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ABARE is a professionally independent government economic research agency.

### **Previous fisheries surveys reports**

#### ***Northern prawn fishery***

<i>Years covered</i>	<i>Reference</i>
1980-81 to 1981-82	BAE (1984a)
1986-87 to 1987-88	Collins and Kloessing (1988)
1989-90 to 1990-91	ABARE (1993a)
1990-91 to 1991-92	ABARE (1993b)
1992-93 to 1993-94	ABARE (1996a)
1994-95 to 1995-96	ABARE (1997)

#### ***East coast prawn fishery***

<i>Years covered</i>	<i>Reference</i>
1980-81 to 1982-83	BAE (1985a)

#### ***East coast tuna fishery (now the eastern tuna and billfish fishery)***

<i>Years covered</i>	<i>Reference</i>
1989-90 to 1990-91	ABARE (1993a)
1991-92 to 1992-93	ABARE (1994)
1993-94 to 1994-95	ABARE (1996b)

#### ***Southern rock lobster fishery***

<i>Years covered</i>	<i>Reference</i>
1981-82 to 1982-83	BAE (1985b)

#### ***Bass strait scallop***

<i>Years covered</i>	<i>Reference</i>
1993-94 to 1994-95	BAE (1985b)

### ***South east fishery***

<i>Years covered</i>	<i>Reference</i>
1978-79 to 1980-81	BAE (1984b)
1985-86 to 1987-88	Geen, Brown and Pascoe (1989)
1989-90 to 1990-91	ABARE (1993a)
1990-91 to 1991-92	ABARE (1993b)
1991-92 to 1992-93	ABARE (1994)
1992-93 to 1993-94	ABARE (1996a)
1994-95 to 1995-96	ABARE (1997)

#### ***Southern bluefin tuna fishery***

<i>Years covered</i>	<i>Reference</i>
1980-81 to 1981-82	BAE (1986)

#### ***Southern shark fishery***

<i>Years covered</i>	<i>Reference</i>
1988-89	Battaglione and Campbell (1991)
1990-91 to 1991-92	ABARE (1993b)
1992-93 to 1993-94	ABARE (1996a)
1993-94 to 1994-95	ABARE (1996b)

#### ***Torres Strait prawn fishery***

<i>Years covered</i>	<i>Reference</i>
1989-90	Battaglione, Reid and Collins (1992)
1992-93 to 1993-94	ABARE (1996a)
1994-95 to 1995-96	ABARE (1997)

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# Foreword

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ABARE has been undertaking economic surveys of selected Commonwealth fisheries since the early 1980s. Detailed information on fleet characteristics and economic performance is collected each year and published in an ongoing series of reports.

The survey information is used by fisheries policy makers, managers, researchers and the fishing industry. For example, it is used by the Department of Agriculture, Fisheries and Forestry in assessing the Australian Fisheries Management Authority's performance in managing Commonwealth fisheries. The information is made publicly available so that the industry can also independently assess the performance of fisheries and the impacts of management policies.

The current survey format has been in place since 1992. Gradually, a consistent

time series is being developed for each fishery, to enable changes to be tracked over time. Time series data on costs and returns are crucial for economic assessments of fisheries, in the same way that catch and effort data are crucial for scientific assessments. As far as possible, the economic information in this report is presented in a consistent format, to allow comparisons between fisheries and over time.

This fisheries surveys report contains detailed estimates of the financial and economic performance of operators in the fisheries surveyed by ABARE in 1998.

STEPHEN BEARE  
*Acting Executive Director*  
December 1998

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# Acknowledgments

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## **Industry**

ABARE surveys are voluntary. Cooperation of fishing operators and their accountants in providing data is essential for the success of the fisheries surveys. The advice provided by the Australian Fisheries Management Authority (AFMA), industry representatives and the relevant Management Advisory Committees is also greatly appreciated.

## **Management and research agencies**

AFMA and the Marine and Freshwater Research Institute (MAFRI) provided logbook information necessary to select a sample and provide relevant population statistics. In particular, Thim Skousen of AFMA and Russell Hudson of MAFRI provided valuable assistance. AFMA was supportive of the data collection and offered valuable advice.

## **Funding**

The 1998 surveys of the southern shark fishery, eastern tuna and billfish fishery and the Bass Strait scallop fishery were

funded by ABARE and the Fisheries Resources Research Fund.

## **ABARE staff**

ABARE's fisheries surveys program involves a cooperative effort among industry, fisheries management and research agencies and ABARE staff. Paula Holland, Adam Stokes and Debbie Brown of the Fisheries Economics Section undertook the analyses and compiled the report with the assistance of Laurie Cannon of the Information Services Section.

Sample selection and sample weighting were performed by Walter Shafron of the Rural Economic Analysis Section. Data were collected, entered and edited by Lorraine Crowe, Fiona Fitzsimmons, Ron Godenzi, Damo Nambiar, Richard Paton, Lou Sissian and Robin Stafford of the Information Services Section. Survey administration and questionnaire design were carried out by Laurie Cannon, Paul Philips and Tony Wain. Programming and computer systems support was provided by Shona Lambert and Ken Colbert of the Information Services Section.

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# Summary

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## 1998 surveys

ABARE conducted economic surveys of three major Commonwealth fisheries in 1998 — the southern shark fishery, the eastern tuna and billfish fishery, and the Bass Strait scallop fishery. Presented in this report is information on per boat cash receipts, costs, profits, debt and equity for each fishery in 1995-96 and 1996-97.

For the southern shark and eastern tuna and billfish fisheries specifically, the information is also disaggregated into their major sectors. For the southern shark fishery, results are presented for operators with five, six and ten net units, hook operators and shark specialists (those earnings at least 80 per cent of fishing income from shark sales in the survey year). For the eastern tuna and billfish fishery, results are provided for the longline and other sectors.

Projections for 1997-98 have not been included for any of the fisheries surveyed this year because adequate catch and effort data were not available.

## Southern shark fishery

The southern shark fishery is located in Commonwealth waters off south eastern Australia. It has traditionally been managed under complementary state and Commonwealth arrangements, involving a range of entry and effort controls (ABARE 1996). In June 1997 it was announced that individual transferable quotas (ITQs), along with some input controls, would be the focus of future management arrangements to be implemented in 1999.

The value of production in the fishery was estimated at \$17.8 million in 1996-97 or around 6 per cent of total Common-

wealth fisheries production (ABARE 1998).

From the survey, average boat profits for the fleet were estimated to be around \$17 900 in 1996-97, with an average rate of return to capital estimated to be around 14 per cent. Hook operators recorded the best performance in the southern shark fishery, earning the highest estimated average boat profits (\$43 000). Shark specialists also performed relatively well, with an average estimated boat profit of around \$24 200. The poorest performance in the fishery was estimated to come from the smallest net operators, which were estimated to incur a business loss of \$7300 on average.

Average cash receipts for all operators in the fishery were estimated to be around \$276 600 in 1996-97. Shark receipts dominated operator incomes, although lobster receipts were also significant.

Across the fleet in 1996-97, the average level of debt per boat was estimated to have declined by 12 per cent. Boat purchases were estimated to have accounted for 64 per cent of overall debt.

## Eastern tuna and billfish fishery

The eastern tuna and billfish fishery is one of the largest fisheries, by area, in Australia. The major species caught include yellowfin, bigeye and skipjack tunas and broadbill swordfish. Sharks and finfish are also caught as bycatch (ABARE 1996). In 1996-97, the estimated value of the production in the fishery was \$36.4 million, up from \$20.9 million in 1995-96 (ABARE 1998). The longline and minor line sector accounted for around 77 per cent of the value of the catch of the fishery in 1996-97, with the rest accounted

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for by the purse seine and pole sector (ABARE 1998).

Average boat profits across the fleet were estimated to be \$1400 in 1996-97, with an average rate of return to capital estimated to be 6 per cent. Nonlongline operators were estimated to be the best performing sector, with an average estimated boat business profit of \$10 100. This compares with estimated boat business losses of \$1200 for the longline sector. These findings are consistent with earlier ABARE surveys into the eastern tuna and billfish fishery where losses were also recorded (ABARE 1996).

Receipts for all operators in the eastern tuna and billfish fishery were estimated to be \$334 300 per vessel in 1996-97. Longline specialists were estimated to earn the highest receipts.

The estimated average level of debt per boat rose by 23 per cent over 1996-97, with boat purchases estimated to account for 70 per cent of debt.

### **Bass Strait scallop fishery**

The Bass Strait scallop fishery is located in state and Commonwealth waters off Victoria and Tasmania. The fishery is divided into three zones, with the central zone being managed by the Common-

wealth in accordance with policies developed by the Australian Fisheries Management Authority (AFMA).

In 1996-97, the estimated value of scallop production for the Bass Strait scallop fishery was around \$8 million (ABARE 1998). Operators in the fishery also hold entitlements to fish for other species, such as lobster, squid and shark, and these activities are a major influence on the performance of operators as a whole (ABARE 1996).

Average boat business losses in the Bass Strait scallop were estimated to be \$17 200 in 1996-97, with an average rate of return to capital estimated to be -2 per cent, — that is, a real loss on investment. The estimated average level of debt per boat declined by 15 per cent during the year. In fact, the estimated level of debt in the Bass Strait scallop fishery was the lowest out of all the fisheries surveyed.

Average total cash receipts per boat in the fishery were around \$215 500 in 1996-97, dominated by receipts for scallop, which accounted for an estimated 48 per cent of income. Lobster and squid were also estimated to constitute a significant proportion of income, accounting for 17 per cent and 16 per cent of receipts respectively.



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# ABARE fisheries surveys

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ABARE has been undertaking economic surveys of Australian rural industries since the 1940s, and of selected Australian fisheries since the early 1980s. The current fisheries surveys program involves surveying each Commonwealth fishery every few years, or more frequently where the fishery is undergoing major changes and monitoring is particularly important. The aim is to gradually develop a consistent time series of economic information for each fishery. Such a database is vital for assessing the economic performance of fisheries, in the same way that time series information on catch and effort is vital for scientific assessments of each fishery.

Surveys of operators within a fishery are an effective way to gather detailed information on fleet structure and economic performance. The surveys provide a broad range of information on the physical characteristics and financial performance of boats that operate in each fishery.

Based on logbook and boat registry information collected from all licensed fishing operations in Commonwealth fisheries, and supplied by Australian Fisheries Management Authority (AFMA) and the Marine and Freshwater Research Institute (MAFRI), a representative sample of Commonwealth endorsed boats is selected in each fishery and stratified by type of operation, boat size and catch.

Between February and June the owner of each boat selected in the sample is visited by an ABARE officer. The officer interviews the boat owner to obtain physical and financial details of the fishing business for the survey years. In a number of instances the skipper of the boat is also interviewed. Further information is subsequently obtained from accountants,

selling agents and marketing organisations on the signed authority of the survey respondents.

The information collected is summarised in the annual *Australian Fisheries Surveys Report*. Considerable effort is made to reconcile the information obtained from various sources and to produce the most accurate description possible of the physical and financial characteristics of each sample boat in the survey. The data presented in the surveys reports constitute only a small proportion of the total amount of data collected.

## The 1998 surveys

In 1998 ABARE surveyed three Commonwealth fisheries — the southern shark fishery, the eastern tuna and billfish fishery and the Bass Strait scallop fishery. All three fisheries were previously surveyed in 1996, and information for 1993-94 and 1994-95 was presented in *Australian Fisheries Surveys Report 1996* (ABARE 1996).

Results for all three fisheries for 1995-96 and 1996-97 are presented in this report. Information is presented for the whole fleet of Commonwealth boats endorsed to operate in each fishery, and also for major sectors within the fleet, where possible. For the southern shark fishery, sectoral results are provided for five, six and ten net unit operators, hook operators and shark specialists (those earning at least 80 per cent of fishing income from shark sales in the survey year). For the eastern tuna and billfish fishery, sector results are provided for longline operators and those using other methods. Results for the Bass Strait scallop fishery are presented for the fishery as a whole.

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# Southern shark fishery

## Survey results

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### The fishery

The southern shark fishery is a multigear fishery located in Commonwealth waters off the Victorian, Tasmanian and South Australian coastlines (map 1). The fishery targets school and gummy shark, but covers all species of demersal shark taken commercially by hook and demersal gillnet fishery methods. The fishery has operated for over sixty years, with operators initially using longline methods to target primarily school shark. By the 1970s gillnetting had become the dominant fishing method which, together with the ban on the sale of school shark in Victoria in 1972 because of mercury poisoning scares, saw gummy shark become the primary targeted species. Gummy and school shark have accounted for around 90 per cent of the total shark catch since 1970, although in recent times this has dropped to around 80 per cent as stocks and catches decline and operators target other species (Walker, Taylor, Hudson and Bridge 1998).



The estimated gross value of production from the fishery in 1996-97 was \$17.8 million, around 6 per cent higher than in 1995-96. Total catch increased by 3 per cent over the period, to nearly 5000 tonnes (whole live weight). The fishery currently accounts for around 5 per cent of the gross value of production from Commonwealth fisheries in 1996-97 (ABARE 1998).

Gillnetters claim the majority of the total catch, although shark is also caught as bycatch by operators in other Commonwealth and state fisheries. The fishery generally operates all year, but is heavily reliant on weather conditions. The larger boats have the capacity to fish in almost any conditions. Fishing effort tends to be concentrated in summer and autumn when calmer seas prevail. Many rock lobster fishers also hold shark endorsements, contributing to an upsurge in shark fishing during the rock lobster closed season or during poor seasons. A number of gillnet operators also target scale fish as part of the south east non-trawl fishery.

Traditionally, the majority of the shark catch has been landed in Victoria and South Australia because of the higher price paid than in Tasmania. While much of the product is sold as flake on the domestic market, other products have developed in recent years, including shark liver oil, fins and cartilage.

### Biological status of the fishery

Sharks are generally long lived, slow growing and produce relatively few offspring. In addition, sharks have a long gestation period, and it is some years before juveniles become vulnerable to fishing. These stock characteristics make

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shark highly prone to stock collapse from overfishing.

School sharks are distributed throughout the waters of southern Australia. They inhabit the continental shelf and upper slope and are captured, mainly near the bottom, from shore to depths of 550 metres. They are also found in the pelagic zone and well offshore.

Recent scientific assessments by the Southern Shark Fishery Assessment Group concluded that the stock of school shark had been depleted to between 15 and 46 per cent of its unfished biomass (Walker, Stone, Brown and McLoughlin 1997). It suggested that current catches were unsustainable and that a reduction in catch was required to rebuild stocks. To address the stock declines, management has focused on restricting catches of large female school shark. The biological objective of management for school shark is to rebuild the stock above the 1996 level over the next fifteen years.

Gummy sharks are endemic to the temperate waters of the continental shelf and slope off southern Australia, from Port Stephens in New South Wales, around Tasmania and as far north as Geraldton in Western Australia. Gummy sharks are demersal.

Assessments suggest that gummy shark stocks currently represent between 40 and 55 per cent of their unfished biomass. The stability of recruitment and catch per unit effort levels in recent years suggest that present catches are sustainable (Walker et al. 1997). The current management objective is to stabilise the gummy shark adult biomass at 1994 levels.

## **Management of the fishery**

The responsibility for management of the southern shark fishery is currently shared between the Commonwealth, Victorian, Tasmanian and South Australian governments. The state jurisdiction extends up to three nautical miles from the baseline (roughly the coastline), with the Commonwealth responsible for the remainder within the Australian fishing zone. While all jurisdictions have generally applied

complementary management arrangements, ongoing negotiations have been held to develop a single jurisdiction under an Offshore Constitutional Settlement agreement in preparation for the possible introduction of individual transferable quotas (ITQs) (ABARE 1996).

Numerous methods have been adopted to control fishing. These include limited entry, bycatch and catch limits, area closures and input controls such as gear restrictions and maximum and minimum mesh sizes. In June 1997 it was decided in principle that ITQs, along with some input controls, would be the focus of future management arrangements. Currently, input is being sought from the major stakeholders in anticipation of an ITQ system being implemented by early 1999. Because shark is also caught by operators outside the southern shark fishery (both as targeted catch and bycatch), it is proposed that some proportion of the total allowable catch be allocated to those operators, while for others bycatch restrictions will remain, at least in the short term.

AFMA will establish an Independent Allocation Advisory Panel to advise on how ITQs should be shared across users. However, the final allocation formula has yet to be developed. The total allowable catch, on which the allocation is to be made, will be based on annual stock assessments undertaken by the Southern Shark Fishery Advisory Group.

The history of management arrangements in the fishery have until now been one of consistent attempts by management to reduce effort to protect stocks. In October 1987 a gillnet amalgamation scheme was endorsed to create a limited entry gillnet fishery. This was introduced in April 1988 under the Southern Shark Fishery Management Plan, when gillnet endorsements based on units of fishing capacity were issued to operators with a history of fishing in the southern shark fishery. Depending on their catch history, Commonwealth endorsed operators were issued with either a category 'A' endorsement for six units of net, or a category 'B' endorsement for five or less units of net. A net unit was defined as a monofilament

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gillnet with a headrope length of 600 metres and the net 20 meshes deep, where a mesh was a single square of net not less than 15 centimetres wide. During the first two years of the management plan fishers were allowed to amalgamate two class 'A' licences into a special 'A10' category at the expense of forfeiting two net units. This process removed 40 boats and 80 net units from the fishery from an initial allocation of 1234 net units issued to 241 boats.

In April 1991 further net reductions were implemented, reducing the total amount of net units in the fishery by a third. This proceeded on the basis of reducing the amount of net units allowed in each of the 'A' and 'B' licence categories. However, concerns from operators about inequitable reductions in net numbers between operators led to management redefining net units as 420 metres in length in April 1993, and reinstating the original number of net units to each category.

From January 1994, the hook sector was brought under management. Applicants who could meet certain entry criteria were granted shark hook permits on July 1995 to use either 1000 or 2000 hooks, depending on catch history. Others were given bycatch limits.

During 1993 and 1994, seasonal catch restrictions were introduced to protect pregnant school sharks during their migration to breeding grounds when they were highly vulnerable. During this period, area and seasonal restrictions were also placed on general shark fishing.

A study of the effectiveness of seasonal closures in the shark fishery showed that the closures were not effective in reducing the mortality of adult female school sharks (Walker, Stone, Battaglione and McLoughlin 1995). The mesh size of a gillnet in part determines the size and age of sharks captured. For example, larger mesh allows small shark to swim through the net but actually increases the probability of capture for large sharks which would otherwise have a tendency to be deflected from the nets. Given these issues and the need to prevent the capture of large sharks while they are pupping,

management introduced a maximum mesh size of 1650 millimetres from January 1997.

## Boats surveyed

For the purpose of the survey, the population was defined as boats endorsed for the southern shark fishery that caught shark in the survey years. Boats that held endorsements for the fishery but that did not fish for shark in the fishery were excluded from the survey population.

As with previous surveys of the southern shark fishery (see ABARE 1996), the gillnet fleet was divided into three sectors on the basis of the number of net units allocated under the current management plan: boats with ten units; six units; and five or less units. The units refer to the amount of gillnet that a boat may use, where each unit is equivalent to 420 metres. For example, a boat with ten net units may fish with no more than 4.2 kilometres of net in the water at any one time. A sample of boats from each sector was chosen for inclusion in the survey. Longline operators with shark hook endorsements were also included in the survey.

Based on logbook data, there were 118 active vessels in the fleet in 1996-97, one less than in 1995-96. This compares with 116 active vessels in 1994-95 and 113 in 1995-96 (ABARE 1996).

Of the 118 boats in 1996-97, 35 operators were licensed for five or less units of net, 25 operators for six units of net, 37 operators for ten units of net and 21 longline operators were licensed to use hooks. For the survey, a total sample of 40 boats was selected from the population of 118 eligible boats. Of these 40 boats, 13 boats were sampled from the 35 operators with five or less units of net; seven boats from the 25 operators with six units of net; 12 boats from the 38 operators with ten units of net; and eight boats from the 21 operators longline operators.

Many operators in the southern shark fishery are licensed to fish in other fisheries, such as rock lobster. Consequently, a major influence on the financial performance and level of activity of operators

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in the southern shark fishery is income from fishing operations elsewhere. For the survey, operators who obtained more than 80 per cent of total receipts from shark fishing operations in the southern shark fishery were defined in the survey as shark specialists. From the population of 118 boats, 28 were classified as being specialists, of which ten were sampled.

### **Financial performance**

The major measures of the financial performance of surveyed boats in the southern shark fishery are shown in table 1. It should be noted that these estimates include activities in other fisheries as well as in the southern shark fishery. A major influence on the financial performance of boats in the southern shark fishery over the period is income from fishing operations in other fisheries. For example, in 1996-97, 40 per cent of average total cash receipts for the fleet came from lobster fishing.

A summary of major measures of financial performance is presented in table 2 for all shark specialists and for shark specialists with ten net units.

### **Receipts**

Average cash receipts per boat for all operators in the southern shark fishery are estimated to have been \$276 600 in 1996-97. Shark receipts dominated operator incomes, accounting for an estimated 46 per cent of receipts (table 1) and around two-thirds of fish sales overall (table 3).

Net operators with six net units are estimated to have had the highest average receipts in the fishery, with receipts for 1996-97 estimated at around \$375 000. This was also higher than the estimated average receipts for all the specialist fleet. Receipts were lowest for the smallest net operators with average estimated receipts of \$176 300 in 1996-97.

As noted earlier, many southern shark fishery operators hold endorsements in other fisheries, so that shark fishing is a part time or seasonal activity for operators who may also fish for rock lobster, scallops, scale fish or other species. The degree of involvement and dependence

on the shark fishery varied between sectors. On average, the smaller the operator, the lower the reliance on shark. For example, shark receipts in 1996-97 for operators with five units or less of net were estimated to constitute only 19 per cent of total cash receipts, but this proportion increased to 27 per cent and 87 per cent of receipts for operators with six and ten units respectively.

Receipts from all nonshark operations also varied across the fleet, with hook operators and net operators with six units accounting for the highest level of nonshark receipts. For example, an estimated \$273 700 in 1996-97, nonshark receipts were highest for the six net unit sector, followed by an estimated \$195 000 for nonshark receipts for the hook sector. The other net sectors are estimated to have earned below the overall fishery average for nonshark receipts, with estimated receipts of \$143 100 and \$43 600 for the sectors with five units or less and ten net units respectively.

### **Costs**

For the fishery as a whole, total cash costs per boat are estimated to have been around \$241 100 in 1996-97. The greatest expenditure was for crew, which accounted for an estimated 41 per cent of costs in 1996-97. Repairs and maintenance also represented a significant outlay for operators, accounting for an estimated 14 per cent of expenditure in the same year.

Within the fishery, the size and nature of costs varied from sector to sector. While crew costs dominated for all sectors, they were most significant for hook operators (estimated at over half total fishing costs) and least significant for net operators with six net units (estimated at 25 per cent).

For shark specialists, the average total cash costs were an estimated \$216 100 in 1996-97, with crew costs dominating, as for other sectors.

### **Boat cash income and profit**

Boat cash income and business profit provide an indication of the ability of the operator to remain viable in the fishery in the short to medium term, without the need for recourse to additional finance.

# 1 Financial performance of southern shark fishery boats

Average per boat

Unit	5 units or less		6 units		10 units	
	1995-96 p	1996-97 p	1995-96 p	1996-97 p	1995-96 p	1996-97 p
<b>Receipts</b>						
Shark receipts	\$ 65 000 (35)	33 200 (25)	87 500 (11)	101 300 (9)	248 800 (26)	289 300 (10)
Lobster receipts	\$ 77 600 (37)	90 000 (36)	178 900 (40)	223 200 (37)	0 (0)	14 400 (81)
Scallop receipts	\$ 0 (0)	0 (0)	0 (0)	0 (0)	23 400 (88)	9 100 (61)
Squid receipts	\$ 0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	8 200 (81)
Other fishing receipts	\$ 48 900 (38)	43 200 (37)	21 100 (52)	4 200 (103)	4 900 (64)	5 800 (37)
Nonfishing receipts	\$ 9 100 (47)	9 900 (32)	20 700 (44)	46 300 (48)	71 700 (67)	6 100 (39)
Total cash receipts	\$ 200 600 (17)	176 300 (19)	308 200 (23)	375 000 (26)	348 800 (9)	332 900 (8)
<b>Costs</b>						
Administration	\$ 3 800 (26)	5 300 (23)	11 200 (28)	13 800 (32)	6 800 (11)	7 400 (11)
Bait	\$ 3 800 (32)	2 600 (37)	9 500 (44)	11 400 (38)	300 (102)	100 (85)
Crew costs	\$ 73 000 (14)	73 800 (15)	98 700 (10)	81 700 (18)	114 800 (21)	135 600 (8)
Food	\$ 3 200 (24)	3 500 (20)	7 600 (32)	9 800 (33)	5 900 (29)	6 200 (16)
Freight and marketing	\$ 3 000 (52)	3 100 (54)	4 600 (91)	3 100 (108)	12 200 (48)	13 800 (38)
Fuel	\$ 21 500 (26)	21 500 (24)	31 300 (35)	54 700 (31)	17 900 (28)	24 300 (11)
Insurance	\$ 5 500 (25)	4 800 (20)	6 000 (18)	9 600 (46)	8 100 (19)	8 800 (18)
Interest paid	\$ 11 400 (43)	12 400 (39)	20 200 (46)	62 200 (45)	11 900 (30)	10 200 (33)
Licence fees and levies	\$ 10 900 (13)	10 400 (12)	15 400 (14)	17 800 (15)	17 300 (22)	12 900 (5)
Repairs and maintenance	\$ 26 900 (17)	21 300 (14)	29 500 (25)	38 800 (29)	40 500 (20)	50 900 (18)
Other costs	\$ 9 200 (35)	10 100 (33)	18 300 (16)	24 000 (23)	17 500 (47)	24 600 (48)
Total cash costs	\$ 172 200 (15)	168 800 (16)	252 300 (16)	326 900 (26)	253 200 (15)	294 800 (8)
<b>Boat cash income</b>	\$ 28 400 (44)	7 500 (171)	55 900 (55)	48 100 (72)	95 600 (30)	38 100 (49)
less depreciation a	\$ 12 900 (19)	14 800 (13)	18 200 (20)	21 700 (17)	9 600 (19)	16 500 (21)
<b>Boat business profit</b>						
plus interest, leasing and rent	\$ 15 500 (84)	-7 300 (170)	37 700 (76)	26 400 (137)	86 000 (34)	21 600 (76)
	\$ 13 100 (42)	15 100 (39)	26 000 (49)	69 100 (43)	22 300 (36)	28 100 (40)
<b>Profit at full equity</b>	\$ 28 600 (54)	7 800 (189)	63 700 (61)	95 500 (48)	108 300 (28)	49 700 (40)
<b>Capital</b>						
- excl. quota and licences	\$ 229 900 (11)	246 100 (12)	393 400 (32)	475 600 (41)	280 600 (9)	305 900 (15)
- incl. quota and licences	\$ na	920 400 (18)	na	1 916 200 (26)	na	957 700 (11)
<b>Rate of return to capital b</b>	% 12 (49)	3 (184)	16 (53)	20 (58)	39 (23)	16 (37)
<b>Rate of return to full equity c</b>	% na	1 (176)	na	5 (30)	na	5 (39)

Continued ⇨

# 1 Financial performance of southern shark fishery boats *continued*

Average per boat

	Unit	Hooks		All boats	
		1995-96 p	1996-97 p	1995-96 p	1996-97 p
<b>Receipts</b>					
Shark receipts	\$	34 300 (40)	31 400 (44)	123 000 (18)	127 600 (8)
Lobster receipts	\$	187 300 (29)	185 200 (24)	93 400 (21)	111 500 (19)
Scallop receipts	\$	0 (0)	0 (0)	7 500 (88)	2 900 (61)
Squid receipts	\$	0 (88)	0 (79)	0 (88)	2 600 (81)
Other fishing receipts	\$	4 000 (51)	3 500 (41)	21 100 (28)	16 200 (31)
Nonfishing receipts	\$	9 500 (44)	6 300 (46)	31 600 (49)	15 800 (31)
Total cash receipts	\$	235 100 (22)	226 400 (19)	276 600 (8)	276 600 (9)
<b>Costs</b>					
Administration	\$	5 900 (22)	4 800 (19)	6 700 (12)	7 700 (14)
Bait	\$	5 200 (37)	4 900 (35)	4 100 (25)	4 100 (25)
Crew costs	\$	94 000 (18)	92 000 (17)	95 500 (9)	98 100 (7)
Food	\$	2 900 (30)	3 100 (26)	4 900 (16)	5 600 (14)
Freight and marketing	\$	600 (69)	400 (59)	5 800 (36)	6 000 (31)
Fuel	\$	14 800 (25)	15 400 (23)	21 200 (16)	28 400 (14)
Insurance	\$	4 700 (32)	4 200 (32)	6 300 (11)	7 000 (16)
Interest paid	\$	3 600 (56)	2 100 (63)	12 000 (23)	20 400 (31)
Licence fees and levies	\$	11 800 (19)	10 600 (21)	14 100 (10)	12 800 (6)
Repairs and maintenance	\$	26 600 (37)	19 900 (18)	31 700 (12)	34 000 (12)
Other costs	\$	6 600 (29)	6 600 (29)	13 300 (23)	17 000 (25)
Total cash costs	\$	176 700 (18)	164 000 (17)	215 600 (8)	241 100 (9)
<b>Boat cash income</b>	\$	58 400 (42)	62 400 (31)	61 000 (20)	35 500 (29)
less depreciation a	\$	20 000 (15)	19 400 (15)	14 200 (9)	17 600 (9)
<b>Boat business profit</b>	\$	38 400 (62)	43 000 (43)	46 800 (26)	17 900 (56)
plus interest, leasing and rent	\$	4 900 (41)	3 400 (45)	17 300 (23)	28 500 (26)
Profit at full equity	\$	43 300 (55)	46 400 (41)	64 100 (22)	46 400 (27)
<b>Capital</b>					
- excl. quota and licences	\$	345 000 (24)	343 700 (24)	300 700 (11)	330 800 (14)
- incl. quota and licences	\$	na	1 086 800 (20)	na	1 172 700 (11)
<b>Rate of return to capital b</b>	%	13 (46)	14 (42)	21 (19)	14 (28)
<b>Rate of return to full equity c</b>	%	na	4 (32)	na	4 (21)

a Depreciation adjusted for profit or loss of capital items sold. b Excluding value of quota and licences. c Including value of quota and licences. p Preliminary. na Not available.

Note: Figures in parentheses are relative standard errors, expressed as a percentage of the estimates.

## 2 Financial performance of specialist southern shark fishery boats

Average per boat

	Unit	10 units		All boats	
		1995-96 p	1996-97 p	1995-96 p	1996-97 p
<b>Receipts</b>					
Shark receipts	\$	269 000 (34)	331 400 (8)	211 500 (29)	228 600 (8)
Lobster receipts	\$	0 (0)	0 (0)	500 (75)	300 (82)
Scallop receipts	\$	0 (0)	3 400 (81)	0 (0)	2 000 (81)
Squid receipts	\$	0 (0)	0 (0)	0 (0)	0 (0)
Other fishing receipts	\$	2 200 (69)	2 700 (48)	1 500 (66)	1 900 (42)
Nonfishing receipts	\$	95 300 (62)	5 400 (53)	63 600 (60)	5 000 (35)
Total cash receipts	\$	366 500 (12)	342 900 (8)	277 100 (11)	237 800 (7)
<b>Costs</b>					
Administration	\$	7 700 (9)	7 700 (13)	6 100 (9)	5 900 (11)
Bait	\$	300 (107)	100 (86)	300 (77)	300 (45)
Crew costs	\$	106 500 (29)	146 900 (8)	83 000 (24)	101 600 (7)
Food	\$	4 800 (37)	6 900 (17)	4 500 (28)	5 900 (14)
Freight and marketing	\$	8 400 (67)	18 000 (36)	5 400 (67)	10 700 (36)
Fuel	\$	19 000 (37)	22 500 (12)	16 700 (30)	17 400 (11)
Insurance	\$	6 900 (18)	7 500 (16)	5 300 (18)	5 000 (15)
Interest paid	\$	15 800 (20)	12 200 (35)	13 700 (24)	10 200 (31)
Licence fees and levies	\$	19 100 (25)	12 500 (5)	14 700 (21)	10 000 (4)
Repairs and maintenance	\$	42 200 (26)	42 100 (9)	32 700 (23)	29 800 (9)
Other costs	\$	19 900 (57)	30 000 (50)	13 500 (53)	19 300 (47)
Total cash costs	\$	250 600 (21)	306 400 (8)	195 900 (18)	216 100 (7)
<b>Boat cash income</b>	\$	115 900 (28)	36 500 (45)	81 200 (26)	21 700 (50)
less depreciation a	\$	10 700 (21)	12 100 (15)	11 300 (15)	12 800 (10)
<b>Boat business profit</b>	\$	105 200 (32)	24 400 (65)	69 900 (31)	8 900 (123)
plus interest, leasing and rent	\$	27 600 (36)	34 300 (43)	21 300 (32)	23 300 (38)
<b>Profit at full equity</b>	\$	132 800 (24)	58 700 (36)	91 200 (23)	32 200 (41)
<b>Capital</b>					
- excl. quota and licences	\$	286 400 (11)	245 400 (9)	237 000 (10)	211 900 (9)
- incl. quota and licences	\$	na	993 500 (14)	na	782 300 (11)
<b>Rate of return to capital b</b>	%	46 (18)	24 (32)	38 (18)	15 (39)
<b>Rate of return to full equity c</b>	%	na	6 (36)	na	4 (40)

a Depreciation adjusted for profit or loss of capital items sold. b Excluding value of quota and licences. c Including value of quota and licences. p Preliminary. na Not available

Note: Figures in parentheses are relative standard errors, expressed as a percentage of the estimates.



Average cash income per boat for the fishery as a whole was an estimated \$35 500 in 1996-97. Hook operators earned the highest boat cash income, with an estimated average income of \$62 400 in 1996-97. Cash income was lowest for the smallest net operators, who earned an estimated \$7500 in 1996-97.

Boat profit provides a measure of return to the business unit by allowing for depreciation of capital. Average boat profits for the fleet are estimated to have been around \$17 900 in 1996-97. Hook operators recorded the best performance of the fishery, with average boat profits estimated as \$43 000. As with boat cash income, small net operators had the lowest boat profit, with an estimated loss of \$7300. Shark specialists performed relatively weakly as a whole in 1996-97, with average estimated boat profits of around \$8900. However, specialist operators with ten net units performed comparatively

well, with average boat business profits estimated at \$24 400.

Average profit at full equity for the entire fleet is estimated to have been around \$46 400 in 1996-97. Performances varied across the fleet. Net operators with six units of net were estimated to have had the best performances in the fishery, with an estimated average profit at full equity of \$95 500, reflecting the higher average receipts. As with boat business profit, profit at full equity was estimated to be lowest for small net operators with average profits of \$7800. In comparison with the overall shark fleet, the specialist shark fleet was estimated to perform less well, with average estimated profits at full equity of \$32 200.

### Rates of return

The estimated average rate of return to capital (excluding quota and licences) for the fishery as a whole was around 14 per

## 3 Estimated quantity of fish sold by boats in the southern shark fishery (product weight) Average per boat

	Units	5 or less net units	6 net units	10 net units	Hooks	All boats
<b>1995-96</b>						
Number of boats	no.	13	7	12	8	40
Gummy shark	kg	5 567 (29)	10 114 (24)	25 348 (24)	4 410 (60)	12 635 (17)
School shark	kg	4 188 (61)	3 356 (62)	10 672 (50)	1 644 (38)	5 635 (34)
Other or unspecified shark	kg	105 (58)	539 (39)	4 618 (41)	221 (76)	1 658 (36)
Total shark	kg	9 859 (36)	14 009 (10)	40 638 (25)	6 274 (42)	19 927 (18)
Other finfish	kg	11 805 (34)	10 466 (52)	857 (52)	740 (56)	6 075 (27)
Lobsters	kg	2 877 (38)	6 714 (40)	0 (0)	6 802 (29)	3 457 (21)
Scallops	kg	0 (0)	0 (0)	1 948 (88)	0 (0)	622 (88)
Squid	kg	0 (0)	0 (0)	0 (0)	23 (88)	4 (88)
<b>1996-97</b>						
Number of boats	no.	13	7	14	8	42
Gummy shark	kg	3 875 (26)	9 805 (34)	31 953 (10)	3 368 (62)	13 845 (9)
School shark	kg	1 080 (32)	6 007 (69)	11 114 (23)	1 994 (37)	5 433 (22)
Other or unspecified shark	kg	163 (56)	377 (44)	3 200 (35)	153 (75)	1 159 (30)
Total shark	kg	5 119 (25)	16 190 (10)	46 266 (10)	5 515 (43)	20 437 (8)
Other finfish	kg	10 846 (36)	2 582 (104)	634 (49)	1 181 (39)	4 173 (31)
Lobsters	kg	3 353 (35)	8 049 (38)	515 (81)	6 342 (24)	3 990 (20)
Scallops	kg	0 (0)	0 (0)	1 036 (61)	0 (0)	325 (61)
Squid	kg	0 (0)	0 (0)	6 869 (81)	4 (79)	2 155 (81)

Note: Figures in parentheses are relative standard errors, expressed as a percentage of the estimates.

cent in 1996-97. Again, net operators with six net units had the best overall sector performance, earning an estimated average rate of return to capital of 20 per cent in 1996-97. On the other hand, while average estimated returns for specialist shark operators were around 15 per cent, in comparison specialist operators with ten net units had an average estimated return to capital of around 24 per cent in 1996-97. It was estimated that small nonspecialist net operators (those with five or less net units) had the lowest performance, with an average estimated return to capital of around 3 per cent.

### Debt and equity

Debt and equity for southern shark boats was calculated only for those operators who responded on debt in the survey. Information on debt and equity is given

in tables 4 and 5. Across the fleet in 1996-97, the average level of debt per boat is estimated to have declined by 12 per cent from an opening balance of \$208 700 to a closing balance of \$182 900 (table 4). Of this, boat purchase is estimated to have accounted for 64 per cent of debt, and working capital for 17 per cent.

For specialist shark operators, average debt per boat is estimated to have more than doubled in 1996-97, from an opening balance of \$41 700 to a closing balance of \$98 100 (table 5). Boat purchase is estimated to have accounted for around 83 per cent of debt.

Boat business equity provides a measure of the financial ownership of a fishing enterprise. The average boat business equity ratio for all vessels in the southern shark fishery is estimated to have been around 85 per cent in 1996-97.

#### 4 Boat debt and equity of southern shark fishery boats in 1996-97

Average per boat

	Units	All boats <b>p</b>
Capital (including quota and licenses) at 30 June <b>a</b>	\$	1 183 300 (10)
Boat business debt at 1 July <b>b</b>	\$	208 700 (32)
Boat business debt at 30 June <b>b</b>	\$	182 900 (29)
Change in debt over year <b>b</b>	\$	-25 900 (81)
Boat business equity at 30 June <b>a</b>	\$	1 000 500 (10)
Boat business equity ratio at 30 June <b>a</b>	%	85 (4)

**a** Average per boat responding on debt. **b** Average per responding boat. **p** Preliminary.  
*Note:* Figures in parentheses are relative standard errors, expressed as a percentage of the estimates.

#### 5 Boat debt and equity of specialist southern shark fishery boats in 1996-97

Average per boat

	Units	All boats <b>p</b>
Capital (including quota and licenses) at 30 June <b>a</b>	\$	852 300 (13)
Boat business debt at 1 July <b>b</b>	\$	41 700 (31)
Boat business debt at 30 June <b>b</b>	\$	98 100 (39)
Change in debt over year <b>b</b>	\$	56 400 (58)
Boat business equity at 30 June <b>a</b>	\$	754 200 (12)
Boat business equity ratio at 30 June <b>a</b>	%	89 (4)

**a** Average per boat responding on debt. **b** Average per responding boat. **p** preliminary.  
*Note:* Figures in parentheses are relative standard errors, expressed as a percentage of the estimates.

# Eastern tuna and billfish fishery

## Survey results

### The fishery

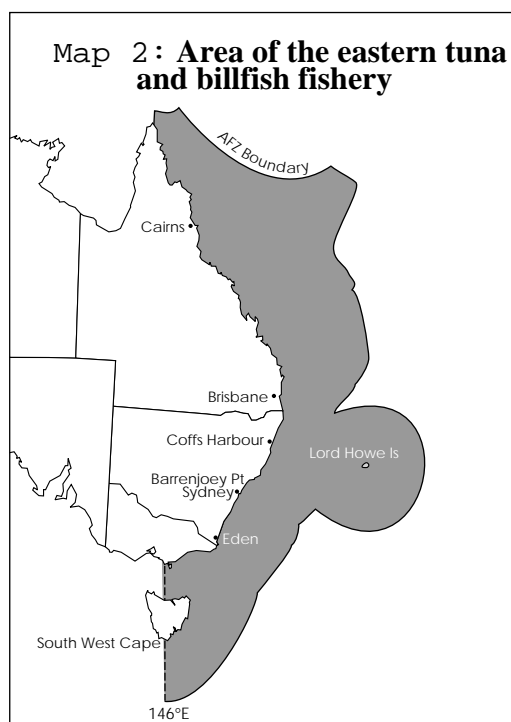
The eastern tuna and billfish fishery, while managed as a single fishery, is a complex fishery system involving multiple species and multimethod fishing activities. The fishery extends along the entire east coast of Australia, from north of Cape York to the southern limit of the 200 nautical mile Australian Fishing Zone below Tasmania and the border of Victoria and South Australia. The fishery also encompasses waters around Lord Howe Island (map 2). The fishery itself is divided into zones partitioned along inshore/offshore boundaries and northern/southern boundaries (Campbell and Miller 1998).

The fishery consists primarily of domestic pelagic longline operators who

target higher valued adult yellowfin and bigeye tuna as well as broadbill swordfish for sale on the Japanese market. These longliners also catch other tuna species including albacore as well as shark as bycatch. In addition there is also a purse seine and pole sector that targets mainly skipjack tuna for the domestic canning industry. A number of Japanese boats have also been permitted to operate in the fishery in the past under bilateral agreements or as part of joint venture activities. However, these activities did not occur in 1997-98 as an agreement between Australia and Japan was unable to be reached.

In 1996-97 the gross value of the fishery was \$36.4 million, up sharply from the \$20.9 million recorded for 1995-96 (ABARE 1998). Catch in the fishery has also increased in recent years, with the volume of fish caught increasing 64 per cent in 1996-97 to 8781 tonnes. Overall, the per unit value of catch in the eastern tuna and billfish fishery has increased marginally. The longline and minor line sector of the fishery landed 3892 tonnes in 1996-97, at a gross value of \$27.9 million. The purse seine and pole sector catch of 4889 tonnes was valued at \$8.5 million (ABARE 1998). While yellowfin tuna accounted for only 20 per cent of the landed catch by weight, it accounted for 42 per cent of the total value of catch from the fishery.

Currently around 230 longline operators are authorised to fish in the eastern tuna and billfish fishery. However, only around sixty of these do so on a full time basis, with the majority of operators fishing seasonally or as part of their diversified operations. In addition a large body of latent effort exists in the fishery as some operators do not use their pelagic longline entitlements. The vessels used by the



longline fleet have traditionally been smaller boats averaging around 18 metres that are not custom built for pelagic longline operations. These are generally converted tuna pole vessels or trawlers. These boats allow between 200 and 1000 hooks to be set a day, with a fishing trip running for less than a week to ensure freshness and quality of tuna. However, operators have recently invested in larger boats, allowing more than 1000 hooks to be set (Campbell and Miller 1998). With the introduction of bigger boats, longline operators have extended the range of their operations and have moved further offshore (Ward, Hampton, Caton and Gunn 1997).

The purse seine and pole sector operates primarily along the New South Wales south coast and off north eastern Tasmania from November to May when surface temperatures are above 17°Celsius (Ward et al. 1997). The purse seine and pole sector targets skipjack. Although different in fishing method, the seiners often work in conjunction with pole boats and light planes. The planes locate skipjack schools from the air, pole boats will then feed the fish to bring them to the surface while the seiners surround the school with the nets.

Purse seine operators first started fishing for tuna and other pelagic species in the region in the 1930s. The fishery expanded in the 1970s, although southern bluefin tuna was the primary target species at the time. It was not until major cutbacks in the southern bluefin tuna quota, and the redirection of southern bluefin tuna to sashimi outlets, rather than canning, that attention was directed to purse seining for skipjack. The fleet has changed substantially since 1988, because of the multipurpose nature of most of the vessels. The catch tends to vary substantially, reflecting the activity levels of operators and the annual variability in skipjack availability off south eastern Australia at the southern extreme of its range (Campbell and Miller 1998).

As with the longline sector the purse seine sector has a fair degree of latent effort, with many fishing endorsements unused. The boats in the fleet range in size

from 13 to 42 metres, with most of the fleet consisting of multipurpose or converted boats.

## **Biological status of the fishery**

Tuna and billfish species found off the east coast of Australia are highly migratory and are thought to form part of western and central, or eastern Pacific stocks. The level of mixing between the different fish stocks is unknown. Over sixty species of finfish are regularly caught in the fishery. Approximately thirty of these are tunas and mackerels, six species are billfish, with the remainder a mix of pelagic sharks and other finfish (Campbell and Miller 1998).

Yellowfin tuna inhabit tropical and subtropical waters where the temperature is greater than 15°Celsius. They are fast growing, reaching maturity at two years and are thought to live for between eight and ten years (Campbell and Miller 1998). They can grow to over 100 kilograms, although the average weight of yellowfin caught by Australian longliners is around 55 kilograms.

Currently the status of yellowfin stocks in the fishery is unknown, but it is thought to be moderately fished (Caton, McLoughlin and Staples 1997). Catch rates recorded by the Japanese and US fleets in the Pacific have fluctuated and show no noticeable trend. This is likely to reflect climatic factors such as El Niño and the subsequent impact on recruitment. Tagging studies suggest that the exploitation rate is only around 20 per cent of the total stock, although regional overexploitation is likely in some instances (Campbell and Miller 1998).

Skipjack tuna inhabit tropical and subtropical waters, although the adult fish can be found in cooler waters. Skipjack are highly productive species, growing rapidly to reach maturity after one year. The stock structure is not well known, with adult skipjack commonly traveling long distances. Current stock assessments suggest that the skipjack stock may be underfished, although a degree of uncertainty exists.

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Evidence on the biological status of the other species in the fishery, such as bigeye, albacore, broadbill swordfish and striped marlin, remains sketchy. Stocks are generally not considered to be overexploited, although there have been a number of conflicting studies for bigeye tuna (Campbell and Miller 1998).

## Management of the fishery

The eastern tuna and billfish fishery incorporates both commercial and recreational fishing activities. The commercial sector of the fishery is managed by both Commonwealth and state governments. Under Offshore Constitutional Settlement agreements the major tuna species and all billfish are managed by the Commonwealth government. The small tuna and tunalike species generally found on the continental shelf are managed by the states. The recreational fishing sector is also managed by state management authorities.

Currently, the commercial fishery is managed by input controls, with the emphasis on reducing effort. These controls include limited entry, zoning, boat restrictions, bycatch provisions and gear restrictions. However, with the large amount of latent effort that exists in the fishery, the issue remains whether these controls have any long term influence on effort in the fishery.

Historically, the pelagic longline sector has been subject to limited entry controls. Longline endorsements relate to specific areas of access, with a total of seven categories of endorsements issued. Coinciding with this, vessels fishing within 50 nautical miles of the coast are subject to a maximum size of 32.67 metres. Purse seine operators have also been subject to limited access arrangements through area specific endorsements relating to four zones, and through a boat size limit of 32.67 metres.

However, new management arrangements have been announced for the fishery. The new arrangements, due to be implemented in mid-1999, will limit the amount of gear (primarily hooks) used. Existing access zones, with the exception of Zone E off North Queensland, are proposed to be eliminated, along with the

restrictions on vessel lengths. It is proposed that these restrictions will be replaced with gear unit and boat based Statutory Fishing Rights. The mechanism to allocate these rights will be determined in early 1999.

## Boats surveyed

The domestic east coast tuna and billfish fleet comprises a number of fishing methods: pelagic longline, purse seine, pole and line and minor line fishing methods (including troll and handlines). Based on logbook data, there were 152 active vessels in the fleet in 1996-97, of which 118 were pelagic longliners, 28 were minor liners and 6 were purse seine vessels.

The target population for the survey was defined as those vessels that held a Commonwealth tuna permit for the fishery and that caught more than one tonne of tuna in the survey year. The fleet was separated into two groups: longline specialists and others (purse seining and pole and line). The total number of vessels eligible for the survey was 127 in 1995-96. Twenty-four vessels were sampled from a population of 94 in the longline specialist category and nine vessels from a population of 33 in the other methods category. In 1996-97, the total eligible population was 152 vessels of which 30 longliners were sampled from a population of 118, while ten vessels of a population of 34 were sampled from the other methods category.

## Financial performance

The major measures of financial performance of the vessels surveyed in the eastern tuna and billfish fishery are provided in table 6. It was not possible to publish separate data for purse seine vessels because of the small sample size in the survey, although information was collected for both years.

The categories used this year are the same as the categories used in the previous economic surveys of the fishery conducted by ABARE (1994, 1996). The longline fleet accounted for around three-quarters of the vessels sampled in both

## 6 Financial performance of eastern tuna and billfish fishery boats

Average per boat

	Unit	Longline specialists		Nonlongline specialists		All boats	
		1995-96 p	1996-97 p	1995-96 p	1996-97 p	1995-96 p	1996-97 p
<b>Receipts</b>							
Tuna receipts	\$	152 200(14)	199 100(10)	160 900(45)	209 900(34)	154 400(16)	201 500(11)
Other finfish receipts	\$	63 700(32)	112 500(33)	16 200(43)	48 200(52)	51 400(30)	98 100(30)
Bycatch receipts	\$	22 900(42)	28 300(35)	16 700(78)	5 600(88)	21 200(37)	23 200(33)
Nonfishing receipts	\$	7 200(25)	10 300(15)	12 300(27)	15 700(24)	8 500(19)	11 500(13)
Total cash receipts	\$	246 000(11)	350 200(11)	206 100(34)	279 400(30)	235 500(12)	334 300(11)
<b>Costs</b>							
Administration	\$	8 500(16)	11 000(18)	5 600(26)	8 600(25)	7 700(14)	10 400(15)
Bait	\$	15 900(36)	22 200(38)	4 400(37)	2 800(35)	12 900(33)	17 800(36)
Crew costs	\$	77 000(10)	102 400(8)	82 800(21)	91 700(24)	78 500(9)	100 000(8)
Freight and marketing	\$	31 600(19)	39 500(16)	6 300(59)	14 000(49)	25 000(18)	33 800(15)
Fuel	\$	23 800(13)	27 300(11)	17 900(30)	28 400(28)	22 300(12)	27 600(11)
Ice	\$	3 500(33)	3 500(30)	700(61)	500(56)	2 700(31)	2 800(29)
Insurance	\$	9 900(13)	12 000(8)	6 400(41)	11 700(33)	9 000(13)	11 900(10)
Interest paid	\$	11 800(21)	13 900(18)	4 400(78)	7 400(47)	9 800(21)	12 500(17)
Leasing	\$	5 400(42)	3 900(35)	4 100(83)	5 500(56)	5 100(37)	4 200(30)
Licence fees and levies	\$	8 100(12)	10 400(9)	4 500(29)	6 400(25)	7 200(11)	9 500(8)
Repairs and maintenance	\$	38 800(15)	64 100(19)	40 400(37)	62 300(40)	39 200(15)	63 700(17)
Other costs	\$	14 200(20)	15 400(11)	15 800(37)	18 600(26)	14 600(18)	16 100(11)
Total cash costs	\$	248 500(11)	325 600(11)	193 300(27)	257 900(28)	234 000(10)	310 300(10)
<b>Boat cash income</b>	\$	-2 500(303)	24 600(35)	12 800(183)	21 500(84)	1 500(548)	24 000(33)
less depreciation a	\$	23 900(18)	25 800(17)	12 100(22)	11 400(21)	20 800(16)	22 600(15)
<b>Boat business profit plus interest, leasing and rent</b>	\$	-26 400(33)	-1 200(758)	700(3393)	10 100(159)	-19 300(45)	1 400(539)
	\$	17 400(19)	18 100(15)	8 500(50)	13 100(48)	15 100(18)	17 000(15)
<b>Profit at full equity</b>	\$	-9 000(96)	16 900(49)	9 200(268)	23 200(75)	-4 200(212)	18 400(41)
<b>Capital</b>							
- excl. quota and licences	\$	285 500(16)	295 500(14)	232 500(34)	251 500(29)	271 800(14)	285 700(12)
- incl. quota and licences	\$	na	719 800(8)	na	400 500(30)	na	648 300(8)
<b>Rate of return to capital b</b>	%	-3(93)	6(48)	4(246)	9(49)	-2(214)	6(38)
<b>Rate of return to full equity c</b>	%	na	2(48)	na	6(48)	na	3(39)

a Depreciation adjusted for profit or loss of capital items sold. b Excluding value of quota and licences. c Including value of quota and licences. p preliminary. na not available.

Note: Figures in parentheses are relative standard errors, expressed as a percentage of the estimates.

1995-96 and 1996-97 and the results for that sector tend to dominate the average results for the whole fleet.

### Receipts

Average total cash receipts for all operators in the fishery are estimated to have been \$334 300 per vessel in 1996-97. Longline specialists are estimated to have earned the highest receipts, with an average of \$350 200 in 1996-97, compared with estimated average receipts for other operators of \$279 400. The higher total receipts for the longline sector reflected higher average other finfish sales in 1996-97, which were estimated to be over double value of other finfish receipts from other method operators in the fishery.

For all operators in the fishery, estimated average total receipts for tuna operators were 42 per cent higher than in 1995-96. These higher receipts partly reflect an increase in sales of other finfish

as well a rise in the average price received for tuna (see table 7 and ABARE 1998).

### Costs

Average costs for boats in the fishery are estimated to have been around \$310 300 in 1996-97. On average, crew costs were the most significant cost for operators, estimated to account for around third of total cash costs. This was also reflected in the costs for the individual sectors, with crew cost estimated to account for 31 per cent of longline costs and 36 per cent of costs for other operators. Repairs and maintenance represented a significant proportion of expenditure in 1996-97, accounting for an estimated 21 per cent of total cash costs (table 6).

### Boat cash income and profit

Average boat cash income for the entire fishery is estimated to have been \$24 000 in 1996-97. Average boat cash income for

## 7 Estimated quantity of fish sold by boats in the eastern tuna and billfish fishery (live whole weight) Average per boat

	Units	Longline specialists	Nonlongline specialists	All boats
<b>1995-96</b>				
Number of boats	no.	24	9	33
Southern bluefin tuna	kg	1 512 (38)	0 (0)	1 119 (38)
Yellowfin tuna	kg	10 476 (19)	3 779 (42)	8 736 (17)
Bigeye tuna	kg	493 (44)	103 609 (74)	27 287 (73)
Albacore	kg	2 568 (28)	306 (41)	1 980 (27)
Skipjack	kg	6 700 (88)	15 599 (73)	9 012 (58)
Total tuna	kg	21 749 (35)	123 293 (60)	48 135 (42)
Other finfish	kg	12 509 (34)	4 767 (47)	10 497 (31)
<b>1996-97</b>				
Number of boats	no.	30	10	40
Southern bluefin tuna	kg	1 626 (33)	1 150 (62)	1 519 (29)
Yellowfin tuna	kg	13 687 (10)	66 944 (57)	25 600 (33)
Bigeye tuna	kg	4 738 (70)	67 506 (82)	18 778 (67)
Albacore	kg	2 423 (23)	697 (68)	2 037 (22)
Skipjack	kg	67 (54)	5 572 (63)	1 298 (61)
Total tuna	kg	22 540 (16)	141 868 (40)	49 232 (26)
Other finfish	kg	21 923 (36)	50 173 (75)	28 242 (37)

Note: Figures in parentheses are relative standard errors, expressed as a percentage of the estimates.

the longline sector was an estimated \$24 600, compared with an estimated average of \$21 500 for other operators.

Average boat profits across the fleet are estimated to have been \$1400 in 1996-97. Longline operators are estimated to have been the poorest performing sector, with average estimated boat business losses of \$1200. By comparison, other operators are estimated to have earned average boat business profits of \$10 100.

The occurrence of losses in the longline sector is consistent with earlier ABARE surveys of the eastern tuna and billfish fishery. In the 1996 survey, for example, average boat business losses for these boats were estimated at around \$14 600 and \$18 000 for 1993-94 and 1994-95 respectively.

Profit at full equity for the entire fleet is estimated to have been around \$18 400 in 1996-97. As with boat business profits, estimated profit was higher for nonlongline operators, with an average estimated profit of \$23 200. By comparison, profit at full equity for the longline sector was around \$16 900.

### Rates of return

The estimated rate of return to boat capital across the fishery in 1996-97 was around 6 per cent. Following trends noted in earlier surveys (ABARE 1996), the rate of return to boat capital in the nonlongline sector was higher than the overall fishery average, at 9 per cent in 1996-97.

For 1996-97, it is estimated that the nonlongline sector was again the best performing sector of the fleet, with a rate of return to full equity of around 6 per cent, double the average return for the whole fleet, and higher than the rate for the longline sector of 2 per cent.

## 8 Boat debt and equity of eastern tuna and billfish fishery boats in 1996-97

Average per boat

	Units	All boats p
Capital (including quota and licenses)		
at 30 June a	\$	594 300 (10)
Boat business debt		
at 1 July b	\$	76 700 (24)
Boat business debt		
at 30 June b	\$	94 100 (21)
Change in debt over year b	\$	17 300 (94)
Boat business equity		
at 30 June a	\$	500 200 (12)
Boat business equity ratio		
at 30 June a	%	84 (4)

a Average per boat responding on debt. b Average per responding boat. p Preliminary.

Note: Figures in parentheses are relative standard errors, expressed as a percentage of the estimates.

The relative performance of the two sectors has not changed since the last ABARE economic survey of the fishery in 1996. In 1993-94 and 1994-95, the nonlongline sector was also the better performing sector, with rates of return above the average (ABARE 1996).

### Debt and equity

Across the fleet in 1996-97, the estimated average level of debt per boat rose by 23 per cent from an opening balance of \$76 700 to a closing balance of \$94 100. Of this, boat purchases accounted for 70 per cent of debt and working capital for 16 per cent (see table 8).

Boat business equity provides a measure of the financial ownership of a fishing enterprise. The average boat business equity ratio in the eastern tuna and billfish fishery was 84 per cent in 1996-97.



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# Bass Strait scallop fishery

## Survey results

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### The fishery

The Bass Strait scallop fishery is located in state and Commonwealth waters off Victoria and Tasmania (map 3). Both state and Commonwealth agencies share the responsibility for managing the fishery, which is divided into a Commonwealth and two state zones. The fishery started around 1970 when concentrations of scallops were first located in Bass Strait off Lakes Entrance in eastern Victoria. It is primarily a winter fishery, with operators targeting squid and rock lobster during the summer months (Bass Strait Scallop Consultative Committee 1997a). In 1996-97 the fishery accounted for around 35 per cent of Australia's total production of scallops, equivalent to 3491 tonnes shell weight (ABARE 1998).

The gross value of production fishery was \$14 million in 1995-96, falling in 1996-97 to an estimated \$8 million (ABARE 1998). The major factor affecting fishery income during the 1997 season was strong competition on the export and domestic markets (Bass Strait Scallop Consultative

Committee 1997b). The majority of scallop production is sold on the domestic market, although exports to Hong Kong and Singapore are important.

Operators harvest the scallops by dredging. Although damage to the sea floor from this technique is regarded as minimal (Bass Strait Scallop Consultative Committee 1997a), development of an 'environmentally friendly' scallop dredge has been identified as a priority of research (Caton and McLoughlin 1997).

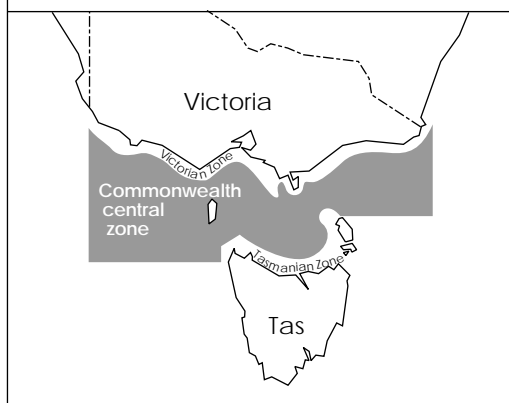
### Biological status of the fishery

Almost the entire commercial catch in the fishery consists of the southern (or king) scallop (*Pecten fumatus*). Scallops are characterised by a wide and patchy distribution, occurring naturally from the mid-north coast of New South Wales, along the southern coastline, including the east and north coasts of Tasmania, to as far north as Shark Bay in Western Australia. At present, the state of the stocks is uncertain (Caton and McLoughlin 1997).

Spawning occurs over a lengthy period between winter and spring, with the exact timing varying from area to area. Growth rates of scallops can vary quite markedly between these areas, with maturity usually being reached in the first year and spawning occurring in the second year. This results in natural large variations in annual recruitment due to environmental conditions and fishing concentration.

Because of this, stock numbers and catches tend to vary considerably. Heavy fishing and poor stock recruitment has led to some areas in Tasmanian and Victorian waters being closed to fishing. Management controls have been geared toward overcoming this stock variability.

Map 3: The Bass Strait scallop fishery



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## Management of the fishery

Management of the Bass Strait scallop fishery is shared by the Commonwealth, Victorian and Tasmanian governments under an Offshore Constitutional Settlement agreement introduced in 1986. The fishery was divided in an effort to overcome the gap in management approaches between the two states, separating the fleets to facilitate enforcement. The fishery has since been managed as three separate zones: two twenty nautical mile inshore zones controlled by the adjacent state, and a third Central Zone between the other two controlled by the Commonwealth.

After the Offshore Constitutional Settlement agreement was established, the Central Zone was managed by limited entry controls only until closures were enacted in mid-1990 to assist stock replenishment. Following this, a preliminary management plan was implemented in 1991 for the Central Zone sanctioning the use of various input and output constraints. Fears that the rate of harvesting was unsustainable led to the instalment of a number of controls to ensure compliance. These included limiting entry to 155 entitlements, area and seasonal closures, individual bag limit quotas, catch per trip limits and minimum shell sizes.

The Bass Strait Scallop Consultative Committee (1997a) has noted that these management arrangements act as an impediment to industry restructure, especially the nontransferable nature of the current bag limits which has encouraged overcapitalisation. In 1997, the committee proposed a number of changes to the management arrangements of the fishery with the stated purpose of improving the economic efficiency and sustainability of the fishery, by controlling effort, improving stock recruitment and minimising habitat impacts of fishing practices.

The four main strategies recommended are: limited entry, appropriate use of seasonal and area closures, minimum size limits and discard rates, and the introduction of individual transferable quotas by June 1999 (Bass Strait Scallop Consultative Committee 1997a). This signals

a decisive move away from trip and bag limits and gear controls. Although the committee has not yet indicated how quota would be allocated, it has warned operators against increasing effort by purchasing existing entitlements as a means of obtaining or improving catch history as catch history accrued after June 1997 will not be considered (Professional Fisherman 1997).

## Boats surveyed

As with previous surveys of the Bass Strait scallop fishery, the target population for this survey was defined as boats that held endorsements for the Commonwealth managed zone of the Bass Strait scallop fishery and that caught scallops within the survey years. Boats that held endorsements and did not fish during the survey period were excluded from the population.

Unlike previous surveys it was not possible to divide the fleet into separate groups because of incomplete data. Information is therefore presented for average performance across the fleet.

The number of vessels in the fishery has increased since the last survey of the fishery in 1996. According to logbook data, there were only 83 active vessels in the fishery in 1994-95 (ABARE 1996). By 1995-96, however, there were 124 active vessels in the Bass Strait scallop fishery according to logbook data, and 19 of these were surveyed. In 1996-97, the number of active vessels decreased to 91, of which 28 were sampled.

## Financial performance

It should be noted that operators in the Bass Strait scallop fishery target species from other fisheries, such as squid or rock lobster. The activities in these other fisheries were a major influence on the financial performance of the boats in the Bass Strait scallop fishery over the survey period.

## Receipts

Average total cash receipts per boat in the fishery were around \$215 500 in 1996-97,

## 9 Financial performance of Bass Strait scallop fishery boats

Average per boat

	Units	All boats	
		1995-96 <sup>p</sup>	1996-97 <sup>p</sup>
<b>Receipts</b>			
Shark receipts	\$	1 900 (88)	16 300 (74)
Lobster receipts	\$	15 400 (61)	36 200 (59)
Scallop receipts	\$	108 600 (12)	103 500 (11)
Squid receipts	\$	11 700 (62)	35 500 (24)
Other fishing receipts	\$	22 400 (95)	16 800 (77)
Nonfishing receipts	\$	19 100 (70)	7 100 (16)
Total cash receipts	\$	179 200 (16)	215 500 (11)
<b>Costs</b>			
Administration	\$	4 300 (29)	5 500 (14)
Bait	\$	700 (62)	500 (62)
Crew costs	\$	74 500 (12)	95 000 (11)
Food	\$	3 800 (19)	4 000 (12)
Freight and marketing	\$	300 (97)	2 200 (85)
Fuel	\$	20 700 (15)	24 700 (9)
Insurance	\$	7 500 (29)	9 200 (14)
Interest paid	\$	6 300 (26)	6 700 (19)
Licence fees and levies	\$	6 500 (11)	10 000 (8)
Repairs and maintenance	\$	24 900 (12)	38 600 (20)
Other costs	\$	18 900 (61)	16 500 (41)
Total cash costs	\$	168 400 (16)	212 900 (10)
<b>Boat cash income</b>			
	\$	10 800 (68)	2 600 (302)
less depreciation <sup>a</sup>	\$	16 800 (19)	19 800 (12)
<b>Boat business profit</b>			
	\$	-6 000 (95)	-17 200 (38)
plus interest, leasing and rent	\$	9 200 (25)	9 200 (18)
Profit at full equity	\$	3 200 (187)	-8 000 (81)
<b>Capital</b>			
- excl. quota and licences	\$	401 100 (28)	369 500 (14)
- incl. quota and licences	\$	na	671 600 (10)
Rate of return to capital <sup>b</sup>	%	1 (199)	- 2 (81)
Rate of return to full equity <sup>c</sup>	%	na	- 1 (85)

<sup>a</sup> Depreciation adjusted for profit or loss of capital items sold. <sup>b</sup> Excluding value of quota and licences. <sup>c</sup> Including value of quota and licences. <sup>p</sup> Preliminary. **na** Not available. *Note:* Figures in parentheses are relative standard errors, expressed as a percentage of the estimates.

dominated by receipts for scallop, which accounted for an estimated 48 per cent of income (table 9).

As with the previous survey of the fishery (ABARE 1996), lobster and squid were also estimated to constitute a significant proportion of income, accounting for 17 per cent and 16 per cent of receipts respectively. On the other hand, the sale of squid and other finfish figured strongly in the volume of fish sold (table 10).

### Costs

For the fishery as a whole, average total cash costs per boat were estimated to have been around \$212 900 in 1996-97. Crew costs were the highest expenditure, accounting for 45 per cent of expenditure in 1996-97. Repairs and maintenance, at \$38 600 in 1996-97, contributed a significant proportion of costs — 18 per cent of the total.

## 10 Estimated quantity of fish sold by boats in the Bass Strait scallop fishery (live whole weight)

Average per boat

	Units	All boats
<b>1995-96</b>		
Number of boats	no.	19
Gummy shark	kg	297 (78)
School shark	kg	0 (0)
Other or unspecified shark	kg	79 (104)
Total shark	kg	376 (63)
Other finfish	kg	18 251 (96)
Lobsters	kg	586 (61)
Scallops	kg	8 685 (13)
Squid	kg	7 287 (63)
<b>1996-7</b>		
Number of boats	no.	28
Gummy shark	kg	2 079 (72)
School shark	kg	0 (0)
Other or unspecified shark	kg	648 (85)
Total shark	kg	2 727 (75)
Other finfish	kg	13 572 (85)
Lobsters	kg	1 344 (58)
Scallops	kg	10 465 (9)
Squid	kg	29 274 (24)

*Note:* Figures in parentheses are relative standard errors, expressed as a percentage of the estimates.

### Boat cash income and profit

Average boat cash income for the Bass Strait scallop fishery in 1996-97 was an estimated \$2600. Boat business profit provides a measure of return to the operator by allowing for the depreciation of capital. In 1996-97, the average boat in the Bass Strait scallop fishery was estimated to have made a business loss of \$17 200. At full equity, the average loss was an estimated \$8000 in 1996-97.

### Rates of return

The estimated average rate of return to capital in the Bass Strait scallop fishery was -2 per cent in 1996-97 — that is, a real loss on investment.

### Debt and equity

Information on debt and equity for the boats surveyed is reported in table 11. Across the fleet in 1996-97, the estimated average level of debt per boat declined by 15 per cent from an opening balance of \$64 700 to a closing balance of \$55 300. Of this, boat purchase accounted for an estimated 66 per cent of debt and working capital for 20 per cent.

## 11 Boat debt and equity of Bass Strait scallop boats in 1996-7

Average per boat

	Units	All boats <sup>p</sup>
Capital (including quota and licenses) at 30 June <sup>a</sup>	\$	673 600 (13)
Boat business debt at 1 July <sup>b</sup>	\$	64 700 (21)
Boat business debt at 30 June <sup>b</sup>	\$	55 300 (27)
Change in debt over year <sup>b</sup>	\$	-9 400 (60)
Boat business equity at 30 June <sup>a</sup>	\$	618 300 (15)
Boat business equity ratio at 30 June <sup>a</sup>	%	92 (3)

<sup>a</sup> Average per boat responding on debt. <sup>b</sup> Average per responding boat. <sup>p</sup> Preliminary.

*Note:* Figures in parentheses are relative standard errors, expressed as a percentage of the estimates.

Boat business equity provides a measure of the financial ownership of a fishing enterprise. The estimated average boat business equity ratio in the Bass Strait scallop fishery was 92 per cent in 1996-97.

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# Definitions of items

## and reliability of estimates

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### Boat characteristics

Information on the physical characteristics of boats was obtained from both logbook information and survey interviews.

**Effort** is measured in terms of the number of hooks set or the search time for the eastern tuna and billfish fishery. For the southern shark fishery, effort is measured in terms of net or hook entitlements. For the Bass Strait scallop fishery, effort is measured in terms of hours dredged.

**Catch** is expressed in kilograms. The catch information reported applies only to the fishery surveyed. However, catches from other fisheries are included for the purpose of estimating boat fishing receipts.

**Shark specialists** are those operators holding Commonwealth endorsements for the southern shark fishery, where gross shark receipts account for more than 80 per cent of total fish receipts.

### Financial items

Cash receipts are the financial inflows to the boat during the year from the sale of fish, nonfishing activities including charter operations, and other sources (insurance claims and compensation, quota and/or endorsements leased out, government assistance and any other revenue). Receipts shown from the sale of fish are prior to any deductions made by marketing authorities for freight and selling charges. Where appropriate these charges are included in costs. Receipts also include amounts received in the survey year for fish harvested and delivered in previous years.

**Cash costs** include the payments made for both permanent and casual hired labor and payments for materials and services

(including payments on capital items subject to leasing, rent, interest, licence fees and repairs and maintenance). Labor costs include wages, salaries and share of receipts paid to owner operators, partners and their families. If family or other labor were unpaid, an estimate of the cost of their labor (based on rates comparable with their employed counterparts in the fishery) was obtained at interview and has been included in cash costs. Capital and household expenditures were excluded.

**Boat cash income** is defined as the difference between total cash receipts and total cash costs.

**Depreciation** is a noncash cost representing the cost of wear and tear on capital items during the survey year.

Depreciation figures, including depreciation for the hull, engine and other onboard and shore based plant, equipment (excluding gear) and structures, were estimated by the diminishing value method, based on the current replacement cost and age of each item. The rates applied are the standard rates allowed by the Commissioner of Taxation. For items purchased or sold during the survey year, depreciation is assessed as if the transaction had taken place at the midpoint of the year.

This method of calculating depreciation is also used in other ABARE industry surveys and an explanation of this method and a comparison with the previous method appears in ABARE's *Australian Fisheries Survey Report 1994*.

**Boat business profit** is defined as boat cash income less depreciation.

**Profit at full equity** is defined as boat profit, plus rent, interest and finance lease payments. It is the return produced by the resources used in the fishing business, and is the profit from fishing that would

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accrue to the owners if they fully owned the assets employed in the business.

**Capital** is defined as the value placed on the assets employed by the surveyed boat business. It includes the total gross value of the boat, including the value of the hull, engine and other onboard and shore based plant, equipment (including gear) and structures. Estimates are also reported for the value of quotas and endorsements held by the surveyed boat.

**Rate of return to boat capital** is calculated on total capital as if all fishing assets were wholly owned by the proprietors so that the financial performance of all sample boats can be compared, regardless of the proprietors' equity in the business. Rate of return to boat capital is computed by expressing profit at full equity as a percentage of total capital (excluding quota and licence value). The rate of return to boat capital provides an indication of the impact of management changes on the fishery.

**Rate of return to full equity** is computed by expressing profit at full equity as a percentage of total capital (including quota and licence value). This gives operators interested in investing in a new boat and/or licence a measure of the economic performance of the fishery.

**Debt** information for operators in each of the fisheries was collected at interview. Change in debt over the year is calculated for each boat as the difference between debt at 1 July and the following 30 June. It is an estimate of the change in indebtedness of a given population of boats during the financial year.

**Boat business equity** is derived by deducting the boat business debt from the value of capital employed in, and owned by, the fishing business.

**The equity ratio** is reported as a percentage of capital employed in, and owned by, the fishing business. The debt and equity figures shown are averages for boats for which information on debt was available.

## Target populations

Population information for the surveyed fisheries was obtained from logbooks and

boat registry data supplied by AFMA and, in the case of the southern shark fishery, MAFRI. Fishery management arrangements may be based on a calendar year so the fleet structure may change in the middle of the financial year. As a result, the target populations included only those boats that operated in the fishery in both the first and second halves of the financial year.

For the southern shark and Bass Strait scallop fishery only boats that recorded catches of the target species in the year were included in the target population. In the eastern tuna and billfish fishery, only boats that caught more than one tonne of tuna in the survey year were included in the target population.

## Sample weighting

Because the sample sizes for each sector of a fishery are not necessarily proportional to the actual population sizes of the sectors, the estimates presented in this report are all calculated by appropriately weighting the data collected from each sample boat. The sample weights are derived by comparing the total numbers of boats in the target populations, and total catches from the annual logbook data collected by AFMA, with the corresponding numbers and catch details of the boats in the various survey samples.

Different sample weights are used in the estimates for the different years, because of differences in population numbers and outputs, as well as in sample numbers and outputs, between years. Technical details of the method of weighting used are given in Bardsley and Chambers (1984).

## Sampling errors

Only a small proportion of the total number of boats in a particular fishery are sampled to produce the survey estimates. The differences between these estimates and the estimates that would have been obtained if information had been collected from all boats (the population or census values) are called sampling errors. The

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more boats there are in the sample, the smaller the sampling error is likely to be. So, for example, boat group estimates are likely to have greater sampling errors than fisherywide estimates.

As a guide to the reliability of the survey estimates, estimates of 'standard errors' have been calculated. These estimated errors, expressed as a percentage of the survey estimates (termed 'relative standard errors'), are given next to each estimate in parentheses.

### **Example of the use of relative standard errors**

To obtain the standard error from the relative standard error, multiply the relative standard error by the survey estimate and divide by 100. For example, if average total cash receipts are estimated to be \$100 000 with a relative standard error of 6 per cent, the standard error for this estimate is \$6000.

There is roughly a two in three chance that the census value (which would have been obtained if all boats in the target population had been surveyed) is within one standard error of the survey estimate. There is roughly a nineteen in twenty chance that a census value is within two standard errors of this survey estimate.

Thus, in the above example, there is an approximately two in three chance that the census value is between \$94 000 and \$106 000, and an approximately nineteen in twenty chance that the census value lies between \$88 000 and \$112 000.

### **Comparing estimates**

Greater caution should be exercised when calculating estimates of change derived from the survey estimates than when using the estimates themselves.

When comparing estimates between different industries, it is important to recognise that the differences are also subject to sampling error. An estimate of the standard error of the difference can be constructed by adding the squares of the estimated standard errors (note: not of the relative standard errors) of the component estimates, and then taking the square root of the result.

For example, suppose that total cash receipts were \$100 000 in one industry and \$125 000 in another – a difference of \$25 000 – and that the relative standard errors are given as 6 per cent and 8 per cent respectively. The standard error of the difference ( $v$ ) can be estimated as:

$$v = [(0.06 \times \$100\,000)^2 + (0.08 \times \$125\,000)^2] = \$11\,662.$$

Hence, the *relative* standard error of the difference is:

$$(\$11\,662 / \$25\,000) \times 100 = 47 \text{ per cent.}$$

Similar estimates of the standard errors of differences can be made when comparing years. Under some circumstances, those estimates would be conservative — that is, they would be overestimates of the standard errors of differences.

However, in instances where there are substantial changes in the population from year to year, the estimation of standard errors is more complex and recourse to the survey database would probably be required.

There may also be differences in data quality between the two estimates being compared: final estimates are more reliable than preliminary estimates because the final data have been cross-checked against a greater number of external data sources, lowering the probability of nonsampling errors.

### **Nonsampling errors**

The values obtained in a survey are affected by errors other than those related directly to the sampling procedure. For example, respondents may provide inaccurate information and mistakes may occur in the editing and processing of data.

ABARE's experience in conducting surveys has resulted in procedures designed to minimise nonsampling errors. However, when drawing inferences from estimates derived from sample surveys or from census data, users of data should bear in mind that nonsampling as well as sampling errors can occur.

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