Chapter 19
Torres Strait Prawn Fishery

M Flood and D George

FIGURE 19.1 Relative fishing intensity in the Torres Strait Prawn Fishery, 2012

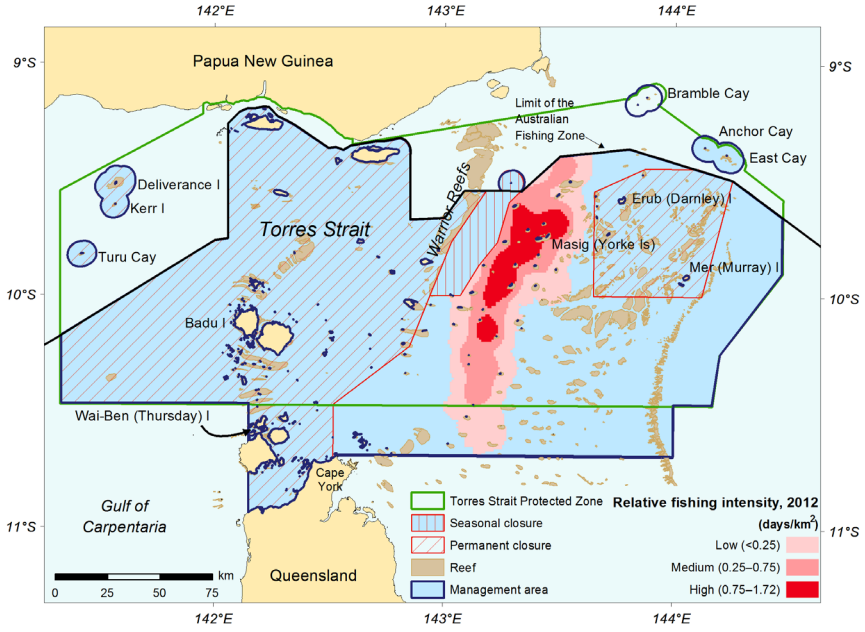


TABLE 19.1 Status of the Torres Strait Prawn Fishery

Status	2011		2012		Comments
Biological status	**Fishing mortality**	**Biomass**	**Fishing mortality**	**Biomass**	
Brown tiger prawn (*Penaeus esculentus*)					Catch in recent years is below MSY. Most recent estimate of biomass is above B_{MSY}.
Blue endeavour prawn (*Metapenaeus endeavouri*)					Catch in recent years is below MSY. Most recent estimate of biomass is above B_{MSY}.
Economic status	NER were negative in 2008–09 but may have improved since then. The input control on vessel size and a failure to address latent effort may be hindering the fishery's performance against its objective to promote economic efficiency.				

Notes: B_{MSY} Biomass at maximum sustainable yield. **MSY** Maximum sustainable yield. **NER** Net economic returns.

Fishing mortality	Not subject to overfishing	Subject to overfishing	Uncertain
Biomass	Not overfished	Overfished	Uncertain

19.1 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' (Figure 19.1). The Australian fishery is managed by the Torres Strait Protected Zone Joint Authority (PZJA), established under the *Torres Strait Fisheries Act 1984*. Currently, all licences in this fishery are held by the non-Indigenous Transferable Vessel Holder sector.

Under the Torres Strait Treaty, Papua New Guinea is entitled to 25 per cent of the TSPF resource in the Australian jurisdiction, and Australia is entitled to 25 per cent of the TSPF resource in the Papua New Guinea jurisdiction. Historically, some Australian boats have 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 boats 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, effort had been decreasing, largely as a result of economic conditions in the fishery (Figure 19.2). The total catch from the fishery increased by approximately 82 per cent from 2011 to 2012.

The fishery is subject to several spatial and temporal closures (Figure 19.1). These have been initiated for various reasons, including protection of undersized tiger prawns (i.e. those that are below commercially marketable sizes; Watson & Mellors 1990), protection of pearl shell beds and protection of breeding populations of marine turtles.

The TSPF is a jointly managed fishery that falls under PZJA jurisdiction and different legislation from Commonwealth fisheries. The PZJA released a harvest strategy for the TSPF in 2011 (AFMA 2011), which defines a set of trigger, target and limit reference points and decision rules for the fishery as a whole and for tiger prawns. A catch trigger also exists for endeavour prawns. Triggers are set at levels that acknowledge the reduced effort in the fishery in recent years, and the harvest strategy provides for revision and update if activity in the fishery increases. The strategy has a long-term economic target that will be pursued once catch-and-effort triggers in the fishery are reached. A short-term economic target is not in place because the fishery does not currently have the resources to calculate biomass at maximum economic yield (B_{MEY}). As well, since a B_{MEY} target would reduce fishing effort, there is concern that introducing an economic target would put additional pressure on operators when the fishery is already under economic pressure.

The harvest strategy's limit reference point is set as 20 per cent of unfished biomass ($0.2B_0$), consistent with the default provided for in the Commonwealth Fisheries Harvest Strategy Policy (HSP; DAFF 2007). The current target reference point (B_{TARG}) is based on maximum sustainable yield (MSY)—that is, $B_{TARG} = B_{MSY}$. In contrast, the triggers in this fishery are aligned with the concept of MEY, consistent with the fishery's goal to move to MEY-based targets when fishing activity increases. The triggers are based on fishers catching 75 per cent of the Australian portion of total allowable catch or total allowable effort (TAE), set using a proxy of $B_{MEY} = 1.2\ B_{MSY}$, equating to $0.34B_0$.

FIGURE 19.2 Prawn catch by species, and effort, in the TSPF, 1989 to 2012

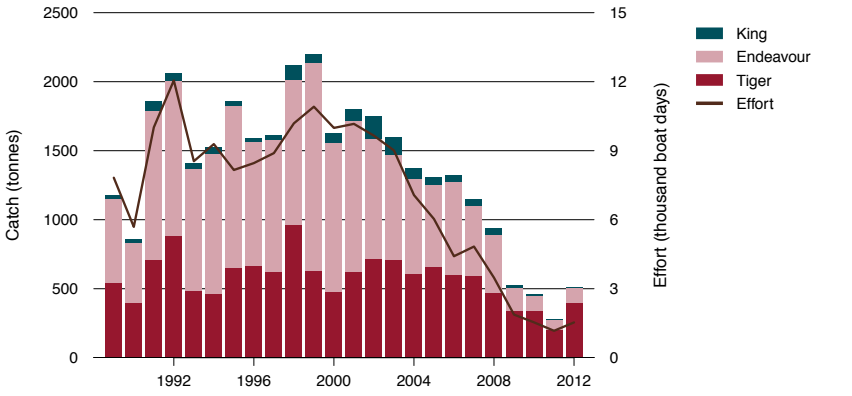


TABLE 19.2 Main features and statistics for the TSPF

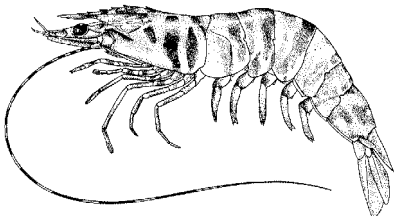
Fishery statistics a	2011			2012		
Stock	**TAE (days)**	**Catch (t)**	**Real value (2010–11)**	**TAE (days)**	**Catch (t)**	**Real value (2011–12)**
Brown tiger prawn	–	203.5	$2.90 million	–	395	$5.17 million
Blue endeavour prawn	–	73.7	$0.54 million	–	114.6	$0.93 million
Total fishery	**9 200**	**294.8**	**$3.89 million**	**9 200**	**532.2**	**$6.72 million**
Fishery-level statistics						
Effort (days)	1 171			1 535		
Fishing permits	61 (15 licences not attached to vessels)			61 (13 licences not attached to vessels)		
Active vessels	17			17		
Observer coverage	43 days (3.75% of activated effort)			39 days (2.8% of activated effort)		
Fishing methods	Otter trawl					
Primary landing ports	Cairns, Innisfail					
Management methods	Input controls: TAE on fishing nights, individual transferable effort units, limited entry (although licences are transferable), gear restrictions, time and area closures, vessel length restrictions					
Primary markets	Domestic: frozen International: United States, Japan, Europe—frozen					
Management plan	*Torres Strait Prawn Fishery management plan 2009* (DAFF 2009)					

a Fishery statistics are provided by fishing season, unless otherwise indicated. Real-value statistics are by financial year. Fishing season is 1 March to 1 December.
Notes: **TAE** Total allowable effort. – Not applicable.

Prawn trawling gear
AFMA

19.2 Biological status

19.2.1 Brown tiger prawn



Line drawing: FAO

Stock assessment

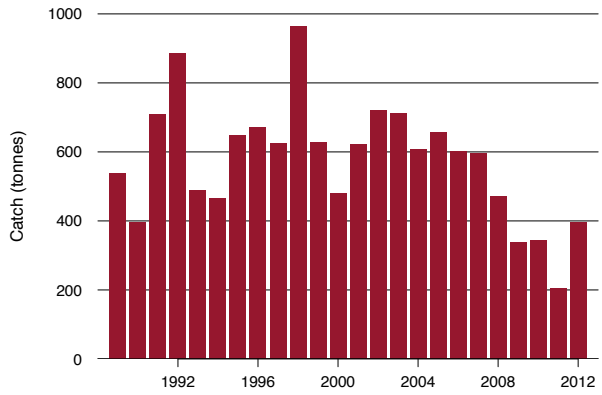
The most recent stock assessment for brown tiger prawns in the Torres Strait was completed in 2006 using data to the end of 2003 (O'Neill & Turnbull 2006). Since the 2006 assessment was released, some further assessment model runs with additional years of data have been conducted (Taylor et al. 2007), but no full reassessments have been undertaken. The most recent estimate of tiger prawn biomass suggested that the stock was increasing and was between 0.6 and 0.8 of unfished biomass (B_0; Taylor et al. 2007). This was considerably higher than B_{MSY}, which was estimated to be around $0.28B_0$–$0.38B_0$ (O'Neill & Turnbull 2006). The delay-difference model (O'Neill & Turnbull 2006) estimated MSY for tiger prawns to be 606 t (90 per cent confidence interval [CI] 436–722 t), and effort at MSY (E_{MSY}) to be 8245 fishing nights[1] (90 per cent CI 5932–9823 t) using the Ricker spawner–recruitment relationship. Using the Beverton–Holt spawner–recruitment relationship, MSY was estimated to be 676 t (90 per cent CI 523–899 t) and E_{MSY} to be 9197 nights (90 per cent CI 7116–12 231 t).

The 2006 assessment is still being used to inform management decisions in the fishery. However, brown tiger prawn is a relatively short-lived species with variable recruitment that can be influenced by environmental factors. Changes in fleet dynamics and vessel efficiency are also likely to influence the long-term utility of the 2006 assessment. As a result, the outputs from this stock assessment are likely to have become less reliable over time.

Tiger prawn catch in the TSPF was 395 t in 2012, up from 203.5 t in 2011 (Figure 19.3).

1 The terms 'day' and 'night' are used interchangeably in this chapter when discussing fishing effort because effort units are allocated in days, but fishing occurs at night.

FIGURE 19.3 Tiger prawn catch in the TSPF, 1989 to 2012



Stock status determination

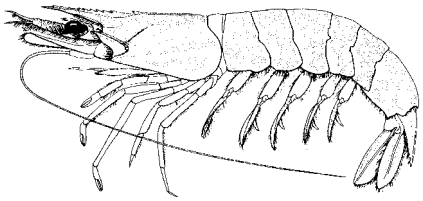
Assessment of status for this stock in 2012 is based on a comparison of recent catches (Figure 19.3) with estimates of MSY (O'Neill & Turnbull 2006), a comparison of active effort with estimates of E_{MSY} (O'Neill & Turnbull 2006) and the 2006 estimates of biomass (Taylor et al. 2007).

The tiger prawn catch has been below the 2006 estimates of MSY for both Ricker (606 t) and Beverton–Holt (676 t) spawner–recruitment relationships for the past seven seasons. The effort applied to the fishery has been below the estimates of E_{MSY} for the past nine seasons and below the lower 90 per cent CI of both relationships for E_{MSY} for the past seven seasons. As a result, the stock is classified as **not subject to overfishing** in 2012.

Although the HSP does not apply to the jointly managed TSPF, the default HSP proxy limit of $0.2B_0$ is used to inform status evaluations. The 2006 estimate of tiger prawn biomass (between 0.6 and 0.8 of B_0) was considerably higher than B_{MSY} and therefore well above the HSP proxy limit reference point of $0.2B_0$. Since fishing effort has been below the estimated E_{MSY} for some time, the stock is classified as **not overfished** in 2012.

Tiger prawn
AFMA

19.2.2 Blue endeavour prawn



Line drawing: FAO

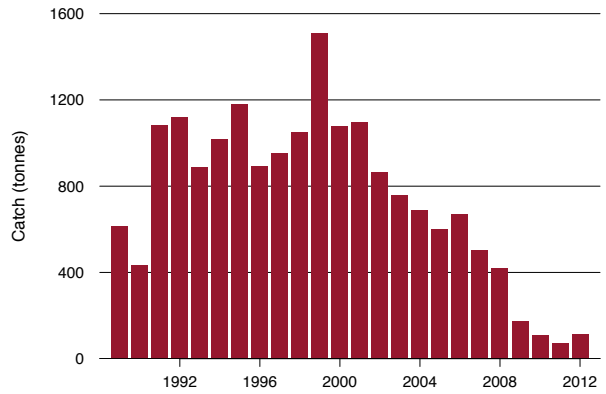
Stock assessment

The most recent stock assessment for blue endeavour prawn was completed in 2009 using data to the end of 2007 (Turnbull et al. 2009). This assessment evaluated abundance of cohorts (based on sex, size and age) of the stock through time, allowing tracking of size-related variability in productivity.

The deterministic size- and age-structured model with a fixed steepness value of 0.5 estimated MSY to be 1105 t (90 per cent CI 1060–1184 t) and E_{MSY} to be 10 079 nights (90 per cent CI 9667–10 800 t). While a stochastic size-and age-structured assessment was also run, this model did not achieve convergence of parameter estimates, and was not accepted. Similarly, the deterministic model with fixed steepness of 0.7 did not achieve convergence. The biomass estimate from the deterministic model with steepness fixed at 0.5 was around $0.8B_0$.

Endeavour prawn catch in 2012 was 114.6 t, up from 73.7 t in 2011 (Figure 19.4).

FIGURE 19.4 Endeavour prawn catch in the TSPF, 1989 to 2012



Stock status determination

The stock status classification for blue endeavour prawn in 2012 is based on a comparison of recent catches (Figure 19.4) with estimates of MSY from the 2009 assessment, comparison of effort with estimates of E_{MSY} and the 2009 estimates of biomass. The deterministic model configuration (with fixed steepness of 0.5) recommended by Turnbull et al. (2009) estimated MSY at 1105 t (90 per cent CI 1060–1184 t) and E_{MSY} at 10 079 nights (90 per cent CI 9667–10 800 t). Since 2002, catch has been below the lower 90 per cent CI of the MSY (1060 t), and effort has been below the lower 90 per cent CI of E_{MSY} (9667 nights). As a result, the stock is classified as **not subject to overfishing** in 2012.

Although the HSP is not prescribed for the TSPF, in the absence of a prescribed limit reference point for this stock, the default HSP proxy limit reference point of $0.2B_0$ is used to inform status. The 2007 biomass estimate from the deterministic model with a fixed steepness value of 0.5 was around $0.8B_0$ (Turnbull et al. 2009). This would put the stock biomass above the estimated B_{MSY} of $0.43B_0$ and well above the HSP proxy limit reference point of $0.2B_0$. As a result, the stock is classified as **not overfished** in 2012.

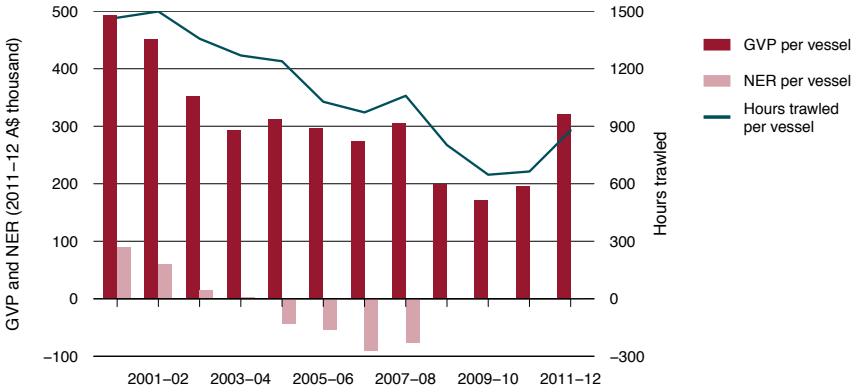
19.3 Economic status

19.3.1 Key economic trends

ABARES has conducted economic surveys of the TSPF since the early 1990s, allowing calculation of net economic returns (NER) and financial performance measures. The fishery was scheduled to be surveyed in 2011, but the survey was not completed because of low vessel numbers and low survey participation. The previous economic survey of the TSPF was conducted in 2009. NER were estimated at –$3.3 million for the 2008–09 financial year (Vieira & Perks 2009). Before that, estimated NER had been declining between 2000–01 and 2008–09, linked to rising fuel prices and falling beach prices for prawns caught in the fishery.

No new survey-based estimates of NER are available after 2008–09. However, general trends in NER can be inferred from trends in vessel-level indicators for the fishery. Between 2000–01 and 2009–10, the number of hours trawled per vessel declined substantially in response to declines in profitability (Figure 19.5). Gross value of production (GVP) per vessel (an indicator of vessel revenue) also followed a declining trend. This trend has reversed in recent years, with increases in GVP per vessel in both 2010–11 and 2011–12. GVP per vessel in 2011–12 was approximately $320 000, the highest it has been since 2001–02 (when positive NER were being generated). However, at the same time, effort input per vessel remained at historically low levels in 2011–12 at 878 trawl hours per vessel (the fourth lowest level since 2000–01). Higher revenue per vessel in 2010–11 and 2011–12, combined with lower effort levels, suggests that vessel-level profitability has improved. Stability in the number of active operators in the fishery between 2010–11 and 2011–12 supports the idea that vessel profitability may have improved; before this, the number of active operators declined each year since 2000–01.

FIGURE 19.5 GVP, NER and hours trawled per vessel in the TSPF, 2000–01 to 2011–12



Notes: **GVP** Gross value of production. **NER** Net economic returns.

Skirtun and Vieira (2012) analysed the drivers of the recent profitability trends in the TSPF, using a profit decomposition approach. They found that the key drivers of declining profitability from 1998–99 to 2007–08 were falling output prices and rising fuel prices; the negative contribution from these two factors was highest in 2006–07. The authors note that, historically, profitability trends in the fishery have tended to reflect those in the Northern Prawn Fishery (NPF), but this has not been the case in recent years. They identify the key reason for the divergence in trends as a difference in the relative growth in economic productivity. Average vessel productivity in the TSPF has followed an increasing trend but not to the same extent as in the NPF.

Prawn trawler
AFMA

19.3.2 Management arrangements

The fishery is managed using input controls. A limit on the number of boat licences and tradeable fishing nights are the main input controls, and these are combined with other restrictions on gear and vessel characteristics (DAFF 2009). Skirtun and Vieira (2012), in their analysis of profit trends in the TSPF, suggest that management arrangements in the fishery may have been a constraint on greater productivity gains and, therefore, higher profitability. The recent divergence in trends in economic performance of the NPF and TSPF may also be linked to differences in management arrangements. Although both the NPF and the TSPF are managed with input controls, restrictions on trade in effort entitlements have been greater in the TSPF until recently (DAFF 2009). These restrictions may have unnecessarily constrained autonomous adjustment in the TSPF and, as a result, fishery-level efficiency. High levels of latent effort have persisted in the TSPF and are likely to have reduced the incentive to trade in effort entitlements, limiting the movement of effort entitlements to the most efficient fishers. Currently, there are 61 licences in the fishery, of which 21 were active in the 2011–12 financial year (resulting in a latency of 66 per cent).

The TSPF is also managed through limits on maximum vessel size (DAFF 2009). Since larger vessels tend to have larger fuel and catch-holding capacities, such vessels can stay at sea longer and are better able to operate in geographically isolated fisheries, such as the TSPF. Therefore, by preventing the use of larger vessels, this management arrangement may be constraining economic performance in the fishery. In recognition of these issues, in early 2011 the PZJA, in consultation with the Torres Strait Prawn Management Advisory Committee (TSPMAC), recommended that trials be undertaken of alternative fishing gear and vessel size configurations in the fishery (PZJA 2011). Consultation through the TSPMAC regarding this recommendation is ongoing.

19.3.3 Performance against economic objective

The TSPF is managed according to the economic objective of promoting economic efficiency and ensuring the optimal utilisation of the fishery resource, consistent with ecologically sustainable development and precautionary principles. Although these objectives are implicitly consistent with maximising economic yields, the recently implemented harvest strategy for the fishery does not currently have a target biomass level associated with an estimate of MEY (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). The B_{MSY} target will remain until decision rules relating to increased fishing activity are activated that will require a B_{MEY} target to be determined and implemented (AFMA 2011).

The biomass levels of brown tiger and blue endeavour prawns are well above B_{MSY}, and so economic performance is currently not constrained by biomass. However, low to negative NER have been present in the fishery over the past decade, and vessel numbers and effort levels have declined in response to the fishery's low profitability. This suggests that economic performance in this fishery could be improved.

One key concern regarding economic performance in the TSPF relates to the TAE, which has been consistently set at levels associated with high effort latency. This implies that the fishery has been allowed to operate in a manner consistent with the open-access equilibrium, a theoretical point associated with zero economic profits and overcapacity. This is supported by recent estimates of negative NER in the fishery.

For the fishery to generate positive NER, allowable effort would need to be reduced to levels that are associated with positive profits. However, for the TSPF, this is made difficult by the length of time for which the current management situation has been maintained and the level of adjustment that is required. A potential low-cost approach to this adjustment would involve taking advantage of the market-based management tool used in the fishery (transferable effort units) so that, as the TAE is reduced, effort units would be traded towards the most profitable operators. The recent low profitability of the fishery would make such adjustment at the operator level difficult, and the period allowed for such adjustment might be extended to take this into account.

High levels of latent effort mean that any improvement in fishery profitability can quickly dissipate with the activation of latent effort, while increased catches are likely to reduce biomass to less profitable levels. As indicated above, the fishery may have reversed its trend of declining profitability. However, this possible improvement in profitability may be eroded (or return to a decline) if excessive latent effort in the fishery is activated.

Another concern for economic performance is that input controls may be impeding the economic efficiency of operators, with limited benefits for fishing mortality. In particular, the restriction placed on vessel size is considered a constraint on the fishery's economic performance.

19.4 Environmental status

Prawn trawling is a relatively non-selective fishing method, and a variety of byproduct and bycatch species are caught together with the target species. Bycatch typically includes finfish, cephalopods, crabs, lobsters, scallops, sharks and rays. Trawling also has potential impacts on benthic communities and protected species, including turtles, sea snakes and syngnathids (seahorses and pipefish). Research surveys between 2004 and 2006 collected independent data on the weight, composition and distribution of bycatch in the TSPF (Turnbull & Rose 2007). The surveys were conducted in two areas: the main prawn trawling grounds, and adjacent areas that are seasonally or permanently closed to trawling. No major differences were found in the overall composition and abundance of bycatch species between areas that are open, partially closed and entirely closed to trawling. However, there were some differences in the relative proportions of different bycatch species between open and closed areas.

The TSPF was reassessed against Parts 13 and 13A of the *Environment Protection and Biodiversity Conservation Act 1999* on 13 March 2013. Recommendations associated with the resulting approvals include the PZJA agencies setting appropriate trigger points in the fishery; the PZJA ensuring that relevant risk assessments for bycatch species, habitats and ecosystems in the TSPF are undertaken when the TSPF harvest strategy trigger points are reached (AFMA 2011); and the PZJA continuing to implement appropriate mitigation measures to ensure sustainability of bycatch species, habitats and ecosystems impacted by the fishery.

A Level 1 (Scale, Intensity, Consequence Analysis) ecological risk assessment has been conducted for the TSPF (Turnbull et al. 2007). The fishery also has a bycatch action plan, but this has not been updated since 2005 (AFMA 2005). Pitcher et al. (2007) provide comprehensive data on the biodiversity of seabed habitats of the Torres Strait, cataloguing more than 3600 species, comprising fishes, bycatch and species making up the benthos. Examination of the likely extent of past effects of trawling on the benthos and bycatch over the TSPZ indicated that trawling has had a significant effect on the biomass of 21 of the 256 species analysed. Of the 21 species, 9 have shown a negative response to trawling and 12 a positive response.

Within the TSPF, the PZJA requires operators to use turtle excluder devices in trawl gear. This requirement has been in place since the beginning of the 2002 fishing season. In 2004, the use of bycatch reduction devices became mandatory. In May 2008, the PZJA also agreed to implement trawl exclusion zones around Deliverance Island, Kerr Islet and Turu Cay (Figure 19.1) to protect important nesting areas for green turtles (*Chelonia mydas*) and flatback turtles (*Natator depressus*).

The Australian Fisheries Management Authority publishes quarterly reports of logbook interactions with threatened, endangered and protected species on its website. In 2012, 1550 sea snakes (species unknown) were caught in the TSPF, of which 1173 were released alive, 9 were dead and the remainder had an unknown life status. A total of 69 seahorses or pipefish were caught, all of which were dead. A single narrow swordfish was caught and released alive. Four green turtles and one unclassified turtle were caught, and all were released alive.

19.5 Literature cited

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Prawn trawler
AFMA