Stock Status Summary – 2021/22

NSW Stock Status Summary – Ghost Nipper (*Trypaea austaliensis*)

Assessment Authors and Year

Chick, R.C. 2022. NSW Stock Status Summary 2021/22 – Ghost Nipper (*Trypaea austaliensis*). NSW Department of Primary Industries, Fisheries. 9 pp.

Stock Status

Current stock status	On the basis of the evidence contained within this assessment, Ghost Nippers are currently assessed as **sustainable**.

This stock status summary outlines the more detailed information available in the NSW stock assessment report for Ghost Nippers (Chick 2022).

Stock structure & distribution

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.

Biology

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).

FISHERY STATISTICS

Catch information

Commercial

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 ≥5 t being harvested in 3 out of the last 6 years, and in each of the last 2 years. Since 2009/10, annual catches have consistently been dominated with catch from one estuary, Port Hacking (average 92% 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 (<~400 kg.yr^{-1}) from the Myall and Hawkesbury Rivers. Total catch in the last two years have been ~5 t and at or among the highest levels reported in the fishery (Figure 1). Importantly, patterns of change in annual catch for the state-wide fishery are not necessarily consistent with patterns of catch at smaller spatial scales.

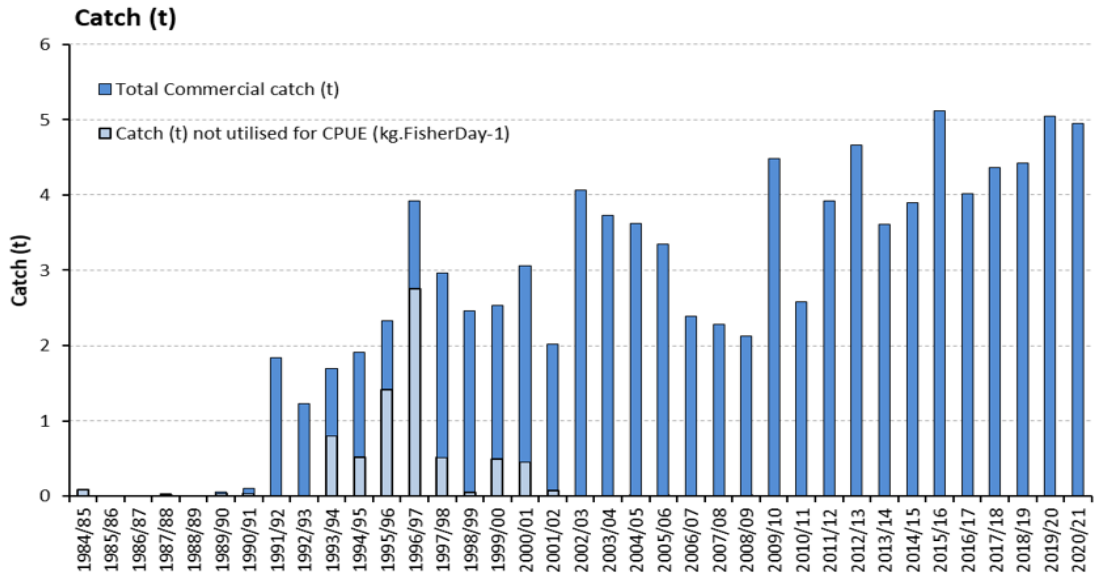

Figure 1. Total annual commercial catch (t) of Ghost Nippers from 1984/85 to 2020/21.

Recreational & Charter boat

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 ± 0.16 million individuals (i.e. ~3.9 t and ~2 t, respectively). Although, calibrations 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: 2.4 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. 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).

Since 2009/10, Charter Boat annual harvests of nippers have averaged ~11 kg.yr^{-1} (range: 0.8 – 42 kg/yr^{-1}; no catch reported prior to 2015/16). More than 78% of the total annual catch from this fishery has been reported to the Tweed River (from which there has been no other reported commercial catch of Nippers). Four other NSW estuaries have reported catch of Nippers from the Charter Boat Fishery, with a total annual catch ≤2 kg.yr^{-1}.

Indigenous

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 and Unreported

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 2019/20 (no public report available for 2020/21), with the exception of 2015/16 and 2017/18. Annual seizures have ranged between 1 363 and 8 900 individual nippers (i.e. ~4 – 27 kg).

Fishing effort information

Commercial

Estimated commercial effort in FisherDays (effort$_{dy}$) increased from less than 100 days (1984/85–1990/91) to >450 days during the late 1990s (Figure 2). 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. In 1998/99, 497 days were reported, a historical maximum. Effort$_{dy}$, 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 (Figure 2). 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$_{dy}$ was 495 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. Since 2013/14, the number of days fished per year has generally increased, with ≥500 effort$_{dy}$ reported in 2019/20 and 2020/21, and the highest levels of effort reported in the fishery.

Effort in reported hours fished (effort$_{hr}$) has remained relatively stable in most years since 2009/10, averaging ~1800 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 2020/21, effort$_{hr}$ was 2185 hours, an increase of >400 hr from 2019/20 (Figure 2).

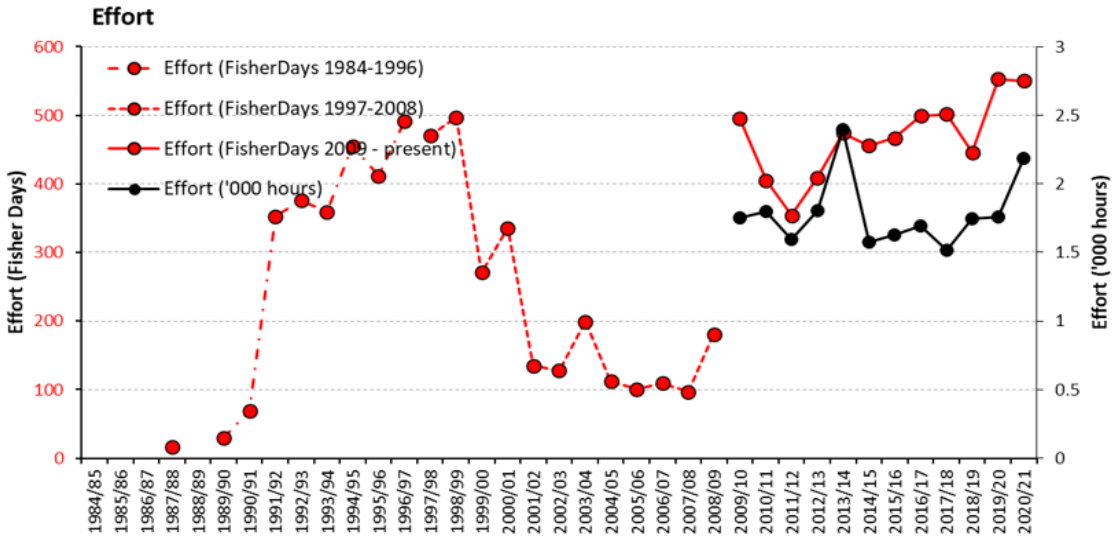

Figure 2. Total annual commercial effort on fishing for Ghost Nippers from 1984/85 to 2020/21.

Catch Rate information

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 (Figure 3). 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 (with substantial within year variation), reflecting similar increasing levels of catch and effort and has averaged 9 kg.day^{-1} (range 6.4 – 11.4 kg.day^{-1}). In 2020/21, the average daily catch rate was 8.9 kg.day^{-1} (Figure 3).

Since 2009/10, annual estimates of catch (kg) per hour (CPUE$_{hr}$) have averaged 2.4 kg.hr^{-1} (range 1.52–3.2 kg.hr^{-1}), with substantial within year variation and has remained relatively stable, despite exceptions in 2010/11 and 2013/14 when CPUE$_{hr}$ was 1.4 and 1.5 kg.hr^{-1}, respectively (Figure 3). These anomalous CPUE$_{hr}$ levels coincide with and partially reflect changes in the composition of fishers between years, the spatial distribution of catch and effort among estuaries. 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.

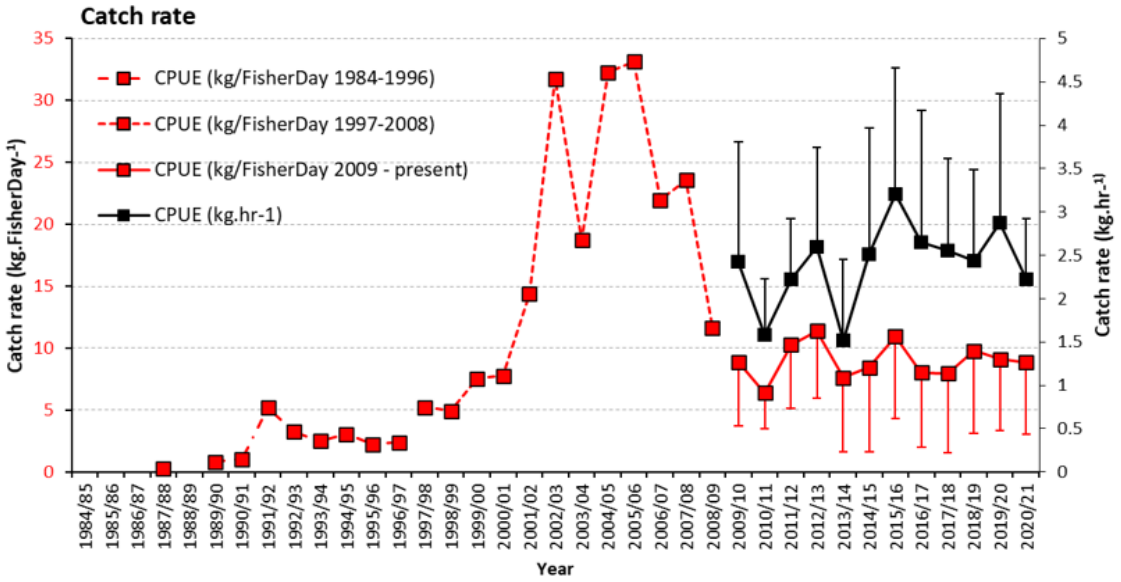

Figure 3. Average annual catch rate (kg.hr^{-1} and kg.FisherDay^{-1}), from 1984/85 to 2020/21 (plus or minus one standard deviation, respectively, from 2009/10).

In Port Hacking, patterns of nominal ($CPUE_{hr}$) and standardised catch rate ($StdCPUE_{hr}$) do not show any substantial divergence, with changes through time consistent in both series of data (Figure 4). Catch rates were generally at or below the long-term average from 2009/10 to 2014/15. Since 2014/15, catch rate has increased, to levels at or above the long-term average, with that in 2019/20 the second highest level recorded since 2009/10. In 2020/21, average $CPUE_{hr}$ declined to a level just below the long-term average (Figure 4).

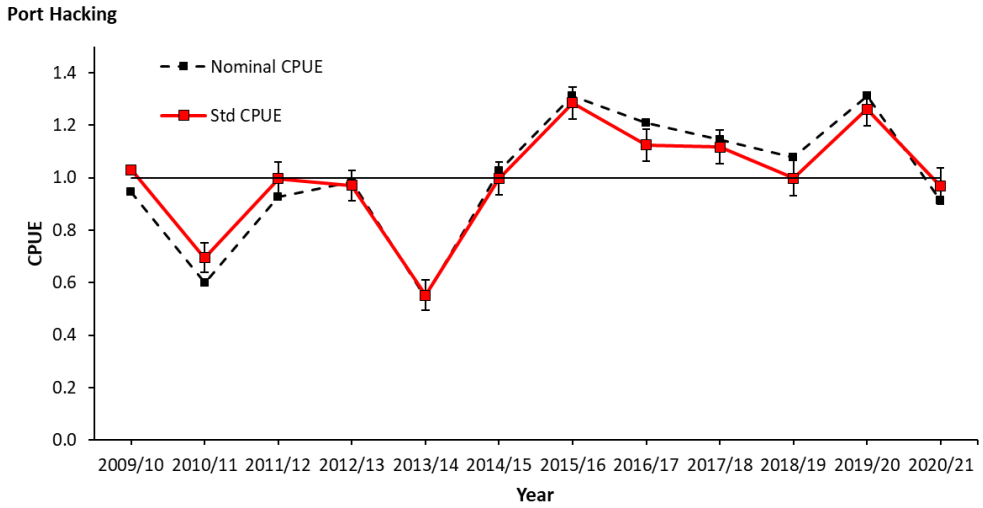

Figure 4. Port Hacking - standardised commercial catch rate (red line with 95% confidence intervals) and nominal catch rate (dashed black lines) scaled to the 12-year average catch rate (horizontal solid black line) from 2009/10 to 2020/21.

STOCK ASSESSMENT

Stock Assessment Methodology

Year of most recent assessment:

2021/22 (using data to end of June 2021)

Assessment method:

A review of indicators (weight-of-evidence approach) was used to assess the status of the NSW Ghost Nipper stock. Included in this approach are: knowledge of biology and population structure; patterns of catch, catch rate (incl. standardised catch rate) across the fishery and within key estuaries; and estimates of biomass from fishery-independent surveys in key estuaries from 2015/16 and 2016/17.

Main data inputs:

- Catch (commercial) (t) – 1984/85 to 2020/21
- Catch (recreational) (t) 2000/01, 2013/14, 2017/18
- CPUE (kg.day^{-1}) – 2009/10 to 2020/21
- CPUE (kg.hr^{-1}) – 2009/10 to 2020/21
- Fishery-independent survey-based estimates of biomass (2015/16, 2016/17)

Data interpreted at state-wide and estuary scales.

Key model structure & assumptions:

- Standardised catch rates (using cede v. 0.04) (Haddon, 2018). Assumption: annual catch rates are a relative index of abundance not unduly influenced by factors other than those accounted for through standardisation.

Sources of uncertainty evaluated:

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

Some uncertainty remains in the assessment, including: i) no definitive evidence for the inferred stock structure; ii) a discontinuous time series and uncertainty associated with the accuracy of early (pre-2009/10) reporting of commercial fishery data; iii) noisy commercial fishery data (i.e. few fishers, low numbers of FisherDays, inconsistently fished through time) from most fished estuaries; iv) the influence of current management arrangements (i.e. share management, TACs and individually transferable quota) on fishing activity, unrelated to stock abundance; v) substantial but decreasing recreational catches that have uncertainty associated with comparisons through time (due primarily to differences in survey designs); vi) unknown levels and distribution of Aboriginal cultural catch; vii) unquantified levels of IUU catch; viii) uncertainty of the reliability of fishery-independent survey data from 5-6 years ago, to inform current stock status; and ix) factors unrelated to fishing that influence change in population size and structure through time, and influence fishing activity unrelated to biological stock status.

Despite and whilst including consideration of these uncertainties, the weight of evidence provided is sufficient to support an understanding that the biomass of nippers is at a level sufficient to ensure that on average, future levels of recruitment are adequate and fishing mortality is at a level to avoid the stock being recruitment impaired, resulting in a classification of the Nipper stock status of **sustainable**.

Status Indicators - Limit & Target Reference Levels

Biomass indicator or proxy	None specified in a formal harvest strategy. This assessment used a weight-of-evidence approach, with data including: • Nominal $CPUE_{hr}$ (state-wide and estuary) • Nominal $CPUE_{dy}$ (state-wide) • Standardised $CPUE_{dy}$ (estuary - Port Hacking) • Fishery independent survey estimates of B (2015/16, 2016/17)
Biomass Limit Reference Point	None specified in a formal harvest strategy.
Biomass Target Reference Point	None specified in a formal harvest strategy.
Fishing mortality indicator or proxy	None specified in a formal harvest strategy. This assessment used a weight-of-evidence approach, with data including: • Catch (state-wide and estuary scale)
Fishing mortality Limit Reference Point	None specified in a formal harvest strategy.
Fishing Mortality Target Reference Point	None specified in a formal harvest strategy.

Stock Assessment Results

On the basis of the evidence provided the NSW stock status of Nippers is classified as **sustainable**.

A weight-of-evidence approach has been used to support a stock status determination of 'sustainable' for the NSW Ghost Nipper stock. This classification is supported by: i) species biology together with the low-energy environments inhabited by nippers suggesting a level of stock structuring likely at the level of estuary and populations are resilient to processes affecting abundance (i.e. highly fecund, relatively short lived and small size-at-maturity); ii) state-wide levels of catch that have been moderately increasing with catch rates ($CPUE_{dy}$, and $CPUE_{hr}$) that have been relatively stable or increasing since 2009/10; iii) catches and standardised catch rates ($StdCPUE_{hr}$) from Port Hacking (the estuary that has consistently contributed a harvest >90% of the state-wide annual catch) have increased since 2009/10, with increasing levels of catch (>4 $t.yr^{-1}$) in the last 5-6 years being caught at catch rates generally exceeding the long-term average; iv) catches and catch rates ($CPUE_{hr}$) from Shoalhaven/Crookhaven River have been relatively stable and consistent since first being commercial fished in 2013/14; 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 through time; and vi) independent surveys of nipper population structure (size and weight) and density 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 to support inferences of sustainable harvest declines as time between the survey and current assessment increases; Chick 2022).

Stock Assessment Result Summary

Biomass status in relation to Limit	NA – no biomass limits has been set. Weight-of-evidence provided is sufficient to support an understanding that the biomass of Ghost Nippers is at a level sufficient to ensure that on average, future levels of recruitment are adequate.
Biomass status in relation to Target	NA – no biomass target has been set.
Fishing mortality in relation to Limit	NA – no fishing mortality limit has been set. Weight-of-evidence provided is sufficient to support an understanding that fishing mortality is at a level to avoid the stock being recruitment impaired.
Fishing mortality in relation to Target	NA – no fishing mortality target has been set.
Current stock status	**Sustainable**

Fishery interactions

Fishing for Ghost Nipper 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 interactions have been reported between the EGHG Fishery and species protected under the Environment Protection and Biodiversity Conservation *Act 1999*.

DPI Fisheries manages a Code-of-conduct for Charter Boat Fishery operators in the Tweed River, where there is a unique, land-based operations that includes tourist groups with 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

There is some uncertainty in the determination of stock status. This uncertainty is associated with the inferred understanding of stock structure; patterns of commercial catch and catch rates in different estuaries that are inconsistent with patterns within the whole fishery; different methods to collect and levels of recreational catch that have reduced over the years, whilst having limited ability to attribute these catches at the scale of estuaries; unknown levels of Indigenous cultural catch; and unknown levels of IUU catch. Uncertainty in these data contribute to uncertainty in understanding changes in biomass and fishing mortality at relevant scales.

Further, factors other than fishing, including environmental factors, likely affect change in the abundance and productivity of nippers and are not considered in this assessment. Processes and effects are likely to be spatially and temporally variable. Identifying and quantifying these environmental effects and understanding the interaction between environmental factors and the effects of fishing would help inform relative impacts of fishing on populations. Finally, factors that do not directly impact on nipper populations but can influence fishery-dependent measures of fishery and stock performance, such as global-scale disruptions (e.g. COVID-19 pandemic and associated social impacts; FAO 2021) and large scale, state-wide disruptions (e.g. bushfires declared a natural disaster in 2019/20). The influence of these factors has not been quantified or considered in the assessment, beyond their acknowledgement.

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