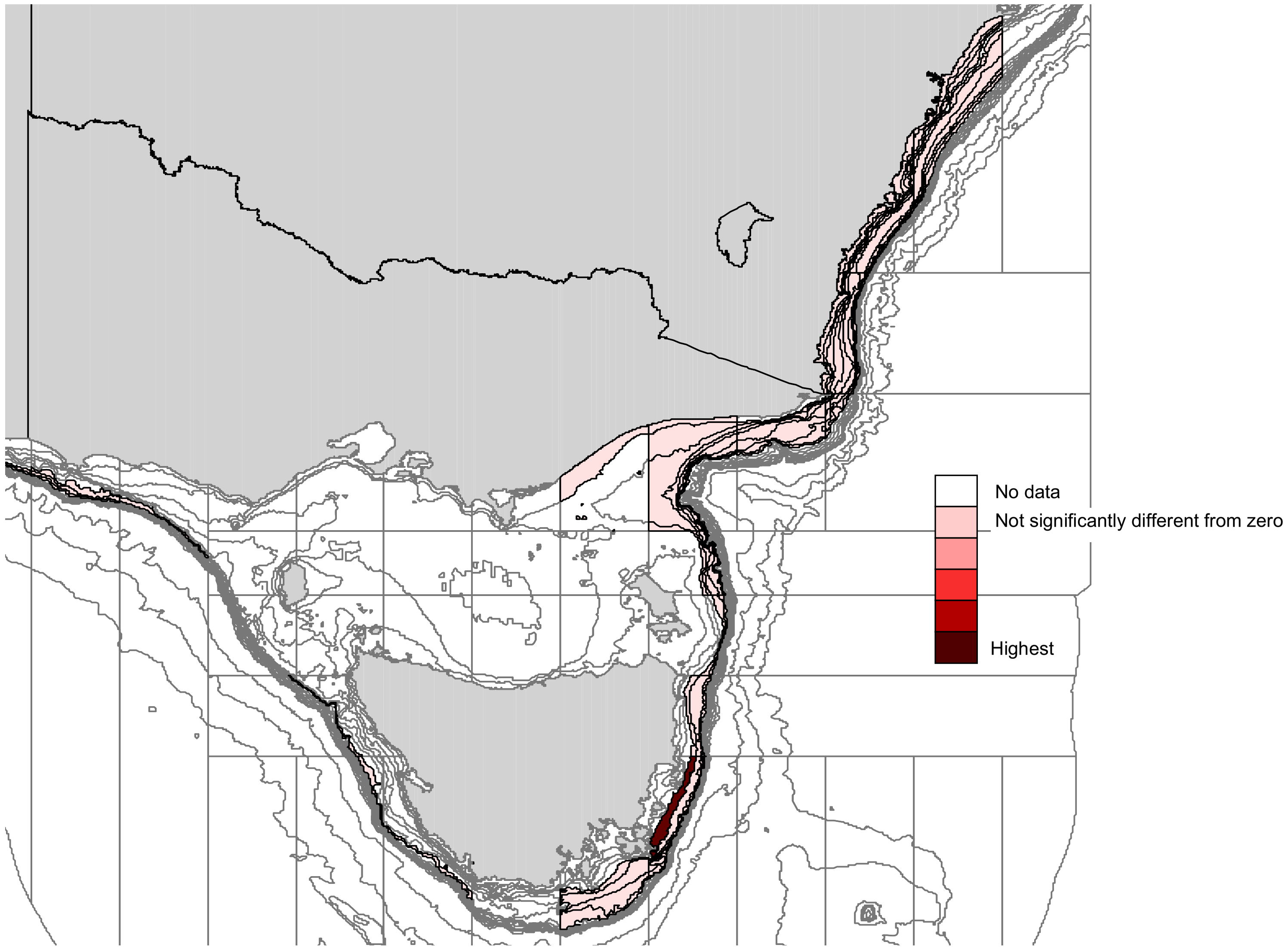
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 Janusry 2007

Map 1.06a. Grey spotted catshark (*Asymbolis analis*) 2000–06 Otter trawl 0–300 m depth South Australia



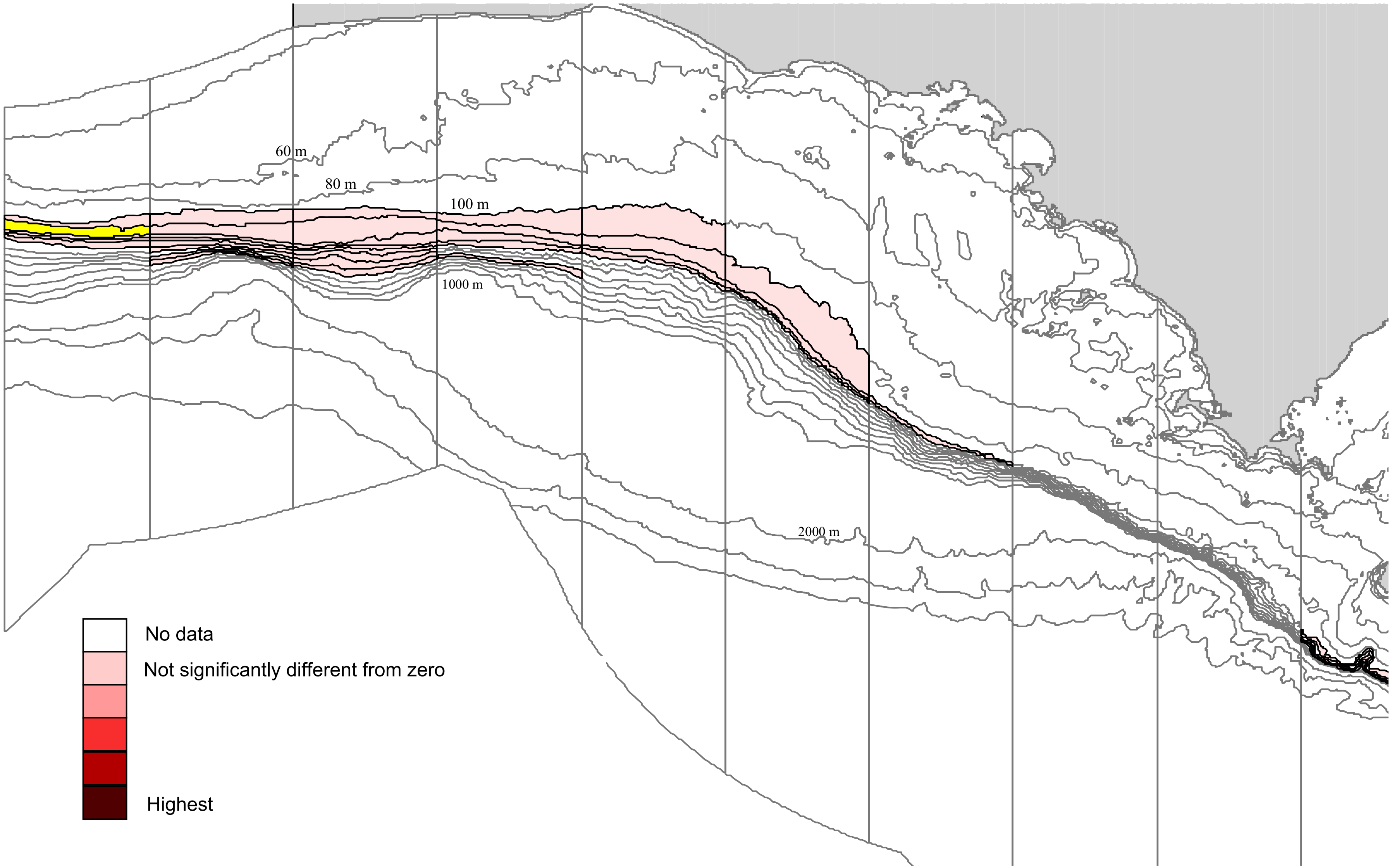
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.06b. Grey spotted catshark (*Asymbolis analis*) 2000–06 Otter trawl 0–300 m depth eastern region



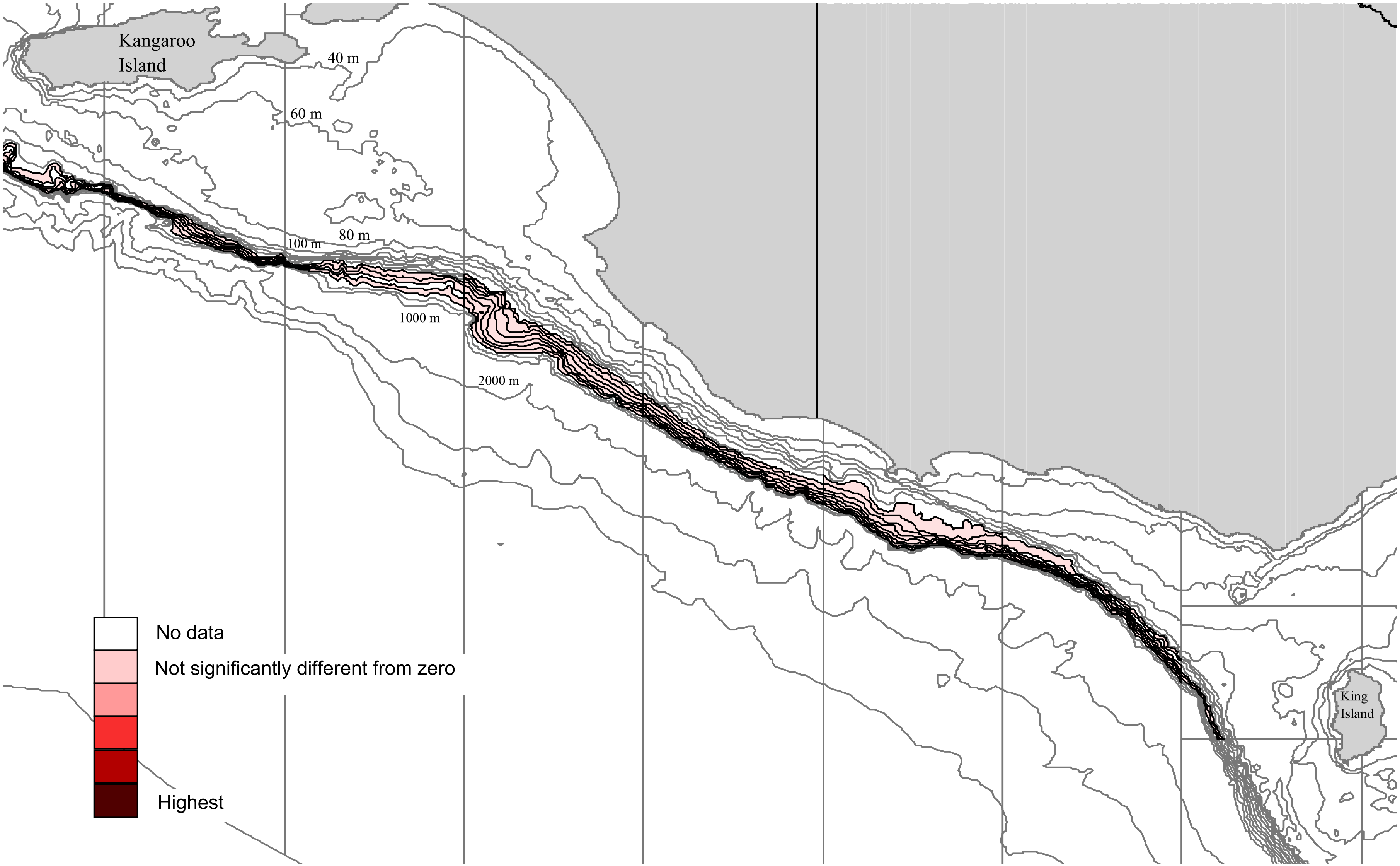
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 Janusry 2007

Map 1.07a. Greeneye spurdog (*Squalus mitsukurii*) 2000–06 Otter trawl 120–800 m depth Great Australian Bight



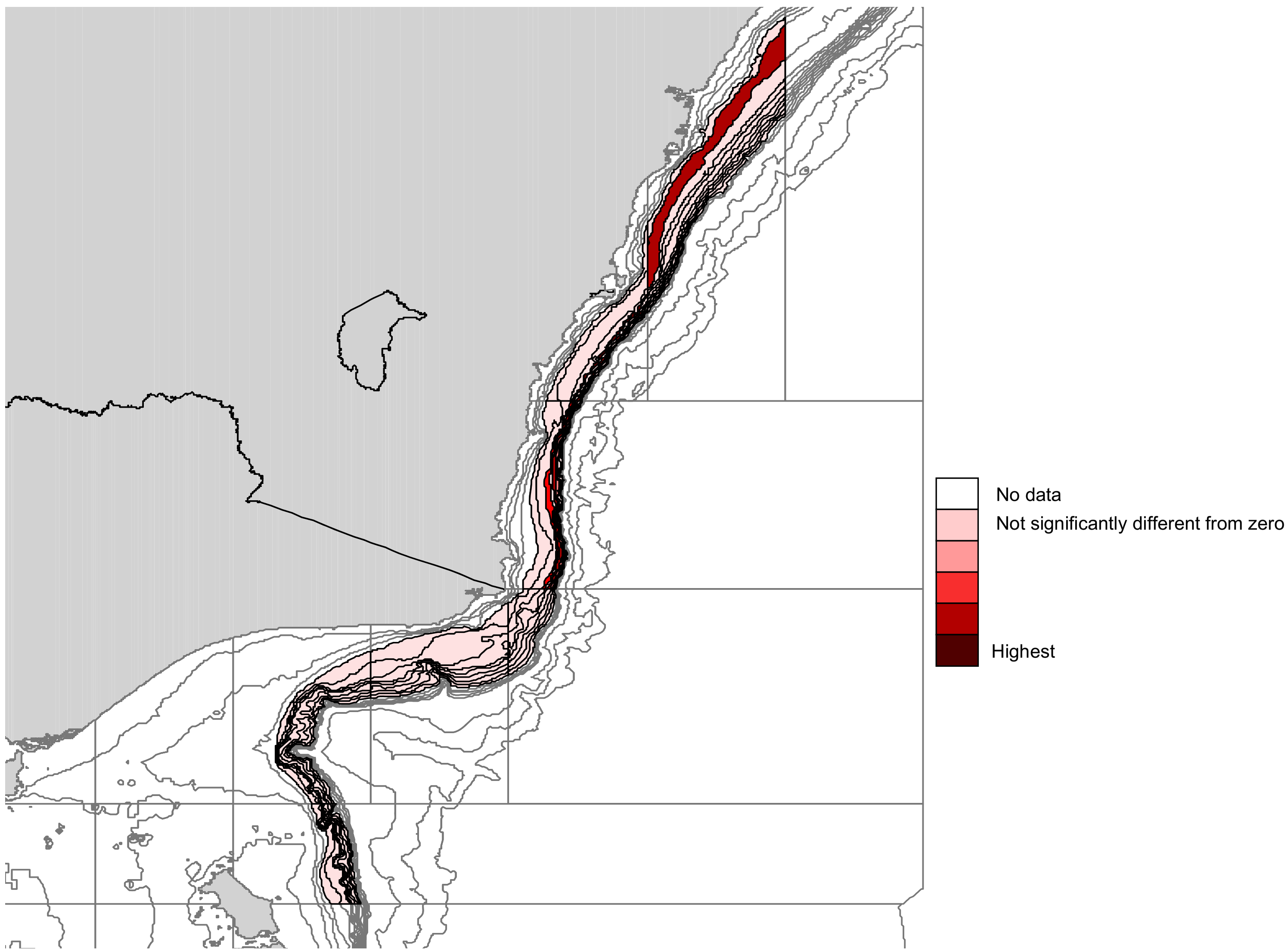
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.07b. Greeneye spurdog (*Squalus mitsukurii*) 2000–06 Otter trawl 120–800 m depth Kangaroo Island–King Island



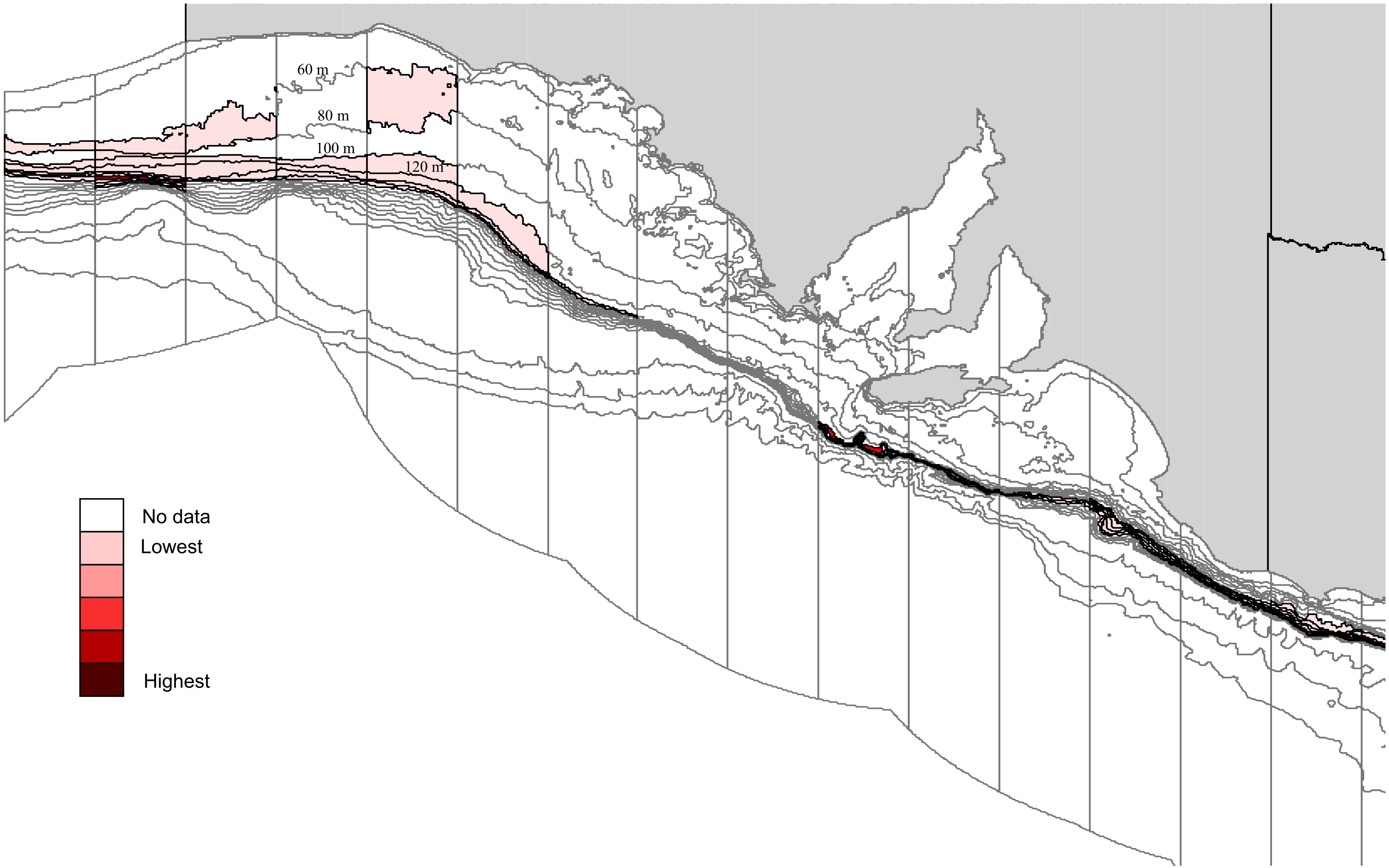
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.07c. Greeneye spurdog (*Squalus mitsukurii*) 2000–06 Otter trawl 120–800 m depth eastern region



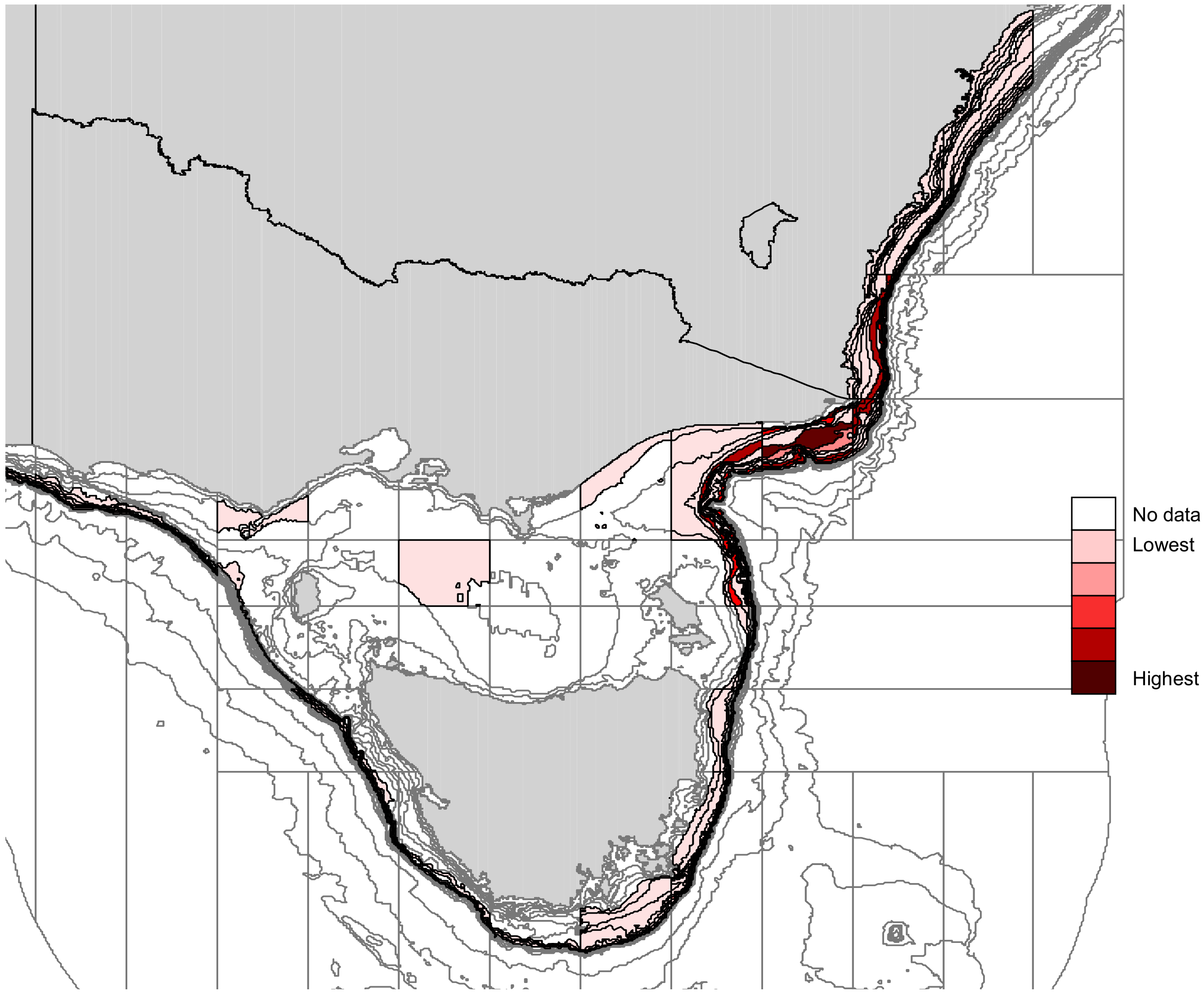
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 Janusry 2007

Map 1.08a. Gummy shark (*Mustelus antarcticus*) 2000–06 Otter trawl 0–600 m depth South Australia



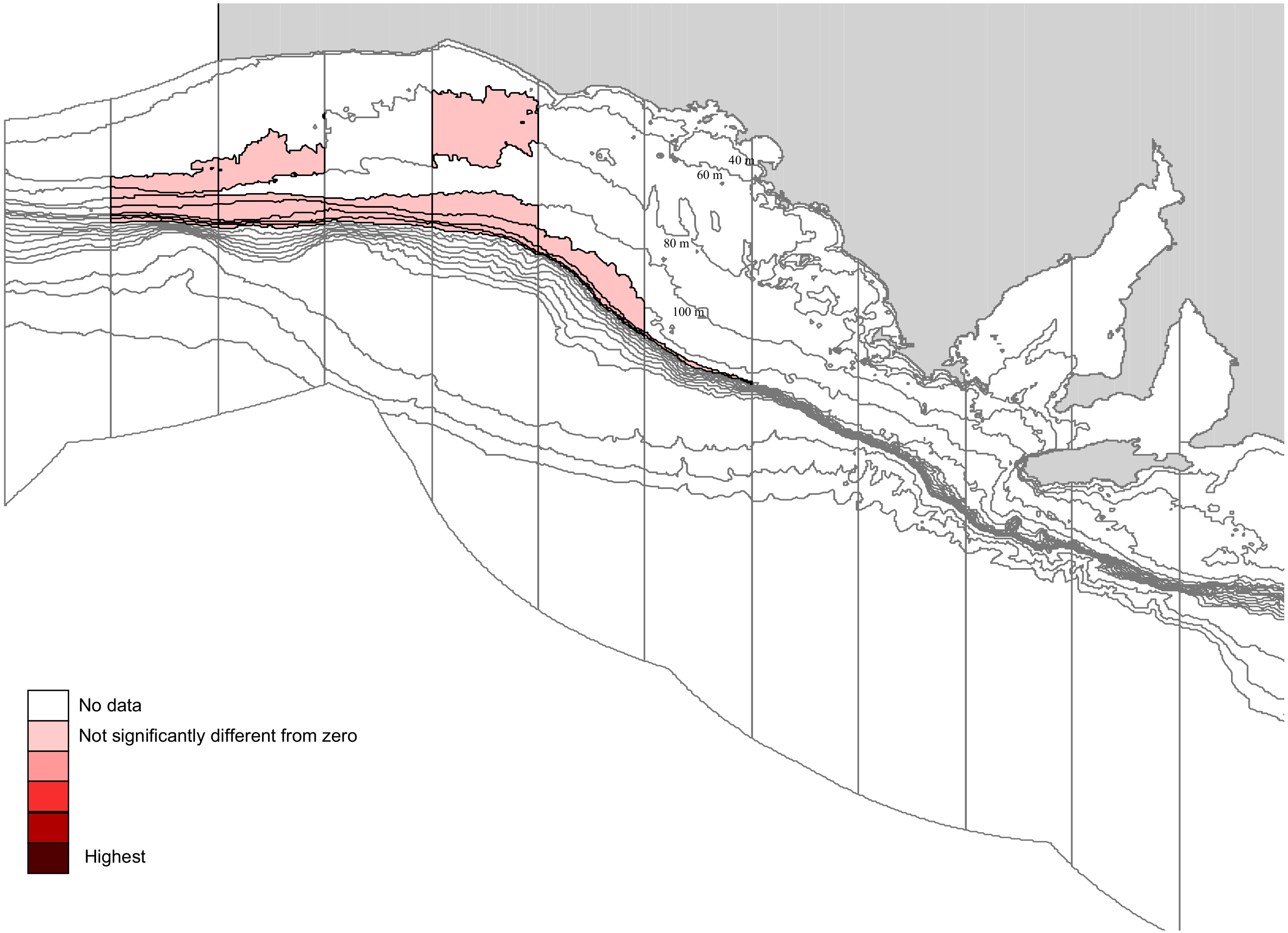
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.08b. Gummy shark (*Mustelus antarcticus*) 2000–06 Otter trawl 120–600 m depth eastern region



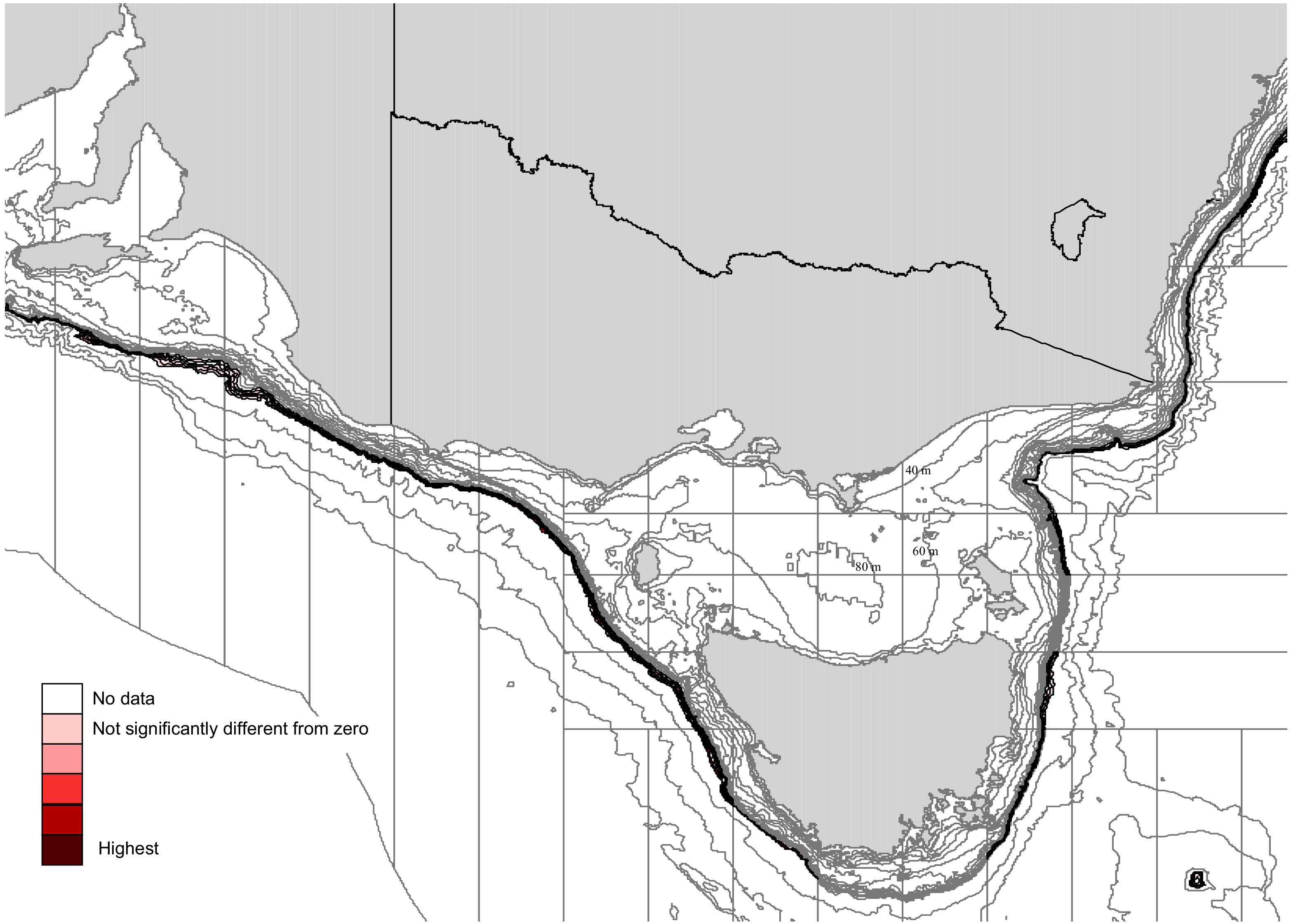
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 Janusry 2007

Map 1.09a. Ornate angel shark (*Squatina tergocellata*) 2000–06 GABTF 0–300 m depth Great Australian Bight



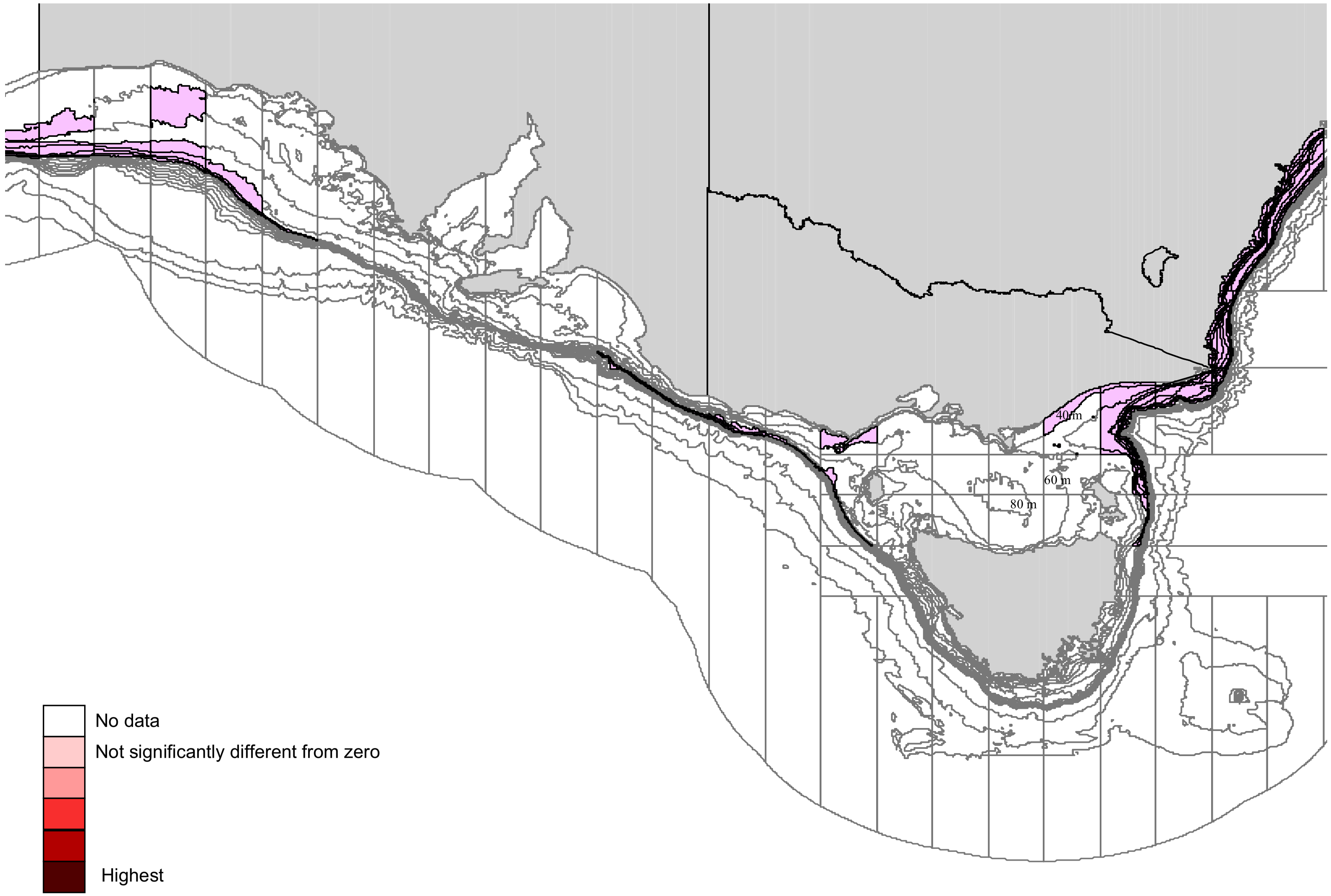
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.10a. Owstons dogfish (*Centroscymnus owstoni*) 2000–06 SETF 0–600 m depth south-eastern Australia



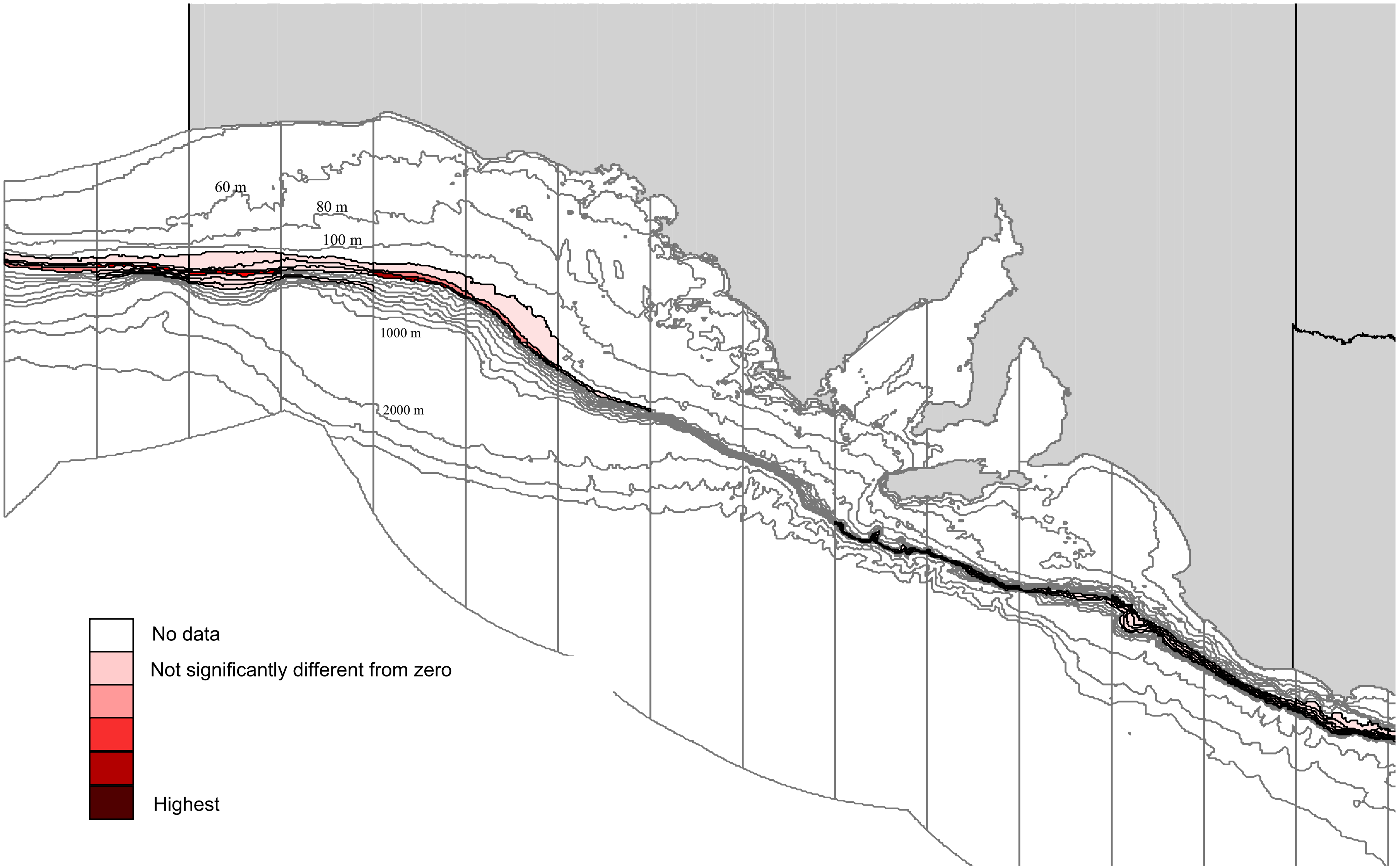
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.11a. Port Jackson shark (*Heterodontus portusjacksoni*) 2000–06 Otter trawl 0–300 m depth southern Australia



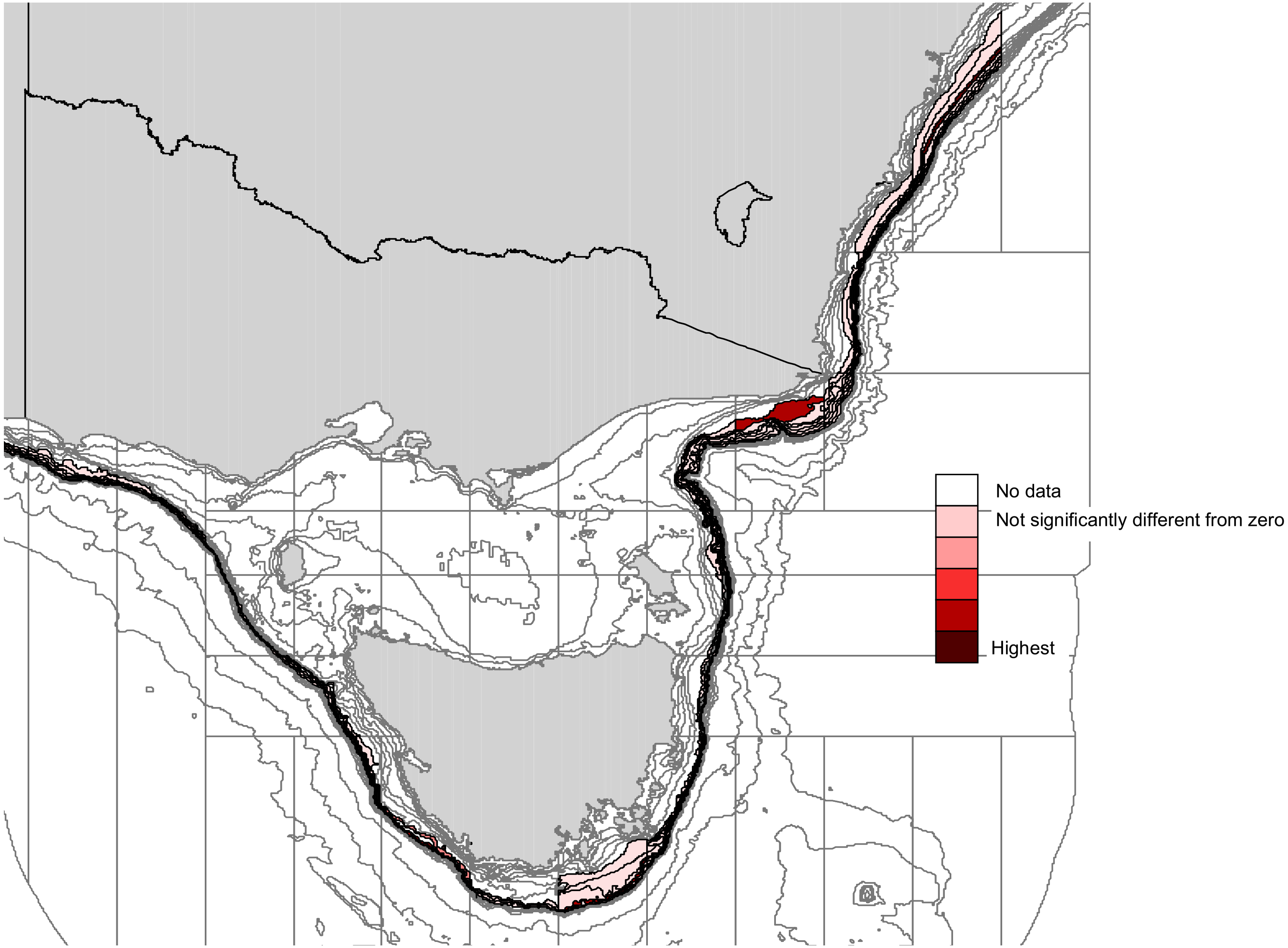
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.12a. Sawtail shark (*Galeus boardmani*) 2000–06 Otter trawl 140–600 m depth South Australia



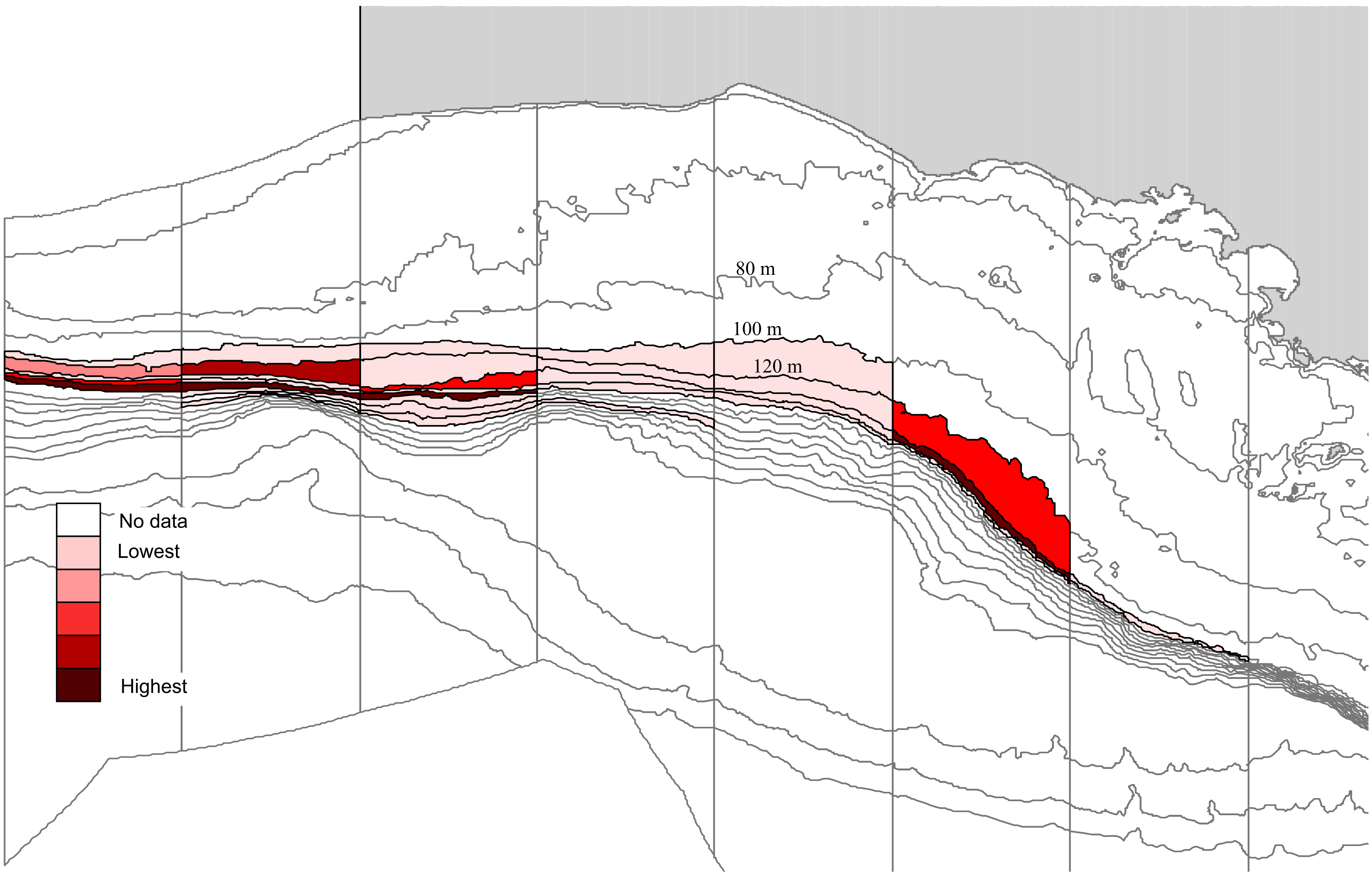
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.12b. Sawtail shark (*Galeus broadmani*) 2000–06 Otter trawl 140–600 m depth eastern region



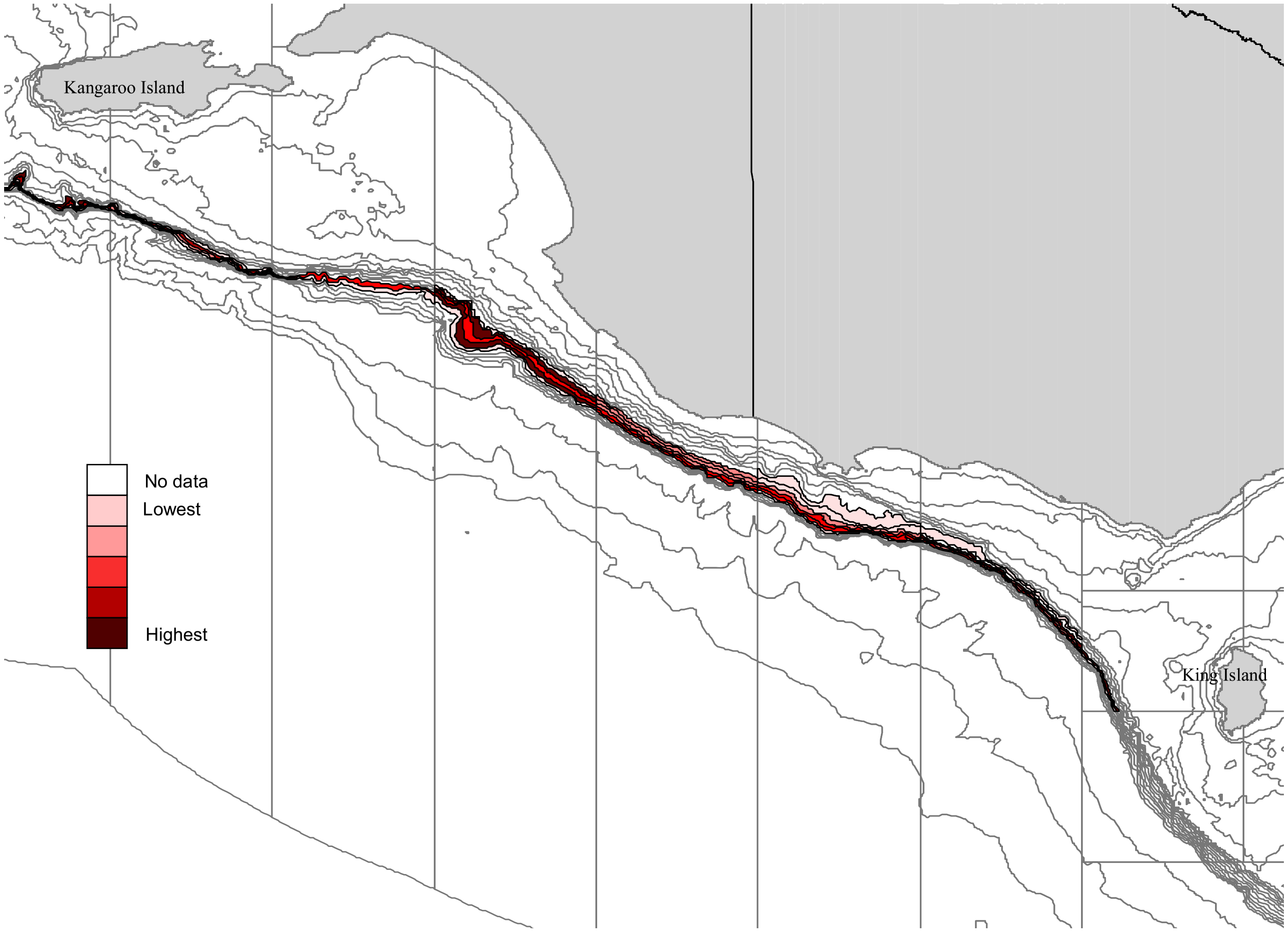
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 Janusry 2007

Map 1.13a. School shark (*Galeorhinus galeus*) 2000–06 Otter trawl 80–600 m depth Great Australian Bight



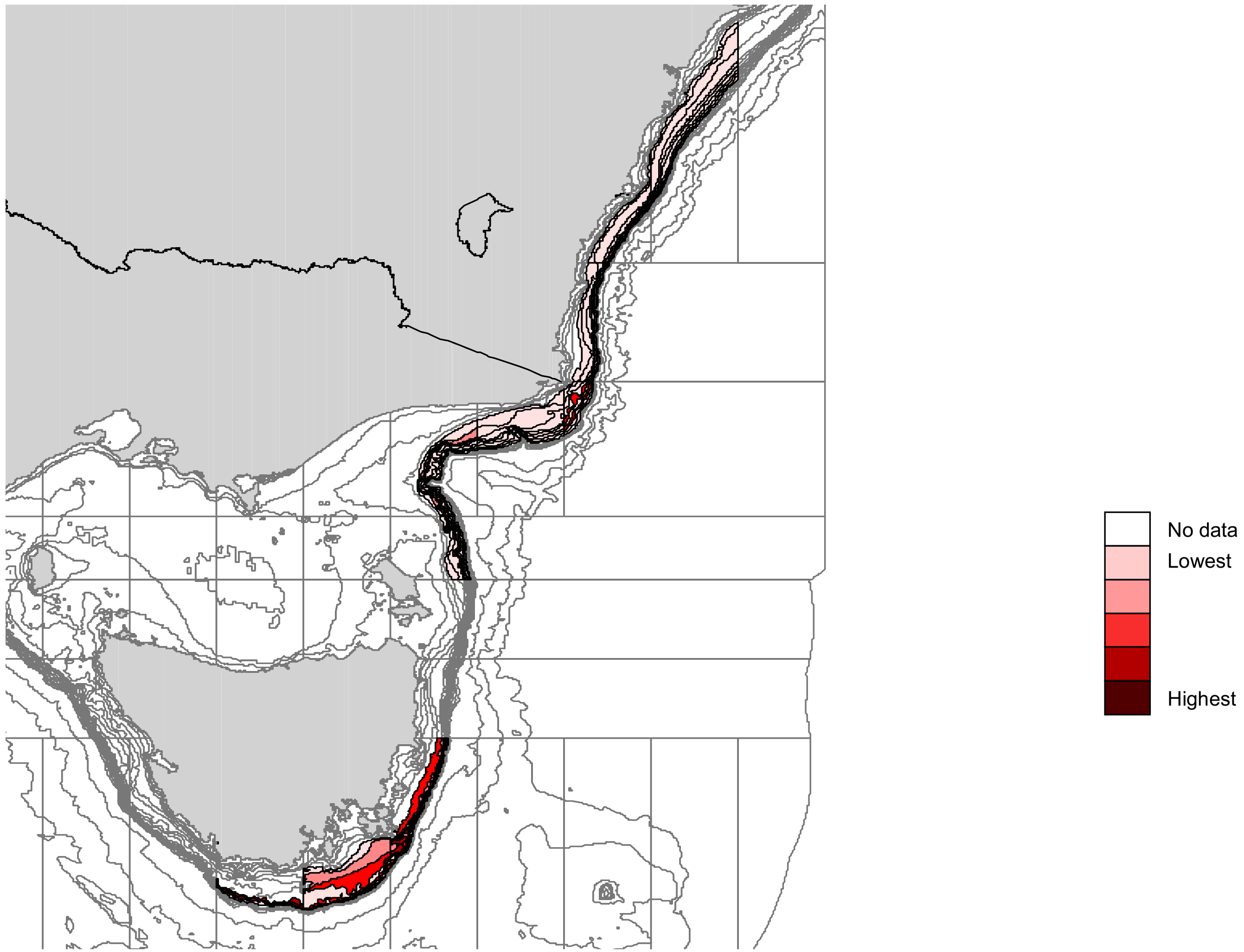
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 25 June 2006

Map 1.13b. School shark (*Galeorhinus galeus*) 2000–06 otter trawl 120–600 m depth western region



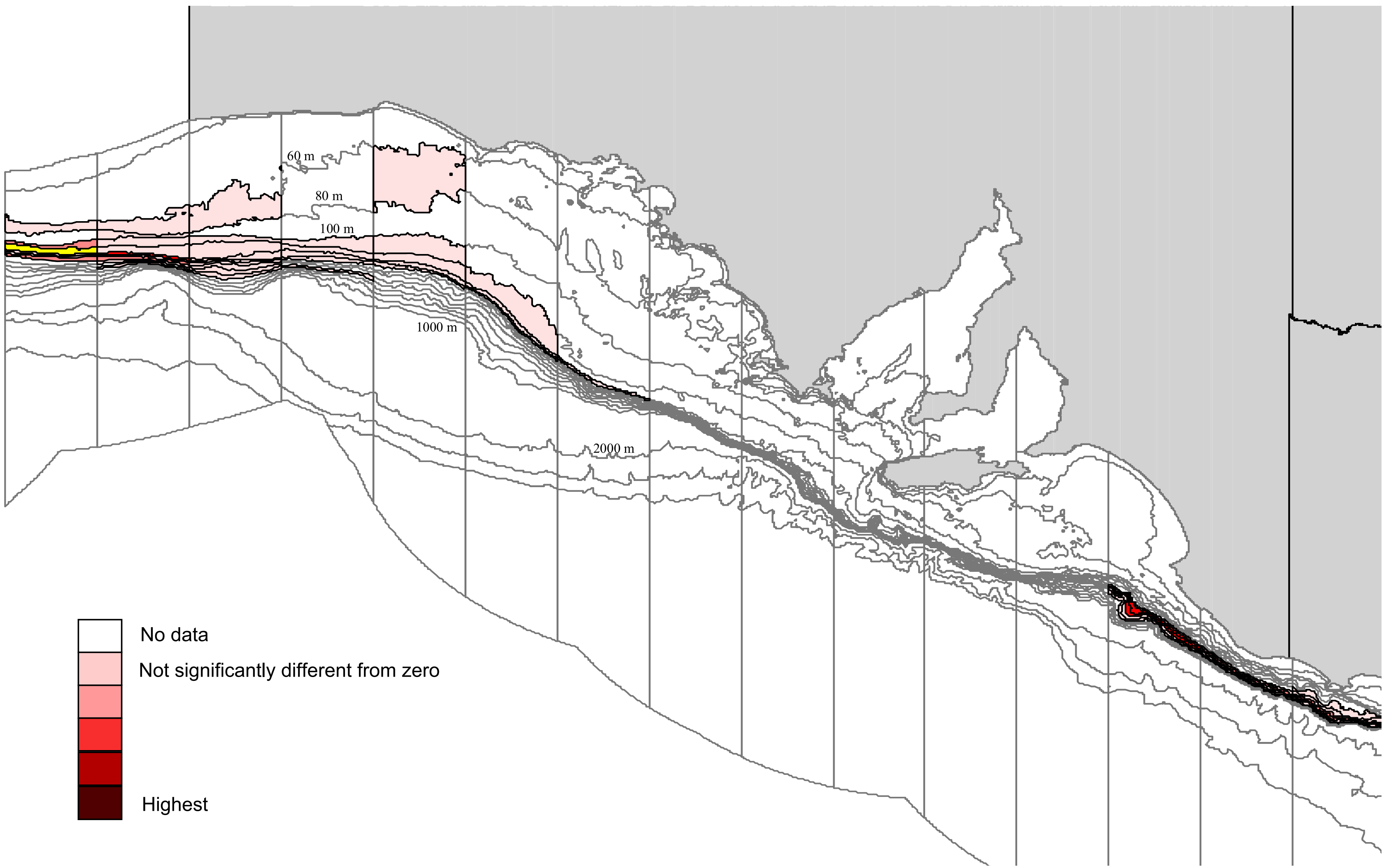
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 25 June 2006

Map 1.13c. School shark (*Galeorhinus galeus*) 2000–06 otter trawl 120–600 m depth eastern region



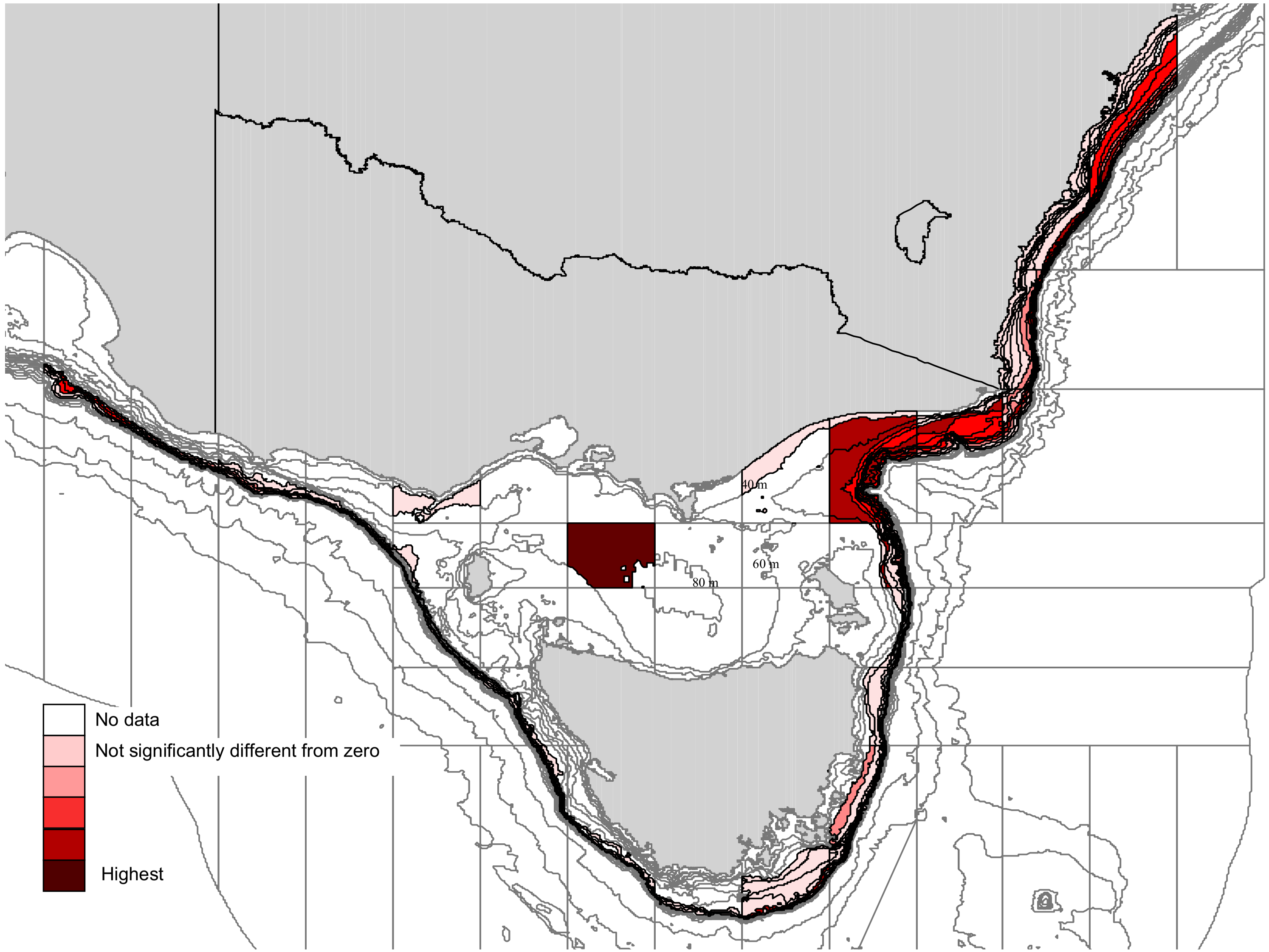
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 25 June 2006

Map 1.14a. Spikey spurdog (*Squalus megalops*) 2000–06 Otter trawl 120–800 m depth South Australia



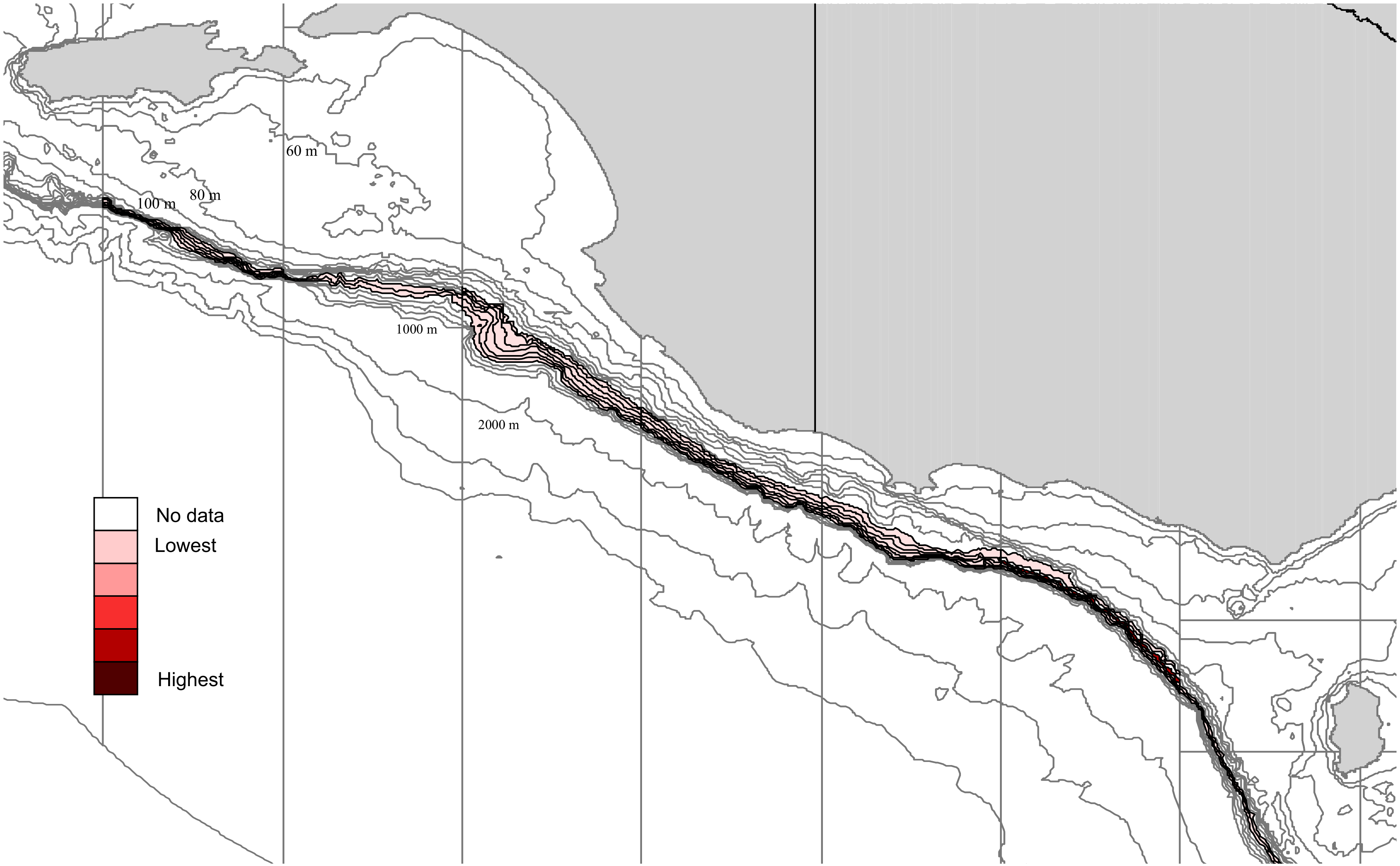
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.14b. Spikey spurdog (*Squalus megalops*) 2000–06 Otter trawl 0–600 m depth south-eastern Australia



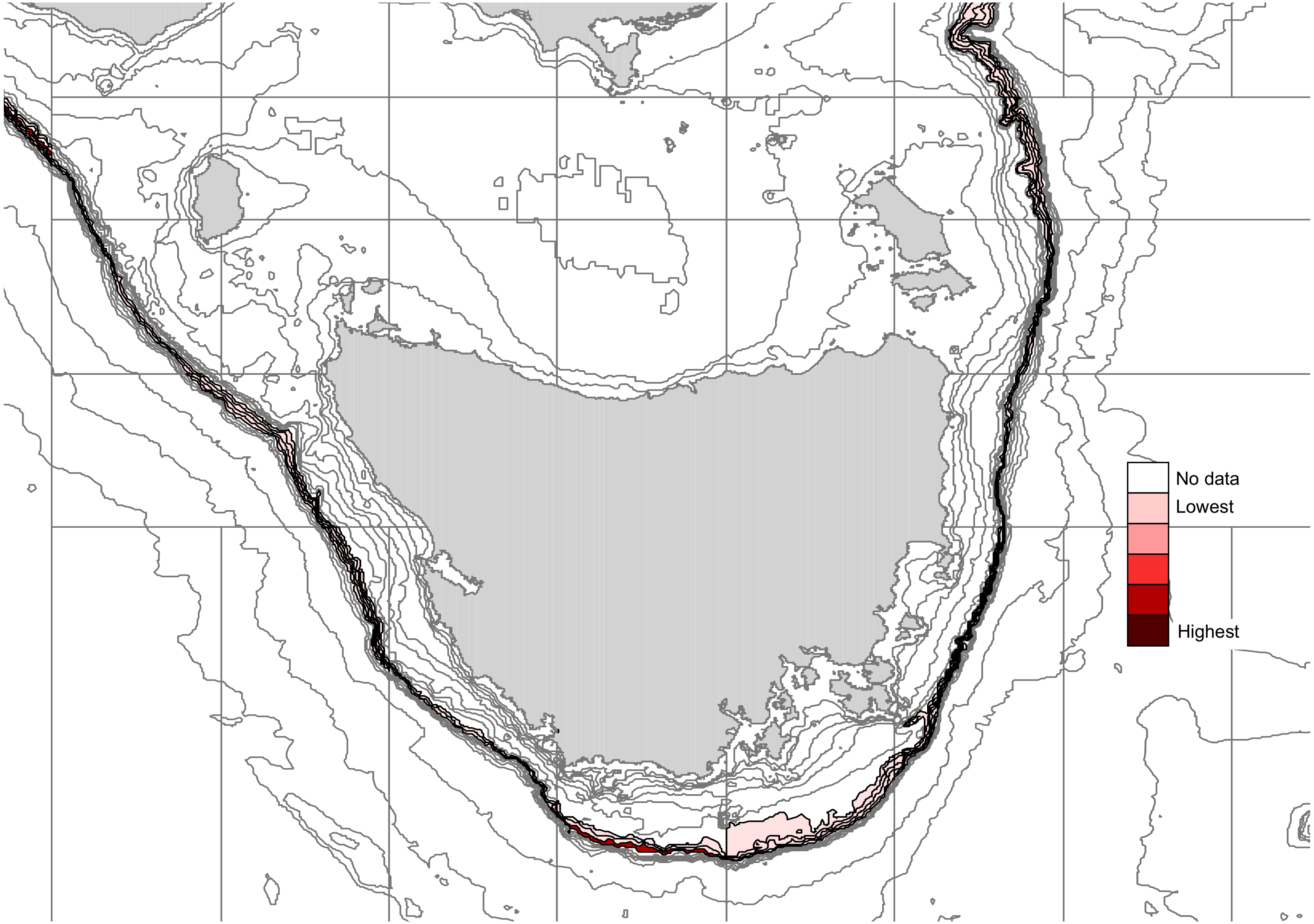
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.15a. Whitefin swell shark (*Cephaloscyllium* sp A) 2000–06 Otter trawl 200–700 m depth western region



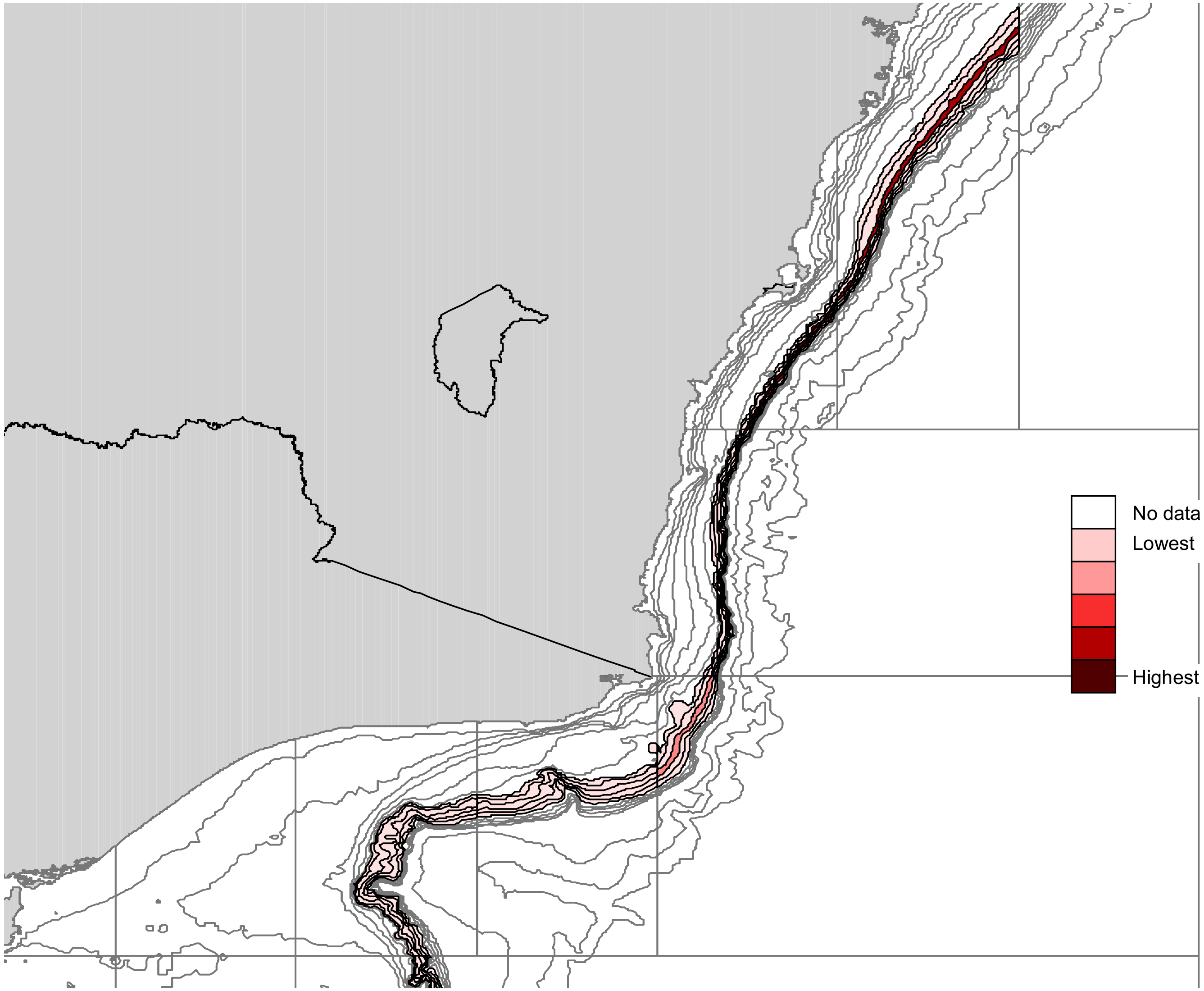
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 1.15b. Whitefin swell shark (*Cephaloscyllium* sp A) 2000–06 Otter trawl 200–700 m depth Bass Strait and Tasmania



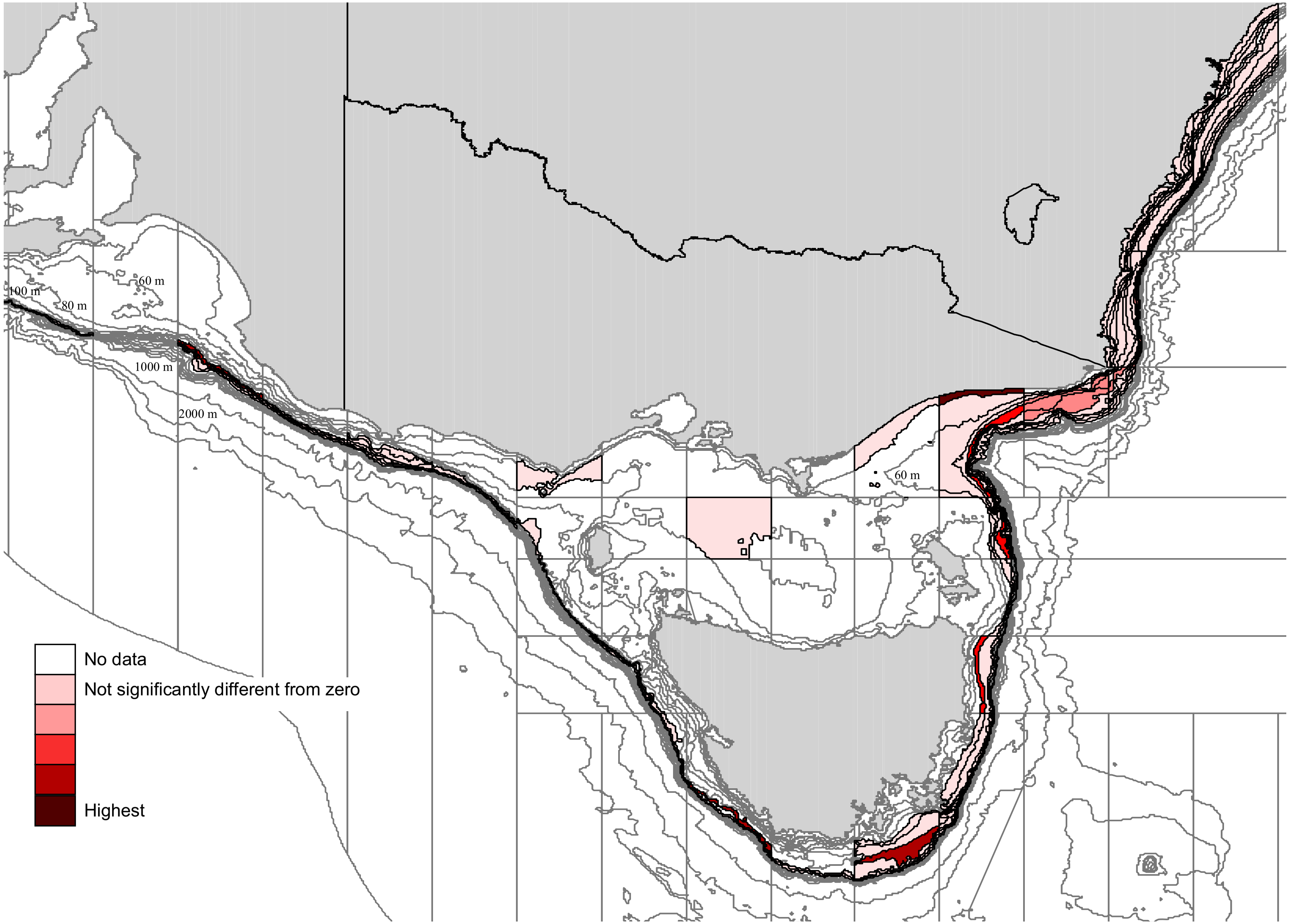
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 Janusry 2007

Map 1.15c. Whitefin swell shark (*Cephaloscyllium* sp A) 2000–06 Otter trawl 200–700 m depth New South Wales



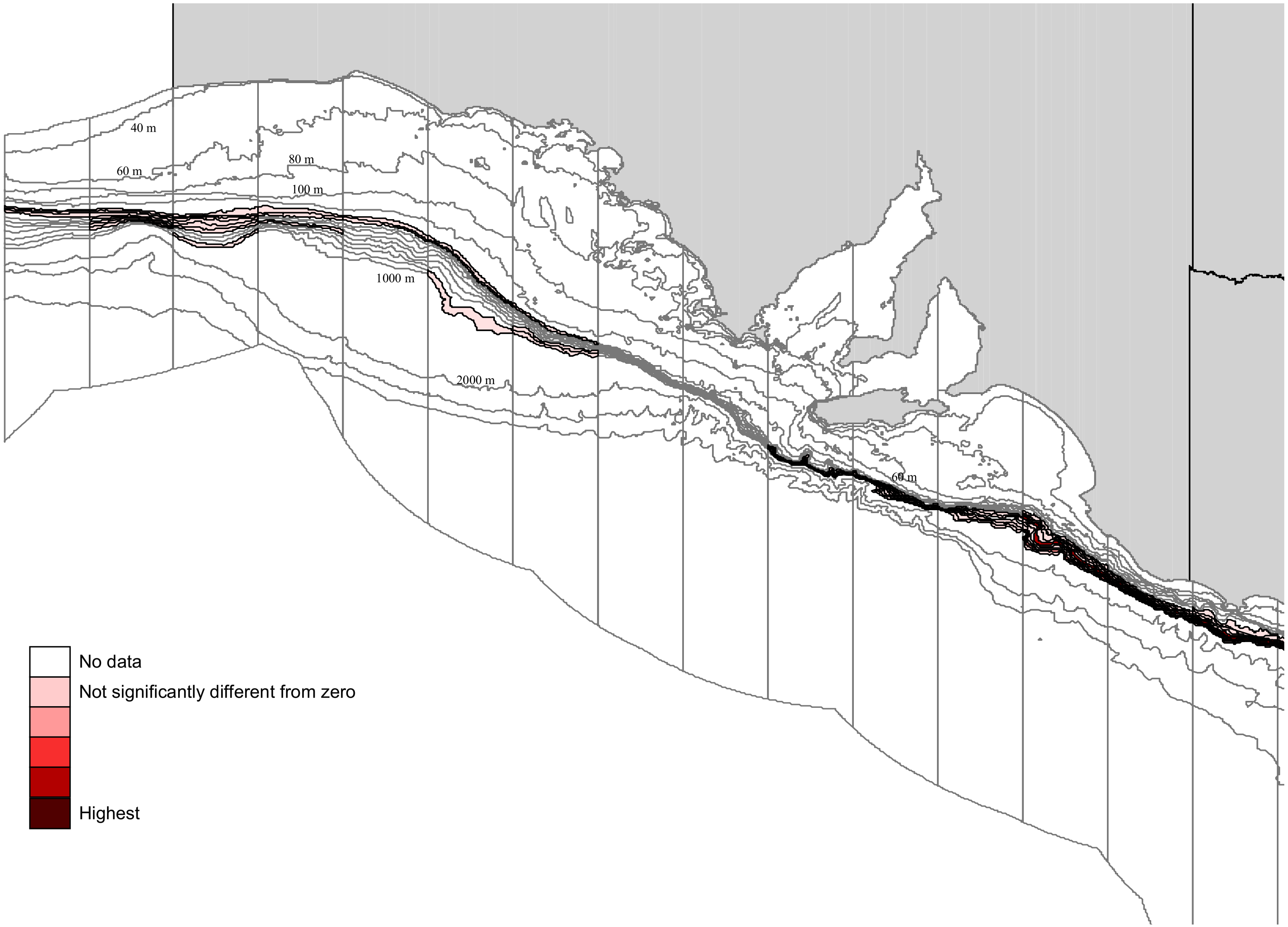
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 Janusry 2007

Map 2.01a. Banded stingaree (*Urolophus cruciatus*) 2000–06 Otter trawl 0–400 m depth southern Australia (longitude 136–151°E)



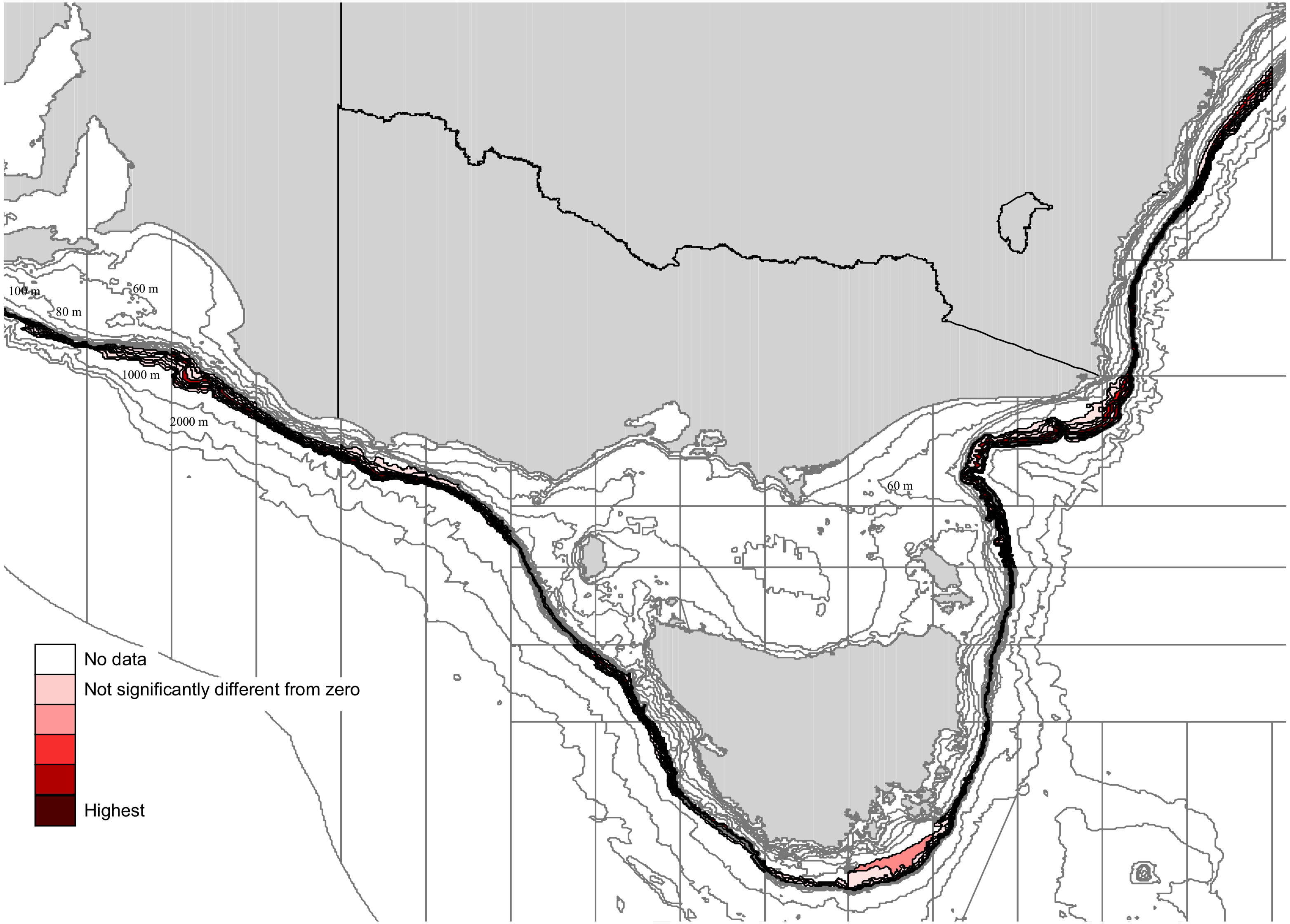
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 2.02a. Bight skate (*Dipturus gudgeri*) 2000–06 Otter trawl 160–1000 m depth South Australia (longitude 126–151° E)



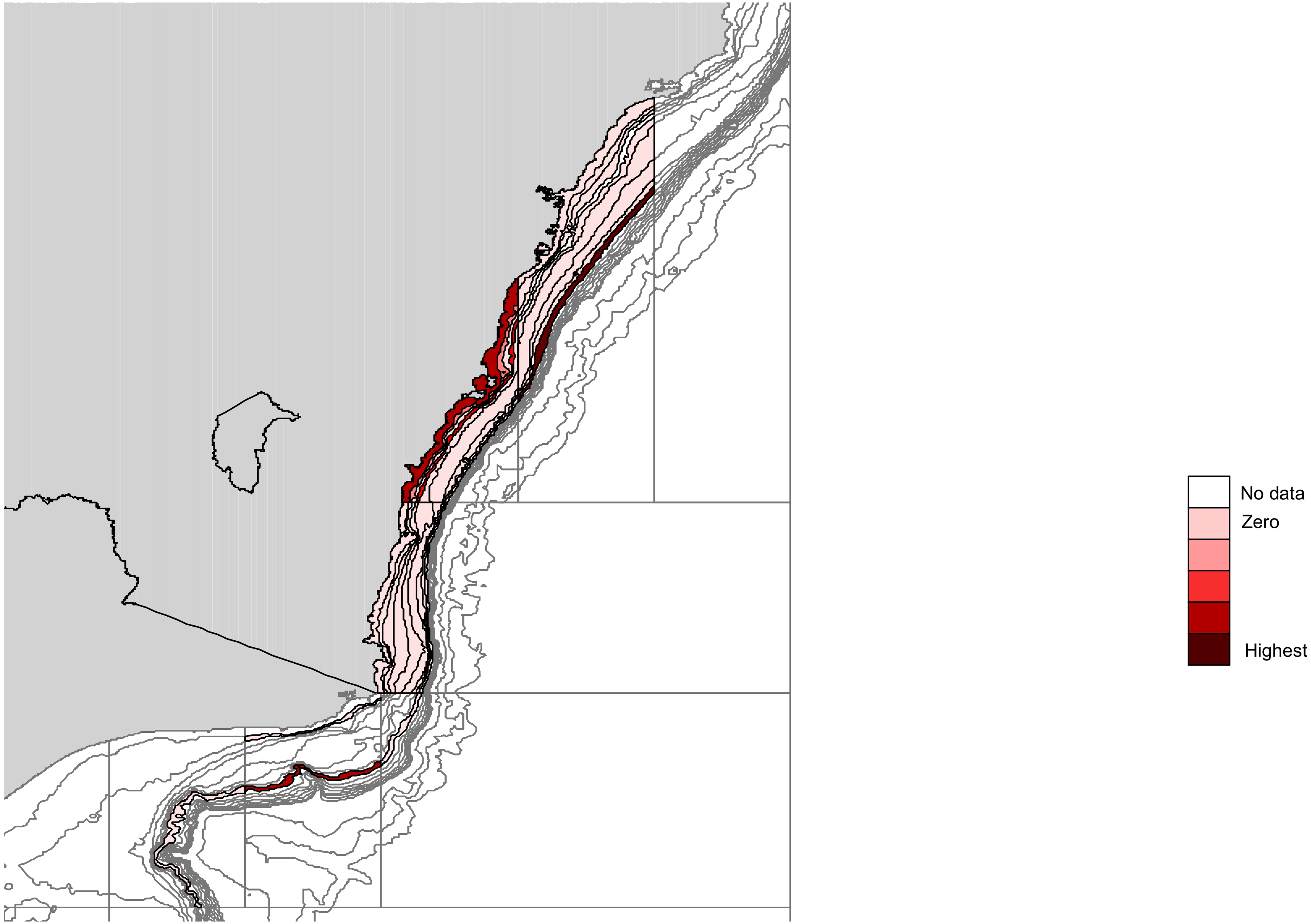
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 2.02b. Bight skate (*Dipturus gudgeri*) 2000–06 Otter trawl 160–1000 m depth south-eastern Australia (longitude 126–151° E)



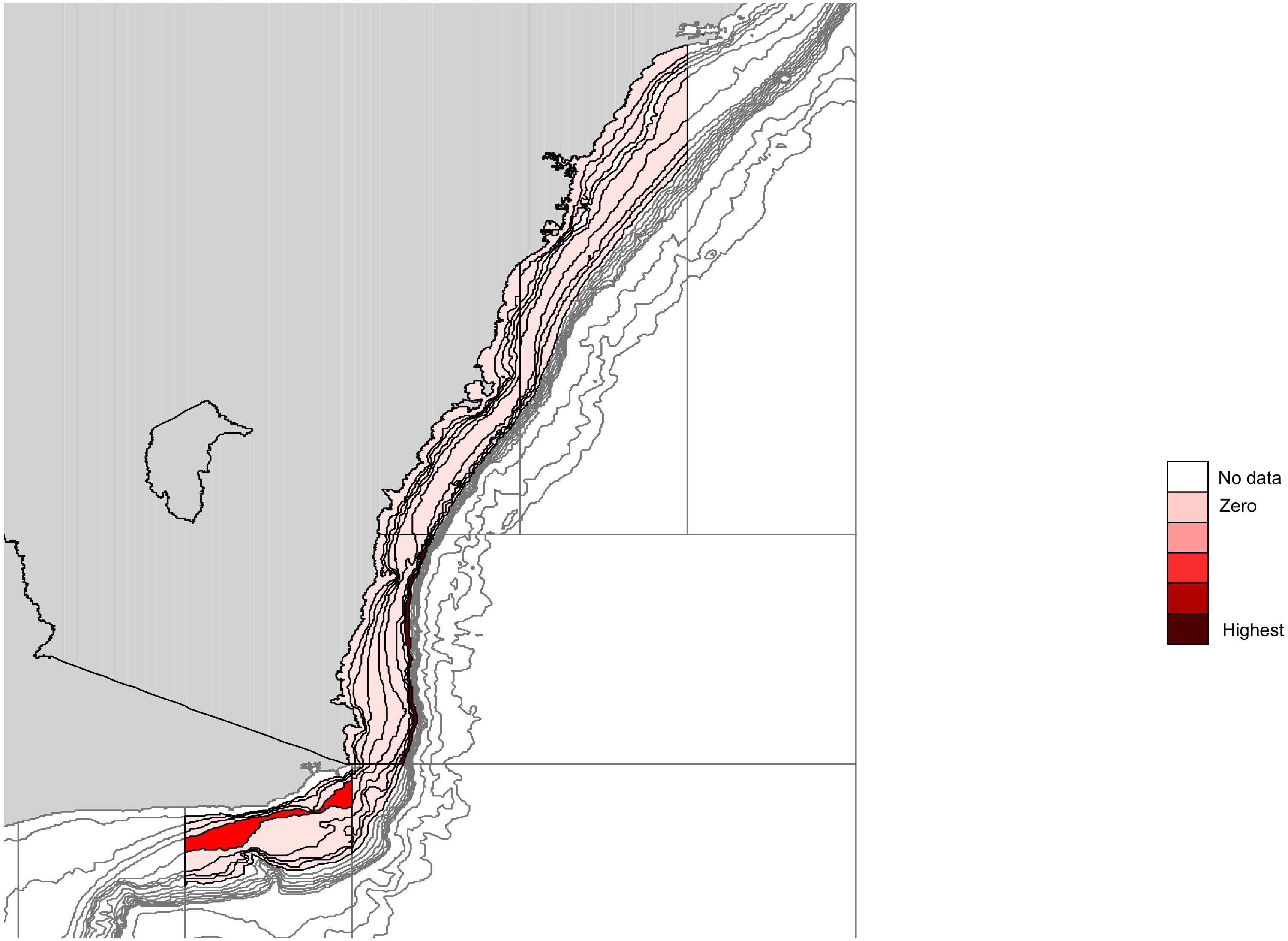
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 2.03a. Common stingaree (*Trygonoptera testacea*) 2001–06 SETF 0–300 m depth eastern Australia (longitude 148–151° E, latitude <38°S)



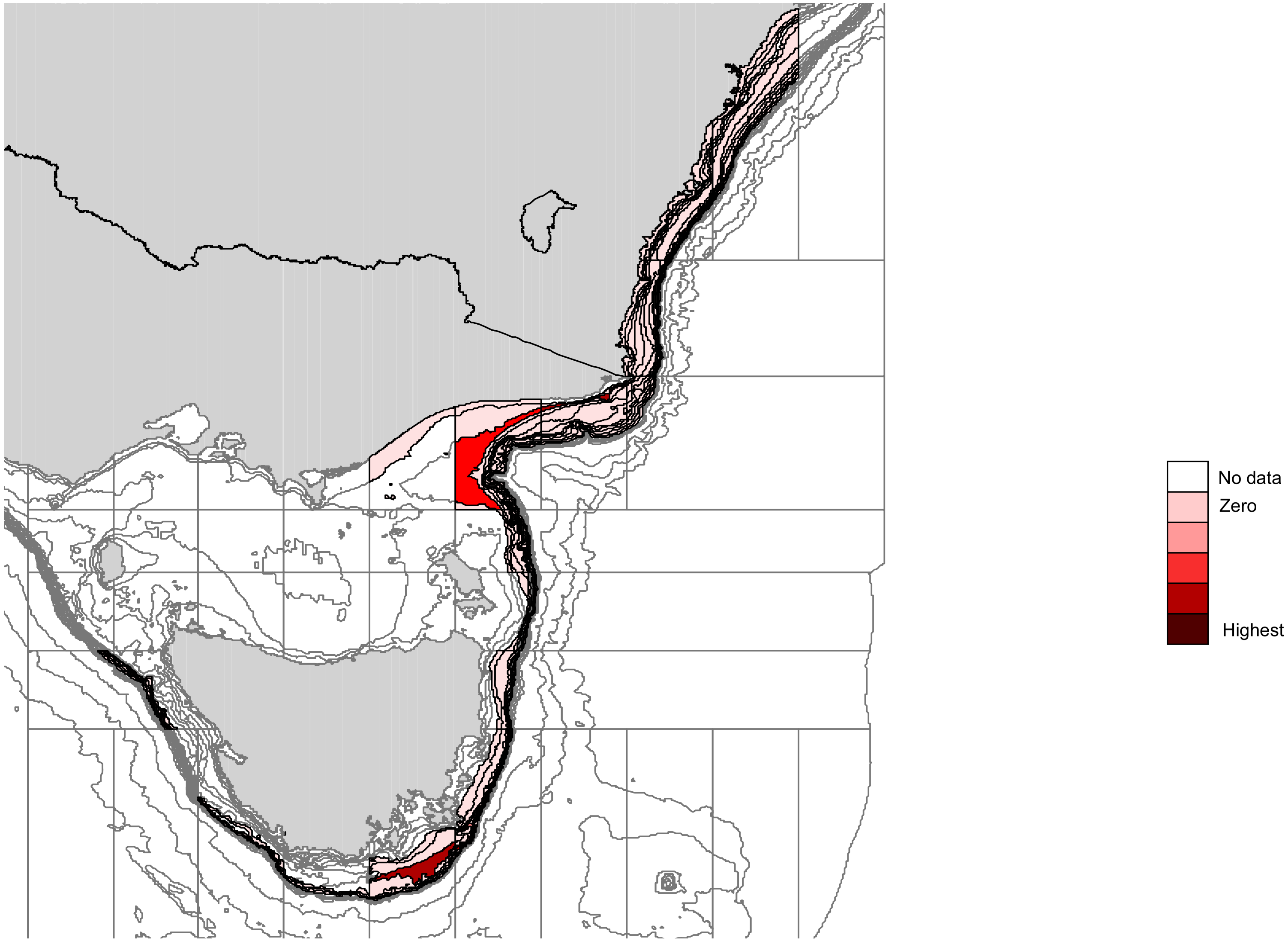
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 2.04a. Greenback stingaree (*Urolophus viridis*) 1998–06 SETF 0–300 m depth eastern Australia (longitude 149–151°E, latitude <38°S)



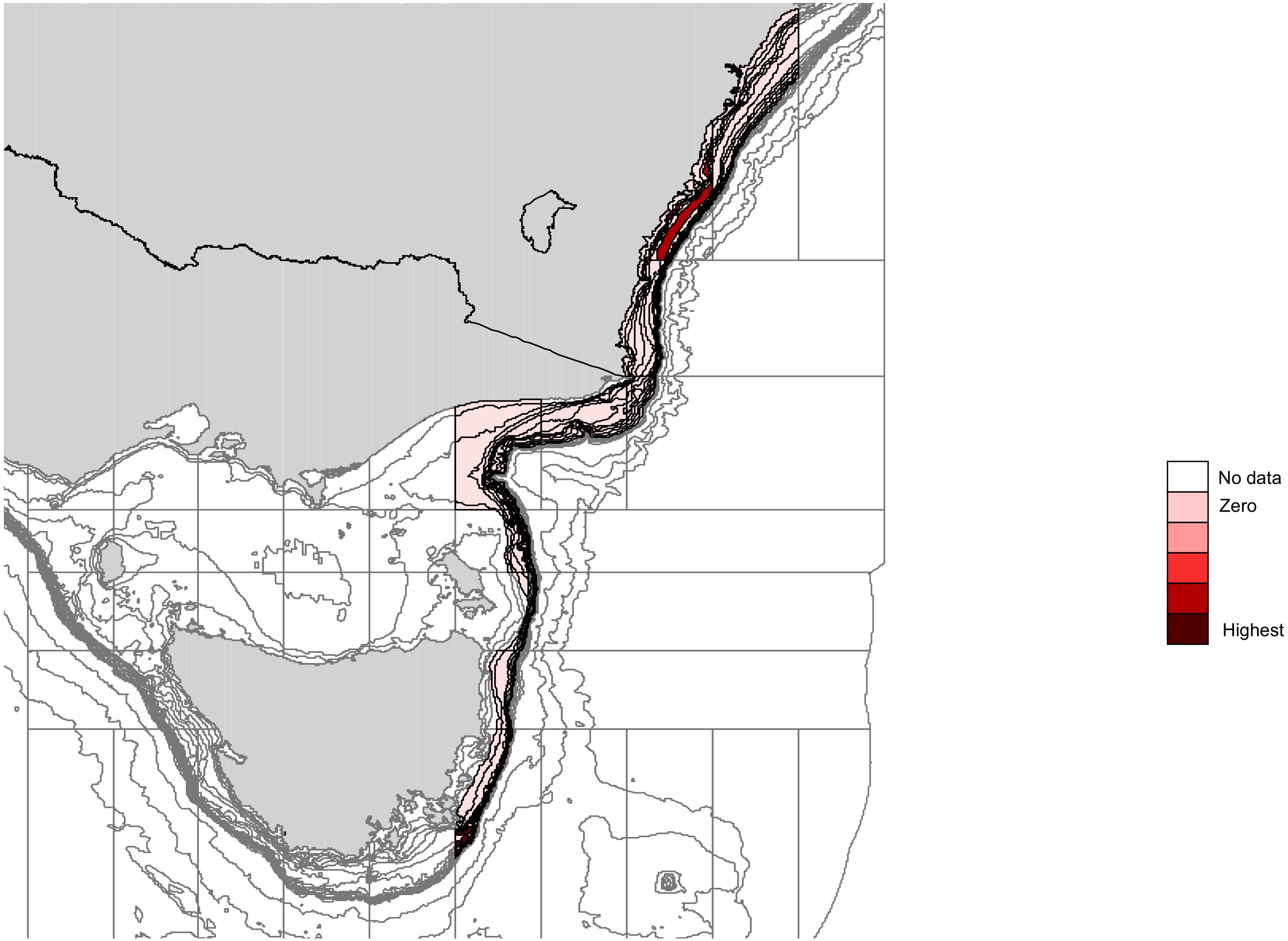
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 2.05a. Melbourne skate (*Dipturus whitleyi*) 1998–06 SETF 0–600 m south-eastern Australia (longitude 145–151° E)



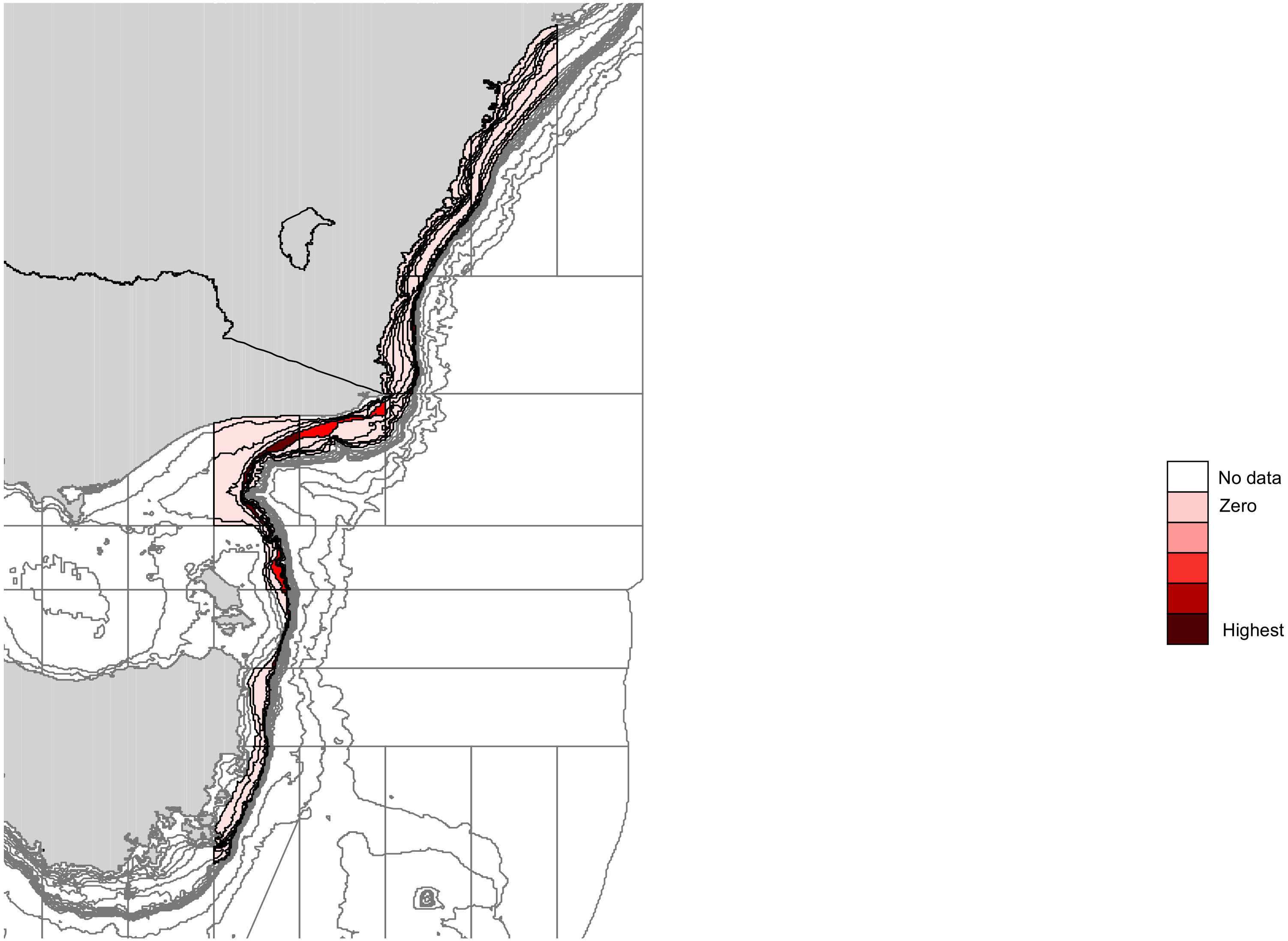
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 4.06a. Peacock skate (*Pavoraja nitida*) 2001–06 SETF 0–600 m depth eastern Australia (longitude 148–151° E)



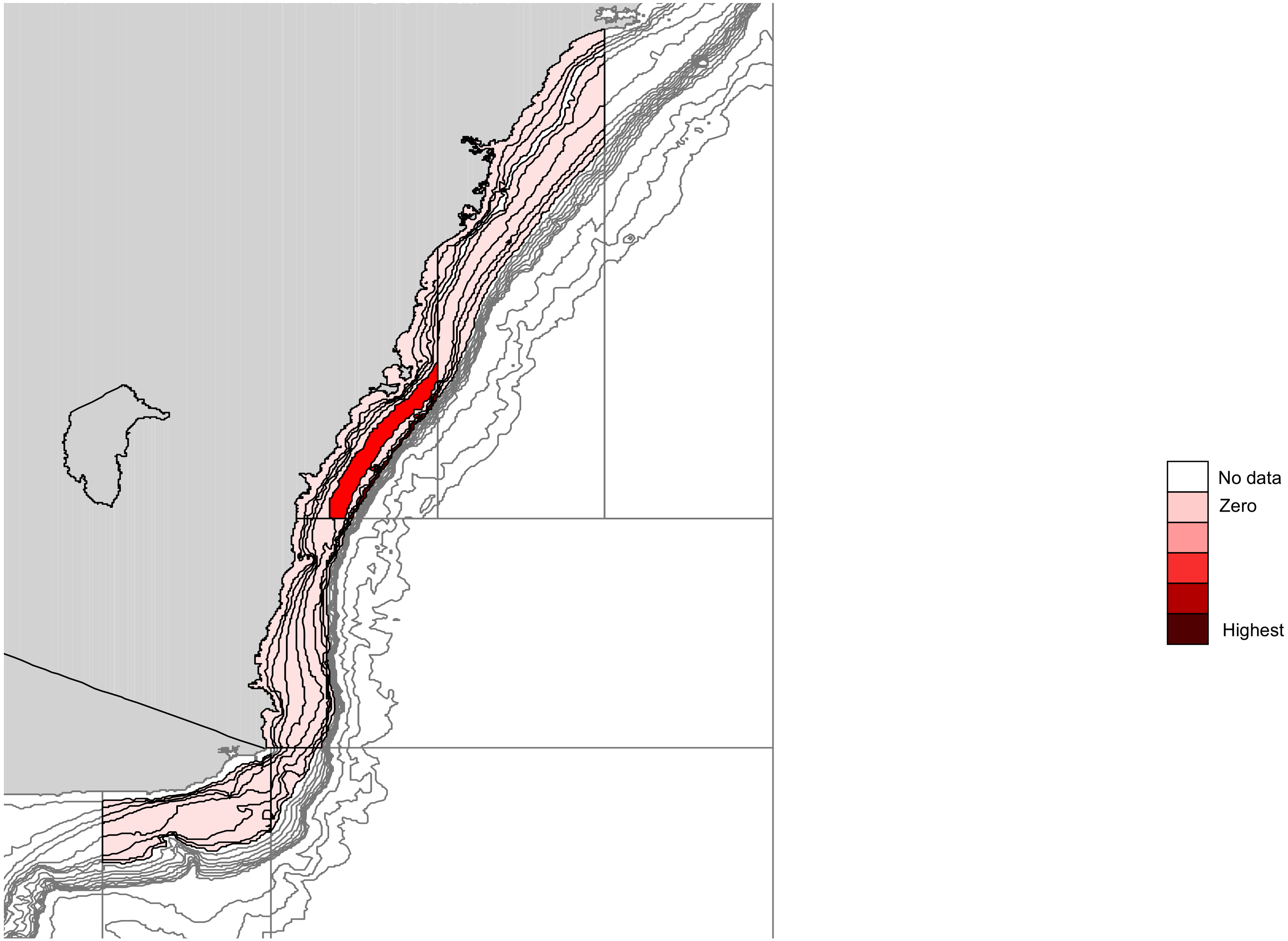
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 2.07a. Sandyback stingaree (*Urolophus bucculentus*) 1998–06 SETF 0–300 m depth eastern region (longitude 148–151° E)



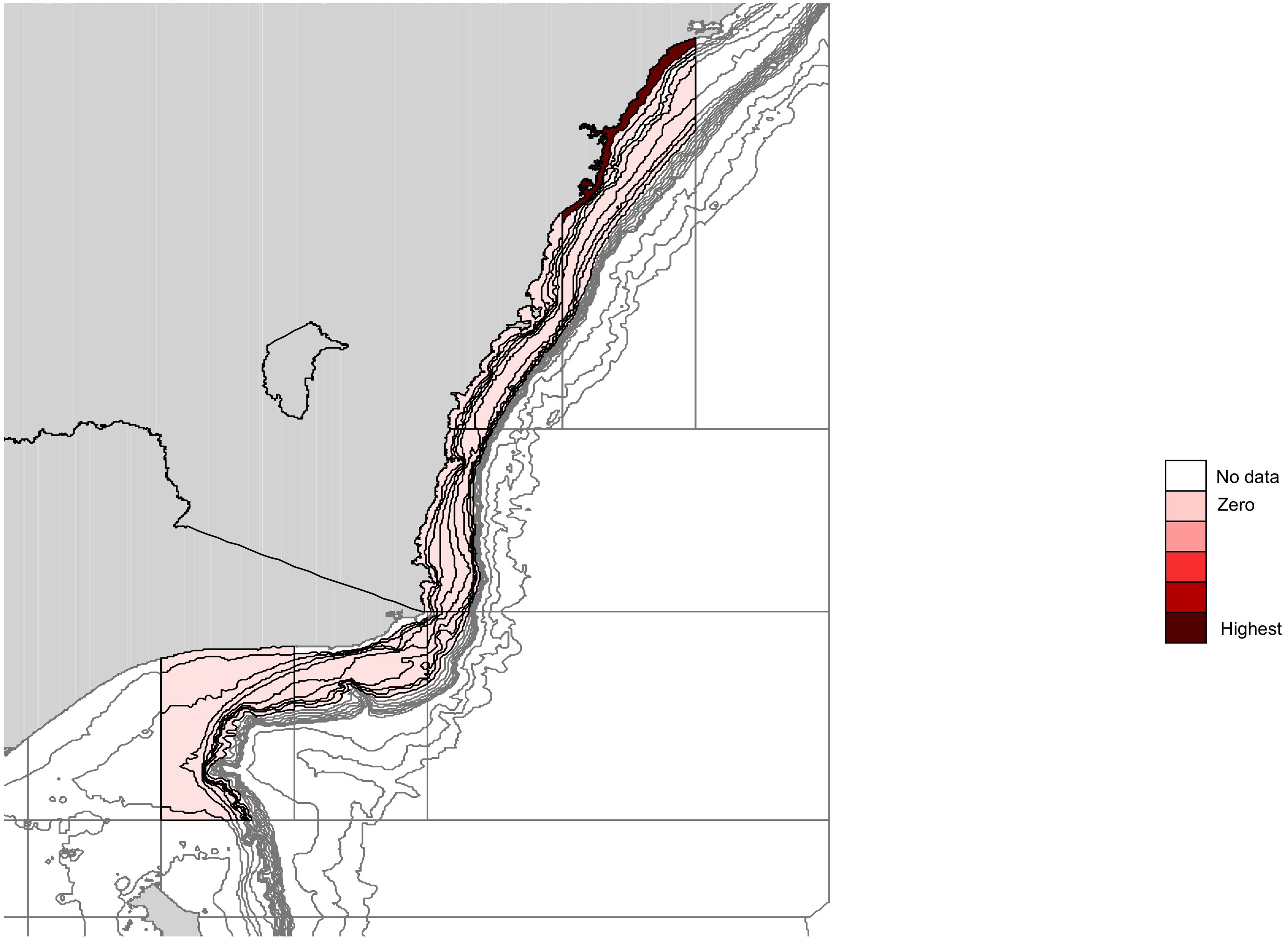
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 2.08b. Smooth stingray (*Dasyatis brevicaudata*) 2002–06 SETF 0–300 m depth eastern Australia (longitude 149–151° E)



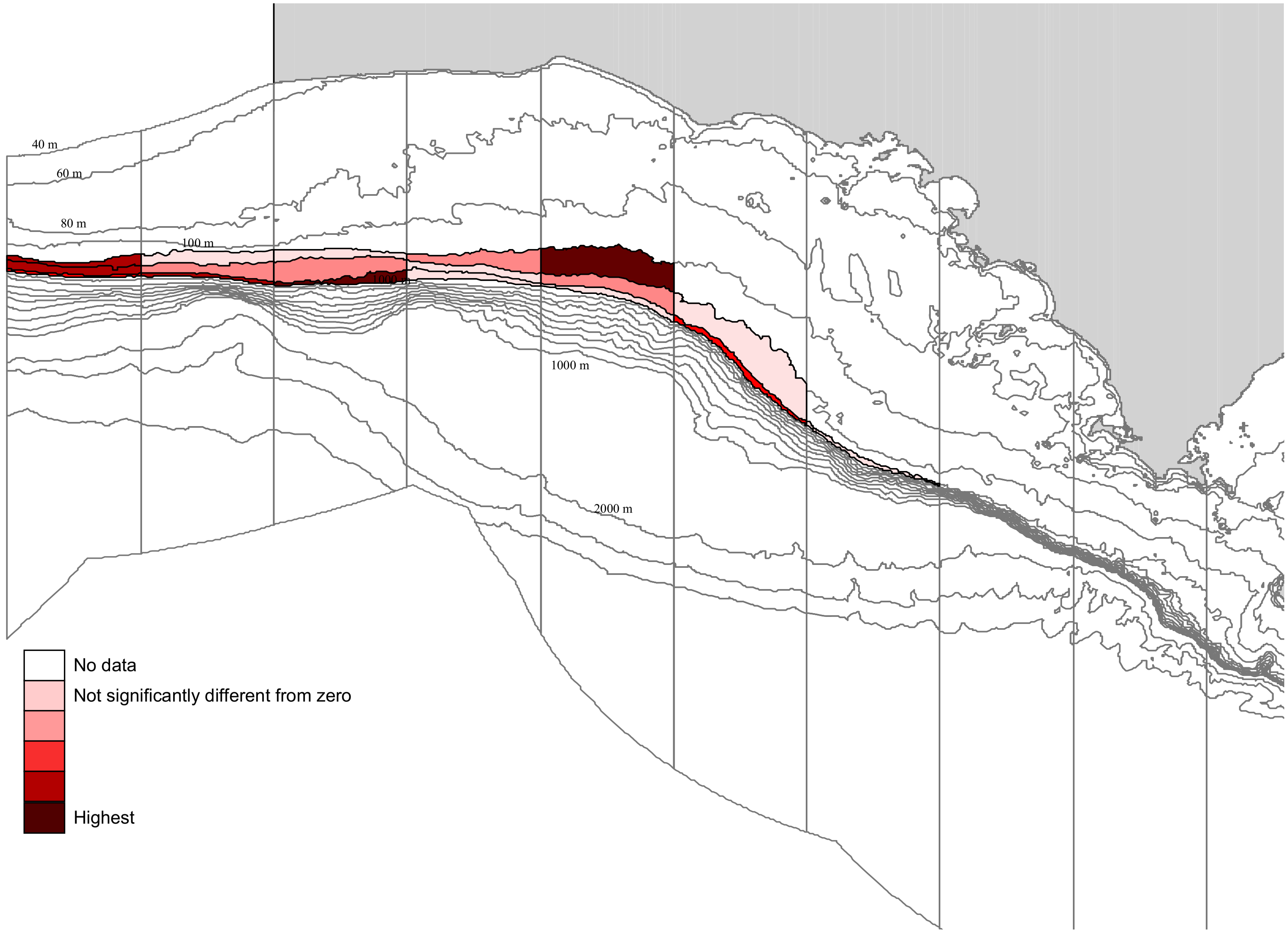
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 2.09a. Southern eagle ray (*Myliobatis australis*) 1998–06 SETF 0–300 m depth eastern Australia (longitude 148–151°E, latitude <39°S)



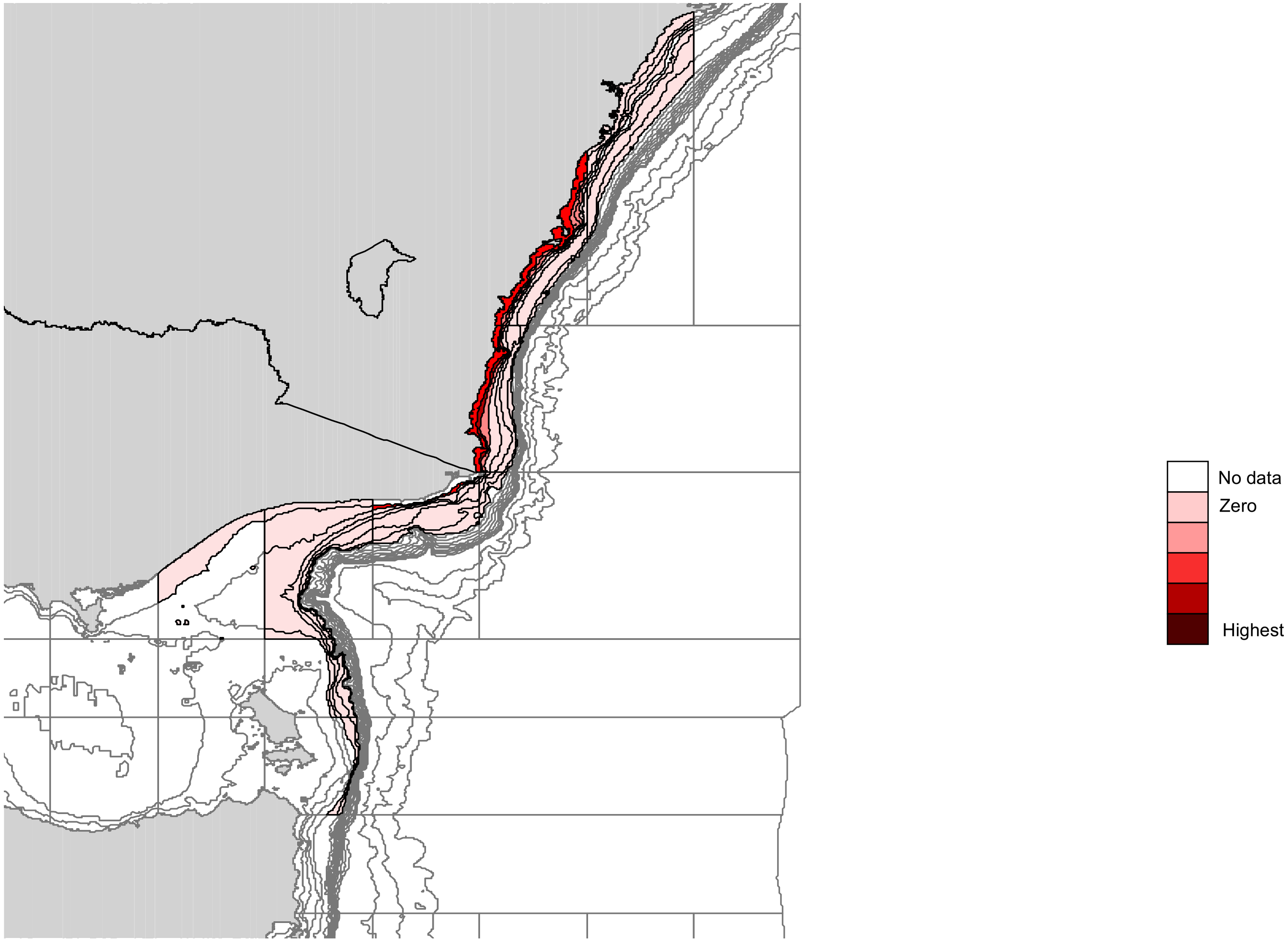
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 2.10a. Southern fiddler ray (*Trygonorrhina fasciata*) 2000–06 SETF 0–200 m depth Great Australian Bight (longitude 127–151° E, lat. <38° S)



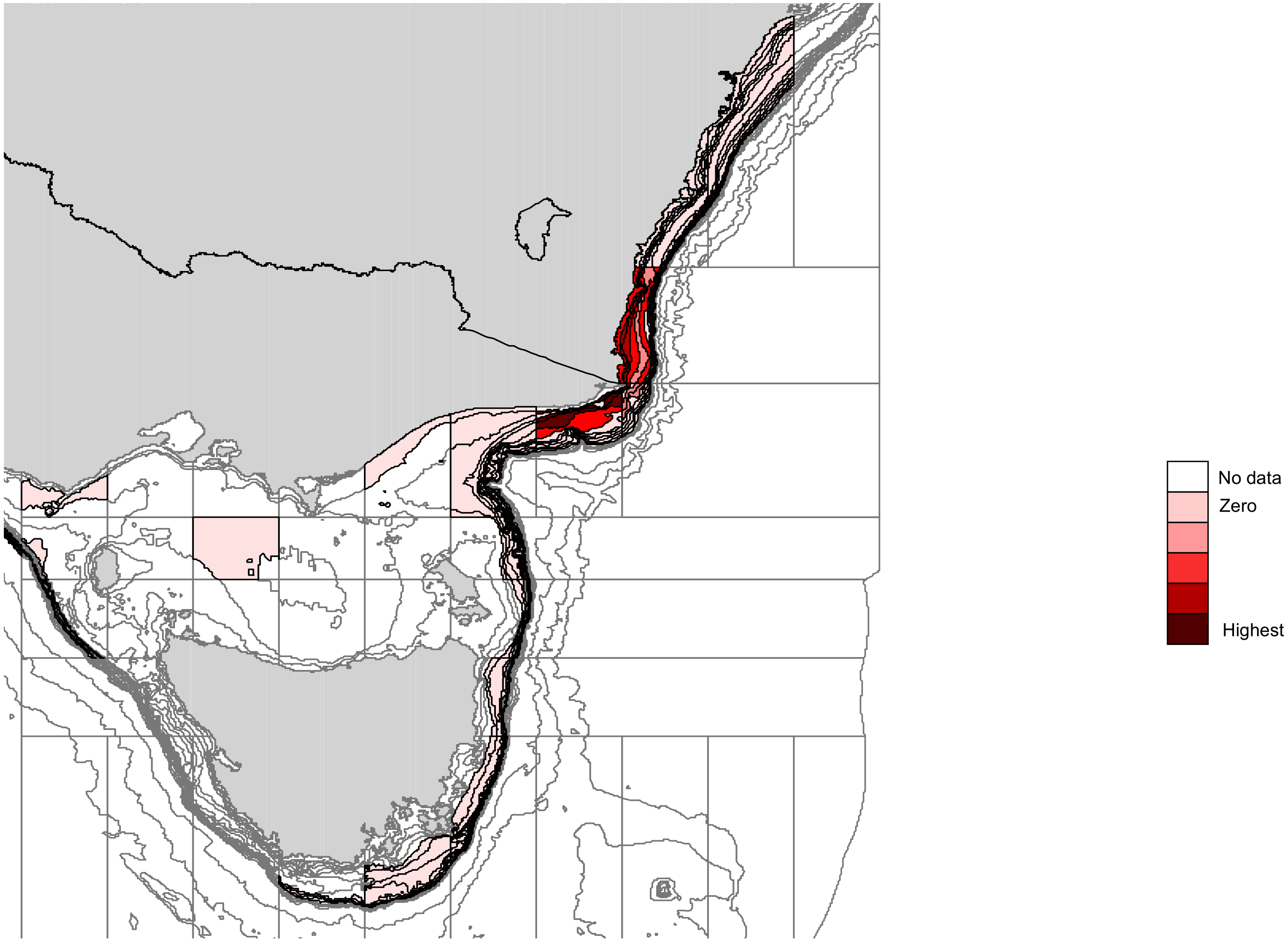
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 2.10b. Southern fiddler ray (*Trygonorrhina fasciata*) 2000–06 SETF 0–200 m depth eastern Australia (longitude 148–151° E, latitude <38° S)



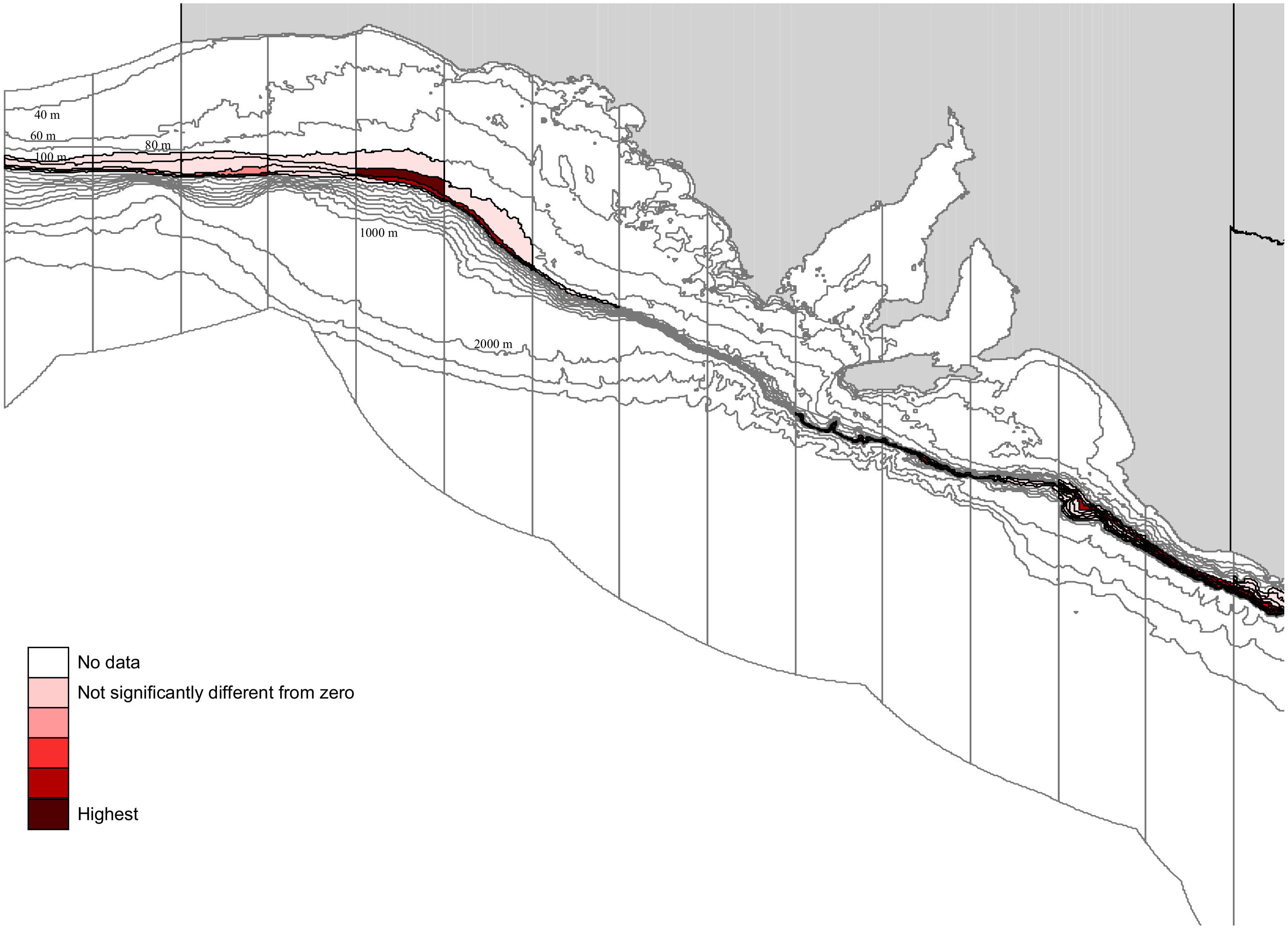
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 2.11a. Sparsely spotted stingaree (*Urolophus paucimaculatus*) 1998–06 SETF 0–300 m depth eastern Australia (longitude 148–151° E)



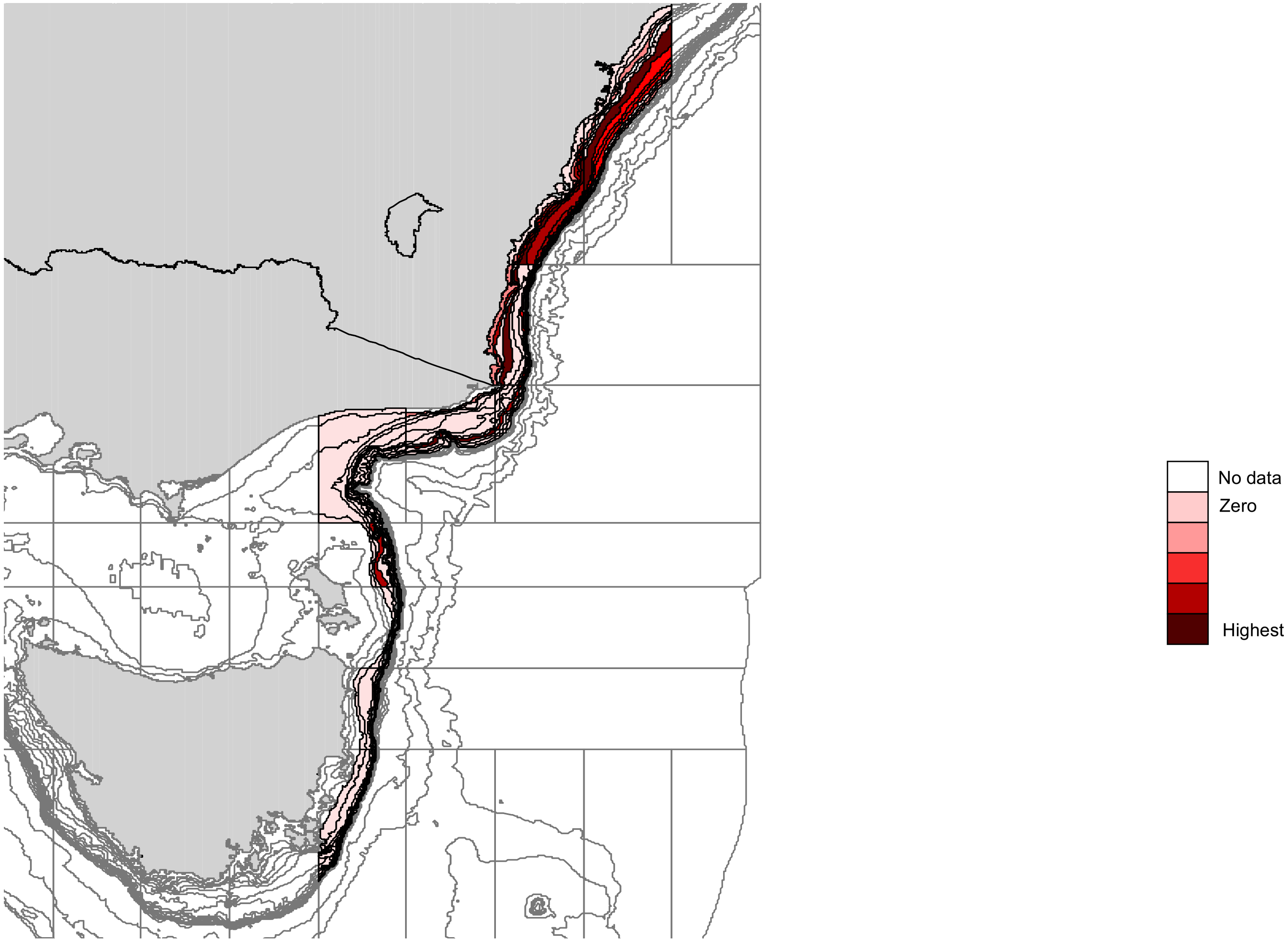
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 2.12a. Short-tail torpedo ray (*Torpedo macneilli*) 2000–06 otter trawl 60–600 m depth southern Australia (longitude 127–151°E)



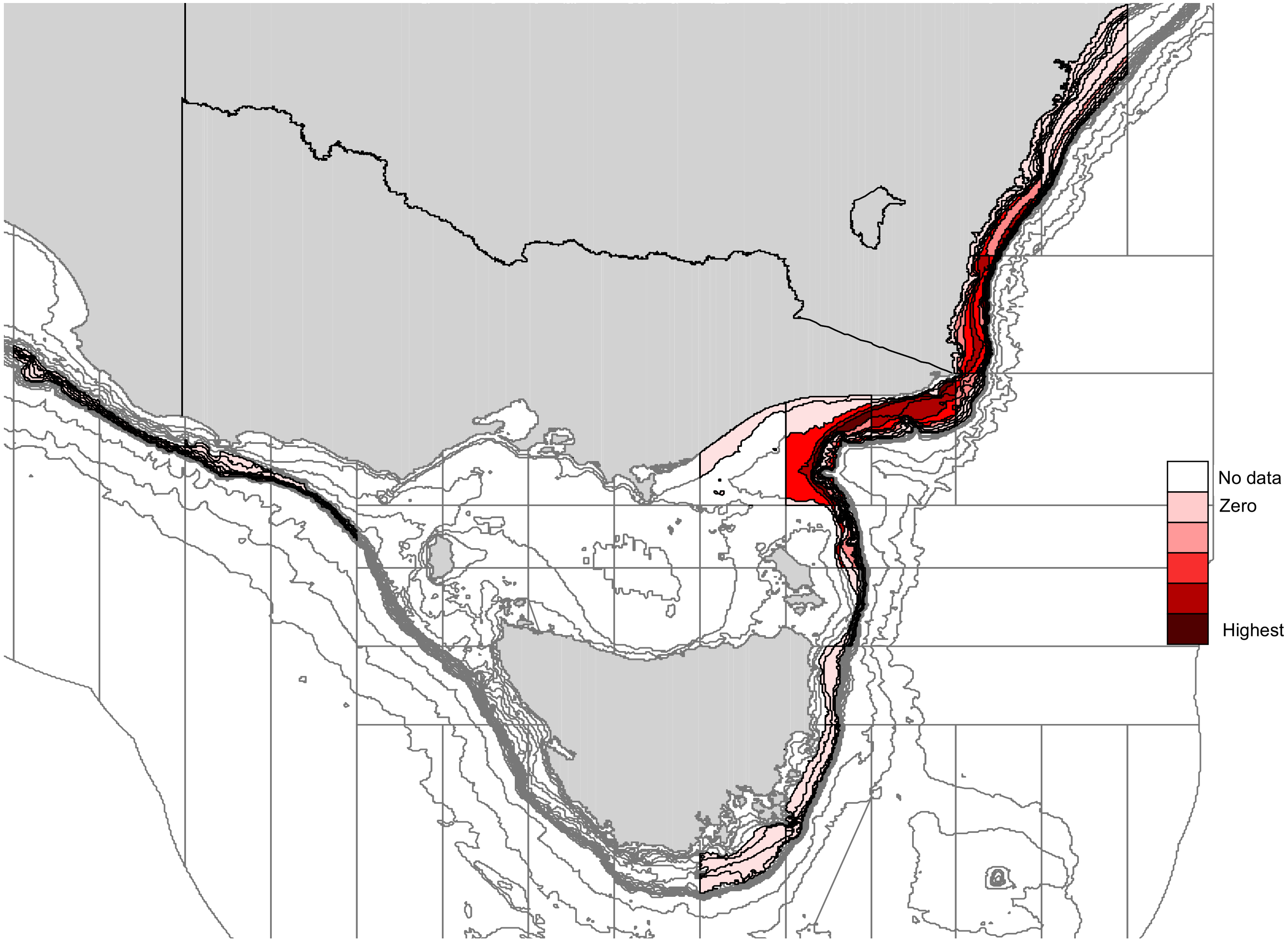
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 2.13a. Sydney skate (*Dipturus australis*) 1998–06 SETF 60–600 m depth eastern Australia (longitude 148–151° E)



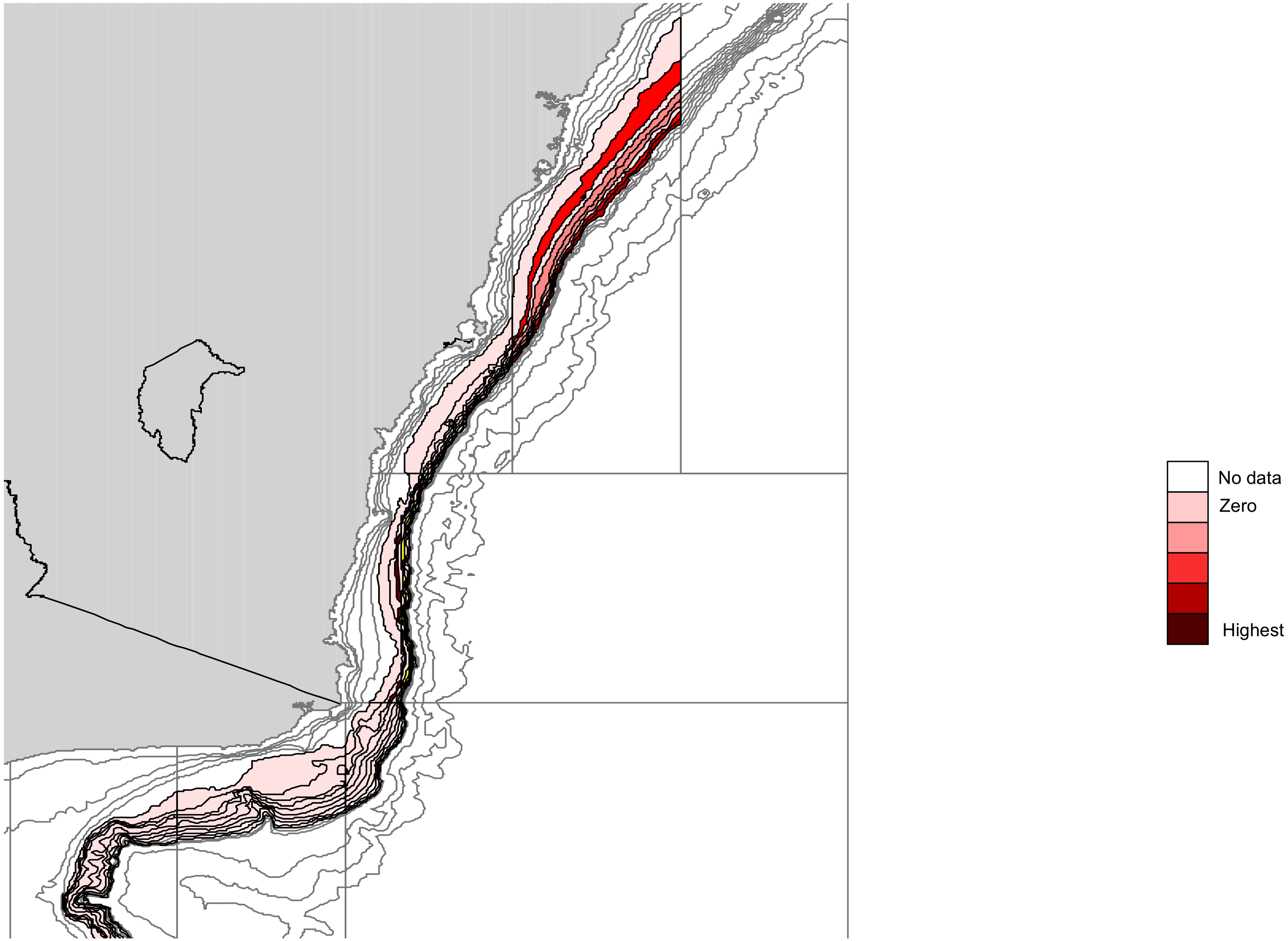
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 2.14a. Tasmanian numbfish (*Narcine tasmaniensis*) 2000–06 otter trawl 0–600 m depth southern Australia (longitude 127–151° E)



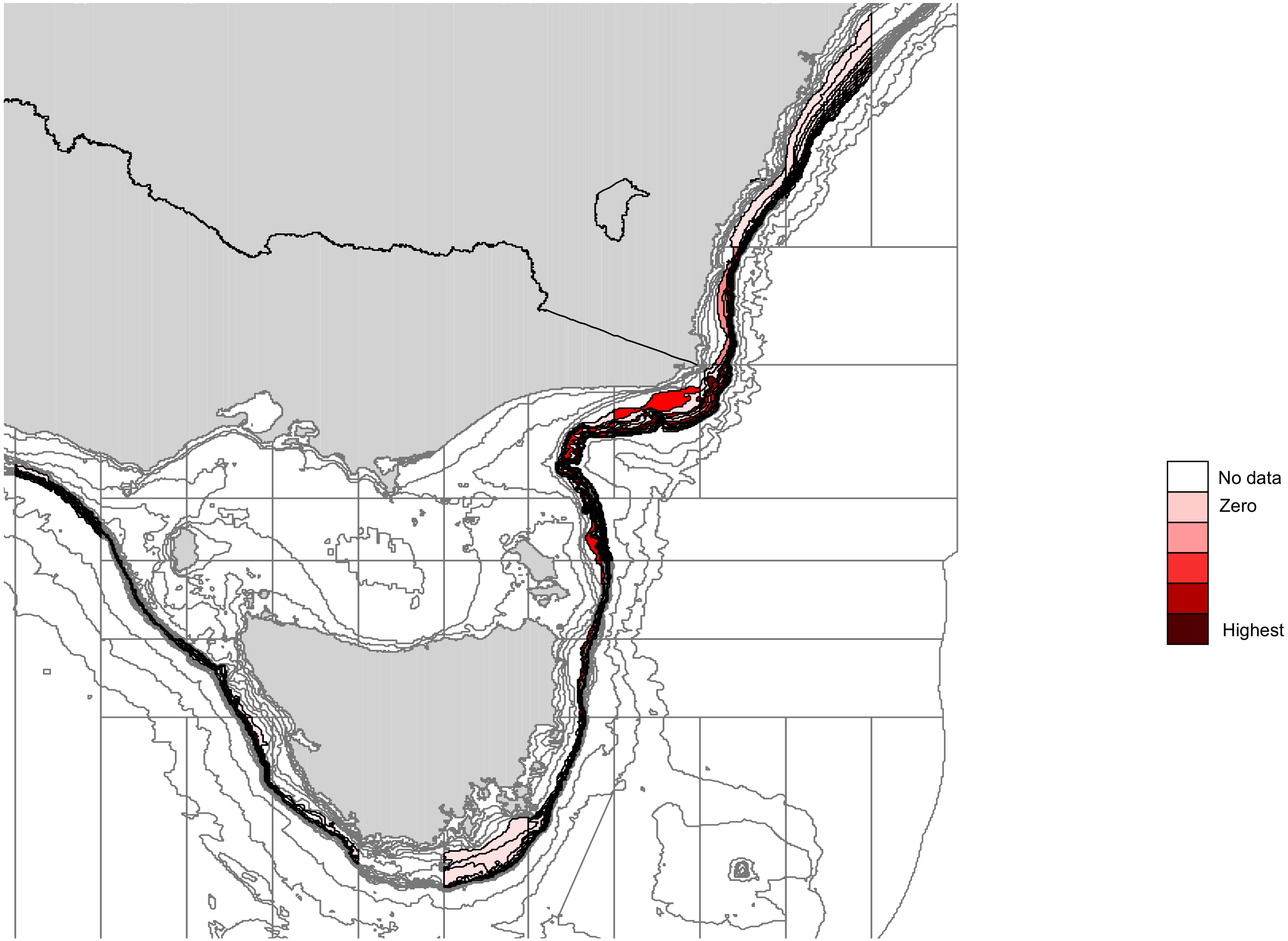
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 3.01a. Blackfin ghostshark (*Hydrolagus lemures*) 2002–06 SETF 140–1000 m depth eastern Australia (longitude 148–151° E)



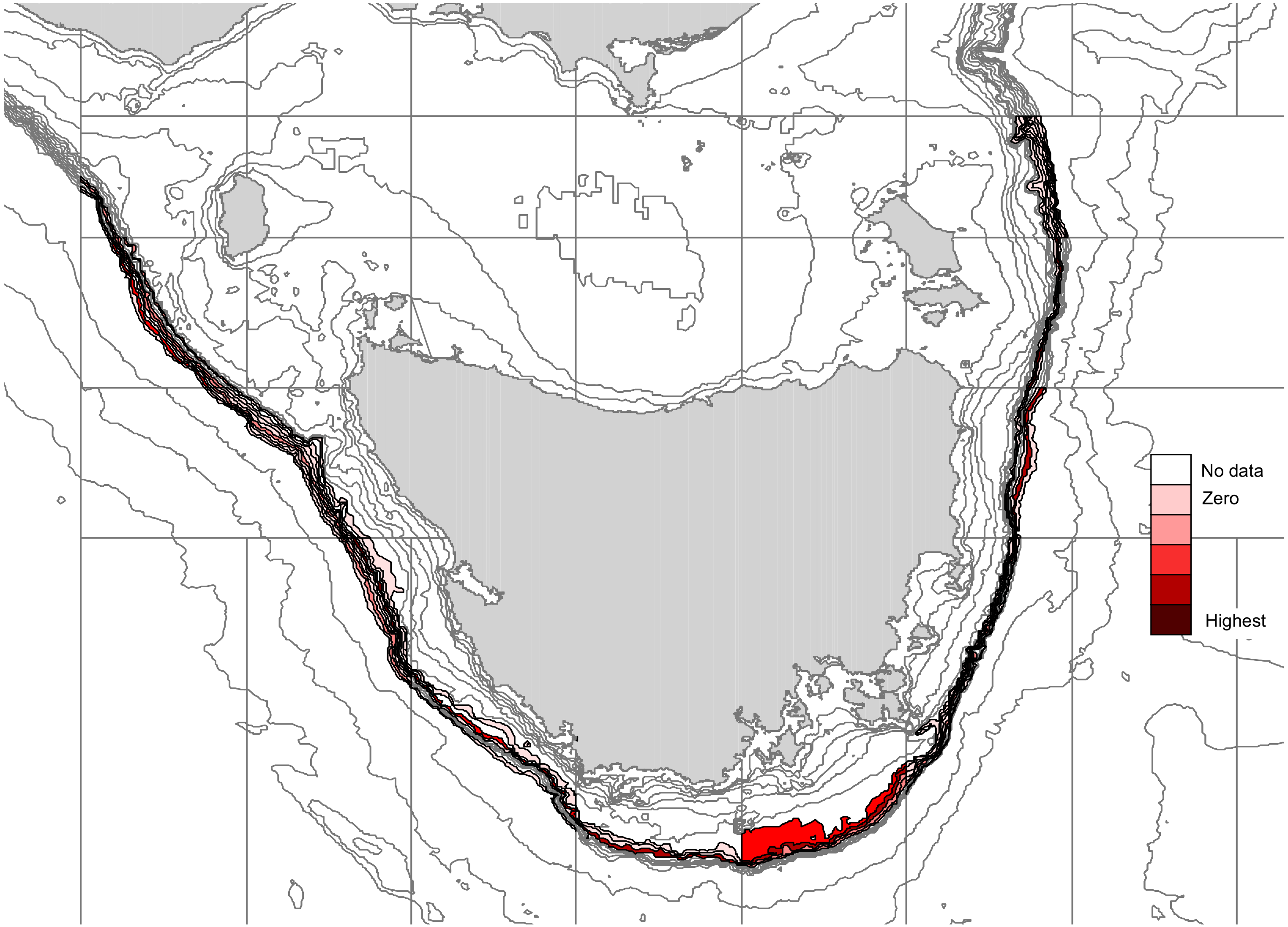
Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 3.02a. Ogilbys ghostshark (*Hydrolagus ogilbyi*) 2000–06 SETF 140–1000 m depth south-eastern Australia (longitude 141–151° E)



Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007

Map 3.03a. Southern chimaera (*Chimaera* sp a) 2000–06 SETF 200–1000 m depth south-eastern Australia (longitude 136–151° E)



Source: PIRVic Queenscliff Centre, DIMSAS-SESSF, ISMP 22 January 2007