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Financial and economic performance of the Torres Strait Prawn Fishery

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Summary

ABARES has undertaken economic surveys of key Commonwealth fisheries since the early 1990s. This report presents the most recent results from the ABARES financial and economic survey of the Commonwealth Torres Strait Prawn Fishery (TSPF). Owing to a low level of fishing effort in recent years, it has become more difficult to collect a large sample of data from the fishery. In this survey, financial and economic data were collected from a small number of vessels, five vessels operating in the fishery in 2010–11 and 2011–12, representing 20 per cent of the population of vessels. Given the small sample size in this survey, care should be taken when drawing conclusions from the results.

The TSPF is located adjacent to the Commonwealth Northern Prawn Fishery (NPF) and Queensland's East Coast Otter Trawl Fishery (ECOTF). Trawlers that operate in the TSPF typically also operate in these adjacent fisheries to balance income from their fishing operations throughout the year. Most operators in the fishery are based in far north Queensland, with Cairns being the main home port of the fleet. Management of the fishery is closely aligned to that used for the ECOTF, where vessel length and gear configurations are similar. Most vessels operating in the Commonwealth NPF are unsuited to the TSPF because of controls on the maximum vessel length and restrictions on gear size. However, a small proportion of TSPF vessels fish in the NPF because their vessel characteristics meet requirements.

The TSPF is a key Torres Strait fishery and the second largest in value. The fishery generated a gross value of production (GVP) of $6.0 million in 2012–13, accounting for 22 per cent of the total GVP ($26.9 million) of Torres Strait fisheries in that year. This production value is substantially lower than that in 1998–99, when real GVP peaked at $42 million. Since 1998–99 GVP from the fishery has steadily declined, reflecting the lower effort expended in the fishery. Market factors have made fishing in the Torres Strait less profitable. These factors include a high Australian dollar and greater competition from aquaculture produced prawns, which has led to reduced output prices. Operating costs have increased significantly as a result of higher fuel prices and labour costs. In addition to reducing effort, the fleet has responded to adverse market conditions with autonomous exit from the fishery and increased emphasis on targeting the high unit value brown tiger prawn rather than Endeavour prawns.

The remoteness of the fishery poses additional challenges. All inputs must be transported by a mothership from Cairns to the Torres Strait, and catch is shipped back to Cairns for distribution to more southern markets. This adds considerably to operating costs of the fishery, particularly in years when fuel prices are high.

The net economic return (NER) from the TSPF has generally declined in line with falls in fishery GVP. Since 2000–01 NER has declined and remained negative in all years surveyed by ABARES since 2004–05. Negative NER between 2004–05 and 2007–08 was largely driven by the decline in fishing income, when catch in the fishery decreased by an annual average of 12.5 per cent. Economic returns in 2008–09 and 2009–10 have not been estimated because the fishery was not surveyed in those years. The most recent survey results show NER in 2010–11 and 2011–12 remained negative but improved compared with 2007–08, mainly resulting from increases in catch and prices for the main species caught over the survey period.

The lack of positive NER from the fishery since 2004–05 remains an issue of concern to managers. Given the fishery's geographical isolation, lack of supporting infrastructure and low participation, it is likely that returns will not rise significantly without a change in the operating environment. High input costs and low prices made it difficult to operate profitably in the fishery in 2010–11 and 2011–12. Lower prices for diesel fuel and a lower Australian dollar exchange rate are likely to improve economic returns and participation in the fishery in 2013–14 and 2014–15.

The fishery is formally managed by the Torres Strait Protected Zone Joint Authority. Before it can make changes to input settings in response to adverse market conditions, the authority generally conducts complex consultative processes with stakeholders. These include the local Indigenous community, which relies on the sea for its livelihood. The authority must also consider any changes against its broader social and economic objectives in managing Torres Strait fisheries.

Key results

Financial performance

- Financial performance estimates are calculated for the average vessel in a fishery and include all cash receipts and cash costs that have been earned and incurred from all business activities within the survey period, including from operating in other fisheries (such as the Commonwealth NPF and Queensland ECOTF).
- The 2013 TSPF survey collected data for 2010–11 and 2011–12.
- Profit at full equity—an estimate of profits based on all assets being fully owned by operators—was negative for the average vessel in the fishery in 2010–11 and 2011–12, at –$89 491 and –$87 366 respectively (Table 1).
- The change in profit at full equity was primarily attributed to higher cash receipts, which in turn led to higher vessel cash income and higher profit at full equity.

Table 1 Key financial performance results, Torres Strait Prawn Fishery
Vessel-level average

Category	Unit	2010–11	2011–12
Total cash receipts	$	607 169	666 043
Total cash costs	$	670 720	719 133
Boat cash income	$	–63 551	–53 090
less depreciation	$	43 625	41 855
Boat business profit	$	–107 176	–94 945
plus interest leasing rent	$	17 684	7 578
Profit at full equity	$	–89 491	–87 366

Economic performance

- NER for the fishery declined from –$2.1 million in 2010–11 to –$2.7 million in 2011–12 (Table 2).
- In 2012–13 preliminary NER (including management costs) were estimated at –$2.3 million using non-survey based methods.
- The negative NER from the TSPF is mainly attributed to the high costs associated with operating in a remote fishery.

Table 2 Key economic performance results, Torres Strait Prawn Fishery
Total fishery

Category	Unit	2010–11	2011–12	2012–13p
Fishing income	$m	4.9	7.3	5.3
Operating costs	$m	4.2	7.3	5.4
Fishery cash profit	$m	0.6	–0.0	–0.1
– less owner and family labour, opportunity cost of capital and depreciation				
– plus interest, leasing and management fees				
Net return (excluding management costs)	$m	–1.6	–2.3	–1.9
Net return (including management costs)	$m	–2.1	–2.7	–2.3

p ABARES preliminary estimate.

Other indicators

- Between 1993–94 and 2007–08, total factor productivity in the TSPF increased at an annual average rate of 4.8 per cent. The largest increase was between 2000–01 and 2007–08 as the number of operating vessels declined following the 2005–06 voluntary licence surrender process. The productivity increase can be attributed to a combination of factors: less competition among a smaller fleet; the possible exit of some less productive vessels; and a larger tiger prawn stock allowing for easier catch. Total factor productivity was not assessed for 2010–11 and 2011–12 owing to a lack of survey data for 2008–09 and 2009–10. Data must be analysed over a continuous period to determine trend movements in productivity.
- Analysis of input costs and output prices faced by fishers operating in the TSPF in 2010–11 indicate that the negative NER of the fishery in that year mainly reflected unfavourable market conditions—input costs increased more rapidly than output prices. In contrast, improvement in economic returns in 2011–12 was driven by a 21 per cent increase in output prices while input costs increased by 3 per cent. Additionally, an increase in catch and a possible decline in input use indicate that productivity may have improved and contributed to the improvement in economic returns.
- From 1997–98 to 2011–12, overall TSPF management costs increased by 23 per cent in real terms to reach $0.4 million. The cost per active vessel also increased in proportion to the smaller number of active vessels, which decreased from 83 to 25 vessels during this period.
- The average estimated sale price of a fishing night entitlement in the TSPF from the surveyed sample was $379 in 2010–11 and the median value of a vessel licence was $20 000. On average, each vessel that operated in the TSPF during the 2010–11 season held 170 fishing night entitlements. This compares with an average of 116 nights held by the surveyed sample in 2011–12, at an estimated price of $472. The median value of a vessel licence was $27 500 in 2011–12.

- Introduction of the total allowable effort cap of 9 200 days in 2006 significantly reduced latency in unused fishing nights. However, latency levels quickly reinstated, especially post 2009. Between the 2009 and 2013 fishing seasons, effort levels in the TSPF were on average 74 per cent below the 6 867 days available to Australian operators.

1 Introduction

ABARES has undertaken regular surveys of key Commonwealth fisheries since the early 1990s. The data are used to assess the financial performance of operators in the fishery and the economic performance of the fishery as a whole. Both performance measures act as important indicators for fishery managers (Box 1). In early 2014, ABARES expanded the former Australian fisheries surveys report series to include other economic indicators using the survey data collected to provide a more comprehensive assessment of fishery level performance. These indicators include productivity indexes, entitlement values and management costs.

This report presents Torres Strait Prawn Fishery (TSPF) survey-based results for 2010–11 and 2011–12. It also presents non-survey based results for 2012–13. The fishery was not surveyed in the 2008–09 and 2009–10 financial years because of the low level of fishing effort recorded in those years. Owing to this gap in the data series for TSPF, which commenced in 1993–94, productivity results are available only to 2007–08.

Two primary economic indicators are used in this report—financial performance and economic performance. Financial performance estimates are calculated for the average vessel in a fishery and include all cash receipts and cash costs earned and incurred in the survey period from all fishing operations, including in fisheries not covered by the survey. These estimates reflect the average vessel's profit and loss statement for all business activities. The key indicator of economic performance presented is net economic return (NER), which is reported at the fishery level. NER estimates differ from financial performance estimates because they relate to the surveyed fishery only and include depreciation, the opportunity cost of capital and the opportunity cost of labour. Appendix A provides definitions of these costs.

Each indicator provides different information. Vessel-level financial performance information shows the operating context of the fishery. For example, positive financial profits at the vessel level may reveal how operators continue to operate in a fishery that is generating negative NER. These estimates are relevant to all industry operators as they can compare their individual performance with that of the average vessel.

Economic performance is relevant to fishery managers and policymakers because NER relates only to the specific fishery being managed. NER accounts for all cash receipts, cash costs and economic costs and indicates the economic return to society from harvesting the fishery resource. The TSPF is managed to achieve objectives of the *Torres Strait Fisheries Act 1984* and the *Torres Strait Prawn Fishery Management Plan 2009*, which include promoting economic efficiency in use of the fishery's resources. Interpreting fishery NER trends and drivers, together with other economic indicators, can assist in assessing its performance against this objective.

Management of the fishery is closely aligned to that of Queensland's East Coast Otter Trawl Fishery (ECOTF), where vessel length and gear configurations are similar. Most vessels operating in the Commonwealth Northern Prawn Fishery (NPF) are unsuited to the TSPF because of controls on the maximum vessel length and restrictions on gear size. However, a small proportion of TSPF vessels fish in the NPF because the NPF does not restrict vessel length and sets tradeable gear units for the fishery as a whole.

The TSPF is formally managed by the Torres Strait Protected Zone Joint Authority. Its primary objective is to ensure optimum use of its resources consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle in the *Torres Strait Prawn Fishery Management Plan 2009*. This includes preserving ecologically sustainable traditional fishing opportunities for traditional inhabitants of Australia and Papua New Guinea. Before it can make changes to input settings in response to adverse market conditions, the authority usually conducts complex consultative processes with stakeholders. Stakeholders include the local Indigenous community, which relies on the sea for its livelihood.

Twenty-five vessels were active in the fishery in 2010–11 and 2011–12. The survey sample was small, at five vessels in both years, representing 20 per cent of the population in both years. Given the small sample size, care should be taken when drawing conclusions from these results. Relative standard errors are provided with the survey results to guide interpretation.

Box 1 Economic indicators for fisheries management

In September 2007 the Australian Government released the Commonwealth Fisheries Harvest Strategy Policy to provide increased guidance for managing Australia's Commonwealth fisheries sustainably and profitably. The policy's objective is to maintain key commercial stocks at ecologically sustainable levels and to maximise the economic returns to the Australian community by targeting maximum economic yield (MEY) (DAFF 2007). Although the policy does not prescribe management arrangements for fisheries jointly managed by the Australian Government and other management agencies, such as the Torres Strait Prawn Fishery, the Protected Zone Joint Authority (PZJA) has asked its management forums to advise on whether the policy should be applied to Torres Strait fisheries. The TSPF is managed according to the economic objective of promoting economic development and ensuring optimal use of the fishery resource. The recently implemented harvest strategy for the fishery does not have a target biomass level associated with an MEY estimate (B_{MEY}). This is because the fishery has a low economic value and the cost of estimating a B_{MEY} target is expected to be high (AFMA 2011). As such, a B_{MSY} target, a target biomass level associated with achieving maximum sustainable yield (MSY), will be used until fishing activity increases to a point where a B_{MEY} target is to be determined and implemented (AFMA 2011). Assessment of net economic returns in the TSPF gives fisheries managers and policymakers useful information about economic performance and activities. In fishery management, several economic indicators generally serve two main purposes: informing management decisions against the economic objective and monitoring management performance against the economic objective.

Informing management decisions against the economic objective

Some economic indicators are forward-looking and can advise fishery managers on policy settings necessary to achieve MEY. These may be required for the TSPF in the future. Bio-economic models provide indicators that serve this purpose; models have been developed for the Commonwealth Northern Prawn Fishery (Kompas & Che 2004) and the Commonwealth Southern and Eastern Scalefish and Shark Fishery (Kompas & Che 2008). Management strategy evaluation based approaches that include an economic component can also serve this purpose and may be an area for future research on general fishery management.

Monitoring management performance against the economic objective

Other economic indicators are backward-looking and can assist in assessing the impact of previous management decisions on economic performance. Most indicators examined in this report fall into this category. This includes the survey-based estimation of net economic return (NER), productivity indexes, entitlement values, management costs and profitability indexes.

Total factor productivity analysis is an economic tool used to assess how well fishers use inputs such as fuel and labour to produce outputs (catch) and how their ability to convert inputs to outputs has changed over time, with changes in the fishery's operating environment. Productivity indexes inform fishery managers about the effect of management arrangements on average productivity levels in the fishery.

Analysis of management costs helps fishery managers understand the overall burden of these costs on a fishery. Management costs become more burdensome to a fishery when the number of concession holders reduces significantly. This is because a large portion of management costs are set to recover the fixed costs of managing the fishery, which does not tend to reduce when fishers exit. Measures of management costs, as a proportion of gross value of fishery production (GVP) and per active vessel, provide general information about the cost-effectiveness of fishery management.

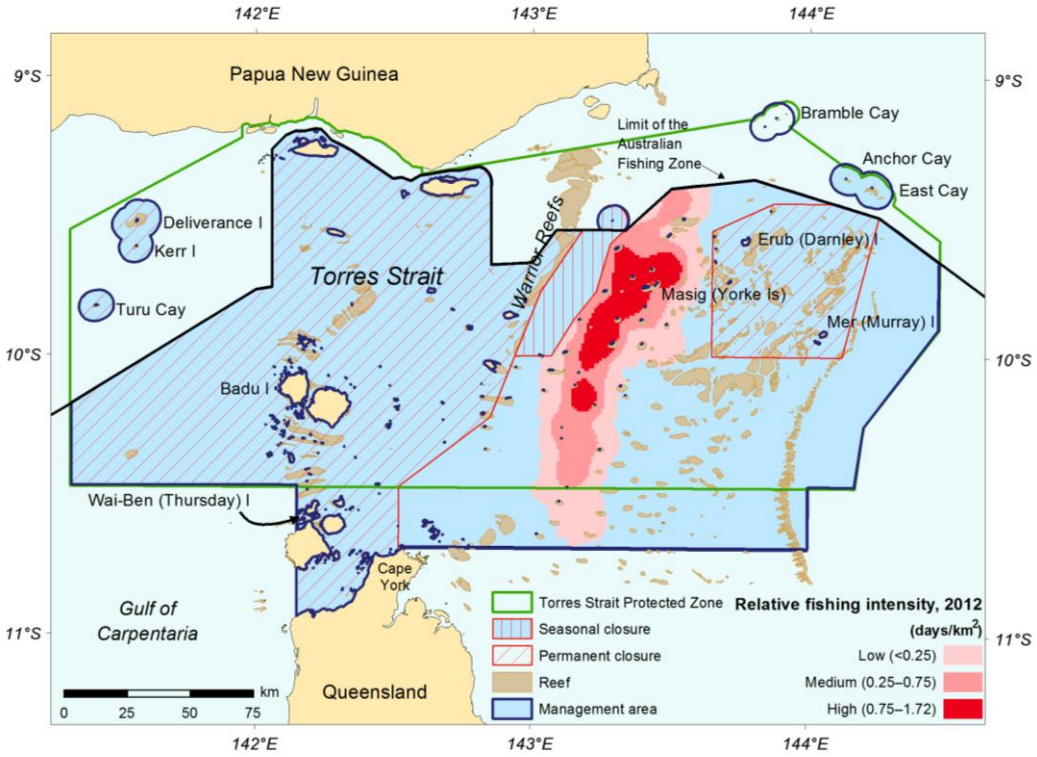
Entitlement values signal the current value of resources in the fishery. If entitlement values increase over time, it suggests that resources are being managed effectively because operating in the fishery is deemed to have become more profitable.

2 Background

Description of the fishery

The Torres Strait Prawn Fishery (TSPF) operates in the eastern part of the Torres Strait Protected Zone (TSPZ) and south of the TSPZ, in Queensland waters defined as the 'outside but near area' (Map 1). The Australian fishery is managed by the Protected Zone Joint Authority (PZJA), established under the *Torres Strait Fisheries Act 1984*. All licences in this fishery are held by the non-Indigenous Transferable Vessel Holder sector. Many operators in the fishery also hold endorsements in other prawn fisheries, including the Queensland East Coast Otter Trawl Fishery and the Commonwealth Northern Prawn Fishery (NPF).

Map 1 Relative fishing intensity, Torres Strait Prawn Fishery, 2012



Under the Torres Strait Treaty, ratified in 1985, Papua New Guinea is entitled to 25 per cent of the TSPF resource in the Australian Fishing Zone and Australia is entitled to 25 per cent of the TSPF resource in the Papua New Guinea area of fisheries jurisdiction. In the past some Australian vessels fished in Papua New Guinea waters, but this ceased soon after ratification of the Torres Strait Treaty. There is no official record of Papua New Guinea vessels fishing in Australian waters, and Papua New Guinea operators have only sporadically activated their entitlements to fish in their own waters of the TSPZ. Up to and including the 2011 fishing season, fishing effort was decreasing, largely as a result of economic conditions in the fishery (Georgeson, Stobutzki & Curtotti 2014). In the 2012 fishing season total catch in the TSPF increased by approximately 82 per cent. Georgeson, Stobutzki and Curtotti (2014) note that the stocks fished in the TSPF are not overfished or subject to over fishing, with the two main target species, brown tiger prawns and blue endeavour prawns both having an estimated biomass level in excess of the level associated with maximum sustainable yield. The fishery is subject to several spatial and temporal closures, initiated for various reasons—including to protect undersized tiger prawns, pearl shell beds and breeding populations of marine turtles (Cocking & Turnbull 2014).

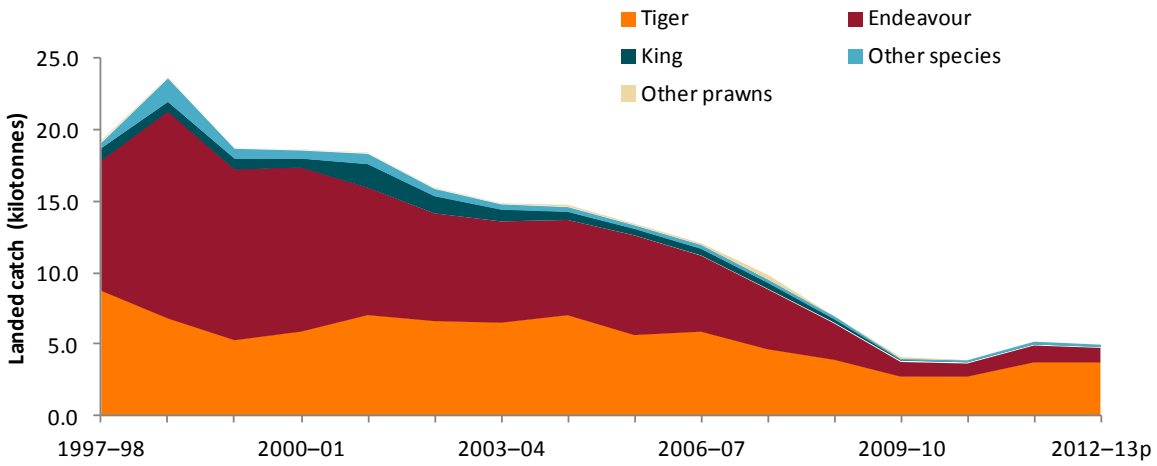
The *Harvest strategy for the Torres Strait Prawn Fishery 2011* (AFMA 2011) defines a set of triggers, targets and limit reference points and decision rules for the fishery as a whole and for tiger prawns. The harvest strategy also defines a catch trigger for Endeavour prawns. The current triggers are set to reflect the reduced effort in the fishery in recent years and can be revised and updated if activity in the fishery increases.

Given the current low level of effort in the fishery, the harvest strategy sets a total allowable effort (TAE) consistent with achieving a biomass at maximum sustainable yield (B_{MSY}). The strategy also defines a long-term economic target based on setting a TAE consistent with achieving a biomass at maximum economic yield (B_{MEY}), which will be pursued once fishery catch-and-effort triggers are reached. The PZJA is not pursuing this long-term economic target because the fishery does not have the resources to calculate B_{MEY} and catch-and-effort triggers have not been reached. Additionally, because a B_{MEY} target would reduce fishing effort compared with B_{MSY}, there is concern that introducing an economic target would put additional pressure on operators when the fishery is already under economic pressure. Setting a B_{MEY} target could cause some licence holders to surrender their entitlements, which would result in fewer operators sharing management costs (AFMA 2011).

Key economic trends

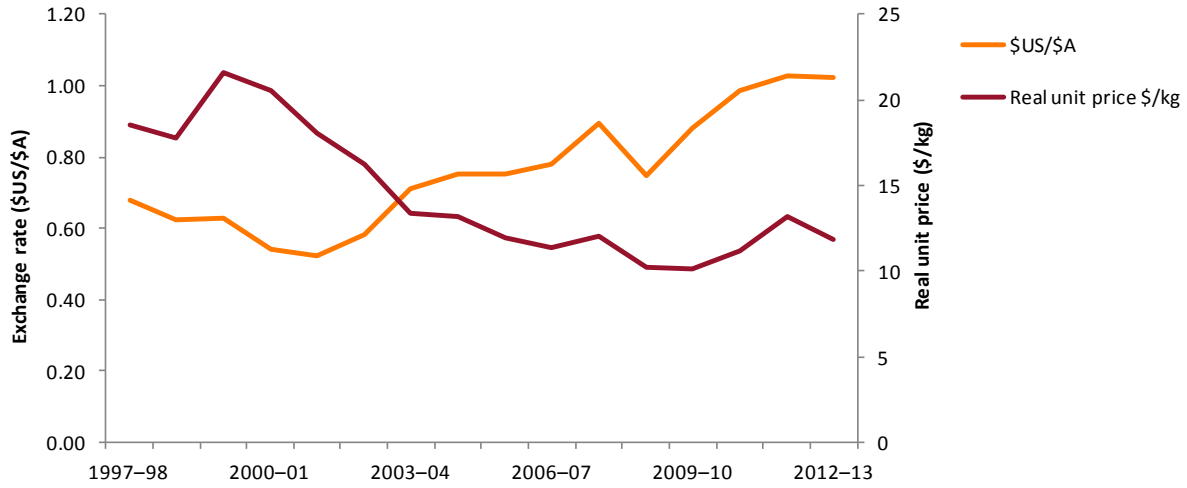
The fishery targets predominantly tiger and Endeavour prawns (Figure 1). Production from the fishery decreased by an average of 15 per cent each year between 1998–99 and 2009–10. This was primarily driven by the decline in Endeavour prawn catch, from 1446 tonnes in 1998–99 to 102 tonnes in 2009–10, an average annual decline of 21 per cent. Over the same period, prawn prices received by TSPF operators declined at an average annual rate of 5 per cent in real terms. Most of this reduction can be attributed to a decline in prices for tiger and Endeavour prawns of 7 per cent over this period. The strong appreciation of the Australian dollar in this period also contributed to lower prices, as fishers sought to maintain their competitiveness in international markets and meet increased import competition in the domestic market (Figure 2).

Figure 1 Landed catch of key species, Torres Strait Prawn Fishery



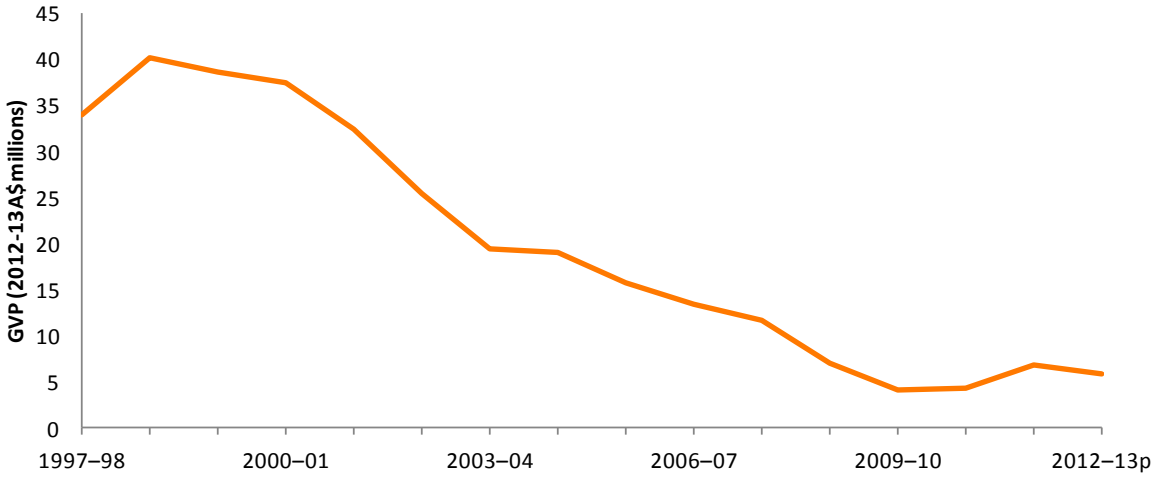
p ABARES preliminary estimate.

Figure 2 Exchange rate and average real unit price, Torres Strait Prawn Fishery 1992–93 to 2012–13p



The real gross value of production (GVP) in the TSPF peaked at $42 million in 1998–99 (Figure 3). It then declined consistently to a low in 2009–10 of $4.2 million before rising at an average annual rate of 13 per cent to $6.0 million in 2012–13. Increases in volume of production and unit prices drove the increase from 2009–10 to 2012–13. In 2012–13 tiger prawns accounted for the largest share of GVP (80 per cent; $4.8 million), followed by Endeavour prawns (13 per cent; $0.8 million) and minor catch of king prawns (0.5 per cent; $27,000). Non-prawn species, mainly Moreton Bay bug, scallop and squid, accounted for the remainder of the catch, with a combined GVP of $0.4 million (Stephan & Hobsbawn 2014).

Figure 3 Real gross value of production, Torres Strait Prawn Fishery



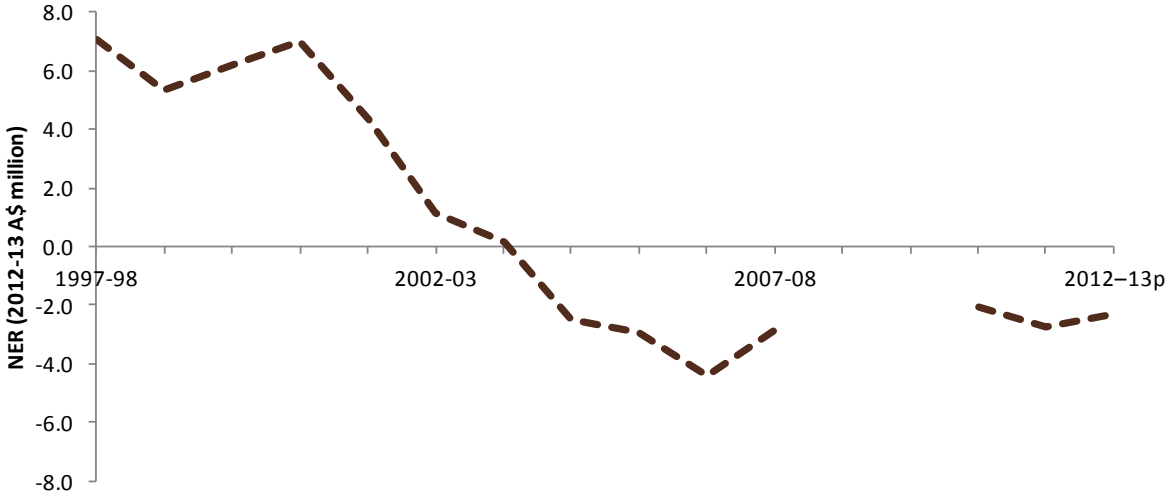
The declining trend in real GVP since 1998–99 can be attributed to lower effort expended in the fishery, resulting in significantly lower production. A cost–price squeeze, caused by lower prawn prices and higher input costs, has dampened expectations of achieving a satisfactory rate of return from operating in the fishery. Fishing in the strait has been less profitable as a result of a range of market factors, including a high Australian dollar, greater competition from aquaculture produced prawns and increased costs of operation, particularly higher fuel prices and labour costs. Lower effort expended in the fishery reflects the fleet's adjustment to these prices and costs. The output mix from the fishery also shifted away from lower unit value Endeavour prawns toward higher unit value tiger prawns. Endeavour prawns comprised 61 per cent of the catch by volume in 1998–99 but just 20 per cent by 2012–13.

Net economic return (NER) in the TSPF has declined since 2000–01 and remained negative in all years surveyed by ABARES since 2004–05 (Figure 4). Negative NER between 2004–05 and 2007–08 was driven largely by the decline in fishing income, resulting from catch decreasing by an annual average of 12.5 per cent and costs increasing, particularly for fuel. The fishery was not surveyed in 2008–09 and 2009–10, so economic returns were not estimated. The most recent survey results show NER for 2010–11 and 2011–12 improved compared with 2007–08 but remained negative as a result of a combination of continuing high operating costs and low output prices. NER improved but remained negative in 2011–12 despite an increase in catch and prices for major species caught by the TSPF.

Since 2000–01 several factors have combined to reduce NER in the TSPF. These include increases in the price of diesel fuel, a decline in the price received for prawns in the domestic market, a decline in the export unit value of prawns (resulting from the high value of the Australian dollar) and competition from farmed prawns in the domestic and export markets.

The remoteness of the fishery poses additional challenges. All inputs must be transported by a mothership from Cairns to the Torres Strait, and catch is shipped back to Cairns for distribution to southern markets. This adds considerably to operating costs of the fishery, particularly in years when fuel prices are high. In addition, the PZJA must consider any changes to management settings against its broader social and economic development objectives for the region.

Figure 4 Real net economic returns, Torres Strait Prawn Fishery



p ABARES preliminary estimate. GVP: gross value of production. NER: net economic return.

Note: Time series of financial and economic performance tables are available in the accompanying Excel spreadsheet at ABARES publications.

Many fishers endorsed to operate in the TSPF have options to fish in other prawn fisheries, where operational logistics of catching and distributing prawns to markets are less challenging. These fisheries include Queensland's East Coast Otter Trawl Fishery (ECOTF) and the Commonwealth NPF. Larger vessels operating in the NPF fleet have limited opportunity to operate in the TSPF because of TSPF restrictions on vessel length and gear size. Vessel length in both the TSPF and the ECOTF is limited to 20 metres; most vessels in the NPF fleet are larger than 20 metres.

Given the low effort levels in the fishery, implementing a B_{MEY} target under the *Harvest strategy for the Torres Strait Prawn Fishery 2011* (AFMA 2011) remains problematic. However, the harvest strategy offers little guidance on alternative management options for improving the economic performance of the fishery during a period of negative returns. This requires that management continue to focus on possible alternative options for improving returns in the fishery.

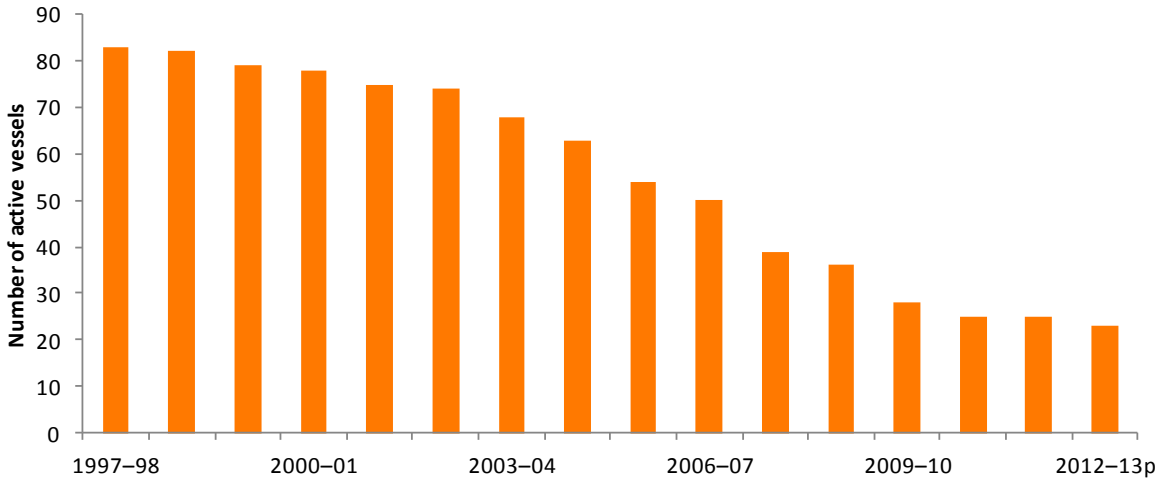
Demographic profile of fishers operating in the Torres Strait Prawn Fishery

The median age of skippers was 38 years in 2010–11 and 44 years in 2011–12. On average, skippers had around seven years experience operating in the TSPF and 23 years fishing experience in total. Year 10 completion was the highest education level attained for 60 per cent of skippers in 2010–11 and 100 per cent in 2011–12. In 2010–11 the highest qualification obtained by skippers was a trade/technical apprenticeship.

Current management arrangements

The harvest strategy's limit reference point is set at 20 per cent of unfished biomass ($0.2B_0$), consistent with the default provided in the *Commonwealth Fisheries Harvest Strategy Policy* (DAFF 2007). The target reference point (B_{TARG}) is based on maximum sustainable yield (MSY)—that is, $B_{TARG} = B_{MSY}$. This target is not based on achieving a maximum economic yield (MEY) from the fishery, but the triggers in this fishery are aligned with the concept of MEY. This is consistent with the fishery's goal to move to MEY-based targets when fishing activity increases (AFMA 2011). Triggers are set at levels that acknowledge the reduced effort and fewer vessels operating in the fishery in recent years (Figure 5). They are based on fishers catching 75 per cent of the Australian portion of TAE, set using a proxy of $B_{MEY} = 1.2\ B_{MSY}$ and equating to 34 per cent of the pre-fishing biomass ($0.34B_0$). The strategy sets a long-term economic target, which will be pursued once catch-and-effort triggers in the fishery are reached.

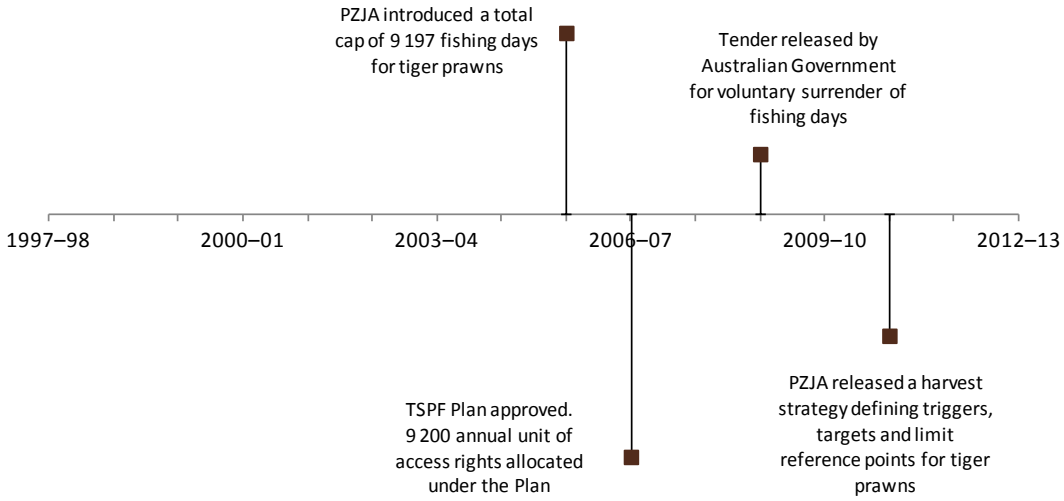
Figure 5 Number of vessels operating, Torres Strait Prawn Fishery



p ABARES preliminary estimates.

The fishery predominantly uses input controls to achieve its target. The PZJA sets a TAE at the beginning of each fishing season, based on total allowable fishing days for the entire fishery. The current MSY target results in 9 200 allowable fishing days (Figure 6). Australia's share under the Torres Strait Treaty is 75 per cent of this number or 6 867 days. This limit was set in 2005 and has not changed since. These fishing days are distributed among concession holders on the basis of their entitlement holdings, and lease trade is allowed between concession holders during the fishing season.

Figure 6 Key management changes, Torres Strait Prawn Fishery



Note: **PZJA** Protected zone joint authority.

Other input controls include restrictions on gear and vessel size, with both inputs generally configured to match the Queensland ECOTF. Larger vessels tend to have larger fuel and catch-holding capacities, so they can stay at sea longer and are better able to operate in geographically isolated fisheries such as the TSPF. Therefore, in preventing the use of larger vessels, this management arrangement may be constraining the fishery's economic performance. In recognition of these issues, the PZJA and the Torres Strait Prawn Management Advisory Committee (TSPMAC), recommended that the fishery trial alternative fishing gear and vessel size configurations (PZJA 2011). The proposed configurations would be similar to those in the Commonwealth NPF, where larger vessels and trawl nets are allowed.

Prior to a trial taking place, the PZJA Standing Committee requested that consultation with traditional inhabitants take place on the issues of boat and net size. These consultations took place in May 2013 (de Fries and Betzel 2013). Community resistance to the proposal was substantial. The main concerns were the risk of larger vessels causing pollution in the area, potential interference with the Torres Strait Tropical Rock Lobster Fishery, potential for increased bycatch and detriment to habitat, and lack of flow of benefits back to the community. The Torres Strait Prawn Management Advisory Committee discussed the results (TSPMAC 2013), and the PZJA and the TSPMAC are still considering whether to allow the trials.

Other management controls include seasonal and spatial closures to protect juvenile prawns, to improve economic yield from fishing and to protect areas of importance to the traditional sector, including tropical rock lobster, pearl shell dugong and turtle grounds.

3 Financial and economic performance

Financial performance

The survey population for a given year consists of vessels that recorded more than 1 tonne of catch in the Torres Strait Prawn Fishery (TSPF). The population was 25 vessels in both 2010–11 and 2011–12. The survey sample was five vessels in both years, representing 20 per cent of the population in both 2010–11 and 2011–12. Given the small sample size, care should be taken when drawing conclusions from these results. Survey method details are in Appendix B.

Some operators surveyed indicated that they operated in other fisheries during the survey period. Time spent operating in other fisheries varied between operators. Receipts and costs associated with operating in these fisheries have been included in the average vessel financial performance results to reflect the average vessel's profit and loss statement for all business activities. The financial performance of the average vessel operating in the TSPF improved slightly between 2010–11 and 2011–12 (Table 3). The average vessel's boat cash income increased by around $10 461 as result of a higher increase in total cash receipts (10 per cent or $58 874) compared with that of total cash costs (7 per cent or $48 413).

The large increase in average total cash receipts in 2011–12 (to $666 043 per vessel) was supported by strong growth in seafood receipts, which increased by 16 per cent to reach $624 464. Contributing to the increase in seafood receipts was an increase in tiger and Endeavour prawn catch from 2010–11 to 2011–12. Tiger prawn catch in the TSPF increased by 36 per cent (99 tonnes) between 2010–11 and 2011–12 and Endeavour prawn catch increased by 29 per cent (26 tonnes) (Skirtun, Sahlqvist & Viera 2013).

In 2011–12 the average vessel total cash costs increased by $48 413 (or 7 per cent) to $719 133. Fuel costs accounted for the largest share of cash costs, at $246 913 (34 per cent) in 2011–12. Compared with 2010–11, fuel costs increased by 2 per cent ($4 407). Labour costs were the second-largest cost, accounting for 30 per cent (or $213 505) of total cash costs. Profit at full equity for the average TSPF vessel was estimated at –$87 366 in 2011–12, only a slight improvement from 2010–11.

Table 3 Financial performance of vessels operating in the Torres Strait Prawn Fishery

Average per vessel

Revenue	Unit	2010–11		2011–12	
Seafood receipts	$	538 213	(18)	624 464	(31)
Non-fishing receipts	$	68 957	(6)	41 579	(35)
Total cash receipts	$	607 169	(16)	666 043	(28)
Costs					
Administration	$	12 187	(24)	8 968	(15)
Crew costs	$	244 376	(26)	213 505	(25)
Freight and marketing expenses	$	8 264	(46)	17 685	(66)
Fuel	$	242 506	(8)	246 913	(16)
Insurance	$	20 688	(11)	19 166	(20)
Interest paid	$	14 688	(43)	5 510	(55)
Licence fees and levies	$	11 301	(12)	19 891	(44)
Packaging	$	15 846	(39)	8 734	(34)
Repairs and maintenance	$	48 224	(37)	141 122	(62)
Other costs	$	52 640	(33)	37 639	(21)
Total cash costs	$	670 720	(11)	719 133	(28)
Boat cash income	$	–63 551	(110)	–53 090	(70)
less depreciation **a**	$	43 625	(32)	41 855	(50)
Boat business profit	$	–107 176	(76)	–94 945	(36)
plus interest leasing rent	$	17 684	(29)	7 578	(40)
Profit at full equity	$	–89 491	(88)	–87 366	(41)
Capital (excluding quota and licences)	$	430 728	(16)	313 431	(25)
Capital (including quota and licences)	$	581 241	(19)	748 592	(41)
Rate of return to boat capital **b**	%	–21	(93)	–28	(47)
Rate of return to full equity **c**	%	–15	(97)	–12	(45)
Population	no.	25	na	25	na
Sample	no.	5	na	5	na

a Depreciation adjusted for profit or loss on capital items sold. **b** Excluding value of quota and licences. **c** Including value of quota and licences.

Note: RSE Figures in parentheses are relative standard errors (RSEs). For any given standard error, an RSE will be higher for estimates closer to zero. A guide to interpreting RSEs is in Appendix A.

Economic performance

Economic returns in the TSPF remained negative in 2010–11 and 2011–12 at –$2.1 million and –$2.7 million respectively (Table 4). NER have been negative in the fishery since 2003–04 but began to improve after 2006–07. Fishing income increased by 50 per cent in 2011–12 as a result of an increase in landed catch. Landed catch of tiger and Endeavour prawns (the two main species) increased by 36 per cent and 28 per cent, respectively. However, fishing costs rose by more than income in 2011–12, by 73 per cent. As a result, NER declined slightly in 2011-12 to –$2.7 million.

Preliminary estimates of NER for the fishery are estimated to have remained negative in 2012–13 at –$2.3million.

Table 4 Fishery cash profit and net economic returns, Torres Strait Prawn Fishery
Total fishery (2012–13 A$ million)

Category	2010–11		2011–12		2012–13p
Receipts					
Fishing income	4.9	(31)	7.3	(32)	5.3
Cash costs					
Operating costs	4.2	(28)	7.3	(28)	5.4
Fishery cash profit	0.6	(64)	–0.0	(64)	–0.1
Less					
– owner and family labour	1.7	(65)	1.1	(31)	0.7
– opportunity cost of capital	0.3	(46)	0.6	(59)	0.6
– depreciation	0.5	(56)	0.9	(50)	0.9
plus interest, leasing and management fees	0.3	(48)	0.3	(36)	0.3
Net return (excluding management costs)	–1.6	(77)	–2.3	(52)	–1.9
Management costs	0.5	–	0.4	–	0.4
Net return (including management costs)	–2.1	–	–2.7	–	–2.3

p Preliminary non-survey based estimates. For estimation method, see Appendix C.
Note: Longer time series are available in the accompanying Excel spreadsheet at ABARES publications. Figures in parentheses are relative standard errors (RSEs). RSEs are not available for 2012–13 results because of estimation method used (Appendix C).

4 Other key indicators

Several other economic indicators are used to assess economic performance of a fishery. These indicators include the trend in economic productivity, changes in input costs and output prices, trend change in management costs and changes in entitlement values.

Productivity

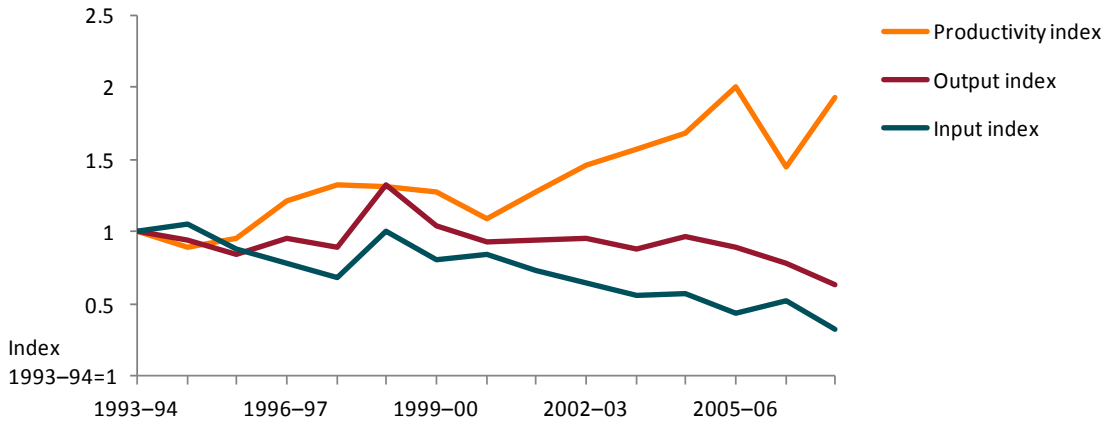
Total factor productivity (TFP) analysis of a fishery presents the fishers' ability to convert inputs into outputs over time. Results from this analysis can assist in evaluating changes in net economic return (NER) over time and provide an understanding of the factors driving changes in productivity. Changes in productivity generally reflect changes in a fishery's operating environment, such as management settings that regulate fishers' technology choices, changing market conditions and changes in the mix of outputs produced. Market conditions include variations in input costs and import competition and changes in the value of the Australian dollar.

Changes in a fishery's operating environment and/or market conditions can provide fishers with incentives to pursue vessel-level productivity improvements. Increasing productivity may be necessary to keep the business financially viable—for example, to offset any negative effects on profitability from adverse market conditions such as increasing input costs or competition. Adverse market conditions can also help drive autonomous structural adjustment within the industry. Autonomous structural adjustment can result in fishing rights moving to more profitable fishers and less efficient or less profitable vessels exiting the industry, resulting in a more productive residual fleet.

TFP analysis was undertaken for the Torres Strait Prawn Fishery (TSPF) between 1993–94 and 2007–08, the period for which survey data are available. Survey data are available for 2010–11 and 2011–12 but if these years are added to the analysis it creates a gap in the data series. Further, a time series greater than two years is required for a meaningful analysis. The output index incorporates tiger, Endeavour and king prawns and other species caught. Productivity of this fishery was not adjusted for stock changes because relevant stock biomass data are not available.

Average annual productivity growth for the TSPF was 4.8 per cent between 1993–94 and 2007–08, with most of the growth in productivity occurring after 2001–02 (Figure 7). From 2001–02 to 2007–08, productivity increased as the input index decreased faster than the output index. The productivity increase in this period was influenced by changes in the fleet size and stock biomass. The number of operating vessels decreased from 75 in 2001–02 to 28 in 2009–10 (61 per cent). The decline in vessel numbers over this period was accelerated by the 2005–06 voluntary licence surrender process. Stock biomass data were not available for the analysis, but assessments indicate that tiger prawn biomass has steadily increased since 2000 (Cocking & Turnbull 2014). This is likely to have contributed to the change in output mix of the fishery, which has moved from Endeavour prawns to tiger prawns since then. Therefore, the productivity increase can be attributed to a combination of factors: less competition among the smaller fleet, the possible exit of less productive vessels, a larger stock of tiger prawns allowing for easier catch and a consequent switch from Endeavour prawns in the output mix (Stephan & Vieira 2013).

Figure 7 Productivity indexes, Torres Strait Prawn Fishery



Between 2005 and 2009 many management changes were implemented in the TSPF aimed at decreasing effort levels and improving economic performance. Despite the reduction in total effort cap amounts, unused (or latent) effort remained in the fishery (Skirtun & Vieira 2012). Latent effort was largely a result of unfavourable economic conditions, reflecting historically low prawn prices and high costs, particularly for fuel.

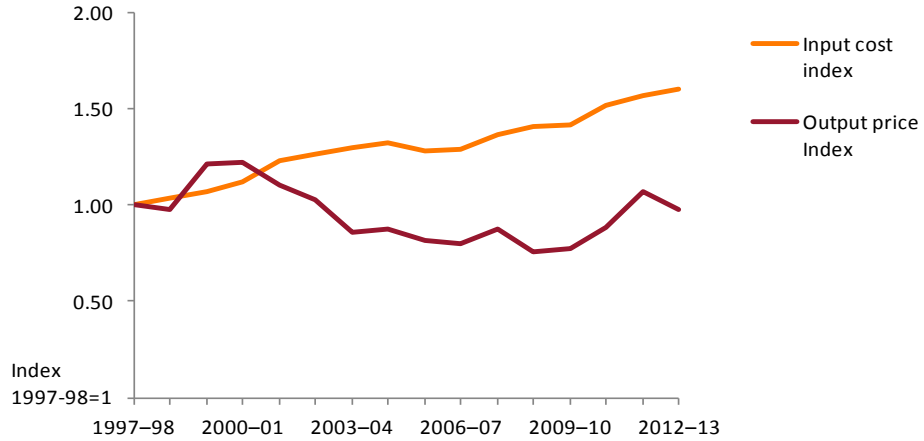
Skirtun and Vieira (2012) also noted the distinction between the economic performance of the TSPF and the Northern Prawn Fishery (NPF), which faced similar deterioration in economic conditions in the early 2000s. The TSPF has exhibited productivity growth but not sufficient for it to maintain positive NER (Vieira & Perks 2009). Participation in the fishery has declined considerably as a result. In contrast, productivity growth in the NPF allowed it to move from negative NER to positive NER. The authors suggest that differing management approaches and objectives of the two fisheries may be factors in the differences in economic performance but also acknowledge the important role that the banana prawn season has in sustaining NER in the NPF.

Input costs and output prices

Input costs and output price trends can indicate whether changes in NER are driven by productivity increases (or decreases) or by favourable (or unfavourable) prices. Between 1997–98 and 2011–12 the input cost index increased trend at an annual average rate of 3.3 per cent (Figure 8). The input cost index consists of fuel, labour, repairs and capital. However, this index is largely driven by the cost of fuel. The output price index includes the price of tiger, Endeavour, king and other prawns as well as other species caught in the TSPF. It is primarily driven by the price of the two main species caught in the fishery: tiger prawn and Endeavour prawn. The output price index displays periods of declining, constant and increasing trends. However, over the entire analysis period (1997–98 to 2012–13) the output price index declined at an average annual rate of 0.14 per cent.

Between 2001–02 and 2011–12 operators faced challenging conditions, where output prices did not maintain pace with input cost increases (Figure 8). Over the same period NER fell, suggesting that much of the decline was attributable to unfavourable pricing conditions. Productivity growth in this period helped moderate the decline in NER.

Figure 8 Input cost and output price indexes, Torres Strait Prawn Fishery
Average by financial year



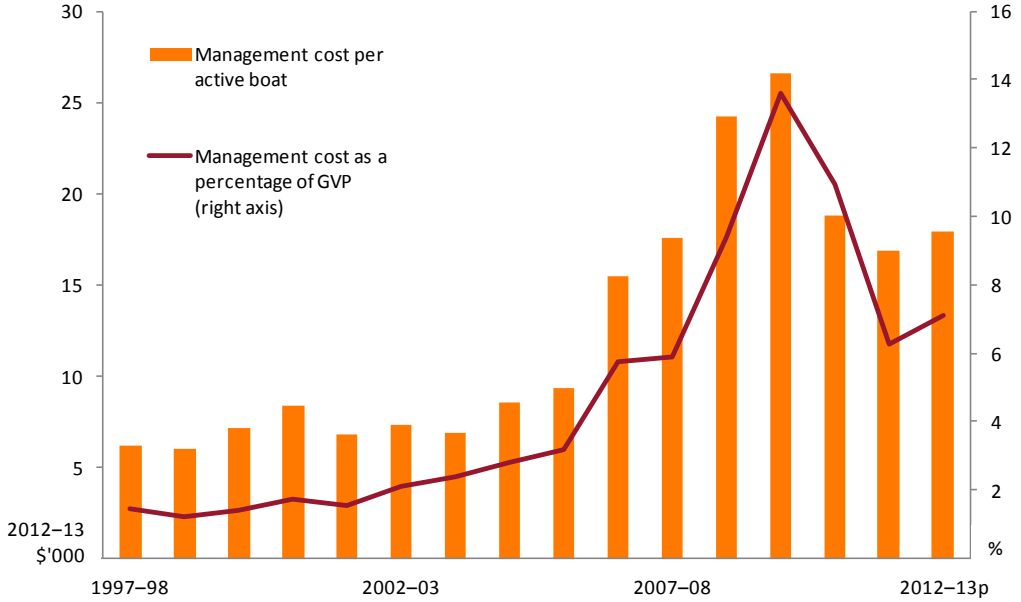
In 2010–11 the improvement in pricing conditions may have contributed to the improvement in NER from 2007–08 levels. In 2010–11 the average price of outputs increased by 14 per cent while the average cost of inputs increased by 7 per cent. The large increase in output prices was primarily driven by price increases for other species (more than doubled), tiger prawns (8 per cent) and Endeavour prawns (8 per cent). The increase in input costs in 2010–11 was mainly driven by the 13 per cent increase in the cost of fuel, which typically accounts for around 40 per cent of total costs in the TSPF.

In 2011–12 pricing movements continued to support the improvement in NER. In 2011–12 the average price of outputs increased by 21 per cent, while the average price of inputs increased by 3 per cent. Productivity growth may have also assisted in improving NER. Operating costs in 2011–12 declined by 16 per cent, despite the increase in average input prices, while catch volumes increased by 32 per cent. These trends indicate that operators in the TSPF reduced their input use during 2011–12, which may indicate an increase in productivity as fewer inputs were used to produce more outputs.

Management costs

From 1997–98 to 2011–12 the overall management costs of the TSPF increased by 23 per cent in real terms to reach $0.4 million. The cost per active vessel also increased in proportion to the smaller number of active vessels, which decreased from 83 to 25 during this period (Figure 9).

Figure 9 Average management cost per active vessel and as share of GVP



p ABARES preliminary estimate.

The average management cost per vessel increased only slightly between 1997–98 and 2005–06 but increased at a faster rate after 2005–06 until 2009–10, reflecting a 61 per cent reduction in vessel numbers between 2005–06 and 2009–10. Higher management costs per vessel are an outcome of vessels exiting the fishery. The increase in average management costs while vessel numbers declined indicates that management costs have large fixed cost elements, most of which are independent of the number of vessels operating. From 2009–10 to 2011–12 the average management cost per vessel declined by 37 per cent, to around $17 000 a vessel as vessel numbers fell by 11 per cent. Management costs per vessel increased in 2012–13 by 6 per cent to $18 000 a vessel, reflecting the slight decline in vessel numbers. Management cost as a percentage of GVP followed a similar trend to the average management cost per vessel. Management costs as a percentage of GVP started to increase from 1997–98 and peaked in 2008–09, reflecting the declining trend in GVP during those years. As GVP improved between 2009–10 and 2011–12, management costs as a percentage of GVP declined to 6 per cent in 2011–12.

Entitlement values

To operate in the TSPF, vessels must have a fishing licence and transferable fishing access rights—units of fishing capacity (UFCs). A total of 9 200 UFCs are allocated under the Torres Strait Prawn Fishery Management Plan 2009. The PZJA issued these UFCs to Australian TSPF vessel licence holders when the plan was introduced. Each season, UFCs are converted into an annual use entitlement for each operator depending on the total allowable effort (TAE) set for that year (Cocking & Turnbull 2014). TSPF vessel licence holders can transfer unused UFCs for one season only to other TSPF vessel licence holders. UFCs are automatically transferred back before the next season. In January 2014 there were 46 active and 15 inactive vessel licences in the TSPF.

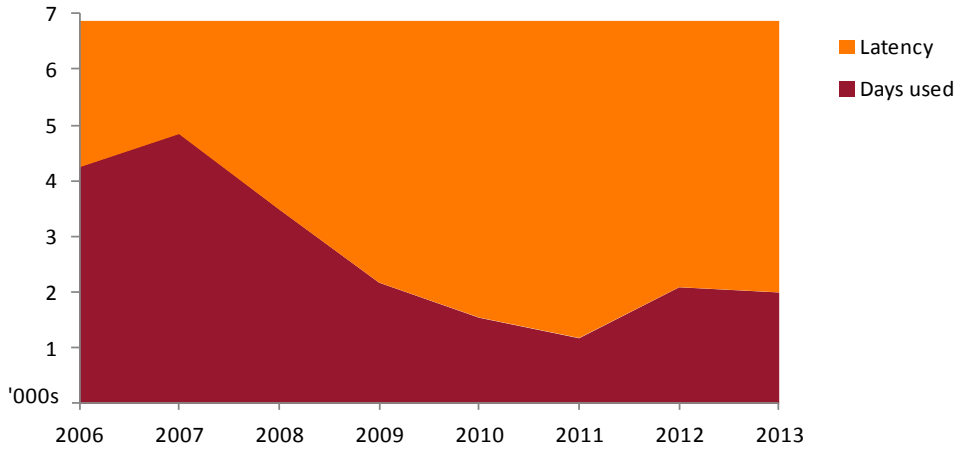
Entitlement values are estimated from valuations placed on the licence and UFCs by fishers operating in the TSPF. These valuations are usually subjective and may differ between operators. ABARES commenced collecting estimated entitlement values in the 2011–12 TSPF survey.

Entitlement values reflect the fishery's prawn stock and price expectations. In general, entitlement values reflect expected vessel profitability in the fishery. Over time, changes in entitlement values can indicate economic performance in the fishery. The average estimated sale price of a fishing night entitlement in the TSPF from the surveyed sample was $379 in 2010–11, while the median value of a vessel licence was $20 000. On average, each vessel that operated in the TSPF during the 2010–11 fishing season held 170 fishing night entitlements. This compares with an average of 116 fishing night entitlements held by the surveyed sample in 2011–12, at an estimated price of $472 per night. The median vessel licence value was estimated at $27 500 in 2011–12. These estimates provide limited information from the current survey. However, a time series of entitlement values will offer insights into an average fisher's perspective on the underlying performance of their fishery.

Quota latency

A significant level of latency, in unused allowable fishing days, has existed in the fishery since the early 2000s. When the TAE cap of 9 200 fishing days was introduced in the 2006 season to better align with the estimated maximum sustainable yield (MSY) for tiger prawns, latency in the fishery reduced to 38 per cent. However, latency levels progressively increased after 2007 (Figure 10). From 2009 to 2013 effort levels in the TSPF were substantially below the 6 867 days available for fishing to Australian operators. High latency levels typically indicate that fishers have little incentive to operate in the fishery, either because of poor market conditions relative to input costs and/or because of low fish stock levels. Given that tiger and Endeavour prawn stocks are estimated to be well above levels associated with MSY (see Georgeson, Stobutzki & Curtotti 2014), the low incentive to fish in the TSPF indicates that the fishery's cost structure is not compatible with output prices achieved from operating in the fishery.

Figure 10 Used and unused allowable fishing days, Torres Strait Prawn Fishery



5 Performance against management objectives

The Torres Strait Prawn Fishery (TSPF) is managed according to the objective of promoting economic efficiency and ensuring optimal use of fishery resources. The fishery harvest strategy does not yet have a target biomass level associated with an estimate of maximum economic yield (B_{MEY}). This has been attributed to the low economic value of the fishery and the high cost of estimating a B_{MEY} target (AFMA 2011). Under the harvest strategy, the B_{MSY} target will remain until effort and/or catch triggers are reached. When these triggers are reached for two consecutive years the fishery will be required to undertake research with the aim of implementing a B_{MEY} target (AFMA 2011).

Estimated net economic return (NER) in this fishery was negative from 2003–04 to 2011–12 and forecast to remain negative in 2012–13. Negative NER is generally driven by low fishing receipts, which may be the result of poor catch and prawn prices or high input costs. General management changes that promote positive NER involve reducing allowable effort to levels associated with positive profits or reducing latency. Such management changes may not be appropriate in the TSPF due to the small and declining number of vessels operating in the fishery. As such, negative NER in this fishery is associated with unfavourable market conditions, which are beyond management control.

This report presents several indicators other than NER that the authors used to assess economic performance of the TSPF. Productivity analysis was undertaken for the period 1993–94 to 2007–08. It showed that fishery productivity increased as a result of less competition among a smaller fleet, the possible exit of less productive vessels and a larger stock of tiger prawns, which allowed for easier catch. More recent analysis of input costs and output prices, undertaken from 1997–98 to 2012–13, showed that the negative NER in 2010–11 and 2011–12 was influenced by unfavourable market conditions (which affected the price of outputs and the cost of inputs) rather than low productivity.

In 2011–12 the average management cost per vessel declined. However, on a per vessel basis costs were higher than those in the 1990s and early 2000s, because fishery management costs in 2011–12 were shared among fewer vessels. The increase in management costs per vessel between 2005–06 and 2009–10 reflects the exit of vessels from the fishery. Similarly, the increase in management costs as a share of gross value of production (GVP) declined during these years as catch, vessel numbers and NER declined.

The lack of positive NER from the fishery since 2004–05 remains an issue of concern to managers. Given the characteristics of this fishery (including geographical isolation, lack of supporting infrastructure and low participation), it is unlikely that returns will rise significantly without a change in the operating environment. High input costs and low prices during the survey years made it difficult to operate in the fishery profitably. Given the fishery's high latency level, management must remain vigilant to changes in the operating environment and move to the long-term maximum economic yield target when participation in the fishery improves.

Management must also have options for dealing with periods of low economic returns and participation in the fishery, particularly when status of stocks targeted is above levels associated with achieving maximum sustainable yield. The harvest strategy offers little guidance on this. Lower diesel fuel prices and a lower exchange rate for the Australian dollar are likely to improve economic returns and participation in the fishery in 2013–14 and 2014–15. However, restrictions on vessel length and gear size, and difficulties to date in changing these, mean that management should continue to focus on alternatives for improving returns and participation in the fishery.

Appendix A: Survey definitions

This appendix provides definitions of key financial performance variables, net economic return (NER) and the ABARES method of calculating NER. Use of NER as an indicator of economic performance is discussed briefly after definitions.

Financial performance

ABARES used these definitions of key variables in the analysis of vessel-level financial performance.

Total cash receipts represent returns from sale of fish, from non-fishing activities (including charter operations) and from other sources (insurance claims and compensation, quota and/or endorsements leased out, government assistance and any other revenue) in the financial year.

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

In other cases, the cooperative or agency pays the crew directly for the catch; the owner's financial records might include only the revenues 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 vessel 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 vessels 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 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 vessel-related aspects of the fishing business, such as crew or onshore administration costs, but do not cover the cost of onshore labour to process fisheries products.

On many vessels, the costs of labour are reflected in the wages paid by vessel owners and/or in the share of the catch they earn. However, in some cases, 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. This 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 what it would cost to employ someone else to do the work.

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

Depreciation costs are 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. ABARES uses this method of calculating depreciation in other industry surveys.

Vessel business profit is vessel cash income less depreciation.

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

Capital is the value placed on the assets employed by the business that owns the surveyed vessel. It includes the value of the vessel, hull, engine and other onboard equipment (including gear). Estimates are also reported for the value of quotas and endorsements held by the surveyed vessel. 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 vessel and gear. The value of quota and endorsements held is not included in the estimate.

Rate of return to vessel capital is calculated as if the proprietors owned all fishing assets. This enables financial performance of sample vessels to be compared regardless of proprietors' equity in the business. Rate of return to vessel 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).

Net economic return

Net economic return is the long-run profit 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.

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

$$NR = R - CC - OWNFL + ILR - OppK - DEP + recMC - totM$$

cash receipt | operating costs | capital cost | 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

totMC = total management costs.

Note that recovered management costs are those management costs paid by industry through management fees; they are included in total cash costs (CC). These costs are removed (as indicated by '+ recMC') to prevent double counting, given that these costs are a component of total management costs. Similarly, interest and quota/permit leasing costs are removed (indicated by '+ ILR'), because these costs at the fishery level represent revenues that have been redistributed to external investors in the fishery.

Survey-based estimation of net economic return

Fish sale receipts

Fish sale receipts are usually taken from fishers' financial accounts. Where a fisher operates in more than one fishery, they are asked to indicate the proportion of total fish sales 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' received for the catch. Beach price is the price received for fish at its first landing point.

Income received from leasing out quota and licences is not included as income in calculating net economic return. This item represents a redistribution of profits among investors in the fishery. Also, the amount a fisher earns from leasing out quota and licences relates to the amount of profits the fishery generates. Therefore, including leasing revenue would result in double counting.

Operating costs

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

Labour costs are often specified in fishers' accounts as wages. However, in calculating net returns, an estimate of the opportunity cost of labour is needed. 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 is not easily identifiable in fishers' accounts. Owners and their families are often involved in operating a vessel, either as skippers and crew or onshore as accountants and shore managers. Some will be paid market value for their labour, some will not be paid at all and others will be paid very high amounts (for example, as director fees or manager fees). In these cases, ABARES 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 non-family 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 calculation of net returns for the same reason they are excluded from income. See 'Fish sale receipts' for explanation.

Capital costs

To calculate capital costs, an estimate of the value of capital is needed. ABARES 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 equivalent item. By accounting for previous depreciation and inflation, these data are used to estimate the total value of capital invested in the fishery for the survey year.

As mentioned, 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 had been invested elsewhere. This cost is not identifiable in fishers' accounts. A real interest rate that represents the long-term average rate of return that could be earned on an investment elsewhere is applied to the value of capital in the fishery. For fisheries surveys, ABARES uses a rate of 7 per cent per year.

Depreciation expense is the cost of capital becoming less valuable over time as a result of wear and tear and obsolescence. Depreciation expense is not consistently identifiable in fishers' accounts, so ABARES calculates the annual depreciation of vessels based on the capital inventory list collected during the surveys and predetermined depreciation rates for each capital item type.

Management costs

Management costs are those costs associated with harvesting fish in the fishery. Management costs have two components: recovered management costs and non-recovered management costs. Recovered management costs (recMC) are recovered from fishers and appear in the accounts of fishers as payments of management fees or levies. Non-recovered management costs are not charged to fishers but instead are covered by the managing body or government. Calculation of net economic returns requires 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 contained in fishers' accounts. This estimate of recovered management costs is based only on a sample of the fishery, so 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 non-recovered management costs. For these reasons, recovered management costs from fishers' accounts are ignored (as indicated by +recMC in the net returns equation). Total management costs (totM) as supplied by AFMA are then used to estimate net economic returns.

Net economic return and economic performance

Maximum economic yield (MEY) is the point where levels of effort, catch and stocks in a fishery maximise the difference between revenue and cost—that is, fishery profit. NER estimates do not reveal how a fishery is performing relative to this maximum potential, but NER trends together with other indicators can indicate whether the MEY objective is getting closer to being met.

Appendix B: Survey methods

Collecting economic survey data

ABARES has undertaken economic surveys of selected Commonwealth fisheries since the early 1980s and regularly surveyed particular fisheries since 1992. Under the current program ABARES surveys major Commonwealth fisheries every two years. It aims to develop a consistent time series of economic information for each fishery. Such information, in conjunction with scientific assessments of each fishery, is vital for assessing fisheries' economic performance.

Survey information is made publicly available so the performance of fisheries and the impact of management policies can be assessed independently.

Sample design

ABARES surveys are designed and samples selected on the basis of information provided by AFMA. This information includes data on the volume of catch, fishing effort and vessel characteristics.

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

In practice, this sample is seldom fully realised. Non-response is relatively high across fishery surveys, reflecting difficulty in contacting some operators and reluctance of others to participate. This may bias the results—for example, if profitability of respondents and non-respondents differs significantly. Sample design and weighting systems have been developed that reduce the non-response effect, but care must still be taken when interpreting survey information.

Between February and August, an ABARES officer visits the owner of each vessel selected in the sample. The officer interviews the vessel owner to obtain physical and financial details of the fishing business for the survey years. When necessary, the skipper of the vessel is also interviewed. ABARES subsequently obtains further information from accountants, selling agents and marketing organisations on the signed authority of the survey respondents.

ABARES reconciles the information obtained from various sources to produce the most accurate description possible of the financial characteristics of each sample vessel in the survey.

Sample weighting

All population estimates presented in this report were calculated from the weighted survey data of sample vessels. ABARES calculates a weight for each vessel in the sample based on how representative that vessel is in the population. Sample weights are constructed such that individual weights sum to the number of vessels in the fishery fleet and the weighted sum of sample vessel catch approximates the total catch for the fishery, as recorded in AFMA logbooks.

That is,

$\Sigma w_i = P$ and $\Sigma w_i x_i = X$

where:

w_i is the weight for the i^{th} vessel

P is the number of vessels in the population

x_i is the catch for the i^{th} vessel

X is the total catch for the target population.

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

Reliability of estimates

ABARES generally surveys a relatively small number of vessels out of the total number of vessels in a particular fishery. Estimates derived from these vessels are likely to be different from those that would have been obtained if information had been collected from a census of all vessels. The number of vessels in the sample, the variability of vessels in the population and, most importantly, the design of the survey and the estimation procedures used influence how closely the survey results represent the population.

Measures of sampling variation have been calculated as a guide to reliability of survey estimates. 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

Relative standard errors can be used to calculate confidence intervals for the survey estimate. First, the standard error is calculated 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 $6 000.

The chance that the census value (the value that would have been obtained if all vessels in the target population had been surveyed) is within one standard error of the survey estimate is roughly two in three. The chance that the census value is within two standard errors of the survey estimates is roughly 19 in 20. Therefore, in this example, the chance that the census value is between $94 000 and $106 000 is two in three and the chance that the census value is between $88 000 and $112 000 is 19 in 20.

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 estimates of total cash receipts were $100 000 for one year and $125 000 for 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:

$$\sqrt{(0.06 * \$100\,000)^2 + (0.06 * \$125\,000)^2} = \$9\,605$$

The relative standard error of the difference is:

$$(\$9\,605/\$25\,000) * 100 = 38\%$$

The population of a fishery may change 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.

Non-sampling 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 non-respondents on a particular variable being surveyed.

ABARES survey staff are generally very experienced and undergo rigorous pre-survey training, aimed at minimising non-sampling errors. However, when drawing inferences from estimates derived from sample surveys, users should be aware that both sampling and non-sampling errors occur.

Appendix C: Non-survey based estimation of net economic return

ABARES has developed a non-survey based method of estimating net economic returns for financial years where survey data are not yet available. It allows more timely estimation and reporting of net economic return estimates that can better inform both industry and government decision-making. This method is intended to complement collection of data and publication of results normally undertaken through the fisheries surveys.

Method

The method used to calculate non–survey based estimates of net economic return for a non-survey year (a year for which no survey data are available) uses regression estimates for key components of net economic return. Regression approaches use the most relevant variables for each fishery, given unique fishing methods and other characteristics. In all cases, each component is estimated based on an assumed sample of the population and a set of corresponding assumed weights. This assumed sample represents those vessels expected to be sampled in the next survey, on 2012–13 accounts.

Reliability of estimates

Estimates from the regression analysis are subject to uncertainties. For example, it is not certain that historical relationships and sample representativeness will hold in the most recent year. Operating conditions in the fishery may change, which would result in changes in receipts and costs not foreseeable using this method.

Estimates should be used as an indication of the likely direction and magnitude of changes in net economic return. For each receipt and cost category, the coefficient of determination (R^2) indicates the extent to which the explanatory variables can explain variation in the dependent variable. Lower coefficients of determination suggest a greater level of uncertainty surrounding the estimates.

Cash receipts

Cash receipts are the primary component of net economic return calculations, because all other costs are deducted from cash receipts. Cash receipts represent income from fishing operations in the surveyed fishery. Therefore, for non-survey years, gross value of production (GVP) is a good indicator for cash receipts because it has a close relationship with fishing income. Preliminary estimates of GVP were made using average price data and catch data. Variables included for each fishery include preliminary GVP and time trend (Table C1).

Table C1 Regression model for average cash receipts, Torres Strait Prawn Fishery

Variable	Estimate	Standard error	t-statistic	Pr(>|t|)
Intercept	1.90e+0.2	8.63e+04	0.002	0.9984
GVP	1.22e+00	2.66e–01	4.587	0.0195
Vessel dummy	–2.17e+05	1.24e+05	–1.755	0.1776
Year dummy	2.33e+05	5.80e+04	4.016	0.0277
R2	0.95	–	–	–
Prob(F-stat)	17.74	–	–	–

Operating costs

The key drivers of operating costs in any fishery are fuel and labour. Therefore, accurately calculating operating costs for a non-survey year requires selecting variables that influence these two components. For labour, share payment systems imply a close relationship between fishery GVP and labour costs. In contrast, fuel costs depend on fuel prices and hours trawled in the Torres Strait Prawn Fishery. Hence, preliminary estimates of operating cost were based on gross value of production (GVP) and fuel cost (Table C2).

Table C2 Regression model for average operating costs, Torres Strait Prawn Fishery

Variable	Estimate	Std. error	t-statistic	Pr(>|t|)
Intercept	3.99e+04	2.68e+05	0.149	0.895
GVP	1.59e–01	2.09e+00	0.076	0.946
Fuel cost	2.77e+00	5.63e+00	0.493	0.671
Year dummy	8.73e+04	1.82e+05	0.480	0.679
Vessel dummy	–2.40e+04	3.90e+05	–0.615	0.601
R^2	0.60	–	–	–
Prob(F-stat)	0.75	–	–	–

Interest, leasing and management fees

Interest and leasing fees represent a redistribution of profits to investors in the fishery. As such, they are not costs at the fishery level. They are estimated based on historical ratios and values.

Management fees for the purpose of estimation are taken from AFMA (recovered and non-recovered) and include all costs for managing the fishery, not just those recovered from industry. They are also estimated based on historical ratios and values.

Opportunity cost of capital and depreciation

Capital values, the opportunity cost of capital and depreciation expenses were estimated based on:

- an implied capital rate of 7 per cent
- an assumed rate of depreciation to implied capital that is equal to that in the most recent surveyed year
- a capital upgrade rate that is estimated from a moving average 5 (MA5) of historical implied capital growth.

Management costs

Total management costs (recovered and non-recovered) for 2012–13 were based on AFMA's budgeted estimates.

Appendix D: Productivity methodology

Productivity measurement

Productivity is defined as the quantity of output produced with a given quantity of inputs. For example, a partial measure of productivity for a fishing vessel would be kilos of a particular species of fish produced per hook used. A more complete measure of productivity would be the total catch per unit of all the inputs used. This approach is preferred as a measure of productivity and is usually referred to as total factor productivity.

Various methods have been developed to quantitatively assess total factor productivity trends for industries and individual enterprises within industries (see Coelli et al. 2005 for discussion). A frequent approach to measuring productivity trends uses index number theory. In this report a Fisher quantity index is used to measure total factor productivity trends for key Commonwealth fisheries (Box D1). Fishery-level input, output and total factor productivity indexes were estimated for each of the Commonwealth fisheries analysed and for each year where data were available. The Fisher quantity index is well suited to handling the range of inputs and outputs recorded in ABARES fisheries economic survey data. For example, ABARES fisheries economic survey data contain many zero entries, which are well handled by the Fisher quantity index approach.

As with other index number approaches that measure productivity, the Fisher quantity index enables measurement of productivity trends with multiple inputs and outputs. The prices paid for inputs and received for outputs are used as weights to derive aggregations of outputs and inputs, which are expressed in index form. Output and input indexes are estimated using both a Laspeyres and a Paasche index approach. A geometric mean of these indexes is derived to determine the Fisher output and input indexes. Total factor productivity is measured as the ratio of the Fisher output and Fisher input indexes.

Data

Data used for this total factor productivity analysis are sourced from the ABARES Australian fisheries surveys dataset. The surveys dataset comprises physical and financial survey data for a sample of vessels operating in key Commonwealth fisheries. Inputs incorporated in the input indexes for each fishery are labour, fuel, repairs and capital. Output indexes for each fishery are described in the results section for each individual fishery. Population estimates are derived using sample vessel data from this database and calculated for each of the fisheries analysed in this report. A weight is calculated for each vessel in the sample, to represent its importance in the total unobserved population. The weight is generally based on the vessel's catch representation. Weighted vessel-level information is used to derive fishery level input and output indexes.

Box D1 Fisher index

Using price and quantity data for a set of outputs (inputs), the Laspeyres quantity index Q_{0t}^{L} can be defined as:

$$Q_{0t}^{L} = \frac{\sum_{i=1}^{N} p_{i0} q_{it}}{\sum_{i=1}^{N} p_{i0} q_{i0}} = \sum_{i=1}^{N} W_{i0} \frac{q_{it}}{q_{i0}}$$

where

$$W_{i0} = \frac{p_{i0} q_{i0}}{\sum_{i=1}^{N} p_{i0} q_{i0}}$$

is the share of ith item in the total value of outputs (inputs) in the base period (denoted by 0). The Laspeyres index compares a total quantity in time period *(t)* to a base period.

The Paasche index (Q_{0t}^{P}) is defined as:

$$Q_{0t}^{P} = \frac{\sum_{i=1}^{N} p_{it} q_{it}}{\sum_{i=1}^{N} p_{it} q_{i0}} = \left\{ \sum_{i=1}^{N} W_{it} \left(\frac{q_{i0}}{q_{it}} \right) \right\}^{-1}$$

where

$$W_{it} = \frac{p_{it} q_{it}}{\sum_{i=1}^{N} p_{it} q_{it}}$$

is the share of ith item in the total value of outputs or inputs in the current period (denoted by t). Like the Laspeyres index, the Paasche index compares a total quantity in time (t) to a base period (0).

The Fisher index (Q_{0t}^{F}) is the geometric mean of Laspeyres and Paasche indexes, defined as:

$$Q_{0t}^{F} = \sqrt{Q_{0t}^{L} Q_{0t}^{P}}$$

The TFP index can be calculated as the ratio of the Fisher output (Q_{0t}^{FO})and input(Q_{0t}^{FI}) indexes:
$TFP_{0t} = \frac{Q_{0t}^{FO}}{Q_{0t}^{FI}}$

Total factor productivity inputs and outputs

Total inputs consist of 13 items, which can be split into four major groups:

Capital—capital costs account for all capital items associated with the fishing business. These include the vessel, hull, engine, onboard equipment, vehicles and sheds. The estimate of capital is based on the depreciated replacement value. The quantity variable used for all capital is the average value of capital stock deflated by the respective prices indexes for each.

Fuel—Fuel costs include the costs of all fuel, oil and grease. The quantity variable used for all fuel is the average of fuel use deflated by the fuel price paid.

Labour—Labour includes the number of crew employed in vessel-related aspects of the fishing business, such as crew or onshore administration costs, but does not cover the cost of onshore labour involved in processing fisheries products. It covers owner/partner, family and unpaid labour.

Repairs—Repairs costs include vessel and motor vehicle repairs, gear costs and other repairs expenditure. The quantity variable is the value of all repairs deflated by the price of repairs.

Outputs are the species caught by vessels in each fishery. For the Torres Strait Prawn Fishery, outputs are tiger, king, Endeavour and other prawns as well as other species caught. The price variable is the price received for the species caught. The quantity variable is the number of kilograms of each species caught by individual vessels.

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