Chapter 5

Northern Prawn Fishery

J Larcombe, A Bath and R Green

FIGURE 5.1 Relative fishing intensity in the Northern Prawn Fishery, 2015

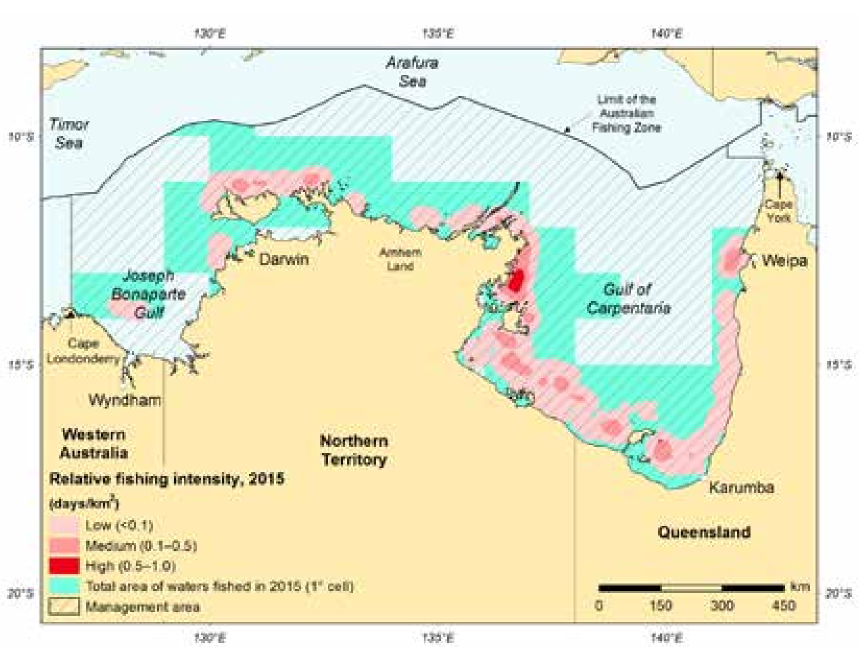


TABLE 5.1 Status of the Northern Prawn Fishery

Status	2014		2015		Comments
Biological status	**Fishing mortality**	**Biomass**	**Fishing mortality**	**Biomass**	
Red-legged banana prawn (*Fenneropenaeus indicus*)	Green	Green	Green	Green	Recent catches are below MSY estimates. Biomass is estimated to be above the TRP.
White banana prawn (*Fenneropenaeus merguiensis*)	Green	Green	Green	Green	High natural recruitment variability is primarily linked to environmental factors. Harvest strategy aims to provide for adequate escapement.
Brown tiger prawn (*Penaeus esculentus*)	Green	Green	Green	Green	Effort is below E_{MSY}, and catch is below MSY. Spawner stock size is above the LRP of $0.5S_{MSY}$.
Grooved tiger prawn (*Penaeus semisulcatus*)	Green	Green	Green	Green	Effort is near E_{MSY}, and catch is below MSY. Spawner stock size is above the LRP of $0.5S_{MSY}$.
Blue endeavour prawn (*Metapenaeus endeavouri*)	Green	Green	Green	Green	Catch is below the estimate of MSY. Spawner stock biomass is above the LRP of $0.5S_{MSY}$.
Red endeavour prawn (*Metapenaeus ensis*)	Yellow	Yellow	Yellow	Yellow	No current stock assessment.
Economic status	NER were estimated at $5 million in 2012–13 and continued to improve in 2013–14 to $12 million as a result of improved prawn prices. In 2014–15, lower fuel prices and improved banana prawn prices indicate positive signs for NER in the fishery.				

Notes: E_{MSY} Effort that achieves MSY. **LRP** Limit reference point. **MSY** Maximum sustainable yield. **NER** Net economic returns. S_{MSY} Spawner stock size at MSY. **TRP** Target reference point.

	Green	Red	Yellow
Fishing mortality	Not subject to overfishing	Subject to overfishing	Uncertain
Biomass	Not overfished	Overfished	Uncertain

5.1 Description of the fishery

Area fished

White banana prawn (*Fenneropenaeus merguiensis*) is mainly caught during the day on the eastern side of the Gulf of Carpentaria, whereas red-legged banana prawn (*F. indicus*) is mainly caught in Joseph Bonaparte Gulf (Figure 5.1). White banana prawns form dense aggregations ('boils') that can be located using spotter planes, which direct the trawlers to the aggregations. The highest catches are taken offshore from mangrove forests, which are the juvenile nursery areas. Tiger prawns (*Penaeus esculentus* and *P. semisulcatus*) are primarily taken at night (daytime trawling has been prohibited in some areas during the tiger prawn season). Most catches come from the southern and western Gulf of Carpentaria, and along the Arnhem Land coast. Tiger prawn fishing grounds may be close to those of banana prawns, but the highest catches come from areas near coastal seagrass beds, the nursery habitat for tiger prawns. Endeavour prawns (*Metapenaeus endeavouri* and *M. ensis*) are mainly a byproduct, caught when fishing for tiger prawns.

Fishing methods and key species

The Northern Prawn Fishery (NPF) uses otter trawl gear to target a range of tropical prawn species. White banana prawn and two species of tiger prawn (brown and grooved) account for around 80 per cent of the landed catch. Byproduct species include endeavour prawns, scampi (*Metanephrops* spp.), bugs (*Thenus* spp.) and saucer scallops (*Amusium* spp.). In recent years, many vessels have transitioned from using twin gear to mostly using a quad rig comprising four trawl nets—a configuration that is more efficient.

Management methods

The NPF is managed through a series of input controls, including limited entry to the fishery, individual transferable effort units, gear restrictions, bycatch restrictions, and a system of seasonal and spatial closures. The fishery has two seasons: a 6–12-week banana prawn season starting in April, and a longer tiger prawn season, running from August to November. Two distinct components of the NPF harvest strategy are used to manage the two seasons of the fishery. Both operate within the management system of input controls (Dichmont et al. 2012) and use season length controls that are informed by the real-time monitoring of catch and catch rates. The harvest strategies have been subjected to management strategy evaluation testing (Buckworth et al. 2013; Dichmont et al. 2006), to assess their performance against the objectives of the Commonwealth Fisheries Harvest Strategy Policy (DAFF 2007).

The merits of two NPF management systems—input (effort) and output (total allowable catch)—have been intensively evaluated for several years. In late 2013, mainly because of the difficulty in setting catch quotas for the highly variable white banana prawn fishery, the Australian Fisheries Management Authority (AFMA) determined that the fishery would continue to be managed through input restrictions and units of individual transferable effort. The harvest strategies will be reviewed every five years.

Fishing effort

The NPF developed rapidly in the 1970s, with effort peaking in 1981 at more than 40 000 fishing days and more than 250 vessels. During the next three decades, fishing effort and participation were reduced to the current levels of around 7 500 days of effort and 52 vessels. This restructuring of the fishery was achieved through a series of structural adjustment and buyback programmes, and the implementation of management measures to unitise and control fishing effort. Total catches also fell during this period, but by a much smaller percentage, illustrating the clear transformation of the fleet to more efficient vessels.

Catch

Total NPF catch in 2015 was 7 825 t, comprising 7 696 t of prawns and 129 t of byproduct species (predominantly bugs, squid and scampi). Annual catches tend to be quite variable from year to year because of natural variability in the banana prawn component of the fishery.

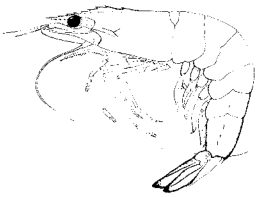
TABLE 5.2 Main features and statistics for the NPF

Fishery statistics a	2014 fishing season b		2015 fishing season b	
Stock	**Catch (t)**	**Real value (2013–14)**	**Catch (t)**	**Real value (2014–15)**
Banana prawns	6 245	$69.1 million	3 931	$62.0 million
Tiger prawns	1 688	$40.6 million	3 168	$34.4 million
Endeavour prawns	677	$5.5 million	554	$8.5 million
Other catch (prawns)	11	$0.4 million	43	$0.5 million
Other catch (not prawns)	86	$1.6 million	129	$1.5 million
Total fishery	**8 707**	**$117.2 million**	**7 825**	**$106.8 million**
Fishery-level statistics				
Effort	Banana season: 2 476 boat-days Tiger season: 5 624 boat-days		Banana season: 2 249 boat-days Tiger season: 5 940 boat-days	
Fishing permits	52		52	
Active vessels	52		52	
Observer coverage	Crew member observers: 843 days (10.4%) Scientific observers: 117 days (1.4%)		Crew member observers: 1058 (12.9%) Scientific observers: 159 days (1.94%)	
Fishing methods	Otter trawl			
Primary landing ports	Cairns, Darwin, Karumba. Much of the catch is offloaded onto mother ships at sea.			
Management methods	Input controls: individual tradeable gear units, limited entry, gear restrictions			
Primary markets	Domestic: fresh and frozen International: Japan—frozen			
Management plan	Northern Prawn Fishery Management Plan 1995 (amended 2012)			

a Fishery statistics are provided by fishing season, unless otherwise indicated. Real-value statistics are by financial year. Therefore, changes in catch may appear to be inconsistent with changes in value. **b** Fishing season for banana prawns: 1 April to 15 June; for tiger prawns: 1 August to 29 November.

5.2 Biological status

Red-legged banana prawn (*Fenneropenaeus indicus*)



Line drawing: FAO

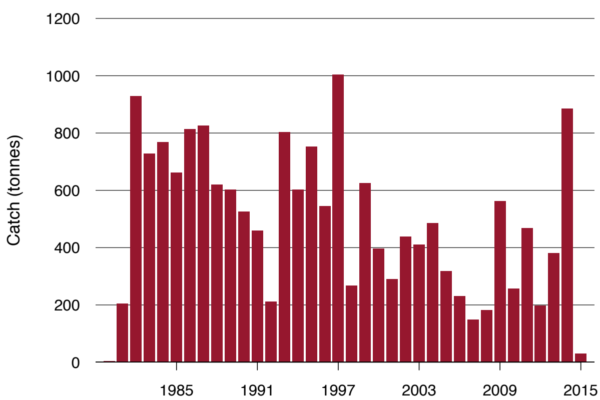
Stock structure

Red-legged banana prawn is widely distributed across the Indo-West Pacific. In Joseph Bonaparte Gulf, a single stock is assumed for assessment purposes.

Catch history

The bulk of the NPF red-legged banana prawn catch is taken in Joseph Bonaparte Gulf, with a smaller proportion taken in the wider NPF to the east. A small amount of catch is also taken in regions adjacent to the NPF. The catch of red-legged banana prawn is usually a relatively small component of the total banana prawn catch in the NPF. Catch was 886 t in 2014, which was the highest since 1997, but dropped substantially in 2015 to 56 t (Figure 5.2).

FIGURE 5.2 Red-legged banana prawn catch, 1980 to 2015



Source: CSIRO

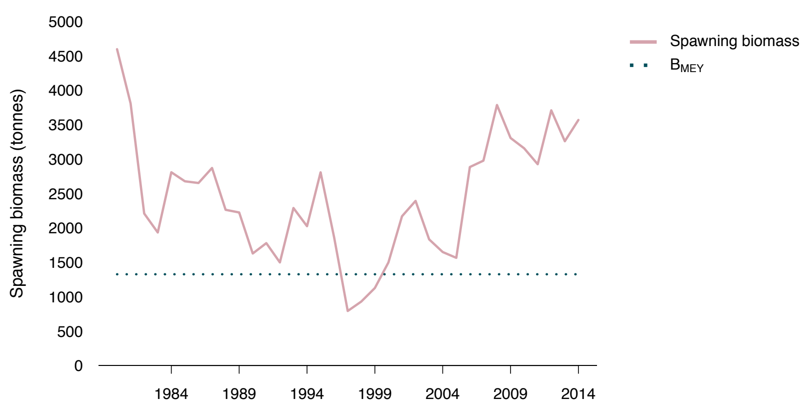
Stock assessment

Estimates of maximum sustainable yield (MSY) and its corresponding spawning biomass level (B_{MSY}) are difficult to derive for short-lived, variable stocks such as red-legged banana prawns. Typically, yield is determined largely by the strength of annual recruitment, and therefore annual sustainable yields can be expected to fluctuate widely around deterministic estimates (Plagányi et al. 2009).

The most recent accepted assessment for the stock was undertaken in 2015 (Buckworth et al. 2015), and includes data up to and including 2014. The assessment model uses quarterly time steps of catch and effort. As a result, outputs from the model depend on the distribution of effort across fishing seasons, and sensitivity to this aspect has been explored. The base case assumes that the distribution of future catches per quarter will be the average of the patterns seen in 2012 to 2014. The estimate of spawning stock biomass in 2014 was approximately 3.2 times the B_{MSY} and also well above the biomass associated with maximum economic yield (MEY; proxy level $1.2B_{MSY}$) (Figure 5.3). Fishing mortality in 2014 was estimated to be below the level associated with MEY.

The 2015 season saw very low levels of effort in Joseph Bonaparte Gulf (76 days) and corresponding very low levels of catch (30 t in Joseph Bonaparte Gulf and 56 t in total). Catch rates were also low, but were poorly sampled because of the low effort. The stock assessment relies heavily on fishery-dependent catch and catch rates; for 2015, the model was not able to provide reliable estimates of stock status. One explanation for the low levels of catch and effort in 2015 is the more favourable tiger prawn fishing in the Gulf of Carpentaria, which experienced unusually high catch rates in 2015—this explanation was accepted by the Northern Prawn Fishery Resource Assessment Group (NPRAG) as a contributing factor. Another explanation is that recruitment or availability was lower in 2015 as a result of anomalous environmental factors, including strong El Niño conditions and considerably reduced tidal flows—this possibility was acknowledged by NPRAG. Under the harvest strategy, when effort is below 100 days in one year, the fishery remains open in both seasons of the following year. However, given the uncertainties around status, NPRAG agreed to additional data collection and analysis during the first season of 2016, to provide early indications of stock status before an assessment update is undertaken in early 2017.

FIGURE 5.3 Estimated spawning biomass for red-legged banana prawn, 1980 to 2014

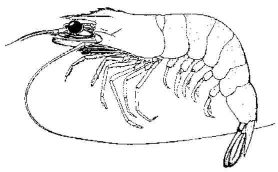


Source: Buckworth et al. 2015

Stock status determination

The 2015 red-legged banana prawn catch of 56 t was substantially lower than in recent years and well below the estimated long-term average MSY range (750–900 t; Buckworth et al. 2015). Given this low catch and the high estimated spawning biomass level in 2014, the stock is classified as **not subject to overfishing**. The most recent estimate of biomass (2014) was well above the target reference point. However, there was no assessment in 2015 following low catch and effort levels, and there is uncertainty and some concern about the cause of these lower catch levels. Noting the importance of additional monitoring and assessment planned for 2016 and 2017, the red-legged banana prawn stock is classified as **not overfished**.

White banana prawn (*Fenneropenaeus merguiensis*)



Line drawing: FAO

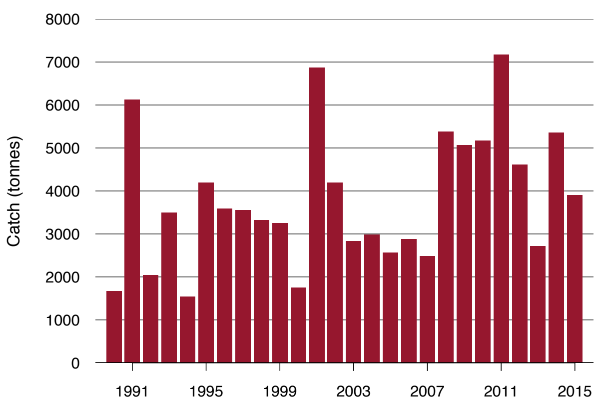
Stock structure

The stock structure of white banana prawn is uncertain. In the NPF, there is some evidence of substock structuring associated with significant river mangrove areas, but, in the absence of clear information on biological stock structure, status is reported at the fishery level.

Catch history

Catch in 2015 was 3 901 t (Figure 5.4). Seasonal catch is highly variable and is associated with rainfall in some areas (Venables et al. 2011).

FIGURE 5.4 White banana prawn catch, 1990 to 2015



Source: CSIRO

Stock assessment

The environmentally driven variability of this resource means that a robust stock–recruitment relationship cannot be determined and that annual sustainable yields are largely dependent on annual recruitment. Consequently, it has not been possible to develop a stock assessment for white banana prawn. To explore the possibility of implementing total allowable catches for the fishery, CSIRO modelled the relationship between historical catch and rainfall, to investigate whether it is possible to predict the next year's catch based on the most recent wet-season rainfall. Unfortunately, large uncertainties remain because the model cannot accurately predict catch levels in some years, particularly in recent years (Buckworth et al. 2013).

Harvest rates for white banana prawn in the fishery are understood to have been high (>90 per cent of available biomass) in some years (Buckworth et al. 2013), but banana prawns are believed to be resilient to fishing pressure, and recruitment appears to be more closely associated with seasonal rainfall than fishing mortality. The harvest strategy for the stock has, inter alia, an objective to allow sufficient escapement to ensure an adequate spawning biomass and to allow subsequent recruitment. This is achieved by closing the season when catch rates fall below a trigger level associated with permitting sufficient prawns to escape to ensure an adequate spawning biomass for subsequent recruitment (based on an analysis of historical data, Dichmont et al. 2012). In addition, the trigger is designed to achieve an economic outcome by closing fishing when catch rates fall below uneconomic levels. The catch-rate trigger level for the closure of the banana prawn season is being reviewed from the perspective of its performance in achieving economic objectives and stock sustainability (allowing sufficient escapement).

Stock status determination

With the adoption of the harvest strategy, a relatively small fleet size and a lack of evidence of recruitment overfishing, this stock is classified as **not subject to overfishing** and **not overfished**.

Deploying the gear
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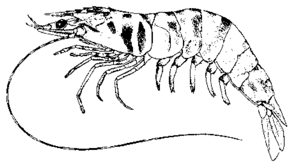
Brown tiger prawn (*Penaeus esculentus*)



Line drawing: FAO

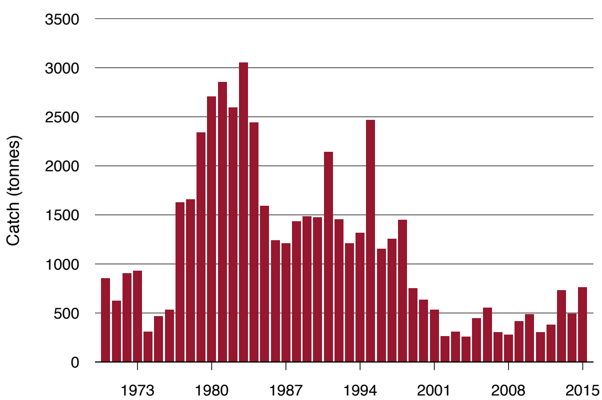
Stock structure

Brown tiger prawn appears to be endemic to tropical and subtropical Australian waters. Some genetic evidence indicates that there are separate stocks on the east and west coasts (Ward et al. 2006). However, the biological stock structure in the NPF is uncertain, and the population in the Gulf of Carpentaria is assumed to be a single stock for management purposes.

Catch history

Brown tiger prawns are caught primarily in the first season in the southern and western Gulf of Carpentaria, but also in waters westwards towards Joseph Bonaparte Gulf. Catch of brown tiger prawn in 2015 was 763 t (Figure 5.5). This was an increase from 2014 and similar to 2013 catch levels.

FIGURE 5.5 Brown tiger prawn catch, 1970 to 2015



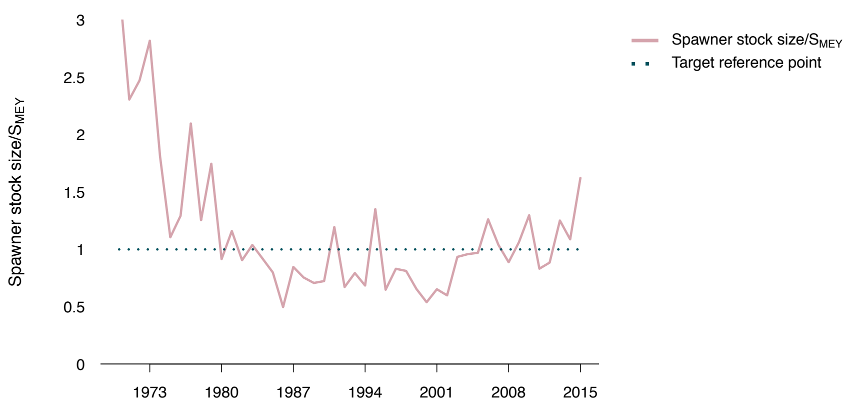
Source: CSIRO

Stock assessment

The stock assessment for the tiger prawn fishery uses a multispecies (covering brown and grooved tiger prawns, and blue endeavour prawn), weekly, sex- and size-structured population model, combined with a Bayesian hierarchical production model for blue endeavour prawn. It is integrated with an economic model that calculates MEY. Assessments are conducted every two years. For the most recent assessment (Buckworth 2016), 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 at MSY (S_{2015}/S_{MSY}) was 175 per cent (range across sensitivities 151–178 per cent). The base-case estimate of the size of the spawner stock as a percentage of stock size at MEY (S_{2015}/S_{MEY}) was 162 per cent (Figure 5.6) (range across sensitivities 136–162 per cent).

For the most recent assessment, the estimate of effort in 2015 as a percentage of effort at MSY (E_{2015}/E_{MSY}) was 36 per cent (range across sensitivities 32–34 per cent). The estimate of effort in 2015 as a percentage of effort at MEY (E_{2015}/E_{MEY}) was 35 per cent (32–43 per cent). Catch of brown tiger prawn was 492 t in 2014 and 763 t in 2015 (Figure 5.5), substantially less than the base-case estimate of MSY (1 186 t).

FIGURE 5.6 Spawner stock size as a proportion of S_{MEY} for brown tiger prawn, 1970 to 2015

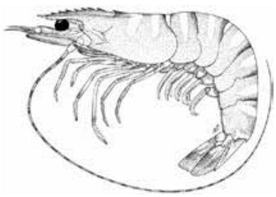


Source: Buckworth 2016

Stock status determination

Effort in recent years has been less than the level associated with MSY, catches in recent years have been less than MSY, and the estimate of biomass for the base-case model (and all other sensitivities) was above the limit reference point ($0.5S_{MSY}$) in the most recent assessment. Brown tiger prawn in the NPF is therefore classified as **not subject to overfishing** and **not overfished**.

Grooved tiger prawn (*Penaeus semisulcatus*)



Line drawing: Karina Hansen

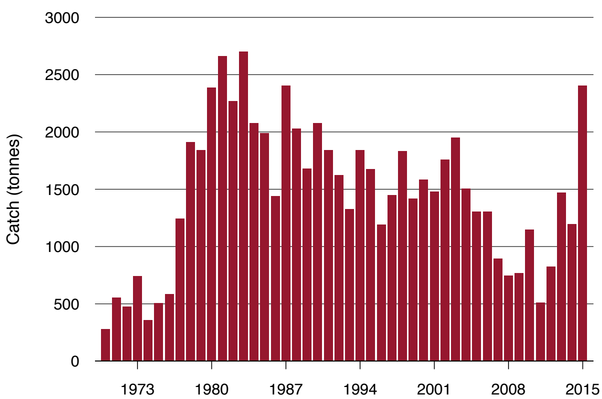
Stock structure

Grooved tiger prawn ranges across northern Australian waters, the Indo-West Pacific and the Mediterranean. The biological stock structure is uncertain, but the population near the Gulf of Carpentaria is assumed to be a single stock for management purposes.

Catch history

Annual catches of grooved tiger prawn, which is primarily taken in the second season, peaked in the early 1980s at more than 2 500 t and have shown a declining trend since then (Figure 5.7). Catch of grooved tiger prawn in 2015 was 2 405 t, which was a substantial increase from the 2014 catch of 1 196 t, and the highest catch of this species since the early 1980s.

FIGURE 5.7 Grooved tiger prawn catch, 1970 to 2015



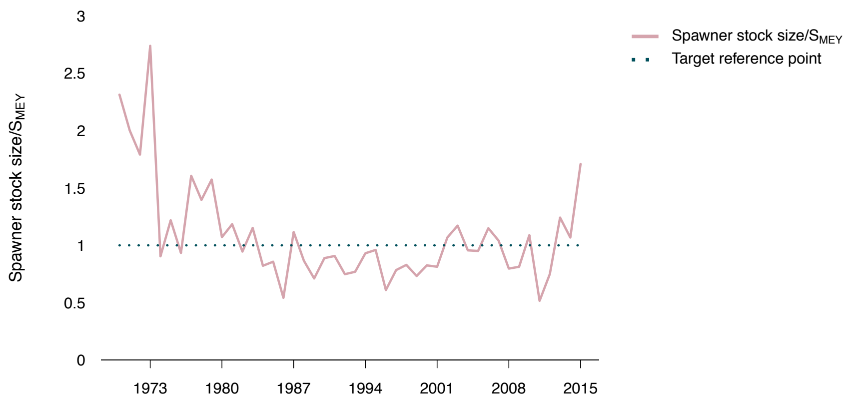
Source: CSIRO

Stock assessment

For the most recent assessment (Buckworth 2016), 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 (range across sensitivities 177–235 per cent). The base-case estimate of the size of the spawner stock as a percentage of spawner stock size at MEY (S_{2015}/S_{MEY}) was 171 per cent (Figure 5.8) (range across sensitivities 152–171 per cent).

For the most recent assessment, the estimate of effort in 2015 as a percentage of effort at MSY (E_{2015}/E_{MSY}) was 83 per cent (50–90 per cent). The estimate of effort in 2015 as a percentage of effort at MEY (E_{2015}/E_{MEY}) was 101 per cent (98–122 per cent). The catch of grooved tiger prawn in 2015 was 2 405 t (Figure 5.7), which was more than the base-case estimate of long-term average MSY (1 605 t).

FIGURE 5.8 Spawner stock size as a proportion of S_{MEY} for grooved tiger prawn, 1970 to 2015

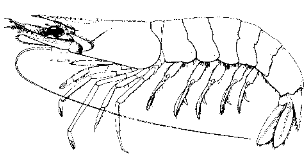


Source: Buckworth 2016

Stock status determination

Although the catch of grooved tiger prawn in 2015 exceeded the estimated long-term MSY, this catch was supported by higher than average levels of recruitment in 2015. Additionally, effort in 2015 was estimated to be less than the level associated with MSY and close to the level associated with MEY. The spawning stock biomass for the base-case model (and all other sensitivities) is estimated to be well above the biomass levels associated with MSY and MEY, and therefore also above the limit reference point ($0.5S_{MSY}$). Grooved tiger prawn in the NPF is therefore classified as **not subject to overfishing** and **not overfished**.

Blue endeavour prawn (*Metapenaeus endeavouri*)



Line drawing: FAO

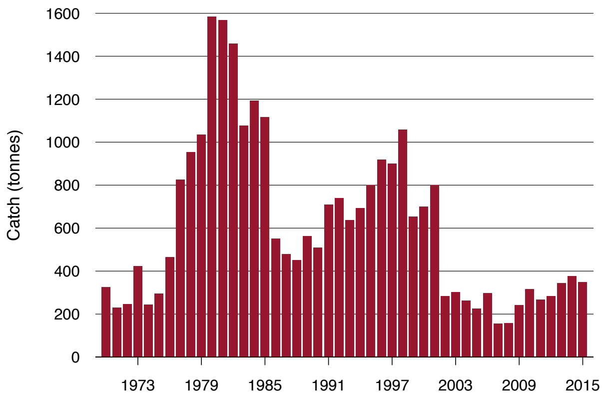
Stock structure

Blue endeavour prawn ranges across northern Australia waters and parts of the Indo-West Pacific. The biological stock structure is uncertain, but the population in the NPF is assumed to be a single stock for management purposes.

Catch history

Annual catches of blue endeavour prawn peaked in the early 1980s at more than 1 500 t, and again in the late 1990s at 1 000 t (Figure 5.9). Since 2002, annual catches have averaged around 300 t, and the 2015 catch was 348 t. Blue endeavour prawn is a byproduct of the tiger prawn fishery, and so catches are linked to changes in effort targeting tiger prawns.

FIGURE 5.9 Blue endeavour prawn catch, 1970 to 2015



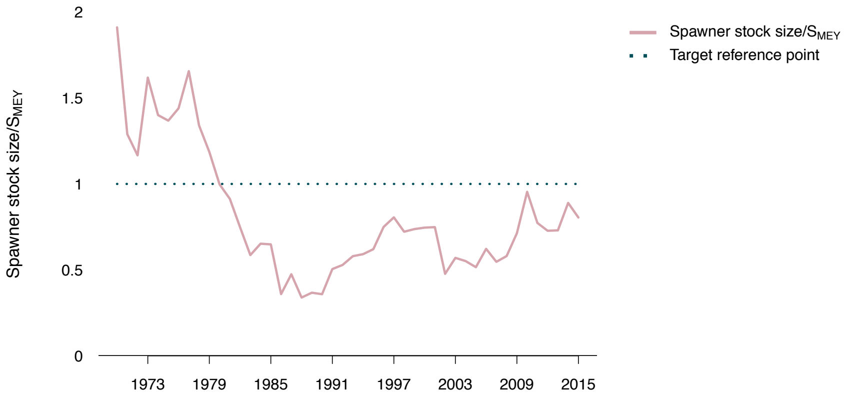
Source: CSIRO

Stock assessment

Stock size is assessed using a Bayesian hierarchical biomass dynamic model, within the same overall bio-economic model system as used for the two tiger prawn species (Buckworth 2016).

The base-case estimate of the size of the blue endeavour prawn spawner stock at the end of 2015 as a percentage of stock size at MSY (S_{2015}/S_{MSY}) was 77 per cent (range across sensitivities 77–97 per cent). The base-case estimate of the size of the spawner stock as a percentage of stock size at MEY (S_{2015}/S_{MEY}) was 80 per cent (Figure 5.10) (range across sensitivities 72–84 per cent). The catch of blue endeavour prawn was 377 t in 2014 and 348 t in 2015 (Figure 5.9), substantially less than the base-case estimate of MSY (813 t).

FIGURE 5.10 Spawner stock size as a proportion of S_{MEY} for blue endeavour prawn, 1970 to 2015

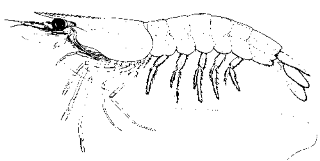


Source: Buckworth 2016

Stock status determination

The catch in 2015 was well under the estimated MSY, and the estimate of spawner stock size for the base case was above the limit reference point ($0.5S_{MSY}$). Blue endeavour prawn in the NPF is therefore classified as **not subject to overfishing** and **not overfished**.

Red endeavour prawn (*Metapenaeus ensis*)



Line drawing: FAO

Stock structure

Red endeavour prawn ranges across northern Australian waters and parts of the Indo-West Pacific. The biological stock structure is uncertain, but the population within the NPF is assumed to be a single stock for management purposes.

Catch history

Annual catches of red endeavour prawn have been variable over the history of the fishery, with peak annual catches in excess of 800 t in 1982 and 1997. Since 1998, catches have been below 400 t, and the 2015 catch was 206 t. Red endeavour prawn is a byproduct of the tiger prawn fishery.

Stock assessment

Although attempts have been made to assess red endeavour prawn, no reliable assessment is available to determine stock status. Catches during recent years have been quite low compared with historical highs. This is most likely related to a fall in fishing effort directed at tiger prawn rather than any indication of a fall in red endeavour prawn biomass.

Stock status determination

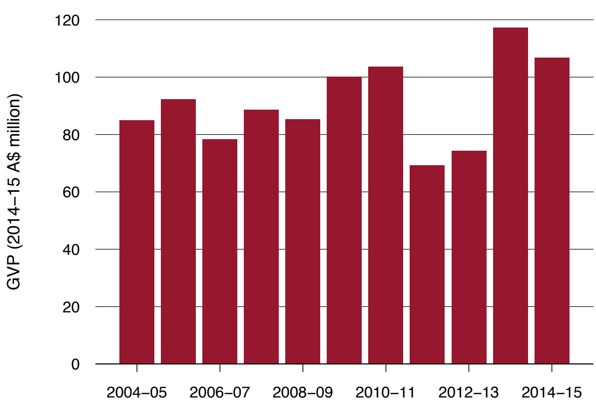
Given the absence of information on the sustainability of catches or the state of the biomass, this stock is classified as **uncertain** with regard to the level of fishing mortality and biomass.

5.3 Economic status

Key economic trends

The gross value of production (GVP) in the NPF fluctuated during the decade to 2014–15, peaking at $117 million (in 2014–15 dollars) in 2013–14 and reaching a low of $69 million in 2011–12 (Figure 5.11). The GVP in the fishery declined to $107 million in 2014–15, but this still represented one of the highest value years in the fishery during the past decade.

FIGURE 5.11 GVP for the NPF, 2004–05 to 2014–15



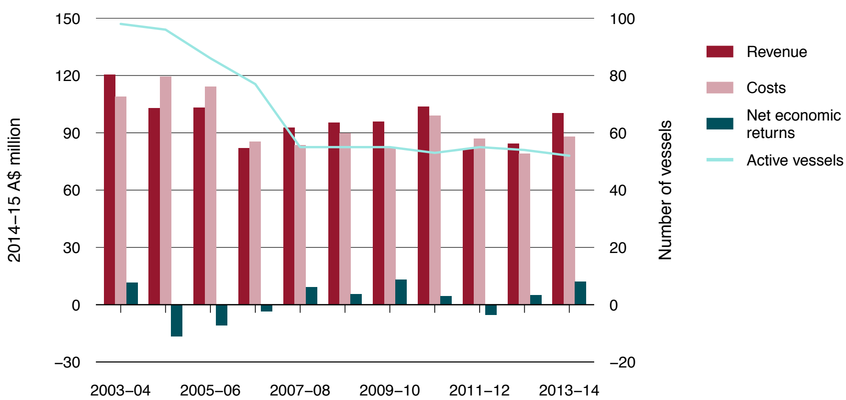
Notes: **GVP** Gross value of production. 2014–15 data are preliminary.

Since the early 1990s, ABARES has used data from economic surveys of the NPF to estimate the level of net economic returns (NER) earned in the fishery. The most recent survey in 2015 provides survey-based estimates of NER for the 2012–13 and 2013–14 financial years (Bath & Green 2016).

The level of real NER in the NPF has varied considerably during the past 15 years (Figure 5.12). In 2000–01, real NER were estimated at $86 million. NER fell sharply in the following years to reach –$17 million in 2004–05 (in 2014–15 dollars). Between 2004–05 and 2006–07, real NER remained negative. During this time of declining profitability, three management changes occurred in the fishery. From 2004–05 onwards, the fishery began targeting MEY in the tiger prawn component of the fishery and the Securing our Fishing Future (SOFF) structural adjustment programme (which concluded in 2006–07) was implemented. Management changes that allowed the adoption of quad gear trawl configuration also occurred in this period. Together, these changes are likely to have assisted in improving the economic performance of the fishery since 2014–05

The SOFF removed 43 class B statutory fishing rights from the fishery, reducing the already declining active vessel numbers from 86 in 2005–06 to 55 in 2007–08. Since then, real NER in the fishery have been positive each year, apart from 2011–12, peaking at $13 million in 2009–10, while active vessel numbers have declined slightly, to 52 active vessels in the 2015 fishing season. This improvement was mainly driven by increasing revenue from higher landings of banana prawns (Skirtun et al. 2014), as well as a likely improvement in the fleet's efficiency after structural adjustment and targeting of MEY. In 2011–12, real NER fell by more than $10 million to –$5 million, as a result of lower landings of banana prawns. NER recovered to $5 million in 2012–13 and continued to improve in 2013–14 to $12 million as a result of improved prices. Real unit prices improved in 2014–15, with banana prawn prices increasing from $11.96 per kg in 2013–14 to $13.58. Together with lower fuel prices, this indicates positive signs for NER in the fishery for 2014–15.

FIGURE 5.12 Real revenue, costs, NER and active vessel numbers for the NPF, 2003–04 to 2013–14



Notes: **NER** Net economic returns. NER include management costs.
Source: Bath & Green 2016

Total factor productivity in the fishery increased from 2004–05 to 2010–11, at a rate robust enough to offset declining terms of trade from declining prices and high fuel costs (Bath & Green 2016; Figure 5.13 and 5.14). This trend was largely driven by growth in outputs and a slightly declining inputs index. Most of the increase in the outputs index coincides with increases in banana prawn catch per vessel (Figure 5.15); however, targeting MEY of the tiger prawn component of the fishery would also have supported this improved productivity at a time of declining terms of trade. Because the productivity index was not adjusted for stock effects, productivity growth also reflects favourable environmental conditions that allowed increases in catch, rather than just changes in efficiency measures and technology adopted by fishers.

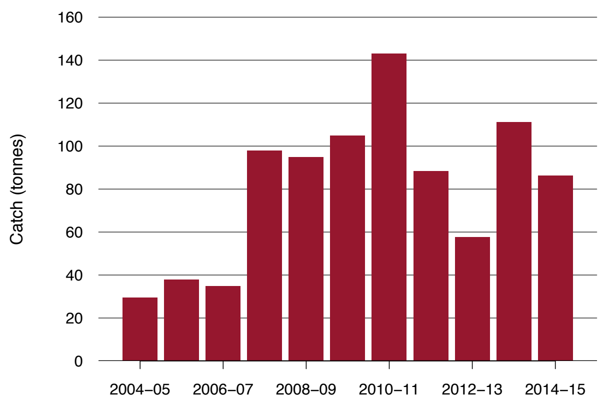
Banana prawn catch per vessel has fluctuated since 2010–11, including a sharp reduction in 2011–12 and 2012–13, which contributed to negative NER in 2011–12 but was offset by higher prices for banana prawns in 2012–13. Higher landed catches in 2013–14 led to improved growth in total factor productivity. Other factors that are likely to have improved productivity include the structural adjustment buyback and, more recently, many vessels moving to quad trawl gear, which is more fuel-efficient.

Inputs have proved stable, despite variation in seasonal conditions. If fewer inputs were used in less abundant fishing seasons, total factor productivity and NER would be higher overall and more stable. Recent management changes, including the introduction of an MEY catch trigger for banana prawns, seek to address this, but it is too early to assess the impact of these changes on total factor productivity.

FIGURE 5.13 Total factor productivity index, 2004–05 to 2013–14

FIGURE 5.14 Terms of trade index, 2004–05 to 2013–14

FIGURE 5.15 Average banana prawn catch per vessel, 2004–05 to 2014–15



Source: Skirtun et al. 2014

Management arrangements

The NPF is managed using input controls. The main control is individual tradeable gear units, which limit the length of headrope on trawl nets. Controls on season length, spatial closures and other gear restrictions are also applied.

An assessment of the impact of the structural adjustment package by Vieira et al. (2010) suggested that, for the benefits of the package to be preserved, management arrangements in fisheries targeted by the package need to be set in ways that prevent a repeated build-up of fishing capacity. For these reasons, AFMA recommended a range of amendments to the management arrangements in the fishery, to better align banana prawn catch levels with the MEY objective; these amendments were implemented throughout the 2014 and 2015 fishing seasons. In 2014, an MEY catch-rate trigger for banana prawn was introduced to the fishery (AFMA 2015). It is too early to disentangle the effect of these changes from other factors.

Performance against economic objective

The tiger prawn component of the fishery (tiger and endeavour prawns) has explicit MEY targets (three species-level biomass MEY targets), and a bio-economic model is used to estimate annual fishing effort required to move towards spawning stock sizes at MEY (S_{MEY}) across the stocks. Stock assessments are undertaken every two years. Spawning stock size of both species of tiger prawn were above S_{MEY} at the end of the 2015 season (Buckworth et al. 2016). Spawner stock size of blue endeavour prawn for the same period was estimated to be below S_{MEY}. Effort levels as a proportion of effort at MEY for brown tiger prawn and grooved tiger prawn were estimated to be at or below MEY. Current effort limits in the fishery are based on outputs from the fishery's bio-economic model, and are designed to achieve an MEY (profit maximisation) target across a seven-year projection period (noting that the target changes with every assessment because of changes in biological and economic parameters).

Recruitment for all species is highly variable. For white banana prawn, recruitment is associated with rainfall in some areas, and so no B_{MEY} target is defined for white banana prawn. Instead, an MEY-based catch-rate trigger, with mechanisms in place to adjust total annual effort levels to ensure that the fishery remains sustainable and profitable, was implemented for the 2014 banana prawn season and will be refined over subsequent seasons (AFMA 2015).

Red-legged banana prawn, primarily caught in Joseph Bonaparte Gulf, was assessed in 2015 (Buckworth et al. 2015), using data up to and including 2014. Spawning stock biomass was estimated to be well above biomass associated with the proxy MEY in the 2014 season.

The targeting of MEY in the fishery is consistent with the economic objective of maximising economic returns and could be expected to increase NER in the fishery. MEY targeting of the tiger prawn component of the fishery began in 2004–05. Despite declining terms of trade over 2004–05 to 2010–11, productivity and NER improved. Although the targeting of MEY over the period is likely to have supported these improvements, other factors such as the structural adjustment package and improved banana prawns catch also contributed. The banana prawn catch trigger targeting MEY has only been in place since 2014, so it is too early to determine its effect on NER.

5.4 Environmental status

The NPF was reaccredited under part 13 of the *Environment Protection and Biodiversity Conservation Act 1999* on 20 December 2013. The current approval of a wildlife trade operation (part 13A) expires on 9 January 2019. Four recommendations accompanied the strategic assessment, including improvement of the monitoring systems for byproduct and refinement of bycatch mitigation measures.

The NPF was certified as a sustainable fishery by the Marine Stewardship Council in November 2012 (MSC 2012).

Ecological risk assessment of the NPF has assessed 9 target species, 135 byproduct species, 516 discard species (chondrichthyans and teleosts only), 128 protected species, 157 habitats and 3 communities (AFMA 2008). Following review of the level 2 Productivity Susceptibility Analysis (PSA) risk rankings, using residual risk guidelines (AFMA 2008), 26 species remained at high risk. During and following the level 2 PSA work, selected taxonomic groups were the subject of level 2.5 studies (Brewer et al. 2007). Milton et al. (2008) estimated temporal trends in abundance of sea snakes in the NPF to provide a quantitative assessment of trawling on populations. Although most populations had been relatively stable, two species (spectacled seasnake [*Hydrophis kingii*] and large-headed seasnake [*H. pacificus*]) showed evidence of decline on the trawl grounds. Results from a level 3 Sustainability Assessment for Fishing Effects analysis of elasmobranchs in the NPF (Zhou & Griffiths 2011) indicate that, of the 51 species considered, fishing impacts may have exceeded the maximum sustainable fishing mortality harvest rate for 19 species, although these estimates were highly uncertain. Based on these risk assessments, three species are currently considered to be at high risk in the NPF: porcupine ray (*Urogymnus asperrimus*) and two species of mantis shrimp (*Dictyosquilla tuberculata* and *Harpiosquilla stephensoni*).

AFMA publishes quarterly reports of logbook interactions with protected species on its website. In the NPF in the 2014 calendar year, 60 turtle interactions were reported, and all turtles were released alive; 476 sawfish were caught, of which 326 were released alive, 9 were injured and the remainder were dead; and 7 682 sea snakes were caught, of which 6 324 were released alive, 7 were injured, 322 had an unknown life status and the remainder were dead. Reports also indicate that 28 seahorses or pipefish were caught—21 were dead and 7 were released alive.

5.5 References

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