NSW Stock Status Summary 2021

Ghost Nipper (*Trypaea austaliensis*)

Assessment Authors and Year

Chick, R.C. 2021. NSW Stock Status Summary 2020/21 – Estuary General Fishery (Hand Gathering) – Ghost Nipper (*Trypaea austaliensis*). NSW Department of Primary Industries. Fisheries NSW, Port Stephens Fisheries Institute. 12 pp.

Stock Status

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

Nippers form a large component of the macroinvertebrate infauna assemblage in large areas of low-energy intertidal sandy and muddy environments along the eastern and southern coast of Australia (Hailstone and Stephenson 1961, Poore and Griffin 1979). There are no published studies describing the genetic or functional biological stock structure of nippers and they are currently assumed, for the purposes of current assessment and management, to constitute a single management unit.

There is likely to be some stock structuring. The biology of the species, together with the relatively low-energy estuarine environments they inhabit, suggest that local populations do not significantly contribute recruits to other estuaries, and that populations within estuaries could constitute functionally separate biological stocks. However, if, as with other Crustacea, there is an extended pelagic larval stage (unlikely given brooding females), and active larval dispersal exposes larvae to local and large-scale oceanographic currents outside parental estuaries, the population structure could be panmictic or substantially more complex, with estuary populations falling on a spectrum of complex population sources and sinks.

Nippers are common to many NSW estuaries and are a common source of bait for recreational fishers, either sourced directly via bait pumping on sandflats in estuaries, or indirectly through the sale of nippers as live bait in retail outlets, supplied by commercial fishers in the NSW EGHG fishery.

Nippers are dioecious, female-brooding, decapod crustaceans. The species has moderately high fecundity (~2000–4000 eggs per female) and, although size at maturity (~5–8 mm carapace length) and reproductive periodicity (ovigerous females generally peak in summer in NSW) vary spatially and temporally, there is an apparent latitudinal gradient, with more southern populations maturing at smaller sizes and becoming ovigerous earlier than those further north (Rotherham 2004). The length of the post-hatching pelagic larval stage and the contribution of local and large-scale oceanography and other environmental factors to recruitment success are not well known. Rotherham (2004) estimated von Bertalanffy growth parameters L_∞ and k ranged 12.6–15.8 mm and 0.37–0.98 year^{-1}, respectively. Estimates of maximum age (3–4 years); natural mortality (M) 1.21-1.81 year^{-1}; total mortality (Z) 1.18–3.76 year^{-1} and fishing mortality (F) 0.23–0.94 year^{-1} have been estimated, although with high levels of uncertainty (Rotherham 2004). Nonetheless, the estimates of M are consistent with those for other burrowing mud prawn species (*Upogebia pusilla* M = 0.9, Conides et al. 2012;

Lepidophthalmus siriboia lower M = 1.7, Filho et al. 2013), and with M = 1.1 estimated using 'Hoenigs method' for a maximum age of 4 years (Hewitt and Hoenig 2005).

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

Stock Status

The status of the NSW Ghost Nipper stock is classified as **sustainable**.

he weight of evidence supporting this status determination includes: i) Species biology and an understanding of stock structuring, likely at the level of estuary, that suggests resilient populations; ii) state-wide levels of catch that have been moderately increasing with catch rates (catch per day, and catch per hour) that have been relatively stable or increasing since at least 2009/10; iii) Catches and standardised catch rates from Port Hacking (that contributes >90% of the state-wide annual catch) have increased since 2009/10, with relatively high catches (~4.2 $t.yr^{-1}$) being caught at catch rates exceeding the long-term average; iv) Catches and catch rates from Shoalhaven/Crookhaven River that have been relatively stable and consistent since 2013/14, with catch rates in two of the last three years exceeding the long-term average; v) consistent annual patterns of monthly catch for the whole fishery and in Port Hacking and regular monthly catches in the Shoalhaven/Crookhaven River, indicating no substantial change in the availability of nippers to the commercial fishery; and vi) independent surveys of nipper population structure and biomass from Port Hacking and Shoalhaven River, in 2015/6 and 2016/17 that indicated biomass levels capable of sustaining known catches with high confidence (noting that confidence in these data is reduced as time between the survey and current assessment increases).

Fishery statistics summary

State-wide catch records incorporate three periods of reporting i.e. prior to 1997/98, from 1997/98 to 2008/09 and from 2009/10 to present (see Appendix 1 – Chick 2021). These changes affect the consistency of the data series and have implications on interpretation of changes in these metrics through time. The interpretation of effort in FisherDays ($effort_{dy}$) and associated metrics is particularly problematic, with changes to reporting requirements and challenges in accurately allocating daily effort among species within a multi-species fishing method.

$Effort_{dy}$, from July 2009, are derived from the number of distinct fishing dates entered on daily catch returns by each fisher in each month where the method was reported and the species was harvested in that month, irrespective of whether the species was reported on those days. This is to provide some consistency with this data series prior to July 2009. From July 1997 to June 2009, $effort_{dy}$ are the number of days fished, by each method, as entered on monthly catch returns, while from July 1983 to June 1997, $effort_{dy}$ are limited to catch records in which only a single fishing method was entered on a monthly catch return. Therefore, prior to 1997/98, total $effort_{dy}$ reported within the EGHGF is unable to be allocated to a species-specific catch and is the total $effort_{dy}$ reported by the EGHG fisher for each month, irrespective of the effort applied to harvesting an individual species. CPUE series merged across changes in catch reporting arrangements (1996/97 to 1997/98 or 2008/09 to 2009/10) may not be an accurate representation of changes in catch rate across these years.

Commercial fisher data from 2009/10 includes daily reporting to Estuary Name, for estuary based fisheries or, for ocean based and inland fisheries, a grid based spatial scale ('C-squares' or a 'Grid Code') consisting of a 5x5 nm grid overlaid on NSW, allowing identification of fisher data to spatial scales at this resolution (Appendix 1 in Chick 2021). For this NSW nipper stock assessment report, where fishers have not indicated Estuary Name but included the Grid Code, it has been utilised to allocate reported commercial logbook data to an Estuary Name. Non-reporting of Estuary Name by commercial fishers in any year has generally been small (<5% of all records. Finally, a small percentage (<1%) of annual data have not had effort (hours) reported. Catch data prior to 2009/10 have had limited scrutiny. However, a small number of records in 1998/99 and 2003/04 (n = 1 and 3, respectively) reported monthly catches in excess of 1000 kg. These records represent substantial outliers that are likely a function of reporting numbers of individuals rather than weight (as has been observed on a number fishers monthly catch returns for these years). As such they have been modified and reported weight assume as individuals and converted to weight, assuming the weight of 3 g per individual (DPI unpublished data).

Nominal and standardised catch rates are presented. Nominal catch rate ($kg.hr^{-1}$) was calculated as the average of daily CPUE ($kg.hr^{-1}$), records with effort of 0 or >12 $hours.day^{-1}$, catch <0.2 or >10 kg/day and catch rate (kg/hr; $CPUE_{hr}$ >5.5 $kg.hr^{-1}$, resulting in the exclusion of <5% of all records. Catch rates (StdCPUE $kg.hr^{-1}$) were standardised using general linear models in the R package 'cede' (v. 0.0.4, Haddon 2018). Variables used were Year, Month of capture and Authorised Fisher. Data were natural log-transformed prior to analysis. Model residuals were visually inspected for adherence to normality and trends in catch rates were compared to those generated using generalised linear models using the gamma distribution with a log link. Minimal differences were observed between the two standardisation methods; therefore, the general linear models were retained.

A total allowable catch (for the commercial fishery) of 5.1 t (i.e 8 year maximum of annual catches from 2009/10 to 2016/17) was implemented for 2019/20 and increased to 5.6 t for 2020/21 (NSW TAFC 2020; not reported in this assessment). Prior to the implementation of a TAC, management controls were implemented to assist with the transition to a share managed, TAC and individual transferable quota (ITQ) system. A state-wide interim total commercial access level (ITCAL) of 8.7 t was implemented in 2015/16, with Regional catch limits applied that summed to the state-wide ITCAL (DPI Fisheries 2014). Information presented in figures and tables in this report are summarised by fishing period (July to June), unless otherwise stated.

Catch Information

Commercial catch

State-wide fishery catch increased to ~2 t from 1984/85 to 1994/95 and ranged between~2 t and 4 t from 1995/96 and 2008/09. Since 2009/10, annual reported commercial catches have generally increased, with >~4.5 t being harvested in 6 out of the last 11 years, and in each of the last 3 years. Since at least 2009/10, annual catches have consistently been dominated with catch from one estuary, Port Hacking (average 93% total $catch.yr^{-1}$). Relatively small but consistent catches since 2013/14, have been reported from the previously unfished Shoalhaven/Crookhaven River and sporadic catches (<~200 $kg.yr^{-1}$) from Myall River. In 2019/20, (the first year of the TAC), total reported catch was 4.5 t, harvested by six authorised fishers. Importantly, these relatively recent (since 2009/10) patterns of change in

annual catch for the state-wide fishery are not necessarily consistent with patterns of catch at smaller spatial scales.

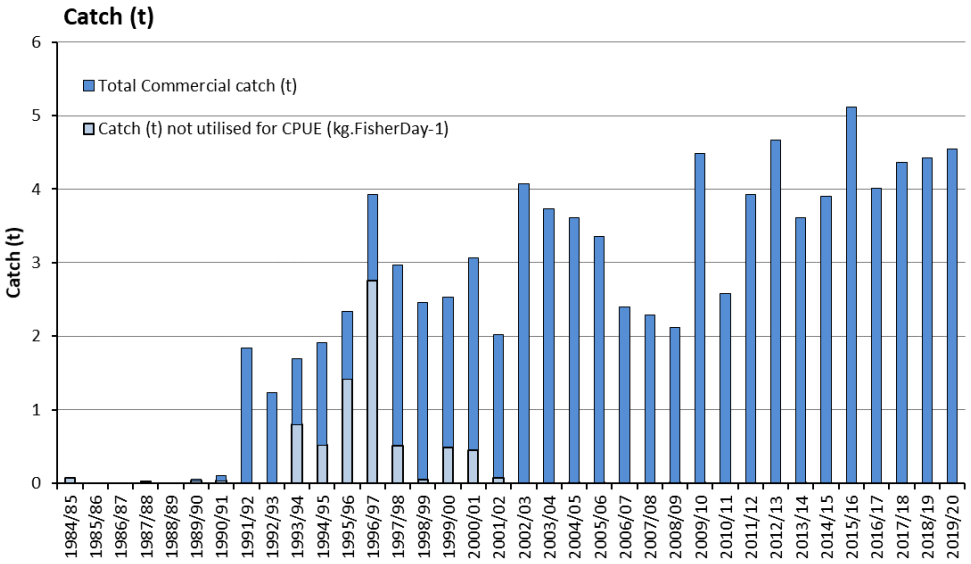

Figure 1 Annual catch (t) of Ghost Nippers in the EGHG Fishery from 1984/85 to 2019/20.

Recreational catch

In 2000/01, the recreational harvest (kept numbers) was estimated to be 2.5 million (±0.5 million SE). At an average weight of 3 g (whole, live weight, ≥10 mm carapace length, NSW DPI unpublished data), this estimate equates to a total recreational harvest of ~7.5 t (± 1.5 t). In 2013/14 and 2017/18, the state-wide survey estimated the retained recreational catch of Nippers was 1.3 ± 0.4 million and ~0.7 million individuals (i.e. ~3.9 t and ~2 t, respectively). Although, corrections made to the 2013/14 survey outcomes, to account for differences in survey design in 2017/18, indicate there was relatively little difference in recreational catch between the two times (2013/14: 2.2 t ± 0.7 t; Murphy et al. 2020). Estimates of recreational catch form the raw survey outputs represent 245%, 108% and 46% of the reported commercial catch for 2000/01, 2013/14 and 2017/18, respectively.

Information collected as part of the 2013/14 survey indicates about half of that catch (0.61 ± 0.24 million SE) was harvested in the summer months (December–February), and ~0.75 million harvested from areas on the northern coast of NSW (Port Stephens to Tweed Heads). The 2017/18 state-wide survey provides estimates of the spatial distribution of the estimated recreational catch into each of the coastal zones described in the survey (see Appendix 1 in Chick 2021). The distribution of the recreational catch was almost evenly distributed away from the two central zones of NSW, to the two most northern and southern zones. Approximately half (980 kg; 49%) of the recreational catch in 2017/18 was harvested from zones 1 and 2 (North and Mid North Coasts) and half (850 kg; 43%) in zones 5 and 6 (Mid South and South Coasts.

Indigenous cultural catch

The benefits (and costs) of fishing generally and professional fishing to the cultural, broader social, health, wellbeing and economic value to Indigenous people and communities are substantial (Voyer et al. 2016). Schnierer and Egan (2012) described a case study in NSW of the impact of management changes on the viability of Indigenous commercial fishers and the contribution commercial fishing and aquaculture makes to Indigenous communities. Included in this case study are estimates of the contribution Indigenous commercial fishers make to Indigenous communities, including the contribution of between 5% - 20% of their annual commercial catch. The contribution made to Indigenous communities by Indigenous commercial fishers was, on average, 9.8% of annual catch and the contribution from broader Indigenous commercial fishers was greater than that made by fishers in the EGHG fishery, with this being a consequence of hand gathering being a "…traditional skill that is widely practiced by coastal families so they can fulfil their own needs." (Schnierer and Egan 2012).

Synthesis of catch composition from Indigenous cultural fishing in NSW indicated that there are at least 18 species in the Estuary General Fishery that overlap with Indigenous fisheries (Schnierer and Egan 2016). In a survey based in the Tweed region, annual catch of nippers by Indigenous fishers was estimated at between 1,774 and 4,166 (Schnierer 2011). Based on an average weight of 3 g, the catch from Aboriginal fishers in the Tweed region in NSW is estimated at <15 kg.year^{-1}. Schnierer (2011) described nippers as among the top 10 culturally most important species and consisted of between 11% and 5% of the total cultural catch of invertebrates and total numbers of all species, respectively. Total effort estimated from this area for the Aboriginal fishery was 542 hours or 92 days (Schnierer 2011). Cultural catch of bait including nippers was also seen to be important in delivering economic benefits to the community (Schnierer 2011).

Illegal, Unregulated, Unreported (IUU) catch

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

There are anecdotal reports of IUU fishing occurring at the scale of estuary, related to minor incidents in both the commercial and recreational fishing sectors. Further, NSW Fisheries Compliance provide annual summaries of seizures of fish and invertebrates due to non-compliance (https://www.dpi.nsw.gov.au/fishing/ compliance/fisheries-compliance-enforcement). These reports indicate regular seizures of nippers each year from 2012/13 to 2017/18, with the exception of 2015/16. Annual seizures have ranged between 1 363 and 8 900 individual nippers (i.e. 4 – 27 kg).

Effort information

Commercial

Estimated effort in FisherDays (effort$_{dy}$) increased from less than 100 days (1984/85–1990/91) to >450 days during the late 1990s. Noting that during this period fishers were required to report their catch monthly and effort (in days fished) by gear type, not linked to catch unless only a single gear type was used and then not linked to species catch within a gear type. Therefore, prior to 1997/98 total effort$_{dy}$ reported within the EGHGF cannot be allocated to a species catch and is the total effort$_{dy}$ reported by the EGHG fisher for each month where one method was reported and the species of interest was also reported in that month (Appendix 1). In 1998/99, the number of days fished was 497 days, a historical

maximum, and declined substantially over the following 3 years, to 135 days in 2001/02. From 2001/02 to 2008/09, $effort_{dy}$ remained below 200 days. The decline in days fished coincided with changes to commercial fishery reporting requirements and the difficulty in allocating effort to catch. Effort was linked to fishing method, irrespective of the catch reported. The substantial decline in $effort_{dy}$ is likely a function of an increased targeting of other species (e.g. Pipis) and fewer monthly catches of multiple species (including Nippers). In 2009/10, reported $effort_{dy}$ increased to 496 days, coinciding with the introduction of changes in commercial reporting, with fishers required to report hours spent hand gathering for each species and per fishing day, reported at finer spatial scales. The change in $effort_{dy}$ from 2009/10 to 2010/11 is principally due to a reduction in effort from one regular dominant (by catch) fisher (as described above for catch). Since 2013/14, the number of days fished per year has generally been stable (average ~500 days.yr^{-1}; range: 453-558 days), although each year for the last 3 years $effort_{dy}$ has decreased. In 2019/20, $effort_{dy}$ was 453 days, the lowest level in 8 years.

Effort in reported hours fished ($effort_{hr}$) has remained relatively stable in most years since 2009/10, averaging ~1700 hr (range 1476–2398 hr), with the exception of a spike in 2013/14, of 2398 hours, coinciding with new entrants to the fishery and their fishing previously unfished estuaries (e.g. Shoalhaven/Crookhaven) and some sporadic fishing, reporting relatively high hours per day, in other estuaries. In 2019/20, $effort_{hr}$ was 1476 hours.

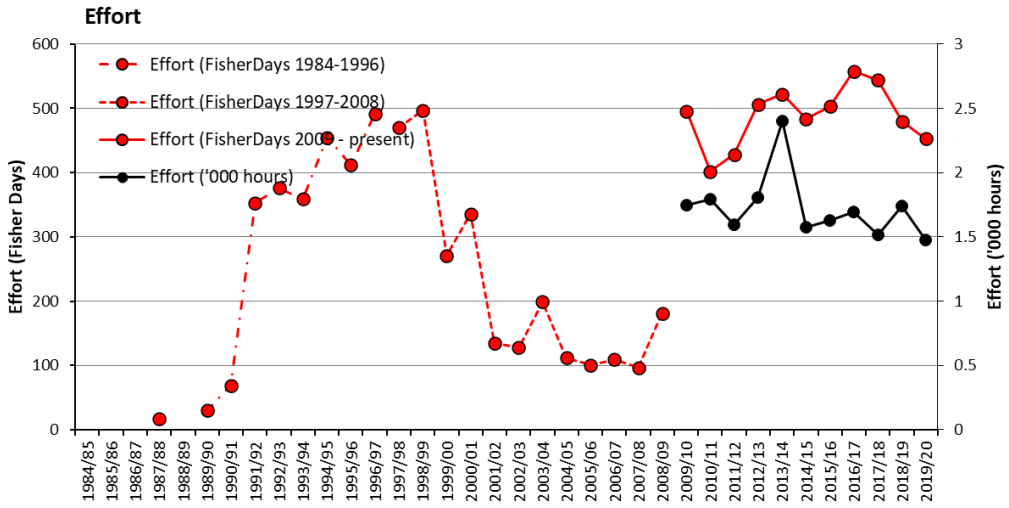

Figure 2 Annual effort* (hours^ and FisherDays*) on Ghost Nippers in the EGHG Fishery from 1984/85 to 2019/20.

*Effort (FisherDays) (a) for July 2009 to present was estimated from the number of distinct fishing dates entered on daily catch returns for each fisher in each month where the method was used, irrespective of whether the species was reported on those days, to be consistent with earlier reporting; (b) for July 1997 to June 2009, was taken from the number of days fished hand gathering as entered on monthly catch returns; and (c) for July 1984 to June 1997, limited to catch records where only a single fishing method was entered on a monthly catch return. Therefore, joining the dots from 1996/97 to 1997/98 or 2008/09 to 2009/10 may not be an accurate representation of changes in catch rate across these years.

^Effort ('000 hours) only available from 2009/10.

Recreational effort

There are limited data describing the recreational fishing effort expended in harvesting Ghost Nippers.

Indigenous cultural effort

Data for Indigenous cultural fishing effort for Ghost Nipper are not well known.

Catch rate information

Commercial

Catch per FisherDay ($CPUE_{dy}$) is a problematic index to estimate and interpret prior to 2009/10, for reasons outlined for the $effort_{dy}$ time series. Using daily effort calculated as explained above, three distinct time periods, with clearly different CPUE trends, can be distinguished. $CPUE_{dy}$ increased from less than 10 $kg.day^{-1}$ (1984/85–2000/01) to a maximum of 33 $kg.day^{-1}$ in 2005/06, probably due to fewer multispecies catches per month and substantially less allocated daily effort. Between 2005/06 and 2008/09, daily catch rate declined substantially, reflecting substantially lower catches and sustained levels of relatively low effort, again likely a function of the challenges in allocating effort to catches during this period. Since 2009/10 (the first year of current commercial fisher reporting requirements), daily catch rate has been relatively stable, reflecting increasing levels of catch and effort and averaging 8.5 $kg.day^{-1}$. In 2019/20 the daily catch rate was 10 $kg.day^{-1}$.

Since 2009/10, annual estimates of catch (kg) per hour ($CPUE_{hr}$) have averaged 2.5 $kg.hr^{-1}$ (range 1.4–3.1 $kg.hr^{-1}$) and have remained relatively stable in most years, with the exception of 2010/11 and 2013/14 when $CPUE_{hr}$ was 1.4 and 1.5 $kg.hr^{-1}$, respectively. These changes in $CPUE_{hr}$ coincide with and partially reflect changes in the composition of fishers between years, the spatial distribution of catch and effort among estuaries and reductions in effort and catch within these years by a dominant individual fisher. Importantly, and as similarly described for fishery-wide levels of catch, change in levels of fishery-wide effort and $CPUE_{hr}$ are not necessarily consistent with patterns at smaller spatial scales.

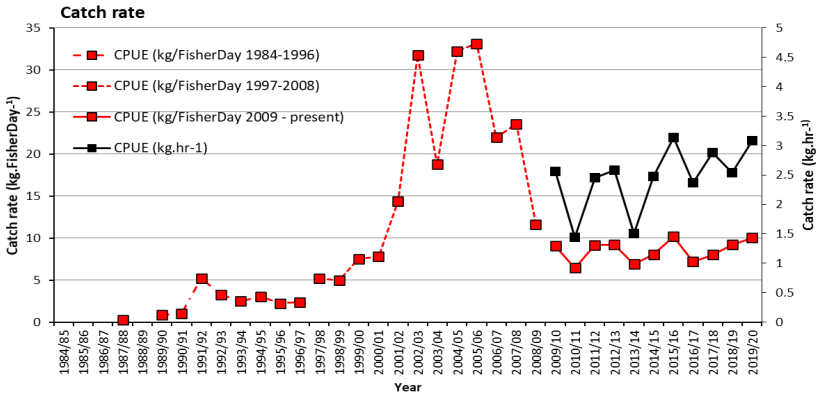

Figure 3 Annual catch rate (catch rate ($kg.hr^{-1\#}$ and $kg.FisherDay^{-1*}$ for Ghost Nippers in the EGHG Fishery from 1984/85 to 2019/20.

#CPUE ($kg.hr^{-1}$) calculated from average daily CPUE ($kg.hr^{-1}$), excluding records with catch >10 $kg.day^{-1}$, effort of 0 or >10\ $hrs.day^{-1}$ and CPUE ($kg.hr^{-1}$) >5.5 $kg.hr^{-1}$. Data only available from 2009/10.

Stock Assessment – list of indicators

Most recent assessment	2021 – **sustainable**
Assessment method	Weight of evidence
Main data inputs	Catch (commercial) (t) – 1984/85 to 2019/20 Catch (recreational) (t) 2000/01, 2013/14, 2017/18 CPUE ($kg.day^{-1}$) – 2009/10 to 2019/20 CPUE ($kg.hr^{-1}$) – 2009/10 to 2019/20 Fishery-independent survey-based estimates of biomass (2015/16, 2016/17)
Main data inputs (rank)†	Catch (commercial) – 1984/85 to 2019/20: (medium quality), long historical time series, but some reporting changes and likely misreporting, limited quality control/error validations Catch (recreational) – 2000/01, 2013/14, 2017/18 (medium quality), different survey methods add uncertainty to comparisons through time. $CPUE_{dy}$ – $kg.FisherDay^{-1}$ 1984/85 to 2019/20: (low quality) compromised by significant reporting changes and inaccuracies in effort data. $CPUE_{hr}$ – $kg.hr^{-1}$ 2009/10 to 2019/20: (medium quality) relatively short time series, some misreporting, some quality control/error validations. Fishery-independent survey based estimates of biomass in recent years (medium quality) – dated and unpublished data.
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

† Main data inputs (rank)

1 – High quality: data have been subjected to documented quality assurance and peer review processes, are considered representative and robust and provide a high level of confidence to support fisheries management decisions.

2 – Medium quality: data have been subjected to some internal quality assurance processes, have some documented limitations, but are still considered sufficiently accurate and informative to be useful to inform management decisions with some caveats.

3 – Low quality: data have been subjected to limited or no quality assurance processes, may be compromised by unknown or documented limitations that have not been fully explored, but are considered the best available information and require a high level of precaution to be exercised when interpreted to inform management decisions.

Status Indicators and Limits - Reference Levels

Biomass indicator or proxy	NA - no formal indicators or reference points determined
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	Sustainable (2020); not SAFS species. (NSW jurisdictional level)
Current SAFS stock status	Sustainable (Chick 2021); not SAFS species. (NSW jurisdictional level)

Fishery interactions

Fishing for Ghost Nipper in the EGHG Fishery is done by hand with a manual hand pump and hand collection of individuals.

Ghost Nippers inhabit sandy substratum often adjoining seagrass habitat and there is anecdotal evidence of fishers (from all sectors) interacting with seagrass habitat.

There are limited, if any interactions with other fisheries and no recorded interactions with TEPS or other protected habitats.

There is fishing activity for Ghost Nippers in the NSW Charter Boat Fishery. Since 2009/10, Charter Boat annual harvests of nippers have averaged ~14 kg.yr^{-1} (range: 2.4 – 42 kg/yr^{-1}), with >~80% of the total catch from this fishery reported to the Tweed River (from which there has been no other reported commercial catch of Nippers). Charter Boat operations in the Tweed River are unique in that they are land-based, providing tourist groups with the opportunity to access intertidal areas and undertake hand-gathering fishing activity, with limited retained harvest. Charter Boat businesses in the Tweed operate under a DPI Fisheries managed Code-of-conduct that includes limited access to fixed areas of the estuary. These areas constitute a small proportion of the available and utilised nipper habitat. There are contrasting views among stakeholder groups that use the estuary regarding the sustainability of this fishing activity, principally related to nipper population persistence and impacts on habitat. Research into the population size, structure, distribution and resilience of nippers to these fishing activities indicates that changes in the abundance of nippers through time are generally consistent between areas of different levels of utilisation throughout the estuary. However, results from structured field experiments investigating the response of nipper populations to a short period of intense fishing activity indicate that these activities can have a significant impact on the short-term abundance of nippers. The frequency of visitations to sites by relatively large numbers of people may result in the persistent decline in the local abundance of nippers (and likely other infauna). However, the operations, undertaken in accordance with the Code-of-conduct, do not pose a substantial threat to the persistence of the nipper population in the estuary.

Qualifying Comments

Uncertainty associated with the assessment relates to limited confidence in the understanding of stock structure and interpreting change in levels and patterns of fishery-dependent data provided by relatively few active fishers and the possible influence of current management arrangements on levels of fishing activity unrelated to the abundance of nippers. Understanding change in recreational fishery catches and Indigenous cultural harvest through time and levels of catch at the estuary scale would contribute to understanding levels of fishing mortality at this scale. Factors other than fishing likely affect changes in the abundance and productivity of nippers (e.g. physical environmental characteristics) and these likely vary among estuaries through time.

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