SESSF Hapuku Stock Status Summary - 2018

Hapuku (*Polyprion oxygeneios*)

(Image from fishesofaustralia.net.au)

Assessment Authors and Year

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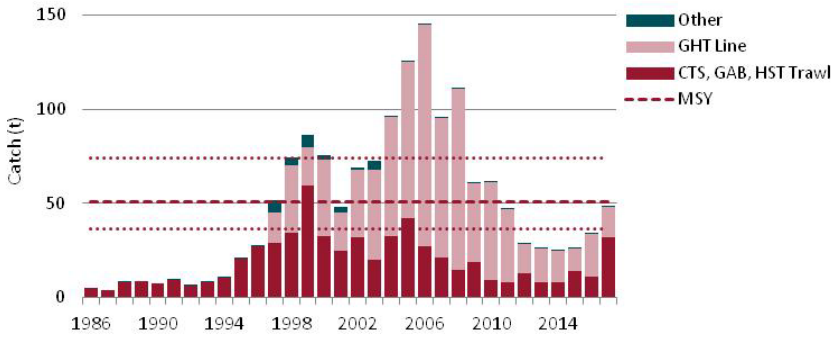
Stock Structure

For the purposes of this assessment, stock status of Hapuku is reported at the jurisdictional level, assuming that all Hapuku caught in Commonwealth Southeast Scalefish and Shark Fisheries (SESSF) constitute one 'stock' for status reporting purposes.

Stock Status

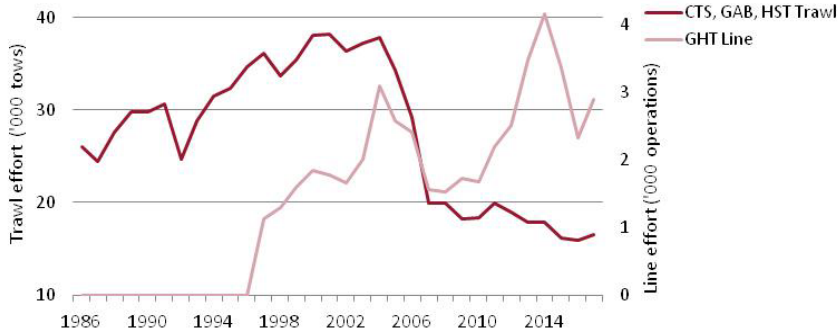
- **Commonwealth**

Catch trends



Total annual Hapuku catch by sector in the Commonwealth Southeast Scalefish and Shark Fishery from 1986 - 2017, compared to MSY estimated in this assessment. Dotted lines show 95% confidence intervals around the MSY estimate.

Fishing effort trends



Fishing effort in the main SESSF fishery trawl (tows) and line (operations) sectors from 1986 - 2017 showing: bottom trawl tows in the Commonwealth Trawl Sector (CTS), Great Australian Bight (GAB) and High Seas Trawl (HST) fisheries; and autoline, longline, dropline and trotline operations in the Gillnet, Hook and Trap (GHT) fishery.

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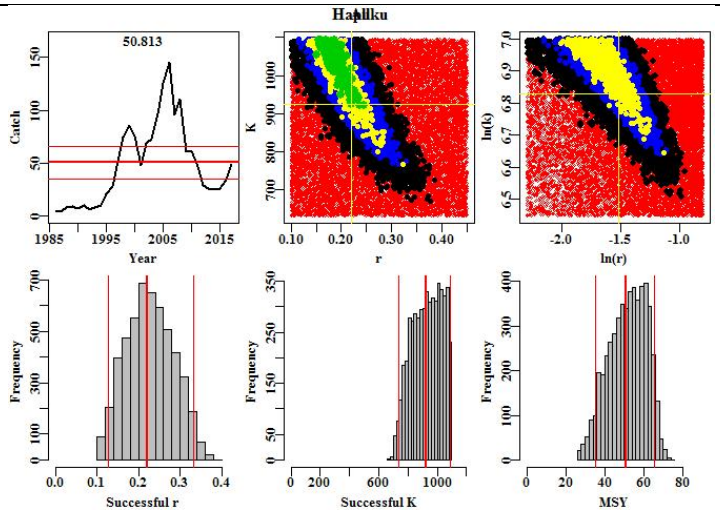
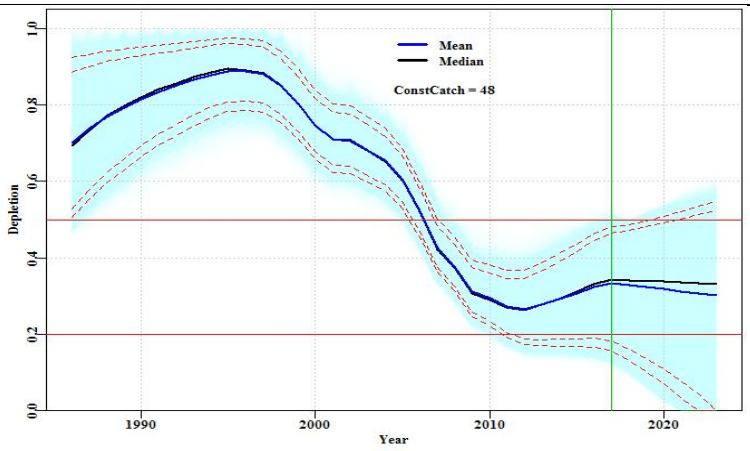
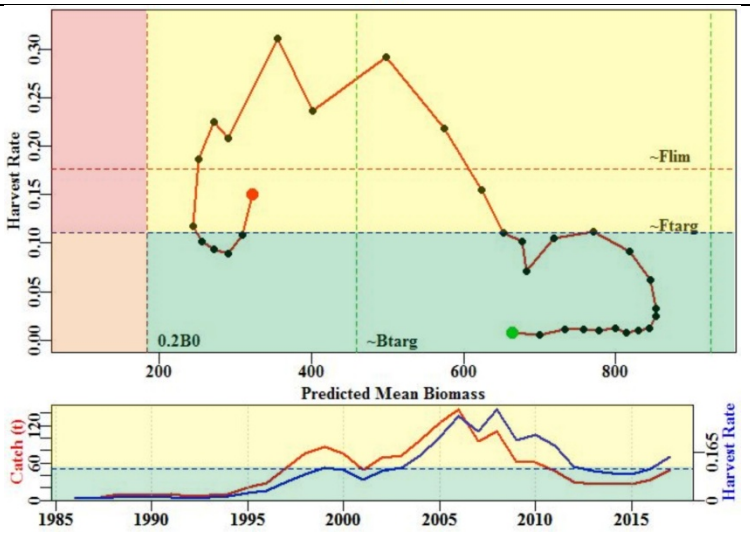
Stock Assessment Methodology

Year of most recent assessment	2018
Assessment method	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.
Main data inputs	Annual total landed catch of Hapuku by calendar year across all sectors and all fishing gears in the SESSF from 1986 - 2017, derived from catch return logbooks for 1986 - 2001, and from Catch Disposal Records from 2002 - 2017.
Key model structure and assumptions	'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 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* = 0.13 - 0.37; and *K* = 743 t - 1167 t. The assessment successfully covered modes in the probability distributions of *r*, *K* and MSY. A key uncertainty not addressed in this assessment relates to stock structure. Hapuku probably constitute a number of separate biological stocks with limited connectivity across the extent of the SESSF, which have been subject to different exploitation patterns.

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	F_{targ}, being the estimated harvest rate that should prevent the stock from declining below the biomass target B_{targ} (B_{MSY}).

Stock Assessment Results

Hapuku 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.	
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 2017, the final year for which data are available. Projected depletion levels are shown for 5 years thereafter at constant catch at the 2017 level of 48t.	
Hapuku stock status trajectory from 1986 - 2017, 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 1986 is indicated by a green point and final year 2017 by a red point. The red line on the bottom plot is catch and the blue line is harvest rate.	
Summary output of key parameters from the Hapuku Catch-MSY stock assessment, showing mean (50%) estimates for r, K, MSY and Current Depletion, with 95% intervals	
Biomass status in relation to Limit	The assessment estimates biomass to have been above B_{targ} from 1986 - 2006, although declining from ~1996 onwards as a result of increasing catches. B is estimated to have remained between B_{targ} and B_{lim} since 2007,

Parameter	2.5%	50.0%	97.5%
r	0.13	0.22	0.37
K	743	931	1,167
MSY	34.6	50.9	74.7
CurrDepl	0.11	0.33	0.55

	declining from 2007 - 2012 and then increasing from 2013 onwards in response to decreased catches. Reported catch (mainly by trawl) increased in 2017, but remained below the mean estimated MSY of 51 t. The mean estimate of current B is ~33% of B_0, with a 95% CI of 11% - 55%. Current estimated mean B is above the B_{lim} level of $0.2B_0$. Five-year projections at the 2017 catch level of ~48 t indicate that biomass is predicted to decline slowly at that catch level.
Fishing mortality in relation to Limit	Estimated mean harvest rate remained low from 1986 - 1994 and then increased fairly rapidly from 1995 onwards, exceeding estimated F_{targ} in 2004 and exceeding estimated F_{lim} from 2005 - 2011, resulting in decreasing biomass over this period. Harvest rate decreased rapidly from 2008 - 2015 as a result of decreased catches, increased to near F_{targ} in 2016 and increased to exceed F_{targ} in 2017. Harvest rate is currently estimated to be 0.15, above the F_{targ} level of 0.11 as a result of the increase in reported trawl catch in 2017.
Previous SAFS stock status	Stock status for Hapuku has not previously been reported in SAFS
Current SAFS stock status	Based on the results of this Catch-MSY analysis, Hapuku is considered to be Depleting

Qualifying Comments

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.

Estimated harvest rates over the period 2007 - 2010 range from 0.21 - 0.31, averaging 0.24. Conversion to fishing mortality rates (for a Type I fishery) results in F estimates ranging from 0.23 - 0.37, averaging 0.28.

These results are consistent with estimates of F derived by Zhou *et al.* (2012) using bSAFE cumulative risk assessment analysis across five SESSF sectors and gear types over 2007 - 2010. The estimated F_{targ} = 0.12 in this assessment (converted from a harvest rate of 0.11 for a Type I fishery) is the same as the F_{msm} = 0.12 of Zhou *et al*. (2012). The F_{lim} = 0.20 in this assessment (converted from a harvest rate of 0.18) lies between F_{lim} = 0.18 and F_{crash} = 0.24 of Zhou *et al*. (2012). Average F=0.28 (converted from an average harvest rate of 0.24) over 2007 - 2010 in this assessment is slightly above the cumulative F = 0.24 of Zhou *et al*. (2012).

References

Haddon M., A Punt and P. Burch (2018) simpleSA: A package containing functions to facilitate relatively simple stock assessments. R package version 0.1.18.

Martell, S. and R. Froese (2013) A simple method for estimating MSY from catch and resilience. *Fish and Fisheries* **14**: 504-514.

Zhou S., M. Fuller and R. Daley (2012) Sustainability assessment of fish species potentially impacted in the Southern and Eastern Scalefish and Shark Fishery: 2007-2010. CSIRO report to the Australian Fisheries Management Authority, June 2012, 49 pp.