Stock Status Summary 2021

NSW Stock Status Summary – Hapuku (*Polyprion oxygeneios)*

Assessment Authors and Year

Chick, R.C. and A. M. Fowler. 2020. NSW Stock Status Summary 2020/21 – Hapuku (*Polyprion oxygeneios).* NSW Department of Primary Industries, Fisheries NSW. 9 pp.

Stock Status

Current stock status	On the basis of the evidence contained within this assessment, Hapuku is currently assessed as **Undefined** for the NSW component of the stock.

Biology and Stock Structure

Hapuku (*Polyprion oxygeneios*) is a large demersal perciform (ray-finned bony fish) broadly distributed in the temperate waters of all southern oceans between the latitudes of 28°S and 43°S (Paxton et al. 1989). The species occurs throughout NSW, with adults found on the continental slope commonly in depths ranging from about 200 m to 500 m.

Demographic information is unavailable for Hapuku in NSW. Investigations from Western Australia and New Zealand indicate the species can attain a large size (up to 180 cm total length, TL) and weight (78 kg), are long-lived (up to 63 years), and moderate- to late-maturing (7–13 years; Francis et al. 1999; Wakefield et al. 2010). Estimates of natural mortality (*M*), previously assumed to be 0.2, suggest it may be as low as 0.13–0.16 (Pavez and Oyarzun 1985) and Francis et al. (1999) estimated *M* to be 0.1 (or less).

A length sample obtained from the commercial fishing sector in NSW during the 1990s indicated that fish were of similar size to those caught in Western Australia and New Zealand (Francis et al. 1999; Wakefield et al. 2010).

Growth rates for Hapuku are age-dependent. Estimates from Western Australia indicate fast initial growth (~15–30 cm TL year^{-1}) during the pelagic juvenile phase, followed by moderate growth (~4.0 cm year-1) during ages 5–9 years, reducing to slow growth (~0.4 cm year^{-1}) beyond 10 years (Wakefield et al. 2010).

The stock structure of Hapuku in NSW is unknown, but panmixia is expected throughout the region, owing to the extended larval/juvenile phase (years) and large-scale genetic homogeneity of congener (same category of fish) *P. americanus* which has similar life-history traits (Roberts 1996; Sedberry et al. 1996; Ball et al. 2000; Wakefield et al. 2010).

The scale of assessment is made at the jurisdictional level (state-wide).

Stock Status

The status of the NSW Hapuku stock is classified as **Undefined**.

This determination is consistent with that of the 2020 Hapuku stock assessment (Chick and Fowler 2020b) and the 2018 Hapuku stock assessment (Chick and Fowler 2018) which was supported by independent review (unpublished, DPI Fisheries 2018). A review of indicators (weight-of-evidence approach) was used to assess the status of the NSW Hapuku stock. There are insufficient data available to support more quantitative stock assessment methods. Uncertainty regarding Hapuku stock structure, biology and recreational catch, decreasing and low levels of commercial catch together with similar patterns in effort (days), and low and variable catches and effort between

different commercial fishing methods, that exacerbate uncertainty surrounding estimates of standardised and nominal catch rates, provide insufficient information with which to reliably determine a stock status.

Fishery statistics summary

Changes in NSW commercial fishery reporting requirements, sources of commercial fishery data and the continuity or otherwise of data sources through time are outlined in Appendix 1 of Chick and Fowler (2020b). Notably, between 1997/98 and 2008/09 (inclusive), fishers reported monthly catch and effort (in days) for each fishing method (gear type). From 2009/10, monthly reports of daily catch and effort (hours) and fishing method have been required. To construct a longer time series of commercial fishery data (i.e. from 1997/98 to present), daily records from 2009/10 have been re-aggregated into monthly catches (kg) by fisher and gear type, with effort in days per month estimated from the number of distinct fishing dates in each month when the method was used and there was a reported landing of the species of interest in that month, irrespective of whether the species was reported on each day, to be consistent with earlier reporting.
Changes in reporting requirements form 1997/98 onward included separate reporting of Hapuku from congener Bass Groper (*P. americanus)*. Hence, fishery data for this species alone is only available from 1997/98. Further, management arrangements including input controls and modified OTL Fishery endorsements to restrict fishing east and west of the 100 fathom depth contour (OTL–Line East and OTL–Line West, respectively) are described in the NSW Fisheries Management (Ocean Trap and Line Share Management Plan) Regulation 2006 (DPI Fisheries 2017). Changes to the endorsement limited the number of fishers endorsed to access deep waters, and hence Hapuku, and prohibited OTL–Line West-endorsed fishers from landing Hapuku (as well as other species). Given the historical catch considerations in the allocation of the endorsements and the habit of Hapuku as a generally deep-water fish, the change to this fishing endorsement is not considered to have substantially impacted on the catch of Hapuku through time. This report includes data available from logbook returns from commercial fishers for the period July 1997 to June 2020 (inclusive), for Hapuku. All reported catches of Hapuku are provided, unless otherwise stated in the text and captions.

Catch information

Commercial fisheries

Since 2012/13, Hapuku have been exclusively caught in the OTL Fishery (i.e. 100% of total reported catch). Prior to 2012/13, minor catches (0-12% of total annual catch) of Hapuku were reported in the Ocean Fish Trawl and Ocean Prawn Trawl Fisheries. Historically, annual catches >100 t have been reported (e.g. 136 t in 1977/78) but these records include unknown proportions of *P. americanus* and unknown but anecdotally reported large catches taken from seamounts, outside of NSW waters.Total annual reported commercial catch of Hapuku has decrease steadily through time, from annual catches >10 t reported prior to 2003/04, including the recent historical peak of 15 t in 1999/00, to <2 t since 2014/15 and in 2019/20, total catch was <1 t (Figure 1 and Chick and Fowler 2020b). Since 1997/98, the majority of Hapuku catch within the OTL Fishery has been reported against dropline gear (Figure 2 and Chick and Fowler 2020b; mean: 74%, range: 22–99%). Although since 2017/18, and as annual catches have continued to decrease, this proportion has become more volatile, with 22% of the 0.5 t catch in 2019/20 reported to dropline gear.

Handlining accounts for most of the remaining catch (mean 13%, range: 0–48%), and exceeded that of dropline gear for the first time in 2019/20, albeit by <100 kg (Chick and Fowler 2020b). Relatively small but variable catches of Hapuku are also consistently reported against 'Other methods' (Chick and Fowler 2020b), primarily setline gear, with other gears (e.g. fish trap and trotline) also reporting highly variable and commonly small catches through time. Catch from droplining has generally decreased through time (Figure 2 and Chick and Fowler 2020b). Average annual catch over the decade from 1997/98 to 2007/08 was 7.8 t (range 3.1 t – 14.5 t) and decreased from levels above 7 t.yr^{-1} to about 5 t.yr^{-1}.

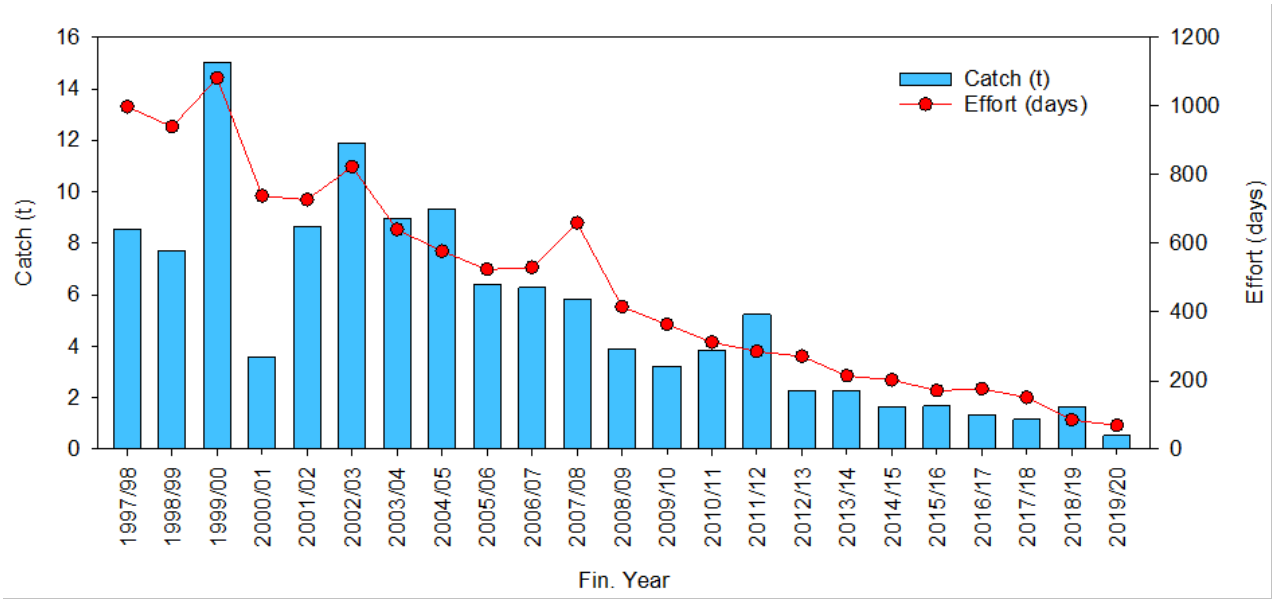

Figure 1. All fishing methods and fisheries combined – Total catch (t) of Hapuku and total effort (days) from 1997/98 to 2019/20. Note: effort (days) from 2009/10 are days fished per month irrespective of species reported to be consistent with effort reported from 1997/98 to 2008/09.

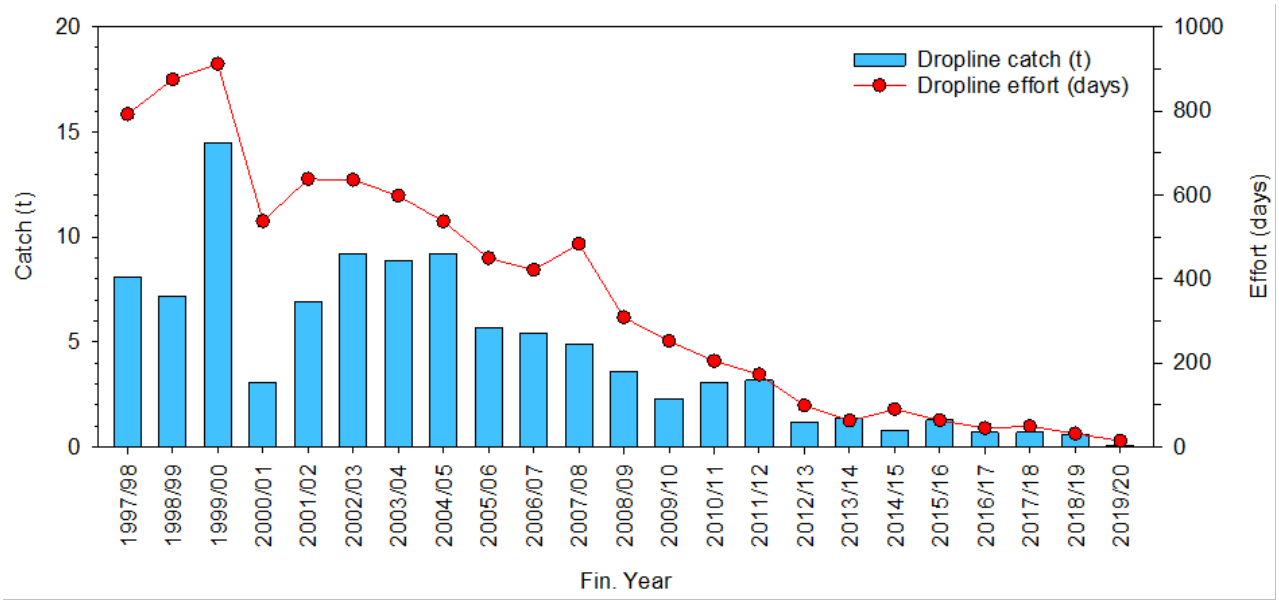

Figure 2. Droplining – Catch (t) of Hapuku and effort (days) from 1997/98 to 2019/20. Note: effort (days) from 2009/10 are days fished per month irrespective of species reported to be consistent with effort reported from 1997/98 to 2008/09.

Recreational and Indigenous cultural catch

Recreational and Indigenous catches are unknown. Hapuku are highly valued by recreational anglers in Australia (Wakefield et al. 2010). Henry and Lyle (2003) estimated the NSW annual recreational harvest of Rock Cod/Gropers (including Hapuku and nine other 'offshore/deep' species) to be 4,770 (± 1,532) individuals. In NSW, offshore (>5km from shore) recreational fishing effort reported in 2000/01 was 1.3% of the state-wide total, equating to 101,480 (± 32,176) fishing events (Henry and Lyle 2003). West et al. (2015) and Murphy et al. (2020) reported no recreational catch of Hapuku in 2013/14 or 2018/19, respectively. Logbook returns from the NSW Charter Boat sector report the catch of 2, 1, 1 and 0 individual Hapuku in 2016/17, 2017/18, 2018/19 and 2019/20, respectively. Anecdotal evidence, including social media reports of catches of Hapuku and Bass Groper, suggests the NSW recreational catch of these species in some years may equate to a substantial proportion (>15%) of the commercial catch.

There is a combined recreational bag limit of five and a boat limit of ten Hapuku, Banded Rockcod, Bass Groper, Gemfish and Blue-eye Trevalla. The boat limit applies to all recreational fishers, including in the charter fishing sector.

There is no understanding of the Indigenous cultural catch of Hapuku.

Illegal, Unregulated, Unreported (IUU) catch

The level of Illegal Unregulated and Unreported (IUU) fishing has not been quantified.

NSW Fisheries Compliance provide annual summaries of seizures of fish and invertebrates due to non-compliance to the public (dpi.nsw.gov.au/fishing/compliance/fisheries-compliance-enforcement). These public reports have not highlighted IUU activity specific to Hapuku within financial years between 2014/15 and 2019/20.

Effort information

Commercial

The pattern of total annual commercial effort reflects that of total catch, with a general decrease over the reporting period. Effort has decreased from ~1000 days per year from 1997/98 to 1999/00 to <100 days in the last two years (Figure 1 and Chick and Fowler 2020b), consistent with a decline in the number of fishing business reporting catches of Hapuku (Chick and Fowler 2020b). Peaks in effort were observed during 1999/00, 2002/03 and 2007/08. Peaks in effort during 1999/00 and 2002/03 corresponded with peaks in total catch, but not during 2007/08, which reflects a disproportionate increase in effort (days) reported using dropline gear. Dropline effort as generally decreased from >750 days.yr^{-1} prior to 2000/01, to between 400-500 days.yr^{-1} to 2007/08 (Figure 2 and Chick and Fowler 2020b).

Recreational and Indigenous cultural catch

Data for recreational and Indigenous effort for Hapuku are unknown.
There is no understanding of the Indigenous cultural effort expended on fishing for Hapuku.

Catch rate information

Commercial

Standardised catch per unit effort ($CPUE_{dy}$, kg.day^{-1}) droplining was estimated using a general linear model from the 'cede' package in the R statistical software. CPUE was standardised for month, fishing business and ocean zone. Fishing business was used as a proxy for vessel, because fishers are no longer required to report fishing vessel numbers on catch returns. Standardised $CPUE_{dy}$ for droplining showed no clear trend between 1997/98 and 2019/20, with gradually increasing variance throughout the series (Figure 3 and Chick and Fowler 2020b). The larger variances later in the series were most likely related to the low number of reported catch events (e.g. n = 4 in 2019/20)
Median nominal $CPUE_{dy}$ for handlining showed no clear trend between 1997/98 and 2019/20 (Chick and Fowler 2020b), including the recent period of increased effort (2009/10 to 2017/18). Peaks in median $CPUE_{dy}$ were observed during 2002/03, 2011/12 and to a lesser extent, in 2018/19, noting the potential uncertainty surrounding estimates derived from low numbers of fishing events.

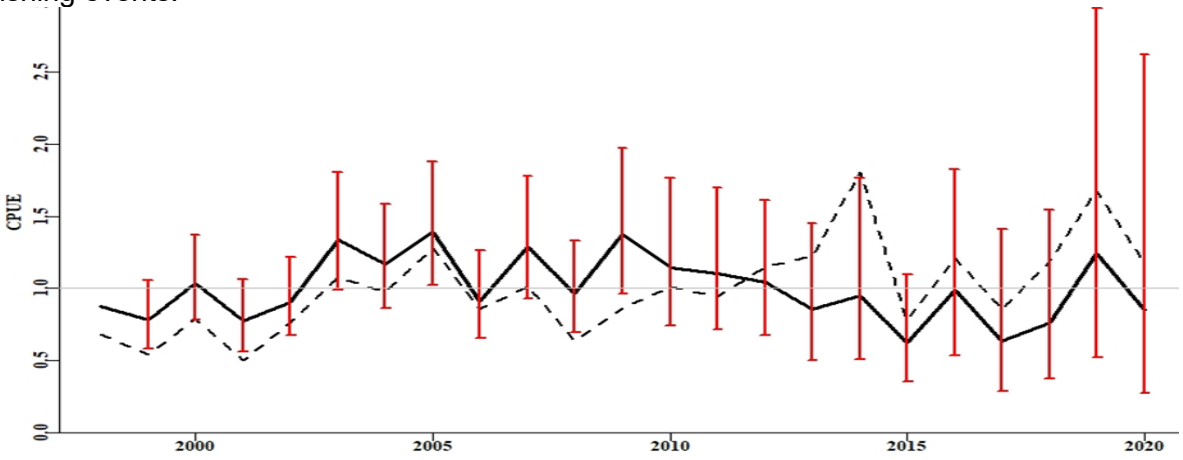

Figure 3. Droplining – Standardised $CPUE_{dy}$ (black line, kg.day^{-1}) for Hapuku from 1998/99 to 2019/20. Error bars represent 95% confidence intervals. Dashed line indicates the geometric mean CPUE (kg.day^{-1}).

Stock Assessment – list of indicators

Most recent assessment	2020 – **undefined**
Assessment method	Weight of evidence
Main data inputs	Commercial catch (t) – 1997/98 to 2019/20 Standardised CPUE dropline (kg.day^{-1}) – 1997/98 to 2019/20 Median nominal CPUE handline (kg.day^{-1}) – 1997/98 to 2019/20
Main data inputs (rank)▪▪	Commercial catch – 2 (medium quality): historical time series, but some reporting changes and likely misreporting, limited quality control/error validations $CPUE_{dy}$ dropline: (low quality), compromised by significant reporting changes and inaccuracies in effort data (see Chick and Fowler 2020b for further details) $CPUE_{dy}$ handline: (low quality), compromised by significant reporting changes and inaccuracies in effort data (see Chick and Fowler 2020b)
Key model structure and assumptions	NA – no model-based quantitative assessment approach was used
Sources of uncertainty evaluated	Known or likely uncertainties in the key indicators were taken into consideration in ranking data inputs to these indicators, and in reaching a conclusion regarding stock status based on the relative weighting of these indicators

Status Indicators and Limits Reference Levels

Biomass indicator or proxy	Standardised CPUE. Used to indicate whether biomass is likely to be increasing, decreasing or stable
Biomass limit reference level	NA – no biomass limits or targets have been set
Fishing mortality indicator or proxy	NA – no agreed proxy of fishing mortality has been defined
Fishing mortality limit reference level	NA – no fishing mortality limit has been set
Target reference level	NA – no fishing mortality targets have been set

Stock Assessment Results – review of indicators

Biomass status in relation to limit	NA – no biomass limits or targets have been set
Fishing mortality in relation to limit	NA – no fishing mortality limit has been set
Previous SAFS stock status	Undefined (2018; NSW jurisdictional level)
Current SAFS stock status	Undefined (Chick and Fowler 2020b;)

Fisheries interactions

Hapuku are primarily caught as bycatch when droplining for Blue-eye Trevalla (*Hyperoglyphe antartica*). Catches of Hapuku and associated fishery statistics may therefore be influenced by changes in the Blue-eye fishery.
NSW OTL Fishery shareholders, fishers and/or their representatives were presented with assessment data and its interpretation through an online meeting. Feedback on the presentation and any other information that may inform the assessment was requested.
Comments from stakeholders included: 1) the reliance on favourable conditions, particularly weak ocean currents, to catch deep-water fishes, including Hapuku; and 2) very recent low levels of catch and effort reflect the level of quota allocated fishers and challenges in obtaining quota to support efficient fishing practices. There was no indication of any disagreement with the data or the assessment.
Notably, Hapuku are landed in Australian Commonwealth fisheries, off the east coast of Australia, including water east of NSW jurisdictional management (AFMA 2020; generally decreasing annual catches; average catch of 59.3 t.yr-1 (range: 20.1 – 144.7 t) between 2002 to 2018; 20.1 t caught in 2018). However, Hapuku are not a quota-managed species in the Commonwealth. The Commonwealth has conducted a Sustainability Assessment for Fishing Effects (SAFE) and residual risk assessment and, in 2018, a Catch-MSY assessment indicating biomass was ~33% of unfished levels and fishing mortality was above sustainable limits, resulting in a Commonwealth stock status classification of depleting (Chick et al. 2018).

Qualifying Comments

NSW catch and effort logbook data vary spatially and temporally across different areas, delineated by changes in fisher reporting requirements and other management changes (Chick and Fowler 2020b). Increased variance in the standardised commercial catch rate since 2009/10, coincides with changes in the reporting requirements of commercial fishers to record daily catch and effort and report those data monthly. Prior to 2009/10, commercial fishers were only required to record and report these data on a monthly basis, i.e. monthly catch and effort. It seems likely that the change to daily recording requirements, in addition to fewer and lower catches, has contributed to uncertainty in this potential indicator of fishery performance and proxy for changes in Hapuku biomass.

Recreational catch is poorly understood.
Factors other than fishing, including climate change and other environmental processes, may affect changes in the abundance and biological functioning of the NSW Hapuku stock(s) through time. Temporal and spatial variations in oceanographic conditions, including temperature change, may influence available trophic resources, growth, population connectivity and ultimately recruitment.

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