Chapter 7
Small Pelagic Fishery

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FIGURE 7.1 Area fished in the Small Pelagic Fishery, 2016–17

Note: Some effort data are not shown on this map for confidentiality reasons.
## Table 7.1 Status of the Small Pelagic Fishery

<table>
<thead>
<tr>
<th>Biological status</th>
<th>2015</th>
<th>2016</th>
<th>Comments</th>
</tr>
</thead>
</table>
| **Australian sardine**
   (*Sardinops sagax*) | | | Recent catches have been below the RBC. Historical catches have been low and are not likely to have reduced biomass below the limit reference point. |
| **Blue mackerel, east**
   (*Scomber australasicus*) | | | Most recent catches have been below the RBC. Historical catches have been low and are not likely to have reduced biomass below the limit reference point. |
| **Blue mackerel, west**
   (*Scomber australasicus*) | | | Recent catches have been below the RBC. Historical catches have been low and are not likely to have reduced biomass below the limit reference point. |
| **Jack mackerel, east**
   (*Trachurus declivis*) | | | Recent catches have been below the RBC. Recent historical catches have been low and are not likely to have reduced biomass below the limit reference point. |
| **Jack mackerel, west**
   (*Trachurus declivis*) | | | Recent catches have been below the RBC. Historical catches have been low and are not likely to have reduced biomass below the limit reference point. |
| **Redbait, east**
   (*Emmelichthys nitidus*) | | | Recent catches have been below the RBC. Historical catches have been low and are not likely to have reduced biomass below the limit reference point. |
| **Redbait, west**
   (*Emmelichthys nitidus*) | | | Recent catches have been below the RBC. Historical catches have been low and are not likely to have reduced biomass below the limit reference point. |

**Economic status**

Estimates of NER are not available for 2015–16 or 2016–17. A decrease in the level of catch in 2016–17 compared with the very high level of catch in 2015–16 suggests that gross value of production is likely to have declined in 2016–17. Changes in NER are uncertain because of a lack of information about changes in cost structures of the industry.

Notes: NER Net economic returns. RBC Recommended biological catch.
7.1 Description of the fishery

Area fished

The Small Pelagic Fishery (SPF) extends from southern Queensland to southern Western Australia (Figure 7.1).

Fishing methods and key species

The fishery includes purse-seine and midwater trawl fishing vessels. The key target species for the purse-seine vessels are Australian sardine (*Sardinops sagax*), blue mackerel (*Scomber australasicus*) and jack mackerel (*Trachurus declivis*). The key target species for the midwater trawl fishery are blue mackerel, jack mackerel and redbait (*Emmelichthys nitidus*).

Management methods

Almost all small pelagic stocks are multijurisdictional (that is, managed by both the Australian and state governments) under Offshore Constitutional Settlement arrangements. The exception is the western stock of Australian sardine, which is managed by South Australia and Victoria.

The 2014 SPF harvest strategy (AFMA 2014a), which was used, in combination with updated scientific advice, to set recommended biological catches (RBCs) and total allowable catches (TACs) for the 2015–16 and 2016–17 fishing seasons, included a three-tier system that was applied separately to each stock. The tiered system was designed to allow greater levels of catch when higher-quality research information was available on stock status. Tier 1, for stocks with the highest quality of information (from daily egg production method [DEPM] surveys), provided for the largest potential RBC as a proportion of the estimated biomass. Tier 3, for stocks with relatively poor-quality information, provided for the smallest RBC.

The SPF tier 1 decision rules used a maximum exploitation rate of 15 per cent of estimated spawning biomass from a recent DEPM survey as the basis for setting RBCs. This is more conservative than the internationally recommended exploitation rate of 20–25 per cent of current total biomass (Pikitch et al. 2012). The maximum duration for staying at tier 1 without a new DEPM survey was five years.

Additional precaution was added to the RBC to account for biomass estimates older than five years. If a DEPM survey was not conducted within five years of the previous survey, the resource would be managed under tier 2 harvest control rules. Under tier 2, maximum RBCs are set based on a maximum exploitation rate of 7.5 per cent of the estimated spawning biomass.

For tier 3, the maximum RBC was set at 500 t for each stock, reflecting that a high level of precaution is warranted when information is lacking. Once the RBC was derived, an allowance for current state catches was deducted before setting the TACs.
Testing through management strategy evaluation (MSE) indicated that using the harvest rates detailed in the harvest strategy would result in biomass being maintained above 20 per cent of unfished biomass levels (0.2B₀) 90 per cent of the time (Giannini et al. 2010). A review of the harvest strategy (Smith et al. 2015), which included ecosystem and population modelling, recommended that the target reference point for SPF target species should be set at 0.5B₀, and the limit reference point at 0.2B₀; that target exploitation rates should be species specific or preferably stock specific; that the average tier 1 exploitation rate of 15 per cent might be too high for lower-productivity species such as red bait and jack mackerel, and potentially too low for higher-productivity species such as sardines and blue mackerel; and that it is generally not safe to apply tier 2 harvest rates unchecked for long periods—for shorter-lived species (blue mackerel and sardine), this can result in unacceptable probabilities of depletion in short periods (five or six years).

Following the review by Smith et al. (2015), the SPF harvest strategy was revised in April 2015 to adopt a target reference point of 0.5B₀ and a limit reference point of 0.2B₀ (AFMA 2015a). The exploitation rates were altered to be stock specific and to limit the time a stock can remain at tier 1 and tier 2. Exploitation rates under tier 1 are now 20 per cent of estimated spawning biomass for Australian sardine, 15 per cent for blue mackerel, 12 per cent for jack mackerel and 10 per cent for red bait. The maximum time at tier 1 without an additional DEPM survey is five fishing seasons for all species. Exploitation rates under tier 2 are half that applied at tier 1. The maximum time at tier 2 without an additional DEPM survey is 5 fishing seasons for Australian sardine and blue mackerel, and 10 fishing seasons for jack mackerel and red bait. The April 2015 revision of the harvest strategy also included the introduction of a new tier (tier 2(b) Atlantis), which provides exploitation rates based on estimates from the Atlantis ecosystem model (Fulton 2012, 2013). Smith et al. (2015) did not test tier 3 of the harvest strategy, and tier 2(b) Atlantis arose as an interim step to deal with these stocks until further work on tier 3 could be undertaken. Tier 2(b) Atlantis applies when a stock is not eligible to remain at tier 2 because the maximum time at tier 1 has been exceeded or because a DEPM survey has never been undertaken. It applies the tier 2 exploitation rates to the lower bound (that is, more conservative) of the spawning biomass estimates obtained from the Atlantis-SPF model. An annual assessment of age and length data is also required to monitor the effects of fishing on the population. The revised 2015 harvest strategy was not used to set RBCs and TACs for the 2016–17 fishing season. The TACs were held at 2015–16 levels as further testing of the harvest strategy was not complete.

To minimise any potential impact of localised depletion, the vessel management plan for the factory trawler limits catch in a 30-day period across a series of numbered grids throughout the fishery. Additionally, a maximum of 75 per cent of the concession holders’ combined SPF western and eastern quota holdings (for all species) can be taken in a single management zone.
Biomass is difficult to estimate for some small pelagic species because of its high interannual variability. A key assumption for assessing small pelagic stocks is that DEPM assessments are a reliable indicator of abundance; however, these surveys are known to have very wide confidence intervals (CIs). In this chapter, spawning biomass estimates are generally presented with the 95 per cent CI of the range of possible estimates. This CI means that, if the models to derive the biomass estimates are run 100 times, the spawning biomass would be within the stated range 95 per cent of the time. Because these ranges are often broad and there is a possibility that spawning biomass might be outside these ranges, great caution needs to be taken when interpreting fishing mortality and biomass against specified limit and target reference points. If fishing mortality approaches RBCs, it may be necessary to consider alternative scenarios of estimated spawning biomass to assess risks to small pelagic stocks.

**Fishing effort**

Most historical fishing effort occurred off the east and west coasts of Tasmania. Purse seining was the main method historically, but has been replaced by midwater trawling since 2002. Effort in the SPF increased in 2014–15, 2015–16 and 2016–17 with the operation of a factory trawler.

**Catch**

Small pelagic fish are generally caught during targeted fishing for a single species. They are also caught in small quantities in other Commonwealth- and state-managed fisheries, including the Southern and Eastern Scalefish and Shark Fishery, the Eastern Tuna and Billfish Fishery, the Western Tuna and Billfish Fishery, and the New South Wales Ocean Hauling Fishery.

Catch in the SPF increased from around 6,000 t in 1984–85 to a peak of almost 42,000 t in 1986–87. Average catches of around 12,000 t per year were also taken in the early 1990s, comprising mostly redbait. Until recently, minimal catch and effort in the Commonwealth SPF have reflected a lack of markets and processing facilities. The operation of a factory trawler vessel in 2014–15, 2015–16 and 2016–17 has led to increased catches. Total Commonwealth catch in the 2015–16 season was 12,004 t, representing 31 per cent of the total TAC of 39,170 t. Total Commonwealth catch in 2016–17 was 8,038 t, representing 19 per cent of the available TAC (Table 7.2).

**Changes to status reporting for the SPF**

Previous versions of the *Fishery status reports* reported on the SPF for the fishing season a year before the most recent season. This lag was due to catch data from state jurisdictions not being available for the most recent Commonwealth fishing season. State catch data have been used previously to determine status for Australian sardine and blue mackerel. The catch of jack mackerel and redbait is predominantly from Commonwealth fisheries. The catch for blue mackerel by Commonwealth vessels increased in the 2015–16 and 2016–17 fishing seasons to the extent that the Commonwealth catch was larger than the state catch. Commonwealth catches of jack mackerel increased by an order of magnitude in the 2015–16 season, but decreased in 2016–17. Stock status is now reported for the 2015–16 and 2016–17 seasons because the trend of increasing Commonwealth catch for these two species necessitates more up-to-date status assessments. The status determination for 2016–17 is based on the assumption that state catches in the season remain similar to those of previous years for all species.
### Table 7.2: Main features and statistics for the SPF

<table>
<thead>
<tr>
<th>Stock name</th>
<th>2015–16 fishing season</th>
<th>2016–17 fishing season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TAC (t)</td>
<td>Catch (t)</td>
</tr>
<tr>
<td>Australian sardine</td>
<td>1,880</td>
<td>114</td>
</tr>
<tr>
<td>Blue mackerel, east</td>
<td>2,630</td>
<td>2,022</td>
</tr>
<tr>
<td>Blue mackerel, west</td>
<td>6,200</td>
<td>979</td>
</tr>
<tr>
<td>Jack mackerel, east</td>
<td>18,670</td>
<td>5,342</td>
</tr>
<tr>
<td>Jack mackerel, west</td>
<td>3,600</td>
<td>613</td>
</tr>
<tr>
<td>Redbait, east</td>
<td>3,310</td>
<td>189</td>
</tr>
<tr>
<td>Redbait, west</td>
<td>2,880</td>
<td>1,135</td>
</tr>
<tr>
<td>Total fishery</td>
<td>39,170</td>
<td>10,394</td>
</tr>
</tbody>
</table>

**Fishery-level statistics**

- **Effort**
  - Purse seine: 128 search-hours
  - Midwater trawl: 316 shots
  - Purse seine: 114 search-hours
  - Midwater trawl: 156 shots

- **Fishing permits**
  - 32 entities held quota SFRs in 2015–16.
  - 32 entities held quota SFRs in 2016–17.

- **Active vessels**
  - Purse seine: 2
  - Midwater trawl: 1
  - Purse seine: 2
  - Midwater trawl: 1

- **Observer coverage**
  - Purse seine: 0%
  - Midwater trawl: 100%
  - Purse seine: 0%
  - Midwater trawl: 100%

- **Fishing methods**
  - Purse seine, midwater trawl

- **Primary landing ports**
  - Eden, Iluka (New South Wales); Port Lincoln (South Australia); Triabunna (Tasmania); Geelong (Victoria)

- **Management methods**
  - Input controls: limited entry, gear restrictions
  - Output controls: TACs, with ITQs implemented from 1 May 2012

- **Primary markets**
  - Domestic: fishmeal, bait and human consumption
  - International: human consumption

- **Management plan**
  - Small Pelagic Fishery Management Plan 2009

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*Fishery statistics are provided by fishing season, unless otherwise indicated. Fishing season is 1 May to 30 April. Real-value statistics are by financial year and are not available for 2016–17.

Notes: ITQ Individual transferable quota. SFR Statutory fishing right. TAC Total allowable catch.*
7.2 Biological status

Australian sardine (*Sardinops sagax*)

Stock structure

Two early studies indicate genetic structuring (Dixon et al. 1993; Yardin et al. 1998); however, they sampled at different locations and reported different population structures. Izzo et al. (2012) used a weight-of-evidence approach to review all available information on population subdivision in sardines and recommended six stock divisions: southern Queensland and northern New South Wales, southern New South Wales, eastern and western Tasmania and Victoria, South Australia, south-west Western Australia, and west Western Australia. However, these boundaries are not conclusive, and additional sampling and analysis are required to clearly define biological stocks. Izzo et al. (2017), using an integrative assessment including genetic, morphological, otolith, growth, reproductive and fishery data, found evidence for at least four isolated stocks (south-west coast of Western Australia, Great Australian Bight and Spencer Gulf, Bass Strait and Port Phillip Bay, and eastern Australia). Therefore, Australian sardine within the SPF is assessed and managed as a single east coast stock (Figure 7.1).

Catch history

State catches of Australian sardine comprise most of the total catch. Unlike in the Commonwealth fishery, state catches are not constrained by catch limits. State catches increased substantially from 2001–02 to 2009–10, contributing to reductions to the Commonwealth TAC. Total sardine catch from Commonwealth and state fisheries (other than that taken in South Australia) peaked in 2008–09 at 4,787 t and decreased to 893 t in 2014–15—it’s lowest level since 2001–02. The total catch in 2015–16 was 1,434 t. The Commonwealth catch for 2016–17 was 131 t (Figure 7.2; state catches are not available for 2016–17).
Stock assessment

The 2015–16 RBC and TAC were set using the 2015 harvest strategy control rules and 2004 DEPM biomass estimate, because the results of the 2014 DEPM survey were not available. The 2015–16 TAC deducted state catches. The outcomes of the DEPM survey were available for setting the TAC for the 2016–17 fishing season; however, the Australian Fisheries Management Authority (AFMA) Commission retained the TAC from the previous year to allow additional testing, including MSE, to be completed on the SPF harvest strategy. This testing was completed in 2016 (Pascoe & Hillary 2016; Punt et al. 2016).

As a result, the 2015–16 and 2016–17 RBCs and TACs were based on a 2004 DEPM survey. This survey estimated the spawning biomass for Australian sardine off eastern Australia during July 2004 to be 28,809 t (95 per cent CI 9,161 to 58,673 t) (Ward et al. 2007). The then Small Pelagic Fishery Resource Assessment Group (SPFRAG) considered this to be an underestimate because the survey did not cover the entire spawning area, and revised the estimate to 40,000 t, based on the proportion of unsurveyed area. Because of the age of the DEPM estimate, the RBC for 2015–16 was set using the tier 2 decision rule (using 10 per cent of the 2004 biomass estimate), which resulted in an RBC of 4,000 t (AFMA 2014b). After deductions for expected state catches, AFMA set the 2015–16 TAC at 1,880 t and subsequently maintained the 2016–17 TAC at the same level pending further testing of the SPF harvest strategy (outlined above).

A DEPM survey of Australian sardine off eastern Australia was conducted during August–September 2014 and estimated spawning biomass to be 49,575 t (95 per cent CI 24,200 to 213,300 t) (Ward et al. 2015a). Another DEPM survey during January 2014 around northern Tasmania and southern Victoria estimated the spawning biomass in this region to be 10,962 t, although this survey only covered a partial area of spawning habitat (95 per cent CI 8,000 to 15,000 t; Ward et al. 2015b).
Previous MSE testing for Australian sardine suggests that the harvest strategy is appropriate, and its application would result in a low probability of the stock falling below 0.2B0, for more than 90 per cent of the time, in line with the Commonwealth Fisheries Harvest Strategy Policy (HSP; DAFF 2007; Giannini et al. 2010). However, the 2015 MSE suggested linking harvest strategy settings to the productivity of the species (Smith et al. 2015). For Australian sardine, it was suggested that tier 1 harvest rates could be increased from 15 per cent to 33 per cent, that tier 2 harvest rates should be set at 50 per cent of tier 1, and that neither should be applied for longer than five years. A tier 1 harvest rate of 20 per cent was formally adopted in the 2017 SPF harvest strategy.

Total catch (Commonwealth plus state) in 2015–16 was 3 per cent of the August–September 2014 biomass estimate (Ward et al. 2015a) and 36 per cent of the RBC. Total Commonwealth catch in 2016–17 was less than 1 per cent of the 2014 biomass estimate and 3 per cent of the RBC. The peak sardine catch (state plus Commonwealth) of 4,787 t in 2008–09 was about 16 per cent of the spawning biomass estimated by the 2004 DEPM survey and 10 per cent of the most recent biomass estimate. Available age-frequency and length-frequency data show no trends of concern (Ward & Grammer 2017).

**Stock status determination**

The peak historical harvest from this stock was approximately 9 per cent of the 2014 spawning biomass estimate, and catches have been low as a proportion of estimated spawning biomass. This level of fishing mortality is unlikely to have substantially reduced spawning biomass. Australian sardine is therefore classified as **not overfished** for both years assessed. Fishing mortality remains a small proportion of estimated biomass, and was below the 2015–16 and 2016–17 RBCs. The stock is therefore classified as **not subject to overfishing** for both years assessed.

**Blue mackerel, east (Scomber australasicus)**

The stock structure of blue mackerel is uncertain. Genetic analysis of samples from southern Queensland, Western Australia and New Zealand indicates population subdivision. Genetic differences were detected between Western Australia and Queensland, and between Western Australia and New Zealand, but not between Queensland and New Zealand (Schmarr et al. 2007; Whittington et al. 2012). No finer-scale analyses of blue mackerel have been undertaken to further define stock structure. Blue mackerel within the SPF is assessed and managed as separate stocks in the eastern and western subareas (Figure 7.1).
Catch history

Most of the blue mackerel (east) catch has historically been taken in state fisheries. However, with the introduction of a freezer vessel, the Commonwealth catch has recently exceeded state catch. Commonwealth catch increased in 2015–16 to 2,022 t (up from 203 t in 2014–15) and decreased to 1,248 t in 2016–17 (Figure 7.3; state catches are not available for 2016–17). Total state and Commonwealth catch was 2,367 t in 2015–16, which is the peak catch for the fishery.

FIGURE 7.3 Commonwealth eastern blue mackerel catch and TAC, 2003–04 to 2016–17

Note: **TAC** Total allowable catch.
**Stock assessment**

The 2015–16 RBC and TAC were set using the 2015 harvest strategy control rules and 2004 DEPM biomass estimate, because the results of the 2014 DEPM survey were not available. The 2015–16 TAC deducted state catches. The outcomes of the DEPM survey were available for setting the TAC for the 2016–17 fishing season; however, the AFMA Commission retained the TAC from the previous year to allow additional testing, including MSE, to be completed on the SPF harvest strategy. This testing was completed in 2016 (Pascoe & Hillary 2016; Punt et al. 2016).

As a result, the 2015–16 and 2016–17 RBCs and TACs for blue mackerel (east) were based on a 2004 DEPM survey. This survey estimated the spawning biomass for blue mackerel (east) to be 23,009 t (95 per cent CI 7,565 to 116,395 t; Ward & Rogers 2007). The SPFRAG considered this to be an underestimate because the survey did not cover the entire spawning area, and revised the estimate to 40,000 t. Because of the age of the assessment, the RBC for 2015–16 was set using the tier 2 decision rule (using 7.5 per cent of the 2004 spawning biomass estimate), which resulted in an RBC of 3,000 t (AFMA 2014b, 2015b). After deducting expected state catches, the Commonwealth TAC was set at 2,630 t for 2015–16. Since setting these TACs, results from a DEPM survey for blue mackerel (east) conducted in 2014 estimated spawning biomass to be 83,300 t (95 per cent CI 35,100 to 165,000 t) (Ward et al. 2015b). The TAC for 2016–17 was set to the same level as the previous year while additional testing was completed.

Total (Commonwealth and state) blue mackerel (east) catch in 2015–16 was 3 per cent of the 2014 spawning biomass estimate. The Commonwealth catch in 2016–17 was 67 per cent of the RBC, 76 per cent of the TAC and less than 2 per cent of the 2014 spawning biomass estimate.

Previous MSE testing for blue mackerel suggests that the harvest strategy is appropriate, and its application would result in a low probability of the stock falling below 0.2B, for more than 90 per cent of the time, in line with the HSP (DAFF 2007; Giannini et al. 2010). However, the 2015 MSE suggested linking harvest strategy settings to the productivity of the species (Smith et al. 2015). For blue mackerel, it was suggested that tier 1 harvest rates could be increased from 15 per cent to 23 per cent, that tier 2 harvest rates should be set at 50 per cent of tier 1, and that neither should be applied for longer than five years. A tier 1 harvest rate of 15 per cent for a maximum of five years and a tier 2 harvest rate of 7.5 per cent for a maximum of five years was adopted by the AFMA Commission in April 2015. The tier 2 harvest control rule was used as the basis for the 2015–16 TAC. The 2016–17 TAC was held at the 2015–16 level pending additional testing on the harvest strategy. This testing was completed in 2016.

There are no trends of concern in the length and age data (Ward & Grammer 2017).
**Stock status determination**

The peak harvest from the stock was 4 per cent of the 2014 spawning biomass estimate, and catches have been low as a proportion of estimated biomass. This level of fishing mortality is unlikely to have substantially reduced spawning biomass. The blue mackerel (east) stock is therefore classified as **not overfished** for both years assessed. Total catch in the 2015–16 fishing season was a small proportion of spawning biomass, decreasing substantially in 2016–17. The 2015–16 RBC was very conservative in comparison with the most recent spawning biomass estimate (3 per cent), and increased to 12,495 t in 2017–18 as a result of the updated biomass estimate. The stock is therefore classified as **not subject to overfishing** for both years assessed.

**Blue mackerel, west (*Scomber australasicus*)**

**Stock structure**

See blue mackerel (east).

**Catch history**

Very little blue mackerel (west) was caught before 2004–05. Total Commonwealth-landed catch increased in 2005–06, peaking in 2008–09 at 2,164 t and decreasing steadily thereafter. There was negligible catch between 2011–12 and 2014–15 in both the state and Commonwealth fisheries. Commonwealth catch was 979 t in 2015–16 with negligible state catch, and 766 t in 2016–17 (Figure 7.4; state catches are not available for 2016–17).

**FIGURE 7.4** Commonwealth western blue mackerel catch and TAC, 2003–04 to 2016–17

Note: TAC Total allowable catch.
Stock assessment

The 2015–16 RBC and TAC were set using the 2014 harvest strategy control rules and 2005 DEPM biomass estimate. The AFMA Commission retained the TAC from the previous year for the 2016–17 fishing season to allow additional testing, including MSE, to be completed on the SPF harvest strategy.

The 2015–16 and 2016–17 RBCs and TACs for blue mackerel (west) were based on a 2005 DEPM survey. This survey estimated the spawning biomass to be 56,228 t (95 per cent CI 10,993 to 293,456 t) (Ward & Rogers 2007); however, the SPFRAG considered this to be an underestimate and adjusted the estimate to 86,500 t. Application of the tier 2 decision rule (using 7.5 per cent of the 2005 spawning biomass estimate) resulted in an RBC of 6,500 t for the 2015–16 (AFMA 2015b) and 2016–17 fishing seasons. The Commonwealth TAC was set at 6,200 t for 2015–16 after state catch had been deducted. The TAC for the 2016–17 season was held at the 2015–16 level pending further testing of the harvest strategy. This testing was completed in 2016 (Pascoe & Hillary 2016; Punt et al. 2016).

Total landings (Commonwealth and state) peaked in 2008–09 at 2,168 t, which is 4 per cent of the spawning biomass estimated by the 2005 DEPM survey. No catch was reported for 2014–15, and no state catch was reported for 2015–16. Commonwealth catch in 2015–16 (979 t) represented 15 per cent of the RBC and 16 per cent of the 2015–16 TAC. Commonwealth catch in 2016–17 (766 t) represented 12 per cent of the 2016–17 RBC and TAC. Available age-frequency and length-frequency data show no trends of concern (Ward & Grammer 2017).

Previous MSE testing for blue mackerel suggests that the harvest strategy is appropriate, and its application would result in a low probability of the stock falling below 0.2B0 for more than 90 per cent of the time, in line with the HSP (DAFF 2007; Giannini et al. 2010). However, the 2015 MSE suggested linking harvest strategy settings to the productivity of the species (Smith et al. 2015). A tier 1 harvest rate of 15 per cent for a maximum of five years and a tier 2 harvest rate of 7.5 per cent for a maximum of five years was adopted by the AFMA Commission in April 2015, with the tier 2 harvest control rule used as the basis for the 2015–16 TAC. The 2016–17 TAC was maintained at 2015–16 levels pending additional testing of the harvest strategy. This testing was completed in 2016.

Stock status determination

The peak harvest from this stock was approximately 4 per cent of the 2005 spawning biomass estimate, and catches have been low as a proportion of estimated spawning biomass. Although this biomass estimate is dated, the level of fishing mortality in any year is unlikely to have substantially reduced spawning biomass. As a result, blue mackerel (west) is classified as not overfished for both years assessed. Current fishing mortality remains a small proportion of estimated biomass, and below the 2015–16 and 2016–17 RBCs. The stock is therefore classified as not subject to overfishing for both years assessed.
Jack mackerel, east (*Trachurus declivis*)

Line drawing: FAO

**Stock structure**

The stock structure of jack mackerel is unclear. A study by Richardson (1982) found evidence of population subdivision between Western Australia, including the Great Australia Bight, and eastern Australia. Richardson (1982) also found evidence of a Wahlund effect (where multiple populations are detected in a single sample) in east coast samples, suggesting some additional structuring. Smolenski et al. (1994) found evidence of structuring between New South Wales and south-eastern Tasmania, although the differences appeared not to be temporally consistent. These studies suggest that further investigation of stock structure in jack mackerel on the east coast is warranted. Currently, jack mackerel within the SPF is assessed and managed as separate stocks in the eastern and western subareas (Figure 7.1).

**Catch history**

The jack mackerel purse-seine fishery was established off Tasmania in the mid 1980s, with initial catches exceeding 40,000 t (Kailola et al. 1993). Catches then declined as a result of absence of surface schools of jack mackerel, and the purse-seine fishery ceased in 2000 (Ward et al. 2011). Commonwealth catch increased to 9,873 t in 1997–98, fluctuated markedly to 2003–04 and declined thereafter as a result of decreasing effort in the fishery. Commonwealth catch decreased from 5,342 t in 2015–16 to 3,966 t in 2016–17 (Figure 7.5; state catches are not available for 2016–17).
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FIGURE 7.5 Commonwealth eastern jack mackerel catch and TAC, 2003–04 to 2016–17

Note: TAC Total allowable catch.

Stock assessment

The most recent DEPM survey for jack mackerel (east) was conducted off eastern Australia in January 2014 (Ward et al. 2015a) and estimated spawning biomass to be 157,805 t (95 per cent CI 59,570 to 358,731 t). The 2015–16 RBC and TAC were set using the 2015 harvest strategy control rules and 2014 DEPM biomass estimate. State catches were deducted from the RBC to obtain the 2015–16 TAC of 18,670 t. The AFMA Commission retained the 2015–16 TAC for the 2016–17 fishing season to allow additional testing, including MSE, to be completed on the SPF harvest strategy. This testing was completed in 2016 (Punt et al. 2016; Pascoe & Hillary 2016).

Total catch (Commonwealth and state) peaked in 2015–16 and was 4 per cent of the 2014 spawning biomass estimate, and 34 per cent of the RBC and TAC. Commonwealth catch in 2016–17 was 2,784 t, representing 2 per cent of the 2014 spawning biomass estimate, and 15 per cent of the RBC and TAC. The length-frequency and age structures of the eastern stock show no signs of concern (Ward & Grammer 2017).

Previous MSE testing for jack mackerel suggests that the harvest strategy is appropriate, and its application would result in a low probability of the stock falling below 0.2B0, for more than 90 per cent of the time, in line with the HSP (DAFF 2007; Giannini et al. 2010). However, the 2015 MSE suggested linking harvest strategy settings to the productivity of the species (Smith et al. 2015). For jack mackerel, it was suggested that tier 1 harvest rates should be decreased from 15 per cent to 12 per cent, that tier 2 harvest rates should be set at 50 per cent of tier 1, and that neither should be applied for longer than 10 years. A tier 1 harvest rate of 12 per cent for a maximum of 5 years and a tier 2 harvest rate of 6 per cent for a maximum of 10 years was adopted by the AFMA Commission in April 2015, with the tier 1 harvest control rule used as the basis for the 2015–16 TAC. The 2016–17 TAC was held at the 2015–16 level pending additional testing of the harvest strategy.
Stock status determination

The peak harvest during the past 30 years in this fishery was 4 per cent of the spawning biomass estimate, with most catches far below this. This level of fishing mortality is unlikely to have substantially reduced spawning biomass. As a result, jack mackerel (east) is classified as not overfished for both years assessed. Current fishing mortality remains a small proportion of biomass, and below the 2015–16 and 2016–17 RBCs. The stock is therefore classified as not subject to overfishing for both years assessed.

Jack mackerel, west (*Trachurus declivis*)

Stock structure

See jack mackerel (east).

Catch history

Total catch (state and Commonwealth) for jack mackerel (west) did not exceed 250 t before 2005–06. Commonwealth catch was zero or negligible from 2011–12 to 2014–15, and increased to 613 t in 2015–16 and 686 t in 2016–17 (Figure 7.6). State catches have been negligible for the past decade.

FIGURE 7.6 Commonwealth western jack mackerel catch and TAC, 2003–04 to 2016–17

Note: TAC Total allowable catch.
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**Stock assessment**

No DEPM survey or estimate of spawning biomass has been conducted for jack mackerel (west) for the review period; however, a DEPM conducted in 2016–17 will be used to inform the 2018–19 TAC. Aerial surveys in the 1970s suggested a biomass off western Tasmania of at least 80,000 t (Williams 1981). However, there remains little empirical data on abundance, biomass or life history for this stock in the intervening three decades (AFMA 2014b, 2015b).

The 2015–16 RBC and TAC were set using the 2015 harvest strategy control rules. In the absence of an empirically derived biomass estimate, RBC was based on a model-derived one (Atlantis-SPF ecosystem model) and tier 2 harvest rate, as per tier 2b of the April 2015 harvest strategy.

State catches were deducted from the RBC to obtain the 2015–16 TAC of 3,600 t. The AFMA Commission retained the 2015–16 TAC for the 2016–17 fishing season to allow additional testing, including MSE, to be completed on the SPF harvest strategy. This testing was completed in 2016 (Pascoe & Hillary 2016; Punt et al. 2016).

The peak catch in 2016–17 was less than 1 per cent of the 1970s biomass estimate and 19 per cent of the RBC. There was very little catch of this stock during the previous 16 years. There was no reported catch for 2014–15. The length-frequency and age structures of the eastern stock show no signs of concern (Ward & Grammer 2017).

Previous MSE testing for jack mackerel suggests that the harvest strategy is appropriate, and its application would result in a low probability of the stock falling below 0.2B0 for more than 90 per cent of the time, in line with the HSP (DAFF 2007; Giannini et al. 2010). However, the 2015 MSE suggested linking harvest strategy settings to the productivity of the species (Smith et al. 2015). For jack mackerel, it was suggested that tier 1 harvest rates should be decreased from 15 per cent to 12 per cent, that tier 2 harvest rates should be set at 50 per cent of tier 1, and that neither should be applied for longer than 10 years. However, there is a paucity of information on life history and productivity for jack mackerel (west). Data from jack mackerel (east) were used instead, which may compromise the model outputs for the stock.

The April 2015 harvest strategy adopted by the AFMA Commission includes a tier 1 harvest rate of 12 per cent for a maximum of 5 years and a tier 2 harvest rate of 6 per cent for a maximum of 10 years for jack mackerel. The harvest strategy also has a tier 2(b) Atlantis for use in instances where no DEPM estimate is available or the length of time a stock can be at tier 2 has been exceeded. The time that a stock can remain at tier 2(b) is indefinite. Tier 2(b) applies the maximum tier 2 harvest rate to the lower bound of the 95 per cent CI range of biomass estimates derived from Atlantis-SPF. In the case of jack mackerel west, the Atlantis-SPF biomass estimate was 60,000 t and the tier 2 exploitation rate was 6 per cent. The 2016–17 TAC was held at the 2015–16 level pending additional testing of the harvest strategy. (Tier 2(b) was removed from the April 2017 version of the harvest strategy.)
Stock status determination

The peak harvest from this fishery was less than 1 per cent of the spawning biomass estimate, and catches have been low as a proportion of estimated biomass. Although the biomass estimate is limited and quite dated, this level of fishing mortality is unlikely to have substantially reduced spawning biomass. As a result, jack mackerel (west) is classified as **not overfished** for both years assessed. Current fishing mortality remains a small proportion of biomass, and below the 2015–16 and 2016–17 RBCs. The stock is therefore classified as **not subject to overfishing** for both years assessed.

Redbait, east (*Emmelichthys nitidus*)

Stock structure

The stock structure of redbait in Australia has not been studied. Redbait within the SPF is assessed and managed as separate stocks in the eastern and western subareas (Figure 7.1).

Catch history

The redbait fishery started in the early 1980s. Total landings (Commonwealth and state) were less than 2,000 t per year between 1984–85 and 2000–01, but increased in 2001–02 and subsequent years, peaking at 7,450 t in 2003–04. Annual catches decreased steadily thereafter. Commonwealth catch in 2015–16 was 189 t, decreasing to 101 t in 2016–17 (Figure 7.7). State catches have been negligible since 2010–11.

FIGURE 7.7 Commonwealth eastern redbait catch and TAC, 2003–04 to 2016–17

Note: TAC Total allowable catch.
Stock assessment

The most recent DEPM surveys for redbait (east), in 2005 and 2006 (Neira et al. 2008), provided estimates of spawning biomass of 86,990 t (coefficient of variation [CV] 0.37) and 50,782 t (CV 0.19), respectively. The average of these two spawning biomass estimates (68,886 t) was used to estimate an RBC of 3,400 t for 2015–16 and 2016–17, using the tier 2 decision rule (AFMA 2014b, 2015b). State catch of this stock is negligible; the Commonwealth TAC was set at 3,310 t for the 2015–16 and 2016–17 fishing seasons.

Peak total (Commonwealth and state) catch in 2003–04 was 10 per cent of the estimated spawning biomass average. No catch was reported in 2014–15. Commonwealth catch in 2015–16 increased to 180 t, which is less than 1 per cent of the spawning biomass estimate, and 5 per cent of the RBC and TAC.

Previous MSE testing for redbait suggests that the harvest strategy is appropriate, and its application would result in a low probability of the stock falling below 0.2B0 for more than 90 per cent of the time, in line with the HSP (DAFF 2007; Giannini et al. 2010). However, the 2015 MSE suggested linking harvest strategy settings to the productivity of the species (Smith et al. 2015). For redbait (east), it was suggested that tier 1 harvest rates should be decreased from 15 per cent to 9 per cent, that tier 2 harvest rates should be set at 50 per cent of tier 1, and that neither should be applied for longer than 10 years. A tier 1 harvest rate of 10 per cent for a maximum of five years and a tier 2 harvest rate of 5 per cent for a maximum of 10 years was adopted by the AFMA Commission for redbait in April 2015. Given the age of the DEPM estimate, the tier 2 harvest control rule was used as the basis for the 2015–16 TAC. The 2016–17 TAC was held at the 2015–16 level pending additional testing of the harvest strategy.

Stock status determination

The peak harvest from this fishery was 10 per cent of the spawning biomass estimate, and catches have been low as a proportion of estimated biomass. Although the biomass estimate is dated, this level of fishing mortality is unlikely to have substantially reduced spawning biomass. As a result, redbait (east) is classified as not overfished for both years assessed. Fishing mortality is low as a proportion of estimated biomass, and below the 2015–16 and 2016–17 RBCs. The stock is therefore classified as not subject to overfishing for both years assessed.

Redbait, west (Emmelichthys nitidus)

Stock structure

See redbait (east).

Catch history

No catches of redbait (west) were reported before 2001–02. Catches increased from 1,100 t in 2001–02 to a peak of 3,228 t in 2006–07, and decreased steadily thereafter, with no reported catch between 2009–10 and 2013–14. No catch was reported in 2014–15. Commonwealth catch was 1,135 t in 2015–16 and 1,140 t in 2016–17 (Figure 7.8; state catches have been negligible in the past).
Stock assessment

No DEPM survey or estimate of biomass has been undertaken for red bait (west). Because of this lack of data, the SPFRAG estimated a spawning biomass by drawing on expert opinion and experience of similar stocks. The 2015–16 RBC and TAC were set using the 2015 harvest strategy control rules. In the absence of an empirically derived biomass estimate, the RBC was based on a model-derived one (Atlantis-SPF ecosystem model) and tier 2 harvest rate, as per tier 2(b) of the April 2015 harvest strategy.

State catches were deducted from the RBC to obtain the 2015–16 TAC of 2,880 t. The AFMA Commission retained the 2015–16 TAC for the 2016–17 fishing season to allow additional testing, including MSE, to be completed on the SPF harvest strategy. This testing was completed in 2016 (Pascoe & Hillary 2016; Punt et al. 2016).

Previous MSE testing for red bait suggests that the harvest strategy is appropriate, and its application would result in a low probability of the stock falling below 0.2B₀ for more than 90 per cent of the time, in line with the HSP (DAFF 2007; Giannini et al. 2010). However, the 2015 MSE suggested linking harvest strategy settings to the productivity of the species (Smith et al. 2015). For red bait (west), it was suggested that tier 1 harvest rates should be decreased from 15 per cent to 10 per cent, that tier 2 harvest rates be set at 50 per cent of tier 1, and that neither should be applied for longer than 10 years.

The April 2015 harvest strategy adopted by the AFMA Commission includes a tier 1 harvest rate of 10 per cent for a maximum of 5 years and a tier 2 harvest rate of 5 per cent for a maximum of 10 years for red bait. The harvest strategy also has a tier 2(b) Atlantis for use in instances where no DEPM estimate is available or the length of time a stock can be at tier 2 has been exceeded. The time that a stock can remain at tier 2(b) is indefinite. Tier 2(b) applies the maximum tier 2 harvest rate to the lower bound of the 95 per cent CI range of biomass estimates derived from Atlantis-SPF. In the case of red bait, the Atlantis-SPF biomass estimate was 58,000 t and the tier 2 exploitation rate was 5 per cent. The 2016–17 TAC was held at the 2015–16 level pending additional testing of the harvest strategy. (Tier 2(b) was removed from the April 2017 version of the harvest strategy.)
Stock status determination

The level of red bait (west) spawning biomass estimated by the Atlantis-SPF model is consistent with spawning biomass estimates for other similar stocks; however, there is little empirical evidence to corroborate the ecosystem modelling. Catches have historically been low in this fishery, and this level of fishing mortality is unlikely to have substantially reduced spawning biomass. As a result, red bait (west) is classified as not overfished for both years assessed. Current fishing mortality remains low. The stock is therefore classified as not subject to overfishing for both years assessed.

7.3 Economic status

Key economic trends

The gross value of production (GVP) in the SPF was estimated to be $1.3 million in 2007–08 (2015–16 dollars). This was 65 per cent lower than the estimate for 2005–06 ($3.7 million), primarily as a result of a rapid decline in prices and production (Figure 7.9). The GVP has been confidential since 2007–08 because five or fewer vessels have operated in the fishery.

In 2007–08, attributed management costs were about 57 per cent of GVP. This indicates that net economic returns (NER) were likely to have been low in that year, even before fishing costs are considered. Management costs increased 56 per cent between 2014–15 and 2015–16 (from $0.8 million to $1.2 million).

The number of vessels remained steady at three in 2016–17. However, fishing effort declined, reflecting the exit from the fishery of a factory trawler part way through 2016–17. A decrease in the level of catch, from 10,394 t in 2015–16 to 8,038 t in 2016–17, suggests that GVP decreased, but is still above the five-year average to 2014–15.

FIGURE 7.9 Real GVP for the SPF, 2005–06 to 2015–16

Note: GVP Gross value of production.
Management arrangements

The fishery is managed largely with output controls, with TACs set for each target species. For the 2016–17 fishing season, 32 entities held statutory fishing rights unchanged from the previous season. Of the combined TACs for small pelagic species that were available in 2015–16, 74 per cent were uncaught. However, the percentage of TACs uncaught increased by 7 percentage points in the 2016–17 fishing season, to 81 per cent. Increased latency in 2016–17 was largely the result of lower catches of eastern blue mackerel and eastern jack mackerel.

Performance against economic objective

A meaningful biomass target to provide maximum economic yield (MEY) is difficult to determine for the SPF because of the high interannual variability in biomass levels (Small Pelagic Fishery Management Plan 2009). The absence of an explicit economic target makes it difficult to determine how effectively the fishery’s harvest strategy is delivering maximum NER to the Australian community. Pascoe and Hillary (2016) suggest that, for fisheries that target schooling species where there is no relationship between catch-per-unit-effort and biomass, such as jack mackerel in the eastern subarea of the SPF, maximum sustainable yield could be used as a proxy reference target for MEY. It is apparent from the low volume of catch relative to the TAC that this fishery has not been achieving its MEY over recent years. The exit from the fishery of a factory trawler part way through the 2016–17 season resulted in higher quota latency compared with the previous season, indicating that economic performance of the fishery may have declined. Despite higher latency, changes in NER are uncertain because of the lack of information about changes in cost structures of the industry as a result of introduction of the factory trawler in the latter part of the 2014–15 financial year and its subsequent departure in 2016.

7.4 Environmental status

Under part 2 of the Small Pelagic Fishery Management Plan 2009, AFMA is required to develop and implement a bycatch and discarding workplan. The objective of the workplan is to ensure that information is gathered about the impact of the SPF on bycatch species, that all reasonable steps are taken to minimise incidental interactions with protected species, and that the ecological impacts of fishing on habitats are minimised.

The management plan for the SPF was most recently accredited under part 13 of the Environment Protection and Biodiversity Conservation Act 1999 on 26 October 2015; this accreditation expires on 26 October 2018. Two conditions were placed on the accreditation: that, before fishing, midwater trawl vessels have mitigation devices in place for dolphins, seals and seabirds; and that new midwater trawl vessels carry one observer for the first 10 trips, with additional observers or monitoring to be implemented after scientific assessment. Minimum levels for observer coverage in the SPF are 10 per cent of days fished for purse-seine vessels and 20 per cent of days fished for midwater trawl vessels.
Because the factory trawler is a new vessel, the vessel management plan accords with the accreditation conditions outlined above, and these conditions are linked to specific risks of interactions with seabirds and marine mammals. For both seabirds and mammals, conditions include the requirement for the concession holder to ensure that an AFMA observer is on board for the first 10 trips or the first 12 months, whichever is longer, and as directed by AFMA thereafter. For seabirds, the concession holder must ensure that the vessel deploys at least one type of physical mitigation measure (tori lines or bird bafflers) at all times while the fishing gear is in the water. For mammals, conditions include the requirement for the vessel to have an AFMA-approved electronic monitoring system operating during all fishing activity. The concession holder must also ensure that the vessel uses a marine mammal excluder device that either allows animals to escape the net or keeps animals out of the net. A series of spatial management controls also apply to the fishery, including the Australian sea lion closures, the Coorong dolphin closure and the Small Pelagic Fishery (Closures) Direction No. 1 2015, amended by the Small Pelagic Fishery (Closures variation) Direction No. 1 2015.

Recent research by CSIRO (Smith et al. 2015) found that depletion of the four main target species in the SPF (jack mackerel, redbait, blue mackerel and Australian sardine) has only minor impacts on other parts of the ecosystem. The research suggested that, unlike other areas that show higher levels of dependence on similar species, such as in Peru (Smith et al. 2011), the food web in southern and eastern Australia does not appear to be highly dependent on SPF target species, and none of the higher trophic-level predators, including tunas, seals and penguins, has a high dietary dependence on the species.

Separate ecological risk assessments have been done for the midwater trawl and purse-seine fishing methods used in the fishery; however, these did not specifically assess a factory trawler. For purse seine, 235 species were assessed at level 2; of these, 108 were assessed as being at high risk (Daley et al. 2007), with 29 remaining at high risk after applying AFMA's residual risk guidelines (AFMA 2010). The ecological risk management plan identifies 3 seal species and 26 whale and dolphin species as being at high risk in the SPF. For midwater trawl, 235 species were assessed at level 2, with 26 of these assessed as being at high risk (Daley et al. 2007). No finfish species were assessed as being at high risk from either purse-seine or midwater trawl operations. The ecological risk assessment for trawling in the SPF is due to be updated in 2016–17.

Interactions with marine mammals are a key environmental concern for the midwater trawl fishery. A study commissioned by AFMA (January 2005 to February 2006) to quantify the nature and extent of interactions, and to evaluate potential mitigation strategies, found that fur seals entered the net in more than 50 per cent of midwater trawl operations during the study. The observed mortality rate was 0.12 seals per shot, using bottom-opening seal excluder devices (Lyle & Willcox 2008). The study concluded that effective, upward-opening seal excluder devices are needed when this type of gear is used. No dolphin interactions were recorded during the study.
In response to these results, AFMA requires all midwater trawlers to have an AFMA-approved, upward-opening seal excluder device before starting to fish. The Commonwealth SPF industry purse-seine code of practice (SPF Industry 2008) requires fishers to avoid interactions with species, where possible; implement mitigation measures, where necessary; release all captured protected species alive and in good condition; and report all interactions with protected species.

AFMA publishes quarterly reports of logbook interactions with protected species on its website. A total of 108 interactions with protected species were reported in the SPF during the 2016 calendar year: 7 were with shy albatross (*Thalassarche cauta*), all of which were dead; 1 was with an unidentified albatross, which was dead; 2 were with unidentified cormorants, which were dead; 51 were with Australian fur seals (*Arctocephalus pusillus*), 6 of which were released alive and 45 were dead; 7 were with New Zealand fur seals (*A. forsteri*), all of which were dead; 1 was with an Antarctic fur seal (*A. gazelle*), which was dead; 1 was with a whale shark (*Rhincodon typus*), which was released alive; and 38 were with shortfin mako sharks (*Isurus oxyrinchus*), of which 20 were released alive and 18 were dead.

### 7.5 References


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