Stock Status Summary 2021

NSW Stock Status Summary – Eastern Australian Salmon (*Arripis trutta*)

Assessment Authors and Year

Stewart, J. 2020. NSW Stock Status Summary 2018/19 – Eastern Australian Salmon – (*Arripis trutta).* NSW Department of Primary Industries. Fisheries NSW. 12 pp.

Stock Status

Current stock status	On the basis of the evidence contained within this assessment, Eastern Australian Salmon is currently assessed as **Sustainable** for the NSW component of the stock.

Stock Structure

The Eastern Australian Salmon (*Arripis trutta*) biological stock is distributed from southern Queensland down the east coast of Australia to western Victoria and Tasmania (Macdonald, 1983). This Eastern Australian biological stock overlaps with the closely related Western Australian Salmon (*Arripis truttaceus*) in Victorian and Tasmanian waters; however each species has differing life-histories (Stanley, 1978). Both species have spawning areas that allow eggs and larvae to be dispersed by the prevailing currents—southwards and then eastwards by the Leeuwin Current (Western Australian Salmon) and southwards by the East Australian Current (Eastern Australian Salmon). The fish then grow and mature before moving back towards their spawning areas which occur at the northern (up-current) parts of their distributions. The two species are morphologically very similar; however landings of "Australian Salmon" can be partitioned into species based on where they are caught (Macdonald, 1983).

The data presented in this summary relate mainly to the NSW part of the Eastern Australian biological stock; however a catch-only method assessment was done using data representing the entire biological stock (NSW, Victoria and Tasmania).

Stock Status – New South Wales

Catch Trends

Commercial fisheries

Commercial landings of Eastern Australian Salmon in NSW are largely market driven and hence display large fluctuations through time (Fig. 1). Landings have been increasing slightly during the past 5 years and were just more than 1,000 t during 2018/19 (Fig. 1). Almost the entire landings are taken by the Ocean Hauling Fishery (average 98% of the total catch since 2008/09), with relatively small quantities reported in the Estuary General and Ocean Trap and Line Fisheries.

Commercial landings across the entire biological stock also fluctuate according to market demands. Total landings from the stock have been declining from approximately 2,000 t p.a. during 2006/07 to 2008/09, to around 870 t in 2016/17 (Fig. 2). These declines were driven by reduced landings in Tasmanian and Victoria (Fig. 2).

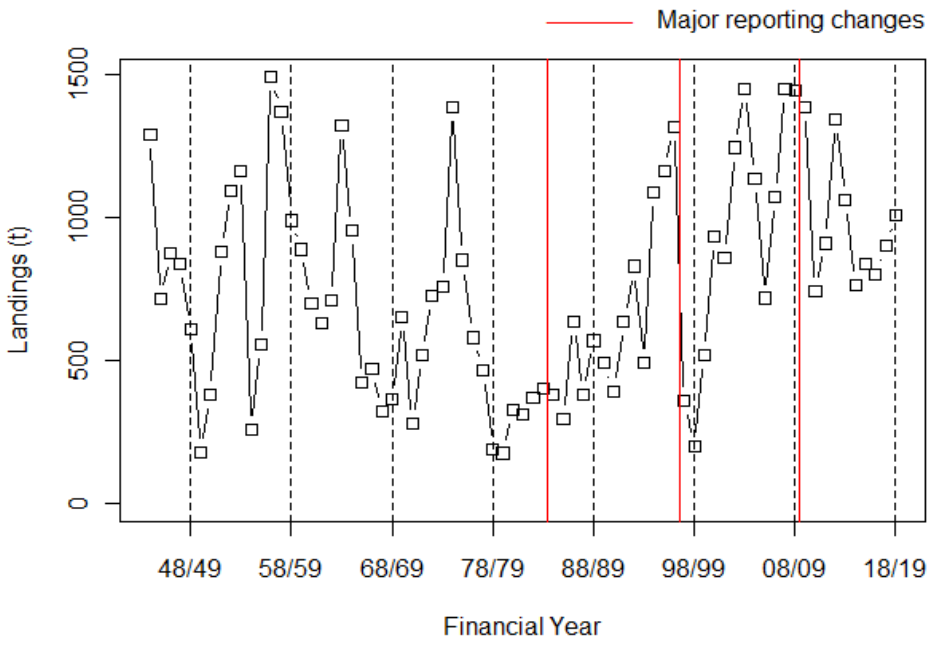


Figure 1. Commercial landings of Eastern Australian Salmon for NSW from 1944/45 to 2018/19 for all fishing methods.

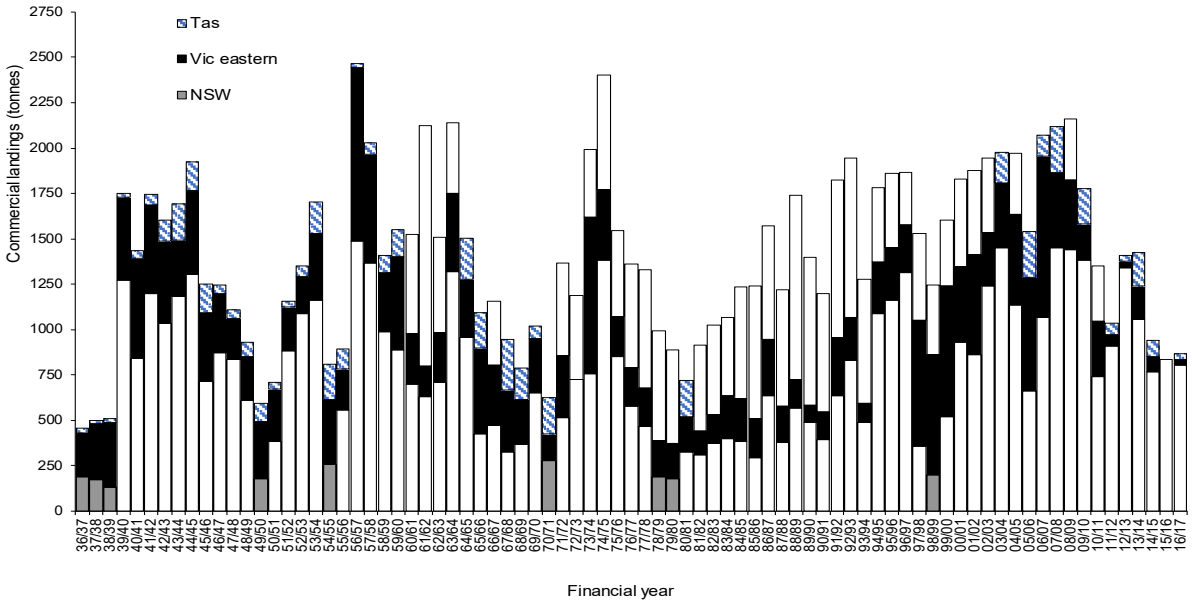


Figure 2. Commercial landings of Eastern Australian Salmon across the entire biological stock from 1936/37 to 2016/17.

Recreational and Indigenous

The most recent estimate of the recreational harvest of Australian Salmon in NSW was 33,948 fish during 2017/18 at around 83 t (Murphy et al. 2020). The estimate encompasses households with a Recreational Fishing Fee licence holder. The previous estimate of approximately 74,000 Salmon retained by recreational fishers during 2013/14 was around 182 t (West et al., 2015). In 2000/01 the Recreational and Indigenous Fishing Survey (Henry and Lyle, 2003) estimated approximately 80,000 fish were retained by fishers in NSW at around 132 t. While these survey results are not directly comparable due to differencing sampling frames, they likely represent a substantial decline in recreational harvest during 2017/18.

There are no data on aboriginal harvest.

Fishing effort trends

Commercial fishing effort on Australian Salmon in NSW is difficult to estimate prior to 2009/10 as the monthly catch returns listed days fished per month by method and had no direct link to the number of days within a month that a particular species was landed. The number of days beach hauling reported for when Australian Salmon were also reported in a month have declined from more than 2,500 in 1999/00 to only 249 during 2018/19 (Fig.3). It is likely that the large drop after 2008/09 was associated with a change in log book reporting rather than a real decline, with data prior to 2009/10 being inflated.

More accurate estimates of fishing effort are available after 2009/10 and show that the number of days using beach hauling on which Australian Salmon were landed have declined steadily to approximately 110 during 2018/19 (Fig. 4).

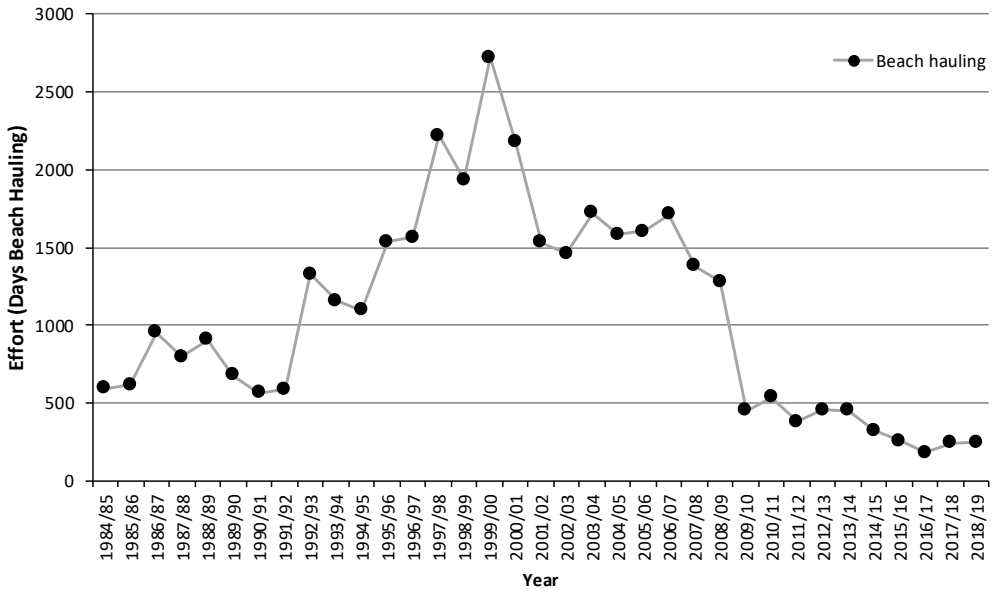


Figure 3. Annual reported days fished for months when Australian Salmon were landed by Beach Hauling 1984/85 to 2018/19.

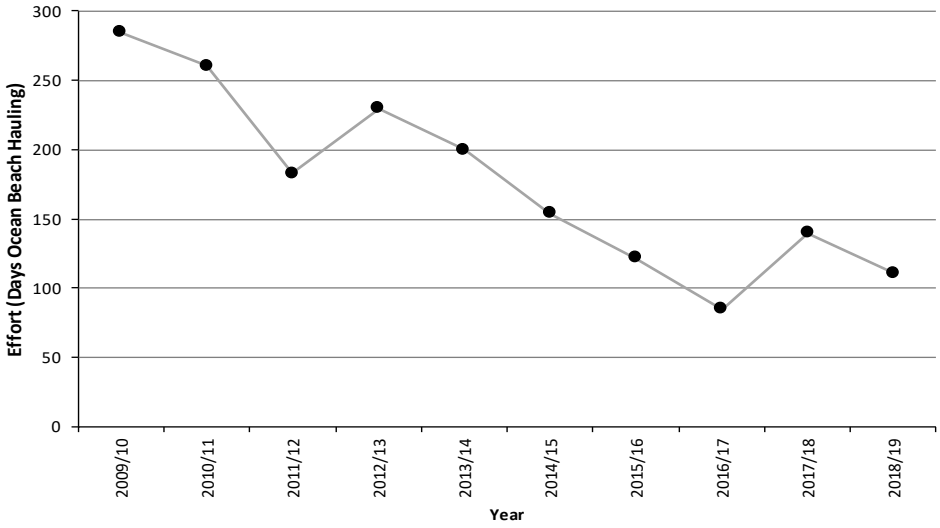


Figure 4. Annual reported days fished when Australian Salmon were landed by beach hauling 2009/10 to 2018/19.

Catch rate trends

Catch rates for Eastern Australian Salmon are unlikely to reflect relative abundance due to the schooling nature of the fish and the encircling type nets used. Nevertheless, nominal (unstandardized) catch rates using beach haul nets have been increasing since 2009/10, when a logbook change occurred (Fig. 5).

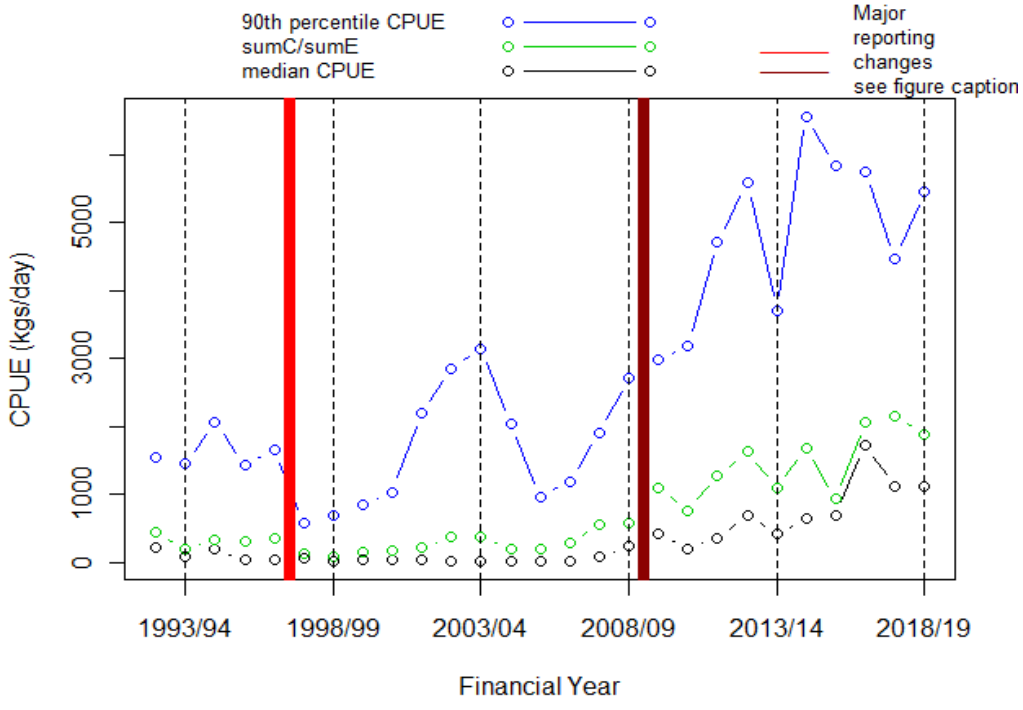


Figure 5. Nominal catch rates (kg/day beach hauling) for Eastern Australian Salmon for the period 1992/93 to 2018/19.

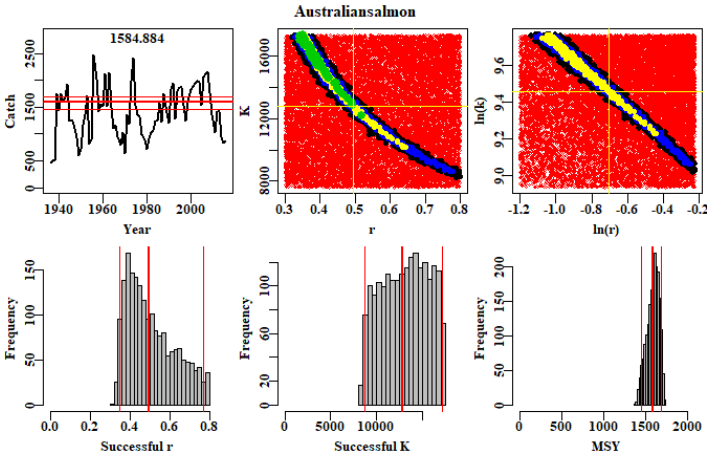
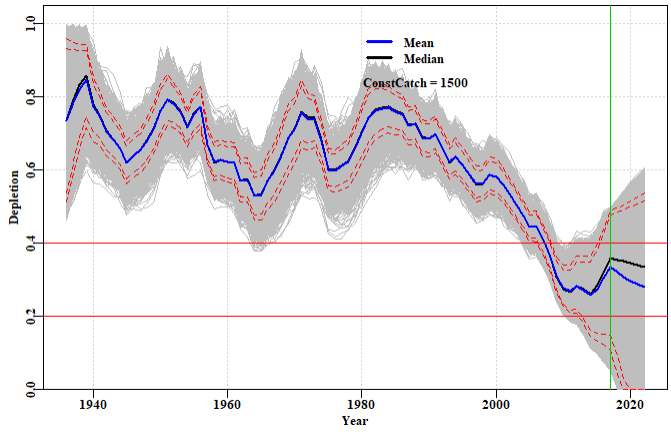
Stock Assessment Methodology

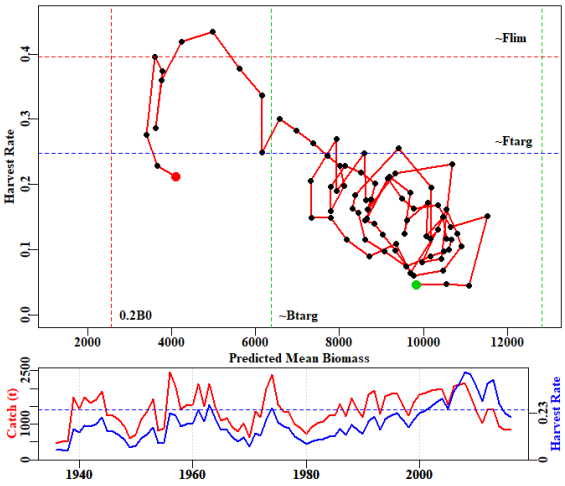
Year of most recent assessment	2020
Assessment method	Weight of Evidence 1. Catch-MSY model-assisted catch-only assessment (Martell and Froese, 2013) using the 'simpleSA' package in R (Haddon *et al*. 2018). This uses population productivity (*r*) and carrying capacity (*K*) parameters of an underlying Schaefer production model, applied to total annual catches, to estimate the ranges in biomass and harvest rate that could have resulted in the annual catches. 2. Catch. 3. Effort. 4. Trends in size and age compositions 1960s to 2008/09.
Main data inputs	1. Annual total landed catch of Eastern Australian Salmon by the NSW, Victorian and Tasmanian commercial fisheries from 1936 – 2016. 2. Size composition in landed commercial catch 1970s to 2008/09. 3. Age composition in commercial catch 2008/09.
Key model structure and assumptions	1. 'Resilience' was set to Medium in the Catch MSY model specification, which allows for a possible range in population growth rate (r) of 0.16 - 0.5. This is consistent with the life-history parameters of Australian Salmon as described in FISHBASE. 2. Trends in size composition in the landed commercial catch 1970s to 2008/09 – assuming these are representative of the fishable stock. 3. Pattern of age composition in commercial catch 2008/09 – assuming this is representative of the fishable stock.
Sources of uncertainty evaluated	The Catch-MSY analysis explored wide ranges of underlying Schaefer production model *r* and *K*, achieving successful biomass and harvest rate trajectories over 95% ranges of: *r* = 0.314 - 0.779; and *K* = 8,670 t – 17,127 t. The assessment successfully covered modes in the probability distributions of *r*, *K* and MSY.

Status Indicators and Limits Reference Levels

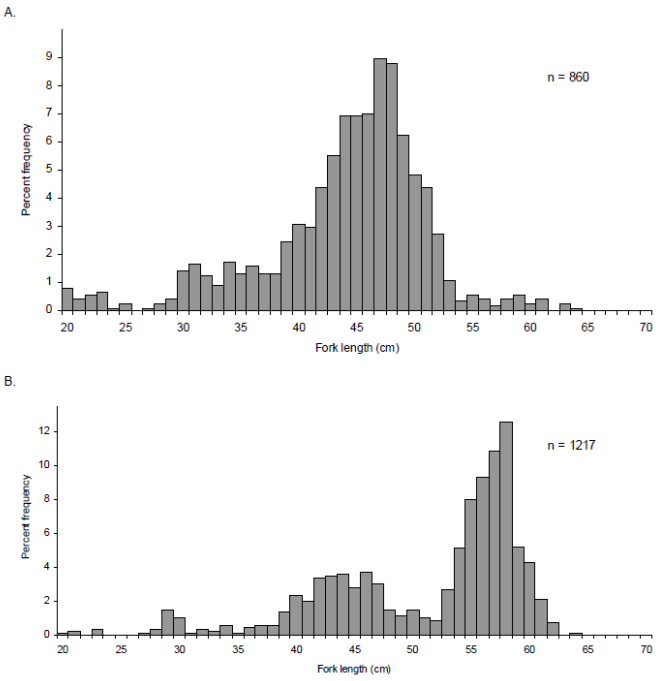
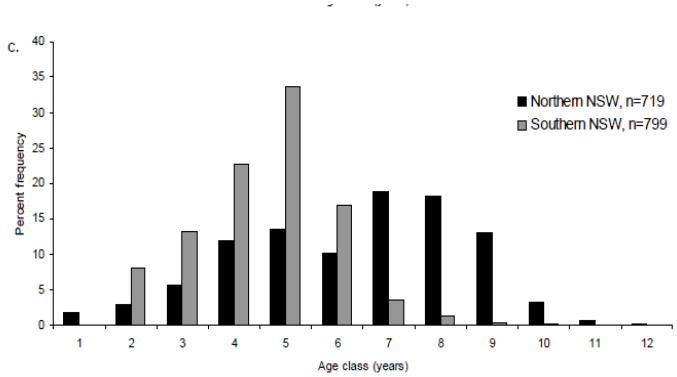
Biomass indicator or proxy	1. Mean annual biomass and depletion level, as estimated in the catch-MSY assessment. 2. Size composition in landed commercial catch. 3. Age composition in landed commercial catch.
Biomass Limit Reference Level	1. B_{lim}, expressed as 0.2 of *K* (B_0), the carrying capacity for the stock as estimated in this assessment. 2. and 3. No formal reference level for size and age compositions; however, trends are assessed.
Fishing mortality indicator or proxy	1. Mean annual harvest rate, as estimated in the catch-MSY assessment. 2. Landed commercial catch. 3. Commercial fishing effort. 4. Size composition in landed commercial catch. 5. Age composition in landed commercial catch.
Fishing mortality Limit Reference Level	1. F_{targ}, being the estimated harvest rate that should prevent the stock from declining below the biomass target B_{targ} (B_{MSY}). F_{lim} being the estimated harvest rate that should prevent the stock from declining below the biomass limit of 0.2 B_0. 2. Landed catch: No formal reference levels determined. Trends in indicator through time are used to estimate trends in fishing mortality. Stock-wide MSY as estimated in this catch-MSY assessment. 3. Fishing effort: No formal reference levels determined. Trends in indicator through time are used to estimate trends in fishing mortality. 4. Size composition in landed catch: No formal reference levels determined. Trends in indicator through time are used to estimate trends in fishing mortality. 5. Age composition: No formal reference levels determined. Qualitative assessment of age truncation.

Stock Assessment Results

1. Eastern Australian Salmon C_{MSY} assessment results showing: annual catch trajectory (t) with estimated MSY and 90th percentile; scatter plots of *K* vs *r* combinations explored with red dots depicting failure and other colours depicting combinations of initial depletion that succeeded for each *r-K* pair (right-hand plot is the log-transformed version of the left-hand plot); and histograms of the probability distributions of successful *r-K* pairs and the resulting MSY estimates, with red lines showing the median and 90th percentile confidence intervals.	
1. Range of depletion trajectories for successful *r-K* pairs, showing mean and median annual depletion and 80th and 90th percentiles (dashed lines). The lower red line is the $0.2B_0$ limit reference point, while the upper is the Schaefer B_{MSY} ($0.5B_0$) target reference point. The vertical green line indicates 2016/17, the final year for which data are available. Projected	

depletion levels are shown for 5 years thereafter at constant catch at 1,500 t.	
1 Eastern Australian Salmon stock status trajectory from 1936 – 2016, showing annual stock status in estimated biomass (t) and harvest rate. Reference levels are shown for biomass target (B_{MSY}) and limit ($0.2B_0$) reference levels, and for the corresponding harvest rates that should keep biomass at or above the target F_{targ} (F_{MSY}) and above the limit F_{lim} (F_{B20}) The start of the trajectory in 1936 is indicated by a green point and final year 2016/17 by a red point. The red line on the bottom plot is catch and the blue line is harvest rate.	
1. Summary output of key parameters from the Eastern Australian Salmon Catch-MSY stock assessment, showing mean (50%) estimates for r, K, MSY and Current Depletion, with 95% intervals. Note that Smith et al., (2019) estimated a commercial MSY for Australian Salmon in NSW to be approximately 1,105 t.	

Parameter	2.50%	50.00%	97.50%
r	0.314	0.479	0.772
K	8,670	13,212	17,127
MSY	1,447	1,597	1,701
CurrDepl	0.097	0.359	0.495

2. Size composition in landed NSW commercial catch 2006/07 to 2008/09. These were similar size ranges as reported during the 1960s and 1970s by Stanley (1978) and Nicholls, 1973).	 Size compositions of Eastern Australian Salmon captured by commercial fishing in New South Wales during 2006 to 2009. A. Southern NSW; B. Northern NSW. From Stewart et al., 2011.
3. Age composition in commercial catch 2006/07 to 2008/09. These were very similar to the age compositions reported during the 1960s (Stanley, 1978).	 Age compositions of Eastern Australian Salmon sampled from commercial landings in southern and northern New South Wales 2006/07, 2007/08 and 2008/09 combined. From Stewart et al., 2011.
Biomass status in relation to Limit	The Catch-MSY model using data since 1936 indicated that the biomass declined following the early 1980s when landings regularly exceeded the estimated MSY of approximately 1,600 t p.a. Lower

<table>
<tr><td></td><td>landings during the past decade has seen the biomass start to increase, and in 2016/17 the depletion estimate was 0.36 which is well above the limit reference point of 0.2. Stability in size and age composition between the 1960s and the early 2000s, during which time biomass was estimated to have declined considerably, also suggest that the biomass has not declined below any lower threshold.</td></tr>
<tr><td>Fishing mortality in relation to Limit</td><td>Estimated mean harvest rate regularly exceeded F_{targ} during the early 2000s but has since declined to be well below the level that would ultimately lead to biomass declining below the limit reference level.
Landed commercial catch across the entire biological stock has been below the estimated MSY of approximately 1,600 t p.a. for the previous 7 years.
Fishing effort beach hauling targeting Australian Salmon has continued to decline steadily since 2009/10, noting that purse-seining also reports substantial quantities.
The size composition in the landed catch in NSW indicates no obvious changes to the adult part of the stock since the 1960s, suggesting that fishing has not markedly altered the size structure.
The age composition in the landed catch in NSW indicates no obvious changes to the adult part of the stock since the 1960s, suggesting that fishing has not markedly altered the age structure.</td></tr>
<tr><td>Previous SAFS stock status</td><td>Within the NSW assessment framework, Eastern Australian Salmon were previously assessed as:
<table>
<tr><th>Year</th><th>Exploitation Status</th></tr>
<tr><td>2001/02</td><td>Undefined</td></tr>
<tr><td>2002/03</td><td>Undefined</td></tr>
<tr><td>2003/04</td><td>Undefined</td></tr>
<tr><td>2004/05</td><td>Undefined</td></tr>
<tr><td>2005/06</td><td>Undefined</td></tr>
<tr><td>2006/07</td><td>Undefined</td></tr>
<tr><td>2007/08</td><td>Fully Fished</td></tr>
<tr><td>2008/09</td><td>Fully Fished</td></tr>
<tr><td>2009/10</td><td>Fully Fished</td></tr>
<tr><td>2010/11</td><td>Fully Fished</td></tr>
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	<table><tr><td>2011/12</td><td>Fully Fished</td></tr><tr><td>2012/13</td><td>Fully Fished</td></tr><tr><td>2013/14</td><td>Fully Fished</td></tr><tr><td>2014/15</td><td>Fully Fished</td></tr></table> **SAFS:** Sustainable (2018). Sustainable (2016). Sustainable (2014). Sustainable (2012).
Current SAFS stock status	The stock in NSW is not considered to be recruitment impaired. The current level of fishing mortality is unlikely to cause the biological stock to become recruitment impaired. On the basis of the evidence provided above, Eastern Australian Salmon is classified as a sustainable stock

Qualifying Comments

This assessment is based largely on commercial fishery data. Given that the recreational harvest has been estimated to be substantially smaller than the commercial harvest, this is unlikely to have had a large influence on the assessment and conclusions.

References

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