Chapter 7
Small Pelagic Fishery

A Moore and K Mazur

FIGURE 7.1 Area fished in the Small Pelagic Fishery, 2013–14

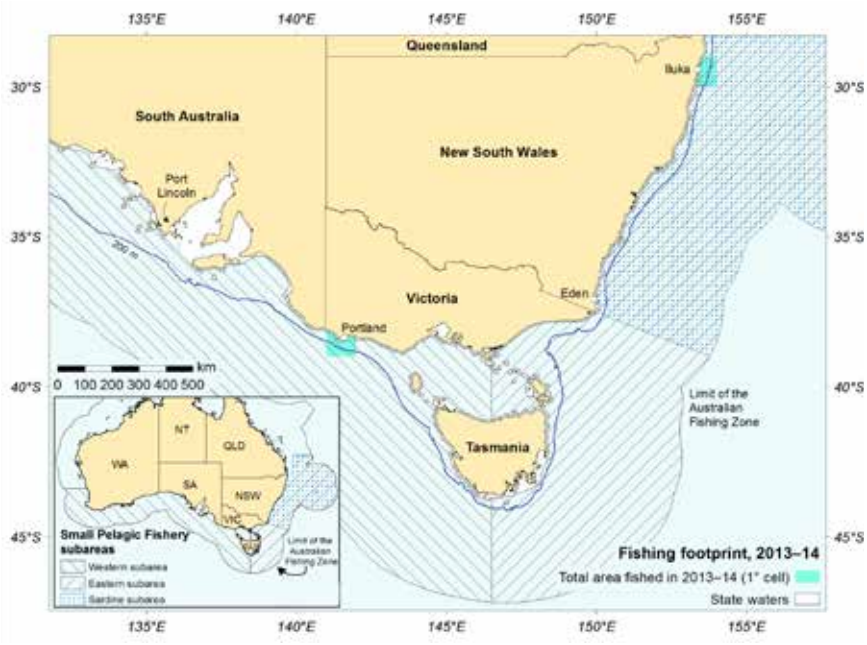


TABLE 7.1 Status of the Small Pelagic Fishery

Status	2013		2014		Comments
Biological status	**Fishing mortality**	**Biomass**	**Fishing mortality**	**Biomass**	
Australian sardine (*Sardinops sagax*)					Recent catches have been below the RBC. Historical catches have been low relative to estimated biomass.
Blue mackerel, east (*Scomber australasicus*)					Recent catches have been below the RBC. Historical catches have been low relative to estimated biomass.
Blue mackerel, west (*Scomber australasicus*)					Recent catches have been below the RBC. Historical catches have been low relative to estimated biomass.
Jack mackerel, east (*Trachurus declivis*)					Recent catches have been below the RBC. Recent catches have been low relative to estimated biomass.
Jack mackerel, west (*Trachurus declivis*)					Recent catches have been below the RBC. Historical catches have been low relative to estimated biomass.
Redbait, east (*Emmelichthys nitidus*)					Recent catches have been below the RBC. Historical catches have been low relative to estimated biomass.
Redbait, west (*Emmelichthys nitidus*)					Recent catches have been low. No biomass estimate is available.
Economic status	Estimates of net economic returns are not available but are likely to be low, given the low levels of effort and high latency in the fishery.				

Notes: **RBC** Recommended biological catch.

Fishing mortality	Not subject to overfishing	Subject to overfishing	Uncertain
Biomass	Not overfished	Overfished	Uncertain

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 has changed between a purse-seine and a midwater trawl fishery. Historically, purse seining was the primary fishing method, but this was replaced by midwater trawling between 2003 and 2008. The fishery has predominantly been a purse-seine fishery in recent years, although it largely changed to a midwater trawl fishery with the introduction of a factory trawler in 2015. The key species are Australian sardine (*Sardinops sagax*), blue mackerel (*Scomber australasicus*), jack mackerel (*Trachurus declivis*) and redbait (*Emmelichthys nitidus*).

Management methods

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

The 2014 SPF harvest strategy used a three-tier system, applied separately to each stock; the chosen management tier depended on availability of information. This tier system was designed to allow greater levels of catch when better research information is available on stock status. Tier 1, with the highest level of information (from daily egg production method [DEPM] surveys), provided for the largest potential recommended biological catch (RBC). Tier 3, with relatively poor information, provided the smallest RBC.

Biomass that supports maximum economic yield (B_{MEY}) is difficult to estimate for small pelagic species because of the high interannual variability in biomass typical of these species. Maximum exploitation rates of 20 to 25 per cent of current biomass are internationally recommended to ensure that a high proportion of fish remain in the ecosystem (Pikitch et al. 2012). As a result, the SPF tier 1 harvest control rules use a maximum exploitation rate of 20 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 20 to 25 per cent of current biomass. If there are no further DEPM surveys, the RBC is reduced from 20 to 10 per cent over five years, from the year the spawning biomass estimate was last determined using the DEPM surveys. This reduction accounts for increasing uncertainty in stock status since the last survey. Testing through management strategy evaluation has indicated that this approach to setting harvest levels under tier 1 is robust for SPF stocks, with most scenarios maintaining stock sizes well above 20 per cent of unfished biomass levels ($0.2B_0$; Giannini et al. 2010). Estimates of spawning biomass provided by DEPM surveys are also usually considered to be underestimates, because the surveys collect eggs from limited parts of the known spawning area of the stock.

If a DEPM survey is not conducted within five years of the last survey, the resource is managed under tier 2 harvest control rules. Under tier 2, maximum RBCs are based on approximately 7.5 per cent of the estimated spawning biomass. For tier 3, the maximum RBC has been set at 500 t for each stock, reflecting a high level of uncertainty and precaution when information is lacking. Once the RBC has been derived, an allowance for current state catches is deducted before the total allowable catches (TACs) for Commonwealth fishers are set.

A review of the harvest strategy (Smith et al. 2015), which included ecosystem and population modelling, suggested that the target reference point for SPF target species should be set at $0.5B_0$ and the limit reference point at $0.2B_0$, in line with the Commonwealth Harvest Strategy Policy default settings (DAFF 2007). The population modelling suggested that target exploitation rates should be species specific or even stock specific. The results suggested that the average tier 1 harvest rate of 15 per cent might be too high for lower-productivity species like redbait and jack mackerel, and potentially too low for higher-productivity species like sardines and blue mackerel. The review also concluded that it is generally not safe to apply tier 2 harvest rates for long periods of time unchecked. For shorter-lived species (blue mackerel and sardine), this can result in unacceptable probabilities of depletion in short time periods (five or six years).

As a result of this review, the Small Pelagic Fishery Harvest Strategy 2008 was revised in April 2015 to adopt a limit reference point of $0.2B_0$ and a target of $0.5B_0$, based on the Commonwealth Harvest Strategy Policy default settings (AFMA 2015). The exploitation rates have also been altered to reflect stock-specific exploitation rates and limit the time species can stay at tier 2.

Some age and length data have been collected for small pelagic species caught in this fishery, but current low catches have resulted in low sample sizes for some species, which are of limited use for updating assessments. For this reason, these data need to be interpreted carefully if they are to be used in determining stock status. The small pelagic species are caught by various state jurisdictions and, where data are available, total catch from these fisheries is considered when estimating total fishing mortality. However, not all sources of catch are quantified, and limited data availability, or confidentiality, make reporting total catches of some stocks difficult. The statistics provided in Table 7.2 are for the Commonwealth fishery.

Fishing effort

Fishing effort has historically been low and remained low in 2013–14, particularly in the Commonwealth component of the fishery. Most fishing effort and catch have historically occurred in the Australian sardine fishery, predominantly within the Victorian and New South Wales state fisheries. Effort in the Commonwealth component of the fishery increased in the 2014–15 fishing season, with the introduction of a factory freezer vessel.

Catch

Small pelagic species are generally caught during targeted fishing for a single species. They have historically been taken in significant volumes within both Commonwealth and adjacent state-managed waters. These species are also caught in small quantities in other Commonwealth and state-managed fisheries, mainly the trawl sectors of the Southern and Eastern Scalefish and Shark Fishery, the Eastern Tuna and Billfish Fishery, the Western Tuna and Billfish Fishery (where they are caught for bait) and the New South Wales Ocean Hauling Fishery. Catch across the fishery has decreased steadily since 2003–04, driven mainly by economic and logistical limitations, rather than any decline in resource abundance. Total Commonwealth catch in the 2013–14 season was around 78 t (Table 7.2).

TABLE 7.2 Main features and statistics for the SPF

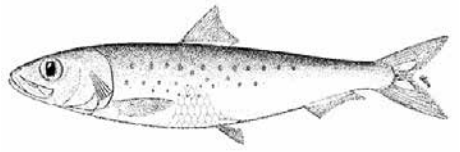
Fishery statistics a	2012–13 fishing season			2013–14 fishing season b		
Stock	**TAC (t)**	**Catch (t)**	**Real value (2012–13)**	**TAC (t)**	**Catch (t)**	**Real value (2013–14)**
Australian sardine	200	15	Confidential	270	77	Confidential
Blue mackerel, east	2 600	1	Confidential	2 700	<1	Confidential
Blue mackerel, west	6 500	0	0	6 500	0	0
Jack mackerel, east	10 100	0	0	9 800	0	0
Jack mackerel, west	5 000	0	0	5 000	0	0
Redbait, east	6 900	0	0	5 000	0	0
Redbait, west	5 000	0	0	5 000	0	0
Total fishery	**36 300**	**16**	**Confidential**	**34 270**	**78**	**Confidential**
Fishery-level statistics						
Effort	Purse seine: 65 search-hours Midwater trawl: 0 shots Jig: 3 hours			Purse seine: 127 search-hours Midwater trawl: 0 shots Jig: 0 hours		
Active vessels	Purse seine: 1 Midwater trawl: 0			Purse seine: 1 Midwater trawl: 0		
Observer coverage	Purse seine: 4 shots (14%) Midwater trawl: 0 hours (0%)			Purse seine: 0 shots (0%) Midwater trawl: 0 hours (0%)		
Fishing methods	Purse seine, midwater trawl					
Primary landing ports	Triabunna (Tasmania); Port Lincoln (South Australia); Eden, Iluka (New South Wales)					
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					
Management plan	Small Pelagic Fishery Management Plan 2009					

a 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. **b** Data for the 2014–15 season from the state jurisdictions were not available at the time of publication. As a result, we do not report on the 2014–15 fishing season

Notes: **ITQ** Individual transferable quota. **TAC** Total allowable catch.

7.2 Biological status

Australian sardine (*Sardinops sagax*)



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Stock structure

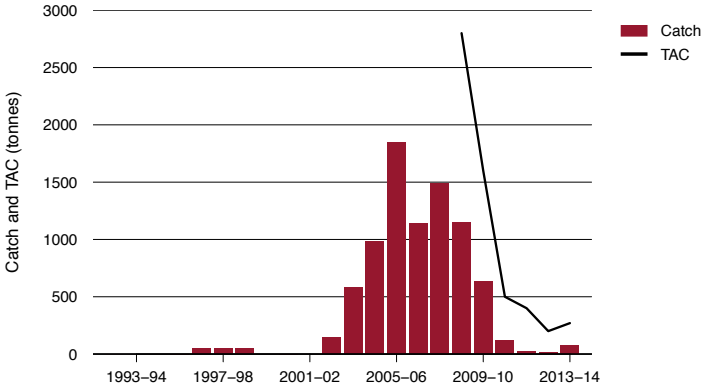
Stock structure of Australian sardine in Australia is not well defined. Two studies indicate genetic structuring in the range of sardines in Australia (Dixon et al. 1993; Yardin et el. 1998). These studies sampled at different locations and provided different population structures. Izzo et al. (2012) used a weight-of-evidence approach to review all available information on population subdivision in sardines, which suggested six stock divisions: southern Queensland and northern New South Wales, southern New South Wales, east and west Tasmania and Victoria, South Australia, south-west Western Australia, and west Western Australia. However, these boundaries are far from conclusive, and additional sampling and analysis are required to clearly discriminate biological stocks.

Catch history

Total sardine catch from Commonwealth and state fisheries (other than that taken in South Australia) peaked in 2008–09 at 4787 t. The total catch decreased from 2148 t in 2011–12 to 1097 t in 2012–13—its lowest level since 2001–02. Total catch in 2013–14 was 1385 t. Since 2010–11, the majority of the catch has been taken by Victoria (~74 per cent) and New South Wales (~24 per cent).

Commonwealth landings in the SPF are still very low but increased from 16 t in 2012–13 to 71 t in 2013–14 (Figure 7.2). Unlike the Commonwealth fishery, state catches are not constrained by catch limits. State catch has increased markedly since the early 2000s, contributing to the recent reductions of the Commonwealth TAC. If state catches increase under current arrangements, total catches could exceed the RBC.

FIGURE 7.2 Commonwealth Australian sardine catch and TAC in the SPF, 1992–93 to 2013–14



Note: **TAC** Total allowable catch.

Stock assessment

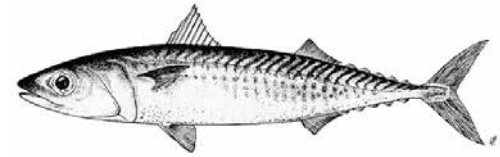
A DEPM survey of Australian sardine around northern Tasmania and southern Victoria in 2014 estimated the spawning biomass to be about 10 962 t (range 8000 to 15 000 t; Ward et al. 2015). However, because the survey did not cover the entire spawning stock, it cannot be used to determine total spawning biomass. The previous DEPM survey in 2004 estimated the spawning biomass for Australian sardine off eastern Australia to be 28 809 t (range 9161 to 58 673 t) (Ward & Rodgers 2007). At the time, the SPF 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. The RBC in 2013–14 was set using the tier 2 harvest control rules (using 7.5 per cent of the 2004 biomass estimate), which resulted in an RBC of 3000 t (AFMA 2013). A substantial quantity of sardine is caught in state fisheries, and the Australian Fisheries Management Authority (AFMA) set the 2013–14 Commonwealth TAC at 270 t, after expected state catch had been deducted.

The peak sardine catch (state plus Commonwealth) of 4787 t in 2008–09 was about 16 per cent of the spawning biomass estimated by the 2004 DEPM survey and 12 per cent of the revised estimate (40 000 t). In 2012, the SPFRAG heard industry concerns about the lack of larger, commercial-sized sardines off southern New South Wales—industry suggested that this was linked to oceanographic conditions (AFMA 2013). Available length-frequency and age data appeared to show a decrease in the number of larger fish sampled in 2012–13 and 2013–14. However, large sardines appear to have become available to the fishery again (AFMA 2014). Total catch in 2013–14 was approximately 5 per cent of the 2004 biomass estimate and 46 per cent of the RBC. Available age and length- frequency data show no trends of concern, although sampling levels remain low.

Stock status determination

Peak catches of sardine in 2008–09 were only 16 per cent of the 2004 estimate of spawning biomass and 12 per cent of the revised estimate (40 000 t), and subsequent catches have been substantially below this level. Because of the age of the estimate of spawning biomass (~10 years), Commonwealth catch is currently constrained under the harvest strategy at or below 7.5 per cent of spawning biomass estimates. Based on the catch history as a proportion of spawning biomass, Australian sardine is classified as **not overfished**. Since total catch in 2013–14 was below the RBC, the stock is classified as **not subject to overfishing**.

Blue mackerel, east (*Scomber australasicus*)



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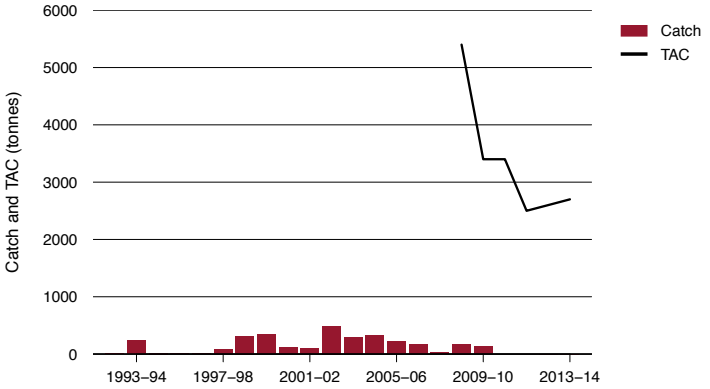
Stock structure

The stock structure of blue mackerel is unclear. Initial genetic analysis of samples from southern Queensland, Western Australia and New Zealand suggested 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 done to further delineate population subdivision. Blue mackerel within the SPF is assessed and managed as separate stocks in the eastern and western subareas (Figure 7.1).

Catch history

The combined total catch from Commonwealth and state fisheries for 1997–98 to 2006–07 ranged from 540 t to 1000 t per year. Since 2007–08, catches have been substantially lower. The total catch in the east for 2013–14 was 415 t. Most of the blue mackerel catch is taken in state fisheries; the Commonwealth catch was less than 1 t in 2013–14, well below the TAC of 2700 t (Figure 7.3). Available age and length-frequency data show no trends of concern, although sampling levels remain low.

FIGURE 7.3 Commonwealth eastern blue mackerel catch and TAC, 1992–93 to 2013–14



Note: **TAC** Total allowable catch.

Stock assessment

The most recent DEPM survey for blue mackerel (east) in 2004 gave an estimated spawning biomass of 23 009 t (range 7565 to 116 395 t; Ward & Rogers 2007). However, 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. The RBC for 2013–14 was set using tier 2 harvest control rules (using 7.5 per cent of the 2004 spawning biomass estimate), which resulted in an RBC of 3000 t (AFMA 2013). After making allowance for state catches, the Commonwealth TAC for 2013–14 was set at 2700 t.

Total blue mackerel (east) landings (state and Commonwealth) peaked in 2002–03 at 1029 t, which is approximately 4 per cent of the spawning biomass estimated by the 2004 DEPM survey (23 000 t) and less than 1 per cent of the revised estimate (40 000 t). Total landings (state and Commonwealth) in 2013–14 were about 1 per cent of the spawning biomass estimate and 15 per cent of the RBC, with Commonwealth catches continuing to remain well below the TAC.

Stock status determination

The peak harvest from this stock was less than 1 per cent of the 2004 spawning biomass estimate. While this estimate is dated, this low exploitation rate is highly unlikely to have reduced spawning biomass. As a result, blue mackerel (east) is classified as **not overfished**. Since total catch in 2013–14 was below the RBC, blue mackerel (east) is classified as **not subject to overfishing**.

Blue mackerel, west (*Scomber australasicus*)

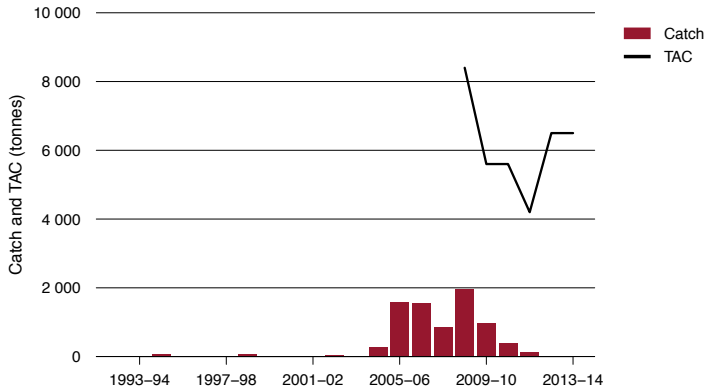
Stock structure

See blue mackerel (east).

Catch history

Very little blue mackerel (west) was caught before 2004–05. Total Commonwealth-landed catch increased substantially in 2005–06, peaking in 2008–09 at 1977 t and decreasing steadily thereafter. There was no Commonwealth catch in 2013–14. Total landings (all state catch) in 2013–14 were very small and confidential, and well below the TAC (Figure 7.4).

FIGURE 7.4 Commonwealth western blue mackerel catch and TAC, 1992–93 to 2013–14



Note: **TAC** Total allowable catch.

Stock assessment

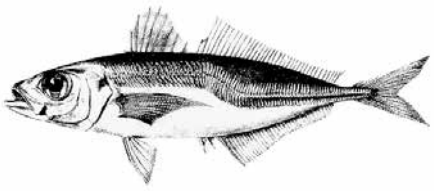
The last DEPM survey for blue mackerel (west), in 2005 (Ward & Rogers 2007), gave an estimated spawning biomass of 56 228 t (range 10 993 to 293 456 t). The RBC in 2013–14 was set using tier 2 harvest control rules (using 7.5 per cent of the 2005 spawning biomass estimate), which resulted in an RBC of 6500 t (AFMA 2013). The Commonwealth TAC was set at 6500 t for the 2013–14 season.

Total landings peaked in 2008–09 at 1977 t; this is approximately 3 per cent of the spawning biomass estimated by the 2005 DEPM survey. Available age and length-frequency data show no trends of concern, although sampling levels remain low. Total catch for 2013–14 was a very small proportion of the 2005 spawning biomass estimate or RBC.

Stock status determination

The peak harvest from this stock was approximately 3 per cent of the 2005 spawning biomass estimate. While this biomass estimate is dated, this low exploitation rate is highly unlikely to have substantially reduced the stock biomass. As a result, blue mackerel (west) is classified as **not overfished**. Since total catch in 2013–14 was well below the RBC, blue mackerel (west) is classified as **not subject to overfishing**.

Jack mackerel, east (*Trachurus declivis*)



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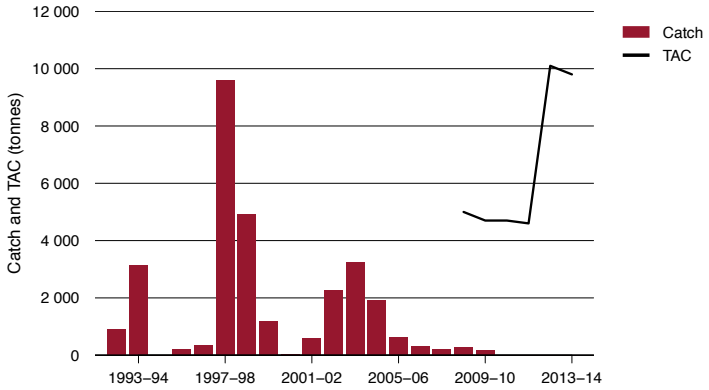
Stock structure

The stock structure of jack mackerel remains 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) between east coast samples, suggesting some additional structuring. Results from 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 developed off Tasmania in the mid-1980s, with initial catches exceeding 40 000 t. Catches then declined substantially. Commonwealth catch increased to 9599 t in 1997–98, fluctuated markedly to 2003–04 and declined thereafter (Figure 7.5); this contributed to purse-seine operations ending in 2000 (Kailola et al. 1993; Ward et al. 2011). Total landings of jack mackerel (east) in 2013–14 were very small and well below the RBC (Figure 7.5).

FIGURE 7.5 Commonwealth eastern jack mackerel catch and TAC, 1992–93 to 2013–14



Note: **TAC** Total allowable catch.

Stock assessment

A dedicated DEPM survey for jack mackerel was conducted off eastern Australia in January 2014 (Ward et al. 2015). The spawning biomass was estimated at 157 805 t (95 per cent confidence interval 59 570 to 358 731 t). The previous DEPM-derived estimate of spawning biomass for jack mackerel in south-eastern Australia was 141 950 t (range 114 900 to 169 000 t) (Neira 2011; based on 2002 survey data). Both estimates are consistent with jack mackerel biomass ranges estimated using ecosystem modelling (Fulton 2012). As the DEPM had not been conducted before the 2013–14 fishing season, the RBC for the 2013–14 season was set using tier 2 harvest control rules (using 7.5 per cent of the 2011 estimate), which resulted in an RBC of 10 600 t (AFMA 2013). This is predominantly a Commonwealth fishery; after deduction of expected state catches, the 2013–14 Commonwealth TAC was set at 9800 t.

Total landings from this stock over the past 15 years were approximately 6 per cent of the spawning biomass estimated from the 2014 DEPM survey. Total catch (all state based) for 2013–14 was a very small proportion of the RBC derived from the 2005 spawning biomass estimate. Available age and length-frequency data show no trends of concern, although sampling levels remain low.

Length-frequency data for *Trachurus* spp. collected off eastern Tasmania (1984–85 to 2009–10) show a shift in modal size towards smaller and younger fish in 2009–10. Samples collected as part of the 2014 DEPM survey suggest no truncation of size classes for jack mackerel (east).

Stock status determination

The peak harvest from this stock over the past 15 years was approximately 6 per cent of the spawning biomass estimated from the 2014 DEPM survey, with catches in most years being far lower than this. This low exploitation rate is unlikely to have reduced spawning biomass. As a result, jack mackerel (east) is classified as **not overfished**. Since total catch in 2013–14 was well below the RBC, jack mackerel (east) is classified as **not subject to overfishing**.

Purse seine
Mike Gerner, AFMA

Jack mackerel, west (*Trachurus declivis*)

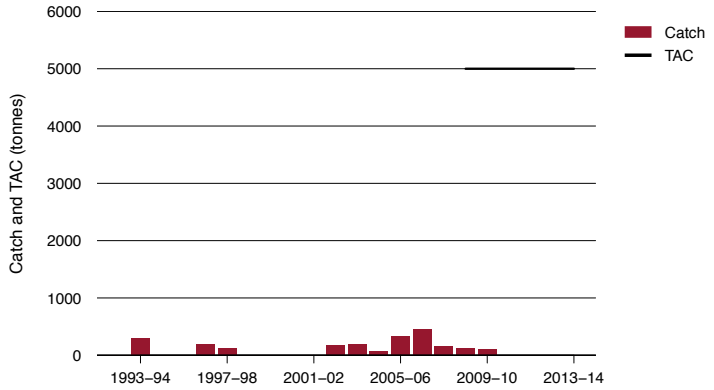
Stock structure

See jack mackerel (east).

Catch history

Total landings for jack mackerel (west) did not exceed 300 t before 2005–06. Catch increased in 2005–06 to 338 t, and peaked in 2006–07 at 463 t. There has been very little catch since 2009–10. Total catch of jack mackerel (west) in 2013–14 was very small and confidential, and well below the RBC (Figure 7.6).

FIGURE 7.6 Commonwealth western jack mackerel catch and TAC, 1992–93 to 2013–14



Note: **TAC** Total allowable catch.

Stock assessment

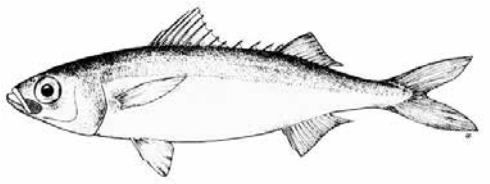
No DEPM survey or estimate of spawning biomass has been conducted for jack mackerel (west). Aerial surveys in the 1970s suggested a biomass off western Tasmania of at least 80 000 t (Williams 1981). In line with the current harvest strategy, a tier 2 approach was used to set an RBC of 5000 t in 2013–14 (AFMA 2013). The RBC has been set at this level since 2008–09. There were negligible state catches, and the Commonwealth TAC was set at 5000 t for the 2013–14 season.

The peak total catch in 2006–07 was less than 1 per cent of the 1981 biomass estimate and 9 per cent of the RBC. Total catch (state) for 2013–14 was a small proportion of the 2005 spawning biomass estimate or RBC.

Stock status determination

Historical aerial surveys suggested a large biomass off western Tasmania (Williams 1981), and, while these are very dated, catches in recent decades are unlikely to have substantially reduced this biomass. As a result, jack mackerel (west) is classified as **not overfished**. Since removals in recent years have been low and total catch in 2013–14 was below the RBC, jack mackerel (west) is classified as **not subject to overfishing**.

Redbait, east (*Emmelichthys nitidus*)



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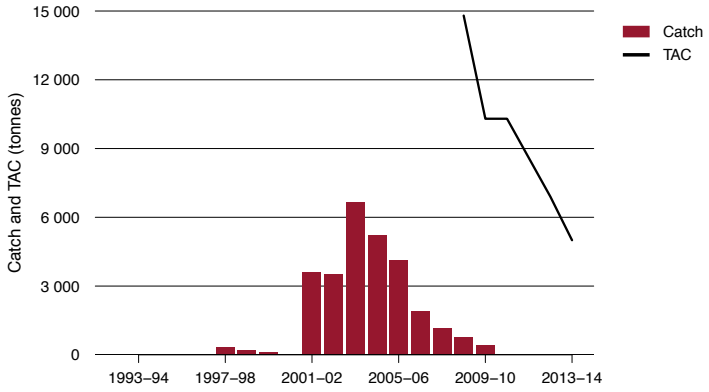
Stock structure

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 sub areas (Figure 7.1).

Catch history

The redbait fishery started in the early 1980s. Total catches were less than 2000 t per year between 1984–85 and 2000–01, but increased substantially in 2001–02 and subsequent years, peaking at 6667 t in 2003–04. Annual catches have decreased steadily since then, with a very small and confidential total catch landed in 2013–14, which was well below the RBC (Figure 7.7).

FIGURE 7.7 Commonwealth eastern redbait catch, 1992–93 to 2013–14



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 and 50 782 t, respectively. The average of these two spawning biomass estimates (68 886 t) was used to set an RBC of 5200 t for 2013–14 (using 7.5 per cent of the spawning biomass estimate) (AFMA 2013). State catch of this stock is very small, and the Commonwealth TAC was set at 5000 t for the 2013–14 season. Peak total landings in 2003–04 were about 10 per cent of the estimated spawning biomass. Less than 1 t total catch was landed in 2013–14.

Stock status determination

The peak harvest from this stock was around 10 per cent of the spawning biomass estimate, and catches in recent years have been well below this level. This low exploitation rate is unlikely to have substantially reduced spawning biomass in the stock. As a result, redbait (east) is classified as **not overfished**. Since total catch in 2013–14 was below the RBC, redbait (east) is classified as **not subject to overfishing**.

Redbait, west (*Emmelichthys nitidus*)

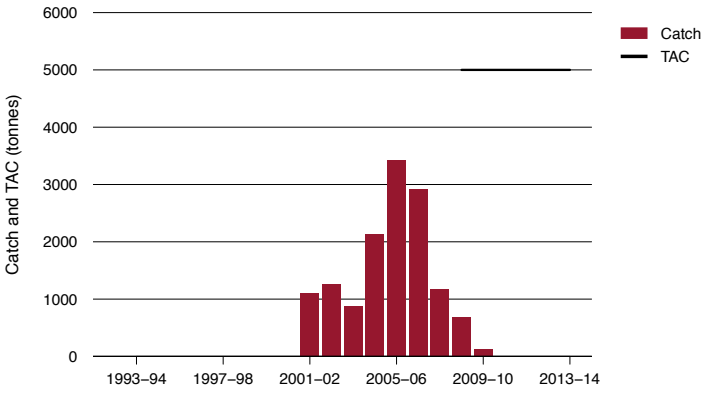
Stock structure

See redbait (east).

Catch history

No catches of redbait (west) were reported before 2001–02. Catches increased from 1100 t in 2001–02 to a peak of 3430 t in 2005–06, and decreased steadily thereafter, with no catch in the past four years (Figure 7.8).

FIGURE 7.8 Commonwealth western redbait catch and TAC, 1992–93 to 2013–14



Note: **TAC** Total allowable catch.

Stock assessment

No DEPM survey or estimate of biomass has been undertaken for redbait (west). The SPFRAG (AFMA 2013) based the 2012–13 RBC recommendation on the tier 2 fixed catch level schedule, which recommended a maximum RBC of 5000 t under the harvest strategy. There are no estimates of state catch, which is probably negligible, and the Commonwealth TAC was set at 5000 t for the 2013–14 season.

Stock status determination

Because no estimates of biomass are available, redbait (west) is classified as **uncertain** with regard to the level of biomass. As catch since 2009 has been below 150 t and well below the RBC, and there has been no catch of redbait (west) in recent years, redbait (west) is classified as **not subject to overfishing**.

7.3 Economic status

Key economic trends

The gross value of production (GVP) in the SPF was estimated to be $1.2 million in 2007–08 (2013–14 dollars). This was 65 per cent lower than in 2005–06 ($3.6 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 of the low number of vessels operating in the fishery (five or fewer). However, it is likely that GVP has not improved, given progressive declines in production since 2007–08.

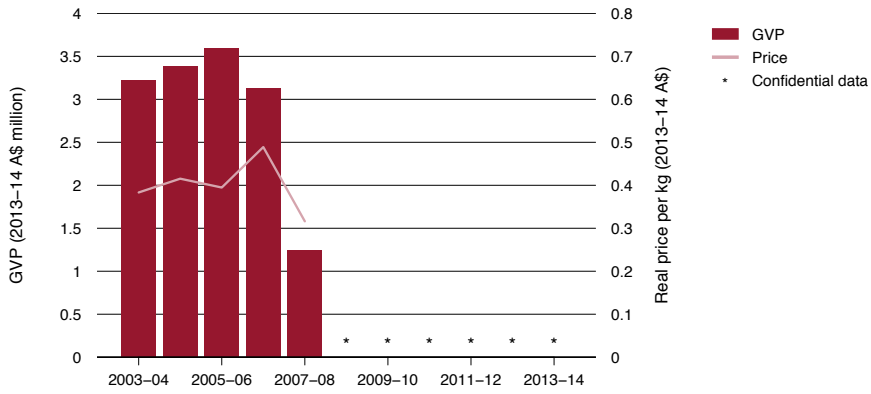
In 2007–08, attributed management costs were about 57 per cent of GVP. This indicates that net economic returns (NER) were likely to have been low in that year, even before fishing costs are considered. Management costs increased 33 per cent between 2012–13 and 2013–14 (from $0.3 million to $0.4 million). The number of vessels remained the same as in 2012–13, and the level of catch has declined, indicating that NER are likely to be low or negative.

Of the combined small pelagic TACs available in 2013–14, 99 per cent were uncaught, with only one active vessel. These high levels of latent effort indicate low interest and probably low profitability in the sector, with fishers appearing to have little incentive to exercise their fishing rights; as a result, NER are likely to be low.

Quota holders applied to deploy a factory trawler, *Abel Tasman* (previously FV *Margiris*), into the fishery in 2012–13. However, the vessel was prevented from entering the fishery after amendments to environmental legislation were made to allow more time for the environmental impacts of the proposed fishing operation to be examined (AMCS 2013; Burke 2013). An expert panel was convened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to consider the environmental impacts of the operation. The first expert panel report was released in October 2014. The initial declaration that limited trawler capacity ended on 24 April 2015, and vessels over 130 m long are now permanently banned from operating in the fishery.

On 12 February 2015, AFMA received notification that Seafish Tasmania Pty Ltd had nominated the *Geelong Star* to fish its concessions in the SPF. Seafish Tasmania Pty Ltd is required to satisfy the Fisheries Management Regulations 1992, the *Fisheries Management Act 1991* and the statutory Small Pelagic Fishery Management Plan. Seafish Tasmania Pty Ltd is also required to meet obligations under the EPBC Act (AFMA 2015). Catches and GVP are expected to substantially increase as a result of the *Geelong Star* fishing in the 2014–15 season.

FIGURE 7.9 Real GVP for the SPF, 2003–04 to 2013–14



Note: **GVP** Gross value of production.

Management arrangements

The fishery is managed with output controls, with a TACs set for each target species. Limits are not set for the number of vessels allowed to operate in the fishery. For the 2013–14 fishing season, 70 fishing entitlements were issued.

Performance against economic objective

A meaningful biomass target to provide maximum economic yield 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. However, it is clear from the low catches, high levels of latent effort and high levels of unfished TAC that this fishery is not optimising NER.

Incorporating economic parameters into a management strategy evaluation (Giannini et al. 2010) could provide improved information that would allow the fishery's harvest strategy to be tailored to achieving higher NER.

7.4 Environmental status

The management plan for the SPF was most recently accredited under part 13 of the EPBC Act on 28 November 2012; this expires on 20 October 2015. Two conditions were placed on the accreditation: to mitigate interactions with protected species and for new midwater trawl vessels in the fishery to have observer coverage for the first 10 trips.

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. 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.

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. No interactions with protected species were reported in the SPF during 2013–14. Seal and dolphin mortalities have been recorded in the SPF for the 2014–15 fishing season and will be reported in next year's *Fishery status reports*.

7.5 References

AFMA 2010, *Residual Risk Assessment of the level 2 ecological risk assessment species results report for the Small Pelagic Fishery, purse-seine*, Australian Fisheries Management Authority, Canberra.

—— 2013, *Report from SPFRAG (Small Pelagic Fishery Resource Assessment Group) 15, 19 March 2013*, AFMA, Canberra.

—— 2014, *Report from SPFRAG (Small Pelagic Fishery Resource Assessment Group) 17, 11–12 March 2014*, AFMA, Canberra.

—— 2015, *Boat nomination to fish in the Small Pelagic Fishery,* AFMA, Canberra, available at www.afma.gov.au/boat-nomination-fish-small-pelagic-fishery.

AMCS 2013, *Super trawler*, Australian Marine Conservation Society, Brisbane, available at www.marineconservation.org.au/pages/super-trawler.html.

Burke, T 2013, *Super trawler stopped again*, media release, Minister for Sustainability, Environment, Water, Population and Communities, Canberra, 25 February, available at www.environment.gov.au/minister/archive/burke/2013/mr20130225.html.

DAFF 2007, *Commonwealth Fisheries Harvest Strategy: policy and guidelines*, Australian Government Department of Agriculture, Fisheries and Forestry, Canberra.

Daley, R, Dowdney, J, Bulman, C, Sporcic, M, Fuller, M, Ling, S, Milton, D & Hobday, A 2007, *Ecological risk assessment (ERA) for effects of fishing, Small Pelagic Fishery*, AFMA, Canberra.

Dixon, PI, Worland, LJ & Chan, BHY 1993, *Stock identification and discrimination of pilchards in Australian waters, using genetic criteria*, Centre for Marine Studies, University of New South Wales, Sydney.

Fulton, EA 2012, *Summary of Atlantis work relevant to Australia's Small Pelagic Fishery*, report to AFMA, CSIRO, Hobart.

Giannini, F, Hobsbawn, PI, Begg, GA & Chambers, M 2010, *Management strategy evaluation (MSE) of the harvest strategy for the Small Pelagic Fishery*, Fisheries Research and Development Corporation project 2008/064, Bureau of Rural Sciences & FRDC, Canberra.

Izzo, C, Gillanders, BM & Ward TM 2012, *Movement patterns and stock structure of Australian sardine (*Sardinops sagax*) off South Australia and the east coast: implications for future stock assessment and management*, final report, FRDC project 2009/021, South Australian Research and Development Institute publication F2011/000487-1, Research Report Series 611, SARDI Aquatic Sciences, Adelaide.

Kailola, PJ, Williams, MJ, Stewart, PC, Reichelt, RE, McNee, A & Grieve, C 1993, *Australian fisheries resources*, BRS & FRDC, Canberra.

Lyle, JM & Willcox, ST 2008, *Dolphin and seal interactions with mid-water trawling in the Small Pelagic Fishery, including an assessment of bycatch mitigation strategies*,

Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, Hobart.

Neira, FJ 2011, *Application of daily egg production to estimate biomass of jack mackerel,* Trachurus declivis*—a key fish species in the pelagic ecosystem of south-eastern Australia*, final report to the Winifred Violet Scott Charitable Trust, Fisheries, Aquaculture and Coasts Centre, Institute for Marine and Antarctic Studies, University of Tasmania.

——, Lyle, JM, Ewing, GP, Keane, JP & Tracey, SR 2008, *Evaluation of egg production as a method of estimating spawning biomass of redbait off the east coast of Tasmania*, final report, FRDC project 2004/039, TAFI, Hobart.

Pikitch, E, Boersma, P, Boyd, I, Conover, D, Cury, P, Essington, T, Heppell, S, Houde, E, Mangel, M, Pauly, D, Plagáanyi, É, Sainsbury, K & Steneck, R 2012, *Little fish, big impact: managing a crucial link in ocean food webs*, Lenfest Ocean Program, Washington.

Richardson, BJ 1982, 'Geographical distribution of electrophoretically detected protein variation in Australian commercial fishes. I. Jack mackerel (*Trachurus declivis* [Jenyns])', *Australian Journal of Marine and Freshwater Research*, vol. 33, pp. 917–26.

Schmarr, DW, Whittington, ID, Ovenden, JR & Ward, TM 2007, 'Techniques for discriminating stocks of blue mackerel *Scomber australiasicus*', in TM Ward & PJ Rogers (eds), *Development and evaluation of egg-based stock assessment methods for blue mackerel* Scomber australiasicus *in southern Australia*, final report, FRDC project 2002/061, SARDI Aquatic Sciences, Adelaide, pp. 53–76.

Smith, A, Brown, C, Bulman, C, Fulton, E, Johnson, P, Kaplan, I, Lozano-Montes, H, Mackinson, S, Marzloff, M, Shannon, L, Shin, Y & Tam, J 2011, 'Impacts of fishing low-trophic level species on marine ecosystems', *Science*, vol. 333, pp. 1147–50.

——, Ward, T, Hurtado, F, Klaer, N, Fulton, E & Punt, A 2015, *Review and update of harvest strategy settings for the Commonwealth Small Pelagic Fishery: single species and ecosystem considerations*, report for FRDC project 2013/028, CSIRO Oceans and Atmosphere Flagship, Hobart.

Smolenski, A, Ovenden, J & White, R 1994, 'Preliminary investigation of mitochondrial DNA variation in jack mackerel (*Trachurus declivis*, Carangidae) from south-eastern Australian waters', *Australian Journal of Marine and Freshwater Research*, vol. 45, pp. 495–505.

SPF Industry 2008, *Commonwealth Small Pelagic Fishery voluntary code of practice*, AFMA, Canberra.

Ward, TM & Rogers, PJ 2007, *Evaluating the application of egg-based stock assessment methods for blue mackerel,* Scomber australasicus, *in southern Australia*, final report to FRDC, Canberra.

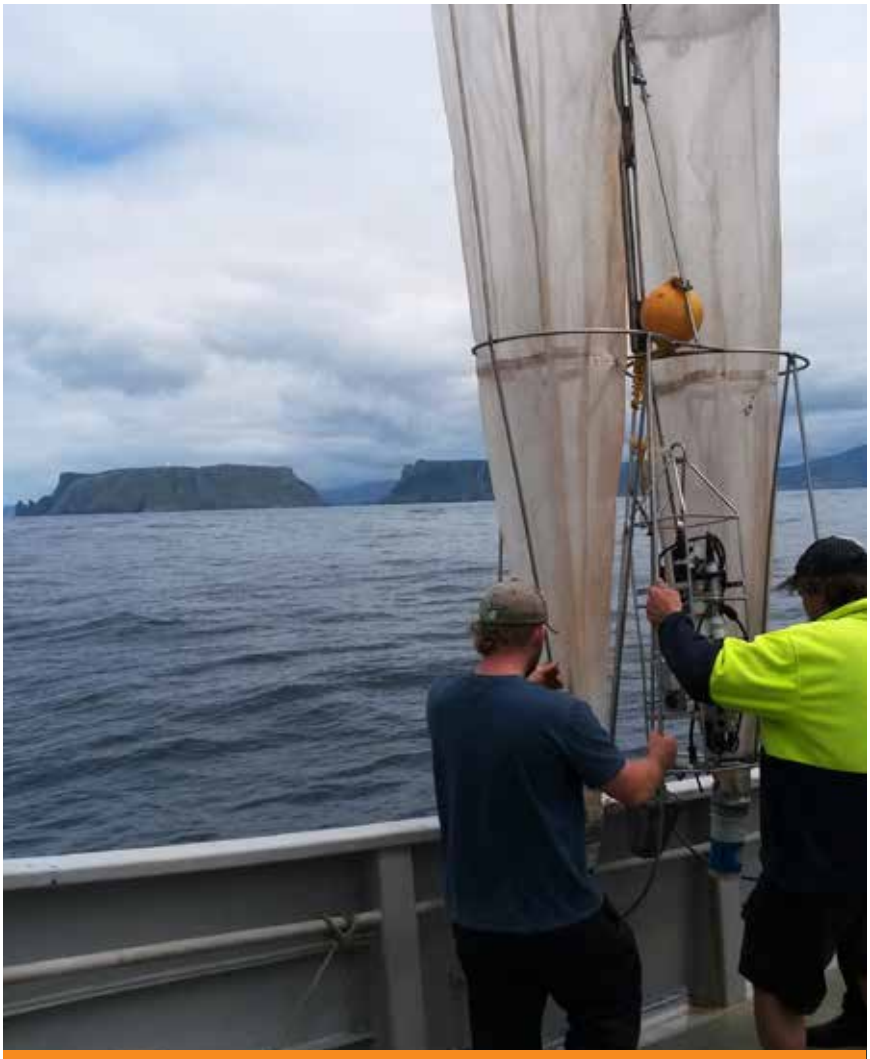
——, Lyle, J, Keane, JP, Begg, G, Hobsbawn, P, Ivey, AR, Sakabe, R & Steer, MA 2011, *Commonwealth Small Pelagic Fishery: status report 2010*, report to AFMA, Canberra.

——, Burnell, O, Ivey, A, Carroll, J, Keane, J, Lyle, J & Sexton, S 2015, *Summer spawning patterns and preliminary daily egg production method survey of jack mackerel and Australian sardine off the east coast*, final report, FRDC project 2013/053, SARDI Aquatic Sciences, Adelaide.

Whittington, ID, Ovenden, JR & Ward, TM 2012, 'Discriminating stocks of blue mackerel using a holistic approach: a pilot study', in JR McKenzie, B Parsons, AC Seitz, R Keller Kopf, M Mesa & Q Phelps (eds), *Advances in fish tagging and marking technology*, American Fisheries Society Symposium 76, pp. 397–417.

Williams, K 1981, *Aerial survey of pelagic fish resources off eastern Australia 1973–1977*, CSIRO Division of Fisheries and Oceans report 130, CSIRO, Australia.

Yardin, MR, Dixon, PI, Coyle, T, Syahailatua, A & Avramidis, M 1998 '*Stock discrimination of Sardinops sagax'* in south-eastern Australia, in TM Ward, M Kinloch, GK Jones, FJs Neira (eds), *A collaborative investigation of the usage and stock assessment of baitfish 76 in southern and eastern Australia with special reference to pilchards* (Sardinops sagax), FRDC Report No. 1994/024, FRDC, Canberra, pp. 85–174.



Sampling for the daily egg production method
John Keane, IMAS