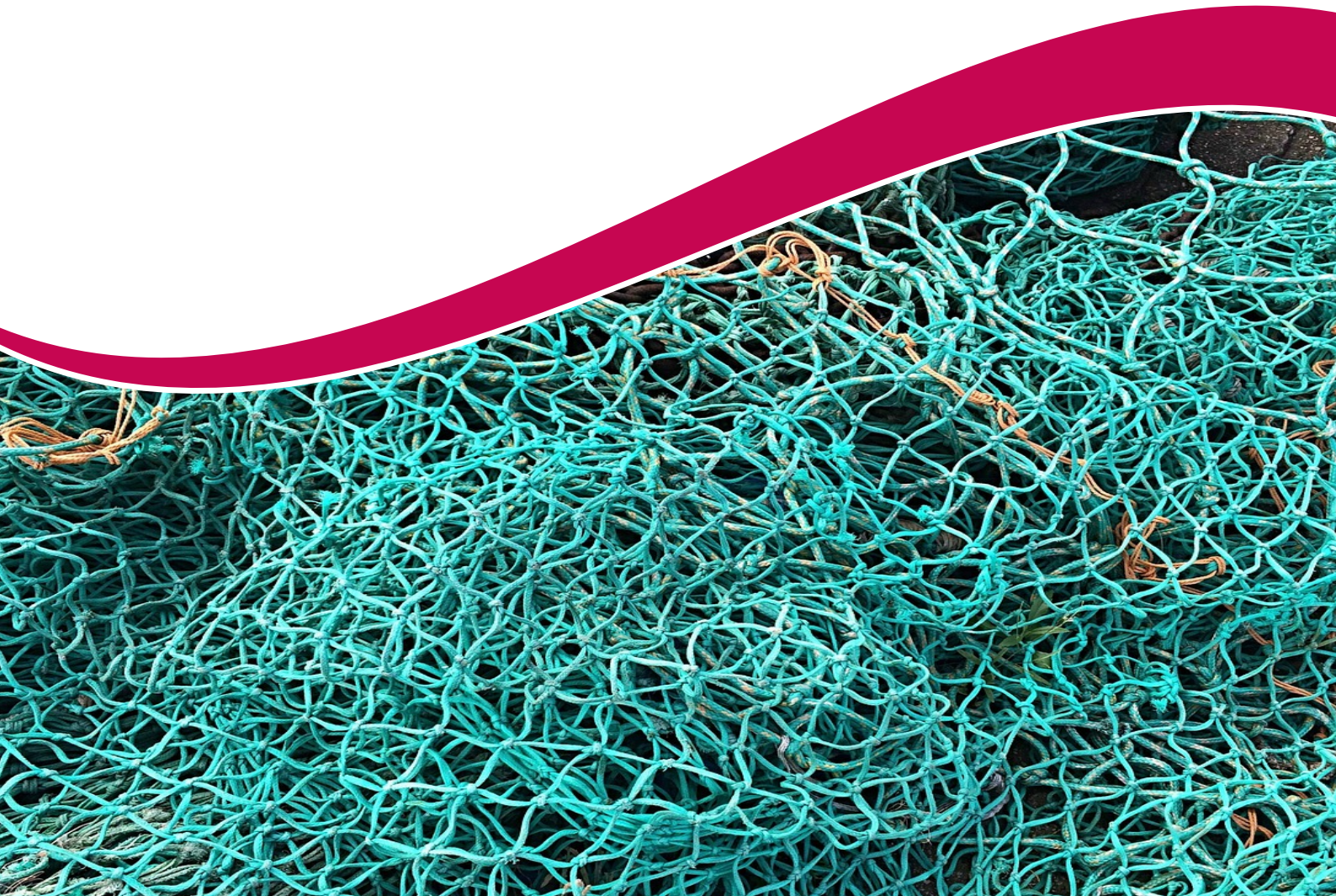
Australian Government

Australian Fisheries Management Authority

# Northern Prawn Fishery
# Harvest Strategy 2022



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# Glossary

## Types of reference points

| Reference Point | Description |
|---|---|
| Target (TRP) | The desired state of the stock or fishery (for example, MEY or $B_{TARG}$) |
| Limit (LRP) | The level of an indicator (such as biomass or fishing mortality) beyond which the risk of overfished to the stock is regarded as unacceptably high |
| MSY | maximum sustainable yield |
| MEY | maximum economic yield |

## Notation

| Notation | Description |
|---|---|
| B | biomass level |
| $B_Y$ | the biomass level in a particular year |
| $B_0$ | the unfished biomass (determined from an appropriate reference point) |
| $B_X$ | the biomass level representing x% of the unfished biomass $B_0$ |
| $B_{LIM}$ | the point beyond which the risk to the stock is regarded as unacceptably high |
| $B_{MEY}$ | the biomass level representing maximum economic yield |
| $B_{MSY}$ | the biomass level representing maximum sustainable yield |
| $E_{MEY}$ | the level of fishing effort which should produce maximum economic yield |
| $E_{MSY}$ | the level of fishing effort which should produce maximum sustainable yield |
| S | spawning biomass level |
| $S_Y$ | the spawning biomass level in a particular year |
| $S_0$ | the unfished spawning biomass (determined from an appropriate reference point) |
| $S_X$ | the biomass level representing x% of the unfished spawning biomass $B_0$ |
| $S_{MEY}$ | the spawning biomass level representing maximum economic yield |
| $S_{MSY}$ | the spawning biomass level representing maximum sustainable yield |
| F | fishing mortality rate |
| $F_Y$ | the fishing mortality rate in a particular year |

| | |
|---|---|
| $F_x$ | the fishing mortality rate which would achieve a spawning biomass level of $B_X$ |
| M | the natural stock mortality rate |
| MEY[1] | the sustainable catch or effort level for a commercial fishery that allows net economic returns to be maximised. In this context, maximised equates to the largest positive difference between total revenue and total cost of fishing |
| MSY[1] | the maximum average annual catch that can be removed from a stock over an indefinite period under prevailing environmental conditions |

## Other acronyms

| Acronym | Description |
|---|---|
| ABARES | Australian Bureau of Agricultural and Resource Economics and Sciences |
| ABC | Allowable Biological Catch |
| AFMA | Australian Fisheries Management Authority |
| CHSP | Commonwealth Fisheries Harvest Strategy Policy 2018 |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| CPUE | Catch per unit of effort |
| ERA | Ecological Risk Assessment |
| FIS | Fishery Independent Survey |
| HSF | Harvest Strategy Framework |
| HCR | Harvest Control Rule |
| MAC | Management Advisory Committee |
| MSE | Management Strategy Evaluation |
| NORMAC | Northern Prawn Fishery Management Advisory Committee |
| NPRAG | Northern Prawn Fishery Resource Assessment Group |
| NPFI | NPF Industry Pty Ltd |
| RAG | Resource Assessment Group |
| TEP | Threatened, Endangered and Protected |

[1] This is consistent with the definition of MEY in the Commonwealth Harvest Strategy Policy

**Table 1: Summary of triggers, reference points and decision rules in the NPF.**

| Species | Limit Reference Point | Target Reference Point | Data used to monitor Reference Point | Decision Rules |
|---|---|---|---|---|
| **Tiger Prawn Fishery** | | | | |
| **Brown Tiger Prawns** | $0.5S_{MSY}$ (moving average of the most recent 5 years) | $S_{MEY}$* | Annual Fishery Independent Surveys, Daily Catch & Effort data from logbooks, seasonal landing returns, economic and industry reported data. | If the LRP for either species is triggered, there will be no targeted fishing for that species in the first fishing season.<br>The TRP optimises the effort over a 7 year moving window to ensure sustainable harvest levels and maximise profits. Any changes to effort levels are applied through spatial or temporal closures or gear.<br>Note: to assist in achieving MEY, an industry agreed MEY CPUE trigger is in place for the tiger prawn season which closes the fishery prior to the end of the season if catch rates drop below 350kgs/day. |
| **Grooved Tiger Prawns** | $0.5S_{MSY}$ (moving average of the most recent 5 years) | $S_{MEY}$* | | |
| **Blue Endeavour Prawns** | $0.5S_{MSY}$ (moving average of the most recent 5 years) | $S_{MEY}$* | Annual Fishery Independent Surveys, Daily Catch & Effort data from logbooks, seasonal landing returns, economic and industry data. | If the LRP is triggered there will be no targeted fishing for this species in the first fishing season |
| **Red Endeavour Prawns** | $0.5S_{MSY}$ (moving average of the most recent 5 years) | $S_{MEY}$* | | No specific decision rule for this species, however decision rules for the tiger prawn fishery apply** |
| **Common Banana Prawn Fishery** | | | | |
| **Common Banana Prawns** | 1. An average catch rate across the fleet of no less than the MEY catch trigger at the end of the 5th week in the banana prawn fishing season.<br>2. A trigger limit of 6.6 t/week of tiger prawns caught at the end of the 4th week in the banana prawn fishing season.<br>3. An average catch rate across the fleet of no less than the MEY catch trigger at the end of the 7th week of the banana prawn fishing season. | | Annual Fishery Independent Surveys, Daily Catch & Effort data from logbooks, seasonal landing returns, economic and industry reported data. | If the daily catch rates of banana prawns in the first fishing season fall below the MEY catch trigger during the:<br>a) 4th and 5th weeks,<br>b) 6th and 7th weeks, or<br>c) 8th and 9th weeks,<br>OR |

| Species | Limit Reference Point | Target Reference Point | Data used to monitor Reference Point | Decision Rules |
|---|---|---|---|---|
| | 4. An average catch rate across the fleet of no less than the MEY catch trigger at the end of the 9th week | | | the pro-rata total tiger prawn catch for first 4 weeks is more than 26.4 tonnes (6.6t/week),<br><br>then the area west of 138 degrees will be closed and the area east of 138 degrees will be closed to daylight fishing between the hours of 8am and 6pm AEST effective from the end of the subsequent week ($6^{th}$, $8^{th}$ or $10^{th}$ week respectively). |
| **Redleg Banana Prawn Fishery** | | | | |
| **Redleg Banana Prawns** | $0.5B_{MSY}$ in two successive data sufficient years*** | $B_{MEY}$ | CPUE data from logbooks | 1. If insufficient fishing days (70) are available to run the assessment, the fishery is opened in the second season the following year.<br><br>2. If sufficient fishing days (70) are available to run the assessment and stock is assessed at below the LRP, the target fishing mortality is reduced by 50% in subsequent year.<br><br>3. If the LRP is triggered again the following data sufficient year, the fishery is closed in the subsequent year.<br><br>If the LRP is triggered immediately following a fishery closure, the fishery will be closed the following year and the RAG will review the stock and consider management options. |

** MEY is optimised across the tiger prawn fishery, not for each species.*

*** The assumption of the tiger prawn decision rules is that because blue and red endeavour prawns are not the main species targeted in the tiger prawn fishery, controlling the season length and TAE of tiger prawns will equally maintain the stock size of blue and red endeavour prawns.*

**** **Data sufficient year:** a year where a minimum of 70 fishing boat days has been achieved and therefore sufficient data are available to run the assessment.*

# 1 Overview

The Northern Prawn Fishery (NPF) harvest strategy, which covers the key commercial species of the fishery, is designed to be consistent with the *Commonwealth Fisheries Harvest Strategy Policy 2018* (CHSP). The objective of the CHSP is the ecologically sustainable and profitable use of Australia's Commonwealth commercial fisheries resources (where ecological sustainability takes priority) through the implementation of harvest strategies that maintain key commercial stocks at ecologically sustainable levels and within this context, maximise the economic returns to the Australian community.

Harvest strategies set out the management actions necessary to achieve defined biological and economic objectives and must contain a process for monitoring and conducting assessments to the conditions of the fishery, and rules that control the intensity of fishing activity (known as decision or harvest control rules).

To meet the objective of the CHSP, harvest strategies aim to pursue an exploitation rate that keeps fish stocks at a level equal to Maximum Economic Yield (MEY) and ensure stocks remain above a limit biomass level ($B_{LIM}$) at least 90% of the time.

With a harvest strategy in place, fishery managers and industry can operate with greater confidence, management decisions are more transparent, and there will be fewer unanticipated outcomes necessitating hasty management responses. Further detail on how to use harvest strategies is provided in the Guidelines to the CHSP (*Guidelines for the Implementation of the Commonwealth Fisheries Harvest Strategy Policy 2018*).

Fisheries globally, including the NPF, are seeing increasing environmental variations as a result of climate change. While climate change is not currently explicitly included within the NPF stock assessments and harvest strategy decision rules, key environmental parameters (e.g. the Southern Oscillation Index or SOI) are monitored and considered by the Northern Prawn Resource Assessment Group (NPRAG) as part of the annual stock assessment review process.

# 2 Background

Prior to the implementation of the NPF harvest strategy in 2007, the management objective for the NPF tiger prawn fishery was maximum sustainable yield (MSY). For management purposes, this was broken down into the levels of spawning stock which should produce the MSY ($S_{MSY}$), and the level of fishing effort which should produce MSY ($E_{MSY}$). Until 2001, the target reference point (TRP) was $S_{MSY}$. $E_{MSY}$ was essentially treated as a limit below which serious remedial action would be implemented.

Following a stock assessment in 2000 that showed the brown and grooved tiger prawn biomass below $S_{MSY}$, the Northern Prawn Fishery Management Advisory Committee (NORMAC) agreed to rebuild brown and grooved tiger prawn stocks to $S_{MSY}$ within five years (by the end of 2006). A new, more conservative TRP was adopted: 'there is a 70+% chance that the spawner population at the end of 2006 will be above or at spawner level targets ($S_{MSY}$).' A stock rebuilding strategy was implemented to pursue this reference point for tiger prawns was successful with the 2006 stock assessment indicating that recovery had occurred and that both species of tiger prawns were no longer overfished. $S_{MEY}$ was officially adopted as the TRP in the

NPF in 2003 with $0.5S_{MSY}$ set as the point at which overfished occurs and was treated as the overfished limit reference point (LRP) once recovery was achieved.

In 2007, the first NPF harvest strategy addressing the biological elements with an aim of achieving the MEY objective was developed. Various amendments to decision rules and methods of assessment were implemented between 2007 and 2012. In 2012, a new NPF harvest strategy which included redleg banana prawns and byproduct catch and trigger limits was formally adopted. Further updates were made in 2014 to include specific economic indicators and 2019 to update the scampi decision rule. A summary of the key changes to the NPF harvest strategy are included in Table 2 below.

**Table 2: Summary of key changes to the NPF Harvest Strategy**

| Version | Updates | Date |
|---|---|---|
| Version 1 (Original) | First NPF harvest strategy under input controls including:<br>- MEY TRP<br>- MSY LRP<br>- Tiger prawn decision rules to adjust effort levels<br>- Changes to season dates<br>- In season triggers for tiger and banana prawns | 2007 |
| Version 1.1 | Minimum effort threshold for tiger prawn fishery introduced | 2009 |
| Version 1.2 | - Minimum effort threshold for tiger prawn fishery updated<br>- Season dates and decision rule reporting periods amended for the banana prawn season<br>- Removal of tiger prawn trigger limit in the banana season | 2010 |
| Version 2 | - Inclusion of the redleg banana prawn<br>- Catch (instead of effort) limits for scampi<br>- Review triggers introduced for squid and bugs<br>- Banana prawn decision rules amended to reduce (rather than extend) season and updates to reporting periods<br>- Effort threshold for the tiger prawn fishery updated | 2012 |
| Version 2.1 | - Inclusion of economic indicators and the collection of economic data added<br>- Change from catch-rate to MEY catch trigger for banana prawns (approved by the AFMA Commission in 2013)<br>- Banana season reporting periods reduced | 2014 |
| Version 2.2 | Includes changes to the decision rules for scampi in section 4(a)(i) | October 2019 |

| Version | Updates | Date |
|---|---|---|
| Version 2.3 | Updates to the byproduct (including scampi catch limit and review triggers for scallops and cuttlefish) and redleg banana prawn decision rule as well as general updates to the background sections and review sections | September 2022 |

The merits of input (effort) and output (total allowable catch) controls have been extensively evaluated in the NPF. In August 2013, mainly because of the difficulty in setting catch quotas for the highly variable common banana prawn fishery (which could result in significant economic losses to the fishery in some years), AFMA determined that the fishery would continue to be managed through input restrictions and units of individual transferable effort. Under input controls, MEY has been adopted as the aspirational target for this fishery noting that significant variability exists in the fishery.

**The tiger prawn (including endeavour), common banana prawn and redleg banana prawn harvest strategies have been tested using the NPF Management Strategy Evaluation (MSE) model.**

This harvest strategy comprises the following key elements:

- Objectives (biological and economic aims)
- Indicators (data from the fishery)
- Monitoring (agreed protocols to get data)
- Reference points (targets and limits)
- Method of assessment (e.g. stock assessment, Catch per Unit of Effort (CPUE) standardisation)
- Decision rules (agreed rules for setting catch levels and implementing catch triggers)

The target and limit reference points and the confidence levels adopted in this strategy have been developed to address the highly variable, short-lived, multi-species nature of the key commercial target species in the NPF.

For ease of reading, and to reflect the multi-species nature of the NPF, this strategy is divided into harvest strategies for the tiger prawn fishery (including endeavour prawns), the common banana prawn fishery, the red legged banana prawn fishery and other target species and byproduct species.

While this harvest strategy only covers the key commercial target species in the NPF, a range of other management measure are in place to minimise the impacts of fishing on the marine environment and bycatch species. These include the use of Turtle Excluder Devices and Bycatch Reduction Devices to minimise bycatch in the fishery (including interactions with Threatened, Endangered and Protected species) and are a fundamental part of the management system for the fishery. Further information can be found in the Northern Prawn Fishery Bycatch Strategy at: afma.gov.au/sustainability-environment/bycatch-discarding/bycatch-discard-workplans.

# 3 Legislative Objectives of the Fishery

The NPF is managed under the *Northern Prawn Fishery Management Plan 1995* (the NPF Plan). The objectives of the NPF Plan can be found at: legislation.gov.au/Series/F2005B02455 and are consistent with the objectives of the *Fisheries Management Act 1991*.

# 4 Fishery Overview

## 4.1 Geographical context

The NPF occupies an area of 780 000 square kilometres off Australia's northern coast (**Figure 1**). It extends from the low water mark to the outer edge of the Australian Fishing Zone (AFZ) along approximately 6 000 kilometres of coastline between Cape York in Queensland and Cape Londonderry in Western Australia.

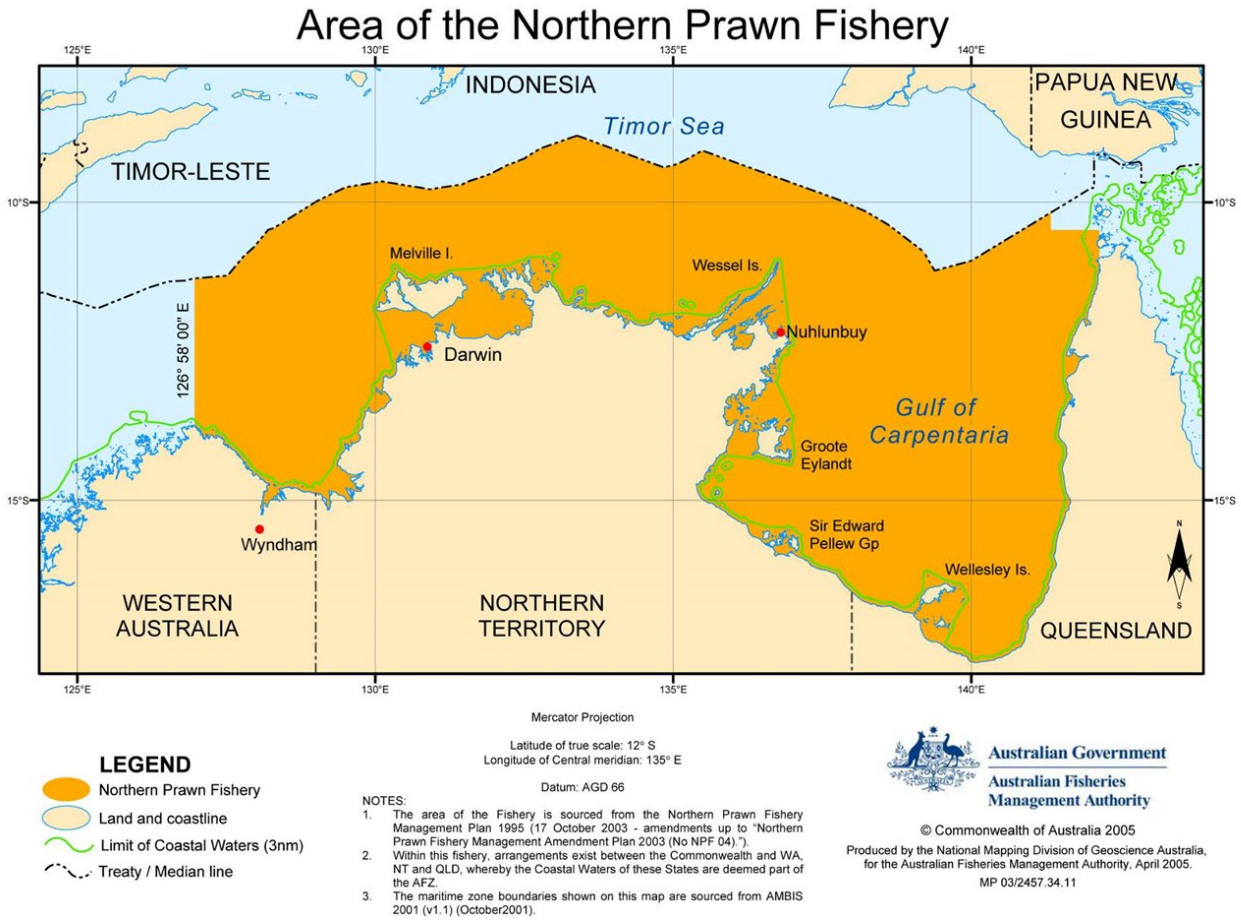



**Figure 1: The spatial extent of the NPF**

In 1988, Offshore Constitutional Settlement arrangements were made between the Commonwealth and the Western Australia, Northern Territory and Queensland governments that moved the management of prawn trawling in the area of the NPF wholly to the Commonwealth by AFMA.

While the NPF covers a wide area, only around 11% of the total NPF area is fished (average of 6x6 minute grids fished from 2010 to 2021) with the major trawl grounds of the NPF being in the Gulf of Carpentaria and the area to the north and south-west of Darwin. The principal reasons that most of the NPF managed area is not trawled are:

- permanent fishery closures of all known shallow water seagrass beds (2.1% of the total area);
- seasonal fishery closures (11% of the total area);
- parts of Commonwealth and state marine parks are closed to trawling;
- unsuitability of areas to trawling due to large reef outcrops;
- low density of the target prawn species (e.g. central Gulf of Carpentaria).

By 1985, 302 licenses were allocated in the NPF. This was reduced to 132 by 2000 through a combination of voluntary buybacks, internal industry restructuring/adjustments and compulsory acquisition programs. The number of vessels in the NPF was further reduced to 52 by 2007. This was due to the combined results of internal industry restructure between 2000 and 2005 whereby 37 trawlers left the fishery, and the 2005/06 Commonwealth's 'Securing our Fishing Future' Structural Adjustment Program in which a further 43 Boat Statutory Fishing Rights (SFRs) were removed from the NPF.

Catch and effort in the fishery has varied considerably as the number of boats operating in the fishery has changed over time. The recent catch and effort in the NPF can be found in the annual Data Summaries on the AFMA website at: afma.gov.au/fisheries/northern-prawn-fishery/data-summaries.

## 4.2 Target species

Target species are the most highly sought component of the catch taken in a fishery. The NPF is a multi-species fishery with nine species of prawns, scampi, bugs, scallops, cuttlefish and squid making up a majority of the catch.

The key commercial species targeted in the fishery include:

- Banana prawns
    - common banana prawn *Penaeus (Fenneropenaeus) merguiensis*
    - redleg banana prawn *Penaeus (Fenneropenaeus) indicus*
- Tiger Prawns
    - grooved tiger prawn *Penaeus semisulcatus*
    - brown tiger prawn *Penaeus esculentus*

Other commercial species in the fishery include:

- Endeavour prawns
    - Blue endeavour prawn *Metapenaeus endeavouri*
    - Red endeavour prawn *Metapenaeus ensis*
- King prawns
    - western king prawn *Melicertus latisulcatus*
    - red spot king prawn *Melicertus longistylus*
- Black tiger prawn *Penaeus monodon*
- Scampi *Metanephrops spp.*

Banana prawns and tiger prawns are the main species targeted in the fishery, accounting for around 85% of the fishery's total prawn catch. Byproduct species include other prawn species, squid, bugs, scallops and cuttlefish. These are generally caught when targeting of banana and tiger prawns, although scampi, and

occasionally squid, are also targeted by NPF operators although the catches of these species is low compared with prawn catches. These species are treated as a byproduct in this harvest strategy.

Individual species of prawns are not distinguished within the banana, tiger and endeavour prawn species groups in the commercial catch, although they are delineated to the species level based on catch location for stock assessment purposes as shown below.

Extensive studies by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Marine Research, including commercial catch sampling and analysis of substrate composition, have shown that the adults of the two commercial species of tiger prawns have different spatial distributions related to substrate type and water depth. This has enabled the commercial catch category of tiger prawns to be approximately split between the two species according to the six-minute square grids. Dichmont et al. 2001 updated the species split methodology in 2001 and included the potential for species split shifts over time and area. This was further updated in 2006 to incorporate the results of the Venables et al. 2006 species distribution project with a new project using the same methodology currently underway (due for completed in late 2023).

Banana prawns are split into the two component species. Redleg banana prawns are caught almost exclusively in deep water (>45 metres) in the Joseph Bonaparte Gulf (JBG) and common banana prawns elsewhere (Dichmont et al. 2001).

Prawn species reach a commercial size at six months and can live for up to two years. Larger sizes bring the highest price. Growth rates vary considerably between species and sexes with females generally growing faster and larger than males. Most species are sexually mature at six months and fecundity increases with age. A twelve-month-old female can produce hundreds of thousands of eggs at a single spawning and may spawn more than once in a season. The eggs sink to the bottom offshore after release and hatch into larvae within about 24 hours. Less than 1% of these offspring survive the two to four week planktonic larval phase and reach suitable coastal nursery habitats where they may settle. After one to three months on the nursery grounds, the young prawns move offshore onto the fishing grounds.

Recruitment of prawns is impacted by a range of environmental factors (rainfall, river flow, sea surface temperature etc). It is well known that there is a relationship between the annual rainfall (generally correlated with the SOI) for common and redleg banana prawns, although the timing and location of the rainfall also plays an important factor (Vance et al. 1985, Broadley et al. 2020, Blamey et al. 2022 and Plagányi et al. 2022). Due to the impact of environmental factors, no clear stock-recruitment relationship has been determined for banana prawns (Buckworth et al. 2013). Environmental factors also impact tiger prawn recruitment, although the linkages between these factors and recruitment are not as clear as they are for banana prawns. Furthermore, a relationship between stock size and subsequent recruitment is exhibited for tiger prawns, (Wang and Die, 1996 and Ye, 2000).

## 4.3 Value of the fishery

The NPF is the most valuable Commonwealth managed fishery and is one of the most valuable fisheries in Australia. The annual gross value of production (GVP) of the fishery has varied between $65 million and $168 million AUD. This can be attributed to the fluctuating annual catch, fishing effort/season lengths, market conditions and foreign exchange rates.

The most recent GVP figures for the fishery can be found in the Australian Bureau of Agricultural and Resource Economics and Science (ABARES) fishery status reports or the Australian fisheries economic indicators reports at: agriculture.gov.au/abares/research-topics/fisheries .

## 4.4 Management regime

The NPF is managed through a suite of input controls including limited entry to the fishery, gear restrictions, bycatch restrictions and a complex system of seasonal, spatial and temporal closures.

The fishery has two seasons: a predominantly banana prawn season that runs from 1 April to 15 June and a longer tiger prawn season that runs from 1 August to 30 November. Catch rates are monitored throughout the fishing seasons, and the season length can be shortened in accordance with harvest strategy decision rules (see the decision rules for the tiger prawn and banana prawn fisheries in sections 5 and 6 below).

The tiger prawn fishery has historically been the most valuable component of the NPF, although banana prawns now contribute a significant component of the value. The management of the NPF is primarily based around the tiger prawn component of the fishery, with endeavour and king prawns are generally caught as incidental catch of tiger prawn fishing activities. A stock assessment is undertaken for brown and grooved tiger prawns and blue endeavour prawns with red endeavour prawns currently included as a sensitivity within the model.

### 4.4.1 Limited entry and gear controls

To fish in the NPF, operators must hold two types of tradable SFRs: a Boat SFR, which controls fishing capacity by placing limits on the numbers of trawlers and a Gear SFR, which controls the amount of gear permitted for use in the fishery. There are currently 52 Boat SFRs and 35 479 Gear SFRs issued for the fishery.

The overall effort in the fishery is limited by the total amount of operational gear (length of headrope/footrope) allowed to be towed in the fishery each year. The total amount of headrope that can be used in the fishery is adjusted as required according to the outcomes of the bio-economic model. This total length of headrope is divided amongst the 35 479 gear SFRs in the fishery which are a tradable asset.

### 4.4.2 In Season catch triggers

The banana and tiger prawn fisheries are managed by fixed length seasons, with some in-season management (including MEY-based catch triggers) aimed primarily at allowing season lengths to be maximised in highly productive years and reducing the season length in years of low production.

### 4.4.3 Closures

A comprehensive system of spatial and temporal closures is in place to assist in addressing biological and economic objectives of the fishery (Kenyon et al. 2005) and broader ecological requirements. A total of 2.1% of the total managed zone of the fishery is subject to permanent closures, while 11% is subject to seasonal closures. Closures in the fishery include:

- permanent closures of seagrass beds and other sensitive habitats, and

- seasonal closures of juvenile prawn stock habitat, designed to coincide with recruitment phases and protect pre-spawning prawns, and ensure prawns are at a commercial size for harvesting.

Discrete spatial closures, end of season and mid-season closures are in place to protect small and spawning prawns. The current end of season closure from 1 December to 1 April was implemented permanently in 2010, although these approximate season closure dates were in place from as early as 1987. The approach of using discrete spatial closures aimed specifically at protecting small prawns was adopted in the early 1980's.

The mid-season closure to protect pre-spawning tiger prawns was implemented in 1987, with the current closure from 15 June to 1 August introduced in 2013. The timing and length of the mid-season closure has varied from time to time in response to the need to adjust effort on tiger prawns (e.g. in 2002/03 inclusive the mid-season closure ran from 13th May to 1st September).

A daylight trawl closure is in place during the second (tiger prawn) fishing season to reduce the capture of spawning tiger prawns. The daylight trawl closure has been in place since 1987, although the closure in its current form was implemented in 1999.

A first season closure of the JBG fishery was introduced in 2021 as a key decision rule for the redleg banana prawn fishery with a first season closure was also in place in JBG from 2007-2010 inclusive.

### 4.4.4 Governance

The NPF is managed under the *Fisheries Management Act 1991*, the *Fisheries Management Regulations 2019* and the *Northern Prawn Fishery Management Plan 1995*. Seasons and closures in the fishery are implemented through Determinations and Directions made under the *Fisheries Management Act 1991*.

Two key committees provide advice to AFMA Management and the AFMA Commission in relation to the NPF:

- The NPRAG has responsibility for assessing the dynamics and status of NPF species, considering the results of stock assessments, and providing scientific advice on management options and strategies. NPRAG membership is comprised of an independent chair, fishery scientists and economists, industry members and AFMA. NPRAG also provides advice to NORMAC.
- NORMAC provides management advice on issues relating to fisheries management. NORMAC membership is comprised of an independent chair, a fishery scientist, industry members, a fishery economist, an environment/conservation member, and the AFMA NPF Manager.

The AFMA Commission considers the advice and recommendations of NPRAG and NORMAC, along with AFMA Management, when making decisions relevant to the NPF.

The NPF has also maintained Marine Stewardship Council (MSC) certification since 2012. While the management of the fishery is primarily considered in the context of AFMA's legislative objectives and government policies, the MSC standards also influence the management of the fishery.

A co-management agreement is in place between the NPF Industry Pty Ltd (NPFI), the NPF industry representative body, and AFMA. NPF Industry provides advice to the NPRAG, NORMAC AND AFMA across a range of issues as required.

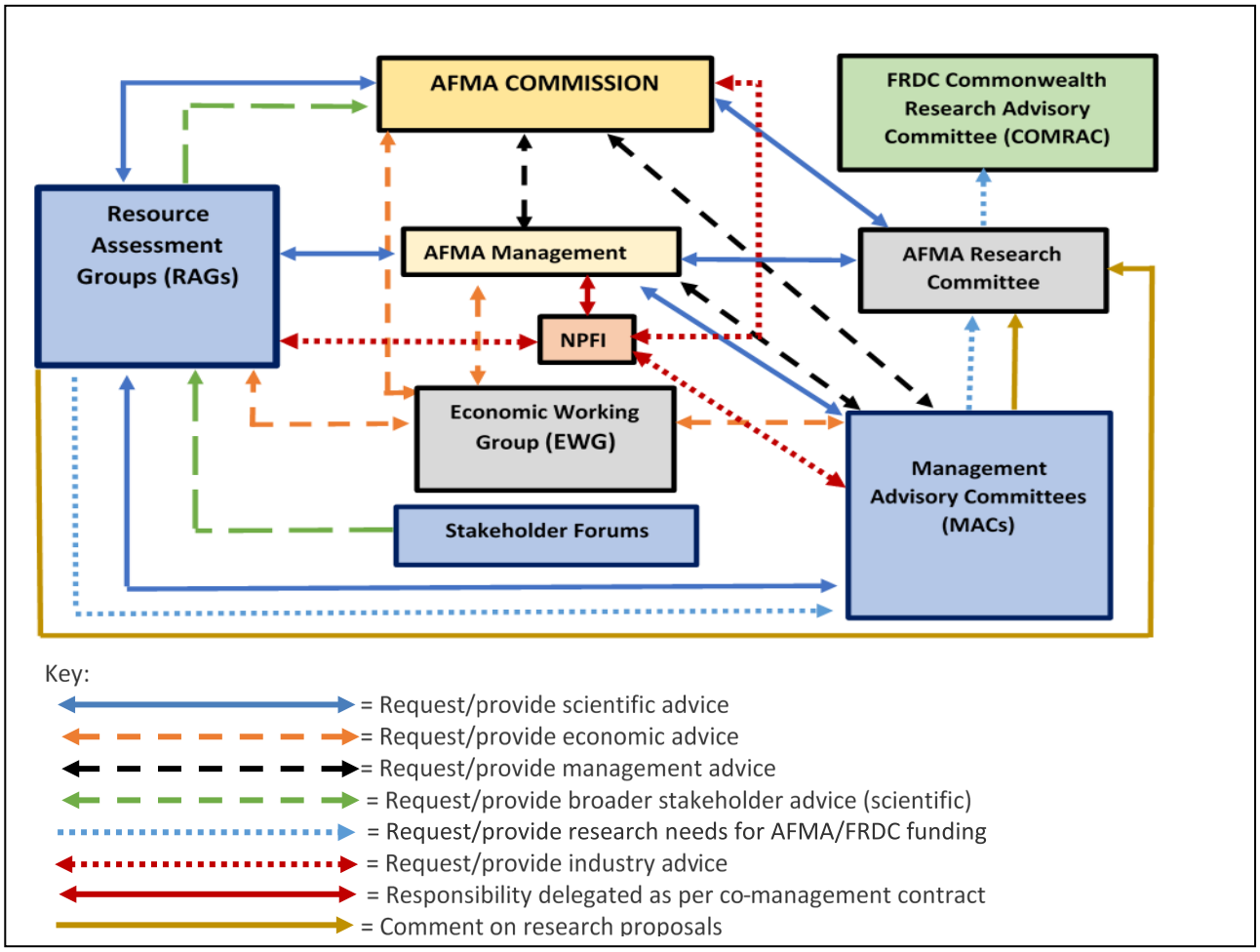



**Figure 2: Diagrammatic representation of advisory bodies and governance relationships. Arrows represent the flow of information and interactions.**

## 4.5 Fishery indicators

### 4.5.1 Data

Reflecting the high value of the fishery, its management needs, and the importance of stock assessments to determine the status of the key commercial target species, a comprehensive data collection program has been established for the NPF to ensure reliable information is available on which to base management decisions (**Figure 3**).

The fishery dependent data collection program consists of catch and effort information collected from daily logbooks. Seasonal landing returns record all catch landings and are used to verify the logbook catch and annual vessel gear surveys are undertaken to track changes in gear and technology in the fishery. This information assists in fishing power studies that assess effort creep which are input into stock assessments.

Fishery-dependent economic data has been collected by NPF Industry Pty Ltd (NPFI) annually since 2010/11 to provide inputs to the NPF's bio-economic model. This was previously collected by ABARES. Biennial economic data is collected by ABARES as inputs to the ABARES public Australian fisheries economic indicators reports.

Additionally, targeted fishery independent research is undertaken as required, but specifically includes:

- annual recruitment surveys undertaken on the key fishing grounds of the Gulf of Carpentaria in February/March each year, and
- biennial spawner surveys undertaken during on the western and southern grounds of the Gulf of Carpentaria in June/July (every second year)

These surveys started in 2002 and are a fundamental component of the tiger prawn stock assessment used to set the Total Allowable Effort (TAE). They provide input to the indices of abundance for both recruits and the spawning stock to which the assessment model is fitted (as well size frequency data).

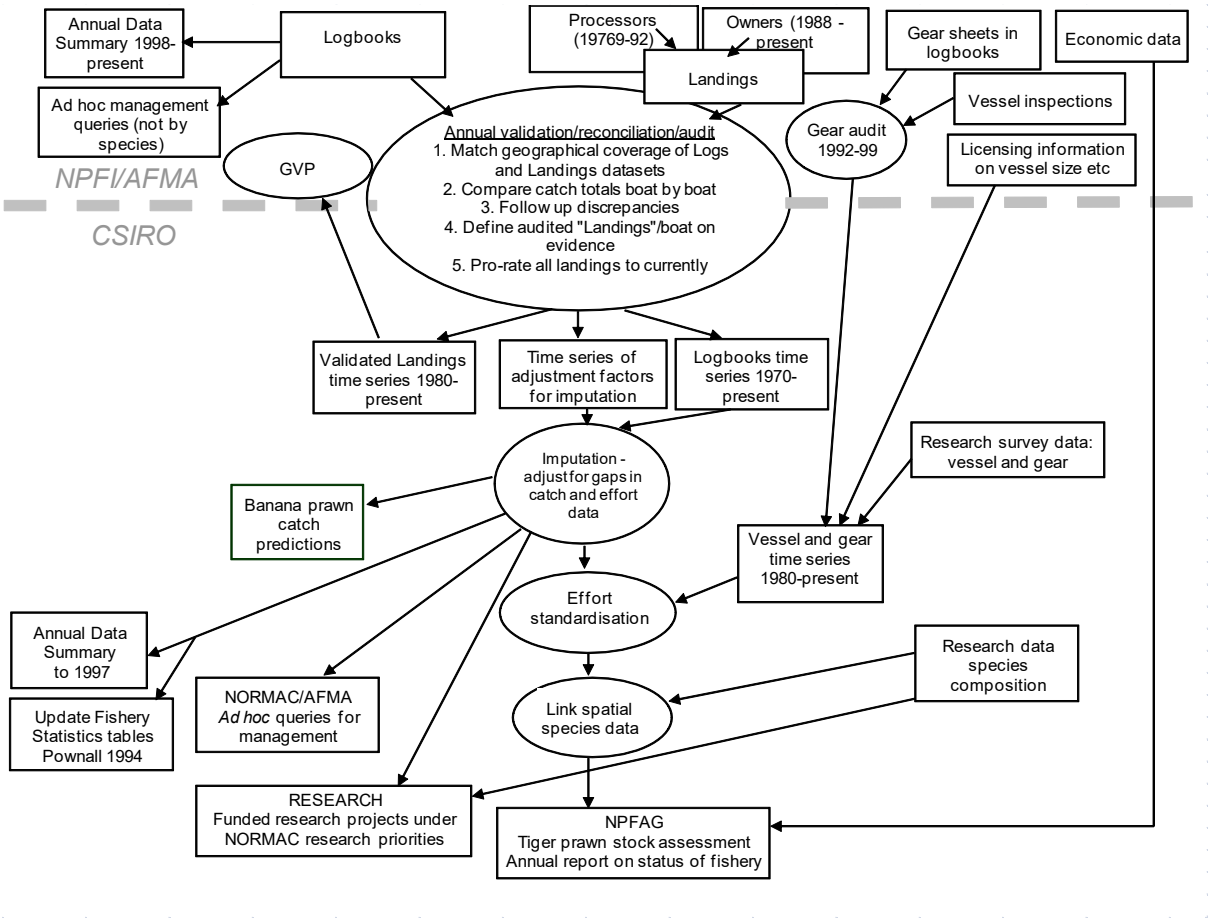



**Figure 3: Sources of data for the NPF, and some routine processing pathways.**

# 5 The Tiger Prawn Fishery

Tiger prawns are caught predominantly in the second season, although there is some targeting of tiger prawns in the latter period of the first season (May and June). Endeavour and king prawns are also caught, primarily incidentally, with bugs the main byproduct of the fishery.

The operational gear (length of headrope/footrope) allowed to be towed in the fishery each year is adjusted according to the outcomes of the bio-economic model. The outputs from the bio-economic model (which includes the biology of tiger and endeavour prawns, and key economic variables) are used to set the level of standardised effort for the fishery.

## 5.1 Operational objective

The operational objective of this harvest strategy is to attain long term MEY from the tiger prawn fishery.

MEY as applied to this fishery, while usually an equilibrium concept, is not constant and depends on the expectations of future prices and costs. Further, MEY depends on the dynamic path chosen to achieve MEY. For operational purposes, the objective of MEY can be considered equivalent to the objective of maximising the net present value (NPV) of the flow of profits in the fishery over an indefinite period. In applying this approach, economic yield for the tiger prawn fishery is calculated using the value of the 'basket' of the two tiger prawn and the two endeavour prawn species which are assumed to be caught jointly. For the NPF tiger prawn fishery, MEY is assumed to be achieved over a seven-year period. The dynamic path to MEY is calculated as the effort level and associated catch in each year over a seven-year projection period that leads to a long run sustainable yield that maximises profits over time.

## 5.2 Fishery monitoring

The range of information collected in the NPF to support the tiger prawn stock assessment and bioeconomic model includes:

- a fishery-independent data collection program based on two modules being:
    - a February/March survey which provides fishery-independent recruitment indices data for banana, tiger and endeavour prawns, and length frequency data for tiger and endeavour prawns in the Gulf of Carpentaria;
    - a biennial June/July survey aimed at providing an index of abundance during the effective spawning season for the main commercial prawn species, and length frequency data for tiger and endeavour prawns in the Gulf of Carpentaria.
- a fishery-wide daily catch & effort logbook program for tiger, endeavour and king prawns, including vessel gear sheets;
- data collected through the annual gear survey run by NPFI to monitor track changes in gear and technology in the fishery through the fishing power model
- seasonal landings returns (data used to ground truth the logbook data);
- industry-reported tiger prawn catch data in the banana and tiger prawn seasons; and
- extensive economic data on revenue and cost components collected from industry by NPFI.

## 5.3 Fishery reference points

### 5.3.1 Stock size

In principle, a stock will be declared overfished if it falls below 0.5 $S_{MSY}$. However, because prawn recruitment is highly variable compared to longer-lived species, the reference point is not applied using a single year's statistic. For the tiger prawn fishery, the LRP for each of the two species of tiger prawns and two species of endeavour prawns is the moving average of $S_Y/S_{MSY}$ over the most recent 5 years. Thus, if the moving average falls below 0.5 $S_{MSY}$, the species is considered overfished.

The appropriateness of the decision rules (described below), in light of the CHSP and the current stock assessment (which includes the two tiger prawn species and blue endeavour prawns with red endeavour

prawns as a sensitivity test), have been confirmed through two MSEs (Dichmont et al. 2008 and Dichmont et al. 2012).

To assess whether the tiger prawn fishery has achieved the operational objective of attaining MEY, the tiger prawn fishery TRP is $S_{MEY}$. It is recognised, however, that the indicator $S_Y/S_{MEY}$ will vary considerably from year to year due to large inter-annual variability in recruitment and changing economic parameters.

### 5.3.2 Effort

The TRP for the economic performance measure of effort is $E_Y/E_{MEY} = 1$, for both species of tiger prawns to indicate if species 'targeting' could be improved, where $E_{MEY}$ is the effort required to produce MEY for the fishery. A value of greater than 1 indicates that effort for the year was in excess of that estimated to be required to produce MEY. The TAE recommended each year is also given for both species of tiger prawns and the sum of both species. However, because of natural inter-annual variability, $E_Y/E_{MEY}$ will exhibit considerable variability. Furthermore, the pathway to MEY is part of the annually derived dynamic bio-economic model calculation and therefore, unlike $B_{MSY}$-type reference points, outputs a non-linear effort pathway to MEY.

The fishery is considered to be experiencing overfishing if $E_Y$ is in excess of the effort that would be expected to result in a stock that is overfished, i.e. moving average of $S_Y/S_{MSY}$ over 5 years £ 0.5.

## 5.4 Method of assessment

### 5.4.1 Tiger prawns

Several stock assessment methods for the tiger prawn fishery have been developed over time – a delay difference model (Dichmont et al. 2001), Bayesian hierarchical biomass dynamic model (Zhou et al., 2009) and a size-based model (Punt et al. 2010). The models can be used in any combination for the different species. The resultant stock assessment and estimated stock-recruitment parameters are then combined with economic parameters to form the bio-economic model (Punt et al., 2010, Kompas et al., 2010). In 2011, the NPRAG agreed base case assessment was a size-based model for both species of tiger prawns and the Bayesian hierarchical biomass dynamic model for blue endeavour prawns.

Two species of endeavour prawns (blue and red endeavour) are caught in the NPF. However, blue endeavour prawns are generally predominant. There is an NPRAG-accepted stock assessment model for blue endeavour prawns (Zhou et al. 2009; Punt et al. 2010). Catches of blue endeavour prawns are considered along with tiger prawns when assessing MEY in the bio-economic model (Punt et al. 2010). In the model, endeavour prawns are treated as being an "incidental catch" of the tiger prawn fishery and as such, blue endeavour prawns are treated as revenue but do not contribute to costs. A red endeavour prawn assessment model is included in the analysis, currently as a sensitivity. The red endeavour prawn assessment model borrowed the same method and priors from the blue endeavour prawn model considering their biological similarity. However, due to the uncertainty, NPRAG has only accepted it as a sensitivity: red endeavour prawn catch is highly variable, unpredictable and usually a small part of the overall prawn catches.

There is limited spatial separation between tiger and endeavour prawns and the correlation between tiger and endeavour prawn catches is quite high (except for 'spikes' in catches of red endeavour prawns which occur very occasionally). As endeavour prawns are generally taken as an incidental part of the tiger prawn catch and effort controls these also apply to endeavour prawns (Pascoe et al. 2010). As a result, the multi-

species bio-economic model combined with a tiger prawn TAE is expected to move endeavour prawns to their TRP of $S_{MEY}$ (Punt et al. 2010). The LRP is also applied to the red endeavour prawn stock as part of a sensitivity test to the base case.

#### 5.4.1.1 Decision rules for the tiger prawn fishery[2]

The assumption of the tiger prawn decision rules is, because blue and red endeavour prawns are a byproduct of the tiger prawn fishery, by controlling the season length and TAE of tiger prawns the stock size of blue and red endeavour prawns will be maintained. This has been tested in MSE's which considered all four species in delay difference models (Dichmont et al. 2008 and Dichmont et al. 2012). There is, however, a specific blue endeavour prawn rule when this species falls below the LRP. The flow chart for the LRPs is given in **Figure 4** below.

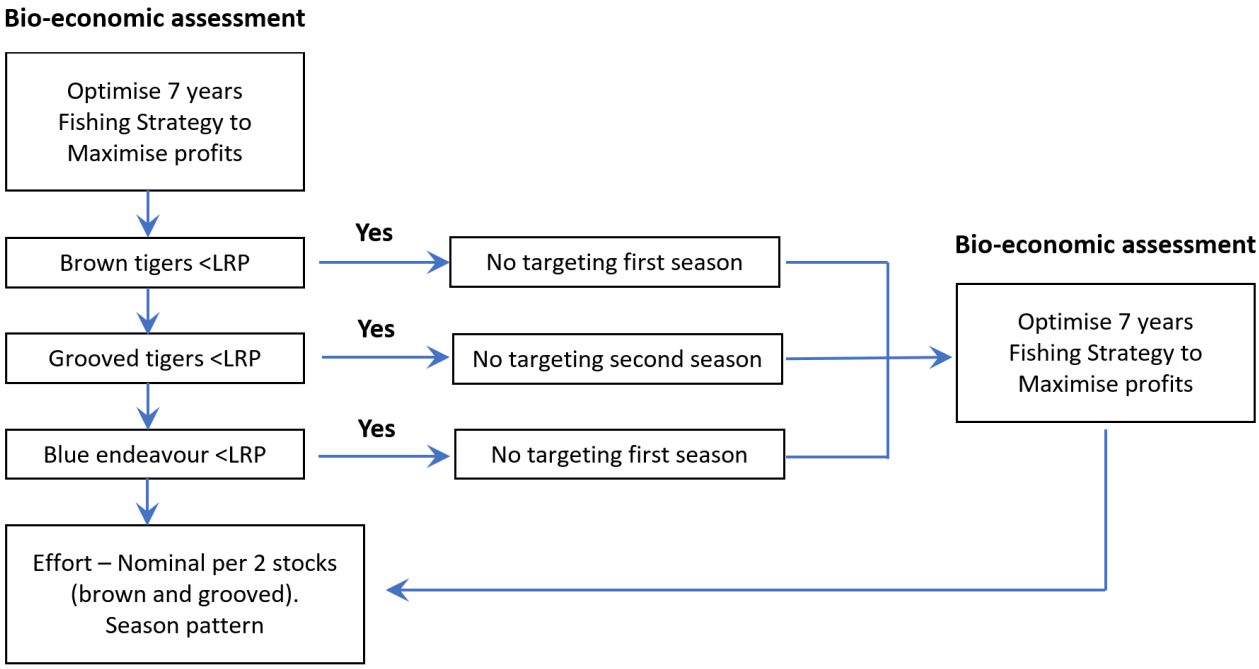



**Figure 4: Limit reference point flow chart.**

##### *5.4.1.1.1 Tiger prawn decision rules*

1. A bio-economic assessment will be undertaken every alternate year, optimising the effort over a seven-year moving window to ensure a sustainable harvest and maximise profits.
2. Providing the LRP is not breached, a minimum nominal effort level for the fleet in any one year is applied in the model to ensure the fishery remains economically viable while still achieving the MEY target within the required seven-year timeframe. This figure will be periodically reviewed to ensure the optimal trajectory achieves the MEY target[3].

[2] For the purpose of this HS, both species of tiger prawns and both species of endeavour prawns comprise the 'tiger prawn fishery'. In the context of the MEY target, endeavour prawns are treated as an economic bycatch of the tiger prawn fishery

[3] Between 2010 and 2022, the effort threshold used in the assessment was based on the total nominal effort in 2007 (5 142 days). This was divided equally amongst grooved and brown tiger prawns (2 571 days), giving an effort threshold of 2 777 days for both brown and grooved tiger prawns (1.08 multiplied by 2 571).

3. The effort in nominal days for each fleet (brown and grooved), for the average of the two years prior to the bio-economic assessment will be applied. This will be calculated as a percentage change from the previous year's actual nominal effort.
4. If the LRP of either tiger or endeavour prawn species is triggered, there will be no targeted fishing for that particular species. A combination of effort controls and spatial and/or temporal measures will be used to prevent targeting fishing on the species that is below the LRP.
5. Effort controls will be applied through the use of spatial and temporal closures and gear; or any combination of these inputs.
6. If effort changes are to be implemented through gear, the change in effort versus the change in gear will be calculated empirically and calculated based on the percentage gear change from the previous year's gear amount.
7. Figure 4 below will be used to calculate any required change in total gear.

$$\Delta E = (1 + \Delta H)^{0.2709} - 1$$

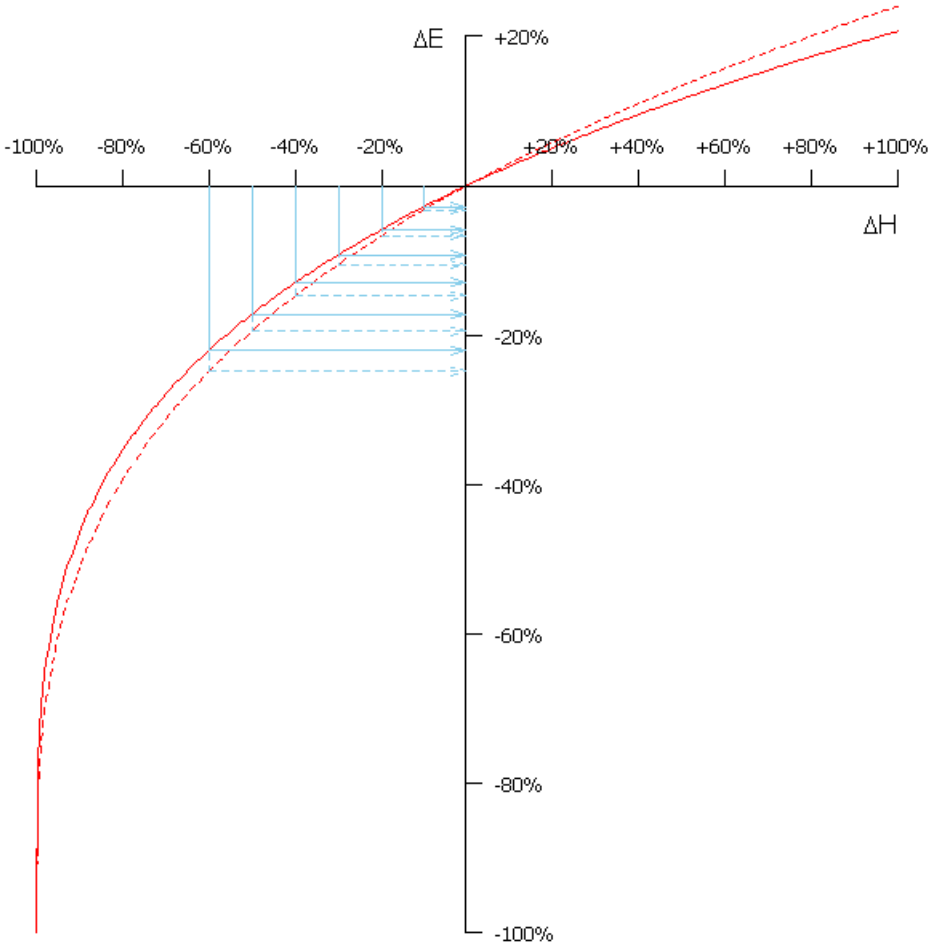



**Figure 5: The relationship between relative increases and reductions in catch for a relative change in headrope length (Venables and Brown, 2007).**

With the large interannual variability of recruitment experienced in a short-lived species such as prawns it is expected that, on occasions, stock size may fall below the LRP. The above decision rule has been MSE tested to ensure that, if the rule is applied, there is 80% or greater probability that, for each of the four species, the value of the 5-year moving average of $S_Y/S_{MSY}$ does not fall below $0.5S_{MSY}$. However, should the monitored value of the moving average of $S_Y/S_{MSY}$ over 5 years actually fall below $0.5S_{MSY}$, the data will be examined critically by fisheries scientists and the NPRAG will assess whether there is need for a more

precautionary management response than that which is called for by the application of the above decision rule.

### 5.4.2 Closures

Spatial and temporal closures will be used for biological/ecological protection (e.g. seagrass, habitat protection), for prawn size protection (e.g. juveniles, pre-spawning adults) and to maximise prawn growth/ increase economic return.

Closures will be introduced and/or amended by NORMAC according to the protocols in the NPF Closures Review 2005 report, "Documenting the history of and providing protocols and criteria for changing existing or establishing new closures in the NPF". A daylight trawl ban will be used to protect spawning tiger prawns in the second (tiger prawn) season.

# 6 The Banana Prawn Fishery

## 6.1 Common banana prawns

### 6.1.1 Operational objectives

The operational objective of this harvest strategy is to allow sufficient escapement from the common banana prawn fishery to ensure an adequate spawning biomass of banana prawns (based on historical data), and to achieve MEY from the fishery.

### 6.1.2 Indicators

The following indicators are used in the banana prawn fishery:

- Banana prawn catch and CPUE data
- Industry data on banana prawn catches during the prescribed catch reporting periods.
- Tiger prawn catch for weeks 1 to 4 (inclusive) of the season.
- Economic survey data, for repairs and maintenance costs
- Economic data provided by NPFI relating to prawn prices and fuel costs

### 6.1.3 Fishery monitoring

There is a range of information collected in the NPF to support the management of the banana prawn fishery including:

- A fishery-wide daily catch & effort logbook program for banana prawns.
- Reported industry data on banana prawn catches in the first (banana prawn) fishing season.
- Reported industry data on tiger prawn catches in the first (banana prawn) fishing season.
- A fishery independent data collection program based on two modules which provide information on the spatial distribution of the fishery:

  - an annual January/February survey which provides data for fishery independent recruitment indices for banana, tiger, and endeavour prawns; and
  - a biennial June/July survey which provides data for a fishery independent spawning index for banana, tiger, and endeavour prawns.
- Seasonal landings returns data.
- Economic data collected by ABARES.
- Economic data collected by the NPFI.
- Fuel cost and prawn price data collected and provided to CSIRO by NPFI.

### 6.1.4 Fishery reference points (abundance indicators)

1. An average catch rate across the fleet of no less than the MEY catch trigger at the end of the 5th week in the banana prawn fishing season.
2. A trigger limit of 6.6 t/week of tiger prawns caught at the end of the 4th week in the banana prawn fishing season.[4]
3. An average catch rate across the fleet of no less than the MEY catch trigger at the end of the 7th week of the banana prawn fishing season.
4. An average catch rate across the fleet of no less than the MEY catch trigger at the end of the 9th week

### 6.1.5 Method of assessment

Due to the marked variation in banana prawn recruitment due to environmental conditions (particularly wet season rainfall), no clear stock-recruitment relationship has been determined (Buckworth et al. 2013). Analyses are also complicated by the highly variable CPUE data which result from the schooling behaviour of the species. As such, there is no formal quantitative stock assessment for banana prawns.

The fishery is managed by a combination of spatial and temporal closures and a fixed season length with in-season management aimed at potentially closing the season earlier to limit fishing pressure on the stock and increase the economic returns in less productive years. Historical records indicate that the banana prawn fishery is sustainable with an annual ten-week fishing season. The high variability and environmental dependency of this species results in significant variations in catch from year to year, and even in the years where there have been very poor catches in some areas, the rebound in the stocks indicates that the banana prawn fishery is resilient in the longer term. The banana prawn (first) season does not start before 1 April or extend beyond 15 June. The subsequent mid-season closure is mainly a measure to protect spawning tiger prawn (females), however, it is also likely to benefit the sustainability and economic returns of all target species.

Management of the common banana prawn fishery has in recent years included an MEY-based catch rate trigger (kg/boat/day). This has been based on catch rate information for specified reference periods, wherein the average is calculated and, if the value falls below the MEY catch trigger, then the fishery is closed a week later.

[4] This trigger limit is in place to permit 'reasonable incidental catch' of tiger prawns in the first 4 weeks of the season, with targeting of tiger prawns permitted after 1 May each banana prawn season. If this trigger is breached, fishing effort is reduced in the second (tiger prawn) season.

The MEY point for the banana prawn fishery is the point such that weekly marginal revenue equals weekly marginal cost i.e. when catch rates fall to the point where revenue generated by the catch is equal to the daily costs of fishing, so that marginal profit falls to zero: the “break even” catch rate.

The MEY trigger will be variable and will be calculated in-season, based on information on the below information on prawn prices and costs. However, the MEY trigger is bounded by a 15% buffer of 500 kgs/boat/day, meaning the minimum MEY trigger is 425 kgs/boat/day and the maximum is 575 kg/boat/day.

**Table 3: Description of the information used to calculate the MEY Trigger.**

| Prices/Costs | Description |
|---|---|
| **Fuel cost** | The 5 industry NORMAC members (minimum of 3 if not all available) will have a teleconference to provide NPFI with a fuel price figure that is based on a combination of fuel prices taken from Darwin, Cairns and the mothership at the end of week 4. If not provided by NPFI, the data will be taken from the previous years’ economic survey |
| **Capital cost with depreciation** | From previous year's economic survey. It may be possible instead to provide capital cost directly without depreciation. |
| **Gear cost** | From previous year's NPFI economic survey |
| **Total variable R&M costs** | This figure is based on Pascoe et al. (2015) |
| **Marketing costs** | From previous year's NPFI economic survey |
| **Price** | The 5 industry NORMAC members (minimum of 3 if not all available) will have a phone hook-up at the end of week four to determine the 'beach price' which will be given to the RAG. The definition of ‘beach price’ will be - 'gross price for sale of product to cold store less freight and unloading charges'. If not provided by NPFI, the data will be taken from the previous years’ economic survey |

### 6.1.6 In-season management: decision rules for early closure of the first season

The first season (banana prawn season) extends for 10 weeks from the start of the season unless the following decision rules are triggered.

#### 1st possible season closure (6-week season)

The fishery is closed at the end of the 6th week from the start of the first season if either:

a) The average daily catch rate of banana prawns for the 4th and 5th weeks of the first season is less than the MEY catch trigger; or
b) The pro-rata total tiger prawn catch for the first 4 weeks is more than 24.4 tonnes (6.6 t/week*4);

### 2nd possible season closure period (8-week season)

The fishery is closed at the end of the 8th week from the start of the first season if:

a) The average daily catch rate of banana prawns for the 6th and 7th weeks of the first season is less than the MEY catch trigger.

### 3rd possible season closure period (10-week season)

The fishery is closed at the end of the 10th week from the start of the first season if:

a) The average daily catch rate of banana prawns for the 8th and 9th weeks of the first season is less than the MEY catch trigger.

To facilitate the assessment of whether an early closure to the season is appropriate based on the decision rule, a "representative sample" of the catch rates for the season across the fleet is required.

The decision rule can only be applied if all catch data (kg/day, or total catch and total days) for the whole fleet (or >95% of NORMAC industry members and advisors) is supplied for the period of the relevant reporting period (e.g. 4th and 5th weeks, 6th and 7th weeks, or 8th and 9th weeks of the season) by 3 days after the end of the final week of the reporting period. If the data is not provided, the season will close at the end of the following week (e.g. 6th, 8th or 10th week).

#### *Reporting requirements*

This information can take the form of either:

a) Providing a copy of the logbooks from each boat fishing for the relevant reporting period (weeks 4 and 5, weeks 6 and 7 or weeks 8 and 9) which shows the catch of banana prawns per day fished; or
b) Providing company records indicating the total catch of banana and tiger prawns for the relevant reporting period (weeks 4 and 5, weeks 6 and 7 or weeks 8 and 9) and the number of days fished per boat during those weeks.

## 6.2 Redleg banana prawns

Redleg banana prawns are caught predominantly in the JBG. Although both common and redleg banana prawns are caught west of 129.3567° longitude and south of 12° latitude (the JBG box), for practical purposes all banana prawns caught within this region will be considered to be redleg banana prawns. In reality, on average, 1% of the NPF total common banana prawn and 83% of the NPF total redleg banana prawn catches are caught in the JBG region (Plagányi et al. 2022).

The redleg banana prawn stock is considered to be all redleg banana prawns caught in the area of the NPF (JBG, Coburg/Melville, and Fog Bay). For assessment purposes however, the stock in the JBG is assessed as

an indicator of the overall stock levels given most of the catch occurs within the JBG (~90% of the total NPF redleg banana prawn catch).

The primary management tool within the redleg banana prawn fishery harvest strategy is the closure of the first (banana) season within the JBG. This decision rule, along with four other options, were tested through a MSE undertaken by CSIRO in 2020 and included testing to ensure it is robust to extreme environmental variations (Blamey et al. 2022, Plagányi et al. 2021). After considering the performance of these options under the MSE, the decision rule which closed the first season in the JBG was selected as the highest performing and most precautionary option to maintain healthy stock levels and deliver economic returns to the fishery.

### 6.2.1 Operational objective

The operational objective of this harvest strategy is to attain long term MEY from the redleg banana prawn fishery.

### 6.2.2 Fishery monitoring

There is a range of information collected in the NPF to support the management of the redleg banana prawn fishery including:

- A fishery-wide daily catch and effort logbook program for banana prawns.
- Seasonal landings returns.
- Selected economic data collected by CSIRO.
- Fishing power data collected by NPFI and CSIRO

The NPRAG monitors the catches within Fog Bay and the Coburg/Melville areas through the annual stock assessment process to ensure that the redleg banana prawn stock assessment for the JBG continues to capture a majority of the stock.

### 6.2.3 Closures

In addition to the first season closure within the JBG, which will be reviewed after five years (2026), the following closures also apply to the redleg banana prawn fishery:

- Spatial and temporal closures for biological/ecological protection (e.g. seagrass, habitat protection), for prawn size protection (e.g. juveniles, pre-spawning adults) and to maximise prawn growth/ increase economic return.
- Closures will be introduced and/or amended by NORMAC according to the protocols in the NPF Closures Review 2005 report, “Documenting the history of and providing protocols and criteria for changing existing or establishing new closures in the NPF”.
- The JBG fishery will open and close at the same time as the rest of the NPF in the second season (tiger prawn season).

## 6.2.4 Fishery reference points

### 6.2.4.1 Limit reference point

The redleg banana prawn fishery LRP is $0.5B_{MSY}$. Prawn annual recruitment is highly variable compared to longer-lived species. This means that the reference point cannot be applied using a single year's statistic.

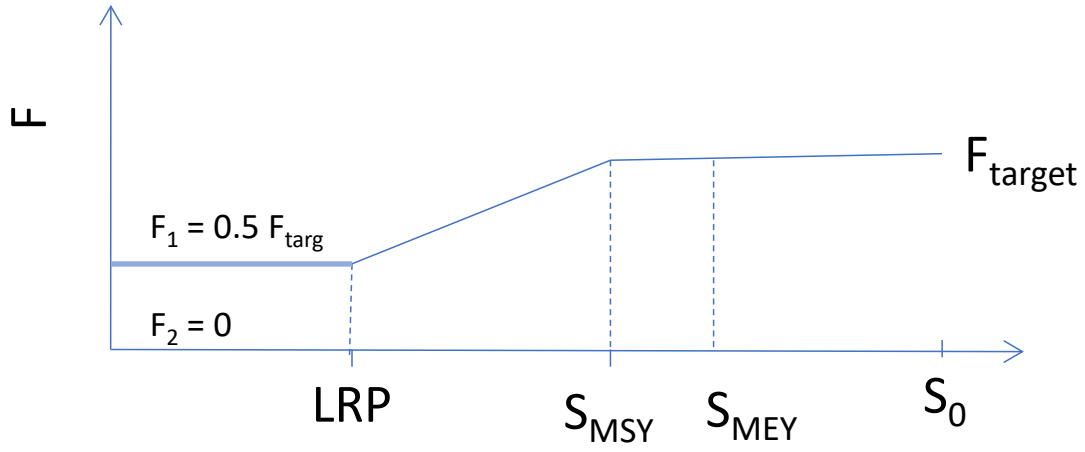
**LRP:** the LRP will be triggered if the Redleg banana prawn stock falls below the LRP in two successive data sufficient years.

***Data sufficient year:*** *a year where a minimum of 70 fishing boat days has been achieved and therefore sufficient data are available to run the assessment.*

### 6.2.4.2 Target reference point

The redleg banana prawn fishery TRP is $S_{MEY}$. This level has previously been agreed as a suitable proxy for MEY based on the reference period industry advised was a period of good economic performance in the fishery (1999-2010). The TRP is the modelled average spawning biomass level from this period that is assumed to correspond to the level that produces the maximum economic returns for the fishery.

As the first season closure decision rule was implemented in the 2021 fishing season for the first time, NPRAG supported maintaining the TRP to allow for assessment of the first season closure performance.




*F=F₁* in year after *B<LRP* for first time, and *F=F₂* if *B<LRP* for second time

**Figure 6: Stylised diagram showing the "hockey stick" rule as described above. LRP is limit reference point, F fishing mortality and $F_{target}$ here is $F_{MEY}$ the fishing mortality at MEY. $S_{MEY}$ is the biomass at MEY and $S_0$ is the unfished or virgin stock size.**

## 6.2.5 Method of assessment

An assessment model is available for redleg banana prawns and is applied to the area of the JBG. It is a quarterly age-based biological model with no economic component internal to the model (in contrast to that for the tiger prawn fishery). For redleg banana prawns, the LRP of $0.5S_{MSY}$ is used (as per the CHSP and Guidelines). The overfishing reference points are the fishing mortality levels that correspond to the above LRP over the long-term. The assessment model provides a TAE output.

The redleg banana prawn assessment is less certain than the tiger prawn assessment. As there are not independent monitoring surveys, the assessment relies on CPUE data only. Although the CPUE data is standardised, the abundance index from CPUE is less certain and is not considered as reliable as an index calculated from fishery-independent data. The confidence limits for the estimates of stock size are broad. As a result, the redleg banana prawn LRP does not align with the tiger and endeavour prawn LRP. The tiger and endeavour prawn LRP is based on the value of the five-year moving average of $S_Y/S_{MSY}$ (where 'S' is stock size). For redleg banana prawns, the LRP is triggered as soon as the stock falls below $0.5S_{MSY}$ for two successive data sufficient years (i.e. two years in a row where sufficient data are available). As the model relies on fisheries dependent data, it will not be possible to reliably update the assessment model in closure or data insufficient years. However, it is assumed that the corresponding very low level of effort means that there is minimal impact of fishing on the stock. For the same reason, the fishery would be re-opened after a single-year closure in order to maintain data availability for the stock assessment. Historically, the stock has only dropped below $0.5S_{MSY}$ once, during 1997-1998.

The stock assessment uses a natural mortality rate of 0.05 per week (based on tagging data from Die et al. 2002) and standardised CPUE data.

## 6.2.6 Decision rules for the redleg banana prawn fishery

### 6.2.6.1 First (banana) season

The primary decision rule in the redleg banana prawn fishery is the closed area during the first (banana) fishing season:

- The JBG area (east of 126.58° longitude to the coastline of mainland Australia in the vicinity of Point Blaze and south of -13° latitude) will be closed to fishing for the first season (banana) each year. This will be reviewed after 5 years (2026).

### 6.2.6.2 Second (tiger) season

The secondary decision rules for the redleg banana prawn fishery determine whether the fishery will be open during the second fishing season based on the results of the stock assessment. The key elements are summarised below and further described in Figure 6:

- Stock assessments undertaken annually (in data sufficient years) using available CPUE data.
    - A stock assessment can only be undertaken if more than 70 fishing boat days fishing effort has occurred in preceding year.
- If insufficient data are available to run the assessment, the fishery is opened in the second season the following year.[5]
- If sufficient data are available to run the assessment and stock is assessed at below the LRP, the target fishing mortality is reduced by 50% in subsequent year.
- If the LRP is triggered again the following data sufficient year, the fishery is closed in the subsequent year.

[5] Insufficient data to run the assessment is due to the low fishing effort, therefore as there has been low effort the previous fishing season (<70 days) there is a reduced risk to the stock in opening the fishery the subsequent season

- If the LRP is triggered in the assessment year immediately following a fishery closure (i.e. the first year the fishery is open following the closure), the fishery will be closed the subsequent year and the RAG will review the stock and consider management options[6].

Examples tables of how decision rules could be applied over subsequent years are provided in Appendix A.

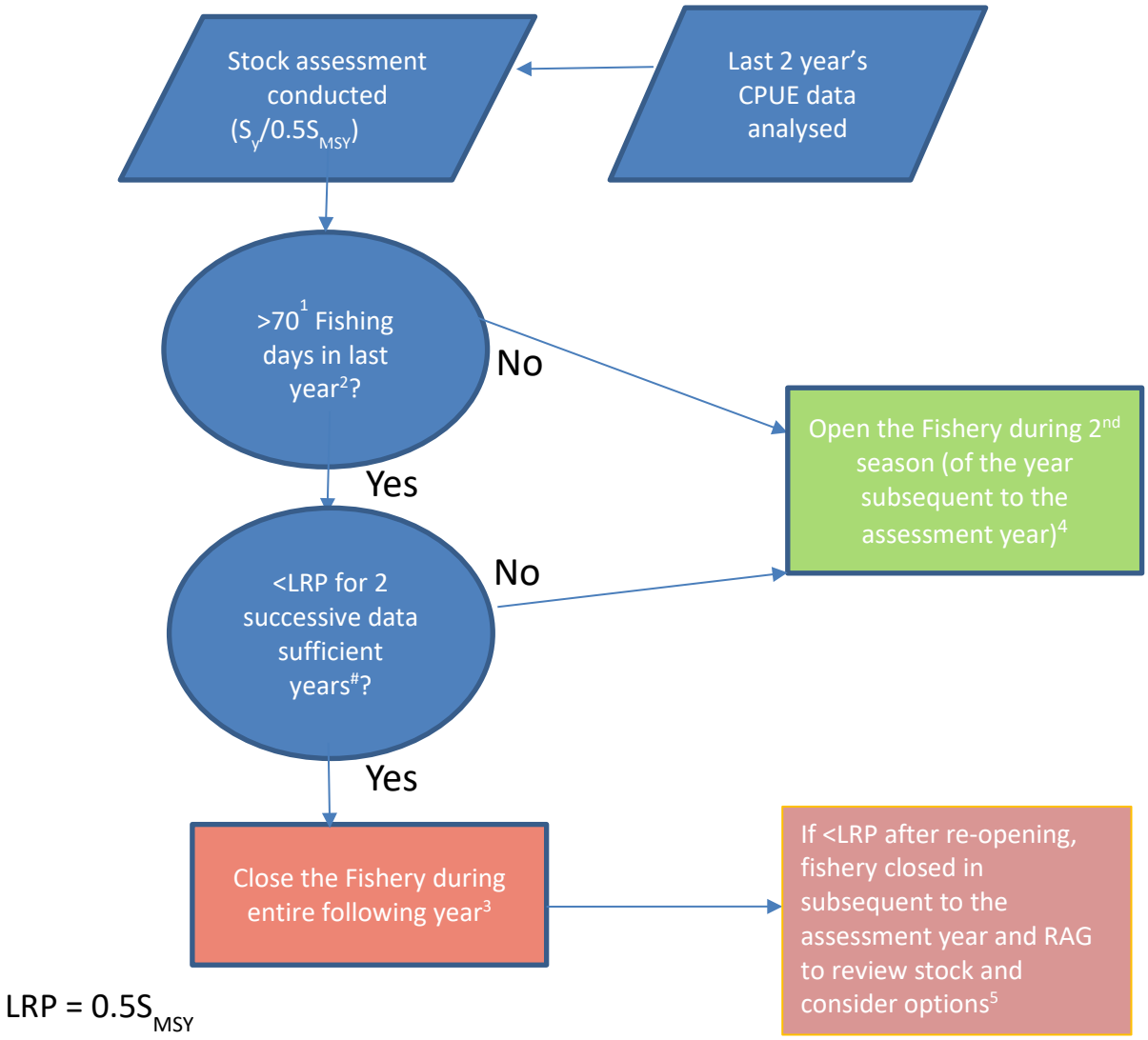



**Figure 7: Redleg Banana Prawn Harvest Strategy Flow Chart**

- *# – **Data sufficient year** means a year where a minimum of 70 fishing boat days has been achieved and therefore sufficient data are available to run the assessment.*[7]
- *1 – The minimum number of fishing boat days required to run the assessment is 70 days over the full fishing year.*
- *2 – If data has been provided for less than 70 fishing boat days during the full fishing year, then fishing will be allowed for the second season.*
- *3 – If the Redleg banana prawn stock size falls below the LRP for two successive data sufficient years, then the TAE is zero for a year (no fishing in the following year). The maximum number of*

[6] In this scenario, the fishery is closed (year one) and re-opened the following year (year two). If the next assessment (based on data from year two) falls below the LRP, the fishery will be closed the subsequent year (year three).

[7] The minimum number of fishing days for the stock assessment was agreed by NPRAG in February 2022 based on the Plagányi et al. 2022 stock assessment review which undertook data and model testing on the minimum number of boat days that could reliably be used to estimate CPUE and hence for input to the stock assessment model.

*years between two successive data sufficient years is four, as this harvest strategy is reviewed every five years.*

- *4 – If the LRP is not triggered in two successive data sufficient years, then fishing will be allowed for the second season.*
- *5 – If the LRP is triggered immediately following a fishery closure (due to consecutive breaches of the LRP), then the TAE is zero for a year (no fishing in the following year) and the NPRAG will review the stock and recommend a course of action.*

# 7 Other Target Species and Byproduct

Byproduct refers to any part of the catch which is kept or sold by the operator but is not the main target species. Specific harvest strategies have not been incorporated in this document for byproduct species.

In addition to key commercial prawn species, scampi is targeted and caught in a specific area of the NPF during the NPF closure periods. However, for the purposes of this harvest strategy, scampi is considered a byproduct species and is not considered a key commercial species under the CHSP as it contributes only a low level of catch and value to the fishery.

Management controls (size/trigger limits) are in place for a range of other byproduct species. In addition, as a number of byproduct species are taken as an incidental part of the tiger prawn catch, the effort controls which apply to tiger prawns also apply to these species.

The byproduct species which are incidentally caught in prawn trawling operations and which are retained because of their commercial value include:

- two species of slipper lobster or bugs (*Thenus indicus* and *Thenus orientalis*), also referred to as bay lobster are exploited in areas where prawns are targeted;
- one species of scallop (*Amusium pleuronectes*), or delicate saucer scallops – taken incidentally in the NPF in coastal waters off the Northern Territory, from around Melville Island across the northern Australia coast to west of Karumba and an area around Weipa;
- squid, cuttlefish, mud crabs and tropical rock lobster; and
- some larger fish species.

A Fisheries Research and Development Corporation (FRDC) funded research project “biology, dynamics and management strategy evaluation for byproduct species in the NPF” developed harvest strategies for byproduct species, including squid (Milton et al. 2010). This report calculated allowable biological catches (ABCs) for major byproduct species, upon which the relevant byproduct limits are based.

A number of ERAs have been undertaken in the NPF since 2007, with the most recent one for the NPF completed in 2021 for the tiger and banana prawn components of the fishery. This identified four species of sawfish to be at potential high risk, with no other species found to be at high risk.

## 7.1 Scampi

Scampi is taken from a deepwater area on the edge of the AFZ north of Melville Island and is targeted during NPF closure periods. Effort in the fishery is low, with a recent average of four NPF trawlers targeting scampi each year. This is a result of the high cost associated with travel to and from the scampi grounds

and the restricted market opportunities for sale of the catch. Scampi catches have been between 20 and 30 tonnes annually, with around 60 total fishing days spent targeting scampi.

There is no current formal stock assessment for scampi. However, in line with the CHSP Guidelines for identifying sustainable and profitable catch levels in small fisheries with limited data, expert opinion on catch levels was sought. An analysis was undertaken in 2007 although considering the uncertainty in the analysis, NPRAG agreed on a 30 tonne limit, which was the in line with the highest historical catches at the time (approximately 29 tonnes in 2002). The most recent ERA undertaken in the NPF in 2021 assessed scampi species as either medium or low risk (Sporcic et al. 2021a and 2021b). On that basis, the NPRAG subsequently supported the retention of the 30 tonne catch limit for scampi.

### 7.1.1 Catch limit for scampi

A catch limit of 30 tonnes in any 12-month period (beginning 2230 hours UTC on 30 November each year) is in place for scampi.

## 7.2 Squid

Squid is a target species under the NPF Plan. However, given the low volume and value of squid taken by NPF trawlers, this resource is treated as a byproduct in this harvest strategy. Squid is managed by the Northern Territory except for take of squid by prawn trawl, which is managed by AFMA. The NPF catch limit for squid of 500 tonnes is based on historical catch levels in the fishery. The Milton et. al (2010) report recommended an ABC of 306 tonnes for squid. NPRAG noted this is below the 500 tonne catch limit and therefore recommended a review trigger at 300 tonnes.

In 2020, expert opinion was sought as part of the ERA process for squid and cuttlefish species in the NPF. The review found that, considering the availability and abundance data along with the biological characteristics of squid (including the episodic 'squid' runs that occur in the NPF), the NPF provides a low-medium risk to the sustainability of squid resources in the Gulf of Carpentaria under current management arrangements, based on current levels and distribution of trawl effort.

### 7.2.1 Catch limit and review trigger for squid

The current decision rules in place for squid (applied in a single calendar year) are:

- 500 tonne catch limit;
- Review trigger at 300 tonnes;

Further details on the review trigger included under section 7.6 below.

## 7.3 Bugs

Bugs (*Thenus indicus* and *Thenus orientalis*) are caught incidentally as part of prawn trawl operations in the NPF, with annual catches varying widely. The Milton et. al 2010 report recommended an ABC of 1 887 tonnes for bugs along with a 65mm carapace width size limit. This was considered by NORMAC in 2011, which recommended a precautionary 100 tonne limit (well below the recommended ABC) along with a 60mm carapace minimum size limit.

### 7.3.1 Management and review trigger for bugs

The current decision rules and management arrangements in place for bugs (applied in a single calendar year) are:

- A 100 tonne review trigger
- 60 mm minimum carapace width size limit
- No retention of berried female bugs
- All bugs to be retained whole
- No removal by any method (including chemical) of eggs from egg bearing females.

## 7.4 Scallops

Scallops (*Amusium spp.*) are caught incidentally as part of prawn trawl operations in the NPF at low levels, with a maximum historical catch of 11.5 tonnes, although catches do vary annually. The Milton et. al 2010 report recommended an ABC of 186 tonnes for scallops.

### 7.4.1 Review trigger for scallops

There is a 50 tonne review trigger in place for scallops (applied in a single calendar year). Further details on the review event are included under section 7.6 below.

## 7.5 Cuttlefish

Cuttlefish (*Sepia spp.*) are caught incidentally as part of prawn trawl operations in the NPF at low levels, with a maximum historical catch of 9.3 tonnes, although catches do vary annually. The Milton et. al 2010 report recommended an ABC of 282 tonnes for cuttlefish.

In 2020, expert opinion was sought as part of the ERA process for squid and cuttlefish species in the NPF. This review found that, considering the availability and abundance data along with the biological characteristics of cuttlefish, under current management arrangements with the current levels and distribution of trawl effort, the NPF provides a low-medium risk to the sustainability of cuttlefish resources in the Gulf of Carpentaria.

### 7.5.1 Review trigger for cuttlefish

There is a 50 tonne review trigger in place for cuttlefish (applied in a single calendar year). Further details on the review event are included under section 7.6 below.

## 7.6 Review trigger events

Reviews of trigger events will be undertaken within six months of it being breached. These will be considered by NPRAG in May the year following the breach and will include, but are not limited to, the following elements:

- Consideration of the life history/characteristics of the relevant byproduct species,

- The results of the most recent ERA, and
- Analysis of available catch, effort and spatial data (logbook and observer data).

# 8 Harvest Strategy Review

The NPF harvest strategy will be reviewed every five years.

Under certain circumstances, it may be necessary to amend the harvest strategy in between scheduled reviews. These circumstances may include but not be limited to (when):

- there is new information that substantially changes understanding of the status of the fishery or sub-fisheries, leading to improved estimates of indicators relative to reference points.
- drivers external to management of the fishery increase the risk to fish stock/s (e.g. the impacts of climate change).
- it is clear the strategy is not working effectively and the intent of the CHSP is not being met.

Further explanation can be found in section 9 of the CHSP Guidelines (DAWR 2018). The consultative and technical processes for amending harvest strategies are set out in section 2.5 of the CHSP Guidelines.

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# Appendix A: Examples of how decision rules could apply over a five-year period for the redleg prawn fishery.

** $F_{TARG}$ multiplier: $F_{TARG}$ is $F_{MEY}$ (the fishing mortality at MEY) estimated annually within the stock assessment model.*

**Table 4: This example demonstrates the responses when sufficient data are (mostly) available and the stock remains above the LRP.**

| | $Y_1$ | $Y_2$ | $Y_3$ | $Y_4$ | $Y_5$ |
|---|---|---|---|---|---|
| **Sufficient data to run assessment?** | Yes | No | Yes | Yes | Yes |
| **Stock below LRP?** | No | ? | No | No | No |
| **$F_{TARG}$ multiplier*** | 1 | 1 | 1 | 1 | 1 |
| **Comments** | Stock not below LRP in Y1, insufficient data to run assessment Y2, with stock not below LRP in the following years (Y3-5). | | | | |

**Table 5: This example demonstrates situation where the stock is below the LRP one year, insufficient data are available to run the assessment the following year and the stock is not below the LRP the subsequent year.**

| | $Y_1$ | $Y_2$ | $Y_3$ | $Y_4$ | $Y_5$ |
|---|---|---|---|---|---|
| **Sufficient data to run assessment?** | Yes | No | Yes | Yes | Yes |
| **Stock below LRP?** | Yes | ? | No | Yes | No |
| **$F_{TARG}$ multiplier*** | 1 | 0.5 | 1 | 1 | 0.5 |
| **Comments** | Stock below LRP in Y1, insufficient data to run assessment Y2, with stock not below LRP the following year (Y3). In Y4, stock below LRP, so fishery pressure reduced by 50% the following year (Y5). However, as stock above the LRP the subsequent year (Y5) the LRP is not triggered in Y5 and therefore fishery remains open with fishing target back to 100% the following year (Y6). | | | | |

**Table 6: This example demonstrates situation where the stock is below the LRP one year, insufficient data are available to run the assessment the next and then the stock remains below the LRP the subsequent year.**

| | $Y_1$ | $Y_2$ | $Y_3$ | $Y_4$ | $Y_5$ |
|---|---|---|---|---|---|
| **Sufficient data to run assessment?** | Yes | No | Yes | No (fishery closed) | Yes |
| **Stock below LRP?** | Yes | ? | Yes | | No |
| **$F_{TARG}$ multiplier*** | 1 | 0.5 | 1 | 0 | 1 |
| **Comments** | LRP triggered in Y1, with fishing pressure reduced in Y2 as a result. Insufficient data was available to run assessment in Y2, but as stock was below LRP in Y3, LRP was triggered (two consecutive data sufficient years) and therefore fishery closed in Y4. Fishery open again in Y5 following full-year closure. | | | | |

**Table 7: This example demonstrates the responses when the stock is below the LRP in consecutive data sufficient years and then immediately following the closure.**

| | $Y_1$ | $Y_2$ | $Y_3$ | $Y_4$ | $Y_5$ |
|---|---|---|---|---|---|
| **Sufficient data to run assessment?** | Yes | Yes | No (fishery closed) | Yes | Fishery closed; RAG review triggered |
| **Stock below LRP?** | Yes | Yes | | Yes | No |
| **$F_{TARG}$ multiplier*** | 1 | 0.5 | 0 | 1 | 0 |
| **Comments** | LRP triggered as stock below LRP in two consecutive years (Y1 and Y2), with fishery subsequently closed (Y3). LRP is triggered in year immediately following closure (Y4), resulting in another fishery closure (Y5) and triggering of RAG review. | | | | |