Australian Fisheries Surveys Report 2001

Economic performance of selected fisheries in 1998-99 and 1999-2000

authors

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ABARE is a professionally independent government economic research agency.

Previous fisheries surveys reports

Northern prawn fishery

Years covered	*Reference*
1980-81 to 1981-82	BAE (1984a)
1986-87 to 1987-88	Collins and Kloessing (1988)
1989-90 to 1990-91	ABARE (1993a)
1990-91 to 1991-92	ABARE (1993b)
1992-93 to 1993-94	ABARE (1996a)
1994-95 to 1995-96	Brown (1997)
1996-97 to 1997-98	ABARE (2000)

East coast prawn fishery

1980-81 to 1982-83	BAE (1985a)

Eastern tuna and billfish fishery (formerly the coast tuna fishery)

1989-90 to 1990-91	ABARE (1993a)
1991-92 to 1992-93	ABARE (1994)
1993-94 to 1994-95	ABARE (1996b)
1995-96 to 1996-97	ABARE (1998a)
1997-98 to 1998-99	ABARE (2001)

Southern rock lobster fishery

1981-82 to 1982-83	BAE (1985b)

Bass Strait scallop fishery

1993-94 to 1994-95	BAE (1985b)
1995-96 to 1996-97	ABARE (1998a)
1997-98 to 1998-99	ABARE (2001)

South east fishery

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

South east nontrawl fishery

1997-98	ABARE (2000)
1998-99	ABARE (2001)

South east trawl fishery

1996-97 to 1997-98	ABARE (2000)

Southern bluefin tuna fishery

1980-81 to 1981-82	BAE (1986)

Southern shark fishery

1988-89	Battaglene and Campbell (1991)
1990-91 to 1991-92	ABARE (1993b)
1992-93 to 1993-94	ABARE (1996a)
1993-94 to 1994-95	ABARE (1996b)
1995-96 to 1996-97	ABARE (1998a)
1997-98 to 1998-99	ABARE (2001)

Southern squid jig fishery

1997-98 to 1998-99	ABARE (2001)

Torres Strait prawn fishery

1989-90	Battaglene, Reid and Collins (1992)
1992-93 to 1993-94	ABARE (1996b)
1994-95 to 1995-96	Brown (1997)
1996-97 to 1997-98	ABARE (2000)

ABARE project 2599

Foreword

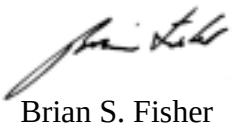
Estimates of the performance of operators in the south east trawl, northern prawn and Torres Strait prawn fisheries — which were surveyed by ABARE in 2001 — are given in this report.

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

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 that the Australian Fisheries Management Authority has used to define and manage the fisheries.

This is the third 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.



Brian S. Fisher
Executive Director

March 2002

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 co-operation 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 Ian Towers, Tony Kingston, Jeff Moore, Ryan Murphy and Trysh Stone from AFMA, John Kung from the Queensland Fisheries Service, and Greg Anderson from the Torres Strait Prawn Entitlement Holders Association.

ABARE staff

David Galeano 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 Laurie Cannon, Peter Beath, Ron Godenzi, Richard Paton, Lou Sissian, Robin Stafford and Theresa Manning of the Data Management and Collection Section. Laurie Cannon, Tony Wain 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.

Peter Gooday, Debbie Brown and Graham Love provided comments on the report.

Funding

The 2001 surveys of the south east trawl, northern prawn, Torres Strait prawn and southern and western tuna and billfish fisheries were funded by the Fisheries Resources Research Fund.

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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, see 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) and the Queensland Fisheries Management Authority, 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 cooperate. 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 data presented in the survey reports constitute only a small proportion of the total amount of data collected.

The 2001 surveys

ABARE surveyed four individual Commonwealth fisheries in 2001 — the south east trawl fishery, the northern prawn fishery, the Torres Strait prawn fishery and the southern and western tuna and billfish fishery. This is the first year that ABARE has surveyed the southern and western tuna and billfish fishery. Unfortunately, the required sample size was not achieved for this fishery, so it was not possible to publish results.

For the other three fisheries — the south east trawl, the northern prawn and the Torres Strait prawn fisheries — estimates are presented for all boats endorsed to operate in each fishery.

For the south east trawl fishery, results are provided for offshore boats, Danish seiners and inshore boats.

For the northern prawn fishery, results are presented for operators with less than 375 net units, for those with 375–475 net units, and for those with more than 475 net units.

For the Torres Strait prawn fishery, results are provided for specialist Torres Strait prawn boats.

Net returns to the fishery

This is the third 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.

South east trawl fishery

Average per boat fishing receipts for offshore boats and Danish seiners fell markedly in 1999-2000. For offshore boats the fall was mainly attributable to the declining catch of orange roughy and a significant fall in the catch in the adjacent South Tasman Rise fishery.

◆

In contrast, for inshore boats, both fishing and nonfishing cash receipts rose strongly.

◆

Many offshore boats and Danish seiners partly offset the fall in their receipts by reducing costs, especially those related to the size of the catch.

◆

Overall, average per boat cash income for offshore boats fell to $272 100 in 1999-2000, while average per boat cash income for Danish seiners fell to $23 100. Average per boat cash income for inshore boats rose to $58 300 in 1999-2000.

◆

In the two years covered by the most recent survey, estimated real net returns to the fishery resource were poor — an estimated $0.4 million in 1998-99, and a loss of 0.1 million in 1999-2000.

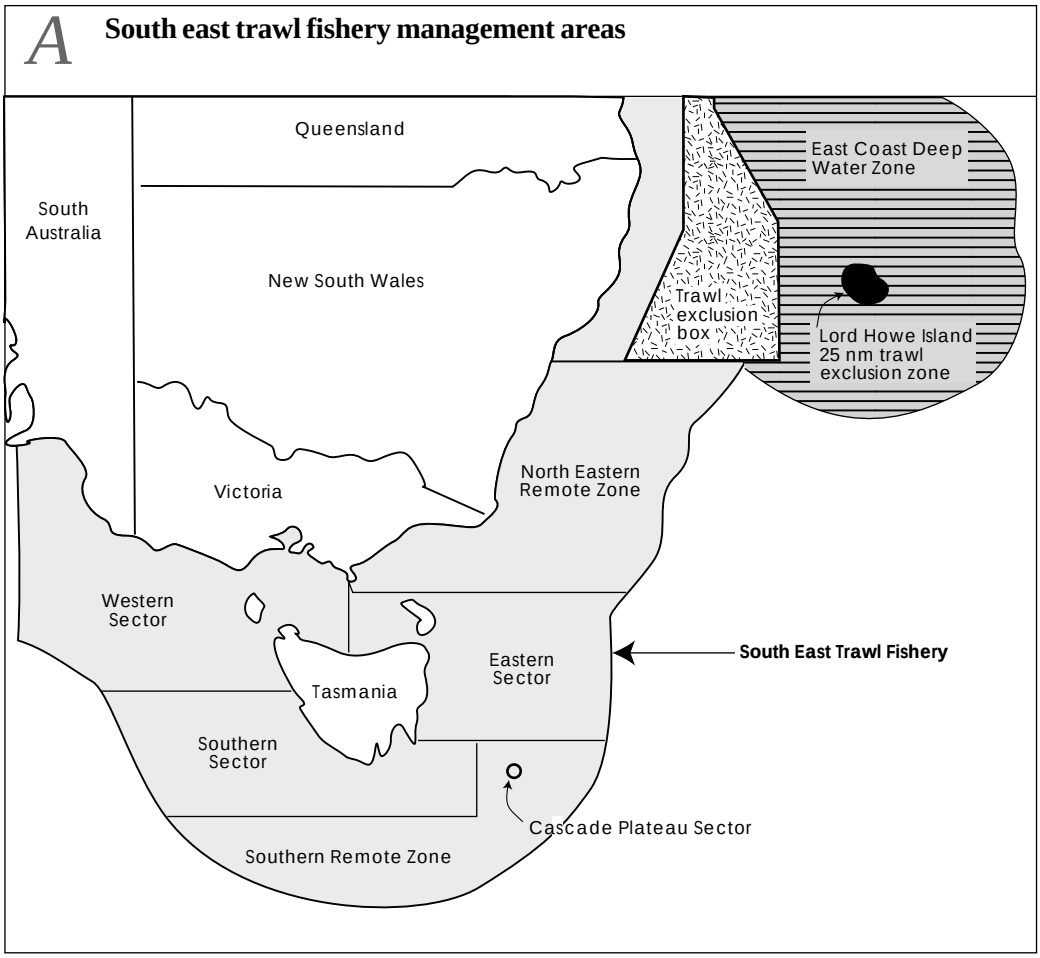
The fishery

The south east trawl fishery is one of Australia's oldest commercial fisheries. Although some processing facilities and export markets have been developed, the fishery continues to supply the bulk of market requirements for fresh fish in New South Wales, Victoria, Tasmania and South Australia.

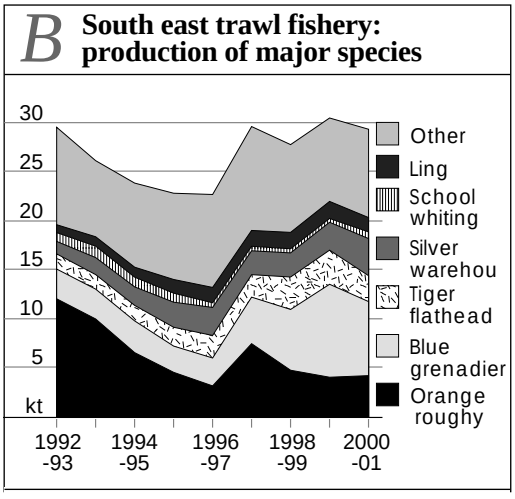
The bulk of the catch consists of twenty species or species groups managed by quota. However, over a hundred species of finfish and deepwater crustaceans are commercially caught. The major species landed (by gross value) are orange roughy, blue grenadier, ling and tiger flathead. Many of the fish species caught in the south east trawl fishery are also caught in other Commonwealth and state fisheries and by recreational fishers. Three types of trawl method are used: otter board, Danish seine and midwater trawl.

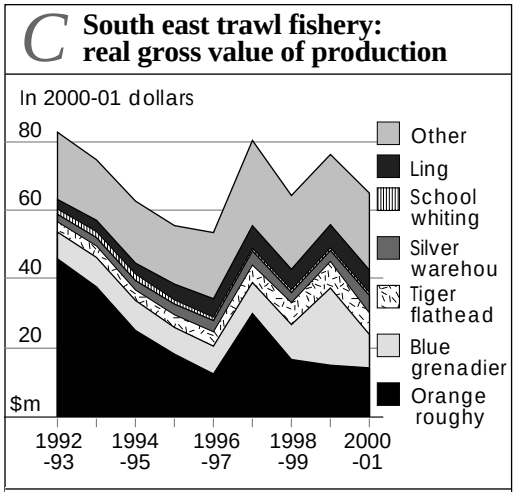
Following the inclusion of the east coast deepwater zone fishery from the 2000 fishing year, management boundaries for the south east trawl fishery now extend from a line east from Sandy Cape in Queensland to a line from Cape Jervis in South Australia. The fishery also includes waters around Tasmania from a distance of three nautical miles offshore (the limit of the state managed waters) to the 200 nautical mile limit of the Australian fishing zone (figure A) (Tilzey 1998).

The volume of catches in the south east trawl fishery have fluctuated in recent years, primarily reflecting fluctuating orange roughy catches (figure B). The catch of blue grenadier has also increased substantially since the mid-1990s. The real gross value of production from the south east trawl fishery has ranged from a low of around $54 million in 1996-97 to an



estimated at $65 million in 2000-01 (figure C). Note that the figures for 2000-01 include landings and values from both the Victorian inshore trawl fishery and east coast deepwater trawl fishery, although these catches constitute only a small





proportion of the total south east trawl fishery catch (and value).

Until the mid-1980s total south east fishery landings were dominated by catches taken off New South Wales and eastern Bass Strait. However, during the late 1980s and early 1990s, increased targeting of orange roughy and blue grenadier in waters around Tasmania brought about a marked increase in Tasmanian and Victorian landings. More recently, the downturn in orange roughy catches has resulted in increased effort in the shallower waters of the south east trawl fishery. Major ports for landing quota species are Port Melbourne, Ulladulla, Devonport, Eden, Lakes Entrance, Portland and Hobart (Smith and Wayte 2001).

Biological status of the fishery

The South East Fishery Assessment Group (SEFAG) is responsible for synthesising biological, ecosystem and economic information on the south east trawl fishery to provide advice to AFMA. In addition they coordinate, evaluate and regularly undertake stock assessments in the fishery.

The biological status of stocks in the south east fishery is published on an annual basis by the SEFAG. The Bureau of Rural Sciences also publishes annual status reports (for example, see Caton and McLoughlin 2000).

Key assessments and changes in quotas for the south east trawl fishery are summarised in table 1.

Management of the fishery

The south east trawl fishery is currently managed using a combination of individual transferable quotas (ITQs) and input controls (limited entry, mesh size and area restrictions). Before ITQ management, the trawl fishery was divided into three sectors (eastern A, eastern B and south west), with different input control requirements.

ITQs were initially introduced for the trawl capture of eastern gemfish in 1989. In 1992, the use of ITQs was extended to cover a further fifteen species. At this time, operators were only allowed to lease quota on a seasonal basis to other operators within the fishery, and the sale of quota was prohibited. Full and permanent transferability of quota has been permitted since January 1994.

Under the ITQ system, each quota species is subject to a total allowable catch (TAC) apportioned between the operators who are entitled to fish. The total allowable catch is set each year by AFMA to satisfy management objectives.

The quota management system in the south east trawl fishery is conducted using a 'carryover' approach. Under this approach, up to a certain amount (usually 20 per cent) of the total individual quota not harvested in one year may be carried over to the next. Similarly, for up to 20 per cent of holdings, overcatch may be deducted from the following year's allocation. Therefore, the TAC set in one year may differ from the actual TAC, once carryover / carryunder has been included.

Since the introduction of ITQs, the only total allowable catch regularly exceeded (although still within the actual TAC, which includes agreed carryover limits) is that for orange roughy in the eastern sector. Even when catches recorded in state waters are added, catches for the remaining species have tended to be below their total allowable catches (Caton and McLoughlin 2000).

A number of changes to the management of the south east trawl fishery have occurred in recent years. Restrictions on the length of vessels were lifted in 1997. On 1 January 1998, a global TAC for three of the quota species, pink ling, blue warehou and blue-eye trevalla, was determined to cover the whole of the south east fishery, including the nontrawl component. This total catch is now divided between the trawl and nontrawl components of the fishery.

Quotas for pink ling and blue warehou can now be seasonally leased across the two sectors, although the permanent transfer of quota across the two sectors is not possible. It is however possible for an operator in one sector to hold quota in another under a separate fishing permit.

Up until the end of 2001, quota for blue-eye trevalla could not be seasonally leased between the trawl and nontrawl sectors. However, from 1 January 2002, 10 per cent (58 094 kilograms in 2002) of the TAC of blue-eye trevalla may be leased from the nontrawl sector to the trawl sector.

In 1999, the east coast deepwater trawl fishery was incorporated into the management of the fishery, and in 2000, access to the area was permitted to anyone holding a class A permit who applied to fish in the zone. Also in 1999, a marine protected area in the Southern Tasmanian Seamounts was declared and is now closed to trawl and demersal nontrawl fishing.

In October 1999 the AFMA board agreed to the concept of incorporating the Commonwealth Victorian inshore trawl fishery into the south east trawl fishery. Permit holders in the Commonwealth Victorian inshore trawl fishery are likely to be restricted to their historical area of access (within 3 nautical miles off Victoria) (AFMA 2001a).

During 2000, AFMA granted long term statutory fishing rights (SFRs) in the fishery. To fish in the fishery, future operators will have to acquire a boat SFR (replacing the former boat permit) and a quota SFR (replacing the former quota allocation). In comparison to quota units and conven-

1 Catches and status of key trawl species in the south east trawl fishery

Species	Agreed and actual TACs and catches [a]					Stock status [b]
	1997	1998	1999	2000	2001	
	tonnes	tonnes	tonnes	tonnes	tonnes	
Blue eye trevalla	125 (agreed) 149 (actual) 113 (catch)	100 (agreed) 116 (actual) 96 (catch)	100 (agreed) 112 (actual) 109 (catch)	100 (agreed) 100 (actual) 89 (catch)	100 (agreed) 102 (actual)	Uncertain
Blue grenadier	10 000 (agreed) 12 496 (actual) 4 534 (catch)	10 000 (agreed) 12 409 (actual) 5 734 (catch)	10 000 (agreed) 11 921 (actual) 9 326 (catch)	10 000 (agreed) 11 938 (actual) 8 647 (catch)	9 991 (agreed) 12 230 (actual)	Fully fished
Blue warehou	700 (agreed) 883 (actual) 789 (catch)	820 (agreed) 880 (actual) 932 (catch)	718 (agreed) 880 (actual) 357 (catch)	615 (agreed) 814 (actual) 434 (catch)	308 (agreed) 475 (actual)	Overfished
Flathead	3 500 (agreed) 4 134 (actual) 2 507 (catch)	3 500 (agreed) 4 009 (actual) 2 664 (catch)	3 500 (agreed) 3 966 (actual) 3 561 (catch)	3 500 (agreed) 3 742 (actual) 3 324 (catch)	3 941 (agreed) 3 941 (actual)	Fully fished
Western gemfish	300 (agreed) 347 (actual) 227 (catch)	300 (agreed) 334 (actual) 185 (catch)	300 (agreed) 346 (actual) 272 (catch)	300 (agreed) 336 (actual) 349 (catch)	330 (agreed) 306 (actual)	Uncertain
Eastern gemfish	1 000 (agreed) 1 000 (actual) 397 (catch)	300 (agreed) 300 (actual) 214 (catch)	250 (agreed) 250 (actual) 159 (catch)	0 (agreed) 200 (actual) 93 (catch)	150 (agreed) 150 (actual)	Overfished
Jackass morwong	1 500 (agreed) 1 800 (actual) 1119 (catch)	1 500 (agreed) 1 779 (actual) 883 (catch)	1 500 (agreed) 1 811 (actual) 939 (catch)	1 200 (agreed) 1 536 (actual) 880 (catch)	1 185 (agreed) 1 413 (actual)	Fully fished
John dory	240 (agreed) 294 (actual) 90 (catch)	240 (agreed) 296 (actual) 127 (catch)	240 (agreed) 287 (actual) 152 (catch)	240 (agreed) 290 (actual) 183 (catch)	240 (agreed) 288 (actual)	Uncertain
Ling	1 600 (agreed) 1 734 (actual) 1 735 (catch)	1 921 (agreed) 1 912 (actual) 1 692 (catch)	2 095 (agreed) 2 284 (actual) 1 705 (catch)	2 095 (agreed) 2 461 (actual) 1 592 (catch)	2 095 (agreed) 2 531 (actual)	Uncertain
Mirror dory	800 (agreed) 978 (actual) 525 (catch)	800 (agreed) 962 (actual) 426 (catch)	800 (agreed) 960 (actual) 352 (catch)	800 (agreed) 977 (actual) 208 (catch)	800 (agreed) 996 (actual)	Uncertain

Continued ➪

tional fishing permits, which are granted annually, SFRs are more secure as they provide long term access to the fishery. SFRs were determined on the basis of fishing permits and quota units held as at 10 September 1998.

Although SFRs have now been granted to eligible persons, these rights do not come into effect until 1 January 2003. The SFRs have been used as the basis for allocating 2001 and 2002 seasonal quota and class A and class B permits (AFMA 2001a). The number of boat SFRs is currently limited to 118.

ITQs for school and gummy shark were brought into the quota management system in 2001 and sawshark and elephant fish quota will come under quota management at the commencement of the 2002 season. This will bring the number of species or species groups managed by quotas in the south east trawl fishery to 20 (AFMA 2001a).

AFMA is in the process of developing a statutory plan of management that will incorporate the management arrangements for the southern shark, Great Australian Bight trawl, south east trawl and south east nontrawl fisheries. It is anticipated that under the plan, separate levies, budgets and management advisory committees will be maintained.

1 Catches and status of key trawl species in the south east trawl fishery *continued*

Species	Agreed and actual TACs and catches [a]					Stock status [b]
	1997	1998	1999	2000	2001	
	tonnes	tonnes	tonnes	tonnes	tonnes	
Ocean perch	500 (agreed) 603 (actual) 393 (catch)	500 (agreed) 587 (actual) 363 (catch)	500 (agreed) 593 (actual) 376 (catch)	500 (agreed) 599 (actual) 351 (catch)	491 (agreed) 595 (actual)	Fully fished
Orange roughy:						Overfished
Eastern	2 000 (agreed) 1 972 (actual) 2 063 (catch)	2 000 (agreed) 1 909 (actual) 1 968 (catch)	2 000 (agreed) 1 910 (actual) 1 953 (catch)	2 000 (agreed) 1 944 (actual) 1 996 (catch)	1 800 (agreed) 1 747 (actual)	
Southern	1 000 (agreed) 1 813 (actual) 454 (catch)	1 000 (agreed) 1 000 (actual) 251 (catch)	700 (agreed) 700 (actual) 176 (catch)	700 (agreed) 700 (actual) 307 (catch)	560 (agreed) 560 (actual)	
Western	1 500 (agreed) 1 717 (actual) 352 (catch)	1 500 (agreed) 1 933 (actual) 361 (catch)	1 500 (agreed) 1 847 (actual) 247 (catch)	1 250 (agreed) 1 613 (actual) 192 (catch)	1 000 (agreed) 1 319 (actual)	
Redfish	1 700 (agreed) 1 993 (actual) 1 543 (catch)	1 750 (agreed) 2 042 (actual) 1 770 (catch)	1 750 (agreed) 1 932 (actual) 1 287 (catch)	1 750 (agreed) 2 097 (actual) 846 (catch)	1 570 (agreed) 1 989 (actual)	Overfished
Royal red prawn	500 (agreed) 624 (actual) 188 (catch)	500 (agreed) 625 (actual) 282 (catch)	500 (agreed) 611 (actual) 415 (catch)	500 (agreed) 561 (actual) 485 (catch)	500 (agreed) 569 (actual)	Uncertain
School whiting	2 000 (agreed) 2 359 (actual) 388 (catch)	2 000 (agreed) 2 423 (actual) 638 (catch)	1 500 (agreed) 1 929 (actual) 744 (catch)	1 500 (agreed) 1 870 (actual) 759 (catch)	1 500 (agreed) 1 899 (actual)	Uncertain
Silver trevally	500 (agreed) 614 (actual) 168 (catch)	500 (agreed) 621 (actual) 233 (catch)	500 (agreed) 601 (actual) 156 (catch)	500 (agreed) 616 (actual) 151 (catch)	449 (agreed) 573 (actual)	Uncertain
Spotted warehou	2 500 (agreed) 2 675 (actual) 2 770 (catch)	3 500 (agreed) 3 383 (actual) 2 411 (catch)	4 000 (agreed) 4 537 (actual) 3 254 (catch)	4 000 (agreed) 4 829 (actual) 3 719 (catch)	4 000 (agreed) 4 706 (actual)	Uncertain

a Agreed TACs are the base TAC for the year decided by AFMA. Actual TACs include carry under / over amounts and cross sectoral leasing. **b** A. Caton, Bureau of Rural Science, personal communication, December 2001.
Source: Smith and Wayte (2001).

Boats surveyed

For the purpose of the survey, the population was defined as boats endorsed for the south east trawl fishery that caught fish in the survey years. Based on the type of fishing operation, boats in the fishery can be divided into four subgroups: inshore trawl boats, offshore boats, Danish seiners and factory trawlers.

Inshore trawl boats generally operate on the continental shelf and upper shelf to around 500 metres. They target a range of species, most destined for the domestic market.

The offshore fleet consists mainly of larger boats that operate primarily out of Tasmanian and Victorian ports. The main target species are orange roughy and blue grenadier, although with the decline in the total allowable catches of orange roughy, some boats are moving toward catching fish for the domestic market.

The Danish seine fleet comprises generally smaller, low powered vessels that operate in shallower waters targeting predominantly whiting and flathead.

The fourth group, factory trawlers, a relatively new group, target blue grenadier and silver warehou off the west coast of Tasmania. These boats catch large quantities of fish and have onboard processing facilities.

Based on logbook data, there were 65 inshore boats in 1998-99 and 59 in 1999-2000. Of these, 21 and 19 were sampled respectively. For the offshore sector, there were 17 boats in the population in 1998-99 and 19 in 1999-2000 of which six and eight were sampled. There were 21 boats in the Danish seine fleet in 1998-99 and 23 in 1999-2000, and in both years, ten were sampled.

There are only a small number of factory trawlers operating in the south east trawl fishery. The fishing operations of these boats are significantly different from any other fishing operations in the fishery. Ideally, information for these factory trawlers should be included in the total. However, as ABARE was unable to sample any of the factory trawlers, the results presented here exclude factory trawlers.

Financial performance of boats

Table 2 provides the major measures of financial performance for boats (excluding factory trawlers) that operated in the south east trawl fishery in 1998-99 and 1999-2000. Table 3 contains information on the performance of boats in the fishery by triptile. To calculate triptiles, the population was ranked according to fish sales, with the third of the population with the lowest fish sales comprising the lower or bottom triptile, and so on. The weighted average cost and earnings for operators within each group was then calculated.

The estimates in tables 2 and 3 include receipts and costs from other fisheries in which the boats operate. In particular, there is a large degree of overlap between the offshore sector of the south east trawl fishery and the South Tasman Rise fishery.

Receipts

Average per boat fishing receipts for the fleet as a whole in 1999-2000 were estimated to be $637 200, down 11 per cent from the previous year (table 2). However, the situation for offshore boats and Danish seiners differed markedly from that for inshore boats.

On average, fishing receipts fell the most for offshore boats. In 1999-2000, average per boat fishing receipts for offshore boats fell by nearly 30 per cent to $1.54 million, partly as a result of the declining orange roughy catch. Additionally, many of the operators in the offshore sector of the south east trawl fishery also operate in the South Tasman Rise fishery, in which catch and gross value fell significantly over the survey period. (The total catch in the South Tasman Rise fishery fell from 3270 tonnes in 1998-99 to 346 tonnes in 1999-2000 and the gross value of the catch fell from $8.7 million to $0.8 million).

For Danish seiners, average per boat fishing receipts fell by an estimated 23 per cent in 1999-2000 to around $233 700.

In contrast, average per boat fishing receipts for inshore boats rose by an estimated 8 per cent to around $503 600.

2 Estimated financial performance of boats operating in the south east trawl fishery

Average per boat

		Inshore boats		Offshore boats		Danish seiners		All boats	
		1998-99	1999-2000	1998-99	1999-2000	1998-99	1999-2000	1998-99	1999-2000
Receipts									
Fishing receipts	$	466 910 (15)	503 630 (13)	2 182 840 (23)	1 541 710 (10)	301 900 (9)	232 660 (34)	716 480 (13)	637 210 (8)
Nonfishing receipts	$	68 780 (23)	120 680 (36)	81 360 (62)	128 280 (32)	3 000 (46)	1 380 (111)	57 450 (23)	94 940 (28)
Total cash receipts	$	535 700 (15)	624 310 (15)	2 264 200 (21)	1 669 990 (9)	304 900 (9)	234 040 (34)	773 930 (12)	732 150 (9)
Costs									
Administration	$	9 320 (16)	12 530 (17)	23 490 (22)	17 110 (21)	6 080 (16)	6 120 (11)	11 000 (12)	11 930 (12)
Crew costs	$	157 760 (16)	156 500 (12)	632 050 (24)	433 490 (12)	113 520 (7)	96 400 (32)	227 020 (13)	194 920 (8)
Freight and marketing	$	68 940 (25)	64 440 (23)	71 130 (27)	48 810 (53)	41 700 (44)	31 490 (86)	63 750 (19)	54 000 (22)
Fuel	$	96 410 (20)	105 480 (17)	289 930 (21)	344 820 (17)	15 690 (19)	10 770 (42)	111 900 (14)	128 940 (12)
Insurance	$	21 310 (17)	23 210 (13)	50 900 (8)	45 840 (14)	6 690 (16)	6 960 (50)	23 210 (10)	23 770 (10)
Interest paid	$	6 340 (41)	7 860 (37)	nf	nf	6 600 (34)	7 630 (27)	5 340 (32)	6 330 (8)
Leasing	$	15 640 (34)	17 850 (36)	82 020 (49)	18 480 (55)	2 680 (48)	1 480 (103)	23 950 (31)	14 240 (29)
Licence fees and levies	$	16 390 (14)	20 590 (17)	53 950 (14)	43 610 (14)	11 380 (20)	10 120 (47)	21 570 (9)	22 540 (11)
Repairs and maintenance	$	126 130 (20)	131 950 (24)	400 040 (19)	360 560 (15)	31 810 (19)	24 760 (25)	152 110 (13)	150 550 (14)
Other costs	$	26 550 (17)	25 610 (13)	39 090 (24)	85 180 (42)	17 170 (26)	15 200 (17)	26 710 (13)	34 440 (20)
Total cash costs	$	544 780 (16)	566 010 (14)	1 642 590 (20)	1 397 900 (11)	53 310 (9)	210 930 (35)	666 550 (12)	641 640 (9)
Boat cash income	$	–9 090 (303)	58 300 (51)	621 610 (25)	272 090 (62)	51 590 (11)	23 110 (46)	107 380 (29)	90 510 (40)
less depreciation **a**	$	25 110 (13)	23 780 (13)	47 780 (9)	45 750 (8)	11 610 (24)	6 800 (52)	26 100 (9)	24 050 (8)
Boat business profit	$	–34 190 (86)	34 520 (86)	573 830 (27)	226 340 (76)	39 980 (11)	16 310 (57)	81 280 (38)	66 460 (55)
plus interest, leasing and rent	$	22 620 (28)	26 620 (26)	82 420 (48)	18 840 (54)	9 270 (16)	9 110 (17)	29 770 (26)	21 170 (22)
Profit at full equity	$	–11 570 (277)	61 140 (54)	656 250 (28)	245 180 (72)	49 250 (8)	25 420 (39)	111 050 (33)	87 630 (44)
Capital (excl. quota and licences)	$	620 340 (29)	537 860 (20)	1 463 400 (9)	1 385 010 (10)	204 820 (15)	186 230 (31)	674 770 (17)	617 150 (11)
Capital (incl. quota and licences)	$	na	1 475 000 (19)	na	2 252 640 (7)	na	485 690 (13)	na	1 396 000 (12)
Rate of return to boat capital b	%	–1.9 (257)	11.4 (57)	44.8 (20)	17.7 (77)	24 (15)	13.6 (42)	16.5 (41)	14.2 (47)
Rate of return to full equity c	%	na	4.1 (45)	na	10.9 (75)	na	5.2 (36)	na	6.3 (43)

a Depreciation adjusted for profit and loss on capital items sold. **b** Excluding value of quota and licences. **c** Including value of quota and licences. **na** Not applicable. **nf** None found in sample.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in 'Survey methods and definitions'.

For the fleet as a whole, the fall in fishing receipts was partly offset by a rise in average per boat nonfishing receipts. These rose by an estimated 65 per cent to $94 900.

Overall, average per boat total cash receipts for the fleet were estimated to be $732 200, down 5 per cent from the previous year.

Costs

Reflecting the relatively large falls in fishing receipts for offshore boats and Danish seiners, average per boat total cash costs for the fleet as a whole fell by an estimated 4 per cent to $641 600.

For the fleet as a whole, average per boat crew costs represented around 30 per

3 Estimated financial performance of boats operating in the south east trawl fishery, by triptile **Triptiles based on value of fish sold**

	Lower triptile				Middle triptile				Upper triptile			
	1998-99		1999-2000		1998-99		1999-2000		1998-99		1999-2000	
	$		$		$		$		$		$	
Receipts												
Fishing receipts	174 640	(17)	160 880	(13)	408 030	(6)	467 530	(8)	1 474 410	(20)	1 259 970	(10)
Nonfishing receipts	21 300	(68)	19 890	(67)	25 930	(30)	74 920	(54)	118 230	(25)	186 320	(32)
Total cash receipts	195 940	(14)	180 770	(16)	433 950	(7)	542 450	(13)	1 592 640	(18)	1 446 300	(8)
Costs												
Administration	5 820	(28)	6 630	(22)	8 420	(13)	13 970	(21)	17 900	(20)	14 920	(16)
Crew costs	75 230	(17)	72 850	(18)	126 390	(3)	163 800	(12)	452 630	(18)	342 090	(12)
Freight and marketing expenses	4 120	(86)	10 200	(72)	58 800	(17)	45 000	(23)	120 090	(17)	104 630	(21)
Fuel	17 380	(10)	20 170	(42)	67 310	(13)	77 650	(14)	235 510	(14)	283 730	(14)
Insurance	7 620	(11)	9 950	(31)	16 460	(17)	18 450	(15)	43 030	(8)	42 230	(12)
Interest paid	1 640	(81)	3 390	(70)	11 420	(30)	11 020	(38)	2 880	(78)	4 410	(55)
Leasing	2 970	(36)	2 090	(61)	9 490	(38)	12 450	(41)	55 650	(40)	27 570	(38)
Licence fees and levies	9 640	(18)	10 090	(29)	16 010	(10)	21 300	(23)	37 110	(15)	35 610	(13)
Repairs and maintenance	28 690	(13)	37 990	(41)	87 650	(24)	69 660	(11)	319 330	(14)	338 670	(14)
Other costs	13 330	(32)	15 080	(24)	21 910	(13)	24 110	(18)	42 780	(17)	63 210	(33)
Total cash costs	166 440	(13)	188 440	(23)	423 850	(8)	457 400	(10)	1 326 900	(13)	1 257 070	(9)
Boat cash income	29 500	(25)	–7 670	(217)	10 100	(214)	85 050	(53)	265 740	(49)	189 230	(51)
less depreciation **a**	13 020	(24)	9 170	(37)	18 680	(11)	21 450	(18)	44 360	(7)	40 790	(7)
Boat business profit	16 480	(46)	–16 840	(114)	–8 580	(260)	63 600	(71)	221 370	(58)	148 440	(66)
plus interest, leasing and rent	4 610	(29)	5 480	(34)	21 400	(22)	24 050	(24)	59 400	(38)	33 180	(33)
Profit at full equity	21 100	(41)	–11 360	(173)	12 830	(180)	87 640	(55)	280 770	(52)	181 620	(56)
Capital (excl. quota and licences)	227 350	(13)	215 030	(21)	360 670	(10)	380 860	(10)	1 356 070	(15)	1 236 340	(13)
Capital (incl. quota and licences)	na		513 280	(12)	na		1 348 300	(26)	na		2 282 220	(10)
	%		%		%		%		%		%	
Rate of return to boat capital b	9.3	(52)	–5.3	(156)	3.6	(184)	23.0	(52)	20.7	(57)	14.7	(61)
Rate of return to full equity c	na		–2.2	(165)	na		6.5	(33)	na		8.0	(60)

a Depreciation adjusted for profit and loss on capital items sold. **b** Excluding value of quota or licence. **c** Including value of quota or licence. **na** Not applicable.

Note: Composition of boats in triptiles may change from year to year due to variation in sales. Figures in parentheses are relative standard errors. A guide to interpreting these is presented in 'Survey methods and definitions'.

cent of total cash costs in 1999-2000, and as crews are generally paid on sharefishing arrangements, average per boat crew costs fell in 1999-2000. Other costs likely to be sensitive to catch size, such as freight and marketing costs, also fell.

For the fleet as a whole, average per boat crew costs fell by 14 per cent to $194 900 in 1999-2000, while freight and marketing costs fell by 15 per cent to $54 000.

On the other hand, average per boat fuel costs, which represented 20 per cent of the fleet's total cash costs in 1999-2000, rose by 15 per cent to $128 900. The other relatively large (around 23 per cent) component of total cash costs — repairs and maintenance — remained little changed in 1999-2000 (table 2).

Examining each sector in turn, average per boat crew costs for offshore boats fell by an estimated 31 per cent. Average per boat freight and marketing costs fell by the same percentage. For Danish seiners, average per boat crew costs fell by an estimated 15 per cent, and freight and marketing costs by 24 per cent. For inshore boats, average per boat crew costs and freight and marketing costs fell marginally.

Average per boat fuel costs for offshore boats rose by 19 per cent. Fuel costs for inshore boats rose by 9 per cent, while fuel costs for Danish seiners are estimated to have fallen.

Boat cash income and profit

For the fleet as a whole, average cash income per boat fell by an estimated 16 per cent to $90 500 in 1999-2000. The fall was most marked in the offshore boats sector. Reflecting the decreased catch and increase in fuel costs, average per boat cash income fell in this sector from an estimated $621 600 in 1998-99 to $272 100 in 1999-2000. Average per boat cash income for the Danish seine fleet also fell, from an estimated $51 600 in 1998-99 to $23 100 in 1999-2000. In contrast, average per boat cash income in the inshore sector increased from an estimated loss of around $9100 in 1998-99, to $58 300 per boat in 1999-2000.

Examining triptiles, based on the value of fish sold, boat cash income rose for midrange operators but fell for the smaller and larger operators. For midrange operators, the estimated rises in both average per boat fishing and nonfishing receipts (15 per cent and 190 per cent respectively) well exceeded the relatively modest estimated rise in average per boat total cash costs (8 per cent). Average per boat cash income for this group rose markedly from an estimated $10 100 in 1998-99 to $85 000 in 1999-2000.

In contrast, the larger third of operators experienced falls in both fishing receipts and total cash costs, but the fall in total cash costs was not sufficient to offset the fall in fishing receipts. Average per boat cash income for this group fell from an estimated $265 700 in 1998-99 to $189 200 in 1999-2000. The smaller group of operators fared worst, experiencing both falls in total cash receipts and rises in total cash costs. Average per boat cash income for this group fell from an estimated $29 500 in 1998-99 to a loss of $7700 in 1999-2000.

Boat business profit is defined as boat cash income less depreciation (adjusted for profit and loss on capital items sold). Depreciation remained relatively stable across all three categories, so changes in boat business profit closely reflected the changes to boat cash income already discussed in detail above. For the fleet as a whole, average per boat business profit fell by an estimated 18 per cent to $66 500 in 1999-2000.

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 individual operator in the fishery, from a broader perspective they represent profits that are redistributed to other investors in the fishery. Profit at full equity provides a measure of the return that would have been earned by the business unit had the boat and capital (including entitlements) been fully owned by the operator.

Average per boat profit at full equity for the fleet is estimated to have been $87 600 in 1999-2000, down 21 per cent on 1998-99 (table 2). Average per boat profit

at full equity fell markedly in both the offshore and Danish seine sectors (by 63 per cent and 48 per cent respectively) but increased by around $72 700 in the inshore fleet.

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.

For the fleet as a whole, the estimated average per boat rate of return to boat capital fell from 16.5 per cent in 1998-99 to 14.2 per cent in 1999-2000 (table 2). The large falls in average per boat rates of return to boat capital in the offshore and Danish seine fleets were partly offset by a strong rebound in the inshore sector.

The estimated average per boat rate of return to boat capital for 1999-2000 was much higher in the middle triptile compared with the upper triptile, owing to the significantly lower level of boat capital in the middle triptile (despite lower levels of profit at full equity).

The estimated rate of return at full equity includes the value of the quota and licences. For the fleet as a whole, the average per boat rate of return at full equity was estimated at 6.3 per cent in 1999-2000 (table 2). Estimates for 1998-99 are not available. However, the 1999-2000 estimate represents a fall on the last rate of return at full equity estimated for the fishery of 10 per cent in 1997-98 (Holland, Gooday, Cox and Shafron 2000).

Debt and equity

Not all sampled boats provided information on debt and equity. However, based on the smaller sample of those that did, the average per boat level of debt rose by $9400 to a closing balance of around $95 500 (table 4).

Boat business equity provides a measure of the financial ownership of a fishing enterprise. The estimated average boat business equity ratio in the south east trawl fishery was 89 per cent.

4 Debt and equity of boats operating in the south east trawl fishery in 1999-2000 **Average per boat**

		All boats	
Capital (incl. quota and licences) at 30 June	$	881 393	(18)
Boat business debt at 1 July	$	86 083	(36)
Boat business debt at 30 June	$	95 467	(33)
Change in debt over year	$	9 384	(126)
Boat business equity at 30 June	$	785 926	(20)
Boat business equity ratio at 30 June	%	89.2	(4)

Note: Figures in parentheses are relative standard errors. A guide to interpreting these is presented in 'Survey methods and definitions'.

Estimates of net return to the fishery resource

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.

The accounts of businesses involved in the fishery are primary sources of deriving a measure of the apparent net return to the south east trawl fishery resources. However, measures of aggregate profit to the businesses involved in the fishery may differ from the net return to the fishery resource in several ways. First, fishers often operate in more than one fishery and their accounts reflect those activities. Second, costs reported in the financial accounts of business may vary from social opportunity costs, particularly for capital, management costs and owners' or family labor. Finally, in some fisheries, the full costs of management may not be charged to operators.

The relationships between total revenue, financial accounts of fishers' costs and the social costs of fishing are described in more detail in Rose et al. (2001). In the absence of a full bioeconomic model of the south east trawl fishery, quantitative or qualitative information on a number of aspects of the fishery may shed light on its relative efficiency. Of particular impor-

5 Real net returns to the south east trawl fishery

In 2000-01 dollars

	Revenue [a]	Cash costs [a,b]	Capital [a,c]	Net returns excl. management costs [d]	Management costs [e]	Net returns incl. management costs	Vessel numbers [f]
	$m	$m	$m	$m	$m	$m	no.
1996-97	64.2 (16)	53.4 (10)	35.8 (11)	4.7 (108)	2.0	2.7	108
1997-98	70.0 (16)	56.6 (11)	30.6 (11)	7.9 (63)	2.8	5.1	107
1998-99	57.1 (13)	50.2 (12)	23.1 (12)	2.9 (89)	2.5	0.4	103
1999-2000	62.7 (15)	56.2 (14)	21.7 (15)	2.7 (142)	2.8	–0.1	101

a Amount attributable to fishery. All costs and capital have been multiplied by (south east trawl fishing receipts divided by total fishing receipts). **b** Cash costs include imputed operator and family labor costs but exclude licence and levy payments and interest payments. **c** Replacement capital (depreciated capital). **d** Calculated as per definition in this report. **e** Costs to AFMA for managing the fishery (A. Kettle, AFMA, personal communication, June 2001). **f** Excludes factory trawlers.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in 'Survey methods and definitions'.

tance are the condition of the fish stock, capital structure, prices of the fishery's products and inputs, and the management structure of the fishery.

To provide an indication of the economic performance of the south east trawl fishery, the net returns to the fishery have been estimated and are presented in table 5. The measure of net return to the fishery includes only those receipts and costs that are attributable to the south east trawl fishery. As a result, the estimated receipts and costs in table 5 will differ from those in table 2 which include all receipts and costs of boats operating in the fishery, including receipts obtained and costs incurred while fishing in other fisheries.

Real net returns (excluding management costs) for the south east trawl fishery fell slightly from an estimated $2.9 million in 1998-99 to $2.7 million in 1999-2000. Both these figures are well down on the estimated $7.9 million real net return for the fishery in 1997-98. Once management costs are included in the calculation, the estimated real net returns to the fishery are $0.4 million in 1998-99 and a loss of $0.1 million in 1999-2000.

The interpretation of the net return measure should be considered in the light of a number of factors including changes in fish stocks, the prices of the fishery's products and inputs, and capital stocks. For example, as the status of some stocks is uncertain, it is difficult to say whether or not the estimated real net returns are sustainable in the long term. If, say, the fishery is overfished, then the estimated real net returns in table 5 may include some return from the liquidation of fish stocks. As such, the estimates may overestimate resource rent. Also, the decrease in net returns displayed between 1998-99 and 1999-2000 occurred against the backdrop of increasing real unit values for some key species such as orange roughy, blue grenadier and tiger flathead.

It is also important to note that the receipts, costs and net returns in table 5 do not include those from factory trawlers. While there are only a few factory trawlers in the fishery, these boats catch a significant proportion of the blue grenadier landed in the fishery. If the factory trawlers are generating positive net returns, then the estimates of net returns in table 5 will underestimate resource rents in the fishery. What can be said, however, is that based on information obtained from the traditional operators in the south east trawl fishery (offshore boats, Danish seiners and inshore boats) the real net return to the fishery resource in 1998-99 and 1999-2000 was poor.

Northern prawn fishery

The prawn catch from the fishery fell significantly in 1999-2000. Despite this, higher prices for prawns meant that for the fleet as a whole, average per boat prawn receipts fell by only 7 per cent.

◆

Small boats experienced the largest fall in average per boat prawn receipts, but were able to effect cost reductions in most cost categories.

◆

Medium boats, while effecting some reductions in costs (generally related to the size of the catch), also experienced increases in a number of other key cost categories.

◆

Large boats effected cost reductions of around the same order as the reduction in prawn receipts, and average per boat cash income for large boats rose slightly.

◆

Estimated real net returns to the northern prawn fishery resource fluctuated substantially through the latter half of the 1990s from highs of around $40 million in 1994-95 and 1997-98 to around $20 million or less in 1996-97 and 1999-2000.

◆

The fishery

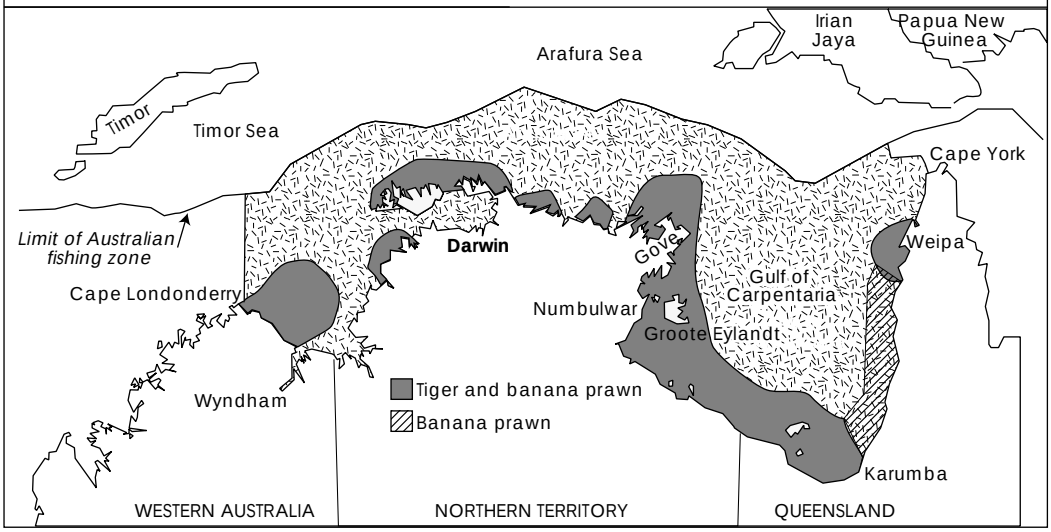
The northern prawn fishery is located off Australia's north coast. Bordered by Cape York in Queensland and Cape Londonderry in Western Australia, it extends from the low water mark to the outer edge of the Australian Fishing Zone (AFZ) (figure D).

Although it is one of the largest fisheries in Australia, only 27 per cent of the fishery is subject to fishing. This is a result of the large area closure enforced in the fishery, and the inshore nature of prawn fishing (AFMA 2001b). The fishery targets nine commercial species of prawns, including white banana (*Penaeus merguiensis*), redlegged banana (*P. indicus*), brown tiger (*P. esculentus*), grooved tiger (*P. semisulcatus*), blue endeavour (*Metapenaeus endeavouri*) and red endeavour (*M. ensis*). Squid is also taken as an opportunistic target species along with scallops and bugs.

Fishing in the northern prawn fishery is divided into two main seasons: a daytime fishery targeting schooling banana prawns, and a night time fishery targeting tiger prawns. The fleet starts fishing for banana prawns at the beginning of the fishing season on 1 April. However, the banana prawn fishery presently lasts only about three to four weeks — so, as the banana prawn catch rates decline, the fleet progressively changes to tiger prawn fishing. This lasts until November, interrupted by a mid-season closure running from mid-May until August.

The remote location of the fishery means that very few boats are based in the region of the fishery itself, and operate instead out of a variety of ports throughout Australia. There are a few main ports

D Northern prawn fishery management areas



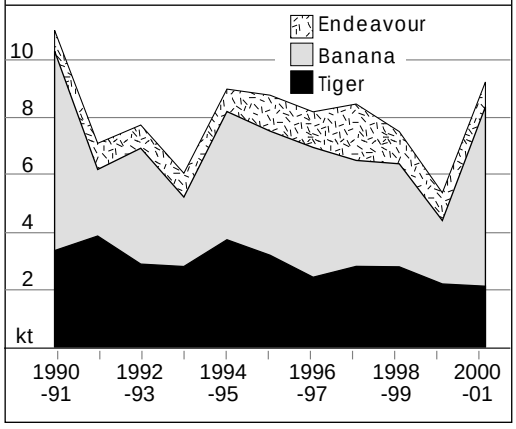
available to the fleet — Darwin, Weipa, Karumba, Groote Eylandt and Gove — during the fishing season. Previously, during the midseason break, boats would often return to home port for any repairs and maintenance. In 2000, because of increasing costs involved in returning to home ports, Darwin was used as a base for some boats during the midseason closure.

Generally, however, infrastructure and onshore facilities to support the fleet have been limited. Prior to 1995, trawlers traveled to Cairns or Darwin for repairs and maintenance until facilities were opened in Karumba. Prawn processing facilities also remained at Karumba until 1992, when A. Raptis and Sons relocated their main processing operations to Brisbane (Pownall 1994). With the decline in onshore based processing companies, motherships have become more important. Several nonfishing companies have concentrated on servicing the fleet at sea, supplying fuel and provisions, and transferring frozen product.

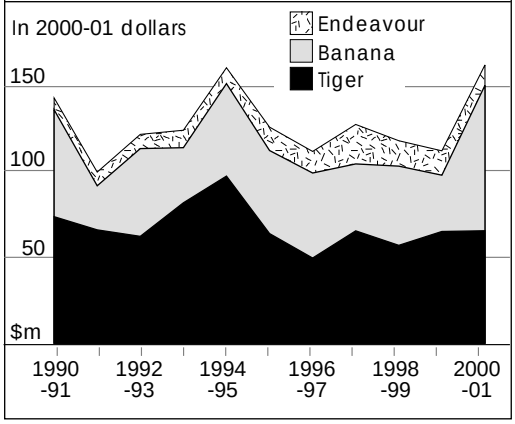
Banana and tiger prawns on average accounted for 86 per cent of the prawn catch in the fishery between 1990-91 and 2000-01 (figure E). Together with prawn catches, a considerable amount of predominantly unused bycatch has traditionally been taken in the fishery but this has been reduced since the introduction of bycatch reduction devices (BRDs) (T. Stone, AFMA, personal communication, November 2001). Most bycatch species have no or extremely low value and are discarded. The few species that have commercial value (for example, bugs) are retained.

The gross value of catch in the northern prawn fishery is the highest of any of the Commonwealth fisheries. In 2000-01 the northern prawn fishery accounted for around 30 per cent of the total value of

E Northern prawn fishery: production



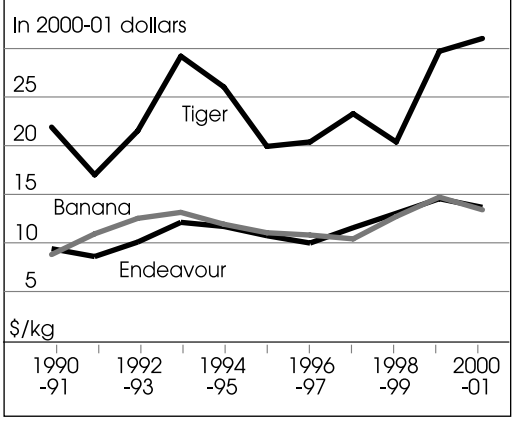
F Northern prawn fishery: real gross value of production



production from Commonwealth fisheries. There was a 49 per cent rise in the real gross value of endeavour, tiger and banana prawn production between 1999-2000 and 2000-01 to $162 million (figure F). The variation in value displayed in figure F is mainly driven by considerable fluctuations in catches of both banana and endeavour prawns (figure E), with catches of banana prawns ranging from 2222 tonnes in 1999-2000 to 6286 tonnes in 2000-01.

Since the majority of the catch is exported to Japan and Asia, exchange rate movements have had a relatively large impact on the value of the fishery. The real prices received for all three key prawn species rose in 1999-2000, aided by the depreciation of the Australian dollar (figure G).

G Northern prawn fishery: real prices



Biological status of the fishery

The Northern Prawn Fishery Assessment Group (NPFAG) assesses the biological status of the northern prawn fishery on a regular basis. The most recent assessment was released in 1999 (Taylor and Die 1999).

The commercial prawn species in the northern prawn fishery have a lifespan of up to two years. Juvenile prawns live in coastal and estuarine areas in beds of seagrass or mangrove lined creeks and rivers. After one to three months on the nursery grounds, the prawns move offshore onto the fishing grounds. While banana prawns reach commercial size before six months of age, the market prefers tiger prawns to be larger (9–12 months old).

Banana prawns

Banana prawn catches in the northern prawn fishery are made up of white banana prawns and red legged banana prawns. Annual total catches of banana prawns have fluctuated widely, ranging from 2000 to 12 000 tonnes. The high annual variation in catches appears to be linked to environmental conditions, especially rainfall, although the effect varies from area to area (McLoughlin 2002).

The NPFAG assessed the white banana prawn part of the fishery as being fully exploited and, although there is no firm evidence of recruitment overfishing, the NPFAG noted that this possibility could not be overlooked. A new research project funded by the AFMA Research Fund was initiated in 1999 to test this hypothesis (Taylor and Die 1999).

A recent study on the status of red legged banana prawns in the Joseph Bonaparte Gulf revealed that the seasonal patterns of fishing effort in the Gulf change not only as a result of fishing closures but also as a function of the level of prawn recruitment in other areas. According to the NPFAG (Taylor and Die 1999), yield per recruit and value per

recruit have increased since the northern prawn fishery midyear closure began in 1987. This suggests that the current closures, although designed to optimise production of white banana prawns and tiger prawns in other parts of the northern prawn fishery, also benefit red legged banana prawn stocks in this area (Taylor and Die 1999).

A tagging study of red legged banana prawns in 1997 and 1998 revealed that the estimate of recruitment for 1998 was only a third the size of the 1997 estimate of recruitment. Stock size estimates for 1998 have not yet been analysed but suggest that the stock was much smaller in 1998 than in 1997 (Taylor and Die 1999).

The sustainable long term average annual catch for both species of banana prawns in the northern prawn fishery is thought to be around 4000 tonnes, approximately the average annual catch of the past ten years (McLoughlin 2002). McLoughlin suggests that the catch of banana prawns from the northern pawn fishery is probably sustainable, but considers the reliability of the assessment to be moderate.

Tiger prawns

After a peak harvest of around 4000 tonnes in 1991-92, total landings of tiger prawns (brown tiger and grooved tiger) had fallen by almost half in 1999-2000 to a little over 2000 tonnes (figure E). The fall in tiger prawn landings occurred despite substantial reductions in effort aimed at increasing stock size (Taylor and Die 1999).

The NPFAG considers effort in the tiger prawn fishery to be currently above that estimated to produce the maximum sustainable yields. In addition, it noted that the spawning stock of tiger prawns during late 1996 and 1997 was well below the target levels of spawning stock required to achieve maximum sustainable yields.

Together with a considerable increase in effective effort for 1998, the NPFAG reported the tiger prawn portion in the northern prawn fishery to be currently overexploited and that any rebuilding of spawning stocks would require significant and urgent effort reductions (Taylor and Die 1999).

While overexploitation of the tiger prawn stock is the most likely hypothesis consistent with the historical data on stocks, the NPFAG acknowledges that another possible explanation is that recruitment has been determined by as yet unidentified environmental factors that affect larval dispersion and/or productivity in nursery areas. The long term sustainable average catch for tiger prawns is considered to be around 4000 tonnes, while that for other (nonbanana) prawns is thought to be around 500 tonnes.

The status of endeavour prawns is uncertain, and no assessments have been made of the potential yield of endeavour prawns or king prawns (McLoughlin 2002).

Management of the fishery

From the mid-1960s, the northern prawn fishery was managed under a variety of arrangements by the Queensland, Western Australian, Northern Territory and Commonwealth governments. In 1988, the Commonwealth government accepted responsibility for the fishery under the terms of an Offshore Constitutional Settlement Agreement (OCS). Under this agreement, the Commonwealth has jurisdiction for the target species of prawns, bugs, scallops, scampi and, where taken by prawn trawl gear, squid. The Commonwealth also has jurisdiction over any bycatch, such as turtles, taken along with target species.

The fishery has historically been managed using input controls. These controls place limits on the type and amount of prawn fishing conducted by individual vessels. Controls have included gear (net) restrictions, voluntary and compulsory vessel buybacks, annual closures, and class A and B statutory fishing rights (SFRs).

To reduce fishing effort on the prespawning stock of tiger prawns, the fishery is seasonally closed during much of the winter months. Until recently, this season closure usually operated from 15

June to 1 August. An end of year closure, operating usually from 1 December until 30 March aims to prevent the capture of small tiger prawns that begin to recruit to offshore grounds at about this time. It also protects small banana prawns that appear in the new year.

In 1998, a compulsory vessel satellite monitoring system was introduced to the fishery as part of general compliance and monitoring. The use of this monitoring system has facilitated a number of alternative 'start of season' arrangements, improved the flow of information to the fleet, and provided details about the distribution of effort in the fishery.

Until July 2000, there were two forms of statutory fishing rights (SFRs) operational in the fishery. These included class A SFRs, which regulated the below deck volume and engine capacity of vessels, and class B SFRs, which regulated vessel numbers. A set number of SFRs were issued, with operators required to purchase SFR units for each cubic metre of hull volume and each kilowatt of engine power associated with their vessels.

Since the release of a 1985 study by CSIRO indicating the existence of recruitment overfishing for tiger prawns, biological overfishing has been considered an issue in the northern prawn fishery (Taylor and Die 1999). Despite the introduction of a voluntary buyback scheme in the early 1990s, a compulsory surrender scheme in 1993, and continued restrictions on boat numbers, the northern prawn fishery was still assessed as being overfished in the late 1990s. The Senate Rural and Regional Affairs and Transport Legislation Committee (2000) indicated that attempts to reduce effort in the fishery had been undermined by persistent effort creep.

Given the identified problems of overfishing and effort creep, AFMA implemented, in 2000, a number of changes to more effectively manage fishing effort in the fishery. In November 1997, the Northern Prawn Fishery Management Advisory Committee (NORMAC) suggested the introduction of gear based management as the most flexible means of controlling fishing effort. Consequently, the limits on boat and engine sizes (class A SFRs) were replaced with gear SFRs. The latter regulate the length of headrope and thereby the size of the net that may be towed by vessels. AFMA anticipated that reducing the length of headrope used in the industry would reduce fishing effort. These gear SFRs were introduced in the fishery on 24 July 2000 (AFMA 2001c).

The translation of class A SFRs to gear SFRs was agreed to on a one to one basis of 10 cm of headrope for each class A SFR. This resulted in a reduction in total gear towed by the fleet by around 15 per cent to 5384 metres (Senate Rural and Regional Affairs and Transport Legislation Committee 2000). On the argument that the new arrangements might potentially disadvantage the fishery's smaller (less than 300 class A SFRs) vessels, these smaller vessels were granted 'top up' gear SFRs for two years (Senate Rural and Regional Affairs and Transport Legislation Committee 2000).

Turtle excluder devices (TEDs) and bycatch reduction devices (BRDs) became compulsory in the fishery in April 2000. These devices had been trialed in the fishery on a voluntary basis for several years.

In September 2001, in response to new concerns about the sustainability of the tiger prawn stocks, the AFMA Board agreed to a further 25 per cent reduction in headrope across the fleet and changed the season dates to reduce the length of the season by 20 days. These additional measures are to be introduced during the 2002 fishing season (AFMA 2001d).

Boats surveyed

For the purposes of the survey undertaken in 2001, the northern prawn fleet was divided into three groups according to boat size (measured by the number of class A SFRs). A sample of boats from each group was then surveyed. The three groups were: less than 375 class A SFRs (small boats), between 375 and 475 class A SFRs (medium boats), and more than 475 class A SFRs (large boats). It is important to note that while the number of class A SFRs are indicative of a boat's capacity to catch prawns, full compliance to the

SFR allocation system may not always occur.

As financial years are used for reporting revenue and cost information, the figures contained in this report are not directly comparable with those for the fishing season.

The target population for the survey was defined as boats that held a Commonwealth northern prawn endorsement for the fishery and fished during that year. The total number of boats eligible for the survey in the 1998-99 financial year was 133. Of these, eight boats were sampled from a population of 31 small boats, 36 from a population of 70 medium sized boats, and 13 from a population of 32 large boats. For the 1999-2000 financial year, the total eligible population was 130 boats, of which eight out of 34 small boats, 37 of 71 medium sized boats, and 15 of 25 large boats were sampled.

Financial performance of boats

The major measures of the financial performance for boats in the northern prawn fishery in 1998-99 and 1999-2000 are shown in table 6. The estimates in the table also include costs and earnings from other fisheries such as the Torres Strait, Kimberley and Queensland east coast prawn fisheries.

There are a number of external factors that affected the performance of operators in the fishery over the survey period. With around 90 per cent of the product from the northern prawn fishery being exported, market conditions overseas and exchange rate conditions have had a major bearing on returns. In addition, environmental factors such as monsoonal rains also have an influence on the availability of prawns for harvesting, particularly banana prawns.

Receipts

Average per boat total cash receipts per boat are estimated to have fallen from $1.04 million in 1998-99 to around $0.97 million in 1999-2000, a decline of around 7 per cent (table 6). The cash receipts of all three boat size categories fell between 1998-99 and 1999-2000, with the fall being the greatest for small boats.

Prawn receipts are estimated to have contributed around 95 per cent of total cash receipts in both survey years for all three boat size categories. Prawn receipts fell in each group over the survey years, with the largest fall for the small boats group.

The estimated prawn receipts do not fully reflect the large drop in the prawn catch illustrated in figure E, as the price received for banana prawns caught in the northern prawn fishery rose significantly between 1998-99 and 1999-2000, particularly the price for tiger prawns (figure G). This increase in Australian dollar prices was partly attributable to the depreciation of the Australian dollar.

Costs

For the fleet overall, average per boat total cash costs are estimated to have fallen slightly to around $792 000 in 1999-2000, from $801 000 in 1998-99 (table 6). Medium boats incurred the largest cash costs in the fishery, reflecting higher fuel, insurance and repairs and maintenance costs relative to small and large boats. Average per boat cash costs for medium size boats rose by around $40 000 over the survey period, while those for small boats fell by around $58 000 and those for large boats fell by $50 000.

For the fleet overall, average per boat crew costs fell by an estimated 9 per cent between 1998-99 and 1999-2000 to around $248 000. This decrease was consistent across boat size categories. As the crew is generally paid a share of fishing receipts, the decrease in crew costs is consistent with the fall in receipts between 1998-99 and 1999-2000.

Fuel, which accounted for around 18 per cent of average per boat total costs in 1999-2000, rose for all boat size categories. Fuel costs rose the most in the medium size category, with an 11 per cent increase.

For the fleet overall, average per boat repairs and maintenance costs are estimated to have risen by 6 per cent to around $194 000 between 1998-99 and 1999-2000. Small and large boat repairs and maintenance costs fell by 15 per cent

6 Estimated financial performance of boats operating in the northern prawn fishery

Average per boat

		Under 375 units				375–475 units				Over 475 units				All boats			
		1998-99		1999-2000		1998-99		1999-2000		1998-99		1999-2000		1998-99		1999-2000	
Receipts																	
Prawn receipts	$	756 490	(9)	685 300	(13)	1 017 530	(3)	1 006 940	(4)	1 158 890	(5)	1 111 080	(6)	990 700	(3)	942 850	(4)
Other fishing receipts	$	25 300	(72)	13 030	(65)	62 000	(43)	13 920	(15)	1 260	(83)	12 180	(25)	38 830	(38)	13 350	(19)
Nonfishing receipts	$	19 130	(40)	40 510	(76)	10 550	(29)	8 810	(22)	11 930	(46)	5 270	(41)	12 880	(21)	16 420	(49)
Total cash receipts	$	800 930	(9)	738 830	(14)	1 090 080	(2)	1 029 670	(4)	1 172 080	(5)	1 128 530	(6)	1 042 410	(2)	972 620	(4)
Costs																	
Administration	$	14 220	(19)	10 750	(21)	13 630	(8)	13 850	(6)	15 480	(27)	13 890	(16)	14 210	(9)	13 050	(6)
Crew costs	$	236 660	(9)	221 470	(13)	282 320	(3)	256 870	(4)	287 640	(6)	258 220	(6)	272 950	(3)	247 870	(4)
Freight and marketing expenses	$	20 050	(15)	12 470	(20)	21 100	(6)	24 680	(13)	23 490	(13)	27 750	(18)	21 430	(6)	22 080	(9)
Fuel	$	88 230	(5)	92 100	(9)	150 380	(3)	167 210	(4)	142 950	(3)	156 480	(5)	134 110	(2)	145 500	(3)
Insurance	$	20 990	(12)	18 440	(14)	38 380	(8)	43 740	(9)	29 960	(2)	22 420	(5)	32 300	(5)	33 030	(7)
Interest paid	$	27 720	(29)	18 570	(22)	36 210	(16)	27 250	(13)	25 340	(40)	25 500	(26)	31 620	(14)	24 640	(10)
Leasing	$	6 600	(58)	9 570	(59)	11 530	(46)	7 730	(31)	16 510	(80)	15 220	(48)	11 580	(37)	9 650	(25)
Licence fees and levies	$	36 790	(11)	28 120	(11)	52 840	(3)	58 120	(8)	58 380	(3)	37 040	(7)	50 430	(3)	46 220	(6)
Packaging	$	9 370	(26)	10 870	(30)	16 990	(4)	16 180	(6)	19 930	(11)	20 760	(7)	15 920	(5)	15 670	(7)
Repairs and maintenance	$	127 300	(13)	107 780	(9)	202 140	(5)	238 640	(10)	191 820	(10)	183 800	(6)	182 210	(4)	193 870	(7)
Other costs	$	22 880	(12)	23 200	(17)	46 960	(7)	56 130	(7)	18 480	(16)	18 400	(9)	34 500	(6)	40 260	(6)
Total cash costs	$	610 800	(7)	553 340	(9)	872 480	(2)	910 390	(4)	829 970	(4)	779 490	(5)	801 260	(2)	791 830	(3)
Boat cash income	$	190 120	(19)	185 500	(37)	217 600	(8)	119 280	(27)	342 110	(14)	349 050	(13)	241 150	(7)	180 790	(15)
less depreciation **a**	$	35 690	(18)	28 970	(17)	61 270	(11)	65 020	(9)	34 420	(5)	32 140	(6)	48 850	(8)	49 270	(7)
Boat business profit	$	154 430	(23)	156 530	(44)	156 330	(13)	54 260	(62)	307 690	(15)	316 910	(14)	192 310	(9)	131 520	(21)
plus interest, leasing and rent	$	35 310	(25)	29 330	(26)	49 020	(14)	35 710	(12)	42 280	(50)	41 820	(24)	44 200	(15)	35 220	(10)
Profit at full equity	$	189 740	(21)	185 860	(37)	205 350	(8)	89 970	(38)	349 970	(11)	358 740	(12)	236 510	(7)	166 740	(16)
Capital (excl. quota and licences)	$	689620	(8)	647 910	(11)	1 292 010	(5)	1 377 460	(4)	1 265 310	(3)	1 222 760	(3)	1 145 180	(3)	1 156 900	(3)
Capital (incl. quota and licences)	$	na		3 180 030	(11)	na		4 088 500	(1)	na		4 376 920	(2)	na		3 906 370	(2)
Rate of return to boat capital **b**	%	27.5	(18)	28.7	(33)	15.9	(11)	6.5	(39)	27.7	(13)	29.3	(12)	20.7	(8)	14.4	(17)
Rate of return to full equity **c**	%	na		5.8	(30)	na		2.2	(38)	na		8.2	(12)	na		4.3	(15)

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 'Survey methods and definitions'.

and 4 per cent respectively over the survey period. However, in the medium boats group, repairs and maintenance costs rose by an estimated 18 per cent.

Boat cash income and profit

Estimated boat cash income and estimated boat business profit provide 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 income and profitability reflect fluctuations in estimated receipts and costs.

On average, estimated boat cash income per boat for the fleet was around $181 000 in 1999-2000, a fall of around 25 per cent from the previous year (table 6). The change in boat cash income was experienced to different degrees by the various boat size categories across the fleet. Boat cash income for medium boats fell by an estimated 45 per cent over the survey period, while that for small and large boats were relatively unchanged.

Boat business profit, which makes an allowance for depreciation, fell by 32 per cent in 1999-2000 from the previous year to an estimated $132 000. Again, the change in boat business profit was experienced to different degrees by the various boat size categories across the fleet. In the medium size category it was estimated to have fallen by 65 per cent over the survey period. Boat business profit for small and large boats was estimated to have increased only slightly over the survey years.

Profit at full equity is estimated by adding leasing costs, interest charges and rent payments to estimated boat profit. While these costs affect the financial position of the individual operator in the fishery, from a broader perspective they represent profits that are redistributed to other investors in the fishery. Profit at full equity provides a measure of the return that would have been earned by the business unit had the boat and capital (including entitlements) been fully owned by the operator.

Estimated profit at full equity for the fleet averaged $167 000 per boat in 1999-2000, 29 per cent lower than in 1998-99 (table 6). Profit at full equity fell in the medium size boat category to around $90 000 in 1999-2000, a 56 per cent decline from the previous year. The average estimated profit at full equity for boats in the small and large size categories remained relatively stable at around $186 000 and $359 000 respectively.

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 rate of return to boat capital decreased on average for the fleet from 20.7 per cent in 1998-99 to 14.4 per cent in 1999-2000 (table 6). This fall was primarily attributable to the fall in the rate of return to boat capital in the medium size boat category, estimated to have fallen from 15.9 per cent in 1998-99 to 6.5 per cent in 1999-2000. The rates of return to boat capital in the small and large size categories are estimated to have increased slightly.

The estimated rate of return at full equity includes the value of the SFRs and licences. For the fleet as a whole, the estimated rate of return at full equity was 4.3 per cent in 1999-2000 (table 6). This represents a fall on the last rate of return at full equity estimated for the fishery of 8 per cent for 1997-98 (Holland et al. 2000).

Debt and equity

Not all sampled boats provided information on debt and equity and based on this smaller sample, the estimated average level of debt per boat fell by an estimated $46 000 to a closing balance of around $345 000 (table 7). Around 26 per cent of closing boat debt was designated as being used for licence and endorsement purchase, 32 per cent for working capital and 42 per cent for boat purchase.

Boat business equity provides a measure of the financial ownership of a fishing enterprise. The estimated average boat business equity ratio in the northern prawn fishery was 91 per cent. Across the

7 Debt and equity of boats operating in the northern prawn fishery in 1999-2000
Average per boat

		Under 375	375–475	Over 475	All boats
Capital (incl. quota and licences) at 30 June	$'000	3 180 (11)	4 170 (1)	4 333 (2)	3 881 (3)
Boat business debt at 1 July	$'000	273 (23)	388 (14)	618 (37)	390 (13)
Boat business debt at 30 June	$'000	239 (22)	323 (16)	608 (36)	345 (14)
Change in debt over year	$'000	–34 (42)	–64 (23)	–10 (152)	–46 (20)
Boat business equity at 30 June	$'000	2 941 (11)	3 847 (2)	3 725 (7)	3 537 (3)
Boat business equity ratio at 30 June	%	93 (2)	92 (1)	86 (6)	91 (1)

Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in 'Survey methods and definitions'.

fleet, the boat business equity ratio for small and medium boats were estimated at 93 per cent and 92 per cent while the average boat in the large size category was estimated to have a boat business equity ratio of 86 per cent.

Estimates of net return to the fishery resource

As discussed earlier, 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.

The accounts of businesses involved in the fishery are primary sources of deriving a measure of the apparent net return to the northern prawn fishery resources. However, measures of aggregate profit to the businesses involved in the fishery may differ from the net return to the fishery resource in several ways. Fishers often operate in more than one fishery and their accounts reflect those activities. Costs reported in the financial accounts of business may vary from social opportunity costs, particularly for capital, management costs and owners' or family labor. Finally, in some fisheries, the full costs of management may not be charged to operators.

The relationships between total revenue, financial accounts of fishers' costs and the social costs of fishing are examined more fully in Rose et al. (2001). In the absence of a full bioeconomic model of the northern prawn fishery, quantitative or qualitative information on a number of aspects of the fishery may shed light on its relative efficiency. Of particular importance are the condition of the fish stock, capital capacity, prices of the fishery's products and inputs, and the management structure of the fishery.

To provide an indication of the economic performance of the northern prawn fishery, the net returns to the fishery have been estimated and are presented in table 8. The measure of net return to the fishery includes only those receipts and costs that are attributable to the northern prawn fishery. As a result, the estimated receipts and costs in table 8 will differ from those in table 6. The latter includes all receipts and costs of boats operating in the fishery, including those incurred while fishing in other fisheries such as the Torres Strait, Kimberley and Queensland east coast prawn fisheries.

Real net returns (including management costs) for the northern prawn fishery fell from an estimated $31.5 million in 1998-99 to around $18.7 million in 1999-2000.

Net returns to the fishery have fluctuated substantially (figure H). The interpretation of these measures and the fluctuating net returns should be considered in the light of a number of factors. The condition of the prawn stocks and prices for the fishery's products may be particularly important in considering net returns from the northern prawn fishery in recent years.

8 Real net returns to the northern prawn fishery
In 2000-01 dollars

	Revenue a		Cash costs a,b		Capital a,c		Net returns excl. management costs d		Management costs e	Net returns incl. management costs	Vessel numbers
	$m		$m		$m		$m		$m	$m	no.
1990-91	140.6	(2)	104.2	(2)	89.6	(1)	19.0	(13)	na	na	169
1991-92	109.3	(3)	89.1	(3)	72.6	(2)	8.3	(25)	na	na	160
1992-93	132.0	(6)	102.3	(5)	71.0	(5)	20.8	(15)	na	na	129
1993-94	144.8	(5)	112.9	(7)	61.8	(4)	20.5	(8)	na	na	132
1994-95	163.8	(7)	109.8	(5)	73.3	(5)	41.5	(16)	1.3	40.2	133
1995-96	139.3	(3)	104.8	(2)	87.1	(7)	19.9	(17)	1.1	18.8	134
1996-97	131.2	(3)	95.5	(3)	76.0	(6)	22.7	(13)	1.1	21.6	128
1997-98	157.9	(1)	103.2	(2)	72.7	(5)	41.3	(5)	1.3	40.0	130
1998-99	142.0	(3)	97.6	(3)	68.1	(9)	32.8	(5)	1.3	31.5	133
1999-2000	113.3	(4)	83.2	(4)	54.1	(10)	20.2	(16)	1.5	18.7	130

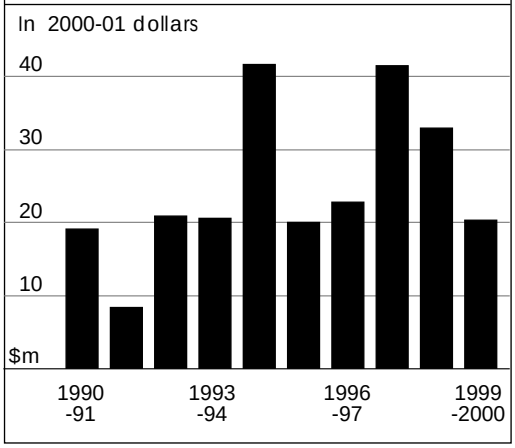
a Revenue is fishing receipts from the northern prawn fishery. All costs and capital have been multiplied by (northern prawn fishery fishing receipts divided by total fishing receipts). **b** Cash costs include imputed operator and family labor costs but exclude licence and levy payments and management costs. **c** Replacement capital (depreciated capital for 1990-91 and 1991-92) is calculated by applying the replacement capital value for boats in the three size groups in 1992-93 to the population in 1990-91 and 1991-92 and then adding depreciation estimates. **d** Calculated as per the definition in this report. **e** Costs to AFMA of managing the fishery (A. Kettle, AFMA, personal communication, June, 2001). **na** Not available.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in 'Survey methods and definitions'.

Fish stocks

If there is a systematic change over time in the fish stock, a measure of the net return for a single year may not be a sufficient indicator of long term resource rent. For example, if the fish stocks are being depleted, the current net return includes revenue from selling off part of the fish stock that will not be available over the long term. Abundance and accessibility to fishers are highly variable over time for many fish species. A number of factors other than the impact of fishing effort may influence the state of fish stocks. Changes in water temperatures, currents, rainfall and other environmental factors may play an important part in determining the state of the fish stock, complicating any attempt to interpret catch, stock and economic data.

While there is no firm evidence of recruitment overfishing in the banana prawn fishery, concerns have been raised over the status of the tiger prawn fishery which, while highly valuable, has been assessed by the NPFAG as biologically overfished. It is possible that the net returns estimated for the fishery include some return from the liquidation of part of the tiger prawn stock. If this is the case, the estimates of net return provided in table 8 are unlikely to be sustainable and will overestimate resource rent.

H Estimated real net returns to the northern prawn fishery (excluding management returns)



Market conditions

Year to year fluctuations in fish prices may also cause large changes in net returns. Reliable measures of product prices are

often likely to be essential to understanding the meaning of primary performance indicators. It is important to distinguish between price changes imposed by market fluctuations and those that result from changes in fishing, handling or marketing methods. Innovation or adaptation in a fishery may often be reflected in a change in product prices.

Australian dollar prices for northern prawn products (including tiger, banana and endeavour prawns) rose sharply between 1998-99 and 1999-2000 (figure G), in part, owing to the depreciation of the Australian dollar.

Torres Strait prawn fishery

Despite a significant fall in the catch of prawns between 1998-99 and 1999-2000, for the fleet as a whole, average per boat prawn receipts are estimated to have remained relatively stable. At around $551 000, average per boat prawn receipts for specialist Torres Strait prawn boats were very similar to the average of all boats operating in the fishery in 1999-2000.

◆

Fuel costs and crew costs were the main contributors to an increase in costs across the fleet of 7 per cent between 1998-99 and 1999-2000. Costs are estimated to have increased by much less for the specialist fleet.

◆

Boat cash income of specialists increased by an estimated 25 per cent between 1998-99 and 1999-2000, but remained stable across the entire fleet on average.

◆

Net returns (assuming no changes to stocks) to the fishery are estimated to have increased in real terms between 1998-99 and 1999-2000, to $4.5 million.

◆

The fishery

The Torres Strait prawn fishery is located between the tip of the Cape York Peninsula and the south coast of Papua New Guinea and is bordered in the west by the Arafura Sea and the Coral Sea to the east. The main prawn fishing ground in the Torres Strait is east of the Warrior Reef complex with a focus around Yorke Island, which is the main anchorage for the fleet (figure I).

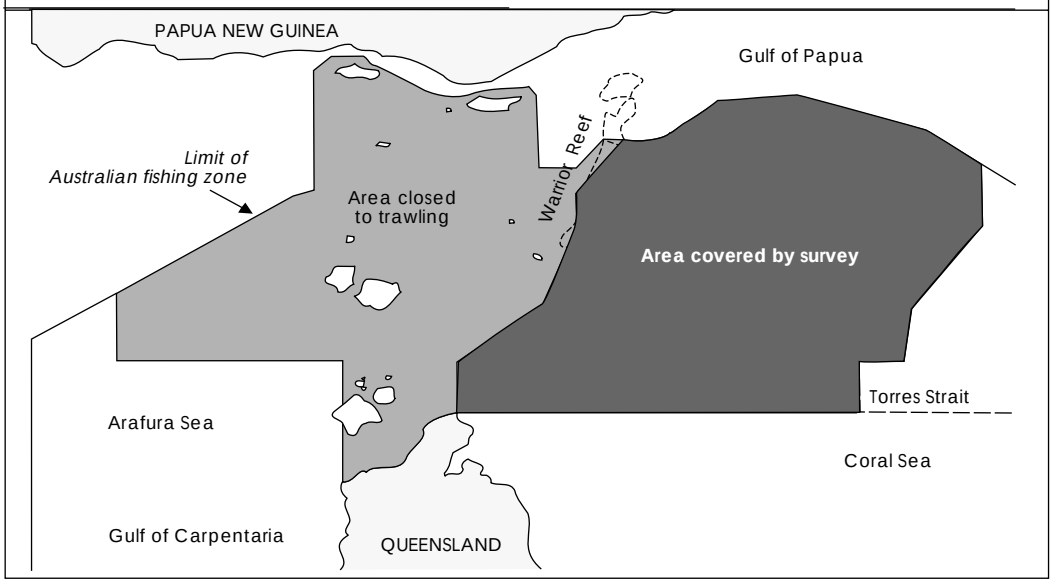
Operators in the fishery target tiger and endeavour prawns. Tiger prawns usually account for between 30 and 40 per cent of the prawn catch and endeavour prawns for around 60 per cent (figure J). King prawns usually account for the majority of the remaining prawn catch.

Together, endeavour and tiger prawns have accounted for over 95 per cent of the real gross value of prawn production from the Torres Strait prawn fishery since 1992-93 (figure K). The real gross value of production from the Torres Strait prawn fishery has increased from around $15 million in 1992-93 to over $25 million a year in the period 1998-99 to 2000-01. The real gross value of production has increased substantially since the sharp falls in 1995-96 and 1996-97, as the real prices for each of the major species have risen in recent years (figure L).

Fishing in the Torres Strait prawn fishery is carried out at night using otter trawls up to 20 metres long with two pairs of nets with a combined headrope and footrope length of 88 metres (to be reduced to 80 metres for the 2002 season) and a mesh size of 45 millimetres (Turnbull and Williams 2002).

Few vessels fish exclusively in the Torres Strait area and most move between the Queensland east coast prawn fishery

I **Torres Strait prawn fishery management areas**



Source: Coles, van Montfrans and Squire (1993)

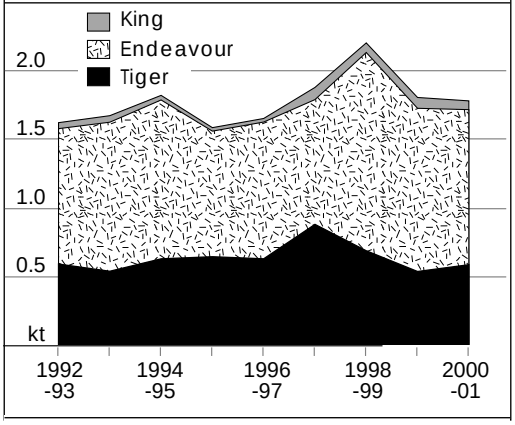
and the northern prawn fishery. The fishing season in the Torres Strait prawn fishery is from March to December. As financial years (July–June) are used for reporting revenue and cost information, the figures contained in this report overlap fishing seasons. For example, the March–June period of the 1999 fishing season is included in the 1998-99 financial year, while the July–December period of the 1999 season is included in the 1999-2000 financial year.

Biological status of the fishery

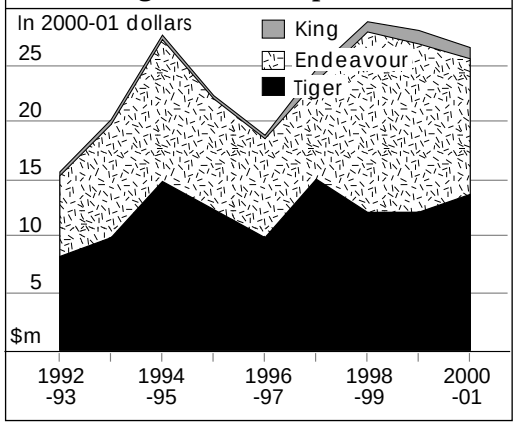
Brown tiger prawns and blue endeavour prawns are both endemic to tropical and subtropical Australia. Both these species are highly fecund, fast growing, short lived, and reach sexual maturity by six months of age (Turnbull and Williams 2002).

Biological overfishing has been considered not to be a threat in the Torres Strait

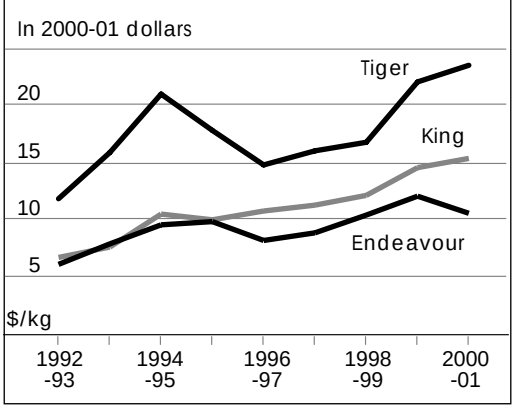
J **Torres Strait prawn fishery: production**



K **Torres Strait prawn fishery: real gross value of production**



L Torres Strait prawn fishery: real unit values



prawn fishery under the existing management arrangements. The first formal assessment of the fishery was conducted in 1991, and updated in 1994. From these assessments, the long term biologically sustainable yield was estimated to be around 1900 tonnes, consisting of 680 tonnes of tiger prawns, 1035 tonnes of endeavour prawns and 185 tonnes of king prawns). The optimal effort required to fish the prawn stock efficiently in the Torres Strait was estimated to vary between 8400 and 12600 boat days (Turnbull and Williams 2002).

Preliminary results of the current stock assessment suggest that the maximum sustainable yield for tiger prawns is around 665 tonnes, close to the average annual catch of 656 tonnes over the years 1980 to 2000 (Turnbull and Williams 2002). The estimated effort required to achieve maximum sustainable yield (10 300 days) is similar to that derived in the previous assessments.

Both tiger and endeavour prawns are caught using trawlers, which sweep a large area of seabed to catch relatively sparsely distributed prawns. Consequently, a wide range of nontargeted commercial species such as bugs, scallops, squid, finfish and sharks are taken as bycatch. Turnbull and Williams (2002) state that a study in 1998 revealed that commercial prawns constituted only between 4 and 11 per cent of total catches, of which target species accounted for just 60 per cent. Noncommercial species such as marine reptiles, mainly turtles and sea snakes, are also taken as bycatch. However, turtle exclusion devices will be compulsory for the start of the 2002 season. Other bycatch reduction devices are being trialed in collaboration with researchers from Southern Fisheries Centre of the Queensland Department of Primary Industries.

Management of the fishery

Management of the Torres Strait prawn fishery as a separate fishery from the northern prawn fishery and Queensland east coast otter trawl fishery only occurred when the Torres Strait Treaty was ratified in 1985. At the time of ratification, about 500 vessels had obtained a licence to operate in the Torres Strait prawn fishery.

The Protected Zone Joint Authority (PZJA) is responsible for monitoring the condition of the Torres Strait prawn fishery and for formulating policies and plans for its management. The PZJA is comprised of the Commonwealth and Queensland ministers responsible for fisheries. The fishery is managed under the provisions of the Commonwealth *Torres Strait Fisheries Act 1984*. Management, licensing, enforcement and research activities are carried out on behalf of the PZJA by the Australian Fisheries Management Authority, the Queensland Fisheries Service, the Queensland Boating and Fisheries Patrol, and the Queensland Department of Primary Industries.

The major objectives of management in the Torres Strait prawn fishery are to conserve the prawn stocks while allowing their optimum utilisation, and maximising opportunities for traditional inhabitants to participate in the fishery. In 1987, among other restrictions, limited entry management of the prawn fishery was introduced to reduce latent effort and to prepare for the catch sharing provisions of the treaty. This management arrangement effectively reduced the number of vessels holding a licence to operate in the Torres Strait prawn fishery to 150. In addition, a boat replacement policy was proposed but this was rejected. Instead,

in 1989, a freeze was implemented on the transfer of licences, and by June 1992 around 110 vessels were licensed to operate in the fishery.

In 1993, interim management provisions were introduced in an attempt to cap effort. Each vessel was allocated a number of fishing days in which it could operate in the Torres Strait prawn fishery. The allocation was based on the greatest number of days the vessel had fished in the Torres Strait in a financial year over the period 1988-89 to 1991-92, with an additional allocation for nonfishing time and breakdowns.

In 1994, interim management provisions were approved under which fishing access (in blocks) was made transferable across operators in the fishery. Under these arrangements, operators selling fishing access are prevented from operating in the fishery in the next year.

Together with these controls, restrictions apply on sizes of boat and gear used in the fishery. Seasonal and area closures of the prawn fishery are an important management tool, keeping sensitive areas free from trawling and allowing protection for areas at important times — such as during recruitment of small prawns to the fishery. The Torres Strait prawn fishery is closed between 1 December and 1 March each year.

By February 1999 the fleet comprised 82 licensed vessels assigned 13 570 fishing days (Jackson, Gaffney and Turnbull 1999). By May 2001 the fleet had fallen to 78 licensed vessels of which 75 fished in the 2000 season. All but one of these vessels is endorsed to fish the Queensland east coast fishery and 17 are also endorsed to fish the Commonwealth's northern prawn fishery.

Despite the fall in boat numbers since the effort quota was introduced in 1993, the current 78 fishing vessels are still capable of expanding fishing effort to the maximum effort quota of 13 570 fishing days. There is general agreement that the current cap of 13 570 quota days is too high and that a significant amount of latent effort exists in the fishery (Turnbull and Williams 2002).

In 1996 the PZJA agreed that the cost of managing the prawn fishery should be recovered from operators in the fishery. Cost recovery commenced on 1 July 1997 and was phased in over three years at 40 per cent, 70 per cent and 100 per cent respectively.

Further changes to the management arrangements for the fishery are planned for the 2002 season, including mandatory use of turtle excluding devices (TEDs). Discussions on facilitating the introduction of bycatch reduction devices (BRDs) in the fishery in the 2002 season are continuing. New shark bycatch limits will also apply for the start of the 2002 season, with operators allowed to retain up to five shark trunks, to a maximum of 30 kilograms, onboard at any time. In addition, the PZJA agreed to an overall ban on shark finning in the prawn fishery beginning in the 2002 season. The maximum permissible length of net to be towed by prawn trawlers will also be reduced from 88 metres to 80 metres.

Boats surveyed

The population of the Torres Strait prawn fishery was defined as boats that held a Commonwealth endorsement for the fishery and caught prawns in the survey years. Based on logbook data there were 82 active Torres Strait prawn boats in 1998-99 and 79 active boats in 1999-2000. Of these, 20 were sampled in 1998-99 and 23 were sampled in 1999-2000.

There are a number of boats operating in the Torres Strait prawn fishery that derive large proportions of their income from other fisheries such as the northern prawn fishery and the Queensland east coast prawn fishery. Consequently, the financial performance of all boats grouped together may not give an indication of the financial performance of a boat that primarily operates in the Torres Strait prawn fishery. As a result, the measures of financial performance in this report include a new group called Torres Strait prawn specialists. For the purpose of the survey, specialists were defined as boats that earned more than 80 per cent of their

fishing income from the Torres Strait prawn fishery.

Financial performance of boats

The principal measures of financial performance for boats operating in the Torres Strait prawn fishery and specialist Torres Strait prawn boats are shown in table 9. Table 10 contains information on the performance of boats in the fishery 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 lower or bottom triptile, and so on. The weighted average cost and earnings for operators within each group were then calculated. The estimates shown in tables 9 and 10 include income obtained and costs incurred by boats that operate in other fisheries such as the northern prawn fishery, or state fisheries such as the Kimberley prawn and Queensland east coast prawn fisheries.

Receipts

Despite the significant drop in the prawn catch in the fishery between 1998-99 and 1999-2000, estimated average per boat prawn receipts for all boats in the fishery

9 Estimated financial performance of boats operating in the Torres Strait prawn fishery

		Specialists				All boats			
Receipts		**1998-99**		**1999-2000**		**1998-99**		**1999-2000**	
Prawn receipts	$	555 520	(6)	550 570	(5)	556 240	(12)	559 890	(9)
Other fishing receipts	$	80 010	(20)	123 260	(20)	48 070	(21)	71 810	(19)
Nonfishing receipts	$	4 120	(41)	5 780	(36)	12 980	(43)	17 410	(68)
Total cash receipts	$	639 640	(6)	679 610	(3)	617 290	(12)	649 100	(9)
Costs									
Administration	$	10 880	(10)	11 790	(16)	11 530	(13)	11 980	(14)
Crew costs	$	218 890	(3)	230 050	(5)	197 680	(11)	217 200	(9)
Freight and marketing expenses	$	20 050	(9)	15 930	(14)	18 300	(10)	14 660	(9)
Fuel	$	81 920	(6)	116 390	(7)	75 080	(9)	102 080	(7)
Insurance	$	14 010	(6)	13 730	(9)	15 430	(13)	15 110	(8)
Interest paid	$	16 800	(31)	20 410	(20)	18 710	(28)	20 130	(17)
Leasing	$	3 990	(51)	3 400	(40)	2 710	(46)	1 730	(40)
Licence fees and levies	$	12 540	(15)	14 190	(22)	14 910	(20)	17 440	(18)
Packaging	$	10 950	(11)	8 290	(8)	9 010	(13)	7 850	(10)
Repairs and maintenance	$	120 060	(13)	94 270	(11)	110 500	(13)	96 170	(9)
Other costs	$	32 730	(10)	30 100	(17)	25 530	(8)	27 890	(10)
Total cash costs	$	542 790	(4)	558 560	(4)	499 390	(10)	532 240	(7)
Boat cash income	$	96 850	(41)	121 050	(17)	117 900	(30)	116 870	(28)
less depreciation **a**	$	31 430	(15)	33 680	(15)	26 650	(14)	27 560	(12)
Boat business profit	$	65 420	(59)	87 370	(26)	91 240	(37)	89 300	(36)
plus interest, leasing and rent	$	22 530	(29)	25 570	(16)	22 780	(27)	23 290	(14)
Profit at full equity	$	87 950	(40)	112 940	(18)	114 030	(31)	112 600	(29)
Capital (excl. quota and licences)	$	417 750	(9)	454 340	(10)	410 540	(15)	453 120	(11)
Capital (incl. quota and licences)	$	na		1 442 550	(11)	na		1 607 950	(17)
Rate of return to boat capital b	%	21.1	(43)	24.9	(17)	27.8	(23)	24.8	(25)
Rate of return to full equity c	%	na		7.8	(20)	na		7.0	(22)

a Depreciation adjusted for profit and 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 'Survey methods and definitions'.

remained stable at around $560 000 (table 9). Average per boat prawn receipts for specialists also remained relatively stable at around $551 000 in 1999-2000. The lower prawn catch was partly offset by the higher prices received for prawns over the survey period. Australian dollar prices were boosted by the depreciation of the Australian dollar, with the majority of production from the fishery being exported.

10 Estimated financial performance of boats operating in the Torres Strait prawn fishery, by triptile

Triptiles based on value of fish sold Average per boat

	Lower triptile				Middle triptile				Upper triptile			
	1998-99		1999-2000		1998-99		1999-2000		1998-99		1999-2000	
	$		$		$		$		$		$	
Receipts												
Prawn receipts	320 060	(23)	342 200	(18)	571 750	(3)	583 180	(5)	752 120	(7)	719 760	(8)
Other fishing receipts	8 260	(115)	26 050	(86)	56 340	(29)	65 000	(34)	76 260	(33)	116 810	(33)
Nonfishing receipts	100	(126)	1 530	(73)	19 960	(39)	6 680	(47)	18 430	(48)	41 150	(75)
Total cash receipts	328 420	(23)	369 780	(20)	648 050	(1)	654 860	(3)	846 810	(5)	877 720	(7)
Costs												
Administration	10 160	(31)	11 720	(38)	12 320	(12)	10 420	(24)	12 070	(20)	13 710	(15)
Crew costs	126 970	(33)	128 050	(23)	211 040	(3)	230 100	(6)	248 910	(5)	279 410	(7)
Freight and marketing	11 710	(16)	13 170	(19)	19 720	(11)	14 730	(21)	22 930	(10)	15 840	(8)
Fuel	44 140	(19)	74 920	(22)	82 720	(3)	103 440	(8)	95 970	(2)	123 520	(6)
Insurance	11 800	(26)	13 730	(17)	15 300	(8)	14 880	(10)	18 750	(15)	16 510	(14)
Interest paid	15 240	(85)	18 150	(51)	19 000	(34)	24 220	(20)	21 520	(33)	17 800	(19)
Leasing	3 810	(126)	1 460	(103)	2 840	(55)	3 730	(48)	1 630	(87)	nf	
Licence fees and levies	11 520	(47)	8 610	(18)	9 490	(14)	17 080	(25)	22 510	(19)	25 200	(22)
Packaging	5 770	(49)	5 090	(28)	11 760	(8)	8 110	(12)	9 540	(19)	9 920	(10)
Repairs and maintenance	110 880	(42)	77 730	(20)	112 520	(9)	88 890	(18)	108 450	(18)	118 720	(4)
Other costs	18 580	(17)	30 310	(22)	30 670	(20)	18 300	(24)	27 300	(11)	35 180	(6)
Total cash costs	370 580	(34)	382 940	(21)	527 390	(3)	533 910	(5)	589 590	(4)	655 800	(3)
Boat cash income	–42 160	(118)	–13 160	(72)	120 660	(14)	120 950	(24)	257 230	(9)	221 920	(28)
less depreciation **a**	17 000	(43)	14 550	(30)	26 150	(13)	31 860	(21)	35 620	(19)	34 290	(13)
Boat business profit	–59 160	(92)	–27 710	(43)	94 520	(19)	89 100	(35)	221 600	(11)	187 630	(34)
plus interest, leasing and rent	19 240	(90)	22 700	(44)	24 840	(23)	28 370	(17)	24 160	(34)	18 840	(19)
Profit at full equity	–39 920	(102)	–5 010	(77)	119 360	(14)	117 470	(25)	245 760	(12)	206 470	(31)
Capital (excl. quota and licence)	279 610	(37)	266 140	(27)	315 980	(14)	462 470	(14)	606 940	(7)	600 820	(8)
Capital (incl. quota and licence)	na		794 870	(20)	na		1 540 190	(15)	na		2 355 640	(21)
	%		%		%		%		%		%	
Rate of return to boat capital **b**	–14.3	(66)	–1.9	(60)	37.8	(24)	25.4	(24)	40.5	(12)	34.4	(31)
Rate of return to full equity **c**	na		–0.6	(67)	na		7.6	(27)	na		8.8	(29)

a Depreciation adjusted for profit and loss on capital items sold. **b** Excluding value of quota and licences. **c** Including value of quota and licences. **na** Not applicable. **nf** None found in sample.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in 'Survey methods and definitions'.

For the fleet as a whole, other fishing receipts increased by around $24 000 in 1999-2000 to almost $72 000. Other fishing receipts also increased substantially for specialist boats to around $123 000 per boat in 1999-2000. The increase is partly attributable to increased catches of scallops from the Queensland east coast fishery.

Costs

For the fleet as a whole, average per boat total cash costs are estimated to have increased by around 7 per cent to $532 000 in 1999-2000 (table 9). This increase was largely driven by increasing fuel costs, which rose by 36 per cent to around $102 000. Average per boat crew costs rose by 10 per cent to around $217 000. Some cash costs such as freight and marketing, leasing and repairs and maintenance costs fell over the survey period, but the magnitude of these falls was not enough to offset the increase in fuel and crew costs.

For specialist boats, average per boat total cash costs are estimated to have risen only slightly to around $559 000 in 1999-2000. Fuel costs rose by an estimated 42 per cent between 1998-99 and 1999-2000 to an average of around $116 000. Average per boat crew costs for specialists rose by an estimated 5 per cent to $230 000 in 1999-2000. Partially offsetting these increased costs, average per boat costs for repairs and maintenance fell by around $26 000 between 1998-99 and 1999-2000.

Boat cash income and profit

Average per boat cash income for the fleet as a whole remained relatively stable over the survey period, and was estimated at around $117 000 per boat in 1999-2000. Boat cash income for specialists increased by an estimated 25 per cent between 1998-99 and 1999-2000 to around $121 000 per boat.

For boats in the upper triptile, cash costs rose by more than cash receipts between 1998-99 and 1999-2000, leading to a decrease in boat cash income of $35 000 to around $222 000 in 1999-2000.

Across the fleet, boat business profit was estimated to have fallen only slightly to around $89 000 per boat in 1999-2000. Despite a marginal increase in depreciation between 1998-99 and 1999-2000, boat business profit is estimated to have increased by 34 per cent to around $87 000 per specialist boat in 1999-2000.

Profit at full equity is calculated by adding leasing costs, interest payments and rent payments to boat business profit. While these costs affect the financial position of the individual operator, they represent some profits that have been redistributed to other investors in the fishery. For the entire fleet, profit at full equity was estimated at around $113 000 per boat in 1999-2000, only a small decrease from 1998-99. For Torres Strait prawn specialists, it was also estimated at around $113 000 per boat. However, this was an increase of about 28 per cent from the previous year. These figures represent the estimated 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.

Despite an improvement of the performance of boats in the lower triptile, boat cash income and profit are still estimated to have been negative in 1999-2000. Estimated boat cash income and profit decreased for boats in the upper triptile.

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) for the entire Torres Strait prawn fleet fell to 24.8 per cent in 1999-2000, from 27.8 per cent for 1998-99. Driving this decrease was the increase in the value of boat capital, while profit at full equity remained relatively constant. Despite the increase in the value of boat capital of specialists in 1999-2000, the increase in profit at full equity between 1998-99 and 1999-2000 was enough to increase the rate of return to boat capital to an estimated 24.9 per cent in 1999-2000.

For boats in the lower triptile, the rate of return to boat capital increased dramatically between 1998-99 and 1999-2000, but still remained negative at –1.9 per cent in 1999-2000. The rate of return to boat capital in the middle and upper triptiles fell to 25 per cent and 34 per cent respectively.

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 operating in the Torres Strait prawn fishery was around $1.2 million in 1999-2000 and the rate of return to full equity for the fishery was estimated at 7 per cent for 1999-2000. For Torres Strait prawn specialists, the estimated value of quota and licences per boat was around $1 million in 1999-2000 leading to a slightly higher estimated rate of return to full equity at 7.8 per cent.

The rate of return to full equity for boats in the lower triptile was estimated at –0.6 per cent in 1999-2000. For boats in the middle and upper triptile the estimated rate of return to boat capital was 7.6 per cent and 8.8 per cent respectively.

Debt and equity

The estimated average level of debt per boat in the Torres Strait prawn fishery rose by about $18 600 between 1998-99 and 1999-2000 to around $264 000 (table 11). The boat business equity ratio provides a measure of the financial ownership of a fishing enterprise. The average boat business equity ratio of the Torres Strait prawn fleet was around 84 per cent.

11 Debt and equity of boats operating in the Torres Strait prawn fishery in 1999-2000 Average per boat

		All boats	
Capital (incl. quota and licences) at 30 June	$	1 607 950	(17)
Boat business debt at 1 July	$	245 490	(19)
Boat business debt at 30 June	$	264 060	(16)
Change in debt over year	$	18 570	(184)
Boat business equity at 30 June	$	1 343 880	(19)
Boat business equity ratio at 30 June	%	83.6	(4)

Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in 'Survey methods and definitions'.

Estimates of net return to the fishery resource

As noted in previous sections, 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.

The relationships between total revenue, financial accounts of fishers' costs and the social costs of fishing are described in more detail in Rose et al. (2001). In the absence of a full bioeconomic model of the Torres Strait prawn fishery, quantitative or qualitative information on a number of aspects of the fishery may shed light on its relative efficiency. Of particular importance are the condition of the fish stock, capital capacity, prices of the fishery's products and inputs and the management structure of the fishery.

To provide an indication of the economic performance of the Torres Strait prawn fishery, the net returns to the fishery were estimated and are presented in table 12. The measure of net return to the fishery includes only those receipts and costs that are attributable to the Torres Strait prawn fishery. As a result, the estimated receipts and costs in table 12 will differ from those in table 9 which include all receipts and costs of boats operating in the fishery, including those incurred while fishing in other fisheries such as the northern prawn, Kimberley and Queensland east coast prawn fisheries.

Despite a fall in revenue in the fishery, real net returns (including management costs) for the Torres Strait prawn fishery are estimated to have risen from

12 Net returns to the Torres Strait prawn fishery

In 2000-01 dollars

	Revenue [a]	Cash costs [a,b]	Capital [a,c]	Net returns excl. management costs [d]	Management costs [e]	Net returns incl. management costs	Vessel numbers
	$m	$m	$m	$m	$m	$m	no.
1992-93	27.7 (10)	23.6 (10)	18.0 (13)	2.1 (34)	na	na	61
1993-94	26.7 (14)	22.6 (14)	15.4 (13)	1.2 (80)	na	na	64
1994-95	27.3 (13)	22.9 (13)	16.0 (14)	1.6 (60)	na	na	60
1995-96	24.0 (7)	20.9 (7)	12.5 (9)	0.8 (54)	na	na	60
1996-97	25.5 (12)	21.7 (11)	11.0 (10)	1.9 (48)	na	na	80
1997-98	28.5 (7)	22.6 (8)	9.0 (8)	4.3 (20)	0.3	4.0	83
1998-99	33.6 (15)	26.8 (14)	15.0 (21)	4.1 (41)	0.2	3.9	82
1999-2000	31.9 (13)	24.7 (12)	12.6 (17)	4.8 (28)	0.3	4.5	79

a Amount attributable to fishery. All costs and capital have been multiplied by (Torres Strait prawn fishing receipts divided by total fishing receipts). **b** Cash costs include imputed operator and family labor costs but exclude licence and levy payments and interest payments. **c** Replacement capital (depreciated capital). **d** Calculated as per definition in this report. **e** Combined management costs for AFMA, QFMA and surveillance. (T. Kingston, AFMA, personal communication, 31 January 2000 and J. Kung, Queensland Fisheries Service, personal communication, 19 February 2002.) **na** Not available.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in 'Survey methods and definitions'.

$3.9 million in 1998-99 to around $4.5 million in 1999-2000.

The interpretation of the net returns measure should be considered in the light of a variety of factors such as changes in fish stocks, the prices of the fishery's products and inputs and capital stocks. The increase in estimated net returns between 1998-99 and 1999-2000 occurred against a backdrop of rising unit prices for prawns and the estimated value of real capital decreased in the fishery from $15 million in 1998-99 to $12.6 million in 1999-2000.

Appendix

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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