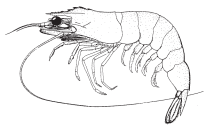
Northern Prawn Fishery


Main features

STATUS

- White and red-legged banana prawns: not overfished and not subject to overfishing.
- Brown tiger prawns and grooved tiger prawns: not overfished and not subject to overfishing.
- Blue endeavour, red endeavour and king prawns: uncertain.

RELIABILITY OF THE ASSESSMENT

- High for tiger prawns.
- Low to moderate for banana prawns, but improving with current assessment work.
- Low for endeavour and king prawns, which are largely byproduct species.

CURRENT CATCH

- 2007 total catch 4310 t: banana prawns 2901 t; tiger prawns 1192 t; endeavour prawns 196 t; king prawns 20 t.
- 2006–07 total value: $64 million, down from $73 million in 2005–06.

LONG-TERM POTENTIAL YIELD

- Around 4000 t per year for banana prawns.
- Maximum sustainable yield (MSY) around 3200 t per year for tiger prawns.

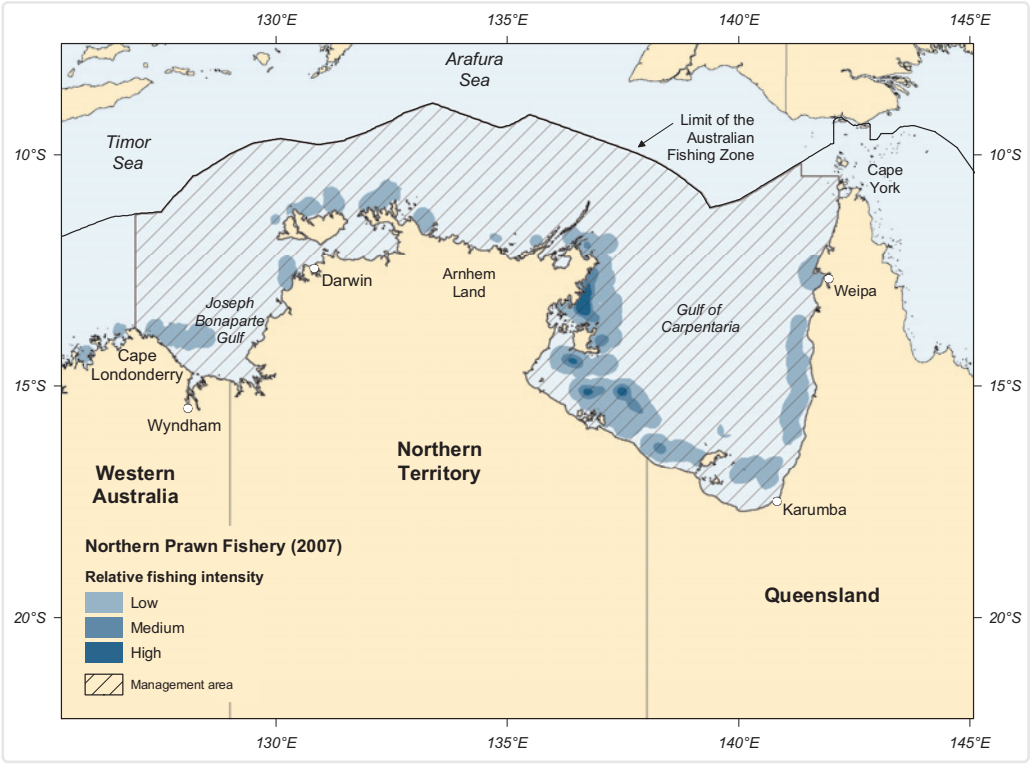
MAIN MANAGEMENT OBJECTIVES

- Maximise net economic returns.
- Ensure consistency with ecologically sustainable development principles.
- Implement cost-efficient management.
- Minimise the incidental catch of non-target commercial and other species.

In 2004, maximum economic yield (MEY) was agreed as the overall target for the tiger prawn fishery. MEY is a biologically more conservative target than MSY in this fishery.

MANAGEMENT METHODS

- Input controls (tradeable gear units), including limited entry, gear restrictions, area closures, seasonal closures and time-of-day closures.
- Harvest strategies in place for banana prawns, tiger prawns and some byproduct/low-volume species.



Highlights

- The Northern Prawn Fishery (NPF) is the most valuable fishery managed by the Australian Government. The value of production has declined from $135 million in 2001–02 to $64 million in 2006–07, due partly to smaller catches but also to lower prawn prices.
- The total prawn catch for the fishery was 5310 t in 2006 and 4310 t in 2007. Banana prawn effort was the lowest for more than 30 years, as were tiger prawn catch and effort in 2007.
- The lower catches reflect reductions in fishing effort as a result of management aimed at rebuilding tiger prawn stocks and moving towards the target reference point of MEY. The recent structural adjustment resulted in a 45% reduction in vessel statutory fishing rights (SFRs) and a 34% reduction in gear SFRs from the start of 2007.
- Future management arrangements for the fishery, including a move to total allowable catch (TAC) and individual transferable quota (ITQ) management, are being developed.
- Grooved and brown tiger prawns were previously assessed as overfished. Recent assessments indicate that the stocks of both species have recovered and are no longer overfished. Reductions in fishing effort indicate that current effort levels are unlikely to lead to overfishing.
- The NPF has invested substantially in bycatch research and mitigation. Bycatch reduction devices (BRDs) and turtle excluder devices (TEDs) became compulsory in 2000. The TEDs have substantially reduced the capture of turtles and other large animals, including sharks and rays. Ongoing observer and independent prawn survey programs are in place.

Background

History of the fishery

The NPF started in the late 1960s and has grown to be the most valuable fishery managed by the Australian Government. Most of the catch is exported to Japanese and other Asian markets.

The NPF is a multispecies fishery that targets prawns using otter trawl. The white banana prawn (*Fenneropenaeus merguiensis*) and the two tiger prawns (grooved, *Penaeus semisulcatus*, and brown, *P. esculentus*) account for about 80% of the landed catch. Red-legged banana prawn (*F. indicus*), endeavour prawns (blue and red, *Metapenaeus endeavouri* and *M. ensis*, respectively) and king prawns (red-spot and western, *Melicertus latisulcatus* and *M. longistylus*, respectively) are also landed, along with some bugs (*Thenus* spp.), scampi (*Metanephrops* spp.), scallops (*Amusium* spp.), squid (*Photololigo* spp.) and finfish.

The management area of the NPF covers over 771 000 km^2 off Australia's northern coast, from Cape Londonderry in Western Australia to Cape York in Queensland, but the actively fished area is much smaller (around 220 000 km^2). The fishery is regarded as having two seasons: a short banana prawn fishery of some 6 weeks starting around April, and a longer tiger prawn fishery starting August–September. Endorsed vessels can operate in both seasons.

The banana prawn fishery operates mainly in the eastern waters of the Gulf of Carpentaria and on isolated grounds along the Arnhem Land coast, targeting white banana prawns, and in the Joseph Bonaparte Gulf, targeting red-legged banana prawns. The white banana prawns form dense aggregations ('boils') that are found by spotters in planes, who direct the trawlers to them. The highest catches are taken in areas offshore from mangrove forests, which are the juvenile nursery areas. White banana prawns are fished mainly during the day.

Red-legged banana prawns do not form such dense aggregations, and can be fished during the day and night throughout the year. However, the high tidal range in the Joseph Bonaparte Gulf means that they are mostly fished around neap tides, when they are easier to catch.

Since 1970, the average annual catch of banana prawns has been 4300 t, but it has ranged widely from around 2000 t to 12 711 t. The highest catches have usually followed higher-than-average rainfall in the previous summer. The white banana prawn contributes more than 80% to the total banana prawn catch and drives the annual variation. Red-legged banana prawn catches have averaged about 800 t per year since the early 1980s. Initially, the Joseph Bonaparte Gulf was fished when catches were low in other parts of the NPF, but now a group of vessels fishes there regularly.

The tiger prawn fishery operates mainly in the southern and western Gulf of Carpentaria and along the Arnhem Land coast. The tiger prawn fishing grounds are often close to those of banana prawns, but the highest catches are in areas near coastal seagrass beds—the juvenile nursery habitat. Historically, vessels switched to targeting tiger prawns when the banana prawn catch rates declined. Tiger prawns are fished at night, mostly in August and September. The tiger prawn catch was highest in the 1980s, peaking at 5751 t. A series of fishing-effort restrictions have been implemented since 1987, and annual catches in the tiger prawn fishery were reduced to an average of 1947 t for the period from 2000 to 2006.

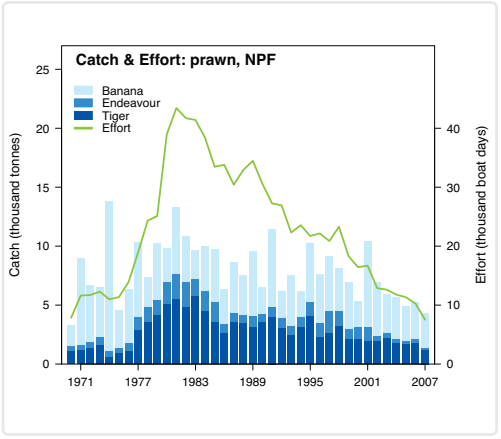
Endeavour and king prawns are caught as byproduct in the tiger prawn fishery. Catches peaked in the 1980s, averaging 1406 t for endeavour prawns and 103 t for king prawns. The catches have declined in recent years to averages of 568 t and 11 t, respectively, for the 2000–06 period.

The management of the NPF was originally shared between Queensland, Western Australia and the Northern Territory. The first management plan was in place in 1977 and limited entry to 302 vessels. The fishery became solely managed by the

Australian Government in 1988 under Offshore Constitutional Settlement arrangements. Since 1984, the Australian Fisheries Management Authority (AFMA), which has responsibility for day-to-day management, has been advised by the Northern Prawn Fishery Management Advisory Committee (NORMAC), which is made up of representatives from industry, management, and the environmental and research sectors. The Northern Prawn Resource Assessment Group (NPRAG) undertakes assessments of the prawn resources and related matters, reporting directly to the AFMA board. In addition, NORMAC has a number of subcommittees addressing issues such as bycatch and ITQ implementation.

The NPF has been managed through input controls, including a limited-entry regime, seasonal and area closures, and gear restrictions. In 1984, in response to concerns about fishing capacity and overcapitalisation, the vessels were 'unitised' according to hull volume and engine power. In 1987, a decline in tiger prawn recruitment resulted in the introduction of a mid-season closure (usually May–August) to reduce effort on tiger prawns before they spawn. The length of the mid-season closure has changed over time, in line with effort-management strategies. At the same time, daylight trawling during the tiger prawn season was banned and vessels were restricted to towing only two nets. A buyback scheme also operated between 1987 and 1993, reducing the number of vessels fishing from about 230 to 125. The opening of the banana prawn season was postponed until April to increase the value of the prawns by letting them grow to a reasonable market size before they are fished.

SFRs were issued in 1995, along with a new management plan under the *Fisheries Management Act 1991*. The SFRs were based on existing effort units in the fishery. Despite the smaller fleet size, there was still concern that the effective effort in the fishery was too high because of the adoption of new technologies by industry. In the latter half of the 1990s, NPRAG advised that the effective effort directed at tiger prawns was well above that required to achieve MSY and should be reduced by 25–30%. In 1997, NORMAC supported the change to gear-based management, controlling the amount of fishing net used (by limiting headrope length). AFMA considered that headrope length would more accurately represent a vessel's fishing power and provide a more direct way of reducing effort if required. Gear-based management was implemented in 2000. The lengths of the fishing seasons have also been shortened to restrict fishing effort, with the shortest fishing seasons (134 days in total) in the years from 2002 to 2004. In 2005, there was agreement to extend the tiger prawn fishing season and permit fishing in August. However, this was linked to measures to minimise tiger prawn catch in the banana prawn season.



In 2001, AFMA commissioned an international expert to review the tiger prawn stock assessment. The review confirmed the results of the assessment—that the tiger prawns were overfished and that the levels of fishing effort were too high to promote recovery. NORMAC then established a 'target' reference point specifying that by the end of 2006, with at least 70% certainty, the spawner biomass would be at or above the biomass that produces MSY (B_{MSY}). Fishing effort was reduced to meet the target, and the biomass of both tiger prawn species has recovered.

In 2004, NORMAC agreed that the overall management objective of the fishery should be MEY and changed the previous spawning biomass target to a 'limit' reference point. Bioeconomic modelling suggested that the fishery required a 30% reduction in effort to achieve the target effort level required for MEY (E_{MEY}). Working towards that target, NORMAC recommended a 25% reduction in the gear SFR, which came into effect in 2005.

The limit on towing more than two nets was lifted from the start of the 2006 fishing season. Vessels were allowed to operate with quad gear, but each vessel adopting new gear was subject to a 10% penalty on their gear SFR. A tradeable input unit system (individual tradeable effort units—ITEs) is in place, setting the headrope length according to the gear unit holding of a vessel.

During 2006, the NPF was involved in the wider structural adjustment package for Commonwealth-managed fisheries, to assist the fishery in achieving the MEY target. The package led to a 45% reduction in vessel SFRs and a 34% reduction in gear SFRs by the start of 2007. A condition of participation was that the fishery would move to management through output controls—specifically, to an ITQ system.

Biology

The prawn species targeted by the NPF are fast growing, short-lived and highly fecund. All live between 1 and 2 years, and most are sexually mature at 6 months. However, fecundity increases with age and individuals may spawn more than once in a season. Fertilised eggs sink to the seafloor and hatch within 24 hours. The larvae are planktonic for 2–4 weeks, during which time they travel to coastal nursery habitats. After 1–3 months there, the young prawns move offshore to deeper water, where they are fished.

The white and red-legged banana prawns use mangrove-lined creeks and rivers as nursery habitats. Adult white banana prawns are found mainly on muddy sediments less than 20 m deep, and reach commercial size before 6 months of age. They spawn throughout much of the year, but the two main spawning periods are March–May and September–November. The later spawning produces most of the prawns in the commercial fishery in April–May the following year.

The red-legged banana prawns are more abundant in the Joseph Bonaparte Gulf, where adults are found in depths of 45–85 m. They are known to aggregate but do not form the large schools typical of the white banana prawn. The highest catches of red-legged banana prawns are taken from the north-western part of the Joseph Bonaparte Gulf, while the nursery areas are mainly in the eastern part. This suggests that the larvae move large distances from the spawning grounds to the nursery grounds, and juveniles must also move large distances from the mangroves to the deeper fishing grounds.

The tiger prawn species use coastal and estuarine seagrass beds as nursery habitat and have similar lifecycles. Brown tiger prawns tend to prefer seagrass along exposed coastlines as nursery areas, while grooved tiger prawns prefer more sheltered seagrass beds in estuaries. Adult brown tiger prawns are fished mostly in 10–20 m over coarse sediments; grooved tiger prawns are taken mostly from fine mud sediments in deeper waters. Both species have two main spawning seasons, August–October and January–February, both of which contribute to the fishery in the following year. Brown tiger prawns move offshore between November and January, whereas grooved tiger prawns do so between January and April.

The 2007 fishery

A total of 51 vessels fished during 2007, down from 77 in 2006 and from 89 in 2005. The banana prawn season ran for 8 weeks from 6 April until 2 June. This comprised a fixed 6 weeks plus a 2-week extension that was triggered, according to the 2007 control rules, in the following way. Banana prawn catch rates were 651 kg/day per vessel in the fourth week of the season and so met the required 500 kg/day per vessel minimum. The catch of tiger prawns for the first 4 weeks of

the season was 1.47 t and therefore met the requirement that tiger prawn catches not exceed 26.4 t. There were 2696 vessel days of effort attributed to the 2007 banana prawn season (2006: 3283 vessel days). The total reported landing of banana prawns for 2007 was 2901 t (2006: 3117 t). Overall catches for the banana prawn season were regarded as fair, with a stronger focus on high product quality and a satisfactorily low bycatch of tiger prawns. The average returns per vessel were an improvement on 2006; however, economic conditions, including fuel and other costs and the prices obtained for banana prawn product, remained unfavourable.

The tiger prawn season ran from 1 August until 28 November 2007. The season comprised a fixed 15 weeks plus a 2-week extension that was triggered, according to the 2007 tiger prawn control rules, as follows. Tiger prawn catch rates for the week from 15 to 21 October were 302.5 kg/night per vessel, meeting the required 300 kg/night per vessel minimum. There were 4829 vessel days of effort attributed to the 2007 tiger prawn season (2006: 6983 vessel days). The total reported landings of tiger prawns in 2007 were 1192 t (2006: 1802 t). This was the lowest tiger prawn season catch and effort recorded since the mid-1970s. Economic conditions, including fuel and other costs and prices obtained for banana prawn product, remained unfavourable.

In 2007, the fishery (including both seasons) reported total prawn landings of 4310 t (2006: 5310 t). Byproduct prawn catches were 196 t of endeavour prawns (2006: 363 t) and 20 t of king prawns (2006: 28 t). The fishery also landed 12 t of bugs, 175 t of squid, 8 t of scallops, and smaller quantities of other byproduct. No catch of scampi was reported.

Catches were valued at $64 million in 2006–07. The value of the fishery has decreased in recent years from the peak of $135 million in 2000–01 as effort has been reduced and prawn prices have declined.

Current monitoring and research

In the NPF, daily logbooks are used to record catch-and-effort data that are validated against landing records. Logbooks contain information on catch, effort, species, size grade, and location and time of fishing, as well as interactions with protected species. The prawn catches are not identified to species level, but are recorded in species groups—banana, tiger, endeavour or king prawn catches—by size category. This information is the basis of the stock assessments.

In 2002, the fishery began twice-yearly, fishery-independent surveys to provide estimates of prawn recruitment (January–February) and adult abundance (July–August). The aim of the surveys is to provide a long-term data series that can be used to determine stock–recruitment relationships, abundance indices and other inputs for the stock assessments. The surveys also collect information on the main byproduct species in the NPF. The survey information is not yet used in the stock assessment because of its relatively small time-series. It has been valuable for NPRAG's examination of king prawns and banana prawn catches in the Weipa area.

Research is in progress on bycatch mitigation through gear technology, the effects of trawling on the marine environment, the potential use of spatial management measures, new and continuing development of stock assessments, and ecological risk assessments. A report that assesses alternative approaches to implementing ITQs in the NPF and their consequences was completed in 2007 by consultants MRAG Ltd.

→ NORTHERN PRAWN FISHERY HARVEST STRATEGY

The NPF harvest strategy includes distinct strategies for the different parts of the fishery and is designed to operate within the current management system of input controls. The tiger prawn strategy has been tested in a simulation environment to assess its performance against the Commonwealth Fisheries Harvest Strategy Policy. The strategies' control rules operate from 2008.

BANANA PRAWNS

Species: White banana prawn and red-legged banana prawn.

Target: No current specific target.

Limit: No current specific limit.

Control rules:

- Season limited to 6 weeks, with the possibility of extension to 8 or 10 weeks provided banana prawn catch rates are maintained (>500 kg/boat per day) and tiger prawn bycatch is low (<6.6 t/week).
- Rules read in conjunction with other management measures, including gear controls and spatial closures.
- Based on an analysis of historical fishery records, which indicated that the approach was likely to result in a sustainable fishery.

TIGER PRAWNS

Species: Grooved tiger prawn, brown tiger prawn, blue endeavour prawn, red endeavour prawn, western king prawn, red spot king prawn.

Target: Long-term MEY from a suite of tiger and endeavour prawns (with recognition that some species, when considered in isolation, may be below or above B_{MEY}, but still subject to the aggregate limit reference point).

Limit: Half of the spawning stock needed to achieve maximum sustainable yield (0.5 S_{MSY}) calculated as the moving average over 5 years (this limit can only be assessed for tiger prawns).

Decision rules:

- Fishing effort for brown and grooved tiger prawn fleets set for 2-year period to maximise profits over a 7-year moving window, based on the results of a bioeconomic assessment conducted every 2 years.
- Fishing effort controlled by modification of area, season and gear (headrope length).
- If limit reference point is triggered, targeted fishing of the species concerned ceases.
- Standardised fishing effort for the fleet in any one year cannot be less than half of the standardised effort targeted at brown tiger prawns in 2006.

KING PRAWNS

King prawns are monitored through logbooks, surveys and seasonal landings. If a consistent decline in abundance is detected over a 3-year period, appropriate management measures (including additional spatial closures), will be implemented to reduce fishing pressure.

SCAMPI

Scampi status is assessed through examination of trends in total annual catch, vessel participation, catch rates and size distribution. A catch of 30 t or greater, or participation of eight or more vessels, in a year will trigger a 30 t TAC in the following year.

Status of stocks

Banana prawns

Previous assessments

In the mid-1980s, analysis of 10 years of white banana prawn catches indicated that the high annual variability was linked to environmental factors, particularly rainfall. A predictive model based on environmental factors was developed for the south-eastern Gulf of Carpentaria. There has been a long-term assumption that there is no strong relationship between spawning stock size and subsequent recruitment levels. Because of this, stock assessment of banana prawns has generally proven difficult, with limited means for estimating yield in the next season. The sustainable long-term annual yield is thought to be around 4000 t, based on the average catch since 1980. Management of the banana prawn fishery has focused on preventing growth overfishing[3] and providing higher returns by minimising the capture of small prawns. Initially, a yield-per-recruit model and pre-season fishing surveys were used to estimate the appropriate opening time for the banana prawn season. The fishery then moved to a set opening date at the beginning of April.

In the late 1990s, there were substantial differences between the predictions from the environmental model and banana prawn catches. A dynamic stock assessment model was developed using the 1970–2000 data. The seven main banana prawn regions were modelled separately, and the models included stock–recruitment relationships as well as environmental factors. The results from that preliminary assessment suggested that in some regions there was a link between the spawning stock size and subsequent recruitment into the fishery. Therefore, there may be potential for the levels of fishing effort to influence recruitment and abundance.

The red-legged banana prawn fishery began in the 1980s in the Joseph Bonaparte Gulf, and an initial yield-per-recruit model was developed for the species in the mid-1990s. The catch of red-legged banana prawns was also linked to some environmental variables, although not as strongly as that of white banana prawns. The yield-per-recruit model was revised in 2002 using estimates of mortality and growth from tagging studies, which suggested that the exploitation rates of the red-legged banana prawn were high, but lower than those of the white banana prawn in the Gulf of Carpentaria. The revised model suggested that the size of the spawning stock on which the fishery was based was substantially smaller than previously thought. The short time-series meant that it was not possible to examine whether recruitment was affected by spawning stock size or fishing mortality.

2007 update

A harvest strategy was developed for banana prawns during 2007 (see box). The strategy aims to allow enough prawns to escape to ensure an adequate spawning biomass of banana prawns, maximise the economic returns from the fishery and minimise the take of tiger prawns during the banana prawn season. The strategy continues the control rule of a fixed 6-week season, with extensions to the season when high catch rates (>500 kg/boat per day in the fourth week) occur. The season length is based on an analysis of historical records, which indicates that 6 weeks of fishing is sustainable. The 500 kg/boat per day catch indicator was derived by taking an average of the catches of the fourth fishing week in the most productive banana prawn seasons over a 10-year period and dividing by the number of boats. The harvest strategy has no specific target or limit reference points because of the lack of a stock assessment and because the relationship between spawning biomass and subsequent recruitment is not clear.

In recent years, there has been concern over the status of white banana prawns in the Weipa region because of low catches compared to historical levels. Those concerns have been allayed by better catches in 2006

3 See Glossary

and 2007 and early indications of very strong catches in the region for 2008. However, there remains a need to monitor and assess banana prawns across the fishery as a set of separate, spatially bounded stocks. This may also need to be reflected in the harvest strategy for the fishery.

Investigations of the strength of the stock–recruitment relationship for white banana prawns continues, as does its consideration by NPRAG. There is particular focus on whether catch per unit effort is an adequate index of abundance in the banana prawn fishery. Fishing mortality is high for white banana prawns but, with the continuing reduction of fleet size, adoption of the harvest strategy and lack of evidence of recruitment overfishing, the species is not considered to be overfished or subject to overfishing.

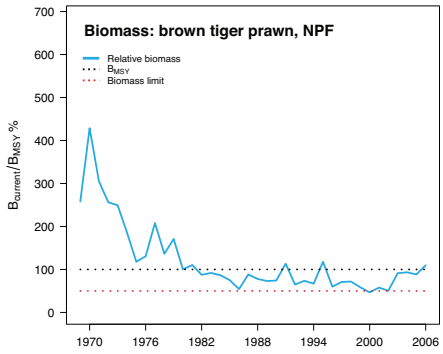
There is no updated assessment of the red-legged banana prawn. However, there has been no evidence of declining recruitment and, given the species' biological similarities to the white banana prawn (including the environmental influence on recruitment), adoption of the harvest strategy, lack of evidence of recruitment overfishing and reductions in fleet size, it is not considered to be overfished or subject to overfishing.

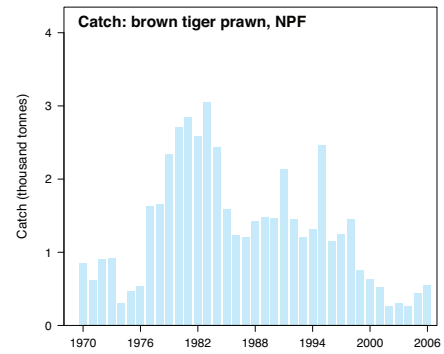
Tiger prawns

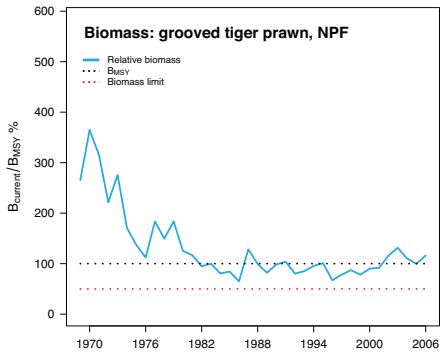
Previous assessments

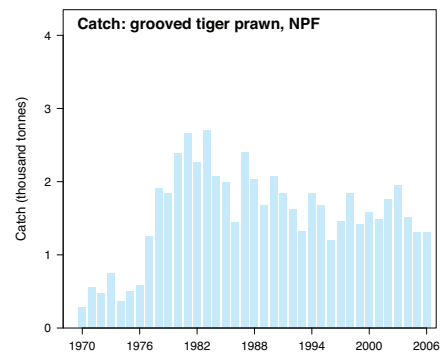
Early tiger prawn assessments treated them as a single species group and stock within the NPF. In 1997, the two tiger prawn species were assessed separately using a dynamic age-structured model and all data from 1970 onwards. The model included an explicit stock–recruitment relationship and incorporated the assumption that the fleet's fishing power, or effective fishing effort, had increased by 5% per year. The assessment suggested a long-term annual yield of around 4000 t from the two species combined, and that the effective effort in the fishery needed to be reduced.

In 2000, the tiger prawn assessment began to examine different models of changes in fishing power and provide more details of the









uncertainty inherent in the assessment. The estimates of recruitment of brown tiger prawns in 1999 and 2000 were the lowest on record. The 2001 stock assessment concluded that the biomass of both tiger prawn species was depleted—most severely for brown tiger prawns, the spawning biomass of which was estimated to be 42–54% of B_{MSY} (the stock size required to achieve MSY). Grooved tiger prawn spawning biomass was estimated to be 66–86% of B_{MSY}. The level of effort in the fishery was too high to promote recovery, and an international expert review of the assessment supported that conclusion. In 2001, NORMAC established a target reference point for the tiger prawn fishery: by the end of 2006, and with at least 70% certainty, spawning biomass was to be at or above B_{MSY}. There was agreement to reduce effort by 40% to help achieve this goal.

The assessment of the stocks at the end of 2002 used a range of scenarios for fishing power and catchability to provide pessimistic and optimistic scenarios. The assumption of a constant 5% per year increase in fishing power was replaced with two fishing-power series. Two estimates of catchability were also used. Recent assessments have continued to use this range of scenarios. The assessment at the end of 2002 suggested that the biomass of brown tiger prawns was still below B_{MSY}, but that the biomass of grooved tiger prawns was above B_{MSY}.

The assessment at the end of 2004 suggested that brown tiger prawn biomass had recovered to be above B_{MSY}; however, there was more uncertainty about the biomass of grooved tiger prawns, with pessimistic scenarios suggesting that it was then below B_{MSY}. In 2004, the NPF adopted MEY as an overall target. B_{MSY} was adopted at that time as the limit reference point. Bioeconomic modelling of the tiger prawn fishery at the end of 2003 suggested that the fishing effort and number of boats were much higher than levels needed to achieve MEY. To move towards this target, NORMAC agreed to a 25% reduction in the amount of gear represented in SFRs (in terms of headrope length) from the start of the 2005 fishing season.

The 2006 assessment incorporated new research to split catches between grooved and brown tiger prawns. The new 'species split' model had a substantial impact on the results of the assessment. Under the conservative scenarios, the assessment indicated that both species of tiger prawn were below the NORMAC limit reference point of B_{MSY}. The revised bioeconomic model indicated that the fishery's economic yield was 74% of its maximum potential economic yield, and that the 'optimal' number of vessels was around 45.

2007 update

The 2007 assessment used four scenarios for fishing power and catchability and the new tiger prawn species-split method. The grooved tiger prawn spawning stock biomass was estimated to be 111–148% of B_{MSY}, and the 2006 fishing effort was 36–55% of E_{MSY} across the four scenarios tested. The brown tiger prawn spawning stock biomass was estimated to be 96–139% of B_{MSY}, and the 2006 fishing effort was 36–63% of E_{MSY} across the four scenarios (medians). Note that these values represent the central estimates over the range of scenarios and not the confidence intervals. These results indicate that the NORMAC limit reference point of B_{MSY} was met for both tiger prawn species.

The 2007 assessment suggests that neither tiger prawn species is overfished, relative to the 0.5 B_{MSY} limit reference point default of the Commonwealth Fisheries Harvest Strategy Policy and the B_{MSY} limit reference point adopted by NORMAC. It also suggests that both species are not subject to overfishing.

Endeavour and king prawns

The long-term yield estimate for endeavour prawns was previously reported as 500 t, but that figure was not based on a rigorous assessment. Catches were variable but lower in the years from 2000 to 2007 (average 524 t) than in previous decades (1990–1999, 1056 t; 1980–1989, 1406 t). The gear and fleet reductions, as well as changes in the length and timing of the fishing season or

Prawn trawler, Darwin

changes in the spatial distribution of fishing effort, could all have contributed to the smaller catches. Stock assessments for both blue and red endeavour prawns were developed during 2007 as part of a broader effort to develop the bioeconomic model for the tiger prawn fishery (in which endeavour prawns are a commercial bycatch) and test harvest strategies against the desired MEY objective. The stock assessment model for blue endeavour prawns is more advanced but still requires refining and validation over several years before it is accepted by NPRAG. The preliminary stock assessment results for the two endeavour prawn species currently contribute to the bioeconomic assessment, but the biomass estimates are not currently subject to a 0.5 B_{MSY} limit reference point that is used for tiger prawns. The status of both blue and red endeavour prawns as overfished and subject to overfishing is uncertain.

The catch of king prawns has declined over the past 10 years, raising concerns about the status of those species. The declines could be due to reductions in the biomass or changes in the timing and location of fishing effort. NPRAG examined the data on king prawns, including fine-scale distribution information from independent surveys. However, it was not able to determine the most likely explanation for the declining catches. NPRAG concluded that seasonal closures in August had been beneficial for the king prawn species and that it should continue to watch the trend. The status of blue-legged and red-spot king prawns as overfished and subject to overfishing is uncertain.

Reliability of the assessment

The deviations from prediction of white banana prawn catches have produced a sharper focus on the assessment of that species, particularly to resolve the uncertainty about whether fishing has an impact on recruitment.

The tiger prawn assessment has been well developed, incorporating improvements in the modelling of changes in fishing power and the species composition of the catch. In 2001, Dr Richard Deriso, the international expert, commented that the NPF tiger prawn assessments were ‘probably the most comprehensive assessments of any prawn populations in the world’, but suggested that uncertainty in some aspects should be reduced.

NPRAG has taken up these suggestions. A number of assumptions are required for the parameters in the assessment model. The sensitivity of the outputs to those assumptions is examined by modelling a range of scenarios. The inception of fishery-independent surveys will substantially benefit future assessments after a longer time-series has been collected, as they will help in understanding the stock–recruitment relationship and the spatial abundance of prawns. The surveys will also help to overcome the reliance on logbook data in the assessments. The current endeavour prawn assessments are regarded as unreliable.

Future assessment needs

Work to refine the stock assessment of white banana prawns and understand the impact of fishing on that species needs to continue. Stock assessments for endeavour prawns need to be further refined so that they can be relied on to provide status information for the two species. NPRAG's watching brief on king prawns and red-legged banana prawns should be maintained; where there is scope, more assessments should be developed.

The move to an MEY target for the fishery has put a greater emphasis on obtaining comprehensive financial and economic data from the fishery. The accuracy of those data, along with forecasts of future economic conditions (such as currency exchange rates and fuel prices), is critical to the success of the bioeconomic model. There is a continuing need to develop assessments that can support the change to an ITQ system, including an ability to forecast the following year's recruitment and a corresponding recommended TAC. There is also a need to understand the effect of the NPF structural adjustment on the fleet's functioning, efficiency and effective effort applied to the various species.

The high-priority research needs for the fishery are:

- assessing the status of stocks
- developing better methods for assessing stock status and setting TACs
- improving the efficiency of fishing gear and techniques to reduce bycatch, increase the survival of bycatch and reduce environmental impacts on the benthos
- improving the knowledge of environmental factors important to the fishery
- increasing the cost-effectiveness of management and making fishing more economically efficient.

Environmental issues

Environmental issues within the NPF include the high proportion of bycatch, interactions with protected species (such as sea turtles and sea snakes), and the potential impacts of trawling on benthic communities. The NPF has a long history of research into environmental matters, particularly bycatch. The industry has been involved through crew-member monitoring of bycatch and evaluation of the effectiveness of bycatch reduction measures. The recent substantial reductions in fishing effort should have a positive effect in these areas. Fewer vessel-days in the fishery are likely to result in a smaller bycatch and smaller impacts on benthic communities.

Work on protected species has focused on interactions with sea turtles. In 2000, TEDs became compulsory in the fishery. Along with industry education programs, TEDs have been very effective in reducing sea turtle bycatch and, to some extent, bycatch of other large species. In 1999, 780 sea turtles were reported in logbooks as caught and released alive, with an additional 96 mortalities. In 2007, 55 turtles were caught and released, and no mortalities were recorded. This substantial reduction has been confirmed by observer programs. One effect of this

improvement has been that the United States has accredited the NPF to export prawns to US markets. There is an increasing focus and ongoing research on the fishery's interactions with other protected species, such as sea snakes.

In the NPF, most of the bycatch comprises small fish and invertebrates. In 2001, mandatory use of BRDs was introduced to enable small bycatch to escape. Various approved BRD designs have differing effectiveness in reducing bycatch and retaining product. A new BRD—the Popeye Fishbox—has shown promising results, with small-sized bycatch reduced by up to 48% and bycatch of sea snakes by up to 87% in trials. The design was tested during the 2007 tiger prawn season, showed early indications of success, and is now approved for use in the NPF.

An ecological risk assessment of the NPF is in its final stages. This research is designed to assess the risk that prawn trawling poses to bycatch species, in order to target bycatch reduction efforts on the most vulnerable species. Targeted research is examining the environmental impact of trawling on benthic communities in the fishery.

The NPF was the first fishery to develop a bycatch action plan, which was revised and released for public comment in 2007. In 2003, the fishery was accredited under the *Environment Protection and Biodiversity Conservation Act 1999*, ensuring that fishers could continue to export their catch until 2008. A number of recommendations required implementation to further improve management of the fishery before its 2008 review.

Further reading

Burke, A & Whitelaw, A 2007, *Northern Prawn Fishery operational information 2007*, Australian Fisheries Management Authority, Canberra.

Dichmont, CM, Deng, AR, Punt, AE, Venables, W & Haddon, M 2006, 'Management strategies for short lived species: the case of Australia's Northern Prawn Fishery 2. Choosing appropriate management strategies using input controls', *Fisheries Research*, vol. 82, pp. 221–234.

MRAG Ltd 2007, *Individual transferable quotas in the Australian Northern Prawn Fishery*, final report, Australian Fisheries Management Authority and NORMAC.

Rose, R & Kompas, T 2004, *Management options for the Australian Northern Prawn Fishery: an economic assessment*, final report, Fisheries Resources Research Fund, Canberra.

Management performance

The fishery is managed under the NPF Management Plan 1995, the objectives of which are to:

- ensure that the utilisation of the fishery resources within the NPF is consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle
- maximise the economic efficiency of the use of those resources
- implement efficient and cost-effective management of the fishery
- effectively communicate and consult with AFMA, the fishing industry, other marine resource users and the broader community
- ensure that the incidental catch of non-target commercial and other species in the NPF is reduced to a minimum.

Management of the NPF has had a different emphasis for the two components of the fishery: the management of banana prawns has focused on controlling the start of the fishing season to maximise the size of prawns caught; the management of the tiger prawn fishery has focused on reducing fishing effort to achieve targets for spawning biomass and, more recently, MEY.

There was a strong management response to the overfished status of tiger prawns. Biological reference points were adopted, and fishing effort was reduced by shortening headrope length and the length of fishing seasons. Recent assessments show that recruitment has increased for both tiger prawn species and that their biomass has recovered.

The movement to an overall fishery target of MEY will benefit both the industry and the stocks. The 25% gear reduction in 2005 was a move towards achieving MEY, as was NPF involvement in the structural adjustment package, which resulted in a 45% reduction in vessel SFRs and a 34% reduction in gear SFRs. The MEY approach in the tiger prawn fishery involves maximising profits across a suite of prawn species, allowing the biomass of individual species to be at any level above the limit reference point. This places a greater emphasis on ensuring that limits are correctly set (they are currently 0.5 B_{MSY}) and then understanding current status in relation to those limits. In this area, the development of preliminary stock assessments for endeavour prawns is encouraging.

A harvest strategy was developed for the fishery during 2007, in accordance with the Commonwealth Fisheries Harvest Strategy Policy. The strategy contains very definitive decision rules for the tiger and banana prawn fisheries. For byproduct and low-volume species, such as king prawns and scampi, the strategy adopts a simpler monitoring approach with a less definitive set of responses. The selection of appropriate indicators for these byproduct species and regular reporting and consideration by NPRAG are fundamental to the success of this simpler approach.

There has been considerable work on and discussion about the future management system for the NPF, particularly about the role of TAC/ITQ management. After the recent structural adjustment, and in line with Australian Government policy, it is intended that an ITQ system will be introduced by the 2009 tiger prawn season. In September 2007, MRAG Ltd completed an independent report on options for introducing ITQs into the fishery in an economically efficient manner and with minimal disruption to the fishery. Two workshops were then conducted to examine various management scenarios involving input and output controls for the tiger and banana prawn fisheries. A move to a TAC/ITQ system has wide implications, including for stock assessment modelling, management costs, environmental performance, economic performance and profitability.

The NPF has a history of management to address the issue of bycatch—it was the first fishery to develop a bycatch action plan—and has taken substantial steps to minimise its broader impacts on the marine ecosystem. The introduction of TEDs, in particular, has successfully managed sea turtle bycatch. BRDs have yet to achieve their full potential, but ongoing work is addressing the problem.

The NPF has also begun the first stage of Marine Stewardship Council certification.