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fisheries surveys report 2002

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Economic performance of selected fisheries in 1999-2000 and 2000-01

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ABARE is a professionally independent government economic research agency.

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foreword

Estimates of the performance of operators in the eastern tuna and billfish, south east nontrawl, southern shark and southern squid jig fisheries — which were surveyed by ABARE in 2002 — are given in this report.

Detailed information on fleet characteristics and business performance has been collected each year since the early 1980s and is published in an ongoing series of fisheries survey reports, as outlined at the end of this report.

ABARE survey information is used by fisheries policy makers, managers, researchers and the fishing industry. For instance, the Department of Agriculture, Fisheries and Forestry – Australia uses the information to assess the Australian Fisheries Management Authority's performance in managing Commonwealth fisheries. As the information is made publicly available, the fishing industry can also independently assess the performance of fisheries and the impacts of management policies.

ABARE's fisheries surveys provide estimates of the financial performance of boats in Commonwealth fisheries. Information has been collected on a basis that is consistent with the approach used by the Australian Fisheries Management Authority to define and manage the fisheries.

This is the fourth year that the surveys have been extended to include estimates of the economic performance of each surveyed fishery. This approach can be used to examine the returns from the fishery to the economy as a whole within the policy constraints of safeguarding sustainability and biodiversity. In addition, this report contains for the first time assessments of AFMA's performance against their economic efficiency objective for each surveyed fishery.

BRIAN S. FISHER
Executive Director

May 2003

acknowledgments

ABARE's fisheries surveys program involves a cooperative effort among industry, fisheries management and research agencies, and ABARE staff.

Industry

ABARE surveys are voluntary. The cooperation of fishing operators and their accountants in providing data is essential for the success of the fisheries surveys. Without this assistance the surveys would not be possible. The advice and comments on a draft of the report provided by industry representatives and representatives of relevant Management Advisory Committees is also greatly appreciated.

Management and research agencies

The Australian Fisheries Management Authority (AFMA) provided the logbook information necessary to select a sample and provide relevant population statistics and information on fishery management costs. In particular, Thim Skousen and Andrew Kettle provided valuable assistance. Assistance was also provided by Margot Sachse, Dave Johnson, Mandy Goodspeed and Dave Alden from AFMA.

ABARE staff

David Galeano and Peter Gooday of the Fisheries Economics Section undertook the analyses and compiled the report.

Sample design and estimation was undertaken by Walter Shafron and Caroline Levantis of the Survey Data Analysis Section. Data were collected, entered and edited by Ron Godenzi, Richard Paton, Lou Sissian, Robin Stafford, Nigel Spoljaric and Eden O'Mara of the Data Management and Collection Section. Laurie Cannon, Tony Wain, Bruce McConnell and Paul Phillips of the Data Management and Collection Section carried out survey administration and questionnaire design.

Programming and computer systems support was provided by Shona Lambert, Xue Huynh and Ken Colbert of the Data Management and Collection Section.

Graham Love provided comments on the report.

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ABARE fishery surveys

Economic surveys

ABARE has been undertaking economic surveys of selected Commonwealth fisheries since the early 1980s and on a regular basis for particular fisheries since 1992. The current fisheries survey program involves surveying major Commonwealth fisheries every few years, or more frequently where the fishery is undergoing major changes and monitoring is particularly important. The aim is to develop a consistent time series of economic information for each fishery. Such a database, in conjunction with scientific assessments of each fishery, is vital for assessing the economic performance of fisheries.

The surveys provide a broad range of information on the physical characteristics and financial performance of boats that operate in each fishery. For details on survey methods used and definitions of physical and financial characteristics discussed in the report, refer to appendix A.

Information from the surveys is made publicly available so the performance of fisheries and the impact of management policies can be independently assessed.

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

In practice this sample is seldom fully realised. Nonresponse is relatively high across fishery surveys, reflecting the difficulty in contacting some operators and a reluctance of others to participate in the survey. Sample design and weighting systems have been developed that reduce the impact of nonresponse, but care is still required when interpreting the information from the surveys.

Between February and June an ABARE officer visits the owner of each boat selected in the sample. 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 obtained from various sources is reconciled to produce the most accurate description possible of the physical and financial characteristics of each sample boat in the survey.

The 2002 surveys

ABARE surveyed four individual Commonwealth fisheries in 2002 — the eastern tuna and billfish fishery, south east nontrawl fishery, the southern shark fishery and the southern squid jig fishery.

Results for these four fisheries for 1999-2000 and 2000-01 are presented in this report. Estimates are presented for all boats endorsed to operate in each fishery. Where possible, subgroups of boats are also presented — for example, for shark specialists in the southern shark fishery.

Net returns to the fishery

This is the fourth year that ABARE has estimated net returns for the fisheries being surveyed. Prior to the 1999 survey report, ABARE surveys provided information only on the financial performance of boats operating in the specified fisheries. For various reasons, discussed in more detail in Rose, Stubbs, Gooday, Cox and Shafron (2000), measures that cover only boat financial performance do not necessarily provide a good indication of the economic performance of the fishery itself. In addition, this report contains, for the first time, assessments of AFMA's performance against their economic efficiency objective for each surveyed fishery.

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 fishing methods. The fishery extends to the limit of the 200 nautical mile Australian Fishing Zone from the tip of Cape York to the southernmost point of the Australian Fishing Zone to the South Australian – Victorian border. The fishery also encompasses waters around Lord Howe Island (figure A). No tuna fishing is permitted inside the Great Barrier Reef Marine Park (GBRMP) without a permit from the GBRMP Authority. Major ports used by the fleet include Cairns, Mooloolaba, Coffs Harbour and Hobart.

The fishery is divided into zones partitioned along inshore/offshore boundaries and northern/southern boundaries (Campbell and Miller 1998). There is also a significant recreational sector targeting the same stocks. The relevant state governments manage this recreational sector.

A Eastern tuna and billfish fishery management areas

Key findings

- Average boat cash income rose by 29 per cent in 2000-01, to around $65 600. This is despite cash costs increasing significantly in 2000-01.
- Real net returns to the longline fishery were estimated to have increased from around $1.6 million in 1999-2000 to $2.2 million in 2000-01.
- The proposed management arrangements of individual transferable effort (ITE) units that limit total allowable effort (TAE) may improve economic returns in the fishery. However, a number of challenges will need to be overcome to ensure that economic returns are maximised under the new management regime.

The commercial fishery operates as two distinct sectors, based on fishing method: the longline sector, which includes longline and minorline fishing methods; and the nonlongline sector, which uses purse seine and pole fishing methods. In 2001-02 the gross value of production (GVP) of the entire fishery was around $79.3 million, of which the longline sector accounted for over 99 per cent.

Longline sector

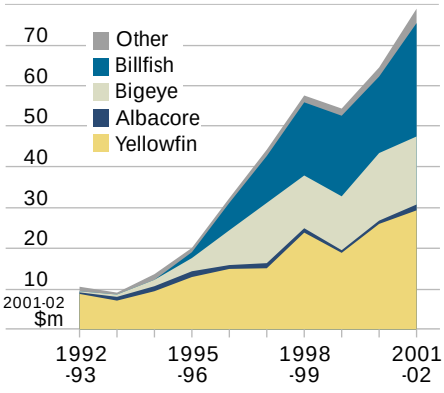
Australian longline and minor line fishers catch over seventy species of fish in the eastern tuna and billfish fishery. The principal species are yellowfin tuna, bigeye tuna, albacore tuna and broadbill swordfish. However, many other species are caught as byproducts, such as striped marlin, pelagic sharks, longtail tuna, rudder fish, black oilfish, dolpinfish, rays bream, moonfish and wahoo. Incidental catches of blue and black marlin occur, but these must be returned to the sea under a legislative amendment that came into effect in July 1998, in recognition that these species are the key target species of the game fishing sector.

There are currently three major regions of domestic longline activity in the fishery: the southern region of the fishery extending northwards to northern New South Wales, the southern Queensland region and the Cairns region. In the southern region of the fishery, Australian longliners have a long history of targeting premium quality yellowfin tuna and bigeye tuna in cool waters of southern New South Wales and yellowfin tuna and striped marlin off northern New South Wales, moving northwards to Brisbane (Campbell 1999).

In recent years the Cairns and southern Queensland regions of the fishery have developed significantly. Bigeye tuna and yellowfin tuna are targeted in these regions. The southern Queensland region of the fishery emerged in August 1996 when several longliners began fishing out of Mooloolaba targeting bigeye tuna for sashimi markets and swordfish for US markets.

A large body of latent effort exists in the fishery, as some operators do not use their pelagic longline entitlements and many operators fish relatively few days in the fishery. In 2000, there were 220 longline permits, of which only 140 were active. Of these, 101 were defined as full time longliners (more than 40 days at sea) (Caton 2002). The average number of sea days per boat in 2000 was 80 and around 9.4 million hooks were set in the longline fishery in that year (Caton 2002).

B Real GVP of the longline sector
Eastern tuna and billfish fishery



The real GVP of the longline sector increased by around 22 per cent in 2001-02 compared with 2000-01 (figure B). Yellowfin tuna accounted for about 37 per cent of longline GVP in 2001-02, with billfish and bigeye tuna accounting for 35 per cent and 21 per cent respectively.

The increase in GVP mainly reflected an increase in catch in 2001-02. The total longline catch

increased from 6638 tonnes in 2000-01 to 8349 tonnes in 2001-02. Billfish accounted for 37 per cent of the catch in 2001-02, with yellowfin tuna and bigeye tuna accounting for 30 per cent and 12 per cent respectively (figure C).

Much of the yellowfin tuna and bigeye tuna caught in the fishery are exported to Japan, with billfish exported to the United States. Consequently, changes in exchange rates can have a marked impact on the price received by fishers. Figure D shows that, between September 1997 and March 2001, the depreciation of the Australian dollar relative to the yen increased the prices received by fishers, compared with what would have been achieved if the exchange rate had stayed constant at the September 1997 rate. However, since March 2001, the Australian dollar relative to the Japanese yen has appreciated steadily. This will have the reverse effect on the prices received by fishers.

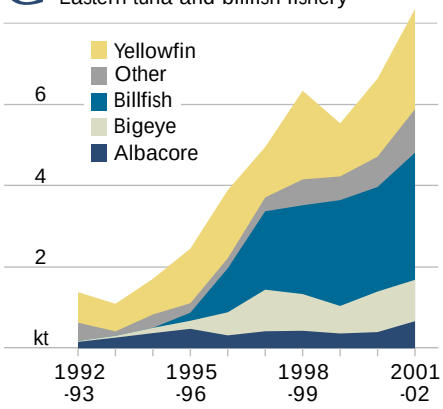
Purse seine and pole sector

Purse seine operators first started fishing for tuna and other pelagic species in the region in the 1930s. The fishery expanded in the 1970s, when southern bluefin tuna was the primary target species.

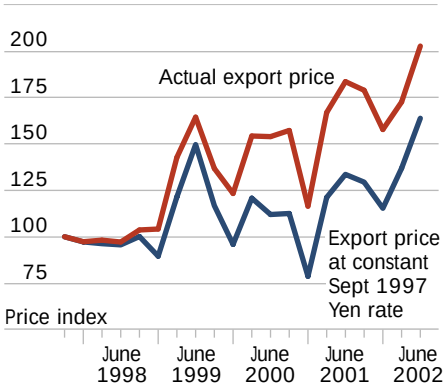
It was not until major cutbacks in the southern bluefin tuna quota, and the redirection of southern bluefin tuna to farming for sashimi outlets rather than canning, that attention was directed to purse seining for skipjack, a low value species.

The purse seine and pole sector, targeting skipjack, operates primarily along the New South Wales south coast and off north eastern Tasmania from November to May when surface temperatures are above 17°C (Caton 2002). 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 then feed the fish to bring them to the surface while the seiners surround the school with the nets.

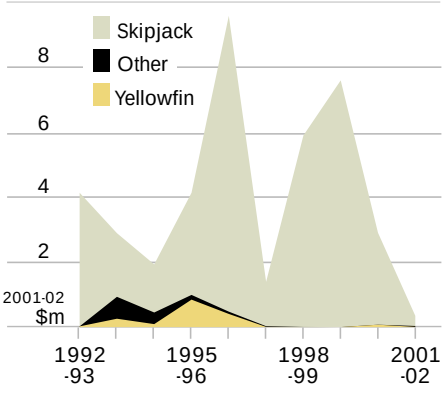
C Production in the longline sector
Eastern tuna and billfish fishery



D Impact of exchange rates on yellowfin tuna prices
Quarterly, ended June 2002

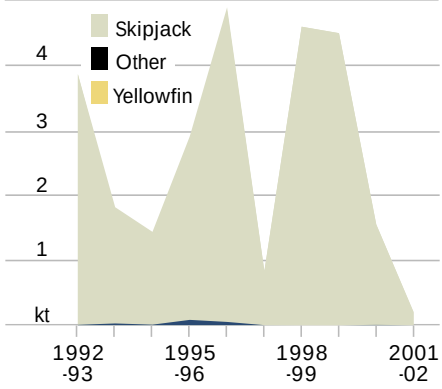


E Real GVP of the nonlongline sector
Eastern tuna and billfish fishery



The real GVP of the purse seine and pole sector fell to just $347 000 in 2001-02 (figure E). The GVP of this sector displays substantial variation because of fluctuating catch (figure F). This variation reflects the activity of operators as well as the annual availability of skipjack off south eastern Australia.

F Production in the nonlongline sector Eastern tuna and billfish fishery



Biological status of the fishery

Yellowfin tuna

Yellowfin tuna inhabit tropical and subtropical waters where the temperature is greater than 15°C and spawn in waters north of Coffs Harbour where the surface temperature is greater than 26°C. They are fast growing, reaching maturity at about two years of age and can grow to over 100 kilograms, although the average dressed weight of yellowfin tuna caught by Australian longliners is around 30 kilograms (Caton 2002).

Two semi-independent stocks of yellowfin tuna are thought to exist in the western and central Pacific Ocean and there may be further substructuring within them. Tagging studies indicate that yellowfin tuna move between the eastern tuna and billfish fishery and the western and central Pacific Ocean. However, even after prolonged periods, many tagged yellowfin tuna are recovered in areas where they were tagged.

According to Caton (2002), the status of yellowfin tuna in the eastern tuna and billfish fishery is uncertain, but perhaps fully fished. Poor recruitment in recent years may have influenced the availability of yellowfin tuna to the fishery, but may also reflect changes in line setting practices associated with the increased focus on swordfish and bigeye tuna (Caton 2002). Uncertainty remains about whether purse seine catches in the wider western and central Pacific Ocean affect longline catches in the eastern tuna and billfish fishery. Nevertheless, localised depletions cannot be ruled out as a possible cause of poor recruitment in recent years (Caton 2002).

Bigeye tuna

Bigeye tuna are slower growing than yellowfin tuna. They mature at about three years of age and can reach 2 metres in length and 180 kilograms when eight years or older. The average bigeye tuna caught by Australian longliners weighs around 35 kilograms.

While there is no clear genetic evidence of separate Pacific Ocean bigeye tuna stocks, there is still the suggestion of localised stock structures in the eastern tuna and billfish fishery.

Overall, the status of bigeye tuna stocks in the fishery is uncertain, with some concern about the impact of increased catches (Caton 2002). Preliminary stock assessment results for bigeye tuna in the Pacific Ocean indicate a long term decline in recruitment. In addition, a decline

in biomass was also evident and localised depletions in the north eastern section of the eastern tuna and billfish fishery cannot be ruled out (Caton 2002).

Broadbill swordfish

Swordfish can grow to over 550 kilograms and reach sexual maturity between two and four years of age. The average size of swordfish caught by eastern tuna and billfish longliners is around 40 kilograms. They have a high reproductive capacity and spawn broadly across the Pacific, including the tropical waters of the eastern tuna and billfish fishery where the sea surface temperature exceeds 24°C (Caton 2002).

Similar to bigeye tuna and yellowfin tuna, swordfish have a Pacificwide distribution. Recent genetic studies indicate that there may be several semi-independent stocks, but the amount of mixing among these stocks is unknown.

There is no quantitative assessment of the south western Pacific stock, so the status of stocks harvested in the eastern tuna and billfish fishery is uncertain. However, there is some concern at decreasing catch rates and depletion of localised aggregations of swordfish are possible (Caton 2002).

Marlins

Striped marlin, blue marlin and black marlin are distributed throughout the tropical and subtropical waters of the Pacific Ocean. The evidence on the structure of stocks of these three species is relatively unclear, with some evidence suggesting that black and blue marlins have a single genetic stock while striped marlin form several semi-independent stocks in the Pacific Ocean.

The longline catch of striped marlin in the eastern tuna and billfish fishery has trebled from 1997 to 2000 (Caton 2002). Recreational catches are also increasing. This increasing catch is placing fishery managers under pressure to determine a process of allocating striped marlin between user groups.

Legislation requires the release of blue and black marlin caught by commercial operators. However, mortality of hooked blue and black marlins by longliners is estimated at around 30 per cent (Caton 2002).

The stock status of marlins in the eastern tuna and billfish fishery as well as the wider Pacific Ocean is uncertain, with no reliable stock assessment available.

Skipjack tuna

Skipjack tuna inhabit tropical and subtropical waters, although the adult fish can be found in cooler waters. Skipjack tuna are a highly productive species, growing rapidly to reach maturity after one year. The stock structure is not well known, with adult skipjack tuna commonly traveling long distances. El Niño – Southern Oscillation episodes, which generate major changes in equatorial western and central Pacific Ocean water temperatures, can

significantly affect the distribution and abundance of skipjack tuna as well as recruitment and vulnerability to fishing. Current stock assessments suggest that the skipjack tuna stock may be underfished, although a degree of uncertainty exists.

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 Commonwealth government manages the commercial sector, including the major tuna and billfish species. The small tuna and tunalike species generally found on the continental shelf are managed by the states. The recreational fishing sector (noncommercial) is also managed by state authorities.

Currently, the commercial fishery is managed by input controls that include limited entry, zoning, boat restrictions, bycatch provisions and gear restrictions. 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. Also, vessels fishing south of Sydney are required to hold a minimum of 500 kilograms of southern bluefin tuna quota to be able to fish for any tuna species.

Purse seine operators have also been subject to limited access arrangements through area specific endorsements relating to four zones. However, with the large amount of latent effort that exists in the fishery, it is questionable whether these controls have any long term influence on effort in the fishery.

In September 2002, AFMA released a draft management plan for public comment. While the proposal does not change the boundaries of the fishery, all zones, except the current zone E, will be removed. The current zone E will be renamed the Coral Sea Zone. To fish in this area, fishers will need an additional permit.

The area of the eastern tuna and billfish fishery will include the high seas area of the current fishing permit.

The primary management tool proposed in the draft management plan is tradable effort units. It is proposed that longline statutory fishing rights will be allocated that will allow each operator to use a certain number of branchline clips each year. Each clip allows the fisher to set one hook. Fishers have to nominate in writing to AFMA how many hooks they intend to use each time they set a line. Each fisher will be required to install a ‘drum monitor’ on their boat, which sends an electronic message to AFMA alerting them that a line has been set. The nominated number of hooks will then be deducted from the fishers’ holdings. It is proposed that the hook units will be fully transferable either by lease or permanent sale. Along with the statutory fishing rights, longliners will also need to hold a boat permit in order to fish.

Minorline statutory fishing rights will be introduced — they will define the maximum number of lines that may be used at any one time in the fishery.

Pending the development of their own skipjack specific management plan, operators in the purse seine sector will be allocated a fishing permit.

Boats surveyed

The target population for the survey was defined as vessels that held a Commonwealth longline or minorline tuna permit for the fishery and that caught more than one tonne of tuna in 2000-01. The purse seine and pole sector of the fishery was not surveyed.

The total number of vessels eligible for the survey in 1999-2000 was 143, of which 20 were sampled. For 2000-01, the total eligible population was 132, of which 32 were sampled.

Generally two years data were collected at interview. However, where boats entered the fishery between survey years, some cooperators were only able to supply one year's data, hence the smaller sample in 1999-2000.

Financial performance of boats

The major measures of financial performance for boats in the eastern tuna and billfish fishery for 1999-2000 and 2000-01 are presented in table 1. Table 2 contains estimates of the financial performance of boats, by triptile. To calculate triptiles, the population was ranked according to fish sales. The third of the population with the lowest fish sales comprised the bottom triptile, and so on. The weighted average costs and earnings for boats were then calculated. The estimates shown in tables 1 and 2 contain costs incurred and receipts obtained by boats that operate in other fisheries and/or the high seas tuna fishery.

Receipts

Average per boat tuna and billfish receipts for the longline fleet as a whole in 2000-01 are estimated to have been almost $564 000, up 30 per cent from the previous year (table 1). Tuna and billfish receipts accounted for around 88 per cent of total cash receipts in 2000-01, with other fishing receipts and nonfishing receipts making up the remainder. Quota leased out and rebates and refunds make up the majority of nonfishing receipts.

Costs

Average total cash costs per boat in the longline fishery were $577 700 in 2000-01, an increase of 36 per cent from the previous year (table 1). Together, crew costs, repairs and maintenance and fuel accounted for around 67 per cent of total cash costs in 2000-01.

Average per boat crew costs, which represented 38 per cent of the fleet's total cash costs in 2000-01, rose by 32 per cent to $220 900. It is important to note that crew costs include the estimated cost of replacing owner operator and family labor with employees to do the same work. The reason for this is that on many boats where owner skippers are involved or family

labor is involved, the labor payments can be low or even nil. To reflect the true market value of the labor, operators are asked to estimate what it would cost to replace owner operator and family labor with paid crew and staff. This is likely to more accurately reflect the true market value of the labor used in the fishing operation.

Repairs and maintenance costs were the next largest expenditure at $90 040 per boat in 2000-01, a rise of 19 per cent from the previous year.

Boat cash income and profit

Despite cash costs increasing significantly in 2000-01, the increase in total cash receipts resulted in average boat cash income increasing by 29 per cent to $65 600 in 2000-01 (table 1). For boats in the upper triptile (table 2) total cash receipts rose by more than total cash costs, leading to boat cash income almost doubling to $205 100 in 2000-01. Despite increases

1 Estimated financial performance of longline boats
Eastern tuna and billfish fishery Average per boat

		1999-2000		2000-01	
Tuna and billfish receipts	$	433 880	(12)	563 990	(8)
Other fishing receipts	$	24 760	(41)	46 970	(27)
Nonfishing receipts	$	15 540	(18)	32 320	(16)
Total cash receipts	$	474 190	(12)	643 280	(8)
Administration	$	12 990	(13)	12 430	(8)
Bait	$	26 750	(28)	28 850	(16)
Crew costs	$	167 290	(12)	220 890	(7)
Fuel	$	44 220	(14)	76 070	(11)
Ice	$	2 420	(47)	3 150	(31)
Insurance	$	17 560	(10)	21 960	(8)
Interest paid	$	21 340	(29)	36 840	(16)
Leasing	$	8 300	(45)	20 080	(35)
Licence fees and levies	$	14 590	(11)	13 750	(11)
Repairs and maintenance	$	75 930	(15)	90 040	(12)
Other costs	$	31 930	(20)	53 630	(14)
Total cash costs	$	423 300	(11)	577 700	(7)
Boat cash income	$	50 890	(33)	65 580	(35)
less depreciation **a**	$	38 880	(21)	47 990	(12)
Boat business profit	$	12 020	(143)	17 590	(128)
plus interest, leasing and rent	$	30 040	(24)	57 060	(16)
Profit at full equity	$	42 050	(35)	74 650	(33)
Capital					
– excluding quota and licences	$	578 240	(20)	790 690	(12)
– including quota and licences	$	na		1 292 510	(8)
Rate of return to boat capital **b**	%	7.3	(38)	9.4	(32)
Rate of return to full equity **c**	%	na		5.8	(32)

a Depreciation adjusted for profit or loss on capital items sold. **b** Excluding value of quota and licences. **c** Including value of quota and licences. **na** Not applicable.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in appendix A.

in total cash receipts for boats in the lower and middle triptile, the boat cash income of these boats fell because of their significantly higher cash costs in 2001-02.

Boat business profit is defined as boat cash income less depreciation (adjusted for profit and loss on capital items sold). Depreciation rose by 23 per cent between 1999-2000 and 2000-01, to almost $48 000. This led to average boat business profit rising by less than $5600 to $17 600 in 2000-01.

Profit at full equity is estimated by adding leasing costs, interest charges and rent payments to boat business profit. While these costs affect the financial position of the operator, they represent some profits that have been redistributed to other investors in the fishery. Profit at full equity represents the average return that would have been earned by the business unit had the boat and capital (including quota and licences) been fully owned by the operator. Profit at full equity rose by 78 per cent between 1999-2000 and 2000-01 to an average of

2 Estimated financial performance of boats, by triptile

Eastern tuna and billfish fishery Triptiles based on value of fish sold – average per boat

		1999-2000					
		Lower		**Middle**		**Upper**	
Tuna and billfish receipts	$	252 960	(6)	388 220	(6)	675 600	(13)
Other fishing receipts	$	8 940	(52)	13 060	(36)	52 850	(47)
Nonfishing receipts	$	8 770	(17)	20 340	(24)	18 720	(37)
Total cash receipts	$	270 670	(4)	421 630	(8)	747 160	(9)
Administration	$	12 520	(20)	11 200	(11)	15 120	(29)
Bait	$	11 440	(19)	13 900	(39)	55 290	(29)
Crew costs	$	94 650	(16)	151 930	(6)	261 650	(13)
Freight and marketing	$	11 410	(41)	28 840	(45)	8 810	(76)
Fuel	$	26 210	(3)	34 960	(27)	72 550	(15)
Ice	$	1 100	(74)	6 550	(49)	140	(69)
Insurance	$	10 310	(12)	19 700	(14)	23 640	(13)
Interest paid	$	10 620	(21)	17 390	(41)	36 760	(49)
Leasing	$	2 480	(98)	9 300	(40)	13 830	(80)
Licence fees and levies	$	12 800	(12)	14 690	(16)	16 480	(26)
Repairs and maintenance	$	41 240	(16)	68 790	(18)	120 800	(17)
Other costs	$	13 330	(27)	18 100	(26)	17 540	(36)
Total cash costs	$	248 130	(8)	395 360	(10)	642 630	(11)
Boat cash income	$	22 550	(78)	26 270	(78)	104 530	(36)
less depreciation **a**	$	17 710	(29)	34 420	(39)	66 350	(26)
Boat business profit	$	4 840	(315)	–8 150	(324)	38 180	(118)
plus interest, leasing and rent	$	13 360	(21)	26 700	(39)	51 530	(38)
Profit at full equity	$	18 200	(84)	18 540	(108)	89 710	(37)
Capital							
– excluding quota and licences	$	264 800	(11)	434 360	(28)	1 055 460	(25)
– including quota and licences	$	na	(11)	na	(28)	na	(25)
Rate of return to boat capital **b**	%	6.9	(77)	4.3	(124)	8.5	(50)
Rate of return to full equity **c**	%	na	(77)	na	(124)	na	(50)

Continued ➪

around $74 700 owing to a substantial increase in the amount of interest, leasing and rent paid by longliners in the fishery.

Rates of return

The rate of return to boat capital is calculated on total capital (excluding the value of quota and licences) as if the proprietors wholly owned all assets so that the financial performance of all boats can be compared regardless of the proprietors' equity in the business.

The estimated average rate of return to boat capital (excluding the value of quota and licences) rose from 7.3 per cent in 1999-2000 to 9.4 per cent in 2000-01. This is despite a 37 per cent increase in the value of boat capital (excluding quota and licences) between 1999-2000 and 2000-01, to an average of almost $791 000 per boat.

2 Estimated financial performance of boats, by triptile *continued*
Eastern tuna and billfish fishery Triptiles based on value of fish sold – average per boat

		2000-01		
		Lower	**Middle**	**Upper**
Tuna and billfish receipts	$	293 270 (12)	508 590 (3)	916 260 (7)
Other fishing receipts	$	18 160 (22)	27 600 (25)	99 960 (37)
Nonfishing receipts	$	34 110 (35)	23 020 (27)	41 120 (22)
Total cash receipts	$	345 530 (12)	559 200 (4)	1 057 340 (5)
Administration	$	11 110 (16)	10 810 (10)	15 700 (15)
Bait	$	15 650 (24)	17 950 (28)	55 460 (18)
Crew costs	$	132 190 (8)	211 450 (7)	326 300 (5)
Freight and marketing	$	24 970 (22)	33 070 (32)	30 970 (41)
Fuel	$	44 440 (17)	63 170 (16)	124 620 (13)
Ice	$	2 130 (37)	4 430 (43)	2 770 (79)
Insurance	$	15 390 (14)	26 080 (15)	24 220 (8)
Interest paid	$	12 520 (25)	33 690 (22)	66 380 (20)
Leasing	$	6 740 (37)	17 200 (43)	37 610 (53)
Licence fees and levies	$	12 940 (12)	11 050 (8)	17 730 (26)
Repairs and maintenance	$	57 740 (35)	97 140 (19)	116 330 (11)
Other costs	$	17 810 (28)	20 610 (15)	34 190 (28)
Total cash costs	$	353 630 (10)	546 650 (8)	852 270 (5)
Boat cash income	$	–8 100 (312)	12 560 (290)	205 070 (16)
less depreciation **a**	$	24 520 (24)	47 990 (21)	73 000 (12)
Boat business profit	$	–32 610 (90)	–35 430 (108)	132 060 (24)
plus interest, leasing and rent	$	19 320 (24)	50 890 (21)	104 380 (18)
Profit at full equity	$	–13 290 (235)	15 460 (208)	236 450 (13)
Capital				
– excluding quota and licences	$	442 380 (18)	750 610 (21)	1 208 070 (14)
– including quota and licences	$	1 057 120 (13)	1 161 640 (14)	1 693 850 (13)
Rate of return to boat capital **b**	%	–3.0 (225)	2.1 (215)	19.6 (19)
Rate of return to full equity **c**	%	–1.3 (236)	1.3 (212)	14.0 (19)

a Depreciation adjusted for profit or loss on capital items sold. **b** Excluding value of quota and licences. **na Not** applicable.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in appendix A.

The rate of return to boat capital in the lower triptile fell markedly from 6.9 per cent in 1999-2000 to –3 per cent in 2000-01, whereas it fell slightly in the middle triptile and rose substantially to 19.6 per cent in 2000-01 in the upper triptile.

The rate of return to full equity (including quota and licences) provides an indication of the return to total capital invested in the business unit. This measure includes changes in the value of quota and licences, boat capital as well as changes in the profitability of the fishing operation. It is the profit from fishing that accrues to the owners of the capital.

3 Debt and equity of boats in the longline sector, 2000-01
Eastern tuna and billfish fishery

		Average per boat	
Capital (incl. quota and licences) at 30 June	$	1 304 830	(10)
Boat business debt at 1 July	$	301 800	(17)
Boat business debt at 30 June	$	320 630	(16)
Change in debt over year	$	18 830	(153)
Boat business equity at 30 June	$	984 200	(11)
Boat business equity ratio at 30 June	%	75.4	(5)

Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in appendix A.

The estimated value of quota and licences per boat in the longline fishery was almost $502 000. This includes the value of licences of other fisheries that boats are endorsed to fish in such as southern and western tuna and state fisheries as well as southern bluefin tuna quota. The rate of return to full equity (including quota and licences) was estimated at 5.8 per cent in 2000-01. The rates of return to full equity in 2000-01 in the lower and middle triptiles were close to zero, while in the upper triptile it was estimated at 14 per cent.

Debt and equity

Average boat business debt was estimated to increase by around $18 800 per boat in 2000-01 to around $320 600 (table 3). The boat business equity ratio provides a measure of the financial ownership of a fishing enterprise. The boat business equity ratio was estimated to be 75.4 per cent in 2000-01.

Economic performance of the fishery

The key economic question about the management of any fishery is whether it results in the maximisation of resource rent. Resource rent is the long run excess of income from a fishery over fishing and management costs. However, it is generally not possible to calculate resource rent, so a proxy measure — net return to the fishery — is calculated. Net returns of the longline sector of the eastern tuna and billfish fishery have been calculated for a number of years and are presented in table 4.

As can be seen in the table, the real net returns (inclusive of management costs) were estimated to be negative up to and including 1997-98. Coinciding with the continued development of the billfish fishery off Mooloolaba in 1998-99, the net returns then rose to a little under $5 million (in 2001-02 dollars). Since then, net returns have fallen and in 2000-01 were estimated at a little over $2.2 million (in 2001-02 dollars). With much of the fisheries products exported to Japan and the United States, receipts have been boosted since 1997 with the depreciation of the Australian dollar relative to the Japanese yen and US dollar.

4 Economic performance of the fishery
Eastern tuna and billfish fishery Total for fishery, in 2001-02 dollars

	1994-95		1995-96		1996-97		1997-98	
	$'000		$'000		$'000		$'000	
Revenue **a**	15 038	(14)	20 733	(10)	38 984	(12)	57 696	(16)
Operating costs **a**, **b**	14 498	(14)	19 890	(10)	34 967	(12)	49 611	(10)
Capital **a**, **c**	14 848	(14)	21 043	(20)	26 456	(19)	49 173	(23)
Net returns **d**	–2 234	(22)	–2 847	(32)	– 901	(105)	– 652	(744)
Management costs **e**	981	na	872	na	763	na	839	na
Net returns **f**	–3 215	(22)	–3 719	(32)	–1 665	(105)	–1 491	(744)

	1998-99		1999-2000		2000-01	
	$'000		$'000		$'000	
Revenue **a**	76 103	(8)	71 510	(11)	79 378	(8)
Operating costs **a**, **b**	58 784	(8)	59 104	(11)	65 952	(6)
Capital **a**, **c**	58 984	(19)	54 845	(22)	52 543	(12)
Net returns **d**	6 024	(80)	2 767	(94)	3 487	(94)
Management costs **e**	1 076	na	1 201	na	1 245	na
Net returns **f**	4 948	(80)	1 566	(94)	2 242	(94)

a Revenue, costs and capital estimates are for boats included in sample (there is no attempt to apportion costs between fisheries). **b** Cash costs include imputed operator and family labor costs but exclude licence and levy payments and interest payments. Labor costs include share payments, which may include net returns to the fishery. **c** Replacement capital (depreciated capital). **d** Excluding management costs. **e** Costs to AFMA of managing the fishery (A. Kettle, AFMA, personal communication, September 2002). **f** Including management costs. **na** Not applicable.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in appendix A.

The low (although not necessarily negative) net returns experienced prior to 1998-99 might have been expected given the management arrangements under which the fishery operates. The large body of latent effort that has existed in the fishery for a number of years (table 5) implies that any above average profits can be competed away relatively quickly with the activation of previously latent effort. It is possible that this has contributed to the downward trend in net returns since 1998-99. Until a management arrangement is implemented that effectively constrains fishing effort, it is unlikely that the larger positive net returns, such as those estimated for 1998-99, can be sustained.

The proposed management arrangements is a system of individual transferable effort (ITE) units that limit total allowable effort (TAE) by restricting the number of branch-line clips (hooks) allowed to be set in the fishery. This system has the potential to constrain fishing effort to a greater degree than the current management arrangements of limited entry and zone restrictions. However, a major concern with input controls (such as ITEs) is that the fishery manager does not have direct control over the total catch in the fishery, or the

5 Latent effort in the longline sector
Eastern tuna and billfish fishery

	Permits	Active **a**	Full time **b**
1994	202	81	33
1995	227	97	46
1996	229	113	49
1997	217	124	54
1998	222	150	100
1999	220	152	111
2000	220	140	101

a Those that reported more than one day at sea. **b** Those that reported more than 40 days at sea.
Source: Caton (2002).

composition of that catch. Effectively, the manager has to set a total allowable catch and then determine the number of hooks required in the fishery to achieve that level of catch.

Input control regimes provide fishers with an incentive to find new ways to fish within the rules. To maintain their share of the total catch, fishers will substitute unrestricted inputs for the restricted input in an attempt to increase their relative fishing power. In addition, the fishing power of individual vessels can be expected to rise as fishing gear and techniques become more efficient and operators' knowledge about the fishery improves. While fishers may become better at catching fish, they are forced to use a combination of inputs that do not necessarily minimise costs for the level of catch. These higher costs mean that net returns are not maximised and increased pressure on the fish stocks is also likely.

Where effort creep occurs, it is likely that input controls will need to be tightened frequently to ensure that fishing mortality is in line with management targets. As Rose (2002) explains, each set of rule changes can be expensive as they generally make some boats and gear redundant. As well, the process of researching, designing and negotiating changes in management regimes can be costly for both fishers and managers. In estimating the long run net returns to the fishery, both sets of periodic costs — those of research and negotiation and those of reinvestment — should be set against any apparent net returns in the years between changes in management regime.

Another potential problem associated with ITEs is that without additional controls, they provide little management control of effort directed at any particular target species. In a multispecies fishery where a degree of targeting is possible, such as the eastern tuna and billfish fishery, fishers will direct their effort at the species and locations that maximise profits. As such, a number of factors may lead to changes in targeting behavior. For example, changes in the relative prices of target species, changes in relative abundance (perhaps as a result of environmental factors) and changes in catchability (perhaps as a result of a change in fishing technology) can be expected to affect the proportion of effort directed at each of the major species.

A major challenge in implementing an ITE based management regime in the eastern tuna and billfish fishery that is efficient and sustainable will be to provide an adequate degree of control over catches of target species without substantially restricting the potential for industry development. It seems that controls in addition to the ITE measures that have been proposed will be required to achieve this.

The potential for localised depletion of major target species is another management challenge in the fishery. If stocks in the eastern tuna and billfish fishery are prone to localised depletion then this implies that, depending on their cost, some form of area based restrictions will be required to ensure economic efficiency. Where some areas of the fishery are more profitable than others — for example, because of their proximity to major ports or relatively high fish abundance — these areas will attract higher levels of fishing effort than the less profitable areas. The incentive to apply additional effort in an area will remain until profits in the more profitable areas are driven down (by additional effort) and profit per area is equalised across the fishery.

Detailed analysis of the relative costs and benefits of alternative management arrangements in the eastern tuna and billfish fishery has not been undertaken. However, the obvious alternative to ITE management would be a system of individual transferable quotas (ITQs) and a total allowable catch. This form of management would avoid the problems associated with effort creep and changes in targeting practices. However, ITQs have other potential problems. The potential for ITQs to encourage discarding and difficulties in setting an optimal total allowable catch in fisheries with unpredictable abundance have been recognised (Rose 2002). The problems that result if stocks in the eastern tuna and billfish fishery are prone to localised depletions are common to ITEs and ITQs, so it is likely that some form of area based management would also be required in addition to ITQs to ensure economic efficiency.

It is not clear that the problems associated with implementing ITQs would result in the net benefits of ITQ management being outweighed by those of ITE management in the eastern tuna and billfish fishery. In comparing the net benefits of ITEs and ITQs it is important that the full costs associated with each regime are accounted for. For example, the periodic costs involved in the development of new sets of rules under an ITE controlled fishery to correct for effort creep must be taken into account. Similarly, the potential loss of profitable opportunities under an ITQ regime in years of high abundance needs to be considered. Detailed analysis of the relative costs and benefits of management alternatives is required for the efficient management of the fishery in the longer term.

southern squid jig fishery – survey results

The fishery

The southern squid jig fishery management area includes Commonwealth waters greater than 3 nautical miles from the territorial baselines of New South Wales, Victoria, South Australia, Tasmania and Queensland up to Sandy Cape (adjacent to Fraser Island) (figure A). The fishery is seasonal, with the majority of the catch taken in autumn. The main fishing grounds are outside Port Phillip Bay, Portland, Lakes Entrance and to a lesser extent off southern New South Wales and eastern Tasmania.

The principal target species is arrow (or gould's) squid (*Nototodarus gouldi*), which is taken using jigging methods. The bycatch involved in arrow squid jigging is usually very small, with other varieties of squid constituting less than 1 per cent of the catch. There have been reports that occasionally pelagic sharks become entangled in the gear and are retained by fishers (Caton 2002). Squid are also caught as a byproduct to trawling activities especially

A **Southern squid jig fishery management areas**

in the south east trawl and Great Australian Bight trawl fisheries.

In 2000-01, there were 84 Commonwealth southern squid jig entitlements, with 44 attached to boats and the remaining 40 unattached. Of the 44 attached, there were 27 active boats in the fishery, with the majority of endorsement holders also holding other permits such as southern shark or state fishery permits. Jiggers have tended to fish only opportunistically for squid during closures or unproductive periods in other fisheries.

The gross value of production (GVP) of the southern squid jig fishery tends to be highly variable. In 2001-02 it was around $735 000 compared with $2.9 million in 2000-01 and just $440 000 in 1999-2000. This is mainly the result of highly fluctuating abundance.

Key findings

- For boats operating in the southern squid jig fishery, boat cash income is estimated to have been around $65 900 in 2000-01. This included receipts and costs incurred in other fisheries that these boats operate in.
- Net returns to the fishery were estimated to be around negative $680 000 in 2000-01. This result is likely to have been at least in part caused by the ineffectiveness of the current management arrangements to limit fishing capacity.
- The proposed management arrangements of individual transferable effort (ITE) units that limit total allowable effort (TAE) may improve economic returns in the fishery. However, it is not clear that this regime will allow for economic returns from the fishery to be maximised over the long term.

Biological status of the fishery

Although very little is known about the biology and the status of stocks of arrow squid, research indicates that they are short lived, reaching a maximum age of about twelve months and probably dying after spawning. Arrow squid tend to aggregate in large schools near the seabed during the day and disperse to some extent at night. During the fishing season the schools appear not to move too far, making them an easier target for jiggers.

Only limited research has been undertaken to determine the biological status of the fishery, squid growth rates and recruitment. In addition, little is known about the relationship between squid stocks and environmental factors, although it is thought that the variable recruitment is caused by environmental factors. The status of squid stocks in the western Bass Strait is uncertain, and stocks are considered to be probably underfished in other areas (Caton 2002).

The Fisheries Research and Development Corporation is funding a three year project spanning the 2000–02 seasons that aims to examine growth rates, age structure, genetics and general life history of arrow squid in Australian waters. This information will then be incorporated into future stock assessments to determine suitable levels of fishing. Reliable catch per unit effort data are also required to estimate stock abundance (AFMA 1999a).

Management of the fishery

Currently, the Australian Fisheries Management Authority (AFMA) manages the fishery by limited entry input controls. However, there is a large body of latent effort present in the

fishery, with less than a third of the permits in the fishery actively fished against in 2000-01. Catches of squid by trawlers in the south east trawl and Great Australian Bight trawl fisheries were 829 tonnes and 58 tonnes respectively in 2000-01. There is no direct management of squid catches in these fisheries.

A discussion paper on future management arrangements for the southern squid jig fishery was released for public comment in June 2002. Proposed management arrangements included transferable gear units allocated to fishers and trigger limits. The proposed catch trigger limit is 4000 tonnes. If the catch trigger limit is reached in any given season, an assessment will be made by AFMA whether a management response is required to limit catches. The discussion paper proposed that the transferable gear units be based on the wattage of lights, the number of jigging machines and the number of boats in the fishery. It has subsequently been agreed that the proposed effort units will only be based on the number jigging machines in the fishery. This decision was made on the basis that it is a simpler approach, that can be more cost effectively enforced and managed (D. Johnson, AFMA, personal communication, April 2003).

AFMA will be establishing an independent Allocation Advisory Panel to provide advice to the AFMA board to consider how fishing concessions should be allocated. Following the initial allocation the total number of jigging machines that can be used in the fishery will be set each season, based on advice from the squid management advisory committee (SquidMAC) and the squid fishery assessment group (SquidFAG).

Squid caught by trawlers in the south east trawl and Great Australian Bight trawl fisheries would continue to be managed separately. However, it is proposed that catch trigger limits of 1800 tonnes and 200 tonnes be implemented in the two fisheries respectively.

Boats surveyed

The target population of the survey was defined as boats that held endorsements for the southern squid jig fishery and that caught squid within the survey years. Boats that held endorsements but did not fish during the survey period were excluded from the population.

Based on logbook data, the number of eligible vessels in the southern squid jig fishery in 2000-01 was 21, of which 11 were sampled. For 1999-2000, the number of eligible boats was 30. However, an insufficient number of operators were willing to be surveyed for that year. Consequently, it was not possible to calculate reliable survey results for 1999-2000.

Financial performance of boats

The major measures of financial performance for boats operating in the southern squid jig fishery for 2000-01 are presented in table 1. It should be noted that many operators in the southern squid jig fishery also operate in other Commonwealth and state managed fisheries, targeting other species such as scallops, sharks and finfish. This mainly reflects the seasonal nature of the fishery. The fishing techniques and equipment required to target these other species are quite different, requiring, in many cases, boats to be rerigged. The activities in

these other fisheries had a major influence on the financial performance of the boats operating in the southern squid jig fishery over the survey period.

Receipts

For the fleet as a whole, total fishing receipts are estimated to have been around $293 300 in 2000-01 (table 1). Squid receipts accounted for a little under half of total fishing receipts, at an estimated $120 600 per boat in 2000-01. Scallop receipts averaged around $20 900 per boat in 2000-01. These scallop receipts are derived from the state scallop fisheries, as the main known commercial scallop beds within the Commonwealth managed Bass Strait central zone scallop fishery have been closed for a number of years. Other fishing receipts accounted for the remaining 43 per cent of fishing receipts, at $108 300 per boat. Other fishing receipts, include receipts from catches of sharks from the southern shark fishery as well as finfish from state and Commonwealth fisheries. Nonfishing receipts such as charter fees, quota leased out and rebates were estimated at around $43 500 per boat in 2000-01.

Costs

Average cash costs across the fleet were an estimated $227 400 per boat in 2000-01. Crew costs, repairs and maintenance and fuel costs were the three largest categories respectively, accounting for 75 per cent of total cash costs (table 1).

1 Estimated financial performance of boats
Southern squid jig fishery Average per boat

		2000-01	
Scallop receipts	$	20 860	(43)
Squid receipts	$	120 600	(10)
Other fishing receipts	$	108 270	(40)
Nonfishing receipts	$	43 540	(50)
Total cash receipts	$	293 260	(17)
Administration	$	4 160	(20)
Crew costs	$	96 040	(10)
Food	$	5 290	(12)
Fuel	$	29 800	(13)
Insurance	$	10 260	(24)
Licence fees and levies	$	14 060	(24)
Repairs and maintenance	$	45 680	(24)
Other costs	$	22 120	(47)
Total cash costs	$	227 410	(13)
Boat cash income	$	65 850	(57)
less depreciation **a**	$	31 210	(23)
Boat business profit	$	34 640	(107)
plus interest, leasing and rent	$	1 350	(45)
Profit at full equity	$	35 990	(103)
Capital			
– excluding quota and licences	$	471 820	(17)
– including quota and licences	$	1 135 180	(21)
Rate of return to boat capital **b**	%	7.6	(104)
Rate of return to full equity **c**	%	3.2	(90)

a Depreciation adjusted for profit or loss on capital items sold. **b** Excluding value of quota and licences. **c** Including value of quota and licences.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in appendix A.

Crew costs are estimated to have been around $96 000 per boat in 2000-01. It is important to note that crew costs include the estimated cost of replacing owner operator and family labor with employees to do the same work. The reason for this is that on many boats where owner skippers are involved or family labor is involved, the labor payments could be low or even nil. To reflect the true market value of the labor, operators are asked to estimate what it would cost to replace owner operator and family labor with paid crew and staff. This is likely to more accurately reflect the true market value of the labor used in fishing operations.

Repairs and maintenance costs and fuel costs were an estimated at $45 700 and $29 800 per boat respectively.

Boat cash income and profit

For the fleet as a whole, average per boat cash income was almost $65 900 in 2000-01.

Boat business profit is defined as boat cash income less depreciation (adjusted for profit and loss on capital items sold). As boat capital is estimated to have been $471 800 in 2000-01, depreciation was relatively high at an estimated $31 200 per boat. Therefore, boat business profit was around $34 600 per boat in 2000-01.

Profit at full equity is estimated by adding leasing costs, interest charges and rent payments to boat business profit. While these costs affect the financial position of the operator, they represent some profits that have been redistributed to other investors in the fishery. It represents the average return that would have been earned by the business unit had the boat and capital (including quota and licences) been fully owned by the operator. Profit at full equity is estimated to have been almost $36 000 in 2000-01.

Rates of return

The rate of return to boat capital is calculated on total capital (excluding the value of quota and licences) as if the proprietors wholly owned all assets so that the financial performance of all boats can be compared regardless of the proprietors' equity in the business. The estimated average rate of return to boat capital (excluding the value of quota and licences) was 7.6 per cent in 2000-01.

The rate of return to full equity (including quota and licences) provides an indication of the return to total capital invested in the business unit. This measure includes changes in the value of quota and licences, boat capital as well as changes in the profitability of the fishing operation. It is the profit from fishing that accrues to the owners of the capital. The estimated value of quota and licences per boat in the southern squid jig fishery was around $663 400. This includes the value of licences and quota of other fisheries that boats are endorsed to fish in, such as the southern shark fishery, state scallop fisheries and state and Commonwealth finfish fisheries. Given this large value of quota and licences, the rate of return to full equity (including quota and licences) was quite low at an estimated 3.2 per cent in 2000-01.

Economic performance of the fishery

The key economic question about the management of any fishery is whether it results in the maximisation of resource rent. Resource rent is the long run excess of income from a fishery over fishing and management costs. However, it is generally not possible to calculate resource rent, so a proxy measure — net return to the fishery — is calculated. Net returns of the southern squid jig fishery have been estimated for 1997-98, 1998-99 and 2000-01 and are presented in table 2. Net returns have not been calculated for 1999-2000 as an insufficient number of operators were willing to be surveyed.

As can be seen in table 2, the real net returns (inclusive of management costs) for all estimated years have been negative. It is likely that the negative net returns are at least in part

caused by the ineffectiveness of the current management arrangements to limit fishing capacity.

As mentioned earlier, AFMA released a discussion paper on future management arrangements for the fishery. In brief, the proposed arrangements included catch and effort trigger limits and individual transferable effort (ITE) units in the form of gear units. The gear units are to be based on the number of squid jigging machines. Total effort can then be set each season in an attempt to limit fishing effort.

The proposed management system is likely to constrain fishing effort more than the current system and economic returns are also likely to improve. However, the major problem with ITEs is the likelihood of effort creep where fishers manage to maintain or increase their fishing capacity despite the restrictions on the number of jigging machines. For example, fishers may be able to do this by increasing the wattage of lights, the number of lines per jigging machine or the number of jigs per line. The usual result is rising costs and a reduction in economic returns as fishers try to maintain their share of the catch. Trade in effort units from inefficient to efficient fishers is also likely to result in an increase in the fishing power of the fleet over time.

In a fishery with substantial fluctuations in abundance, the impact of effort creep will be apparent in low and average abundance years, but not so apparent in high abundance years. It is important to maximise net returns through time, which may require setting a TAE or TAC that balances losses in potential returns in high abundance years against having too much fishing capacity in low and average abundance years. While there may not be concerns about the stock status of squid in the fishery and squid stocks appear to be independent of fishing, ensuring that the net returns are maximised will require effective controls on fishing capacity.

In circumstances where fishers are able to increase their effective fishing power, it is likely that the input controls will need to be tightened frequently to ensure that the total catch is

2 Economic performance of the fishery
Southern squid jig fishery Total for fishery, in 2001-02 dollars

	1997-98		1998-99		1999-2000 **a**	2000-01	
	$'000		$'000		$'000	$'000	
Revenue **b**	1 322	(24)	2 199	(30)	na	2 672	(11)
Operating costs **b**, **c**	1 693	(22)	2 362	(14)	na	2 687	(19)
Capital **b**, **d**	5 660	(58)	5 120	(28)	na	3 157	(11)
Net returns **e**	–1 332	(54)	–1 102	(34)	na	–577	(62)
Management costs **f**	166	na	111	na	na	106	na
Net returns **g**	–1 498	(54)	–1 213	(34)	na	–683	(62)

a Estimates not available for 1999-2000 because of insufficient sample boats. **b** Revenue, costs and capital estimates are apportioned according to total receipts received from the southern squid jig fishery. **c** Cash costs include imputed operator and family labor costs but exclude licence and levy payments and interest payments. Labor costs include share payments, which may include net returns to the fishery. **d** Replacement capital (depreciated capital). **e** Excluding management costs. **f** Costs to AFMA of managing the fishery (A. Kettle, AFMA, personal communication, September 2002). **g** Including management costs. **na** Not applicable.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in appendix A.

in line with managements targets. Each set of changes can be expensive in two ways. First, they may make some boats and/or gear redundant and, second, researching, designing and negotiating new sets of rules can be costly for both fishers and managers. It is important to include both these costs in any analysis of the relative benefits and costs of alternative management regimes for the southern squid jig fishery.

Detailed analysis of the costs and benefits of alternative management arrangements in the southern squid jig fishery has not been undertaken. However, the obvious alternative to ITEs is a system of individual transferable quotas (ITQs) with a total allowable catch (TAC). This will avoid the problems associated with effort creep in ITE managed fisheries. However, ITQs have their own set of potential problems. The problem of highgrading and the setting of an optimal TAC have been acknowledged (Rose 2002).

As all landed catch is deducted from a quota holder's entitlement, there is the incentive for fishers to discard lower valued catch and only keep the higher valued catch. Highgrading will most likely occur when the price differential between the high and low valued catch is relatively large, the direct cost of further fishing is low and the proportion of high value catch expected in future catch is high. In the southern squid jig fishery, the potential for highgrading is likely to be limited as squid is a relatively low value species and the costs of further fishing are likely to outweigh any gains from landing only high value catch.

Unpredictable abundance of squid may limit the fishery manager's ability to set an optimal TAC. Setting a TAC at the average abundance rate may lead to pressure on the stock in years of low abundance and missed profits in years of high abundance. However, under an ITE regime if the total allowable effort is set too high then the race to fish and effort creep are likely to result in these potential rents being dissipated. In the absence of any significant biological knowledge of the stocks, the setting of a fairly arbitrary yet conservative TAC is likely to result in the generation of some positive net returns and the sustainability of the stock in the long run. A similarly arbitrary ITE arrangement cannot guarantee the same result.

In comparing the net benefits of ITEs and ITQs it is important to consider the full range of costs associated with each regime such as the periodic costs associated with the development of new sets of rules under ITEs. Similarly, the potential loss of profits in years of high abundance under an ITQ regime needs to be considered. Detailed analysis of the relative costs and benefits of alternative management regimes is required for the efficient management of the fishery in the longer term.

southern shark fishery – survey results

The fishery

The southern shark fishery is located in Commonwealth waters off the Victorian, Tasmanian and South Australian coasts (figure A). Under a series of Offshore Constitutional Settlement arrangements, the Commonwealth has jurisdiction for the management of school shark, gummy shark, saw shark and elephant fish in state coastal waters, excluding state internal waters.

The operators in the fishery primarily target school and gummy sharks, but catch all species of demersal shark. Sharks are taken using hook and demersal gillnet fishing methods, with the majority of the catch destined for the domestic market.

A Southern shark fishery management areas

Key findings

- Average boat cash income is estimated to have risen by around 16 per cent to around $34 100 in 2000-01, while boat cash income for 'shark specialists' fell slightly to $19 400 in 2000-01.
- With the overlap in operations between the southern shark and south east nontrawl fisheries, and because these two fisheries are to be managed as one fishery from 2003, the net returns for the combined fishery have been estimated. In both 1999-2000 and 2000-01, real net returns are estimated to have been close to zero.
- The proposal to integrate the southern shark and south east nontrawl fisheries (now the gillnet hook and trap fishery) with the Great Australian Bight trawl and south east trawl fisheries is likely to improve economic returns via cost savings from increased quota trades. However, it is important that the total allowable catch is set at a level that allows for economic returns to be maximised. If it is set too high, economic returns are likely to be dissipated.

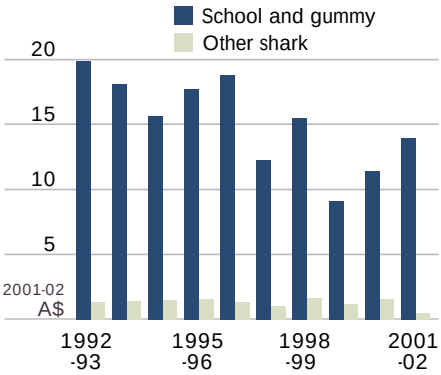
School and gummy sharks accounted for 87 per cent of the catch between 1970 and 2000. Sharks are also caught as a byproduct by fishers operating in other Commonwealth and state fisheries.

The fishery generally operates year round but is reliant on weather conditions. The larger boats have the ability to fish in almost any conditions whereas the smaller boats tend to concentrate their effort in summer and autumn when the seas are calmer.

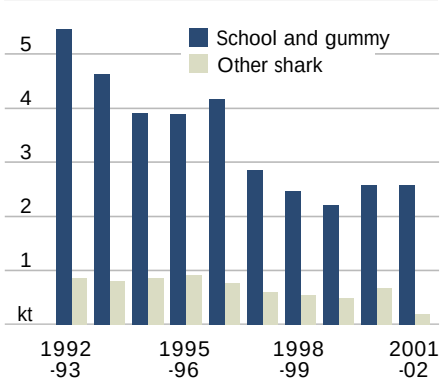
There were 122 gillnet and 38 hook permits valid in the fishery during the 1999-2000 season. However, not all shark permits are fished against all of the time. During poor rock lobster seasons or closures, many rock lobster fishers holding shark permits begin shark fishing. This contributes to an upsurge in shark fishing effort during these periods. Conversely a large number of shark gillnetters also target scale fish as a part of the south east nontrawl fishery.

The real gross value of production (GVP) of school and gummy sharks in 2001-02 was around $14 million compared with $11.5 million in 2000-01. However, as shown in figure B, the real GVP of school and gummy sharks trended downwards over the past decade.

B Real GVP of the southern shark fishery



C Production in the southern shark fishery



Catches of school and gummy shark have also declined, from over 5000 tonnes in 1992-93 to around 2600 tonnes in 2001-02, after a low of around 2200 tonnes in 1999-2000 (figure C). The drop in production is mainly attributable to the fall in the catch of school sharks (M. Sachse, AFMA, personal communication, May 2001).

Biological status of the fishery

School shark

School sharks can live for more than fifty years, with females maturing at around eight to ten years of age. Each female will bear on average between 15 and 43 young.

School sharks move extensively throughout the waters of Southern Australia, probably forming a single genetic stock within the fishery and Western Australian waters (Caton 2002). School sharks are also found around New Zealand, western Europe, the east coast of South America and southern Africa. While there is some evidence of interaction between Australian and New Zealand sharks, significant genetic differences have been found between these stocks.

The status of school shark stocks is 'overfished'. The 1999 stock assessment of school shark indicated that the 1997 level of mature biomass is between 12 and 18 per cent of the 1927 level (Caton 2002). Caton (2002) suggests that in order for management to satisfy its objective that the mature biomass at the start of 2011 exceeds that at the start of 1996 with 80 per cent confidence, the total allowable catch (TAC) needs to be a constant 327 tonnes from 2002. However, a 2001 update of this assessment concluded that the scheduled TACs are not low enough to enable management objectives to be met. Additional management measures are being considered by AFMA (M. Sachse, AFMA, personal communication, May 2003).

Gummy shark

Gummy sharks live for around sixteen years, with females maturing at about five years of age. Depending on their size they can carry from 1 to 38 young at a time.

Gummy sharks are endemic to the waters of the continental shelf and slope off southern Australia. They show no well defined movement patterns and are thought to mix less between regions of Australia than school shark.

The current catch of gummy sharks is probably sustainable (Caton 2002). An updated assessment of gummy shark stocks in 2000 treated gummy shark in Bass Strait, South Australia and Tasmania as separate stocks, though it did not suggest that they should be managed separately at this stage. The assessment indicated that pup production in 1999 as a percentage of the virgin level was between 45 and 78 per cent in Bass Strait and between 72 and 89 per cent in South Australia. It also concluded that the stock status of Tasmania was less certain but probably comparable with the two other areas.

Saw shark family and elephant fish family

A project to examine the biological information of the saw shark family and elephant fish family to help determine the TACs for these species is under way (Caton 2002).

Management of the fishery

The Commonwealth, Victorian, Tasmanian and South Australian governments manage the southern shark fishery. From 1 January 2001 the Commonwealth, under an offshore Constitutional Settlement Agreement, has jurisdiction for school and gummy shark to the high water mark, excluding bays, gulfs and inlets.

Until recently, fisheries management methods have focused on the use of input controls (limited entry, and gear restrictions such as minimum and maximum mesh sizes) in an attempt to control catch per unit of effort.

From 1 January 2001, the fishery was brought under ITQ management. In the first year of its operation, Commonwealth sector TACs were set for school and gummy sharks, apportioned between operators in the southern shark, south east trawl and Great Australian Bight trawl fisheries. Permanent transfer of quota between these fisheries is not permitted, but seasonal leasing is. Permanent transfer of shark quota is only permitted in whole packages

(class A fishing permit and associated quota) pending the outcome of the current legal challenges to the shark quota allocation. Seasonal leasing of shark quota within fisheries is permitted.

The Commonwealth sector TACs (trimmed carcass — 'trunked') for the 2001 fishing season were set at 432 tonnes for school shark and 2159 tonnes for gummy shark, with the majority being apportioned to operators in the southern shark fishery. Some input controls were maintained in the southern shark fishery, including:

- limited entry,
- minimum size limits for school and gummy shark and
- gear restrictions on hooks and mesh nets and gear configurations.

Bycatch limits of south east fishery quota species also apply as well as bycatch limits for state managed fisheries. In 2002 dual endorsed south east nontrawl and southern shark operators had a zero bycatch limit for south east nontrawl quota species and all catches had to be covered with quota. In 2003, the two fisheries were merged under the gillnet, hook and trap fishery, so catches of all quota species must be covered with quota.

For the 2002 season, the global TACs were reduced to 327 tonnes for school shark and 1700 tonnes for gummy shark. In addition, ITQ management was extended to include elephant fish family and saw shark family, with global TACs (trimmed carcass — 'trunked') of 83 tonnes and 362 tonnes respectively. Saw shark quota is apportioned between operators in the southern shark, south east trawl and Great Australian Bight trawl fisheries, with the majority apportioned to the southern shark fishery. In 2002, elephant fish family quota was apportioned between the southern shark and south east trawl fisheries, with a 15 kilogram trip limit for elephant fish caught by Great Australian Bight trawl fishery operators. In 2003, the trip limit was replaced with operators being allocated elephant fish family quota.

The only changes to the input controls in the southern shark fishery for 2002 was the removal of hook limits, and the reduction in the maximum length of gillnet to be used by permit holders to 4200 metres.

In June 2002, AFMA announced that a management plan is being refined that incorporates the southern shark fishery with the south east trawl, south east nontrawl and Great Australian Bight trawl fisheries under common management, expected to come into operation in the 2004 fishing season. In 2003, the southern shark and south east nontrawl fisheries come under common management in the gillnet, hook and trap fishery.

Boats surveyed

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

According to logbook data, there were 99 active southern shark fishery boats in 2000-01 of which 25 were surveyed, and 101 in the population in 1999-2000 of which 23 were surveyed.

Financial performance of boats

The major measures of the financial performance of boats that operated in the southern shark fishery are shown in table 1. Table 1 also presents the financial performance of 'shark specialists.' This includes only boats that earned greater than 80 per cent of their fishing income from the southern shark fishery. Table 2 shows the financial performance of boats operating in the southern shark fishery, by triptile. To calculate triptiles, the population was ranked according to the value of shark sales, with the top third of the population being contained in the upper triptile, the middle third containing boats from the middle triptile and the remainder in the lower triptile. It is important to note that the receipts and costs shown include those made and incurred while these boats were operating in other fisheries such as the state managed lobster fisheries or the Commonwealth's south east nontrawl fishery.

1 Estimated financial performance of boats
Southern shark fishery

		Shark specialists				All boats			
		1999-2000		2000-01		1999-2000		2000-01	
Shark receipts	$	180 150	(20)	184 230	(19)	132 460	(18)	140 210	(16)
Lobsters receipts	$					74 310	(24)	72 120	(27)
Other fishing receipts	$	6 990	(35)	5 540	(28)	19 370	(38)	23 920	(35)
Nonfishing receipts	$	3 820	(29)	4 680	(30)	8 250	(26)	7 760	(21)
Total cash receipts	$	190 950	(20)	194 450	(19)	234 400	(13)	244 010	(13)
Administration	$	5 760	(25)	6 030	(21)	6 250	(16)	6 460	(15)
Bait	$	50	(97)	30	(94)	2 970	(29)	2 770	(30)
Crew costs	$	86 010	(20)	89 310	(19)	102 160	(13)	104 540	(12)
Food	$	2 470	(26)	2 040	(29)	2 760	(21)	2 750	(20)
Fuel	$	15 770	(20)	14 440	(18)	19 070	(15)	19 070	(14)
Insurance	$	5 920	(23)	7 310	(25)	6 410	(17)	7 560	(17)
Interest paid	$	8 990	(42)	8 390	(43)	10 000	(28)	9 290	(27)
Licence fees and levies	$	10 010	(19)	11 650	(19)	11 300	(13)	12 210	(13)
Repairs and maintenance	$	18 420	(19)	17 720	(14)	20 870	(16)	20 410	(16)
Other costs	$	16 860	(21)	18 130	(23)	23 330	(19)	24 890	(20)
Total cash costs	$	170 250	(19)	175 020	(17)	205 120	(13)	209 940	(12)
Boat cash income	$	20 700	(51)	19 430	(59)	29 280	(33)	34 070	(37)
less depreciation **a**	$	8 810	(22)	9 160	(19)	10 690	(16)	11 680	(16)
Boat business profit	$	11 890	(90)	10 280	(114)	18 590	(50)	22 380	(52)
plus interest, leasing and rent	$	10 610	(40)	11 550	(37)	19 340	(26)	19 850	(26)
Profit at full equity	$	22 500	(44)	21 830	(56)	37 930	(27)	42 230	(30)
Capital									
– excluding quota and licences	$	196 740	(22)	201 200	(20)	205 480	(15)	218 930	(15)
– including quota and licences	$	na		700 330	(19)	na		1 114 320	(17)
Rate of return to boat capital **b**	%	11.4	(39)	10.8	(49)	18.5	(24)	19.3	(24)
Rate of return to full equity **c**	%	na		3.1	(47)	na		3.8	(21)

a Depreciation adjusted for profit or loss on capital items sold. **b** Excluding value of quota and licences. **c** Including value of quota and licences. **na** Not applicable.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in appendix A.

Receipts

For the entire fleet, total boat cash receipts are estimated to have risen by 4 per cent between 1999-2000 and 2000-01, to an estimated average of $244 000 per boat (table 1). In 2000-01, around 57 per cent of this was derived from shark sales, which rose by about 6 per cent to $140 200. Lobster receipts are estimated to have remained relatively stable between the two survey years and to have averaged $72 100 per boat in 2000-01, or 30 per cent of total cash receipts. Total cash receipts for 'shark specialists' are estimated to have averaged around $194 500 per boat in 2000-01, a slight increase from the previous year.

The triptile results in table 2 show that boats that had low shark sales had the highest lobster receipts. In 2000-01, nearly 70 per cent of fishing receipts for these boats was derived from lobsters. Many of these boats are lobster specialists, only fishing for sharks in the lobster closed season. Boats in the top third of the population did not have any lobster receipts, with 93 per cent of their fishing income derived from shark sales in 2000-01.

2 Estimated financial performance of boats, by triptile
Southern shark fishery

		Lower third				Middle third			
		1999-2000		2000-01		1999-2000		2000-01	
Shark receipts	$	23 240	(29)	22 880	(27)	95 960	(16)	103 940	(7)
Lobsters receipts	$	130 650	(57)	124 139	(52)	86 470	(66)	88 750	(64)
Other fishing receipts	$	34 130	(75)	31 719	(66)	10 450	(81)	16 900	(76)
Nonfishing receipts	$	7 990	(49)	9 262	(53)	11 100	(60)	5 680	(37)
Total cash receipts	$	196 020	(44)	188 000	(40)	203 980	(30)	215 280	(29)
Administration	$	5 020	(47)	5 065	(41)	5 890	(17)	6 700	(16)
Bait	$	6 370	(60)	5 514	(54)	2 200	(62)	2 460	(60)
Crew costs	$	86 680	(45)	80 863	(38)	83 950	(24)	92 800	(21)
Food	$	2 250	(69)	2 108	(56)	2 230	(23)	2 360	(32)
Fuel	$	15 390	(47)	15 921	(41)	18 060	(34)	20 340	(27)
Insurance	$	4 540	(56)	4 328	(48)	5 860	(25)	7 240	(28)
Interest paid	$	4 960	(62)	5 118	(58)	11 400	(37)	9 960	(36)
Licence fees and levies	$	8 800	(38)	7 824	(38)	9 440	(27)	11 080	(18)
Repairs and maintenance	$	22 030	(43)	19 355	(46)	12 420	(23)	18 470	(15)
Other costs	$	19 110	(43)	19 007	(38)	10 380	(12)	10 160	(23)
Total cash costs	$	179 930	(44)	171 145	(39)	171 340	(23)	195 380	(17)
Boat cash income	$	16 090	(79)	16 855	(73)	32 640	(70)	19 900	(164)
less depreciation **a**	$	8 300	(39)	7 351	(35)	13 050	(32)	13 720	(26)
Boat business profit	$	7 800	(156)	9 505	(121)	19 590	(103)	6 180	(482)
plus interest, leasing and rent	$	18 910	(73)	19 281	(68)	21 630	(46)	20 710	(48)
Profit at full equity	$	26 700	(70)	28 785	(63)	41 220	(68)	26 890	(132)
Capital									
– excluding quota and licences	$	133 950	(44)	123 500	(37)	187 880	(25)	173 580	(25)
– excluding quota and licences	$	na		1 066 733	(48)	na		1 144 860	(43)
Rate of return to boat capital **b**	%	19.9	(50)	23.3	(40)	21.9	(53)	15.5	(114)
Rate of return to full equity **c**	%	na	(30)	2.7	(28)	na		2.3	(90)

Continued ➪

For the fleet, other fishing receipts include, for example, sales of scallops, squid and finfish. In 2000-01 estimated sales of other fishing products were around $23 900, a 23 per cent increase from the previous year. Nonfishing receipts included items such as the charter fees, insurance recoveries and quota leased out. In 2000-01, these were estimated at around $7800 per boat, a slight decrease from 1999-2000.

Costs

Total cash costs for the fleet rose marginally to an estimated average of almost $210 000 per boat in 2000-01 (table 1). With the exception of insurance, all major cost items in 2000-01 remained relatively stable — that is, they rose or fell by less that 10 per cent compared with 1999-2000. Insurance costs rose by 18 per cent over the same period, to $7600. Total cash costs for 'shark specialists' also rose slightly over the survey period to an average of around $175 000 per boat in 2000-01.

2 Estimated financial performance of boats, by triptile

Southern shark fishery *continued*

		Upper third			
		1999-2000		**2000-01**	
Shark receipts	$	290 430	(5)	301 750	(8)
Lobsters receipts	$		.		.
Other fishing receipts	$	12 910	(24)	21 830	(54)
Nonfishing receipts	$	5 470	(31)	8 010	(20)
Total cash receipts	$	308 800	(5)	331 590	(9)
Administration	$	7 990	(20)	7 750	(18)
Bait	$	90	(83)	60	(83)
Crew costs	$	138 570	(7)	141 180	(10)
Food	$	3 890	(19)	3 810	(23)
Fuel	$	24 150	(8)	21 360	(13)
Insurance	$	9 040	(9)	11 380	(15)
Interest paid	$	13 970	(43)	13 250	(42)
Licence fees and levies	$	16 000	(5)	18 040	(8)
Repairs and maintenance	$	28 680	(11)	23 350	(13)
Other costs	$	10 980	(16)	10 900	(16)
Total cash costs	$	268 790	(6)	265 720	(9)
Boat cash income	$	40 020	(40)	65 870	(31)
less depreciation **a**	$	10 760	(17)	14 550	(25)
Boat business profit	$	29 260	(57)	51 320	(37)
plus interest, leasing and rent	$	17 330	(38)	19 670	(31)
Profit at full equity	$	46 600	(25)	70 990	(23)
Capital					
– excluding quota asd licences	$	302 140	(12)	364 860	(14)
– including quota and licences	$	na		1 138 360	(11)
Rate of return to boat capital **b**	%	15.4	(30)	19.5	(22)
Rate of return to full equity **c**	%	na		6.2	(23)

a Depreciation adjusted for profit or loss on capital items sold. **b** Excluding value of quota and licences. **c** Including value of quota and licences. **na** Not applicable.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in appendix A.

Crew costs were by far the largest estimated cost item in both survey years — estimated at $104 500 per boat in 2000-01, about half of total cash costs per boat. In terms of triptiles, estimated crew costs were much higher in the upper triptile at $141 200 in 2000-01. This compares with $92 800 and $80 900 in the middle and lower triptiles respectively. It is important to note that crew costs include the estimated cost of replacing owner operator and family labor with employees to do the same work. The reason for this is that on many boats where owner skippers are involved or family labor is involved, the labor payments could be low or even nil. To reflect the true market value of the labor, operators are asked to estimate what it would cost to replace owner operator and family labor with paid crew and staff. This is likely to more accurately reflect the true market value of the labor used in fishing operations.

Repairs and maintenance were the next largest cash cost, estimated at $20 400 per boat in 2000-01, about 10 per cent of total cash costs. This includes repairs and maintenance to the boat as well as gear and motor vehicles used on shore.

Despite the price of diesel rising over the survey period, average fuel costs per boat in 2000-01 are estimated to have remained steady at $19 100. This may partly reflect the increasing trend of fishers to purchase fuel net of the diesel fuel rebate, rather than paying full price at point of sale and claiming the rebate later.

Boat cash income and profit

Estimated boat cash income provides an indication of the ability of the operator to remain in the fishery in the short to medium term without the need for recourse to additional finance. Changes in this measure simply reflect changes in receipts and costs. While estimated boat cash income for the fleet as a whole rose by 16 per cent to $34 100 in 2000-01, it fell slightly to $19 400 for shark specialists.

Boat business profit is boat cash income less depreciation of capital items. As depreciation remained relatively stable over the survey period, the change in boat business profit estimated for the southern shark fishery fleet closely reflected the increase in boat cash income. For the fleet as a whole, it was an estimated $22 400 per boat in 2000-01.

Profit at full equity is estimated by adding leasing costs, interest charges and rent payments to boat business profit. While these costs affect the financial position of the operator, they represent some profits that have been redistributed to other investors in the fishery. It represents the average return that would have been earned by the business unit had the boat and capital (including quota and licences) been fully owned by the operator. For the fleet as a whole, profit at full equity rose by 11 per cent between 1999-2000 and 2000-01 to an average of $42 200, while it fell marginally for shark specialists to $21 800.

Rates of return

The rate of return to boat capital is calculated on total capital (excluding the value of quota and licences) as if the proprietors wholly owned all assets so that the financial performance of all boats can be compared regardless of the proprietors' equity in the business. The estimated average rate of return to boat capital (excluding the value of quota and licences)

rose from 18.5 per cent in 1999-2000 to 19.3 per cent in 2000-01. The rate of return to boat capital was estimated to be lower for shark specialists at around 10.8 per cent in 2000-01.

The rate of return to full equity (including quota and licences) provides an indication of the return to total capital invested in the business unit. This measure includes changes in the value of quota and licences, and boat capital as well as changes in the profitability of the fishing operation — that is, the profit from fishing that accrues to the owners of the capital.

The estimated value of quota and licences per boat in the southern shark fishery was around $895 400. This includes the value of licences and quota of other fisheries that boats are endorsed to fish in, such as the southern zone rock lobster and other state fisheries. Given this large value of quota and licences, the rate of return to full equity (including quota and licences) was quite low at an estimated 3.8 per cent in 2000-01.

The value of quota and endorsements for shark specialists was around $499 100 per boat, much lower than for the average boat in the fleet as a whole. This led to the rate of return to full equity of around 3.1 per cent in 2000-01, not significantly lower than the fleet average despite profit at full equity being around half that of the fleet on average.

Economic performance of the fishery

The key economic question about the management of any fishery is whether it results in the maximisation of resource rent. Resource rent is the long run excess of income from a fishery over fishing and management costs. However, it is generally not possible to calculate resource rent, so a proxy measure — net return to the fishery — is calculated.

With the large overlap in fishing operations between the southern shark and south east nontrawl fisheries it is difficult to calculate net returns for these fisheries separately. Consequently, the net returns presented here are for the combined southern shark and south east nontrawl fisheries. In addition, from 2003 the southern shark and south east nontrawl fisheries are to be managed together under the gillnet, hook and trap fishery.

The net returns for the combined fishery have been calculated for the three years 1998-99, 1999-2000 and 2000-01. Estimated net returns (inclusive of management costs) for the combined fishery were close to zero in all these years, despite an improvement in 1999-2000 (table 3).

There are two main steps involved in assessing the economic efficiency of fishery management arrangements. First, it needs to be determined what type of management regime is likely to allow for economic returns to be maximised (including the cost of management). Once this is established, the level of catch/effort needs to be determined. Setting catch/effort too high will result in the dissipation of economic returns, while setting it too low will result in missed profitable opportunities.

The main management tool in both the southern shark and south east nontrawl fisheries is a system of individual transferable quotas (ITQs) and a total allowable catch (TAC). ITQs

have been widely advocated as the best management tool to maximise economic efficiency (Rose 2002).

The TAC set in the south east nontrawl and southern shark fishery form part of a Commonwealth sector TAC across these two fisheries plus the south east trawl and Great Australian Bight trawl fisheries. The Commonwealth sector TAC is set and then apportioned across the four fisheries. Whether this TAC has been set at the optimal level is not clear. In the 2002 fishing season, only around 75 per cent of the TAC that applies across the south east nontrawl, southern shark and Great Australian Bight trawl fisheries was landed. For example, only 73 per cent of the 'global' TAC for school shark across the three fisheries was landed. With quotas not binding, it is likely that economic returns will at least partially be dissipated as the TAC has limited impact on restraining the level of effort in the three fisheries.

AFMA has proposed that the south east nontrawl, southern shark, south east trawl and Great Australian Bight trawl fisheries be managed under one common management plan. The main difference between the 'southern and eastern scalefish and shark fishery management plan' and the current arrangements is that the permanent transfer of quota between fisheries will be allowed. Currently only annual leasing of quota is permitted between fisheries. The restriction on the leasing of blue eye trevalla quota will remain under the proposal.

It is likely that the volume of quota traded will increase under the proposal. This is likely to be one of the major benefits of the proposal. Che and Kompas (2002) have shown that there are benefits from increased quota trade in the form of cost savings as quota flows to the more efficient fishers. They demonstrated that in the south east trawl fishery, cost savings of 1.8–2.1 cents per kilogram for every 1 per cent increase in the volume of quota traded have been achieved.

While cost savings from increased quota trades are likely under the proposal, it is important that the TAC is set at a level that allows for economic returns to be maximised. As mentioned previously, if quotas continue not to be binding then the economic returns realised in the combined fishery are likely to be well below the potential returns available.

3 Net returns for the combined fishery
Combined southern shark and south east nontrawl fishery In 2001-02 dollars

	1998-99		1999-2000		2000-01	
	$'000		$'000		$'000	
Revenue **a**	17.1	(10)	19.0	(15)	17.8	(15)
Operating costs **a**, **b**	14.8	(8)	15.2	(14)	14.0	(14)
Annual capital cost **c**	7.2	(17)	8.7	(17)	8.0	(19)
Net returns **d**	0.9	(92)	2.3	(32)	2.3	(43)
Commonwealth management costs **e**	2.1	na	2.1	na	2.2	na
Net returns (including management costs) **f**	–1.2	(92)	0.2	(32)	0.1	(43)

a Revenue, costs and capital estimates are for boats included in sample (there is no attempt to apportion costs between fisheries). **b** Operating costs include imputed operator and family labor costs but exclude licence and levy payments and interest payments. Labor costs include share payments, which may include net returns to the fishery. **c** Replacement capital (depreciated capital). **d** Excluding management costs. **e** Costs to AFMA of managing the fishery (A. Kettle, AFMA, personal communication, September 2002). **f** Including management costs. **na** Not applicable.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in appendix A.

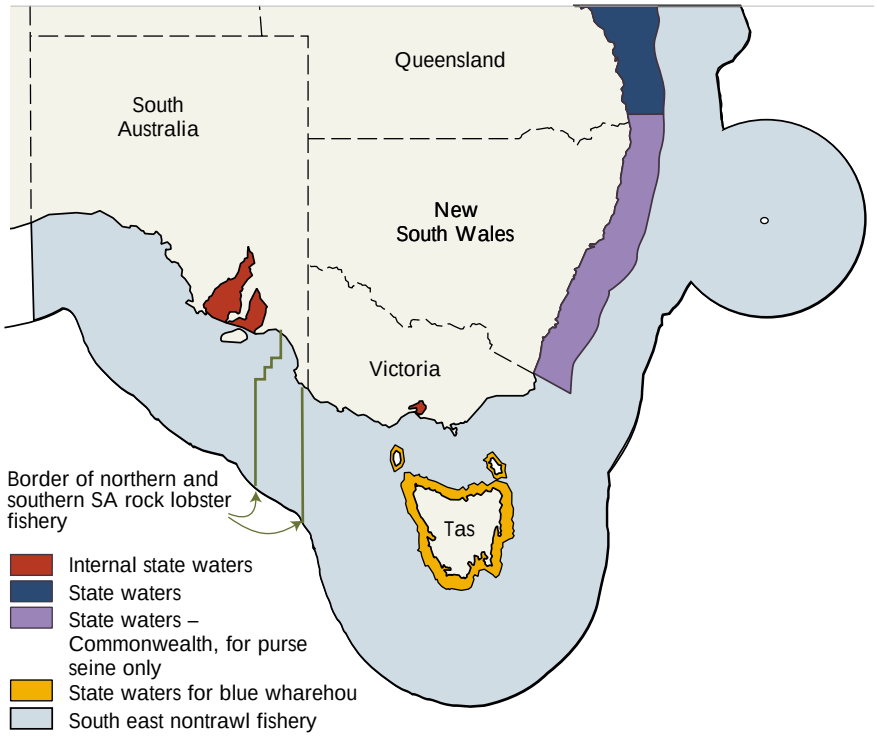
The costs of management under the proposed management plan are likely to change. There may be some cost savings in the form of administration costs, but these are likely to be small. Overall, the proposal to manage the southern fisheries under a common management plan and to allow greater trade in quota across sectors should allow for an increase in economic efficiency.

south east nontrawl fishery – survey results

The fishery

The south east nontrawl fishery is a multispecies fishery located off the south east coast of Australia. The fishery extends from Sandy Cape in Queensland, around New South Wales, Victoria and Tasmania to the South Australian/Western Australian border (figure A). Off New South Wales and Queensland, waters out to about 80 nautical miles are under state jurisdiction except for purse seining, which is managed by the Commonwealth past a three nautical mile limit off the coast of New South Wales. Waters off Tasmania are managed by that state for blue warehou and there is a 12 nautical mile no fishing zone around Lord Howe Island (Caton 2002).

A **South east nontrawl fishery management areas**



The fishery incorporates all fishing methods other than trawl and danish seine, including hook methods, demersal longlining, droplining, troll and handlines. As well, gillnets and a small number of fish traps are used.

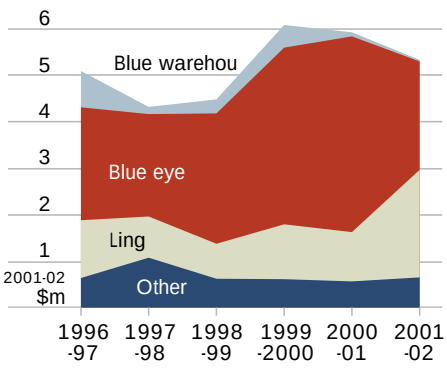
While many finfish species are taken in the nontrawl fishery, until recently three main species — blue eye trevalla, pink ling and blue warehou — were the principal species landed, comprising over 80 per cent of nontrawl landings since 1998-99. Since the 2002 fishing season, operators have tended not to target blue warehou, so pink ling and blue eye trevalla are, to a certain extent, the only species now commonly targeted by the nontrawl operators. Hapuku, ocean perch, ribaldo, blue grenadier, ray's bream, spotted warehou, boarfish and silver trevally are common bycatch of south east nontrawl operators.

Key findings

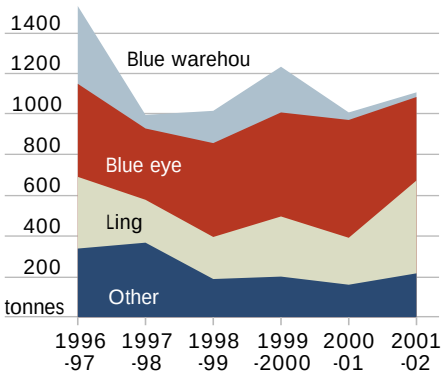
- Boat cash income for boats operating in the south east nontrawl fishery increased by 21 per cent in 2000-01 to $19 900.
- With the overlap in operations between the southern shark and south east nontrawl fisheries, and because these two fisheries are to be managed as one fishery from 2003, the net returns for the combined fishery were estimated. In both 1999-2000 and 2000-01 the real net returns are estimated to have been close to zero.
- The proposal to integrate the southern shark and south east nontrawl fisheries (now the gillnet, hook and trap fishery) with the Great Australian Bight trawl and south east trawl fisheries is likely to improve economic returns through cost savings from increased quota trades. However, it is important that the total allowable catch is set at a level that allows for economic returns to be maximised. If it is set too high, economic returns are likely to be dissipated.

The real gross value of production (GVP) from the fishery was $5.6 million in 2001-02, representing a slight decrease from $6.0 million in 2000-01. However, this is still higher than the $4.3 million of 1997-98 (figure B). The increase in the GVP since 1997-98 is mainly attributable to the increased catch and unit values of blue eye trevalla. In 2001-02 the value of ling catches increased substantially to $2.3 million.

B Real GVP of the south east nontrawl fishery



C Production in the south east nontrawl fishery



The fishery's production rose from around 1010 tonnes in 2000-01 to a little over 1160 tonnes in 2000-01 (figure C). While the catch of ling increased in 2001-02, the catch of blue warehou fell to just 23 tonnes in 2001-02 compared with 383 tonnes in 1996-97.

Biological status of the fishery

The three main quota species in the south east nontrawl fishery are subject to regular stock assessments by the South East Fishery Assessment Group.

Blue eye

Blue eye reach an age of forty years or more and a length of 120 centimetres and are found mostly in depths of 300–550 metres.

A genetic study indicates a common Australian stock, which range from mid New South Wales to south western Western Australia. Catches have tended to be comprised of young, immature fish, while larger mature fish become vulnerable to line fishing when forming seasonal spawning aggregations.

According to the South East Fishery Assessment Group, the status of blue eye is uncertain but in most eastern localities blue eye is probably fully fished with sustainable catches. The majority of the total catch is taken by south east nontrawl operators.

Ling

Ling are thought to attain a maximum age of about thirty years and length of 130 centimetres, reach maturity at five to seven years of age and are commonly caught in waters 300–550 metres deep.

While ling occur from central New South Wales to southern Western Australian and a common stock is assumed for management purposes, it is believed that fish caught in the south east nontrawl fishery may not form a part of a single Australian stock.

The status of ling is uncertain, but is probably fully fished off south eastern Victoria and New South Wales. While present catches are much greater than historical levels, there is the suggestion that the impact of fishing may not have been too heavy on the stock (Caton 2002).

Blue warehou

Blue warehou attain a maximum age of about ten years and a length of 65 centimetres and mature at three to four years of age. The stock structure is unknown, but a common stock is assumed for management purposes. Blue warehou occur in waters throughout the fishery at depths of 50–300 metres.

Catches in the past decade have fallen dramatically, both in the trawl and nontrawl sectors. The most recent stock assessment for blue warehou suggests that the biomass is less than

30 per cent of 1986-87 levels both east and west of Bass Strait and that the stocks are overfished (Caton 2002).

Details of the other species commonly caught by south east nontrawl operators can be found in Caton (2002).

Management of the fishery

Under a series of offshore constitutional settlement arrangements, Tasmania has jurisdiction over blue warehou and certain other species taken in state waters, while the Commonwealth has sole jurisdiction over all sixteen quota species taken off Victoria and South Australia. The Commonwealth also has sole jurisdiction over all sixteen taken off New South Wales and southern Queensland (outside 80 nautical miles, excluding by purse seine which is managed by the Commonwealth outside 3 nautical miles).

Since 1998, the south east nontrawl fishery has been managed under a system of output controls — namely total allowable catches (TAC) and individual transferable quotas (ITQ) — in combination with some input controls in the form of gear and area restrictions. The ITQ scheme used in the nontrawl fishery forms part of a broader ITQ management strategy for the south east fishery as a whole, where sixteen species are managed by ITQs. A 'global' TAC is determined for the combined trawl and nontrawl sectors of the fishery and is then allocated across the two sectors, with scope for fishery managers to adjust the total allowable catches each year.

In 1998, only the three key nontrawl species of blue eye, ling and blue warehou were managed by ITQs. However in 2001, this was extended to cover the remaining thirteen species caught in the south east fishery as a whole. Quotas within the nontrawl fishery are fully transferable on a permanent basis and seasonal leasing within the nontrawl fishery is also permitted. Permanent transfer of quota between the trawl and nontrawl sectors is not permitted. However, seasonal leasing between the sectors is permitted except for blue eye, where only up to 10 per cent of quota can be leased from the nontrawl sector to the trawl sector. There is no restriction on leasing blue eye quota from the trawl to the nontrawl sector.

To provide fishers with flexibility the ITQ system in the south east nontrawl fishery was conducted using a 'carryover' approach where up to 20 per cent of the total individual quota not harvested in one year may be carried over to the next. Similarly, for overcatches of up to 20 per cent of holdings, overcatch may be deducted from the following year's allocation. Catches in excess of 20 per cent over quota holding have to be covered by leasing in or purchasing quota in the year that the fish were caught.

Prior to January 1998, the south east nontrawl fishery was managed exclusively by a combination of input controls (gear and area restrictions) designed to constrain harvesting capacity. However, the ineffectiveness of the input controls in place was evident in the expansion of catches, particularly of blue eye trevalla, in several years leading up to 1998 and was one reason for the decision to implement an ITQ scheme (AFMA 1999b).

Boats surveyed

As with the previous survey of the south east nontrawl fishery, the target population was defined as boats that held endorsements for the fishery and that caught fish during the survey year. Boats that held endorsements and did not fish during the survey year were excluded from the population.

In 2000-01, there were 42 eligible boats of which 15 were sampled. In 1999-00, there were 48 eligible boats of which 17 were sampled.

Financial performance of boats

The major measures of financial performance for boats operating in the south east nontrawl fishery for 1999-2000 and 2000-01 are presented in table 1. Table 2 contains estimates of the financial performance of boats, by halves. To calculate these halves, the population was ranked according to the value of south east nontrawl finfish sales. The half of the population

1 Estimated financial performance of boats
South east nontrawl fishery Average per boat

		1999-2000		2000-01	
South east nontrawl receipts	$	122 260	(24)	132 060	(26)
Other fishing receipts	$	163 420	(18)	173 610	(21)
Nonfishing receipts	$	5 810	(26)	8 560	(28)
Total cash receipts	$	291 480	(10)	314 230	(12)
Administration	$	7 690	(11)	8 300	(13)
Crew costs	$	123 080	(8)	130 970	(10)
Fuel	$	25 720	(15)	25 520	(17)
Insurance	$	8 460	(23)	9 520	(19)
Interest paid	$	8 370	(35)	8 810	(42)
Leasing	$	25 720	(31)	27 130	(31)
Licence fees and levies	$	14 270	(11)	17 060	(14)
Repairs and maintenance	$	34 010	(16)	41 600	(23)
Other costs	$	27 690	(18)	25 400	(14)
Total cash costs	$	275 000	(10)	294 300	(11)
Boat cash income	$	16 480	(87)	19 930	(88)
less depreciation **a**	$	13 800	(13)	13 050	(13)
Boat business profit	$	2 680	(539)	6 880	(259)
plus interest, leasing and rent	$	34 300	(26)	36 220	(26)
Profit at full equity	$	36 980	(32)	43 090	(38)
Capital					
– excluding quota and licences	$	255 790	(15)	252 730	(16)
– including quota and licences	$	na		1 139 950	(14)
Rate of return to boat capital **b**	%	14.5	(34)	17.1	(40)
Rate of return to full equity **c**	%	na		3.8	(33)

a Depreciation adjusted for profit or loss on capital items sold. **b** Excluding value of quota and licences. **c** Replacement capital (depreciated capital). **na** Not applicable.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in appendix A.

with the lowest value of south east nontrawl finfish sales comprised the bottom half and the half of the population with the highest value of south east nontrawl finfish sales comprised the upper half (table 2). The weighted average costs and earnings for boats were then calculated.

Many boats that operate in the south east nontrawl fishery also operate in other Commonwealth and state fisheries such as the Commonwealth managed southern shark fishery and the state managed lobster fisheries. The activities in these other fisheries had a major influence on the financial performance of the boats operating in the south east nontrawl fishery over the survey period.

Receipts

For the fleet as a whole, estimated average per boat fishing receipts rose by 7 per cent between 1999-2000 and 2000-01 to $305 700, of which only an estimated 43 per cent was derived from the south east nontrawl fishery (table 1). The remainder was derived from numerous

2 Estimated financial performance of boats, by halves
South east nontrawl fishery

		Lower half				Upper half			
		1999-2000		2000-01		1999-2000		2000-01	
South east nontrawl receipts	$	14 990	(21)	15 410	(19)	235 060	(19)	252 700	(19)
Other fishing receipts	$	251 270	(16)	262 250	(49)	72 390	(43)	81 920	(49)
Nonfishing receipts	$	8 470	(28)	13 480	(59)	2 830	(64)	3 470	(59)
Total boat cash receipts	$	274 720	(15)	291 150	(16)	310 280	(15)	338 090	(16)
Administration	$	9 650	(14)	9 770	(16)	5 480	(9)	6 780	(16)
Crew costs	$	136 570	(12)	142 390	(13)	107 940	(13)	119 160	(13)
Fuel	$	25 970	(19)	24 750	(26)	25 440	(25)	26 310	(26)
Insurance	$	7 330	(17)	9 430	(36)	9 720	(41)	9 610	(36)
Interest paid	$	10 780	(49)	12 130	(49)	5 660	(52)	5 370	(49)
Leasing	$	13 530	(51)	19 320	(39)	39 410	(37)	35 210	(39)
Licence fees and levies	$	12 540	(16)	13 560	(15)	16 210	(15)	20 690	(15)
Repairs and maintenance	$	27 710	(20)	32 140	(34)	41 080	(24)	51 370	(34)
Other costs	$	23 920	(18)	23 110	(16)	31 920	(30)	27 760	(16)
Total cash costs	$	268 000	(13)	286 580	(16)	282 860	(17)	302 270	(16)
Boat cash income	$	6 730	(222)	4 570	(83)	27 420	(96)	35 820	(83)
less depreciation **a**	$	13 880	(19)	12 570	(21)	13 710	(20)	13 560	(21)
Boat business profit	$	–7 160	(203)	–8 000	(135)	13 710	(198)	22 260	(135)
plus interest, leasing and rent	$	24 700	(36)	32 000	(36)	45 070	(36)	40 580	(36)
Profit at full equity	$	17 540	(77)	24 000	(40)	58 790	(33)	62 840	(40)
Capital									
– excluding quota and licences	$	269 030	(14)	269 440	(29)	240 920	(30)	235 450	(29)
– including quota and licences	$	na		1 268 860	(25)	na		1 006 610	(25)
Rate of return to boat capital **b**	%	6.5	(73)	8.9	(48)	24.4	(41)	26.7	(48)
Rate of return to full equity **c**	%	na		1.9	(34)	na		6.2	(34)

a Depreciation adjusted for profit or loss on capital items sold. **b** Excluding value of quota and licences. **c** Replacement capital (depreciated capital). **na** Not applicable.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in appendix A.

state and Commonwealth fisheries such as the southern shark fishery and the state lobster fisheries. Nonfishing receipts such as charter fees and rebates were estimated at nearly $8600 per boat in 2000-01.

From table 2 it can be seen that boats in the upper half earned a higher proportion of their income from the south east nontrawl fishery. In 2000-01, boats in the upper half earned an estimated 76 per cent of their gross fishing receipts from the south east nontrawl fishery compared with just 6 per cent in the lower half. Boats in the lower half earnt the majority of their receipts from other fisheries such as the southern shark, southern squid and state lobster fisheries.

Costs

For the entire fleet, average cash costs across the fleet were estimated at $294 300 per boat in 2000-01, a 7 per cent increase from the previous year. Together, crew costs, repairs and maintenance and fuel costs accounted for around two-thirds of total cash costs in 2000-01. Average cash costs in both the upper and lower halves increased by 7 per cent in 2000-01 to $302 300 and $286 600 respectively.

For the fleet, crew costs were the largest estimated cash cost at almost $131 000 per boat in 2000-01, representing around 45 per cent of total cash costs. Crew costs includes the estimated cost of replacing owner operator and family labor with employees to do the same work. The reason for this is that on many boats where owner skippers or family labor is involved, the labor payments could be low or even nil. To reflect the true market value of the labor, operators are asked to estimate what it would cost to replace owner operator and family labor with paid crew and staff. This is likely to more accurately reflect the true market value of the labor used in fishing operations.

Repairs and maintenance costs were the next largest item at an estimated $41 600 per boat, a 22 per cent from 1999-2000. Fuel costs remained relatively stable over the survey period and at an estimated $25 500 per boat. This is despite an increase in fuel prices over the survey period. This may reflect the increasing trend of operators to claim the diesel fuel rebate at point of sale in 2000-01. As such, an increased portion of the estimated fuel cost per boat in 2000-01 is net of the rebate.

Boat cash income and profit

For the fleet as a whole, average per boat cash income rose slightly to an estimated $19 900 in 2000-01. Boat cash income was substantially higher in the upper half than the lower half in both survey years. It was estimated at around $35 800 in 2000-01 for the upper half, a 31 per cent increase on the previous year, while it was estimated to fall by 32 per cent in the lower half to $4600 in 2000-01.

Boat business profit is defined as boat cash income less depreciation (adjusted for profit and loss on capital items sold). For the entire fleet, depreciation fell by 6 per cent between 1999-2000 and 2000-01 to $13 050 per boat. This helped increase boat business profit to an estimated $6900 per boat in 2000-01. Depreciation was similar in both the lower and upper

halves and as such changes in boat business profit between the survey years closely reflected changes in boat cash income.

Profit at full equity is estimated by adding leasing costs, interest charges and rent payments to boat business profit. While these costs affect the financial position of the operator, they represent some profits that have been redistributed to other investors in the fishery. It represents the average return that would have been earned by the business unit had the boat and capital (including quota and licences) been fully owned by the operator. For the fleet as a whole, profit at full equity rose by 17 per cent between 1999-2000 and 2000-01 to an average of $43 100, assisted by an increase in the amount of interest, leasing and rent paid by operators. Profit at full equity rose in both halves. For 2000-01, it was estimated at $62 800 for boats in the upper half while for boats operating in the lower half it was estimated at $24 000.

Rates of return

The rate of return to boat capital is calculated on total capital (excluding the value of quota and licences) as if the proprietors wholly owned all assets so that the financial performance of all boats can be compared regardless of the proprietors' equity in the business.

The estimated average rate of return to boat capital (excluding the value of quota and licences) rose from 14.5 per cent in 1999-2000 to 17.1 per cent in 2000-01. This partially reflected a decrease in the estimated value of boat capital (excluding quota and licences) between 1999-2000 and 2000-01 to an average of $252 700 per boat. The rate of return to boat capital was estimated to be significantly higher for boats operating in the upper half. While the return to boat capital rose in both halves, it was estimated at 26.7 per cent in the upper half and 8.9 per cent in the lower half.

The rate of return to full equity (including quota and licences) provides an indication of the return to total capital invested in the business unit. This measure includes changes in the value of quota and licences, boat capital as well as changes in the profitability of the fishing operation. It is the profit from fishing that accrues to the owners of the capital.

The estimated value of quota and licences per boat in the south east nontrawl fishery was around $887 200. This includes the value of licences and quota of other fisheries that boats are endorsed to fish in, such as the southern shark fishery and state lobster fisheries. Given this large value of quota and licences, the rate of return to full equity (including quota and licences) was quite low at an estimated 3.8 per cent in 2000-01. The rates of return to full equity (including quota and licences) in the lower and upper halves were estimated at 1.9 per cent and 6.2 per cent respectively.

Debt and equity

Average boat business debt is estimated to have fallen by around $22 400 per boat in 2000-01 to $108 800 (table 3). The boat business equity ratio provides a measure of the financial ownership of a fishing enterprise. The boat business equity ratio was estimated to be 91.8 per cent in 2000-01.

Economic performance of the fishery

With the large overlap in fishing operations between the southern shark and south east nontrawl fisheries it is difficult to calculate net returns for these fisheries separately. In addition, from 2003 the southern shark and south east nontrawl fisheries are to be managed together under the gillnet, hook and trap fishery. Consequently, estimates of net returns for the combined southern shark and south east nontrawl fisheries have been calculated. These estimates are presented in the 'southern shark' chapter of this report.

3 Debt and equity of boats, 2000-01
South east nontrawl fishery

		Average per boat	
Capital (incl. quota and licences) at 30 June	$	1 322 150	(15)
Boat business debt at 1 July	$	131 170	(44)
Boat business debt at 30 June	$	108 820	(45)
Change in debt over year	$	–22 350	(56)
Boat business equity at 30 June	$	1 213 330	(17)
Boat business equity ratio at 30 June	%	91.8	(4)

Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in appendix A.

survey methods and definitions

Collecting survey data

ABARE surveys are designed and samples selected on the basis of information supplied by the Australian Fisheries Management Authority (AFMA). This information includes data on the size of the catch, fishing effort and boat characteristics.

Because it is not possible to survey all the boats in a fishery, a sample of boats is selected based on their 'representativeness'. Where possible, boats are classified into subgroups based either on the fishing method used (longline boats, purse seine boats, trawlers and so on) or on the size of operations (typically small, medium and large producers). A number of representative boats from each subgroup is then targeted for the survey.

The owners of the sample boats are contacted by ABARE and face to face interviews are conducted. Interviewers ask for information on the physical and financial details of the fishing business. In a number of instances, the skipper of the boat may also be interviewed. In general, information is collected for the preceding two financial years. Major Commonwealth fisheries are surveyed every two years.

Definitions of key variables

Cash receipts represent returns 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) in the financial year.

For the majority of operators, this information is readily available from their own records. However, different operators record their fishing income in different ways. In some cases, such as where fish are sold through a cooperative, some operators may only record the payments received from the cooperative. These payments may be net of commissions and freight as well as net of other purchases made through the cooperative.

In other cases, the crew is paid directly for the catch by the cooperative or agency and the owner's financial records might include only the amount of revenues they received after the crew's share had been deducted.

For these reasons, operators are asked to provide a breakdown of the total catch of their boat and an estimate of the total value of that catch. For consistency, marketing charges may need to be added back into fishing receipts for some boats to give a gross value. Where this is necessary these selling costs are also added into the cost estimates to offset the new revenue

figure. Receipts also include amounts received in the survey year for fish sold 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). Capital and household expenditures are excluded.

Labor costs are usually the highest cash cost in the fishing operation. Labor costs include wages, salaries and an estimated value for owner/partner, family and unpaid labor. Labor costs cover the cost of labor involved in boat related aspects of the fishing business, such as crew or onshore administration costs, but do not cover the cost of onshore labor involved in processing the fisheries products.

On many boats, the costs of labor are reflected in the wages paid by boat owners and/or in the share of the catch they earn. In some cases, however, such as where owner skippers are involved, or where family members work in the fishing operation, the payments made can be low or even nil, which will not always reflect the market value of the labor provided. To allow for this possible underestimation, all owner/partner and family labor was based on estimates collected at the interview of the amount it would cost to employ someone else to do the work.

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

Depreciation costs have been estimated using 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. A comparison with the method used to calculate depreciation in ABARE fish surveys prior to 1995 is contained in ABARE (1996a).

Boat business profit is boat cash income less depreciation.

Profit at full equity is boat profit, plus rent, interest and lease payments.

Capital is the value placed on the assets employed by the surveyed boat business. It includes the value of the boat, hull, engine and other onboard equipment (including gear). Estimates are also reported of the value of quotas and endorsements held by the surveyed boat. Estimates of the value of capital are based on the market value of capital and are usually obtained at interview but in some cases quota and endorsement values are obtained from industry sources.

Depreciated replacement value is the depreciated capital value based on the current age and replacement values of boat and gear. The value of quota and endorsements held is not included in the estimate.

Rate of return to boat capital is calculated as if all fishing assets were wholly owned by the proprietors. This enables the financial performance of sample boats to be compared regardless of the proprietor's equity in the business. Rate of return to boat capital is calculated by expressing profit at full equity as a percentage of total capital (excluding quota and licence value).

Rate of return to full equity is calculated by expressing profit at full equity as a percentage of total capital (including quota and licence value).

Debt information was collected at interview. Change in debt over the year is calculated as the difference between debt at 1 July and the following 30 June.

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 boat business equity expressed as a percentage of capital employed in the fishing business. The debt and equity figures shown are averages for those boats for which information on debt was available.

Net returns to the fishery are estimated as the gross revenue earned in a single fishery, less an estimate of the fishing costs incurred in that fishery including management costs, less the full annualised cost of capital.

Apportioning boat receipts and costs among fisheries

Many boats operate in more than one fishery. To provide estimates of the economic returns from an individual fishery, it is necessary to apportion boat receipts and costs among the fisheries.

Apportioning fishing receipts to particular fisheries is generally straightforward, as information on sales by major species can generally be used to calculate the receipts associated with a fishery. Calculating the costs of a fishing operation that are attributable to a fishery can be more difficult, however. In this report, costs have been apportioned to a fishery based on the proportion of total fishing revenue associated with that fishery.

The net return to the fishery is defined as:

$$\sum_{i=1}^{n} R_i - \sum_{i=1}^{n} p_i\left(OC_i + \left(d_i + r\right)K_i\right) - M$$

where

R_i = total cash receipts attributable to the fishery, excluding any receipts from leasing or sales of licences or quota for boat *i*;

p_i = proportion of total fishing receipts attributable to the fishery for boat *i*;

OC_i = total cash costs *less* interest paid on debt *less* expenditure on leasing or purchase of licences or quota for boat *i*;

K_i = value of capital associated with boat *i* (depreciated replacement value);

d_i = depreciation rate for boat *i* (depreciation *less* capital appreciation associated with boat *i* divided by K_i);

r = real interest rate (assumed at 7 per cent for calculations in this report);

M = costs of managing the fishery;

n = number of boats operating in the fishery.

Sample weighting

The estimates presented in this report are calculated by appropriately weighting the data collected from each sample boat and then using these weighted data to calculate estimates for the population. Sample weights are calculated such that the weights summed represent the target population, and the sum of the weighted catch of the sample equals the logbook totals supplied by AFMA. Technical details of the method of weighting used are given in Bardsley and Chambers (1984).

Reliability of estimates

A relatively small number of boats out of the total number of boats in a particular fishery are surveyed. Estimates derived from these boats are likely to be different from those that would have been obtained if information had been collected from a census of all boats. How closely the survey results represent the population is influenced by the number of boats in the sample, the variability of boats in the population and most importantly the design of the survey and the estimation procedures used.

To give a guide to the reliability of the survey estimates, measures of sampling variation have been calculated. These measures, expressed as percentages of the survey estimates and termed ‘relative standard errors’, are given next to each estimate in parentheses. In general, the smaller the relative standard error, the more reliable the estimate.

Use of relative standard errors

These relative standard errors can be used to calculate ‘confidence intervals’ for the survey estimate. First, calculate the standard error by multiplying the relative standard error by the survey estimate and dividing 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’ (the value that 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 the census value is within two standard errors of the survey estimates. Thus, in this example, there is approximately a two in three chance that the census value is between $94 000 and $106 000, and approximately a nineteen in twenty chance that the census value is between $88 000 and $112 000.

Comparing estimates

When comparing estimates across groups or years it is important to recognise that the differences are also subject to sampling error. As a rule of thumb, a conservative estimate of the standard error of the difference can be constructed by adding the squares of the estimated standard errors of the component estimates and then taking the square root of the result.

For example, suppose the estimates of total cash receipts were $100 000 in one year and $125 000 in the previous year — a difference of $25 000 — and the relative standard error is given as 6 per cent for each estimate. The standard error of the difference can be estimated as

$$\sqrt{[(0.06 \times \$100\,000)^2 + (0.06 \times \$125\,000)^2]} = \$9605$$

so the relative standard error of the difference is:

$$(\$9605/\$25\,000) \times 100 = 38\%.$$

It should be noted that there may be changes in the fishery populations from one year to the next. If these population changes are substantial, differences in estimates may be caused more by the changes in population than by changes in the variables themselves.

Nonsampling errors

The values obtained in a survey are affected by errors other than those related directly to the sampling procedure. For example, it may not be possible to obtain information from certain types of boats, respondents may provide inaccurate information or respondents may differ from nonrespondents in a variable being surveyed.

ABARE's experience in conducting surveys has resulted in procedures aimed at minimising nonsampling errors. However, when drawing inferences from estimates derived from sample surveys, users should bear in mind that both sampling and nonsampling errors occur.

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