Stock Status Summary – 2021

NSW Stock Status Summary – Blue Swimmer Crab *(Portunus armatus)*

Assessment Authors and Year

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Stock Status

Current stock status	On the basis of the evidence contained within this assessment, Blue Swimmer Crab are currently assessed as Sustainable for the NSW component of the stock.

Stock Structure

Stock structure on the east coast of Australia is uncertain, involving overlapping stocks or a semi-continuous stock (Chaplin et al., 2001).

Stock Status – New South Wales

Catch Trends

Commercial

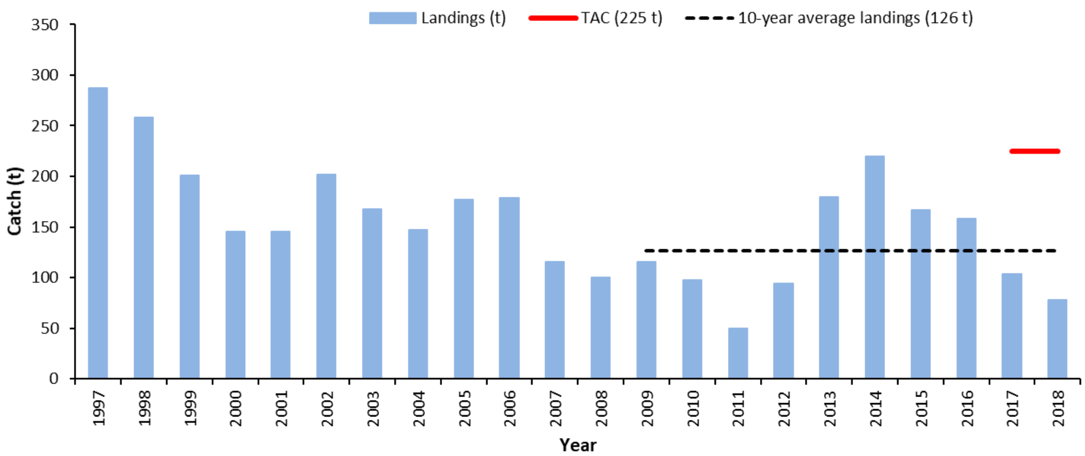


Figure 1. Summary of reported commercial landings of BSC for NSW from 1984–85 to 2018–19 (blue bars), 10-year average landings (dashed line) and, Total Allowable Commercial catch (TAC- red line).

Commercial catches of this species tended to fluctuate around a long-term average of about 144 t over the period 2000–01 to 2016–17. However, following the implementation of quota management and the increase in LMS, reported commercial landings in 2017–2018 and 2018–19 declined to

104 t and 79 t, respectively. This decline is attributed to the management changes rather than a decline in relative abundance. Four estuaries account for 85 per cent of commercial Blue Swimmer Crab landings in New South Wales (79 t in 2018–19), the most important being Wallis Lake (45 t in 2018–19).

Fishing mortality in the Estuary General Fishery (EGF) is now controlled through Total Allowable Catch (TAC) of 225 t, with catch allocations based on current shareholdings, effective from 1 December 2017. The minimum legal length (MLL) for the commercial sector was increased from 60 – 65 mm carapace length (CL) in December 2017.

Recreational and Indigenous

The most recent estimate of the recreational harvest of Blue Swimmer Crabs in NSW was approximately 63 000 crabs at around 14 t during 2017–18 [Murphy et al. 2020]. This estimate was based on a survey of Recreational Fishing Licence (RFL) households. RFL households were comprised of at least one member who possessed a long-term (1 and 3 years duration) fishing licence and included other fishers resident within their households.

A similar survey of RFL households was done in 2013–14 and provides a comparison with data from the 2017–18 survey. The catch of Blue Swimmer Crabs in 2013–14 was approximately 50 600 crabs estimated to weight 27 t [Murphy et al. 2020]. The annual recreational harvest of Blue Swimmer Crabs in New South Wales was previously estimated to lie between 150 and 310 t based on the results of the National Recreational and Indigenous Fishing Survey [Henry and Lyle 2003] and surveys undertaken by New South Wales Department of Primary Industries.

Fishing effort trends

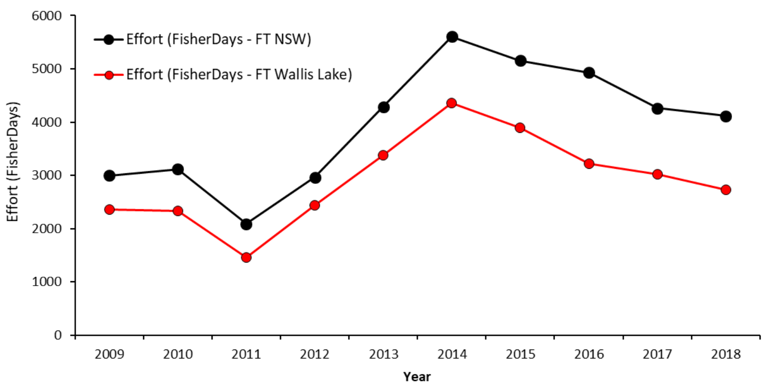


Figure 2. Reported effort (Fisher Days) fish trapping in NSW (all estuaries) and Wallis Lake from 2009–10 to 2018–19.

Nominal effort levels (in the number of fisher days) over the past eight years have remained steady (~4000 per year) and, are well below historical levels (> 8 000 per year).

Catch rate trends

BSC standardised catch rates were predicted from generalised linear models (GLM). The GLM statistical modelling provided an estimate of mean catch rates that were corrected for a variety of variables that bias raw data. The GLM models were fitted using the statistical software packages Cede (Haddon et al., 2018) and R (R Development Core Team 2017). Explanatory model terms considered different catch rates between fishing years, months, individual fisher operations (Authorised fisher ID) and, their transformed fishing effort.

Standardised commercial catch rates (in mean CPUE kg.day-1) is likely to be the most reliable index of relative abundance for BSC. For recent data analysed as mean daily catch rates (available from 2009–10 to 2018–19), catch rates in Wallis Lake have declined by more than 50% in the two most recent years. The impact of recent management changes (i.e. quota management and MLL increase) on catch-rates has not been quantified but are expected to have driven this decline. While catch rates in Wallis Lake in recent years have declined below the recent peak (2014–2016), they are similar to historic levels calculated for a period with consistent management arrangements (1997–2009). Since 2011, catches rates in the other main estuaries (landings > 1 t/ year) have fluctuated around the long-term average.

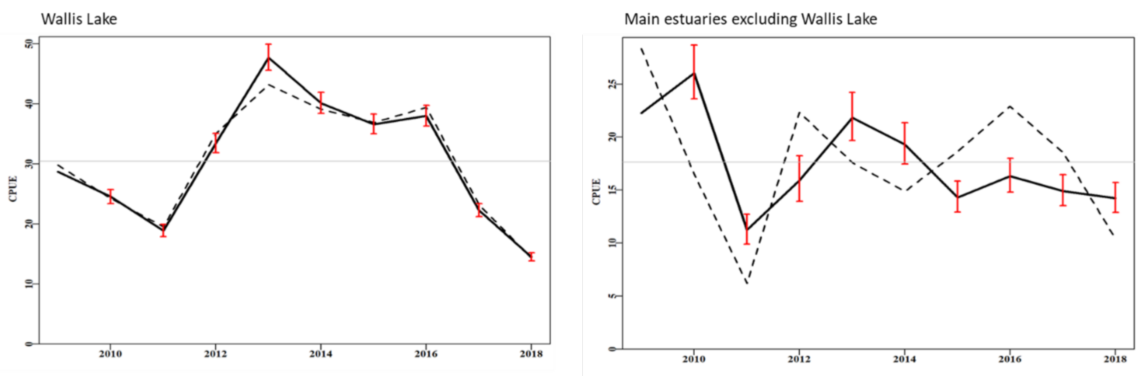


Figure 2. Standardised commercial catch rates from Wallis Lake and major estuaries (nominal scale; CPUE kg day-1 from daily records). The dashed line is the geometric mean CPUE while the solid line with 95% confidence intervals is the standardised CPUE. The horizontal line represents the average catch rate (2009–10 to 2018–19).

Stock Assessment Methodology

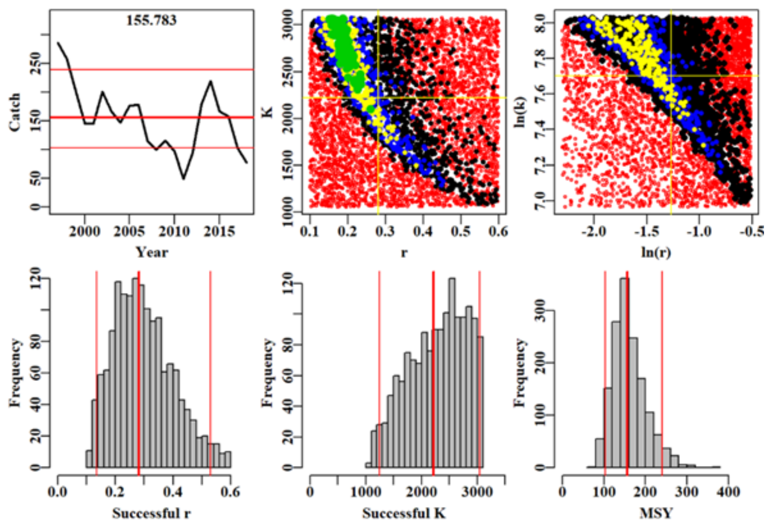
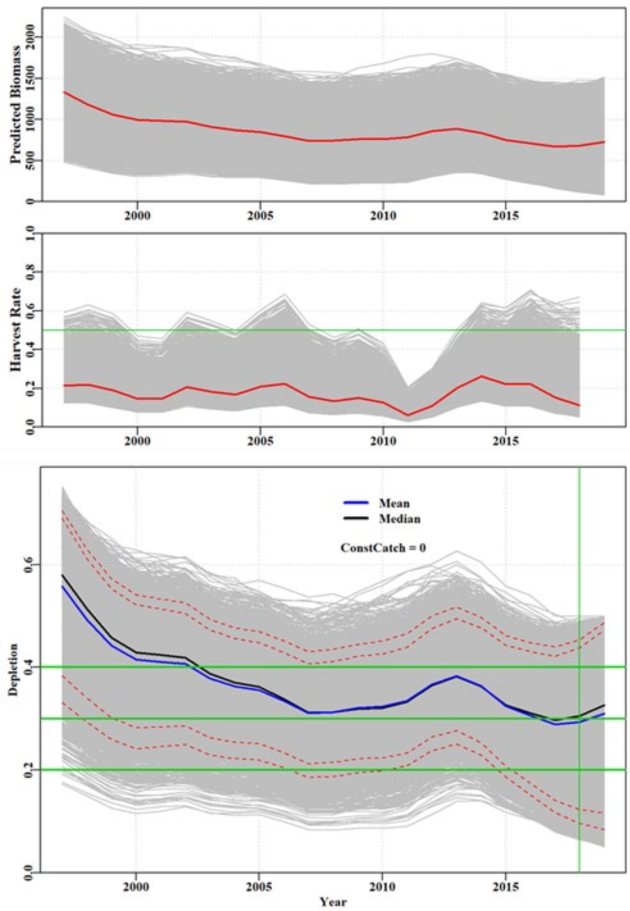
Year of most recent assessment	2020
Assessment method	Weight of evidence approach, including; standardised catch rates, and Catch-MSY model-assisted catch-only assessment.
Main data inputs	1. Landed commercial catch -1984–85 to 2018–19. 2. CPUE- kg. Fisher Day-1 2009–10 to 2018–19.
Key model structure and assumptions	1. Standardised catch rates (using cede v. 0.04) (Haddon et al., 2018). Assumptions: that annual catch rates are a relative index of abundance and not unduly influenced by

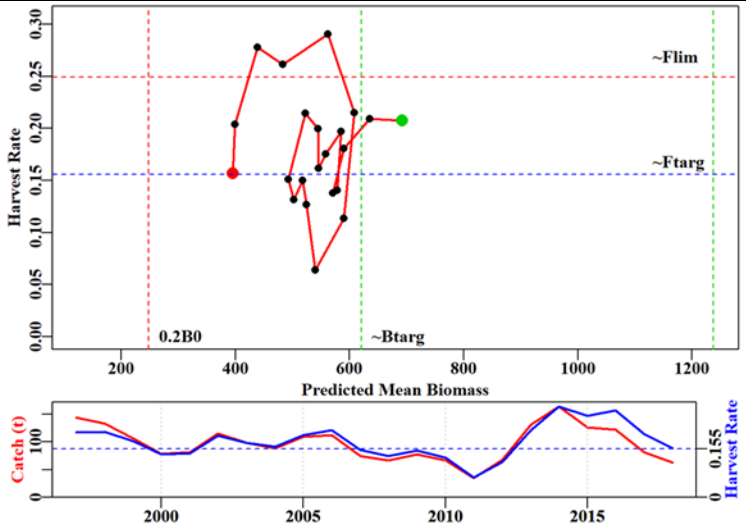
	other factors that are not accounted for through standardisation. 2. Catch-MSY model-assisted catch-only assessment (Martell & Froese, 2013) using the 'simpleSA' package in R (Haddon et al., 2018).This uses population productivity (r) and carrying capacity (K) parameters of an underlying Schaefer production model, applied to total annual catches, to estimate the ranges in biomass and harvest rate that could have resulted in the annual catches. Assumptions: Estimated ranges of the population growth rate parameter (r) and carrying capacity (K) of the stock are pre-determined through an assumed resilience; the underlying population biomass model is very generic and simplistic, with parameters that remain constant through time; the model outcomes are quite dependent on the lower bound of r selected (Martell and Froese 2013). 'Resilience' was set to low in the Catch MSY model specification, which allows for a possible range in population growth rate (r) of 0.1 - 0.6.
Sources of uncertainty evaluated	The effect of four different constant catch scenarios on the 5-year projections of estimated biomass and harvest rate trajectories. The impact of recreational harvest ranging from 10-30% of reported commercial landings on stock depletions.

Status Indicators and Limits Reference Levels

Biomass indicator or proxy	None specified in a formal harvest strategy. For the purposes of this assessment the mean estimated biomass depletion (as a percentage of the estimated maximum biomass, K) from modified Catch-MSY analyses (e.g., Martell & Froese, 2013) was selected as a proxy.
Biomass Limit Reference Level	None specified in a formal harvest strategy. For the purposes of this stock assessment the values of 20% of estimated maximum biomass for the limit reference point (Blim) and 48% of estimated maximum biomass as the target reference point (Btarg) were selected.
Fishing mortality indicator or proxy	None specified in a formal harvest strategy. For the purposes of this stock assessment the estimated harvest rate from modified Catch-MSY analyses was selected.
Fishing mortality Limit Reference Level	None specified in a formal harvest strategy. For the purposes of this stock assessment the estimated harvest rate corresponding to 20% of estimated maximum biomass for the limit reference point (Hlim) and the estimated harvest rate corresponding to when the stock is a 48% of estimated maximum biomass for the target reference point (Htarg) were selected.

Stock Assessment Results

2. BSC CMSY 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.	
2. Range of depletion trajectories for successful r-K pairs, showing mean and median annual depletion and 80th and 90th percentiles (dashed lines). The lower green line is the 0.2B0 limit reference point, while the upper is Btarg (0.48B0) target reference point.	

2. BSC stock status trajectory from 1997–98 – 2018–19, showing annual stock status in estimated biomass (t) and harvest rate. Reference levels are shown for biomass target (BMSY) and limit (0.2B0) reference levels, and for the corresponding harvest rates that should keep biomass at or above the target Ftarg (FMSY) and above the limit Flim (FB20). The start of the trajectory in 1997–98 is indicated by a green point and final year 2018–19 by a red point. The red line on the bottom plot is catch and the blue line is harvest rate.	
2. Summary output of key parameters from the BSC Catch-MSY stock assessment, showing mean (50%) estimates for r, K and Current Depletion, with 95% intervals.	<table><tr><td>Parameter</td><td>5%</td><td>50%</td><td>95%</td></tr><tr><td>MSY</td><td>107</td><td>155</td><td>238</td></tr><tr><td>CurrDepl</td><td>0.06</td><td>0.32</td><td>0.57</td></tr></table>
Biomass status in relation to Limit	Biomass is estimated to have remained between Btarg and Blim from 2001–02 -2018–19. The mean estimate of current Biomass is ~32% of B0, with a 95% CI of 6% - 57%. Current estimated mean B is above the Blim level of 0.2B0. The assessment estimated maximum sustainable yield (MSY) to be around 150 t. Average combined commercial and recreational harvest over the last six years was approximately 170 t (151 and 19 t respectively), with estimated landings in 2014–15 (239 t) well above MSY. Five-year projections at a constant catch of 150 t (~mean catch 1997/98 - 2018/19) indicate that B is predicted to remain stable at that catch level. Five-year stock projections at catch equal to the current TAC (~225 t) with recreational catches estimated at 20% of total harvest include some trajectories that deplete biomass to less than 20% of unfished levels within five years.
Fishing mortality in relation to Limit	Estimated mean harvest rate exceeded estimated Ftarg from 1997–98 to 2000–01 and 2002–03 to 2007–08, resulting in a gradual decline in biomass over this period.

	Harvest rate declined rapidly from 2009–10 to 2011–12, then increased rapidly exceeding Ftarg from 2014–15 - 2016–17. Under revised management arrangements, harvest rate has declined during the last two years and remained near Ftarg in 2018–19.
Previous SAFS stock status	2018 sustainable.
Current SAFS stock status	Using the weight of evidence approach, BSC is considered to be sustainable.

Qualifying Comments

The above evidence indicates that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired. However, if the level of fishing mortality permitted under existing management arrangements (i.e. TAC 225 t) is combined with recreational catches estimated at 20% of total harvest, Catch-MSY model outputs include some trajectories that deplete biomass to less than 20% of unfished levels within five years.

A legal minimum size (LMS) of 65 mm carapace length is enforced for commercial and recreational fishers. Female crabs close to the LMS (60 mm) are sexually mature and are capable of producing one–three batches of eggs within a season (Johnson et al., 2010).

Fishing mortality in the EGF is now controlled through Total Allowable Catch (TAC) of 225 t, with catch allocations based on current shareholdings, effective from 1 December 2017. The increased minimum legal length for the commercial sector, and the implementation of daily possession limit for all ocean fisheries (25 kg) has reduced fishing pressure on the spawning stock.

Nominal effort levels (in the number of fisher days) over the past eight years have remained steady (~4000 per year) and, are well below historical levels (> 8 000 per year). This reduction in fishing effort in combination with stable size compositions in landings indicates that fishing mortality is constrained in New South Wales waters to sustainable levels.

The modelling approaches used in the current assessment are very simplistic and generic; therefore, results should be interpreted with caution. There is high uncertainty in the estimates of biomass depletion, harvest rate and MSY derived from catch data using Schaefer production model-assisted Catch-MSY analysis.

A key assumption in the Catch-MSY analysis is the ability to define a reasonable prior range for the parameters of the Schafer model. Estimated ranges of the population growth rate parameter (r) and carrying capacity (K) of the stock are pre-determined through an assumed resilience; the model outcomes are quite dependent on the lower bound of r selected (Martell & Froese, 2013). 'Resilience' was set to low in the Catch MSY model specification, which allows for a possible range in population growth rate (r) of 0.1 - 0.6.

Catch-MSY modelling may perform poorly for short-lived species, particularly stocks characterised by episodic recruitment and long-term changes in productivity.

The uncertainty regarding the spatial variation in total removals hampers the interpretation of the modified Catch-MSY modelling results.

Likewise, the uncertainty around the accuracy of historical commercial catch data should be considered when interpreting the results of the modified Catch-MSY modelling.

References

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