TIGER PRAWNS

Penaeus esculentus, Penaeus semisulcatus

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STOCK STATUS OVERVIEW

Stock status determination

Jurisdiction	Stock	Fisheries	Stock status	Indicators
Queensland	East Coast Otter Trawl Fishery (Brown and Grooved Tiger Prawn)	ECOTF	Sustainable	Biomass estimate, CPUE, catch, effort
Western Australia	Exmouth Gulf Prawn Managed Fishery (Brown Tiger Prawn)	EGPMF	Sustainable	Biomass and recruitment surveys, catch, CPUE
New South Wales	New South Wales	EGF, EPTF, OTF	Negligible	
Western Australia	North Coast Prawn Managed Fisheries (Brown Tiger Prawn)	KPMF, NBPMF, OPMF	Sustainable	Catch, Effort
Commonwealth	Northern Prawn Fishery (Brown Tiger Prawn)	NPF	Sustainable	Spawning stock size, effort
Commonwealth	Northern Prawn Fishery (Grooved Tiger Prawn)	NPF	Sustainable	Spawning stock size, effort
Western Australia	Shark Bay Prawn Managed Fishery (Brown Tiger Prawn)	SBPMF	Sustainable	Biomass and recruitment surveys, catch, CPUE
Commonwealth	Torres Strait Prawn Fishery (Brown Tiger Prawn)	TSPF	Sustainable	Biomass estimate, catch, effort

ECOTF East Coast Otter Trawl Fishery (QLD)
EGF Estuary General Fishery (NSW)
EGPMF Exmouth Gulf Prawn Managed Fishery (WA)
EPTF Estuary Prawn Trawl Fishery (NSW)
KPMF Kimberley Prawn Managed Fishery (WA)
NBPMF Nickol Bay Prawn Managed Fishery (WA)
NPF Northern Prawn Fishery (CTH)
OPMF Onslow Prawn Managed Fishery (WA)
OTF Ocean Trawl Fishery (NSW)
SBPMF Shark Bay Prawn Managed Fishery (WA)
TSPF Torres Strait Prawn Fishery (CTH)

STOCK STRUCTURE

The standard name 'Tiger Prawn' refers to the species *Penaeus esculentus*, *P. semisulcatus* and *P. japonicus*. Only *P. esculentus* (Brown Tiger Prawn) and *P. semisulcatus* (Grooved Tiger Prawn) are considered in this chapter; *P. japonicus* is not caught commercially in Australian waters.

Brown Tiger Prawns are endemic to tropical and subtropical waters of Australia, while Grooved Tiger Prawns have a wider Indo–West Pacific distribution. There is some genetic evidence of separation of Brown Tiger Prawn stocks from the east and west coasts of Australia [1].

Here, assessment of stock status is presented at the management unit level—Northern Prawn Fishery (Commonwealth) Brown Tiger Prawn, Northern Prawn Fishery (Commonwealth) Grooved Tiger Prawn, Torres Strait Prawn Fishery (Commonwealth) Brown Tiger Prawn, Shark Bay Prawn Managed Fishery (Western Australia) Brown Tiger Prawn, Exmouth Gulf Prawn Managed Fishery (Western Australia) Brown Tiger Prawn, North Coast Prawn Managed Fisheries (Western Australia) Brown Tiger Prawn, East Coast Otter Trawl Fishery (Queensland) Brown and Grooved Tiger Prawn; and at the jurisdictional level—New South Wales.

STOCK STATUS

Northern Prawn Fishery (Brown Tiger Prawn)

Brown and Grooved Tiger Prawn stocks are assessed as part of an integrated bioeconomic model analysis conducted for the Northern Prawn Fishery (Commonwealth) [2]. The base-case estimate of the size of the Brown Tiger Prawn spawner stock at the end of 2015, as a percentage of spawner stock size (S) at maximum sustainable yield (MSY; S_{2015}/S_{MSY}), was 175 per cent [2]. This estimate is higher than the base-case estimate of the size of the Brown Tiger Prawn spawner stock at the end 2013 which was 140 per cent of S_{MSY}. The management unit is not considered to be recruitment overfished [3]. In 2015, fishing effort was only 36 per cent of the level that would achieve MSY [2]. This level of fishing pressure is unlikely to cause the management unit to become recruitment overfished.

On the basis of the evidence provided above, the Northern Prawn Fishery (Commonwealth) Brown Tiger Prawn management unit is classified as a **sustainable stock**.

Northern Prawn Fishery (Grooved Tiger Prawn)

The base-case estimate of the size of the Grooved Tiger Prawn spawner stock at the end of 2015, as a percentage of spawner stock size at MSY (S_{2015}/S_{MSY}), was 185 per cent [2]. This estimate is higher than the base-case estimate of the size of the Grooved Tiger Prawn spawner stock at the end 2013, which was 173 per cent of S_{MSY}. The management unit is not considered to be

recruitment overfished [3]. In 2015, fishing effort on Grooved Tiger Prawns was 83 per cent of the level that would achieve MSY [2]. This level of fishing pressure is unlikely to cause the management unit to become recruitment overfished [3].

On the basis of the evidence provided above, the Northern Prawn Fishery (Commonwealth) Grooved Tiger Prawn management unit is classified as a **sustainable stock**.

Torres Strait Prawn Fishery (Brown Tiger Prawn)

The most recent assessment of Brown Tiger Prawn in the Torres Strait Prawn Fishery (Commonwealth) used two separate modelling approaches, producing two separate estimates of MSY and effort at MSY (E_{MSY}) [4]. Some components of the assessment were updated in 2007 [5], estimating that biomass in 2006 was 60–80 per cent of the unfished (1980) level, and considerably higher than the biomass that supports MSY (B_{MSY}, which is estimated to be in the range of 28–38 per cent of the unfished level) [4,5]. The stock is not considered to be recruitment overfished [6].

Commercial catch of this stock has been below the mean estimates of MSY (606 tonnes [t] and 676 t) for the past 10 seasons (2006–15), and effort has been below the estimates of E_{MSY} (8245 and 9197 fishing nights) for the past 13 and 12 seasons, respectively [6]. This level of fishing pressure is unlikely to cause the management unit to become recruitment overfished.

On the basis of the evidence provided above, the Torres Strait Prawn Fishery (Commonwealth) Brown Tiger Prawn management unit is classified as a **sustainable stock**.

Shark Bay Prawn Managed Fishery (Brown Tiger Prawn)

The status of Brown Tiger Prawn stocks are assessed annually using fishery-independent biomass and recruitment surveys and a weight-of-evidence approach that considers a range of relevant information [7]. The assessment approach is primarily based on separate monitoring of fishery-independent indices (expressed in terms of survey catch rates) of recruitment and spawning stock levels relative to specified reference points [8,9]. Surveys therefore provide an index of annual recruitment and resulting biomass estimates are also used for predicting annual Brown Tiger Prawn catches. Other information collected throughout the season (for example, commercial catches, effort and environmental data) are also evaluated to provide insight into, for example, operational factors that might affect fishery performance, or environmental factors affecting prawn recruitment.

Standardised commercial catch per unit effort (CPUE) data are used as an additional indicator of abundance, to monitor changes in stock levels from year-to-year. The annual commercial catches and catch rates are compared with 10-year (1989–98) average catch and catch rate reference points [10].

A spawning stock–recruitment relationship is evident for Brown Tiger Prawns [11–13] over the range of stock sizes observed during surveys, and the maintenance of adequate spawning stock (using a

target catch rate) to ensure adequate recruitment is the key management objective [10]. Brown Tiger Prawns are managed to achieve reference catch rate levels through control rules [8,9] that trigger a management response in the form of either a review of season/management arrangements if catch rates are at, or below, a threshold reference level, or changes to management arrangements if catch rates are at, or below, the limit reference level. A mandatory closure of the Brown Tiger Prawn northern spawning area is also enforced in June–July to protect the spawning stock. As fishing ceases, fishery-independent surveys are conducted to verify catch rates in the northern and southern spawning areas.

The June 2015 northern spawning stock survey showed a mean standardised catch rate of 7 kg per hour, well below the target level of 25 kg per hour, and below the limit level of 19 kg per hour [8]. However, a second survey in August 2015 indicated a catch rate of 13 kg per hour, just above the limit level. Very high catch rates of Brown Tiger Prawns in the southern spawning area (148 kg per hour in June and 56 kg per hour in August), which were also protected during the spawning period in 2015, confirmed the availability of adequate biomass to ensure successful recruitment. The above evidence indicates that the biomass of this management unit is unlikely to be recruitment overfished.

The 10-year reference point sets an annual target catch range of 400–700 t. For 2015, the Brown Tiger Prawn catch prediction (based on the recruitment surveys) was 410–615 t. The total 2015 catch (434 t) was within the target catch range and the predicted catch range [10,14]. The level of fishing effort since 2007 has remained between 33 000 and 41 000 trawl hours (standardised to twin nets) with fishing effort in 2015 being 40 000 trawl hours. The above evidence indicates that the current level of fishing pressure is unlikely to cause the management unit to become recruitment overfished.

On the basis of the evidence provided above, the Shark Bay Prawn Managed Fishery (Western Australia) Brown Tiger Prawn management unit is classified as a **sustainable stock**.

Exmouth Gulf Prawn Managed Fishery (Brown Tiger Prawn)

Stock assessments for this management unit are undertaken using similar methods to those used in the Shark Bay Prawn Managed Fishery (Western Australia). The management objective is to maintain the spawning biomass (using catch rate as a proxy for biomass) above the historically determined biological reference points [13] with a target of 25 kg per hour and a limit of 10 kg per hour in the spawning stock surveys [15]. Daily monitoring of catch rates ensure cessation of fishing when catch rates drop below the target within the key spawning area or early-August, whichever comes first. Three standardised Brown Tiger Prawn spawning stock surveys were carried out from August–October 2015, achieving an average catch rate of 48.5 kg per hour, well above the target level. The fishery has recovered from the effects of the marine heat wave [16,17] that may have affected the inshore nursery habitat in recent years. The above evidence indicates that the biomass of this stock is unlikely to be recruitment overfished.

Standardised commercial CPUE data are used as an additional indicator of abundance to monitor changes in stock levels from year-to-year. The commercial catches and catch rates are compared with 10-year (1989–98) reference points [10]. The 10-year reference point sets an annual target catch

range of 250–550 t and the 2015 Brown Tiger Prawn catch prediction (based on the recruitment surveys) was 220–330 t. The total 2015 catch of 433 t was within the target catch range but above the catch prediction [10,14]. The level of fishing effort has reduced from historical levels of 35 000–50 000 hours (standardised to twin gear) to 22 000 trawl hours in 2015. The total number of vessels has also reduced from 12 to six. The above evidence indicates that the current level of fishing pressure is unlikely to cause the management unit to become recruitment overfished.

On the basis of the evidence provided above, the Exmouth Gulf Prawn Managed Fishery (Western Australia) Brown Tiger Prawn management unit is classified as a **sustainable stock**.

North Coast Prawn Managed Fisheries (Brown Tiger Prawn)

Small quantities of Brown Tiger Prawns have been landed from the North Coast prawn fisheries in recent years, with Brown Tiger Prawn only being a key target species in the Onslow Prawn Managed Fishery. These fisheries use annual catch in reference to a target catch range as an indicator of acceptable performance, and if the stock is subjected to overfishing. Where the annual catch falls outside of the range this needs to be adequately explained or additional investigations undertaken. In 2015, all the North Coast Prawn Managed Fisheries combined landed less than 10 t of Brown Tiger Prawns [10] reflecting the very low effort expended in these fisheries, particularly for this species. Only two boats operated for 24 nights in total in the Onslow Prawn Managed Fishery in 2015 and the fishing effort in the Kimberley Prawn Managed Fishery in 2015 was the second lowest on record. The fishing effort in the Kimberley and Nickol Bay Prawn Managed Fisheries is primarily directed at Banana Prawns and so overall effort is primarily related to Banana Prawn abundance. The overall annual mean fleet effort in the Nickol Bay Prawn Managed Fishery has reduced since 2007 to around 160 boat days compared to 700 boat days between 1990 and 2005, and in 2015 it was only 133 boat days. The above evidence indicates that the current level of fishing pressure is unlikely to cause the management unit to become recruitment overfished, and the biomass of this management unit is unlikely to be recruitment overfished.

On the basis of the evidence provided above, the North Coast Prawn Managed Fisheries (Western Australia) Brown Tiger Prawn management unit is classified as a **sustainable stock**.

East Coast Otter Trawl Fishery (Brown and Grooved Tiger Prawn)

Recent quantitiative assessment using weekly delay-difference modelling of the combined Brown and Grooved Tiger Prawn resource in the East Coast Otter Trawl Fishery (Queensland) (ECOTF) indicates that fishing mortality may have been above sustainable levels before 2000, depleting spawning stock biomass to 80-90 per cent of the level required to achieve MSY (S_{MSY}) [18]. The spawning stock in the north and south regional sub-stocks which contribute approximately 80 per cent of the landings from this resource, has since recovered to levels consistently at or above two times S_{MSY} (north region) and between 1.2 and two times S_{MSY} (south region) [18]. Nominal catch rate is approximately 45 per cent above the 2000–15 average in the north and south sub-stock regions and in Moreton Bay which contributes 15 per cent of ECOTF Tiger Prawn landings [19,20]. In addition, a significant proportion of the known Brown and Grooved Tiger Prawn distribution is protected in areas closed to trawling. In 2005, an estimated 38 per cent of the Brown Tiger Prawn biomass and 26 per cent of the Grooved Tiger Prawn biomass within the Great Barrier Reef Marine Park (GBRMP), which encompasses the spatial distributions of both north and south region

Tiger Prawn sub-stocks was made unavailable to trawling as a result of permanent closures in 2004 [21]. The above evidence indicates that the biomass of this management unit is unlikely to be recruitment overfished.

In 2000–07, total catch showed a decreasing trend, but this coincided with a significant decline in fishing effort related to: a one-third (130 vessel) reduction in the East Coast Trawl fleet, resulting from introduction of the Fishery Management Plan containing structural adjustment elements. These included: vessel buy-backs, effort quotas and penalties for vessel replacement and quota transfer from 2001 [22]; a second buy-back of 21 vessels with effort quota associated with spatial expansion of GBRMP no-fishing zones in 2004 [23]; and from 2004–09, significant adverse weather and economic externalities, including rising cost of fuel, competition from farmed prawns and crew loss during the mining boom, which negatively impacted the viability of the fishery in general [24]. Catch and effort have been more stable since 2007 and slightly above historical low levels [20]. At 1335 t, the 2015 catch is well below the aggregated north and south region sub-stocks MSY estimate of 1833 t [18]. Recent assessment of combined Brown and Grooved Tiger Prawn fishing effort [18,20,25] estimated an aggregated effort to achieve MSY (E_{MSY}) of 32 877 fishing days. From 2007–15, effort has been well below this level. Semi-quantitative risk assessment of individual Tiger Prawn species found that the risk of their becoming recruitment overfished at the level of fishing pressure exerted on the management unit in 2009 was low for Brown Tiger Prawn [26,27], low for Grooved Tiger Prawn south of the GBRMP [27] and intermediate for Grooved Tiger Prawn within the GBRMP [26]. Although fishing power for Tiger Prawn is estimated to be increasing at a rate of 1.5–3 per cent per year [18], since 2009 the number of trawl days in the GBRMP has declined by 24 per cent [20]. Effective fishing effort in the GBRMP is therefore unlikely to be increasing. The above evidence indicates that the current level of fishing pressure is unlikely to cause the management unit to become recruitment overfished.

On the basis of the evidence provided above, the multispecies East Coast Otter Trawl Fishery (Queensland) Brown and Grooved Tiger Prawn management unit is classified as a **sustainable stock**.

New South Wales

Stock status for New South Wales is reported as negligible due to low catches by this jurisdiction. In the past 10 years, average catch from New South Wales was 5 t. Catch in 2015 was 3.8 t.

BIOLOGY

Brown and Grooved Tiger Prawn biology [10,28,29]

Biology

Species	Longevity / Maximum Size	Maturity (50 per cent)
TIGER PRAWNS	1–2 years; 55 mm CL	East coast: ~6 months; 32–39 mm CL West coast: ~6 months; 27–35 mm CL Northern Australia: ~6 months; 32–39 mm CL

DISTRIBUTIONS

Distribution of reported commercial catch of Tiger Prawns

TABLES

Fishing methods

	Commonwealth	Western Australia	Queensland	New South Wales
Commercial				
Otter Trawl	✔		✔	✔
Various		✔		
Net				✔
Recreational				
Cast Net			✔	

Management methods

Method	Commonwealth	Western Australia	Queensland	New South Wales
Commercial				
Effort limits	✔	✔	✔	
Gear restrictions	✔	✔	✔	
Limited entry	✔	✔	✔	
Spatial closures	✔	✔	✔	
Temporal closures	✔	✔	✔	
Vessel restrictions	✔		✔	
Recreational				
Possession limit			✔	

Active vessels

	Commonwealth	Western Australia	Queensland	New South Wales
	53 in NPF, 24 in TSPF	6 in EGPMF, 11 in KPMF, 5 in NBPMF, 3 in OPMF, 18 in SBPMF	213 in ECOTF	

ECOTF East Coast Otter Trawl Fishery (QLD)
EGPMF Exmouth Gulf Prawn Managed Fishery (WA)
KPMF Kimberley Prawn Managed Fishery (WA)
NBPMF Nickol Bay Prawn Managed Fishery (WA)
NPF Northern Prawn Fishery (CTH)
OPMF Onslow Prawn Managed Fishery (WA)
SBPMF Shark Bay Prawn Managed Fishery (WA)
TSPF Torres Strait Prawn Fishery (CTH)

Catch

	Commonwealth	Western Australia	Queensland	New South Wales
Commercial	3.17Kt in NPF, 558.49t in TSPF	433.20t in EGPMF, 3.92t in KPMF, 1.65t in NBPMF, 433.85t in SBPMF	1.35Kt in ECOTF	861.80kg in EGF, 30.00kg in EPTF, 7.81t in OTF
Indigenous		None	Unknown	
Recreational		None	Unknown	

ECOTF East Coast Otter Trawl Fishery (QLD)
EGF Estuary General Fishery (NSW)
EGPMF Exmouth Gulf Prawn Managed Fishery (WA)
EPTF Estuary Prawn Trawl Fishery (NSW)
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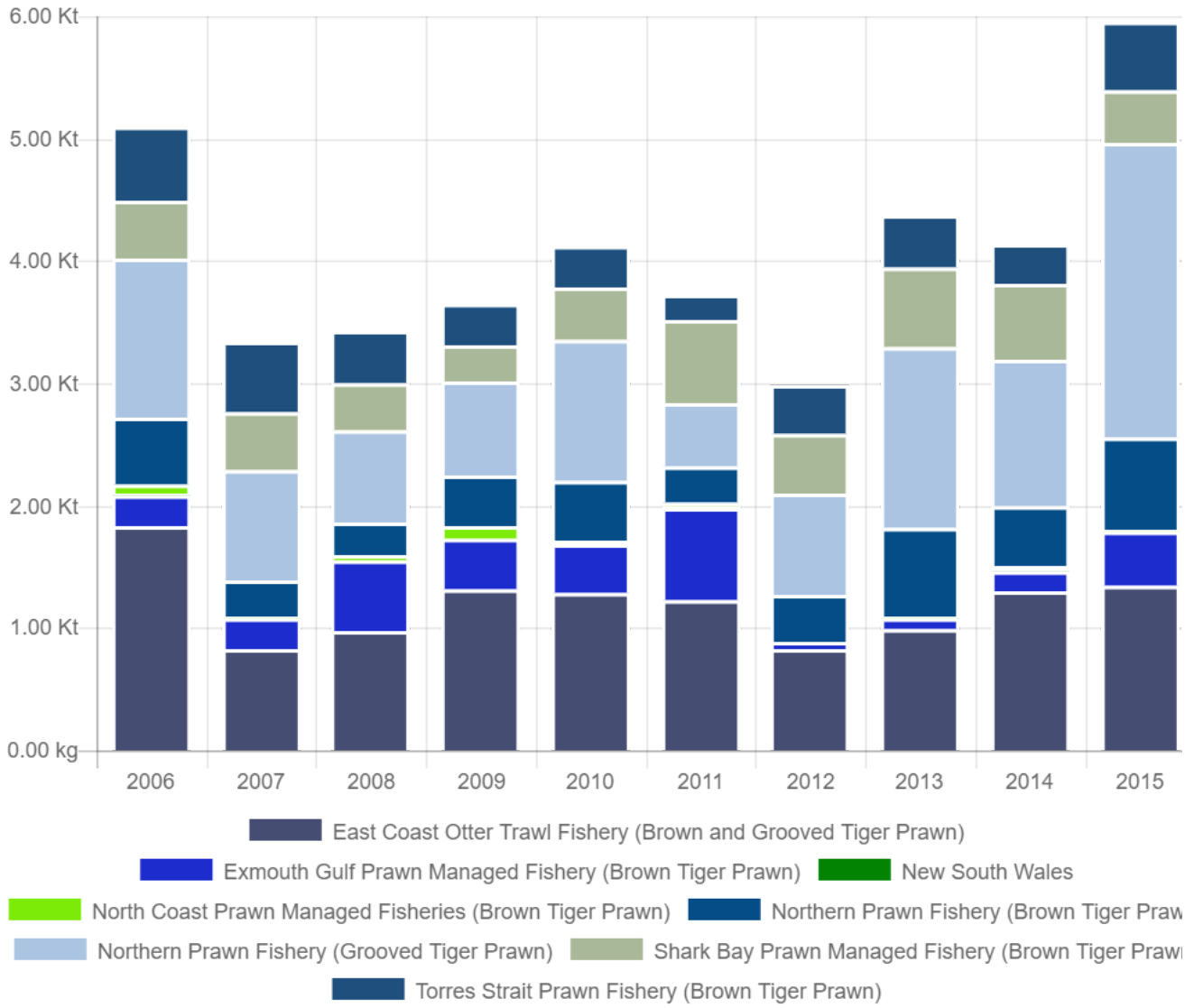
OTF Ocean Trawl Fishery (NSW)
SBPMF Shark Bay Prawn Managed Fishery (WA)
TSPF Torres Strait Prawn Fishery (CTH)

a Commonwealth – Recreational The Australian Government does not manage recreational fishing in Commonwealth waters. Recreational fishing in Commonwealth waters is managed by the state or territory immediately adjacent to those waters, under its management regulations.
b Commonwealth – Indigenous The Australian Government does not manage non-commercial Indigenous fishing in Commonwealth waters, with the exception of the Torres Strait. In general, non-

commercial Indigenous fishing in Commonwealth waters is managed by the state or territory immediately adjacent to those waters. In the Torres Strait, both commercial and non-commercial Indigenous fishing is managed by the Torres Strait Protected Zone Joint Authority (PZJA) through the Australian Fisheries Management Authority (Commonwealth); the Department of Agriculture, Fisheries and Forestry (Queensland); and the Torres Strait Regional Authority. The PZJA also manages non-Indigenous commercial fishing in the Torres Strait.**c Queensland – Indigenous** In Queensland, under the Fisheries Act 1994 (Qld), Indigenous fishers are able to use prescribed traditional and non-commercial fishing apparatus in waters open to fishing. Size and possession limits, and seasonal closures do not apply to Indigenous fishers. Further exemptions to fishery regulations can be obtained through permits.

CATCH CHART



Commercial catch of Tiger Prawns

EFFECTS OF FISHING ON THE MARINE ENVIRONMENT

- Management is in place to reduce the impact of trawling on habitats. In Queensland, the Great Barrier Reef Marine Park (GBRMP) occupies 63 per cent of the East Coast Otter Trawl Fishery (Queensland) (ECOTF) [30], 34 per cent of which is open to trawling [26], but effort is highly aggregated, occurring within only a small fraction of the open area. South of the GBRMP, the fishery operates in only 10 per cent of the area open to trawling [31]. In Western Australia, extensive permanent and temporary closures result in the fleet operating in only seven per cent of the Shark Bay fishery region and 17 per cent of inner Shark Bay [10,32,33], generally less than 30 per cent of the Exmouth Gulf [10,34,35], and less than three per cent of the north coast region [10]. Fishing operations are restricted to areas of sand and mud, where trawling has minimal long-term physical impact, [35–37]. The Northern Prawn Fishery (Commonwealth) (NPF) also uses a system of closures (spatial and seasonal) to manage the fishery, as well as other input controls (for example, limited entry, gear restrictions). A total of 2.1 per cent of the total managed area of the fishery is subject to permanent closures, while 8.3 per cent is subject to seasonal closures [38].

- Although the incidental capture of by-product and bycatch species by trawling can lead to a range of indirect ecosystem effects [39], studies in Queensland and Western Australia found no significant difference in biodiversity or overall distribution patterns of seabed biota between trawled and non-trawled areas [21,34,35]. An assessment of trawl-related risk in the GBRMP found that the ECOTF posed no more than an intermediate risk of overfishing species assemblages exposed to trawling [26]. Spatial contraction and/or temporal reduction in effort in these jurisdictions (see above) are likely to have mitigated the ecosystem impacts of trawling. Similarly, in the NPF, the ecological risk management report identifies priority species at high risk. However, no target or protected species have been assessed as high risk because of the fishery [40].

- The use of bycatch reduction devices (BRDs) is mandatory in all Australian tropical prawn trawl fisheries. BRDs can significantly reduce bycatch—by more than 50 per cent by weight in some fisheries [41]. In the ECOTF, the use of BRDs became mandatory in 1999, and the introduction of turtle excluder devices (TEDs) in 2001 largely eliminated capture of most large bycatch species, including turtles, sharks and rays [42]. BRDs and TEDs became mandatory in the NPF in 2001. Use of TEDs in the NPF reduced turtle bycatch from 5700 individuals per year (pre-2001) to approximately 30 per year (post-2001) [43]. The introduction of TEDs in the Western Australian trawl fisheries in 2003 reduced turtle bycatch by at least 95 per cent [44]. BRDs and TEDs have been mandatory in the Exmouth Gulf Prawn Managed Fishery (Western Australia) since 2003 and in all northern Western Australian prawn fisheries since 2005. All prawn trawlers operating in Western Australia must now use TEDs and BRDs, including secondary fish exclusion devices and hoppers to increase survival of returned fish. Commitment to continuous improvement in bycatch mitigation has facilitated increased use of best-practice TEDs and BRDs in the ECOTF since 2008. Recent ecological risk assessments of the fishery have acknowledged reduced impact of trawling and a general absence of high risk of overfishing most bycatch species [26,27].

ENVIRONMENTAL EFFECTS ON TIGER PRAWNS

- Biomass of prawns can be highly variable and affected by environmental factors such as water temperatures, cyclones and broad-scale oceanographic features [45]. Cyclones can have either a positive or a negative impact on prawn biomass and availability. Early season (December–January) cyclones can increase mortality of small prawns through the scouring of nursery areas, destroying seagrass and algal habitats [46]. Conversely, mortality can decrease when water becomes turbid, because predation decreases [10]. A marine heatwave during the summers of 2010–11 and 2012–13, with water temperatures reaching record high levels in 2012–13, may have affected the structured nursery habitat of Tiger Prawns in the Exmouth Gulf, resulting in very low recruitment [43].

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