Stock Status Summary – 2021/22

NSW Stock Status Summary – Blue Mackerel
(Scomber australasicus)

Assessment Authors and Year

Stewart, J. 2021. NSW Stock Status Summary 2021/22 – Blue Mackerel (*Scomber australasicus*). NSW Department of Primary Industries, Fisheries. 10 pp.

Stock Status

Current stock status	On the basis of the evidence contained within this assessment, Blue Mackerel is currently assessed as **sustainable**.

Stock structure & distribution

The stock structure of Blue Mackerel is uncertain (Patterson et al., 2021). Genetic analysis of samples from southern Queensland, Western Australia and New Zealand indicates population subdivision with differences detected between Western Australia and Queensland, and between Western Australia and New Zealand, but not between Queensland and New Zealand (Ward et al., 2007; Whittington et al., 2012). Blue Mackerel off southern Australia is currently considered to be comprised of two biological stocks: the Western stock that extends from western Tasmania to southern Western Australia and the Eastern stock, which occurs to the east of Bass Strait. Following a data synthesis undertaken to establish management zones in the Small Pelagic Fishery (Commonwealth), Blue Mackerel and other target species are managed in western and eastern sub-areas, which reflect this stock structure. The Commonwealth SPF manages and assesses Blue Mackerel as a single east coast stock.

This stock status summary details stock assessment results (Stewart, 2021) and relevant fisheries statistics to inform the setting of a Total Allowable Catch (TAC) for the NSW purse seine Blue Mackerel quota fishery for the 2022/23 fishing season. Assessment of stock status for Blue Mackerel is principally from the Commonwealth Small Pelagic Fishery (SPF) derived assessment that utilizes estimates of spawning biomass from periodic egg surveys using the Daily Egg Production Method (DEPM). Given that the DEPM-based assessment is for the entire eastern stock, the results are appropriate for application to the NSW component of the stock.

Biology

Blue Mackerel occur in sub-tropical and temperate waters of the Pacific and Indian Oceans. They inhabit inshore and continental shelf waters off all states of Australia except the Northern Territory.

Blue Mackerel mature at about 24-28 cm fork length (FL) and spawning is thought to occur during late winter and spring in outer continental shelf waters off northern NSW and southern QLD. Eggs and larvae have been observed in high abundances in shelf waters with temperatures of 18 to 21°C (Neira and Keane 2008). Blue Mackerel grow relatively quickly, reaching approximately 17-22 cm FL after one year. They reach a maximum age of about 8 years and length of 44 cm FL in Australian waters. Blue Mackerel have been aged to be more than 20 years old in New Zealand.

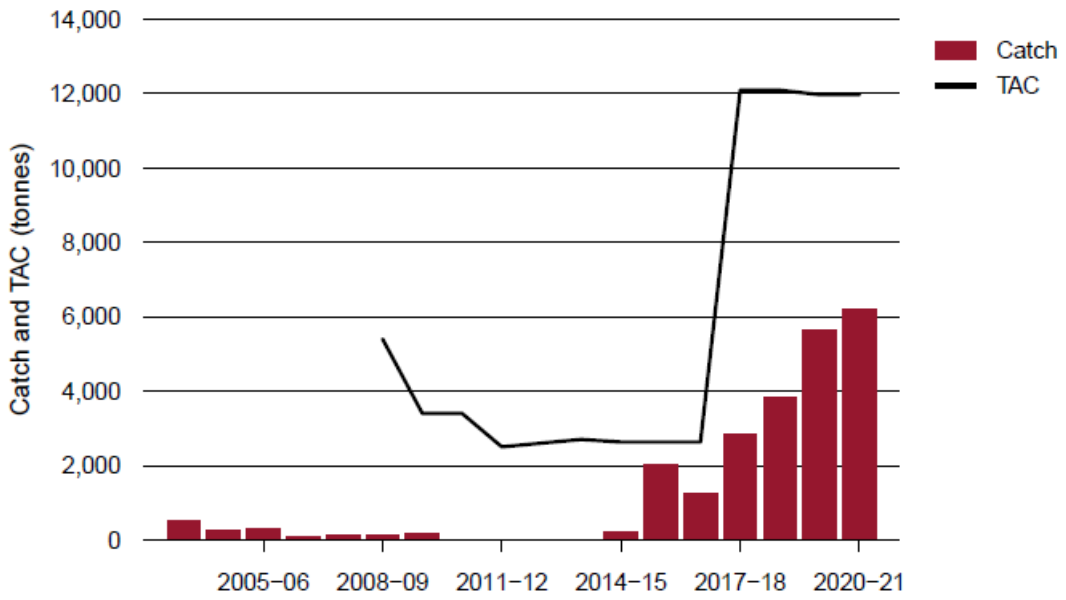
FISHERY STATISTICS

Catch information

Commercial

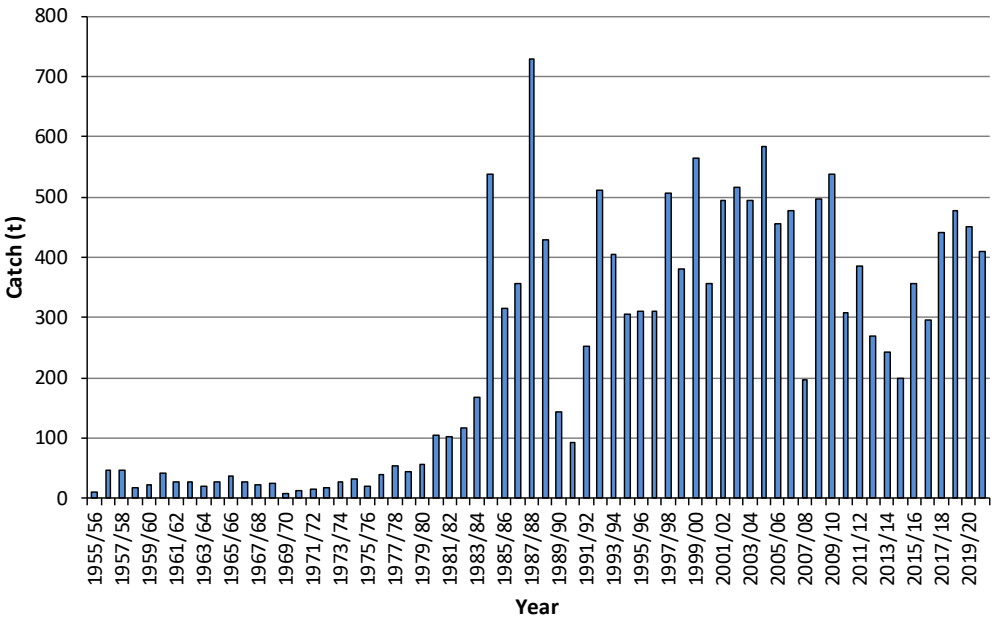
Most of the eastern Blue Mackerel catch has historically been taken in state fisheries. However, with the introduction of a freezer vessel and onshore processing facilities, the Commonwealth catch has exceeded state commercial catches since 2015/16. The total combined catch in 2019/20 (excluding Victorian catches which were confidential but likely minor) was the greatest recorded at 6,124 t, comprising 5,693 t from the Commonwealth and 431 t from state fisheries. In 2020/21 the Commonwealth catch increased to 6,215 t (Fig. 1), noting that state catches were not available when the report was compiled (Patterson et al., 2021). Landings from NSW (Fig. 2) during 2020/21 were likely less than 560 t (comprising approximately 409 t from ocean hauling, 30 t from Commonwealth tuna boats under permit and recreational catch). Total harvest during 2020/21 were therefore likely approaching 7,000 t and the highest on record.

Figure 1. Commonwealth eastern Blue Mackerel catch and TAC 2003/04 to 2020/21 (from Patterson et al. 2021).



Note: TAC Total allowable catch.

Figure 2. Reported landings of Blue Mackerel by the NSW commercial fishery 1955/56 to 2020/21. Data excludes catch reported under section 37 permit for Commonwealth tuna bait.



Information on commercial discarding of Blue Mackerel is limited. Blue Mackerel are rarely released in the commercial line fisher (MacBeth and Gray 2013). Survival of released fish from purse-seine operations is thought to be high (pers. comm).

Recreational & Charter boat

Blue Mackerel are very important to recreational and charter fishers, and the recreational harvest is significant but poorly understood. The most recent survey of recreational harvest in NSW by 1 and 3 year licence holders and housemates was done during 2017/18 and estimated the Blue Mackerel harvest at approximately 41 t (Murphy et al., 2020). Approximated conversions to make the 2017/18 estimate comparable to the 2000/01 state-wide survey that encompassed total recreational harvest scales this to be around 125 t and approximately 25% of the total harvest in NSW waters.

Approximately 20% of Blue Mackerel in recreational catches were released during 2017/18, with unknown survival (Murphy et al., 2020).

Indigenous

There is no information available on the Aboriginal catch of Blue Mackerel in NSW waters.

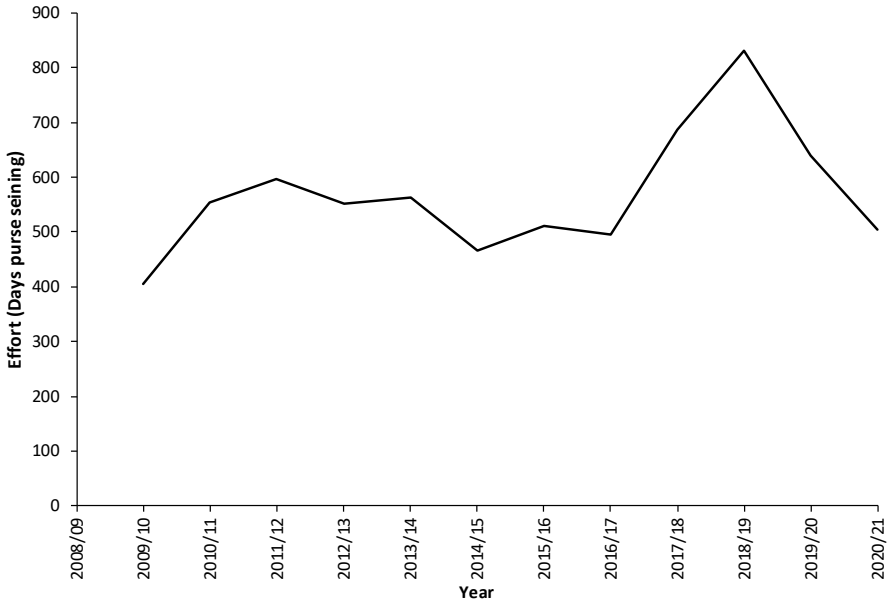
Illegal, Unregulated and Unreported

The level of Illegal Unregulated and Unreported (IUU) fishing is unknown.

Fishing effort information

Days fished in the NSW purse seine fishery when Blue Mackerel were landed remained relatively stable between 2009/10 and 2017/18, fluctuating between approximately 400 and 600 days per year. Days of effort increased to be between around 650 to 850 between 2017/18 and 2019/20 but declined to approximately 500 during 2020/21 (Fig. 3).

Figure 3. Effort (days fished) for purse seine fishers that reported landing Blue Mackerel in NSW 2009/10 to 2020/21.



Catch Rate information

Catch rates of Blue Mackerel by the method of purse seine are unlikely to be useful for inferring relative abundance due to: (i) the schooling nature of the species; (ii) the ability of the gear to encircle entire schools of fish, and; (iii) the market driven nature of fishing operations for this species. Nevertheless, catch rates of Blue Mackerel (kg per day purse seining) have fluctuated since 2009/10 with higher rates during the last two years (Fig. 4). More detailed logbook data in terms of catch per shot indicates similar annual fluctuations and substantial increases in recent years (Fig. 5), noting these are raw catch rates and do not account for factors such as vessel size, net size etc. At present such catch rate standardizations are not required for assessment purposes.

Figure 4. Commercial catch rates (raw kgs per day) of Blue Mackerel using purse seining for years 1997/98 to 2020/21 in NSW.

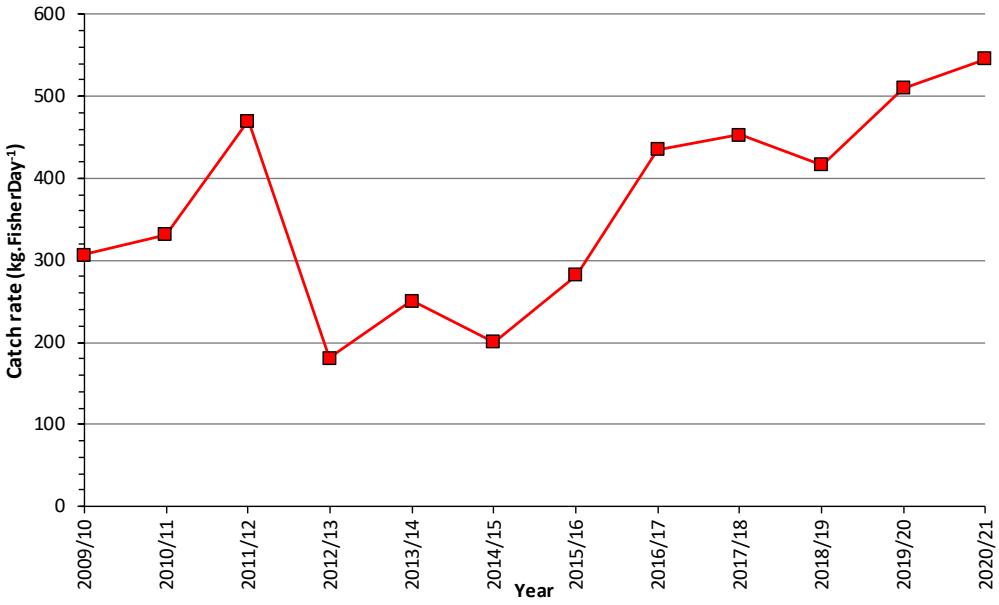
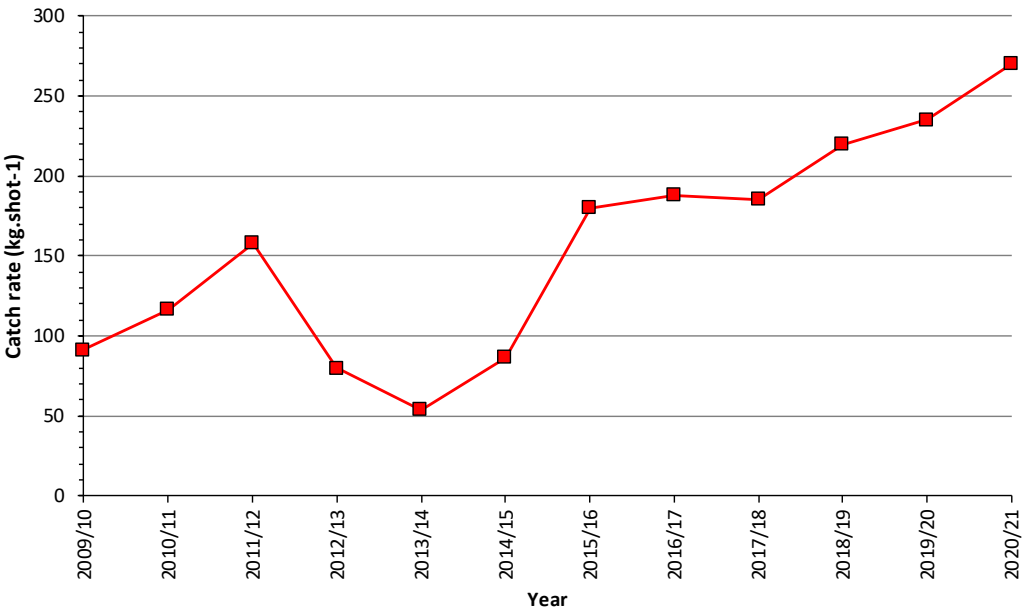


Figure 5. Commercial catch rates (kgs per shot) of Blue Mackerel using purse seining for years 1997/98 to 2020/21 in NSW.



STOCK ASSESSMENT

Blue Mackerel is assessed in terms of biomass through Daily Egg Production Method (DEPM) surveys. Sustainable levels of fishing are assessed through catch as a percentage of biomass. Management Strategy Evaluation (MSE) of the Commonwealth SPF Harvest Strategy (Smith et al., 2015) established that an exploitation rate of up to 23% may be suitable for Eastern Blue Mackerel under the Commonwealth SPF harvest strategy. The current harvest strategy exploitation rate following a Tier 1 assessment is only 15%, ensuring a very low probability of the stock falling below 20% of unfished levels. A Stochastic Stock Reduction Analysis (SSRA) was also done to estimate depletion levels up to 2015 (Punt et al., 2016a; Punt et al., 2016b).

Stock Assessment Methodology

Year of most recent assessment:

2021

2019 - Daily Egg Production Method (DEPM) biomass estimate.

2015 - Stochastic Stock Reduction Analysis (SSRA).

Assessment method:

Daily Egg Production Method (DEPM) biomass estimate (Ward et al., 2021).

Stochastic Stock Reduction Analysis (SSRA) and Management Strategy Evaluation (MSE) of the Commonwealth SPF Harvest Strategy (Smith et al., 2016; Punt et al., 2016a; Punt et al., 2016b).

Main data inputs:

Egg survey during September 2019 between Sandy Cape, Queensland and Ulladulla, NSW. The survey produced estimates of Blue Mackerel egg abundance, egg age and spawning area.

Adult reproductive parameters: average weight, sex ratio, batch fecundity, spawning fraction.

Catch and effort data.

SSRA: Catch, 2014 spawning biomass estimate, growth, maturity, selectivity, stock-recruitment relationship.

MSE: Weight, maturity, and selectivity by age.

Key model structure & assumptions:

SSRA: age-structured model, fixed parameters for weight-at-age, natural mortality, selectivity at age and stock-recruitment steepness. Free parameters unfished recruitment, fishing mortality on fully selected age classes, deviations around the stock-recruitment relationship. 2014 spawning biomass estimate based on the DEPM derived 83,300 t with a CV of 0.5. Assumptions include negligible catch prior to 1997/98, and that assumed parameters are correct.

MSE operating model is age-structured, and recruitment is driven by spawning stock biomass and uses pre-specified values for biological parameters (natural mortality, growth, maturity, and stock-recruit steepness.

Sources of uncertainty evaluated:

Considerable uncertainty exists around all of the key input data for the Blue Mackerel DEPM assessment. Sensitivity analyses were done for all parameters to determine which had the largest

influence on estimated spawning biomass. These were done by varying each individual parameter whilst keeping the others constant at the value used to calculate spawning biomass.

Conclusions were drawn based on the most precautionary parameter estimates, resulting in the spawning biomass likely to be under-estimated.

MSE testing of the SPF harvest strategy rules to examine the probability of the biomass falling below the limit reference point of 20%of unfished levels with a less than 10% chance over 50 years.

Status Indicators - Limit & Target Reference Levels

Biomass indicator or proxy	DEPM derived estimate of spawning biomass.
Biomass Limit Reference Point	20% of unfished levels with a less than 10% chance.
Biomass Target Reference Point	50% of unfished levels
Fishing mortality indicator or proxy	Catch as a proportion of spawning biomass.
Fishing mortality Limit Reference Point	Annual catch is less than 15% of the DEPM derived estimate of spawning biomass. This is the Tier 1 exploitation rate in the Commonwealth SPF Harvest Strategy for setting a Recommended Biological Catch (RBC) for each of five fishing seasons following a DEPM assessment. Five years after a Tier 1 assessment, the RBC is set at the Tier 2 level that is 7.5% of the DEPM derived estimate of spawning biomass. Five years after a Tier 2 assessment, if no updated DEPM is done, the RBC is set at the Tier 3 level that is 3.75% of the DEPM derived estimate of spawning biomass.
Fishing Mortality Target Reference Point	N/A

Stock Assessment Results

Recent harvests of east coast Blue Mackerel have been increasing, but remain below the reference level of 15% of the 2019 derived DEPM estimate of spawning biomass (rounded down to 80,000 t for calculation of the RBC in recognition of the imprecision inherent in such surveys) (Ward et al., 2021) with the RBC calculated as 15% x 80,000 t ~12,000 t. The most recent year that both state (excluding Victorian catches) and Commonwealth catch data were compiled was 2019/20 was the greatest recorded until that time at 6,124 t (Patterson et al., 2021). Combined landings may have approached 7,000 t during 2020/21.

Stock Assessment Result Summary

Biomass status in relation to Limit	Stochastic Stock Reduction Analysis (Punt et al., 2016a; Punt et al., 2016b) estimated that the 2015 depletion of Blue Mackerel was likely to be fairly close to the average unfished level. The SPF Harvest Strategy exploitation rates have been tested to provide a high likelihood that stocks will be maintained, on average, at the target reference point of 50 per cent of unfished levels, with a less than a 10 per cent chance over 50 years of falling below the limit reference point of 20 per cent of unfished levels.
Biomass status in relation to Target	As above
Fishing mortality in relation to Limit	Recent harvests of east coast Blue Mackerel have been increasing, but remain below the reference level of 15% of the 2019 derived DEPM estimate of spawning biomass (rounded down to 80,000 t for calculation of the RBC in recognition of the imprecision inherent in such surveys) (Ward et al., 2021) with the RBC calculated as 15% x 80,000 t ~12,000 t.
Fishing mortality in relation to Target	As above
Current SAFS stock status	Sustainable in 2020
Current Commonwealth stock status	Not overfished and not subject to overfishing

Fishery interactions

Commonwealth Small Pelagic Fishery – purse seine and midwater trawl, interacts with the NSW commercial fishery. The SPF has TACs based on RBCs derived from the SPF harvest strategy rules and then subtracting state catches. The TACs are very large, an order of magnitude greater than the NSW state catches, that until recently have been the largest, and have never been attained.

Commonwealth Tuna boats accessing Blue Mackerel for bait under permit.

Recreational fishers who harvest Blue Mackerel for food and bait. An historically contentious fishery interaction with concerns about the impact of commercial operations on the availability of bait for recreational fishers and on the distribution and therefore availability of gamefish.

Qualifying Comments

The DEPM-based estimates of Blue Mackerel spawning biomass are highly likely to be under-estimates, due to any potential biases in terms of key parameters (such as spawning area and the assumption that surveys are done at the peak spawning time) always leading to under-estimating spawning biomass. A recognised uncertainty in the Blue Mackerel DEPM biomass estimation has been the use of adult reproductive parameters that were obtained from fish collected in South

Australia during the early 2000s. It is a priority of the SPF and AFMA to resolve this uncertainty by sampling representative spawning Blue Mackerel on the east coast.

The very wide confidence intervals of DEPM-derived spawning biomass need to be acknowledged. In 2019 it was estimated to be 88,265 t (95% confidence intervals 33,320 to 143,209 t) Ward et al., 2021. In 2014 it was estimated at 83 300 t with 95% confidence intervals between 35,100 and 165,000 t (Ward et al., 2015), and in 2004 it was estimated at 23,009 t with 95% confidence intervals between 7,565 and 116,395 t (Ward and Rogers, 2007).

It should be noted that a component of the Stochastic Stock Reduction Analysis (Punt et al., 2016a) investigated the effect of temporal auto-correlation in recruitment (alternating periods of high or low recruitment and something that is observed in other small pelagic species) and concluded that "it is not possible to maintain stocks above the reference points considered with the pre-specified probability (10%) even without fishing, but this is not the case if deviations in recruitment about the stock-recruitment relationship are temporally uncorrelated." Such a finding supports the rationale of implementing precautionary harvest strategies that rely on regular biomass estimates.

References

Macbeth, W.G. and Gray, C.A., 2016. Observer-based study of commercial line fishing in waters off New South Wales. Fisheries Final Report Series, (148,151).

Murphy, J.J., Ochwada-Doyle, F.A., West, L.D., Stark, K.E. and Hughes, J.M., 2020, The NSW Recreational Fisheries Monitoring Program - survey of recreational fishing, 2017/18. NSW DPI - Fisheries Final Report Series No. 158.

Patterson, H, Bromhead, D, Galeano, D, Larcombe, J, Woodhams, J and Curtotti, R 2021, Fishery status reports 2021, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. CC BY 4.0. https://doi.org/10.25814/vahf-ng93.

Punt, A.E., Little, R. and Hillary, R. 2016a. Updated management strategy evaluation for Eastern Jack and Blue Mackerel, report for AFMA, CSIRO Oceans and Atmosphere Flagship, Hobart.

Punt, A.E., Little, L.R. and R. Hillary. 2016b. Assessment for Eastern Blue Mackerel. Document submitted to AFMA. 6pp.

Smith, A., Ward, T., Hurtado, F., Klaer, N., Fulton, E. and 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.

Ward, T. M., Grammar, G. L. and Ivey. A. R. (2021). Spawning biomass of Blue Mackerel (*Scomber australasicus*) and Australian Sardine (*Sardinops sagax*) in the East sub-area of the Small Pelagic Fishery. Report to the Australian Fisheries Management Authority. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2021/000047-1. SARDI Research Report Series No 1087. 54pp.

Ward, T.M., Grammer, G., Ivey, A., Carroll, J., Keane, J., Stewart, J. and Litherland, L. 2015. Egg distribution, reproductive parameters and spawning biomass of blue mackerel, Australian sardine and tailor off the east coast during late winter and early spring, FRDC project 2014/033, FRDC & SARDI, West Beach.

Ward, T.M. and Rogers, P.J. 2007. Evaluating the application of egg-based stock assessment methods for blue mackerel, *Scomber australasicus*, in southern Australia, Final report to FRDC, Canberra.