Stock Status Summary - 2020

Crimson Snapper (*Lutjanus erythropterus*)

Timor-Arafura seas

Stock Reduction Analysis

Assessment Authors

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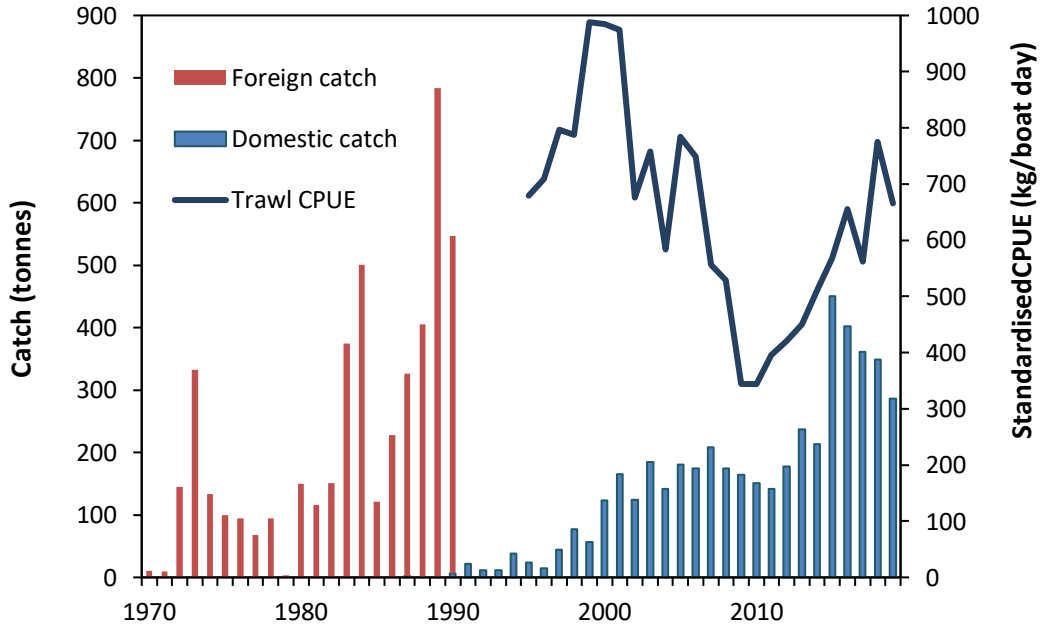
Stock Structure

Crimson Snapper is a long-lived, widespread Indo-Pacific species found throughout tropical northern Australia (Fry and Milton, 2009; Newman et al., 2000). Genetic analyses indicate that there is broad scale connectivity of Crimson Snapper across the Australian Arafura and Timor Seas (Salini et al, 2006). However, more recently Crimson Snapper were found to have separate stocks in Joseph Bonaparte Gulf, Timor and Arafura seas and Gulf of Carpentaria and it is assumed that Crimson Snapper have the same stock structure due to the similarities in their distributions and biology (Saunders et al. 2018).

This assessment was conducted in the Timor- Arafura seas biological stock.

Stock Status

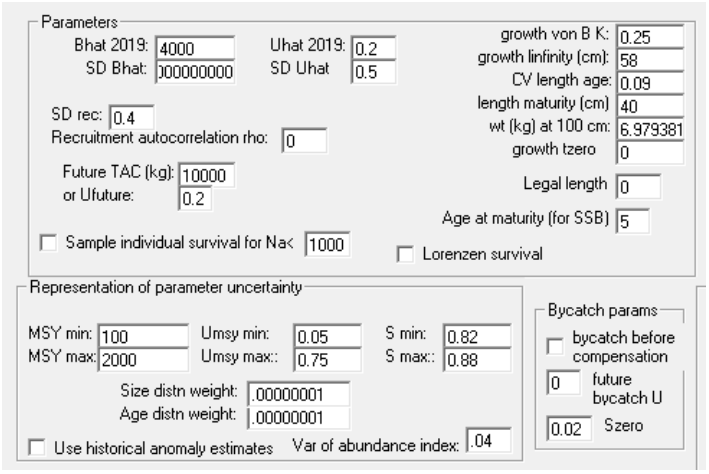
Catch and CPUE trends



Total annual Crimson Snapper catch from 1970-2019 and CPUE (kg per day fished) from 1995-2019

Stock Assessment Methodology

Year of most recent assessment	2020
Assessment method	Stochastic Stock Reduction Analysis (SRA) (Walters et al. 2006) using executable VBA file (Lombardi and Walters 2011).

Main data inputs	Standardised CPUE from the Demersal Fishery trawl sector and annual total landed catch of Crimson Snapper from all fishing sectors by calendar year: • NT commercial logbooks 1983 – 2019; • Taiwanese fishing catch data; • NT Fishing Tour Operator logbooks 1994-2019; and • NT recreational fishing surveys 2000, 2010, 2014 and 2015 CPUE was standardised for individual days fished using by averaging catch over fishing grids (spatial averaging; Walters 2003) and is described in Grubert et al. (2013).
Key model structure and assumptions	The stochastic SRA used in this assessment has three main assumptions. 1) The population is at virgin conditions the first year data is recorded. 2) There is stochastic variation in recruitment for all years. 3) Natural mortality is constant for all years.
Stochastic SRA Input parameters Where: Bhat 2019 is estimated biomass in the final year of the assessment Uhat 2019 is the estimated fishing mortality in the final year of the assessment Growth von B K is the von Beralanffy growth coefficient (k) Growth infinity is L_∞ or the asymptotic length CV length age is the coefficient of variation of the length at age Length at maturity is the length at which 50% of fish are mature. Wt at 100cm is theoretical weight at 100cm Age at maturity in years MSY min, MSY max, Umsy min, Umsy max, S (survival) min and S max are representations of parameter uncertainty	
Sources of uncertainty evaluated	The stochastic SRA used in this assessment is a data moderate approach that uses Umsy, MSY and a string of abundance, in this case CPUE, as leading parameters to assess the effects of historic catch on the stock. Input parameters Bhat and MSY were guided by results of Catch-MSY assessments undertaken for this stock. Despite CPUE having been standardised for fishing area, skipper experience and changes in weather conditions were assumed to have not influenced the annual CPUE significantly. Recruitment is assumed to have log normal distributed annual anomalies.

Status Indicators and Limits Reference Levels

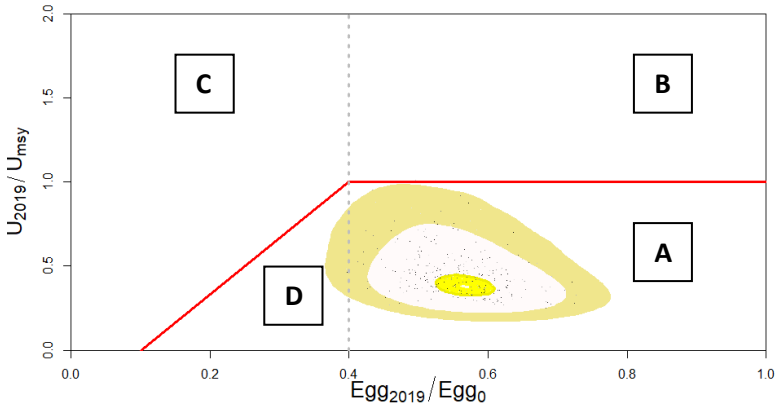
Biomass indicator or proxy	Mean annual biomass and depletion level, as estimated in this assessment.
Biomass Limit Reference Level	B_{lim}, expressed as 20% of *K* (B_0), the carrying capacity for the stock as estimated in this assessment.
Fishing mortality indicator or proxy	Mean annual harvest rate, as estimated in this assessment.
Fishing mortality Limit Reference Level	Fishing mortality (U) expressed as a proportion of U at MSY, with U < Umsy being the estimated harvest rate that will prevent the stock from declining below the biomass target B_{targ} (B_{MSY}).

Stock Assessment Results

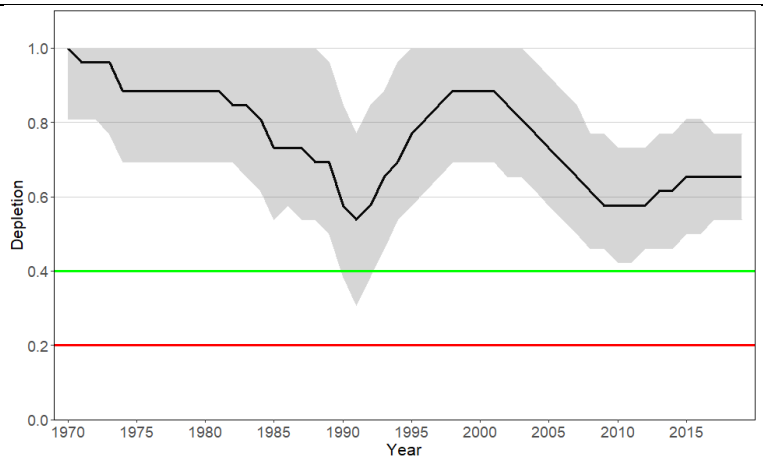
Crimson Snapper stochastic SRA posterior probability plot.

Four status zones:
A - (target zone) Stock not overfished and Overfishing is not occurring.
B – Stock not overfished but overfishing is occurring.
C – Stock overfished and overfishing is occurring.
D – Stock overfished but overfishing is not occurring

The outer edge of each coloured (and cumulative) probability region (from inner-most to outer-most) correspond to a 10%, 80% and 99% chance that the estimated status measures fall within that region.



Depletion trajectory for the Arafura-Timor seas stock of Crimson Snapper. The red line is the $0.2B_0$ limit reference point, the green line is the Schaefer B_{MSY} ($0.4b_0$) target reference point. The greyed area represents the 95% Confidence Intervals.



Summary output of key parameters from the Arafura-Timor seas Crimson Snapper SRA assessment, showing mean (50%) estimates of Current Depletion, MSY and Umsy

Parameter	5%	50.0%	95%
Depletion	0.54	0.65	0.78
MSY	233	346	421
U2019/Umsy	0.15	0.31	0.95

(fishing mortality), with 90% credible intervals.	
Biomass status in relation to limit	Total biomass declined relatively rapidly until the early-1990s before recovering up until the early 2000s. The biomass then steadily declined to 2009 before slightly trending upwards until 2019. The current biomass is estimated to be approximately 0.65 of unfished levels. Of the 1,000,000 simulations run, 83% showed current biomass levels above 0.4 and only 1% were below 0.2 of unfished levels. The model outputs also indicated that current fishing mortality was well below that required to achieve MSY.
Crimson Snapper stochastic SRA posterior probability distribution	The position of the posterior probability distribution indicates that the Arafura stock of Crimson Snapper is not overfished, nor is overfishing occurring.
Previous SAFS stock status	New stock
Current SAFS stock status	Sustainable

Qualifying Comments

The Stochastic SRA is only a data moderate model that is primarily driven by catch and CPUE for this species. The catch for Crimson Snapper is been relatively well reported, however, there are substantial doubts around the accuracy of the large catches by the foreign trawlers in the 1970s and 1980s. Most researchers at the time considered these catches to be an under report of the true harvest. The trawl CPUE has been highly variable through time but has increased substantially over the past 10 years. However, the CPUE has only been standardised by fishing grid and not other variables like skipper and weather as these were assumed not to significantly influence the annual variation in CPUE. Despite these uncertainties, the model outputs suggesting a relatively high biomass level (65% of B_0) is supported by the high biomass predicted by abundance surveys conducted by Ramm (1994) which was immediately after the largest catches for this species, so the relative lower catches from the domestic fishery in the subsequent 30 years would have allowed the stock to rebuild.

References

Grubert, M. A., Saunders, T. M., Martin, J. M., Lee, H. S. and Walters, C. J. (2013). Stock assessments of selected Northern Territory fishes. Northern Territory Government, Australia. Fishery report No. 110.

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Ramm, D. C. (1994). Australia's Northern Trawl Fishery. Final report to the Fisheries Research and Development Corporation project 86/049. Darwin, NT Department of Primary Industry and Fisheries. Fishery Report No 32: 59.

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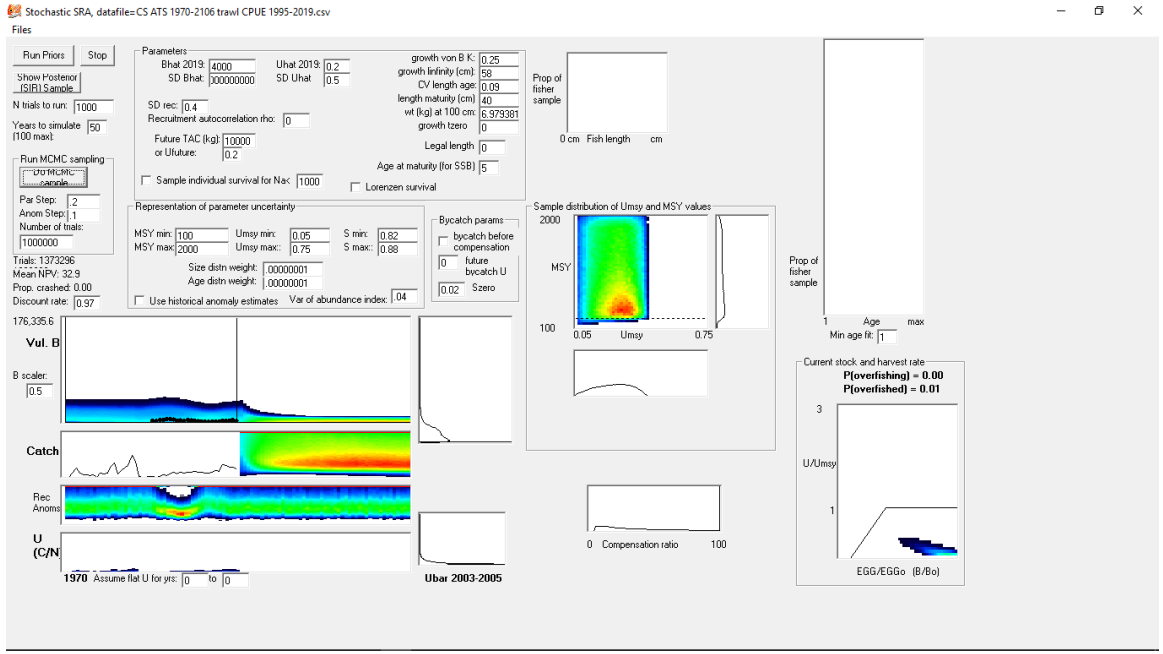
Saunders, T., Barton, D., Crook, D., Hearnden, M. and Newman S. R. (2018). Stock/Management unit division in the Northern Territory Offshore Snapper Fishery. Unpublished fisheries report.

Walters, C. J. (2003). Folly and fantasy in the analysis of spatial catch rate data. Canadian Journal of Fisheries and Aquatic Sciences 60: 1433-1436.

Walters, C. J., J. Korman and S. J. Martell (2006). A stochastic approach to stock reduction analysis. Canadian Journal of Fisheries and Aquatic Sciences 63: 212-223.


Stochastic SRA, datafile=CS ATS 1970-2106 trawl CPUE 1995-2019.csv
Files
Run Priors
Stop
Show Posterior (SIR) Sample
N trials to run: 1000
Years to simulate (100 max): 50
Run MCMC sampling
Do MCMC sample
Par Step: 2
Anom Step: 1
Number of trials: 1000000
Trials: 1373296
Mean NPV: 32.9
Prop. crashed: 0.00
Discount rate: 0.97
Parameters
Bhat 2019: 4000
SD Bhat: 000000000
Uhat 2019: 0.2
SD Uhat 0.5
SD rec: 0.4
Recruitment autocorrelation rho: 0
Future TAC (kg): 10000
or Ufuture: 0.2
Sample individual survival for Nat 1000
Lorenzen survival
growth von B K: 0.25
growth linfinity (cm): 58
CV length age: 0.09
length maturity (cm) 40
wt (kg) at 100 cm: 6.979381
growth tzero 0
Legal length 0
Age at maturity (for SSB) 5
Representation of parameter uncertainty
MSY min: 100
MSY max: 2000
Umsy min: 0.05
Umsy max: 0.75
S min: 0.82
S max: 0.88
Size distn weight: .00000001
Age distn weight: .00000001
Use historical anomaly estimates
Var of abundance index: .04
Bycatch params
bycatch before compensation
0 future bycatch U
0.02 Szero
Prop of fisher sample
0 cm Fish length cm
Sample distribution of Umsy and MSY values
2000
MSY
100
0.05 Umsy 0.75
Prop of fisher sample
1 Age max
Min age fit: 1
Current stock and harvest rate
P(overfishing) = 0.00
P(overfished) = 0.01
3
U/Umsy
1
EGG/EGGo (B/Bo)
176,335.6
Vul. B
B scaler: 0.5
Catch
Rec. Anoms
U (C/N)
1970 Assume flat U for yrs: 0 to 0
Ubar 2003-2005
0 Compensation ratio 100