Stock status summary – Blue Mackerel – 2020

This report for Blue Mackerel *Scomber australasicus* summarizes the current assessment status to aid in the determination of a Total Allowable Catch (TAC) for the NSW purse seine Blue Mackerel quota fishery. The existing assessment upon which this report is based is from the Commonwealth Small Pelagic Fishery (SPF). This assessment is based upon the most recently available spawning biomass estimates that were derived in 2014, noting that an updated estimate from an egg survey done during 2019 will be available sometime during 2020. Current landings of Blue Mackerel on the east coast are considered sustainable, with the stock not overfished and not subject to overfishing.

The structure of this stock status summary is consistent with a format to inform a species status determination against criteria for the Status of Australian Fish Stocks reports (SAFS; www.fish.gov.au). It does not attempt to replicate the detail of the Commonwealth assessment but cites key information from that assessment. Where data are unavailable or considered insufficient to reliably inform the SAFS criteria the summary has been populated with 'NA', rather than removing the criteria. This format has been maintained to transparently represent the data available and highlight areas where supplementary information, alternate data sources or analyses may be required to improve the assessment and determination of species status into the future.

Assessment authors and Year

Stewart, J. 2020. Stock status summary – Blue Mackerel - 2020. NSW Department of Primary Industries. Mosman. 10 pp.

Stock structure

The stock structure of Blue Mackerel is uncertain (Patterson et al., 2019). 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). No finer-scale analyses of Blue Mackerel have been undertaken to further define stock structure.

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.

Stock status

Catch trends

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 recently exceeded state catch. The total combined catch in 2017/18 was 3,119 t, comprising 2,858 t from the Commonwealth and 261 t from state fisheries. The highest reported catches were in 2018/19 when Commonwealth catch was 3,811 t (Figure. 1), noting that state catches were not available when the report was compiled.

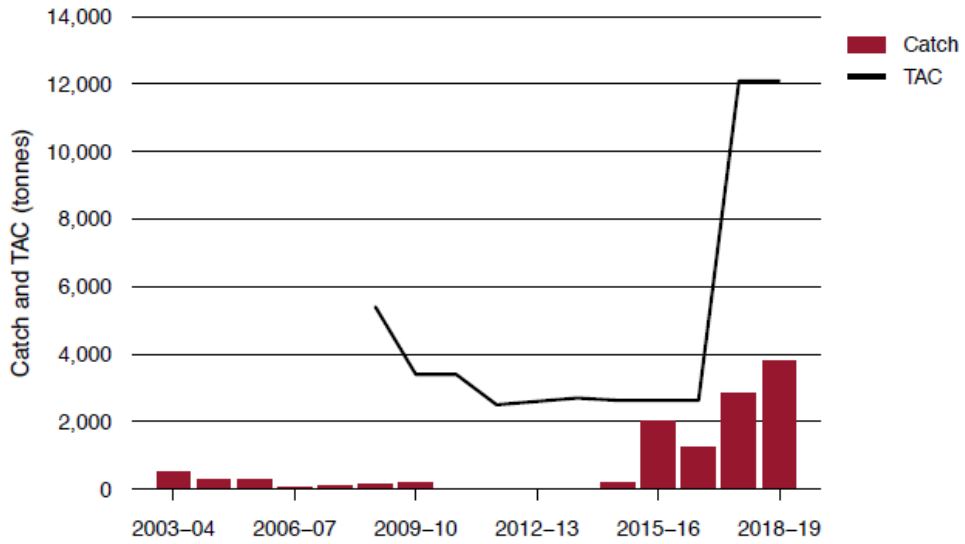

Figure 1. Commonwealth eastern Blue Mackerel catch and TAC 2003/04 to 2018/19 (from Patterson et al. 2019).

Recreational / Indigenous

Blue Mackerel are very important to recreational fishers and the recreational harvest is significant. The recreational harvest of Blue Mackerel in NSW waters was estimated at 147 t (10th and 90th percentiles at 86 and 202 t) during 2000/01 which represented approximately 22% of the total harvest (Henry and Lyle, 2003 and onsite surveys undertaken by NSW DPI). West et al. (2015) re-analyzed these data for NSW residents only and estimated a harvest of approximately 63.2 t. Given that the most recent recreational fishing survey done during 2013/14 only surveyed NSW residents and estimated a harvest of approximately 42.5 t, if the proportion of the total harvest of recreationally caught Blue Mackerel in NSW by NSW residents has remained constant, this estimate can be scaled up to approximately 99 t total recreational harvest in NSW waters during 2013/14, representing approximately 27% of the total harvest in NSW waters. Another survey of recreational harvest was done during 2017/18; however results are not yet available. There is no information available on the aboriginal catch of Blue Mackerel in NSW waters.

Fishing effort trends

Fishing effort is not a consideration for the Commonwealth assessment.

Catch rate trends

Catch rate trends are not a consideration for the Commonwealth assessment.

Stock assessment methodology

Year of most recent assessment	2014 - Daily Egg Production Method (DEPM) biomass estimate. 2015 - Stochastic Stock Reduction Analysis.
Assessment method	Daily Egg Production Method (DEPM) biomass estimate (Ward et al., 2015). 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 August/September 2014 between Sandy Cape, Queensland and Batemans Bay, New South Wales. 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 and assumptions	NA for DEPM. 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 and limits reference levels

Biomass indicator or proxy	Stochastic Stock Reduction Analysis (SSRA) derived depletion level (Punt et al., 2016a; Punt et al., 2016b).
Biomass Limit Reference Level	Biomass falling below the limit reference point of 20% of unfished levels with a less than 10% chance.
Fishing mortality indicator or proxy	Catch as a proportion of spawning biomass.
Fishing mortality Limit Reference Level	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.

Stock assessment results

Biomass status in relation to limit	Stochastic Stock Reduction Analysis (Punt et al., 2016a; Punt et al., 2016b) estimated that the current (2015) depletion of Blue Mackerel was likely to be fairly close to the average unfished level. The estimate of 2015 depletion based on the parameter values on which the MSE conducted by Smith et al. (2015) was based is 0.93, but the uncertainty about that estimate is high, particularly when account is taken of autocorrelation in recruitment
Fishing mortality in relation to Limit	Recent harvests of Blue Mackerel have been well below the reference level of 15% of the 2014 derived DEPM estimate of spawning biomass (estimated to be around 83 300 t with 95% confidence intervals of 35,100 to 165,000 t) (Ward et al., 2015) with the RBC calculated as 15% x 83,300t ~12,500 t. The most recent year that both state and Commonwealth catch data are available is 2017/18, when the total catch was 3,119 t.
Previous SAFS stock status	SAFS 2016 **Sustainable.** SAFS 2018 **Sustainable.**
Current SAFS stock status	The above evidence indicates that the stock is unlikely to be recruitment overfished, and that the current level of fishing pressure is unlikely to cause the stock to become recruitment overfished. On the basis of the evidence provided above, the Eastern biological stock is classified as a sustainable stock.

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.

The very wide confidence intervals of DEPM-derived spawning biomass need to be acknowledged. 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.

Of note is that until recently the NSW state-based catch has been far larger than the Commonwealth catch. Previous assessments have been largely supported by NSW data on the quantities, sizes and ages of Blue Mackerel being harvested in NSW waters. More recent DEPM-based assessments have been funded by the FRDC, with substantial co-investigation from NSW in those assessments.

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.

NSW Fishery

The stock status summary for Blue Mackerel summarizes information from the Commonwealth assessment only. Here, additional information is presented that may assist in understanding the dynamics of the NSW fishery for Blue Mackerel.

Commercial

Total annual reported commercial catches of Blue Mackerel in NSW are available from 1955/56 (fiscal years). NSW landings were low until the commencement of purse seine fishing during the 1980s (Fig. 2). Commercial landings of Blue Mackerel in NSW waters since the mid-1980s have generally been between 300-500 t annually but show considerable fluctuations. These fluctuations are likely to reflect changes in stock availability due to recruitment variability and may also reflect changes in the distribution of fish due to oceanographic processes. Commercial landings in NSW have fluctuated between approximately 200 to 500 t since 2009/10. More than 90% of the Blue Mackerel catch in NSW is reported from the Ocean Hauling Fishery. The Ocean Trap and Line Fishery reports generally between 10 and 30 t p.a., except for an anomaly during 2009/10 when 140 t was reported. Other minor landings are reported from the Estuary General, Ocean Prawn Trawl and Fish Trawl fisheries (Table 1).

Most of the eastern Blue Mackerel catch has historically been taken in the NSW state fishery. However, with the introduction of large-capacity freezer vessels and development of onshore processing facilities, the Commonwealth catch has recently exceeded the state catch. Commonwealth catch has increased to be approaching 3,000 t p.a. in recent years (Fig. 3). The reported harvest of Blue Mackerel by Commonwealth endorsed tuna fishers within NSW waters under permit has been available since 2009/10, with an average reported catch of less than 20 t p.a. during that time; however catches exceeded 40 t during 2018/19.

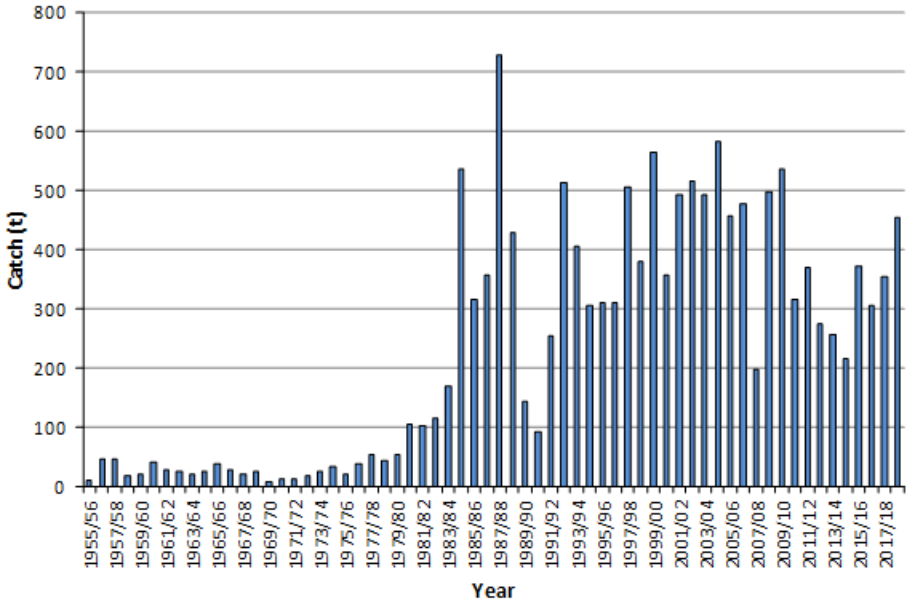

Figure 2. Reported landings of Blue Mackerel by the NSW commercial fishery 1955/56 to 2018/19.

Table 1. Reported landings (tonnes) of Blue Mackerel by fishery in NSW since 1997/98.

Financial Year	Estuary General	Ocean Hauling	Ocean Trap & Line	Ocean Prawn Trawl	Fish Trawl	Total
1997/98	2.6	472.87	21.39	0.35	3.6	500.81
1998/99	0.65	356.08	20.27	0.15	2.2	379.35
1999/00	0.32	534.33	29.66	0.59	0.42	565.32
2000/01	0.27	335.33	20.35	0.43	0.73	357.11
2001/02	2.09	464.95	25.03	0.28	1.24	493.59
2002/03	0.43	483.96	31.62	0.12	0.4	516.53
2003/04	0.52	469.72	22.89	0.08	0.46	493.67
2004/05	0.67	562.47	19.26	0.25	0.52	583.17
2005/06	0.25	441.38	13.68	0.19	1.35	456.85
2006/07	0.03	459.57	14.31	0.49	3.42	477.82
2007/08	0.11	175.96	19.28	0.69	0.77	196.81
2008/09	0.24	454.69	40.03	0.48	2.32	497.76
2009/10	0.96	378.89	140.47	0.09	4.14	524.55
2010/11	0.31	286.36	15.42	0.34	2.28	304.71
2011/12	0.17	328.56	19.98	0.25	5.18	354.14
2012/13	0.5	230.6	22.68	0.14	2.75	256.67
2013/14	0.14	218.31	20.69	0.05	3.92	243.11
2014/15	0.34	183.57	10.75	0.23	4.38	199.27
2015/16	0.99	341.54	12.56	0.18	1.49	356.76
2016/17	0.43	283.7	8.8	0.17	1.82	294.92
2017/18	0.07	325.56	14.84	0.18	0.88	341.53
2018/19	0.08	384.77	22.19	0.4	4.32	411.76

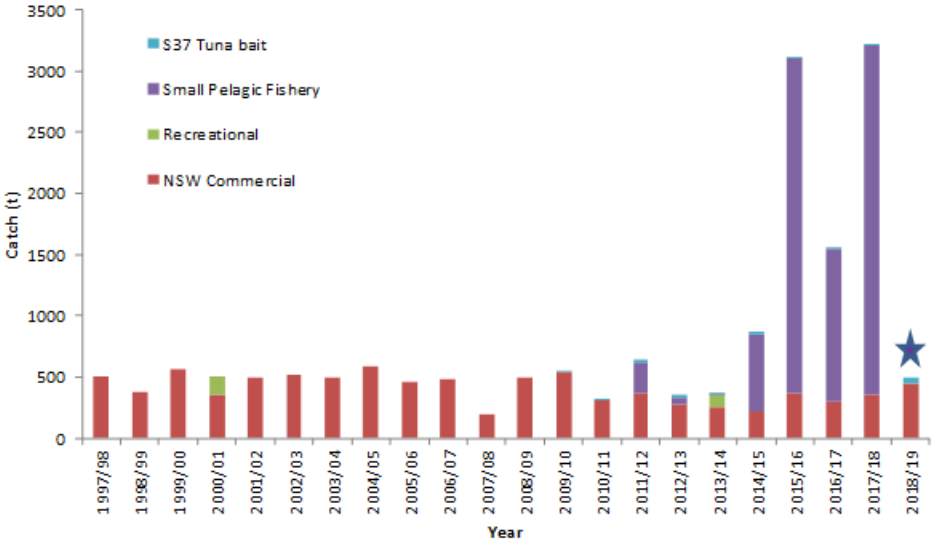

Figure 3. Landings of Blue Mackerel 1997/98 to 2018/19 from each major sector. Landings from the small pelagic fishery were only available as calendar year from 2011 to 2015 and were averaged to approximate landings by financial years for presentation. No data were available for 2018/19 as indicated by the star. Estimates of the recreational harvest are only available for 2000/01 and 2013/14.

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