australian fisheries surveys report 2007

results for selected fisheries, 2004-05 and 2005-06

simon vieira and laura hohnen

october 2007

abare

abareconomics.com

innovation in economics

abare

foreword

Estimates of the performance of operators in the northern prawn fishery and the Torres Strait prawn fishery — which were surveyed by ABARE in 2007 — are given in this report.

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

This report is another in a series of regular fisheries survey reports that have been released every year since the early 1990s. Funding for these reports is provided by the Fisheries Resources Research Fund.

Phillip Glyde
Executive Director

October 2007

acknowledgments

contents

boxes

figures

maps

tables

introduction and summary

This report presents estimates of the financial and economic performance of a number of key Commonwealth fisheries. Estimates are produced using data collected from fishery operators surveyed by ABARE during 2007. ABARE has been undertaking surveys of Commonwealth fisheries since the early 1980s and on a regular basis for key Commonwealth fisheries since 1992 — a list of earlier fisheries surveys reports is presented at the end of this report.

Among other things, the survey data are used to estimate net economic returns, which is the key economic performance indicator referred to in the Fisheries Management Act 1991. As specified in that act, the Australian Fisheries Management Authority (AFMA) is obliged to pursue the maximisation of net economic returns to the Australian community from the management of fisheries. Estimates of net economic returns can be used to assess AFMA's performance against this objective and can also be used to identify what factors other than management have led to changes in a fishery's economic performance.

In 2007 ABARE surveyed two fisheries — the northern prawn fishery and the Torres Strait prawn fishery. Information was collected from operators in both fisheries for financial years 2004-05 and 2005-06. Estimates of the financial and economic performance of these fisheries generated from the survey data collected are presented here.

key results from the surveys

northern prawn fishery

financial performance — per boat

» Between 2004-05 and 2005-06, average seafood **receipts** per boat increased by 16 per cent to $921 000, driven by an increase in landings and higher prices for tiger prawns in 2005-06.

» Average total cash **costs** per boat increased by 11 per cent in 2005-06 to $955 000. A 35 per cent increase in fuel costs was a major contributor to this overall increase.

» In 2005-06, average cash **income** per boat (cash receipts less cash costs) was $24 600, up from a negative income of – $15 400 per boat in 2004-05.

» The average **rate of return** to boat capital (excluding the value of quota and licences) was negative in both years, but improved from – 5.2 per cent in 2004-05 to – 1.5 per cent in 2005-06.

economic performance – fishery as a whole

» For the fishery as a whole, estimates of **net economic returns** (including management costs) in real terms have shown a declining trend since a peak in 2000-01 of $68 million. They became negative for the first time in 2004-05, falling to – $13.6 million, but improved slightly to – $9 million in 2005-06. These figures are substantially lower than the average annual real net return between 1995-96 and 2003-04 of $33.4 million.

Torres Strait prawn fishery

financial performance – per boat

» Average seafood **receipts** per boat fell by 3 per cent between 2004-05 and 2005-06 – from $491 000 to $474 000 per boat as both catches and prawn prices fell in 2005-06.

» Average total cash **costs** per boat increased by 2 per cent between 2004-05 and 2005-06 – from $506 000 to $515 000. Fuel costs were the highest single expense in the fishery, accounting for 36 per cent of total cash costs in 2004-05 and 39 per cent in 2005-06.

» Average cash **income** per boat (total cash receipts less total cash costs) fell from $21 700 in 2004-05 to – $1100 in 2005-06.

» The average **rate of return** to boat capital (excluding the value of quota and licences) fell from 3.5 per cent in 2004-05 to – 1.0 per cent in 2005-06.

economic performance – fishery as a whole

» **Net economic returns** (including management costs) continued on a declining trend to become negative for the first time in 2004-05 – with a value of – $2.2 million. Net economic returns then declined slightly further in 2005-06 to – $2.3 million. These estimates are substantially lower than the average annual net economic return for the period 1997-98 and 2003-04 of $4.0 million.

northern prawn fishery

the fishery

The northern prawn fishery is a multispecies fishery located in Australia's northern waters between Cape York in Queensland and Cape Londonderry in Western Australia (map 1; Larcombe and McLoughlin 2007).

White banana prawns, grooved tiger prawns and brown tiger prawns account for 80 per cent of the fishery's catch. Other key prawn species include the red legged banana prawn, two species of endeavour prawn and two species of king prawn. Some commercially valued nonprawn species are also landed as byproduct, including bugs, scampi, scallops, squid and various finfish (Larcombe and McLoughlin 2007).

Most vessels operating in the fishery are 13–25 metres in length (McLoughlin 2006). In the 2005 season, 89 licensed vessels operated in the fishery with 3364 boat days allocated to target banana prawn in the first period of the season, and 7967 boat days to target tiger prawn in the second period. In the 2006 season, 77 licensed vessels operated in the fishery. The limit of two main trawl nets for

map 1 **location of the northern prawn fishery**
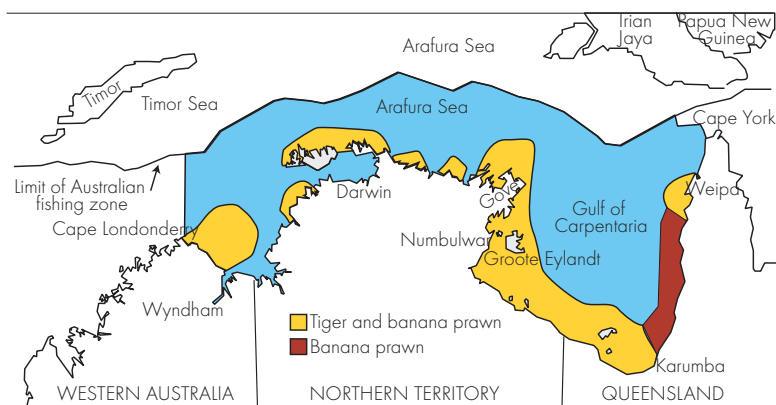
each vessel was removed at the start of the 2006 season; however, adoption of additional gear by a vessel incurs a 10 per cent penalty on their gear statutory fishing rights (SFR) (Larcombe and McLoughlin 2007). In 2005 the average headrope length per vessel decreased to 34.4 metres from 40.8 metres in 2004 (Larcombe and McLoughlin 2007).

After a record low catch in 2004-05, the total prawn catch increased slightly to 5305 tonnes in 2005-06 but remained significantly lower than the highest catch of 9278 tonnes recorded in 2000-01. The 2005-06 catch consisted of 3247 tonnes of banana prawn, 1749 tonnes of tiger prawn, 282 tonnes of endeavour prawn and 27 tonnes of other prawn species (figure A). A total of 95 tonnes of nonprawn products were also landed in 2005-06.

The real gross value of production (GVP) of the fishery increased from $69 million in 2004-05 to $75 million in 2005-06 (figure B). These amounts are substantially lower than the record value of $194 million recorded in 2000-01.

Most of the catch from the fishery is exported – predominantly to Japan. Therefore the economic and financial performance of the fishery is largely influenced by external factors including:

» demand in major foreign markets
» competition from other prawn suppliers and
» the exchange rate.

fig A **landings**
northern prawn fishery
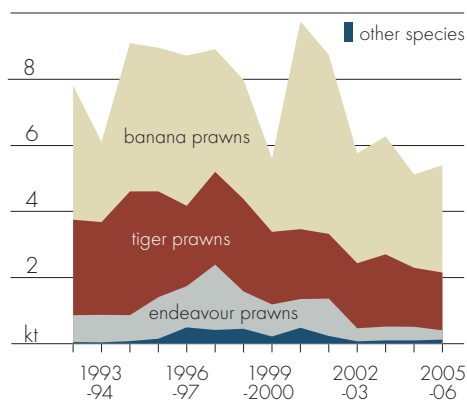
fig B **real gross value of production**
northern prawn fishery, in 2006-07 dollars

biological status

Each year, the Bureau of Rural Sciences collates information on the biological status of prawn stocks in the fishery. The status of each of the key species from the most recent Bureau of Rural Sciences report (Larcombe and McLoughlin 2007) is outlined below. Readers can refer to this report for a more detailed description of each species' biological status.

The terms 'overfishing' and 'overfished' are used throughout this section of the report. Overfishing describes a situation where the removal rate from the stock is unsustainable. Overfished refers to a fish stock with a biomass below a prescribed threshold or limit reference. These terms are fully explained in Larcombe and McLoughlin (2007).

banana prawns

The banana prawn fishery targets white banana prawns and red legged banana prawns. No biological reference points currently exist for banana prawn stocks (both red legged and white) in the fishery. The long term maximum sustainable yield (MSY) for banana prawns is thought to be around 4000 tonnes a year, based on the average catch of banana prawns since 1980. However, catches have varied considerably, ranging from 2000 tonnes to 12 000 tonnes since 1971.

The likely state of stocks is assessed by comparing expected catches and actual catches, with the former being determined according to rainfall data. Variations between the two tend to indicate biomass changes (McLoughlin 2006). Currently the banana prawn stock is considered not overfished.

white banana prawns

White banana prawns are targeted in the eastern waters of the Gulf of Carpentaria and on isolated grounds along the Arnhem Land coast. They make up more than 80 per cent of the banana prawn catch and are generally caught in depths of less than 20 metres, but can be caught in depths up to 45 metres. White banana prawns are typically caught in April, running for only a few weeks before becoming unprofitable to target (McLoughlin 2006). Their capture normally involves 'spotter' planes searching for dense prawn aggregations known as 'boils'. The use of spotter planes means that catches of white banana prawns are mainly taken during the day.

High annual variability in white banana prawn catches has previously been linked to variations in environmental factors, primarily rainfall. The two main spawning periods for the species coincide with monsoonal rains in the area and high catches have been shown to follow years of high monsoonal rainfall. There had been a long term assumption that there was no strong relationship between recruitment levels and the spawning stock size.

However, because of significant deviations from predictions, a dynamic stock assessment model was developed in the late 1990s, incorporating stock–recruitment relationships as well as environment factors. The model assessed seven main banana prawn regions and showed a link in some regions between the spawning stock size and subsequent recruitment into the fishery. Therefore, environmental factors such as rainfall are not the only significant factors influencing recruitment.

Catch forecasts for white banana prawns in the Gulf of Carpentaria between the 2000 and 2002 seasons proved inaccurate. The 2000 catch was almost the lowest on record despite significant rainfall, while catches in 2001 and 2002 were higher than expected (McLoughlin 2006). White banana prawn catches were also poor in normally productive waters off Weipa during 2004 and 2005, with catches of 30 tonnes and 130 tonnes respectively. In 2006, however, a catch of 400 tonnes was recorded in the Weipa region, indicating improved recruitment.

The high variability of white banana prawn catches has prompted increased effort to assess the status of this species, in particular to address the uncertainty about the potential impact of fishing on recruitment. Fleet size has been decreasing and, despite high fishing mortality, there is a lack of evidence that recruitment overfishing is occurring. Hence the stock of white banana prawns is considered not overfished.

red legged banana prawns

Red legged banana prawns make up a smaller proportion of the total catch, averaging around 800 tonnes a year. Trawling occurs both night and day, with most catches taken from the north western area of Joseph Bonaparte Gulf in water depths of 45–85 metres. Spawning is largely linked to rainfall but schooling does not occur to the same degree as with white banana prawns.

In 2002, tagging research data for red legged banana prawns were used to revise a yield per recruit model for the species. The tagging studies showed that exploitation rates of red legged banana prawns were high but were lower than

the exploitation rates of white banana prawns in the Gulf of Carpentaria. The revised model also showed that the spawning stock biomass was likely to be smaller than previously thought. The stock of red legged banana prawns has not been reassessed since 2002. However, as with white banana prawns, the stock of red legged banana prawns is considered not overfished and not subject to overfishing as there is no evidence of declining recruitment and, furthermore, total fleet size has been reduced.

tiger prawns

Tiger prawns are caught near coastal seagrass beds in the southern and western Gulf of Carpentaria and along the Arnhem Land coast. Brown tiger prawns are mostly caught in waters 10–20 metres deep, while grooved tiger prawns are caught in depths of up to 130 metres. Stocks of brown tiger and grooved tiger prawns have improved in recent years.

The maximum sustainable yield (MSY) for tiger prawn is approximately 3200 tonnes. A stock assessment completed in 2001 found the stock of grooved tiger prawn was depleted. A more positive assessment in 2002 revealed improved recruitment of grooved tiger prawns, resulting in the stock being above biomass at maximum sustainable yield (BMSY). Similar positive results were achieved in assessments in 2003 and 2004 – although these results did not hold under all assumptions. The most recent assessment in 2006 confirmed that the stock of grooved tiger prawns was not overfished.

Both the 2001 and 2002 stock assessments revealed brown tiger prawns to be overfished in the northern prawn fishery. The stock assessment in 2004 indicated that the stock had recovered to above BMSY. The assessment in 2006 indicated that the stock's recovery had been maintained and that the stock was not over-fished.

endeavour and king prawns

No biological reference points exist for endeavour or king prawns. Over the past ten years, catch rates have been declining (McLoughlin 2006). Owing to the lack of recent stock assessments, the status of both species is uncertain and it is not known if overfishing is occurring.

management of the fishery

Prior to 1988, management responsibilities for the fishery were shared between the Queensland, Northern Territory and Western Australian governments. It was not until the endorsement of the Offshore Constitutional Settlement Agreement in 1988 that the Australian Government assumed sole management responsibility for the fishery (Larcombe and McLoughlin 2007; NORMAC 2001)

Established in 1992 to replace the Australian Fisheries Service, the Australian Fisheries Management Authority (AFMA) has since been responsible for managing the fishery. The Northern Prawn Fishery Management Advisory Committee (NORMAC) provides advice to AFMA on management issues for the fishery. The committee consists of representatives from areas of research, industry, government and management who provide expert advice on management arrangements, research, monitoring and budgeting (NORMAC 2001).

The fishery has historically been managed with input controls such as gear and vessel restrictions, limited entry, area closures and seasonal closures. A brief history of the management arrangements in the fishery is outlined in table 1. Since 2000, the main management tool has been input controls in the form of restrictions on the length of net headrope allowed to be towed in the fishery. Gear units allocated to each operator specify the length of headrope allowed and operators are free to buy, sell or lease these gear units.

Seasonal closures in the fishery create two distinct fishing seasons, a banana prawn season and a tiger prawn season. In 2006, the banana prawn season was open from 9 April to 21 May and the tiger prawn season was open from 1 August to 15 November. In recent years the fishery has been closed during August. However, in 2005, AFMA agreed to include August in the tiger prawn season to minimise catches of tiger prawn in the banana prawn season.

Since 2006, AFMA has used an adaptive management approach for banana prawns in the northern prawn fishery. Under this approach, the length of the banana prawn season will depend on whether or not catches meet a predetermined decision rule. High catches in 2006 meant that the banana prawn season was extended by two weeks given that the extension would not threaten the sustainability of banana prawn stocks. The banana prawn season was once again extended for the 2007 season, opening earlier on 6 April and closing two weeks later on 2 June (AFMA 2007).

table 1 **history of management changes – northern prawn fishery**

1971	Seasonal closures for banana prawns introduced (Rose and Kompas 2004).
1977, 1980	Controls on boat replacement (Rose and Kompas 2004).
1984	Unitisation of fishery introduced – class A units (fishing right) and class B units (boat hull volume and engine power allowance) (NORMAC 2001) .
mid-1980s	Buyback scheme implemented to reduce effort according to a target of 70 000 units in the fishery (NORMAC 2001) .
1987	April opening date to target market sized prawns and a midseason closure to reduce catch of spawners introduced (Caton and McLoughlin 2004).
1989	20 810 class A units sold under the above scheme but number falls short of target (NORMAC 2001).
1990	Further restructuring through a voluntary buyback scheme and a 30 per cent compulsory reduction in units across the board with a target of 53 844 units. Target achieved and vessel numbers reduced from 216 to 132 by 1993 (NORMAC 2001).
1995	New management plan and statutory fishing rights (SFRs) introduced to replace class A and B units (Caton and McLoughlin 2004).
1999	First season shortened by 14 days and second season by 18 days (Caton and McLoughlin 2004).
2000	New management system based on control of gear units according to headrope length of fishing nets (Caton and McLoughlin 2004). First season shortened by 5 days and second season by 5 days (Caton and McLoughlin 2004).
2002	Effort cut by 40 per cent, achieved through a 25 per cent reduction in total allowable headrope length (Caton and McLoughlin 2004) and a shortening of the first season by 14 days and the second season by 7 days (Caton and McLoughlin 2004).
2004	Maximum economic yield (MEY) defined as target level of catch (Roberts 2004).
2005	25 per cent reduction in total allowable headrope length (Roberts 2004). Tiger prawn season extended to include August (Larcombe and McLoughlin 2007).
2006	Structural adjustment package resulted in a 45 per cent reduction in vessel SFRs and 34 per cent reduction in gear SFRs (Abetz 2006a). The limit on towing only two nets was removed for the start of the 2006 season subject to a 10 per cent penalty on gear SFRs if operators chose to use other gear configurations (Larcombe and McLoughlin 2007).

The catch of unwanted and vulnerable species such as turtles and sharks by trawling has led to increased effort by management and industry to reduce bycatch. Turtle excluder devices (TEDs) became mandatory in the fishery in 2000 and this has resulted in significant reductions of turtle bycatch. All nations wishing to export to US markets must use TEDs when sea turtles are potentially in the waters fished for prawns. The mandatory use of TEDs in the northern prawn fishery meets this requirement, hence prawn exports are allowed into US markets (Larcombe and McLoughlin 2007). To limit the bycatch of smaller species, the mandatory use of bycatch reduction devices (BRDs) was implemented in the fishery in 2001.

In 2004, a new target level of catch set at maximum economic yield (MEY) replaced the target of maximum sustainable yield (MSY) (Roberts 2004). This new target implies that the fishery will be managed so that effort, catch and thus stock biomass are at levels that allow net economic returns to be maximised in the fishery. A 25 per cent reduction in total allowable headrope length was also announced for the 2005 season given the new target reference point for the fishery (Roberts 2004).

In November 2005, the Australian Government announced the $220 million Securing Our Fishing Future structural adjustment package that aimed to address overfishing and to rebuild overfished stocks in Commonwealth fisheries. The northern prawn fishery was a target fishery of the adjustment package. The major component of the package was a $150 million fishing concession buyout process aimed at reducing fishing effort in a number of key fisheries (MacDonald 2005). In total 43 class B statutory fishing rights (SFRs) and 18 365 gear SFRs were purchased from the fishery, representing a 45 per cent and 34 per cent reduction in respective permit numbers (Abetz 2006a). While a substantial effort reduction was achieved through the buyout, measures should now be taken to maintain effective effort at levels associated with MEY (see Elliston and Cao 2004).

Commonwealth fisheries are expected to develop and implement harvest strategies by 2008 in accordance with the 2005 Ministerial Direction to AFMA and the Draft Commonwealth Harvest Strategy Policy. A harvest strategy would use target and limit reference points as the basis for control rules and management decisions. Management of the northern prawn fishery is likely to move toward a system based on individual transferable quotas (ITQs) in the near future.

boats surveyed

For the purpose of the survey, the target population was defined as boats that caught prawns in the northern prawn fishery in 2005-06. In that year, the population was 86 vessels, of which 29 were sampled. Twenty-nine vessels were also sampled for 2004-05, when the population was 96 vessels.

financial performance of vessels in the fishery

Key measures of the financial performance of the fishing fleet are contained in table 2. Many boats that operate in the northern prawn fishery also operate in other fisheries, such as the Torres Strait prawn fishery and Queensland east coast otter trawl fishery. Any receipts and costs earned and incurred by these boats while operating in these other fisheries are included in the financial performance measures in table 2. Definitions of items contained in table 2 are included in 'survey methods and definitions' at the end of this report.

receipts

Average per boat seafood receipts for the entire fishery increased by 16 per cent between 2004-05 and 2005-06 to around $921 000. The increase in average per boat seafood receipts primarily reflected higher landings in the fishery and higher prices for tiger prawns in 2005-06.

costs

In conjunction with the increase in average per boat seafood receipts, average per boat total cash costs also increased in 2005-06 – by 11 per cent to $955 000.

Fuel costs were the highest single expense in the fishery in both survey years. Fuel costs accounted for 32 per cent and 38 per cent of total cash costs per boat in 2004-05 and 2005-06 respectively. Since 2003-04, average fuel costs per boat have risen sharply – by 69 per cent from $218 000 to $368 000 in 2005-06 (figure C).

Labour costs were the second highest single expense in the fishery in both financial years. As crew are generally paid a share of revenue, average boat labour costs increased with revenue to $240 000 in 2005-06 – a rise of 7 per cent. Average per boat labour costs represented approximately a quarter of total cash costs in both 2004-05 and 2005-06.

table 2   **financial performance of boats – northern prawn fishery**
average per boat

		2004-05		2005-06	
cash receipts					
seafood receipts	$	794 329	(4)	921 338	(6)
nonfishing receipts	$	47 140	(17)	58 659	(16)
total cash receipts	$	841 469	(4)	979 997	(5)
cash costs					
administration	$	42 139	(18)	40 551	(18)
crew costs	$	225 096	(4)	239 737	(6)
freight and marketing expenses	$	4 667	(30)	6 589	(27)
fuel	$	271 482	(3)	367 787	(4)
insurance	$	37 442	(4)	37 081	(7)
interest paid	$	7 983	(33)	4 440	(48)
licence fees and levies	$	31 670	(9)	32 651	(11)
packaging	$	11 505	(13)	17 278	(12)
repairs and maintenance	$	147 975	(11)	136 803	(8)
other costs	$	76 937	(13)	72 511	(12)
total cash costs	$	856 894	(4)	955 429	(5)
boat cash income	$	– 15 425	(150)	24 568	(83)
less depreciation **a**	$	53 420	(15)	52 147	(14)
boat business profit	$	-68 844	(37)	-27 578	(76)
plus interest leasing and rent	$	16 373	(43)	12 536	(54)
profit at full equity	$	-52 471	(52)	– 15 043	(145)
capital					
– excl. quota and licence	$	1 002 587	(7)	974 992	(7)
– incl. quota and llicence	$	3 739 665	(5)	3 206 788	(6)
rate of return					
– to boat capital **b**	%	–5.2	(51)	– 1.5	(146)
– to full equity **c**	%	– 1.4	(50)	–0.5	(145)
depreciation from accounts	$	24 428	(20)	18 734	(25)
population	no.	96		86	
sample	no.	29		29	

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'.

Repairs and maintenance costs were the third highest cost item for both financial years. In 2005-06 the average per boat repairs and maintenance cost was $137 000, representing approximately 14 per cent of total cash costs.

Together fuel, labour and repairs and maintenance expenses accounted for 78 per cent of total cash costs in 2005-06. The proportions of the other cost components for the whole fleet remained relatively constant between 2004-05 and 2005-06.

fig C **average fuel costs**
northern prawn fishery, in 2006-07 dollars
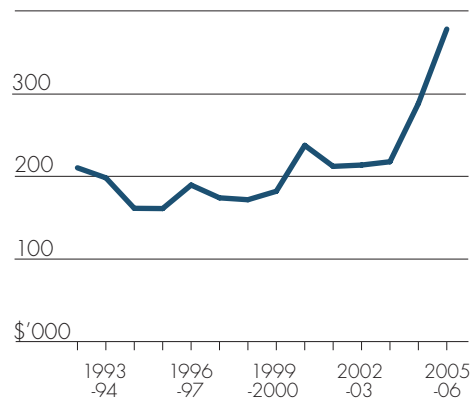
boat cash income and profit

In 2004-05, average cash income per boat was negative $15 400. In 2005-06, despite an increase in total cash costs, average cash income per boat became positive, increasing to $24 600.

Boat business profit is defined as boat cash income less an allowance for depreciation. In both survey years, boat business losses were made — estimated at $68 800 in 2004-05 and $27 600 in 2005-06.

Profit at full equity (which is boat business profit plus interest, leasing and rent) improved from a loss of $52 500 per boat in 2004-05 to a loss of $15 000 per boat in 2005-06. Boat business profit represents the average return that would have been earned by the business unit had the boat and capital (including quota and licences) been fully owned by the operator. While these costs affect the financial position of the operator, they represent some profits that have been redistributed to other investors in the fishery.

rates of return

The rate of return to boat capital is calculated on the value of boat capital (excluding the value of quota and licences) as though the operators wholly owned all assets so that the financial performance of all boats can be compared regard-

less of the operators' equity in the business. The estimated average rate of return to boat capital (excluding the value of quota and licences) was negative in both years but improved from –5.2 per cent in 2004-05 to –1.5 per cent in 2005-06.

The estimated average value of quota and licences attached to each boat operating in the northern prawn fishery in 2005-06 was approximately $2.2 million. This includes the value of licences for other fisheries in which these boats may be endorsed to fish, such as the Torres Strait prawn and Queensland east coast otter trawl fishery. The rate of return to full equity includes the value of quota and licences in addition to other capital, and therefore provides an indication of the return to total capital invested in the business unit. It reflects changes in the value of quota and licences as well as changes in the profitability of the fishing operation — that is, the profit from fishing that accrues to the owners of capital. In 2005-06 the average rate of return to full equity across the fishery increased from –1.4 per cent in 2004-05 to –0.5 per cent.

economic performance of the fishery

The results presented in table 2 show changes in the average receipts and costs of boats that operated in the northern prawn fishery in 2004-05 and 2005-06. However, they shed little light on the economic performance of the fishery because they include receipts and costs earned and incurred from operations in other fisheries and because no allowance is made for the opportunity costs of capital employed in the fishery. Table 3 shows boat cash profit and net economic returns generated from the northern prawn fishery for the period 1992-93 to 2005-06. Only receipts and costs estimated to have been earned and incurred in the northern prawn fishery are included.

Total fishing receipts in the fishery fluctuated significantly over the period 1992-93 to 2005-06. Since 2000-01, fishing income has fallen by 61 per cent in real terms to $80 million in 2005-06. Boat cash profit, which is fishing income less operating costs, averaged around $35 million a year between 1992-93 and 2005-06, with a high of $75 million in 2000-01. In 2005-06, there was a total boat cash loss of $2.2 million. Boat cash profit reveals the cash position of a fishery but does not measure economic performance because it does not incorporate depreciation expenses and opportunity costs.

A measure of economic performance that incorporates depreciation expenses, the opportunity cost of capital and the opportunity cost of owner and family labour is net economic returns. An explanation of the calculation of net economic returns is included in the chapter 'estimating net economic returns for Commonwealth managed fisheries' at the end of this report. Net economic returns (including management costs) in real terms show a declining trend since a peak in 2000-01 of $68 million. They became negative for the first time in 2004-05, falling to -$13.6 million, but improved slightly to -$9 million in 2005-06. These figures are substantially lower than the average annual net return of $33.4 million for the preceding period, 1995-96 to 2003-04. Boat cash profit and net economic returns for the fishery over the entire period are shown in figure D.

It is important to note that factors outside the control of fishery management influence both net economic returns and other measures of financial return in the fishery. For example, movements of the Australian dollar affect the prices received by fishers. Also, the price of inputs, such as fuel and gear, are not controlled by fishery managers. However, the fishery manager can attempt to ensure that profits are maximised given prevailing input and output prices. This may require periodic review of the optimal level of catch and effort.

fig D **boat cash profit and net economic returns** northern prawn fishery, in 2006-07 dollars
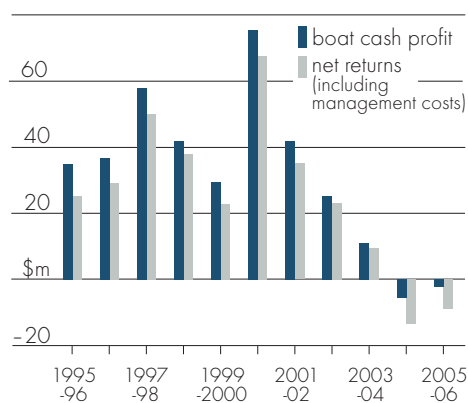
table 3 **net economic returns – northern prawn fishery**
in 2006-07 dollars

		1994-95		1995-96		1996-97		1997-98		1998-99		1999-00	
receipts													
fishing income	$m	192.3	(7)	163.9	(3)	153.6	(2)	184.2	(1)	170.4	(2)	135.8	(4)
cash costs													
operating costs	$m	132.2	(6)	129.0	(2)	116.9	(3)	126.2	(2)	128.7	(2)	106.2	(4)
boat cash profit	$m	60.1	(11)	34.9	(10)	36.7	(9)	58.0	(4)	41.8	(6)	29.6	(13)
less													
– owner and family labour	$m	4.0	(13)	3.4	(15)	4.7	(20)	4.9	(17)	3.9	(18)	4.5	(20)
– opportunity cost of capital	$m	6.0	(5)	7.1	(7)	6.2	(6)	6.0	(5)	5.7	(8)	4.5	(8)
– depreciation	$m	8.5	(5)	9.8	(6)	9.0	(7)	9.6	(5)	8.2	(8)	7.3	(8)
plus interest, leasing and management fees	$m	10.7	(14)	12.0	(8)	13.7	(8)	14.0	(5)	15.6	(7)	11.4	(6)
net return													
– excl. management costs	$m	52.3	(15)	26.6	(15)	30.4	(11)	51.5	(4)	39.6	(7)	24.6	(16)
– incl. management costs	$m	na	na	25.2	na	29.1	na	50.2	na	38.1	na	22.8	na
management costs	$m	na	na	1.3	na	1.3	na	1.3	na	1.5	na	1.8	na
number of active boats	no.	133		134		128		130		133		130	

		2000-01		2001-02		2002-03		2003-04		2004-05		2005-06	
receipts													
fishing income	$m	206.8	(2)	150.2	(3)	117.9	(3)	91.3	(5)	79.0	(4)	80.2	(5)
cash costs													
operating costs	$m	131.4	(2)	108.2	(3)	92.5	(4)	80.2	(5)	84.5	(4)	82.4	(4)
boat cash profit	$m	75.4	(5)	42.0	(6)	25.4	(12)	11.1	(24)	-5.5	(37)	-2.2	(75)
less													
– owner and family labour	$m	4.4	(18)	3.9	(20)	1.6	(32)	1.4	(29)	1.1	(30)	1.0	(28)
– opportunity cost of capital	$m	4.1	(9)	3.3	(8)	2.5	(13)	2.2	(12)	3.9	(14)	2.9	(13)
– depreciation	$m	5.9	(9)	5.3	(8)	2.9	(21)	2.5	(28)	5.5	(14)	4.6	(14)
plus interest, leasing and management fees	$m	8.6	(21)	7.2	(9)	6.6	(11)	6.7	(12)	4.6	(14)	3.8	(17)
net return													
– excl. management costs)	$m	69.5	(5)	36.7	(7)	25.0	(11)	11.8	(22)	-11.4	(23)	-6.9	(24)
– incl. management costs	$m	67.6	na	35.1	na	23.2	na	9.5	na	-13.6	na	-8.9	na
management costs	$m	1.9	na	1.6	na	1.7	na	2.3	na	2.2	na	2.0	na
number of active boats	no.	118		118		101		98		96		86	na

na Not applicable.
Note: Management costs prior to 1995-96 are not available. Figures in parentheses are relative standard errors. For any given standard error, a relative standard error will be higher for estimates closer to zero. A guide to interpreting these is included in 'survey methods and definitions'.

Torres Strait prawn fishery

the fishery

The Torres Strait prawn fishery operates within the Torres Strait Protected Zone (TSPZ), an area of water shared between Australia and Papua New Guinea. The zone is bordered by Cape York Peninsula to the south, Papua New Guinea to the north, the Arafura Sea to the west and the Coral Sea to the east (map 2). Commercial resource sharing arrangements within the zone between Australia and Papua New Guinea are governed by the Torres Strait Treaty, which was ratified in 1985 (Taylor, Turnbull, Marrington and George 2007).

map 2 **location of the Torres Strait prawn fishery**
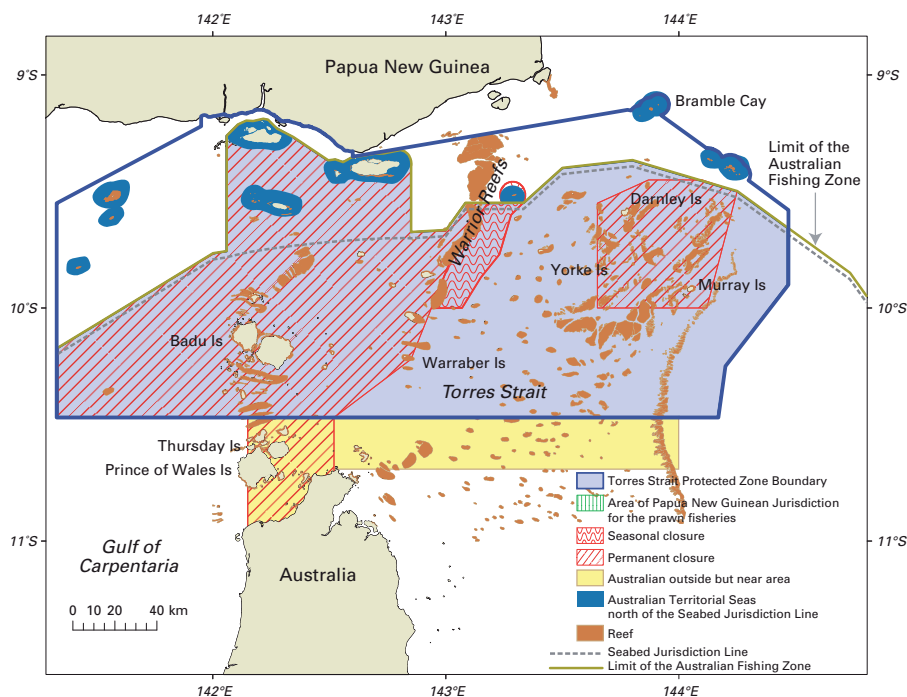
The fishery operates between 1 March and 1 December each year (Taylor et al. 2007) and all trawl activity occurs at night. Operators in the fishery use boats of up to 20 metres in length, with otter trawl nets. Vessels operating in the fishery are able to remain at sea for lengthy periods of time, given support from motherships and fuel barges located in several anchorages around the Torres Strait.

Few vessels fish exclusively in the Torres Strait prawn fishery, with many also operating in the Queensland east coast otter trawl fishery to the south and the northern prawn fishery to the west (Larcombe and McLoughlin 2007).

The two main species targeted in the fishery are brown tiger prawns and blue endeavour prawns. In 2005-06, landings consisted of 567 tonnes of tiger prawns, 694 tonnes of blue endeavour prawns plus 47 tonnes of red spot king prawns (figure E). The remainder of landings were mainly Moreton Bay bugs, scallops and squid.

The real gross value of production of the fishery in 2005-06 was $13.6 million, less than half the record value of $35.8 million in 1998-99 (figure F). Since this peak, prices received in the fishery have fallen, partly through increased international competition (particularly with farmed substitutes from Asia) and the appreciation of the Australian dollar against the US dollar.

fig E **landings**
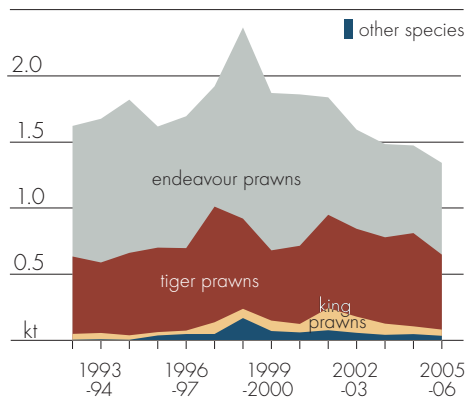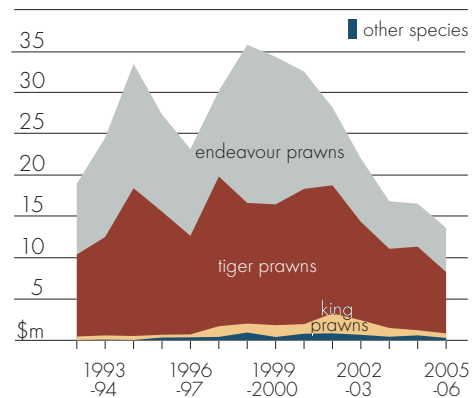Torres Strait prawn fishery

fig F **real gross value of production**
Torres Strait prawn fishery, in 2006-07 dollars

biological status

Each year, the Bureau of Rural Sciences collates information on the biological status of prawn stocks in the fishery. The status of each of the key species from the most recent Bureau of Rural Sciences report (Larcombe and McLoughlin 2007) is outlined below. Readers can refer to this report for a more detailed description of each species' biological status.

The terms 'overfishing' and 'overfished' are used throughout this section of the report. Overfishing describes a situation where the removal rate from the stock is unsustainable. Overfished refers to a fish stock with a biomass below a prescribed threshold or limit reference. These terms are fully explained in Larcombe and McLoughlin (2007).

The earliest official assessment of prawn stocks in the fishery was conducted in 1991. This assessment was further updated in 1994. Results from this assessment indicated a long term sustainable yield for the fishery of 1903 tonnes a year. This total was broken down into a separate yield for each prawn species caught in the fishery – 682 tonnes of brown tiger prawns, 1035 tonnes of endeavour prawns and 186 tonnes of king prawns (Larcombe and McLoughlin 2007).

Assessments in 2000 and 2002 focused on the tiger prawn stock. The assessments estimated the equilibrium maximum sustainable yield (MSY) for tiger prawn as being in the range 532–698 tonnes, with a corresponding effort of 8170 to 11 353 fishing nights (Larcombe and McLoughlin 2007).

Biomass at MSY (BMSY), effort corresponding to MSY (EMSY) and MSY are used as indicators of stock status (Larcombe and McLoughlin 2007). The estimates of MSY and EMSY from the most recent tiger prawn stock assessments conducted in 2006 are similar to the estimates from the 2004 assessment. This assessment used a delay difference model with two variations. The first variation assumed a Ricker stock–recruitment relationship and estimated an MSY for tiger prawns of 606 tonnes and an equivalent level of effort to achieve this catch of 8245 fishing nights. The second variation assumed a Beverton-Holt relationship and estimated MSY for tiger prawns as 676 tonnes, with an equivalent level of effort of 9197 boat nights. In recent years, estimates of tiger prawn biomass have been above BMSY. Therefore the status of the tiger prawn stock is not overfished.

Individual stock assessments have not been undertaken for endeavour and king prawns. The stock status of both species is therefore uncertain. In previous years

the catch of endeavour prawns has exceeded the catch of tiger prawns; however, there is no indication that overfishing of endeavour prawn is occurring. Future stock assessments are planned to assess the status of endeavour prawn in the Torres Strait (Larcombe and McLoughlin 2007).

management of the fishery

Prior to 1985, the fishery was jointly managed with both the Queensland east coast otter trawl fishery and the northern prawn fishery. In 1985, the fishery became managed as a single and separate fishery with the ratification of the Torres Strait Treaty (Hanna, Hogan and Tedesco 2006).

The Protected Zone Joint Authority (PZJA) is now responsible for managing the fishery, as well as other fishing activities in Australian waters within the TSPZ. The PZJA consists of representatives of the Commonwealth and Queensland ministers responsible for fisheries and the chair of the Torres Strait Regional Authority (TSRA) (PZJA 2006). Licensing, enforcement and research activities are carried out on behalf of the PZJA by the Australian Fisheries Management Authority (AFMA), the Queensland Boating and Fisheries Patrol, and the Queensland Department of Primary Industries and Fisheries (Hanna et al. 2006).

The fishery is managed according to the following objectives:

» to control effort in the fishery and provide for catch sharing with Papua New Guinea

» to achieve a level of fishing effort consistent with conservation and optimum use of the Torres Strait prawn resource (PZJA 2007).

Under the Torres Strait Treaty 1985, Papua New Guinea is entitled to a 25 per cent share of all fishery resources located within Australian fisheries jurisdictional waters within the protected zone, south of the fisheries jurisdiction line. It also entitles Australia to a 25 per cent share of fishery resources in Papua New Guinea's fisheries jurisdictional waters within the zone. However, bilateral negotiations have led to Australia forfeiting its right to operate in Papua New Guinean waters in return for a reduction in Papua New Guinea's claim over effort in Australia's waters. Historically, Papua New Guinea participation in Australian waters has been low. As such, during annual bilateral discussions, resource entitlements have generally been converted to effort entitlements in terms of number of boat days

(DAFF 2004). The new arrangements entitled Papua New Guinea to operate up to seven prawn trawlers in 2006 (Colquitt, S., AFMA, personal communication, 2007); however, Papua New Guinea did not activate any of these licences (Larcombe and McLoughlin 2007). Torres Strait Islanders no longer participate in the fishery following the permanent surrender of their interests in 2005 (PZJA 2005).

When the Torres Strait Treaty was ratified in 1985, approximately 500 vessels were endorsed to operate in the fishery. Limited entry was first introduced into the fishery in 1987, together with a number of other restrictions to reduce effort and to further prepare the fishery for allocation of the fishery resource to meet Australia's obligations under the Torres Strait Treaty 1985 (Taylor et al. 2006).

Important management changes were made in 1993 to cap effort, with the introduction of a transferable fishing rights system based on effort units. Entitlements to fish became governed by a fishing day allowance per operator per season. The initial allocation of effort was determined according to the highest number of fishing days for which an operator had participated in the fishery for any one year between 1988-89 and 1991-92. Additional effort allocations were also made to operators to address cases where boats had nonfishing time and breakdowns in these reference years (PZJA 2006). In the following year, these effort units were made transferable in ten day blocks. However, operators who sold units were prevented from participating in the fishery in the following season (Hanna et al. 2006).

A restriction on trawl boat size (20 metres) applies in the fishery (Larcombe and McLoughlin 2007). This restriction was previously complemented by a boat replacement policy. Approved in 2001, the policy provided a disincentive to increase boat size by penalising an operator who purchased a larger boat with a 20 per cent reduction in fishing day entitlements for the following year (Hanna et al. 2006). This boat replacement policy was suspended by the PZJA for the 2006 fishing season to assist restructuring in the fishery. The PZJA noted that boat replacement issues will be addressed for future fishing seasons through the development of new management plans (Abetz 2006b).

A range of other input controls are also applied in the fishery. Of most significance are restrictions on the dimensions of trawl nets. The combined length of headrope and footrope on trawl nets is restricted to 88 metres for all boats in the fishery. Additionally, trawl net mesh size is restricted to 45 millimetres (McLoughlin 2006).

Seasonal and area closures are also enforced in the fishery. The season runs from 1 March to 1 December. An area west of Warrior Reef and an area around Murray and Darnley Islands are closed permanently to trawling. Additionally, an area east of the Warrior Reef is only open during the season after 31 July (map 2; PZJA 2007). Area and seasonal closures aim to reduce catches of juvenile prawns and encourage increased juvenile recruitment rates. The effectiveness of the area closure east of the Warrior Reef was substantiated by research that showed the majority of small brown tiger prawn and higher densities of small endeavour prawn inhabit this area during the closure months. Furthermore, both species migrate from this closed area into the fishery as they increase in size (Larcombe and McLoughlin 2007).

Latent or unused effort remains a concern for management. To address this issue a number of management changes have recently been implemented. The effort cap was reduced from 13 454 fishing nights in 2005 to 9200 in the 2006 season following scientific recommendations for a sustainable level of harvest for the fishery (Larcombe and McLoughlin 2007). Additionally, the Australian Government carried out a voluntary tender process in early 2006 for the surrender of licences by operators to assist Australia in meeting its resource sharing obligation under the Torres Strait Treaty. In February 2006, it was announced that the tender process had resulted in the removal of sixteen licences from the fishery and the surrender of approximately 25 per cent of total fishing effort (Abetz 2006c).

Despite these changes, there was still unused effort in the 2006 season, with only 41 per cent of Australian operators fishing all their allocated fishing nights. A number of vessels used less than half of their allocated fishing nights, while four vessels with large allocations did not fish at all (Larcombe and McLoughlin 2007). Licence holders must hold a minimum number of nights to operate in the fishery. Prior to the 2006 season, the minimum number required was 50 days. Paralleling the total allowable effort reduction in the 2006 season, the minimum number of days required decreased to 34 days (Larcombe and McLoughlin 2007).

Trawling in the Torres Strait is not selective. Nonprawn bycatch is therefore an issue for management. A bycatch action plan for the Torres Strait prawn fishery was released in 1999. Since its release, turtle excluder devices (TEDs) were made mandatory in 2002 and bycatch reduction devices (BRDs) became compulsory in 2004 (Larcombe and McLoughlin 2007). Shark bycatch limits were also introduced in 2002, restricting onboard shark bycatch to five trunks (with a maximum combined weight of 30 kilograms). Shark finning is also banned (Hanna et al. 2006). A second updated bycatch action plan for the fishery was released in 2005 (PZJA 2005).

boats surveyed

For the purpose of the survey, the target population was defined as boats that caught prawns in the Torres Strait prawn fishery in 2005-06. In 2005-06, the population was 54 vessels, of which twelve were sampled. The population was 63 vessels in 2004-05, of which twelve vessels were sampled.

financial performance of vessels in the fishery

Key measures of the financial performance of the entire fishing fleet are contained in table 4. Definitions of items contained in table 4 are included in the chapter 'survey methods and definitions' at the end of this report. Many boats that operate in the Torres Strait prawn fishery also operate in other fisheries such as the northern prawn fishery and the Queensland east coast otter trawl fishery. Any receipts earned and costs incurred by these boats while operating in these other fisheries are included in the financial performance measures in table 4.

receipts

Average per boat seafood receipts fell by approximately 3 per cent between 2004-05 and 2005-06 — from approximately $491 000 to $474 000 per boat — mainly owing to lower catches and prawn prices.

costs

Average total boat cash costs increased by 2 per cent between 2004-05 and 2005-06 — from approximately $506 000 to $515 000 per boat. Fuel costs were the highest single expense in the fishery in both survey years, accounting for 36 per cent of total cash costs in 2004-05 and 39 per cent of total cash costs in 2005-06. Average fuel costs per boat have been generally increasing in real terms since 1998-99 (figure G).

fig G **average fuel costs**
Torres Strait prawn fishery, in 2006-07 dollars

Labour costs were the second largest cost item in the fishery, estimated at $137 000 per boat in 2005-06; just over a quarter of total cash costs. Boat labour is generally paid a percentage share of revenue. Therefore, in conjunction with a decrease in total cash receipts, average labour costs decreased by 12 per cent between 2004-05 and 2005-06.

Repairs and maintenance expenses were the third highest cost item in both survey years, increasing by 27 per cent between 2004-05 and 2005-06 to $79 000 per boat.

Together fuel, labour and repairs and maintenance costs accounted for 81 per cent of total cash costs in 2005-06.

boat cash income and profit

As a result of the decrease in seafood receipts relative to total boat cash costs, average cash income per boat decreased from $21 700 in 2004-05 to –$1100 in 2005-06.

Boat business profit, which is boat cash income less an allowance for depreciation, decreased from an average loss of $2000 per boat in 2004-05 to a loss of $24 400 in 2005-06.

Profit at full equity (which is boat business profit plus interest, leasing and rent) was estimated to be an average loss of $4700 per boat in 2005-06. Boat business profit represents the average return that would have been earned by the business unit if the boat and capital (including quota and licences) were fully owned by the operator. While these costs affect the financial position of the operator, they represent some profits that have been redistributed to other investors in the fishery.

rates of return

The rate of return to boat capital is calculated on total capital (excluding the value of quota and licences) as though the operators wholly owned all assets, so that the financial performance of all boats can be compared regardless of the operators' equity in the business. The estimated average rate of return to boat capital (excluding the value of quota and licences) fell from 3.5 per cent in 2004-05 to –1 per cent in 2005-06.

table 4 **financial performance of boats – Torres Strait prawn fishery**
average per boat

		2004-05		2005-06	
cash receipts					
seafood receipts	$	490 634	(9)	474 078	(11)
nonfishing receipts	$	37 068	(28)	39 980	(34)
total cash receipts	$	527 702	(9)	514 058	(12)
cash costs					
administration	$	10 315	(22)	10 561	(21)
crew costs	$	155 222	(9)	137 325	(10)
freight and marketing expenses	$	17 603	(17)	15 957	(19)
fuel	$	184 230	(9)	199 649	(14)
insurance	$	20 834	(14)	16 762	(12)
interest paid	$	17 846	(27)	17 662	(20)
licence fees and levies	$	7 827	(4)	8 074	(9)
packaging	$	8 687	(17)	9 458	(18)
repairs and maintenance	$	62 214	(16)	79 111	(9)
other costs	$	21 211	(23)	20 587	(16)
total cash costs	$	505 990	(6)	515 145	(8)
boat cash income	$	21 712	(154)	– 1 087	(2422)
less depreciation **a**	$	23 675	(22)	23 275	(16)
boat business profit	$	– 1 963	(1489)	–24 362	(104)
plus interest leasing and rent	$	20 174	(29)	19 690	(21)
profit at full equity	$	18 210	(148)	–4 672	(503)
capital					
– excl. quota and licence	$	527 455	(17)	472 264	(20)
– incl. quota and licence	$	1 283 526	(9)	1 163 166	(10)
rate of return					
– to boat capital **b**	%	3.5	(139)	– 1.0	(512)
– to full equity **c**	%	1.4	(142)	–0.4	(507)
depreciation from accounts	$	11 740	(38)	21 655	(30)
population	no.	63		54	
sample	no.	12		12	

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'.

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 as well as changes in the profitability of the fishing operation – that is, the profit from fishing that accrues to the owners of capital. The estimated value of licences attached to each boat operating in the Torres Strait prawn fishery in 2005-06 was approximately $691 000. This includes the value of licences for other fisheries in which these boats are endorsed to fish such as the Queensland east coast otter trawl fishery. For the fleet as a whole, the rate of return to full equity was estimated to be –0.4 per cent in 2005-06.

economic performance of the fishery

The results presented in table 4 show changes in the average receipts and costs of boats that operated in the fishery in 2004-05 and 2005-06. However, they shed little light on the economic performance of the fishery as they include receipts and costs earned and incurred from operations in other fisheries and no allowance is made for the opportunity costs of capital employed in the fishery. Table 5 shows boat cash profit and net economic returns generated from the Torres Strait prawn fishery. Only receipts and costs estimated to have been earned and incurred in the fishery are included.

Total fishing receipts in the fishery have been in steady decline since reaching a peak in 1998-99 of $39.6 million (in 2006-07 dollars). In 2004-05, total fishing receipts were much lower at $20.3 million and decreased further in 2005-06 to $13.9 million – 65 per cent lower than the peak recorded in 1998-99.

Boat cash profit, which is fishing income less cash operating costs, was negative in both survey years at –$1.4 million in 2004-05 and –$1.7 million in 2005-06. Boat cash profit reveals the cash position of a fishery but does not measure economic performance because it does not incorporate depreciation expenses and opportunity costs.

A measure of economic performance that incorporates depreciation expenses, the opportunity cost of capital and the opportunity cost of owner and family labour is net economic returns. An explanation for the calculation of net economic returns is included in the chapter 'estimating net economic returns for Commonwealth managed fisheries' at the end of this report. Net economic returns (including management costs) in real terms have been falling since 2000-01. As in the northern prawn fishery, net economic returns in the Torres Strait prawn fishery

table 5 **net economic returns – Torres Strait prawn fishery**
in 2006-07 dollars

		1994-95		1995-96		1996-97		1997-98		1998-99		1999-2000	
receipts													
fishing income	$m	32.2	(13)	28.3	(7)	31.0	(11)	35.8	(6)	39.6	(15)	37.6	(13)
cash costs													
operating costs	$m	26.7	(13)	23.9	(7)	22.5	(11)	24.7	(7)	30.2	(16)	28.3	(12)
boat cash profit	$m	5.5	(26)	4.4	(15)	8.4	(16)	11.1	(8)	9.4	(23)	9.3	(20)
less													
– owner and family labour	$m	1.9	na	2.2	(16)	5	(16)	4.7	(16)	3.6	(19)	3.2	(18)
– opportunity cost of capital	$m	1.3	(14)	1.0	(9)	0.9	(9)	0.8	(6)	1.2	(21)	1.0	(17)
– depreciation	$m	2.0	(13)	1.7	(9)	1.4	(11)	1.3	(7)	1.9	(21)	1.7	(17)
plus interest, leasing and management fees	$m	1.5	(23)	1.5	(12)	2.1	(16)	2.0	(9)	2.2	(26)	2.3	(18)
net return													
– excl. management costs	$m	1.8	(60)	0.9	(54)	3.0	(39)	6.3	(16)	4.8	(41)	5.6	(28)
– incl. management costs	$m	na	na	na	na	na	na	6.2	na	4.7	na	5.5	na
management costs	$m	na	na	na	na	na	na	0.1	na	0.1	na	0.1	na
number of active boats	no.	60		60		80		83		82		79	

		2000-01		2001-02		2002-03		2003-04		2004-05		2005-06	
receipts													
fishing income	$m	35.8	(13)	30.2	(9)	23.4	(11)	21.6	(9)	20.3	(18)	13.9	(16)
cash costs													
operating costs	$m	25.5	(14)	23.6	(10)	20.1	(11)	19.4	(11)	21.7	(18)	15.6	(14)
boat cash profit	$m	10.3	(18)	6.7	(12)	3.4	(28)	2.1	(32)	– 1.4	(5 3)	– 1.7	(43)
less													
– owner and family labour	$m	2.4	(29)	1.9	(20)	1.5	(16)	1.8	(21)	0.5	(50)	0.2	(58)
– opportunity cost of capital	$m	1.0	(25)	0.9	(16)	0.7	(22)	0.6	(18)	0.6	(12)	0.5	(14)
– depreciation	$m	1.5	(26)	1.4	(16)	1.1	(23)	0.9	(19)	0.9	(13)	0.7	(13)
plus interest, leasing and management fees	$m	1.0	(34)	1.6	(18)	1.2	(16)	1.6	(15)	1.4	(32)	1.0	(24)
net return													
– excl. management costs	$m	6.4	(22)	4.0	(13)	1.3	(45)	0.4	(162)	– 1.9	(38)	– 2.1	(35)
– incl. management costs	$m	6.2	na	3.8	na	1.1	na	0.2	na	-2.2	na	-2.3	na
management costs	$m	0.2	na	0.2	na	0.3	na	0.2	na	0.3	na	0.2	na
number of active boats	no.	78		75		74		68		63		54	

na Not applicable.
Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in 'survey methods and definitions'.
Management costs prior to 1997-98 not available.

fig H **boat cash profit and net economic returns** Torres Strait prawn fishery, in 2006-07 dollars

boat cash profit
net returns
(including management costs)
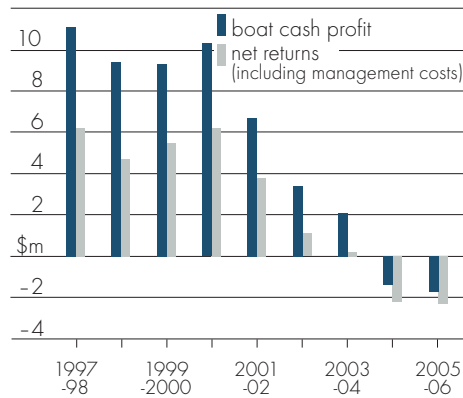
became negative for the first time in 2004-05 with a value of –$2.2 million, and declined further in 2005-06 to –$2.3 million. Net economic returns for the two survey years were lower than the average annual net economic returns (including management costs) of $4.0 million for the preceding period 1997-98 to 2003-04. Figure H shows boat cash profit and net economic returns for the fishery for the entire period.

It is important to note that factors outside the control of fishery management influence both net economic returns and other measures of financial return in the fishery. For example, movements of the Australian dollar affect the prices received by fishers. Also, the price of inputs such as fuel and gear are not controlled by fishery managers. However, the fishery manager can attempt to ensure that profits are maximised given prevailing input and output prices. This may require periodic review of the optimal level of catch and effort.

survey methods and definitions

collecting economic survey data

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.

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

ABARE surveys are designed and samples selected on the basis of information supplied by the Australian Fisheries Management Authority. 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 how representative they are. Where possible, boats are classified into subgroups based either on the fishing method used (for example, longline, purse seine and trawl) or on the size of operations (typically small, medium and large producers). A number of representative boats from each subgroup are then targeted for the survey.

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

Between February and June an ABARE officer visits the owner of each boat selected in the sample. The officer interviews the boat owner to obtain physical and financial details of the fishing business for the survey years. In a number of

instances the skipper of the boat is also interviewed. Further information is subse-quently 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 financial characteristics of each sample boat in the survey.

the 2007 surveys

ABARE surveyed two fisheries in 2007 – the northern prawn fishery and the Torres Strait prawn fishery. Information was collected for the 2004-05 and 2005-06 financial years.

The definitions of key variables used in this analysis are provided in box 1.

sample weighting

All population estimates presented in this report are calculated from the weighted survey data of sample boats. A weight is calculated for each boat in the sample based on how representative that boat is in the population. Sample weights are calculated so that the weights sum to the population of boats that the sample is representing, and the weighted sum of catch reported by the sample boats equals the total catch for the fishery according to AFMA logbook data.

That is,

$$\sum w_i = P \text{ and } \sum w_i x_i = X$$

where: w_i is the weight for the boat i;

   P is the number of boats in the population

   x_i is the catch for the boat i; and

   X is the total catch for the target population.

Technical details of the method of weighting used are given in Bardsley and Chambers (1984).

box 1   definitions of key variables

Total 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 has 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.

Total cash costs include the payments made for both permanent and casual hired labour 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.

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

On many boats, the cost of labour is 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 labour provided. To allow for this possible underestimation, all owner/partner and family labour costs are based on estimates collected at the interview of the amount it would cost to employ someone else to do the work.

continued...

box 1   definitions of key variables   *continued*

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.

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 owning business of the surveyed boat. It includes the value of the boat, hull, engine and other onboard equipment (including gear). Estimates are also reported for 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 the 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).

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.

As 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:

$$\sqrt{(0.06 \text{X} \$100000)^2 + (0.06 \text{X} \$125000)^2} = \$9605$$

so the relative standard error of the difference is:

$$(\$9605/\$25\ 000)\text{x}100 = 38\%$$

It should be noted that there may be changes in the population of a fishery 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 may be affected by errors other than those directly related to the sampling procedure. For example, it may not be possible to obtain information from certain respondents, respondents may provide inaccurate information or respondents may differ from nonrespondents for a particular variable being surveyed.

In conducting surveys, ABARE draws on a depth of experience. Survey staff are experienced and undergo rigorous pre-survey training, 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.

estimating net economic returns for Commonwealth managed fisheries

Under the Fisheries Management Act 1991, one of the Australian Fisheries Management Authority's legislated objectives is to maximise net economic returns to the Australian community from the management of Australian fisheries. Maximising the net economic returns of a fishery involves maximising the economic returns from the use of the natural resource (the fish stock). ABARE's economic surveys provide some of the necessary data to monitor the performance of AFMA against this objective. Data can be used for calculating productivity indexes, creating bioeconomic models of fisheries and estimating a fishery's net economic returns.

ABARE's method of calculating net economic returns is described in this chapter.

net economic returns

Net economic returns are the long run profits from a fishery after all costs have been met, including fuel, crew costs, repairs, the opportunity cost of family and owner labour, fishery management costs, depreciation and the opportunity cost of capital. Estimates of net economic returns can be used as an indicator of a fishery's economic performance for a given time period and over time. For instance, a fishery in which estimated net economic returns have been regularly close to zero or negative is probably not being managed effectively. On the other hand, net economic returns following a positive trend may indicate that a fishery is moving toward the point of maximum economic yield (MEY), where profits from the fishery are maximised. However, it is also possible for short run net economic returns to be generated by 'fishing down' stocks, so interpretation should be made in conjunction with biological information.

Note that while estimates of net economic returns can be used to show how a fishery has performed relative to previous time periods, a net economic return

estimate in isolation does not reveal how a fishery has performed relative to its potential — that is, relative to MEY.

A fishery's net economic return for a given time period can be defined as:

$$NR = \underbrace{R}_{\substack{\text{cash} \\ \text{receipts}}} \underbrace{- \; CC - OWNFL + ILR}_{\text{operating costs}} \underbrace{- \; OppK - DEP}_{\text{capital costs}} \underbrace{+ \; recMC - totM}_{\text{management costs}}$$

where:

NR	net returns
R	total cash receipts attributable to the fishery, excluding leasing income
CC	total cash costs attributable to the fishery, including recovered management costs
OWNFL	imputed cost of owner and family labour
ILR	interest and quota/permit leasing costs
OppK	opportunity cost of capital
DEP	depreciation
recMC	recovered management costs and
totMC	total management costs.

The method of collecting data for each component and then calculating an estimate is outlined below.

calculating net economic returns

fish sale receipts

Fish sale receipts are usually taken from fishers' financial accounts. Where a fisher operates in more than one fishery, he/she is asked to indicate what proportion of total fish sales is attributable to the fishery being surveyed. Any freight or marketing costs must also be deducted. This provides an estimate of net fishing receipts that incorporates only the 'beach price' that has been received for catch — that is, the price received for fish at its first landing point.

Income received from the leasing out of quota and licences is not included as income in the calculation of net economic returns. This item represents a redistribution of profits among investors in the fishery. Also, the amount that a fisher earns from leasing out quota and licences is related to the amount of profits that the fishery is generating. Including leasing revenue would therefore result in double counting.

operating costs

Operating costs include day to day operational expenses that are incurred in order to harvest fish in the fishery. Cash costs (CC) are a component of operating costs that include cost items that are easily identified in fishers' accounts, such as fuel, repairs and gear replacements.

Labour costs are often specified in fishers' accounts as wages. For calculating net returns, however, an estimate of the opportunity cost of labour is required. The opportunity cost of labour is the wage that could have been earned performing a similar role elsewhere. Where a market wage is paid, it is assumed to represent the opportunity cost of labour and is included in the cash costs component of operating costs. The opportunity cost of owner and family labour on the other hand is not easily identifiable in fishers' accounts. Often owners and their families are involved in the operation of a boat, either as skippers and crew or onshore as accountants and shore managers. While some will be paid the market value for their labour, some will not be paid at all and others paid very high amounts often as 'director fees' or 'manager fees'. When this is the case, ABARE survey officers ask survey respondents to estimate the market value of owner and family labour – that is, the amount that would need to be paid to employ a nonfamily member to fulfil the same position. This amount is entered as a component of operating costs – *OWNFL*.

Quota and licence leasing costs and interest expenses are included in cash costs. However, these costs must be removed from the calculation of net returns for the same reason they are excluded from income (see fish sale receipts above).

capital costs

In order to calculate capital costs, an estimate of the value of capital is needed. ABARE survey officers ask fishers to provide information for all capital items associated with the fishing business (including hull, engine, onboard equipment, vehicles and sheds). Information collected for each item includes the year the capital item

was manufactured and an estimate of what it would cost to replace that item with a new and equivalent item. By accounting for previous depreciation and inflation, this information is used to estimate the total value of capital invested in the fishery for the survey year.

As mentioned previously, capital costs include the opportunity cost of capital ($OppK$) and depreciation (DEP). The opportunity cost of capital is the return that could have been earned if capital was invested elsewhere, rather than in the fishery. This cost is not identifiable in fishers' accounts. A real interest rate that represents the rate of return that could be earned on an investment elsewhere is applied to the value of capital in the fishery. ABARE uses a rate of 7 per cent a year for fisheries surveys.

Depreciation expense is the cost of capital becoming less valuable over time through wear and tear and obsolescence. Depreciation expense is not consistently identifiable in fishers' accounts, so ABARE calculates the annual depreciation of boats based on the capital inventory list collected during the surveys (described above) and predetermined depreciation rates for each capital item type.

management costs

Management costs are incurred to ensure that the fishery continues to operate and is therefore a cost associated with harvesting fish in the fishery that must be accounted for. Management costs are made up of two components — recovered management costs and nonrecovered management costs. Recovered management costs ($recMC$) refer to costs that are recovered from fishers and appear in the accounts of fishers as payments of management fees or levies. Nonrecovered management costs refer to management costs that are not charged to fishers, but instead are covered by the managing body or government. The calculation of net economic returns requires the deduction of total management costs, which is the sum of these two components.

Total cash costs (CC) includes an estimate of recovered management costs based on management levy expenses that are contained in fisher's accounts. As this estimate of recovered management costs is based only on a sample of the fishery, it may not be consistent with the actual value of management costs recovered from the entire fishery. AFMA is able to provide an estimate of total management costs for each fishery — that is, the sum of both recovered and nonrecovered management costs. For these reasons, recovered management costs from fishers' accounts are ignored (as indicated by $+recMC$ in the net returns equation). Then, total management costs ($totM$) as supplied by AFMA are used in the estimation of net economic returns.

references

Abetz, E. 2006a, Commonwealth fisheries set for a more secure and profitable future: Results of Round 2 of the fishing concession buyback announced, Media Release by the Minister for Fisheries, Parliament House, Canberra, 22 December.

—— 2006b, Torres Strait prawn fishery arrangements for the 2006 season, Media Release by the Minister for Fisheries, Parliament House, Canberra, 28 February.

—— 2006c, Torres Strait prawn tender concluded, Media Release by the Minister for Fisheries, Parliament House, Canberra, 28 February.

AFMA (Australian Fisheries Management Authority) 2007, *Letter to SFR holders: 2007 Banana Prawn Season Extension*, Canberra, 10 May.

Bardsley, P. and Chambers, R.L. 1984, 'Multipurpose estimation from unbalanced samples', *Journal of the Royal Statistical Society*, vol. 33, pp.290–9.

Caton, A. and McLoughlin, K. (eds) 2004, Status of Fish Stocks Managed by the Australian Government, *Fishery Status Reports 2004*, Bureau of Rural Sciences, Canberra.

DAFF (Australian Government Department of Agriculture Fisheries and Forestry) 2004, *Future Management Arrangement for the Torres Strait Prawn Fishery*, Canberra, May.

Elliston, L. and Cao, L. 2004, *Managing Effort Creep in Australian Fisheries: An Economic Perspective*, ABARE eReport 04.5 Prepared for the Fisheries Resources Research Fund, Canberra, February.

Hanna, D., Hogan, L. and Tedesco, L. 2006, *Torres Strait Prawn Fishery: Performance Measures and Management Options*, ABARE eReport 06.4 Prepared for Fisheries Resources Research Fund, Canberra, April.

Larcombe, J. and McLoughlin, K. (eds) 2007, *Status of Fish Stocks Managed by the Australian Government*, Fishery Status Reports 2006, Bureau of Rural Sciences, Canberra.

MacDonald, I. 2005, Securing our fishing future, Media Release by the Minister for Fisheries, Parliament House, Canberra, 14 December.

McLoughlin, K. (ed) 2006, *Status of Fish Stocks Managed by the Australian*

Government, Fishery Status Reports 2005, Bureau of Rural Sciences, Canberra.

NORMAC (Northern Prawn Fishery Management Advisory Committee) 2001, *Northern Prawn Fishery Strategic Plan 2001-2006*, Canberra.

PZJA (Torres Strait Protected Zone Joint Authority) 2005, *Project Plan for Developing 2007 Management Arrangements*, Australian Fisheries Management Authority, Canberra, November.

—— 2006, *Protected Zone Joint Authority Annual Report 2004-2005*, Australian Fisheries Management Authority, Canberra.

—— 2007, Prawn fisheries, Australian Fisheries Management Authority, Canberra (www.pzja.gov.au/fisheries/prawn.htm).

Roberts, L. 2004, Letter to statutory fishing right holders and owners, Australian Fisheries Management Authority, Canberra, 19 November

Rose, R. and Kompas, T. 2004, *Management Options for the Australian Northern Prawn Fishery: An Economic Assessment*, ABARE eReport 04.12 Prepared for the Fisheries Resources Research Fund, Canberra, August.

Taylor, S., Turnbull, C., Marrington, J. and George, M. (eds) 2006, *Torres Prawn Handbook 2006*, Australian Fisheries Management Authority, Canberra.

—— (eds) 2007, *Torres Prawn Handbook 2007*, Australian Fisheries Management Authority, Canberra.

previous fishery survey reports

northern prawn fishery

1980-81 to 1981-82

BAE (Bureau of Agricultural Economics, now ABARE) 1984, *Northern Prawn Fishery Survey, 1980-81 and 1981-92*, Canberra.

1986-87 to 1987-88

Collins, D. and Kloessing, K. 1988, 'Financial performance in the northern prawn fishery – latest survey by ABARE', *Australian Fisheries*, vol. 47, no. 12, pp. 38–44.

1989-90 to 1990-91

ABARE 1993, *Fisheries Surveys Report 1992*, Canberra.

1990-91 to 1991-92

ABARE 1993, *Fisheries Surveys Report 1993*, Canberra.

1992-93 to 1993-94

ABARE 1996, *Australian Fisheries Surveys Report 1995*, Canberra.

1994-95 to 1995-96

Brown, D. 1997, *Australian Fisheries Surveys Report 1997*, ABARE, Canberra.

1996-97 to 1997-98

ABARE 2000, *Australian Fisheries Surveys Report 1999*, Canberra.

1998-99 to 1999-2000

ABARE 2002, *Australian Fisheries Surveys Report 2001*, Canberra.

2000-01 to 2001-02

ABARE 2004, *Australian Fisheries Surveys Report 2003*, Canberra.

2002-03 to 2003-04

ABARE 2006, *Australian Fisheries Surveys Report 2005*, Canberra

east coast prawn fishery

1980-81 to 1982-83

BAE 1985, 'BAE report on south-eastern prawn fishery', *Australian Fisheries*, vol. 44, no. 1, pp. 36–7.

eastern tuna and billfish fishery

(formerly the east coast tuna fishery)

1989-90 to 1990-91

ABARE 1993, *Fisheries Surveys Report 1992*, Canberra.

1991-92 to 1992-93

ABARE 1994, *Fisheries Surveys Report 1994*, Canberra.

1993-94 to 1994-95

ABARE 1996, *Australian Fisheries Surveys Report 1996*, Canberra.

1995-96 to 1996-97

ABARE 1998, *Australian Fisheries Surveys Report 1998*, Canberra.

1997-98 to 1998-99

ABARE 2001, *Australian Fisheries Surveys Report 2000,* Canberra.

1999-2000 to 2000-01

ABARE 2003, *Australian Fisheries Surveys Report 2002*, Canberra.

2001-02 to 2002-03

ABARE 2005, *Australian Fisheries Surveys Report 2004*, Canberra.

2003-04 to 2004-05

ABARE 2006, *Australian Fisheries Surveys Report 2004*, Canberra.

gillnet, hook and trap

(formerly the south east nontrawl fishery and the southern shark fishery)

1988-89

Battaglene, T. and Campbell, D. 1991, 'Economic survey of the southern shark fishery', *Australian Fisheries*, vol. 50, no. 5, pp. 12–15.

1990-91 to 1991-92

ABARE 1993, *Fisheries Surveys Report 1993*, Canberra.

1992-93 to 1993-94

ABARE 1996, *Australian Fisheries Surveys Report 1995*, Canberra.

1993-94 to 1994-95

ABARE 1996, *Australian Fisheries Surveys Report 1996*, Canberra.

1995-96 to 1996-97

ABARE 1998, *Australian Fisheries Surveys Report 1998*, Canberra.

1997-98

ABARE 2000, *Australian Fisheries Surveys Report 1999*, Canberra.

1997-98 to 1998-99

ABARE 2001, *Australian Fisheries Surveys Report 2000*, Canberra.

1998-99

ABARE 2001, *Australian Fisheries Surveys Report 2000*, Canberra.

1999-2000 to 2000-01

ABARE 2003, *Australian Fisheries Surveys Report 2002*, Canberra.

1999-2000 to 2000-01

ABARE 2003, *Australian Fisheries Surveys Report 2002*, Canberra.

2001-2002 to 2002-03

ABARE 2005, *Australian Fisheries Surveys Report 2004*, Canberra.

2003-04 to 2004-05

ABARE 2006, *Australian Fisheries Surveys Report 2006*, Canberra.

southern rock lobster fishery

1981-82 to 1982-83

BAE 1985, *Southern Rock Lobster Fishery Survey, 1981-82 and 1982-83*, Canberra.

1993-94 to 1994-95

BAE 1985, *Southern Rock Lobster Fishery Survey, 1981-82 and 1982-83*, Canberra.

Bass Strait scallop fishery

1995-96 to 1996-97

ABARE 1998, *Australian Fisheries Surveys Report 1998*, Canberra.

1997-98 to 1998-99

ABARE 2001, *Australian Fisheries Surveys Report 2000*, Canberra.

south east fishery

1978-79 to 1980-81

BAE 1984, *Southern Trawl Fishery Survey, 1978-79 and 1980-81*, Canberra.

1985-86 to 1987-88

Geen, G., Brown, D. and Pascoe, S. 1989, 'ABARE survey of the south east trawl fishery', *Australian Fisheries*, vol. 48, no. 10, pp. 45–7.

1989-90 to 1990-91

ABARE 1993, *Fisheries Surveys Report 1992*, Canberra.

1990-91 to 1991-92

ABARE 1993, *Fisheries Surveys Report 1993*, Canberra.

1991-92 to 1992-93

ABARE 1994, *Fisheries Surveys Report 1994*, Canberra.

1992-93 to 1993-94

ABARE 1996, *Australian Fisheries Surveys Report 1995*, Canberra.

1994-95 to 1995-96

Brown, D. 1997, *Australian Fisheries Surveys Report 1997*, ABARE, Canberra.

Commonwealth trawl
(formerly the south east trawl fishery)

1996-97 to 1997-98

ABARE 2000, *Australian Fisheries Surveys Report 1999*, Canberra.

1998-99 to 1999-2000

ABARE 2002, *Australian Fisheries Surveys Report 2001*, Canberra.

2000-01 to 2001-02

ABARE 2004, *Australian Fisheries Surveys Report 2003*, Canberra.

2002-03 to 2004-05

ABARE 2006, *Australian Fisheries Surveys Report 2005*, Canberra.

southern bluefin tuna fishery

1980-81 to 1981-82

BAE 1986, *Southern Bluefin Tuna Survey, 1980–82*, Canberra.

southern squid jig fishery

1997-98 to 1998-99

ABARE 2001, *Australian Fisheries Surveys Report 2000*, Canberra.

1999-2000 to 2000-01

ABARE 2003, *Australian Fisheries Surveys Report 2002*, Canberra.

Torres Strait prawn fishery

1989-90

Battaglene, T., Reid, C. and Collins, P. 1992, 'An economic survey of the Torres Strait prawn fishery', *Australian Fisheries*, vol. 50, no. 7, pp. 28–31.

1992-93 to 1993-94

ABARE 1996, *Australian Fisheries Surveys Report 1996*, Canberra.

1994-95 to 1995-96

Brown, D. 1997, *Australian Fisheries Surveys Report 1997*, ABARE, Canberra.

1996-97 to 1997-98

ABARE 2000, *Australian Fisheries Surveys Report 1999*, Canberra.

1998-99 to 1999-2000

ABARE 2002, *Australian Fisheries Surveys Report 2001*, Canberra.

2000-01 to 2001-02

ABARE 2004, *Australian Fisheries Surveys Report 2003*, Canberra.

2002-03 to 2003-04

ABARE 2006, *Australian Fisheries Surveys Report 2005*, Canberra.

western tuna and billfish fishery
(formerly the southern and western tuna and billfish fishery)

2001-02

ABARE 2004*, Australian Fisheries Surveys Report 2003*, Canberra.

Asia Pacific Economic Cooperation Secretariat

Association of Southeast Asian Nations – secretariat

AusAid

Australian Centre for Excellence in Risk Analysis

Australian Centre for International Agricultural Research

Australian Fisheries Management Authority

Australian Greenhouse Office

Australian Government Department of the Environment and Water Resources

Australian Government Department of Industry, Tourism and Resources

Australian Government Department of Prime Minister and Cabinet

Australian Government Department of Transport and Regional Services

CRC – Plant Biosecurity

CSIRO (Commonwealth Scientific and Industrial Research Organisation)

Dairy Australia

Department of Business, Economic and Regional Development, Northern Territory

Department of Primary Industries, Victoria

Fisheries Research and Development Corporation

Fisheries Resources Research Fund

Forest and Wood Products Research and Development Corporation

Grains Research and Development Corporation

Grape and Wine Research and Development Corporation

Independent Pricing and Regulatory Tribunal

International Food Policy Research Institute

Meat and Livestock Australia

Murray Darling Basin Commission

National Australia Bank

NSW Sugar

Rural Industries Research and Development Corporation

University of Queensland

Wheat Export Authority