Stock Status Summary – 2022/23

NSW Stock Status Summary – Hapuku (Polyprion oxygeneios)

Assessment Authors and Year

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Stock Status

Current stock status	On the basis of the evidence contained within this assessment, Hapuku are currently assessed as **undefined**.

Stock structure & distribution

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.

The stock structure of Hapuku in NSW is unknown, with no genetic analyses or comparative demographic investigations conducted to date. The extended pelagic phase (egg, larval and juvenile phases - see below) and exposure to strong surface currents through association with floating objects during this period suggest mixing at the scale of ocean basins (Roberts 1996; Wakefield et al. 2010). Panmixia (random mating of individuals within the population) at this scale is supported for congener (same category of fish) *P. americanus* by genetic analyses (mtDNA and microsatellite; Sedberry et al. 1996; Ball et al. 2000), with Hapuku exhibiting similar life-history traits to *P. americanus*.

This report provides a stock status summary from a more detailed NSW stock assessment report (Chick and Fowler 2023).

Biology

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). Hapuku spawn pelagic eggs during a defined season that varies among regions (Roberts 1989; Wakefield et al. 2010). Larvae and juveniles spend 2–4 years in surface waters before settling to adult demersal habitat on continental shelves and slopes.

Length at 50% maturity (L_{50}) in Western Australia has been estimated at 70 and 76 cm TL for males and females, respectively (Wakefield et al. 2010), and 85 and 88 cm TL for males and females, respectively in New Zealand (Johnston 1983). These lengths corresponded to ages at maturity (A_{50}) in Western Australia of 6.8 and 7.1 years for males and females, respectively (Wakefield et al. 2010) and 10–13 years for both sexes in New Zealand (Francis et al. 1999). 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 intermediate growth rate is similar to that reported from tag-recapture data in New Zealand (~4.3 cm TL year^{-1}; Francis et al. 1999).

FISHERY STATISTICS

Catch information

Commercial

Since 2012/13, Hapuku have been exclusively caught in the OTL Fishery (i.e. >99% 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 <2.5 t in each of the ten years from 2012/13 and in 2021/22, total catch was <0.1 t (Figure 1). Since 1997/98, the majority of Hapuku catch within the OTL Fishery has been reported against dropline gear (mean: 74%, range: 21–99%). Although since 2017/18, and as annual catches have continued to decrease, this proportion has become more volatile, with 21% of the 0.6 t catch in 2019/20, and 83% of the 0.7 t catch in 2020/21 reported to dropline gear. Handlining accounts for most of the remaining catch (mean 13%, range: 0–52%).

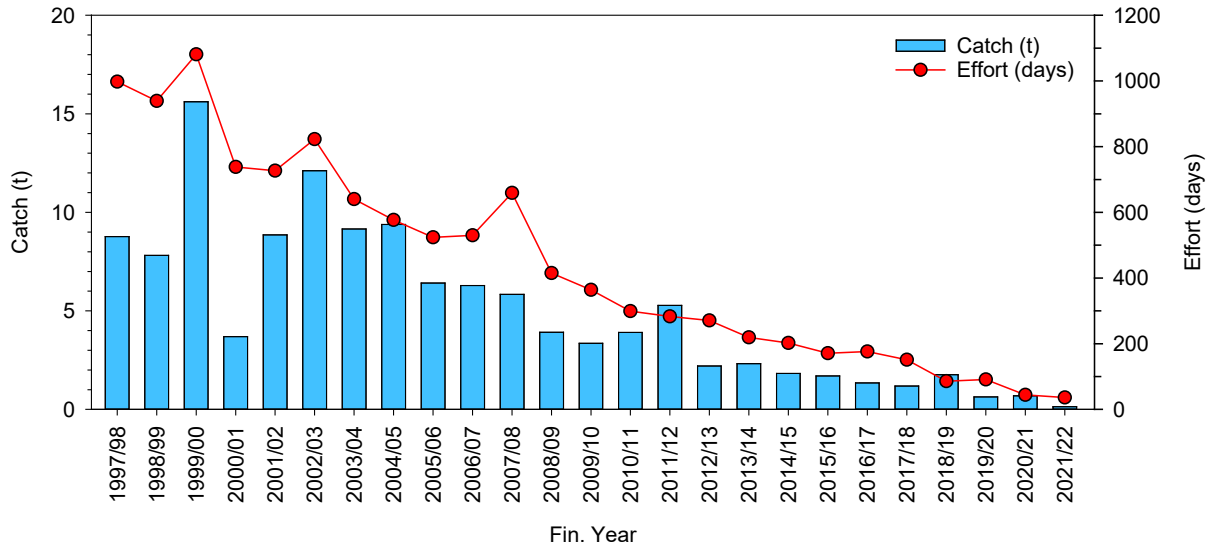

Figure 1. Total catch (t) of Hapuku and total effort (days) from 1997/98 to 2021/22. Note: effort (days) from 2009/10 are days fished per month irrespective of species reported, to be consistent with effort reported from 1997/98 to 2008/09.

Recreational & Charter boat

Recreational catches have not been quantified and logbook returns from the Charter Boat sector indicate <2 individual fish caught per year since 2016/17. 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 of the commercial catch.

Indigenous

Aboriginal cultural catches are unknown.

Illegal, Unregulated and Unreported

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). In 2020/21, there were targeted compliance operations on unlicensed charter fishing activities in the Sydney area and illegal take of deep-water fish species off Sydney. Public reports from NSW Fisheries Compliance have not highlighted IUU activity specific to Hapuku within financial years between 2014/15 and 2020/21.

Fishing effort information

Total annual commercial effort reflects that of total catch, with a general decrease over the reporting period. Total effort across all methods that have caught Hapuku has decreased from ~1000 days per year from 1997/98 to 1999/00 to <100 days in the last four years and 36 days reported in 2021/22 (Figure 1), consistent with a decline in the number of fishing business reporting catches of Hapuku. 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.

Catch Rate information

Standardised catch rate ($CPUE_{dy}$, $kg.day^{-1}$) for droplining only showed no trend between 1997/98 and 2021/22, with increasing variance throughout the series (Figure 2). Peaks and troughs in the series are associated with 95% confidence intervals that overlap those in other years. The larger variances later in the series are most likely related to the low number of reported catch events (e.g. n was 7 and 4 in 2020/21 and 2021/22, respectively).

Due to limited effort, too few handline catches occurred prior to 2012/13 to allow meaningful standardisation of catch rates. Median nominal $CPUE_{dy}$ for handlining showed no trend between 1997/98 and 2021/22 (Figure 3). Peaks in median $CPUE_{dy}$ were observed during 2002/03, 2011/12 and to a lesser extent 2018/19, with the 95% confidence interval in 2011/12 not overlapping those in surrounding years, noting the potential uncertainty surrounding estimates derived from low numbers of fishing events.

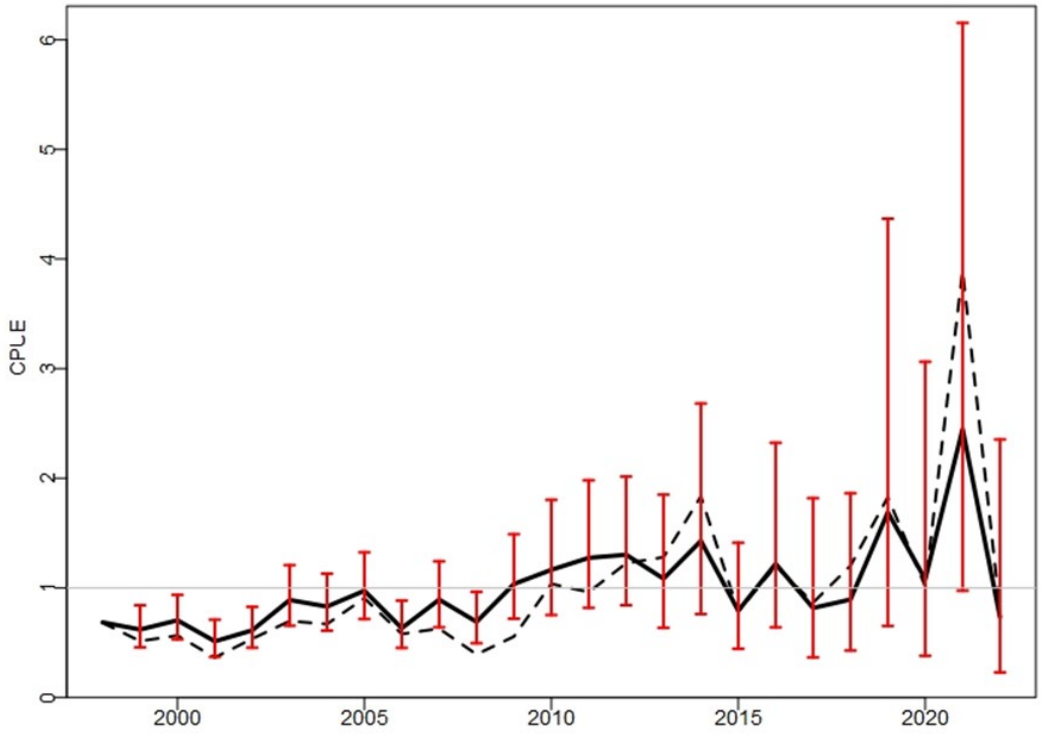

Figure 2. Droplining only – Standardised $CPUE_{dy}$ (black line, kg.day^{-1}) for Hapuku from 1998/99 to 2021/22. Error bars represent 95% confidence intervals. Dashed line indicates the geometric mean CPUE (kg.day^{-1}).

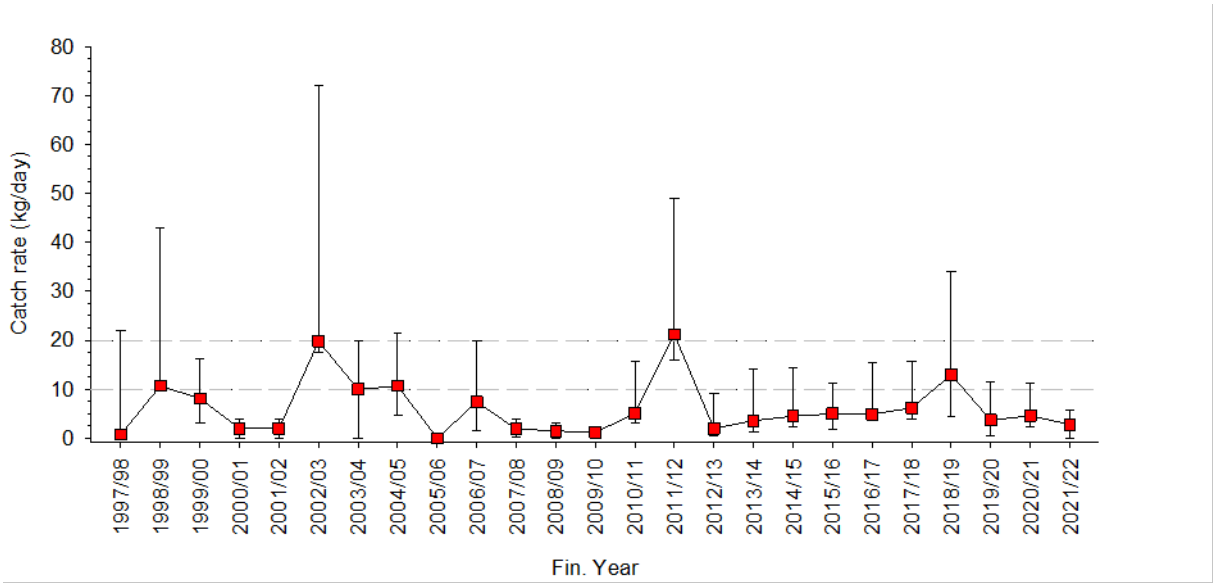

Figure 3. Handline only – median nominal CPUE (kg.day^{-1}) for Hapuku from 1997/98 to 2021/22. Error bars represent interquartile ranges.

STOCK ASSESSMENT

Stock Assessment Methodology

Year of most recent assessment:

2023 (using data to end of June 2022)

Assessment method:

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.

Main data inputs:

Commercial catch from the NSW OTLLE Fishery from 1997/98 to present

Commercial fishery OTLLE – dropline standardised catch rate ($CPUE_{dy}$) from 1997/98 to present.

Commercial fishery OTLLE – handline nominal catch rate ($CPUE_{dy}$) from 1997/98 to present.

Key model structure & assumptions:

NA – no model-based quantitative assessment approach was used.

Sources of uncertainty evaluated:

General data limitations and uncertainty was considered in the weight-of-evidence approach.

Status Indicators - Limit & Target Reference Levels

Biomass indicator or proxy	No formal indicator specified Standardised (OTLLE dropline) $CPUE_{dy}$ Nominal (OTLLE handline) $CPUE_{dy}$
Biomass Limit Reference Point	NA – no biomass limits or targets have been set
Biomass Target Reference Point	NA – no biomass limits or targets have been set
Fishing mortality indicator or proxy	No formal indicator specified Catch (OTLLE, dropline, handline)
Fishing mortality Limit Reference Point	NA – no fishing mortality limit has been set
Fishing Mortality Target Reference Point	NA – no fishing mortality target has been set

Stock Assessment Results

Hapuku are currently assessed as **undefined**.

Together with the uncertainty in total fishing mortality, demographic characteristics of late maturity, slow growth in later life and extended longevity reported from other regions and congener species suggest that the NSW stock(s) is vulnerable to exploitation (Sedberry et al. 1999; Peres and Haimovici 2004; Wakefield et al. 2010). Demography also likely varies across the extent of the stock(s) structure, as reported for south-western Australian stocks (Wakefield et al. 2010) and the extent of stock connectivity could be complex given life-history characteristics and oceanography of the region (e.g. south-east Australian stocks of Blue-eye Trevalla; Williams et al. 2017). Added to these stock(s) and species-specific uncertainties are broader pressures placed on stocks from human induced environmental processes such as climate change (e.g. ocean temperature and pH changes), resulting in greater variability in population responses to all pressures including fishing but also changes that are also likely to impact on fishing activities (Fulton et al 2020). These uncertainties, together with fishing pressures, could precipitate localised depletions or demographic shifts in stocks.

A weight-of-evidence approach was used to assess the status of the NSW Hapuku stock(s). There are insufficient data available to support more quantitative stock assessment methods. Uncertainty regarding stock structure and biology; 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 exacerbate uncertainty surrounding estimates of standardised and nominal catch rates and their use as a proxy for change in biomass; no quantitative measure or indicative trend in recreational catch; and proportionally large and declining levels of Commonwealth catch, with no described effort series and a defined Commonwealth stock status of undefined, provide insufficient information with which to support a reliable determination of stock status for NSW. On the basis of the evidence provided the NSW Hapuku stock is classified as **undefined**.

Stock Assessment Result Summary

Biomass status in relation to Limit	NA – no biomass limits or targets have been set
Biomass status in relation to Target	NA – no biomass limits or targets have been set
Fishing mortality in relation to Limit	NA – no fishing mortality limit has been set
Fishing mortality in relation to Target	NA – no fishing mortality target has been set
Current SAFS stock status	Undefined
Current Commonwealth stock status	Undefined

Fishery interactions

Hapuku are primarily caught as bycatch when fishing for Blue-eye Trevalla (*Hyperoglyphe antartica*). Catches of Hapuku and associated fishery statistics may therefore be influenced by changes in fishing operations and activity for Blue-eye Trevalla.

Hapuku are landed in Australian Commonwealth fisheries, off the east coast of Australia, including waters east of NSW jurisdictional management (AFMA 2021; 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). In 2019, the total catch of Hapuku in Commonwealth Fisheries was about 42 t (Chick et al. 2021). 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. However, uncertainty in stock structure and levels of catch below those projected to inform future stock status resulted in a Commonwealth stock status classification of undefined (Chick et al. 2021).

Qualifying Comments

There are risks to the future sustainability of the NSW Hapuku fishery as a consequence of data limitations, knowledge gaps and imprecise data that provide uncertainty in the assessment and has resulted in a stock status determination of undefined. These include: i) stock structure for Hapuku is unknown, however, it is possible that the stock is broadly distributed throughout south-eastern Australia, or further, and the harvest of Hapuku from NSW and other jurisdictions (e.g. Commonwealth) is from a common stock; ii) changes to reporting (e.g. no requirement to report vessel number) and decreasing fishing events and active fishing businesses has increased uncertainty in estimates of catch rates, used as a proxy for changes in biomass; iii) levels of recreational and Aboriginal cultural catch are unknown and iv) uncertainty in the response of Hapuku stock(s) to factors other than fishing, including changing environmental pressures associated with climate change.

NSW catch and effort logbook data vary spatially and temporally across different eras, delineated by changes in fisher reporting requirements and other management changes (Appendix 1). Increased variance in the standardised commercial catch rate since 2009/10, coinciding with changes in the reporting requirements of commercial fishers to record daily catch and effort and report those data monthly as well as decreasing active fishers and fewer fishing events, contribute to uncertainty in this potential indicator of fishery performance and proxy for change in Hapuku biomass.

Recreational catch of Hapuku and its temporal variability is not captured in the large-scale surveys done to estimate levels of recreational harvest in NSW. Anecdotal evidence from social media posting suggests recreational catch could be a substantial contributor to total catch, particularly as commercial catch continues to decrease, although there are high levels of uncertainty associated with the sources of these data. Given the relatively low recreational effort on offshore/deep species relative to nearshore environments, it is difficult to obtain a reliable estimate of catches of species from this niche component of the broader sector. Even with bag and boat limit restrictions the proportion of recreational catch to commercial catch could be high with relatively low levels of recreational effort. Reducing uncertainty in the relative contribution the recreational fishery makes to fishing mortality will require modification of the survey design supporting the broader recreational fishing survey program.

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). Temporal and spatial variations in oceanographic conditions, including temperature and pH change, may influence available trophic resources, growth, population connectivity and recruitment. Predictions of change to oceanic conditions and subsequent influences on fish stocks within the broad south-eastern area of Australia, including NSW waters strongly suggest the need to consider these influences in response to changes in the assessment of stocks (Fulton et al 2020), including

possible opportunities from positive outcomes for some fish stocks (Hobday et al. 2018, Ogier et al. 2020). These processes may have potentially substantial yet unknown consequences for NSW Hapuku stock(s). Further, whilst fishers reported reduced market opportunities to sell product in 2021/22 (e.g. local restaurants being closed) due to the management of the COVID-19 pandemic (Chick and Fowler 2021), the level of impact has not been quantified.

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