Stock Status Summary – 2022/23

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

Assessment Authors and Year

Chick, R.C. 2023. NSW Stock Status Summary 2021/22 – Ghost Nipper (*Trypaea austaliensis*). NSW Department of Primary Industries, Fisheries. 10 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 2023).

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.

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, with 4.6 t harvested in 2021/22. 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 and within the last 2 years annual catches <160 kg.yr^{-1} have been harvested from the Karuah River. The relatively low catch in 2010/11 can mostly be explained by the unusually low catch of a regular, dominant (by catch) fisher who reported an annual harvest in that year <50% of their average annual catch. Total reported catch in the last three 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.

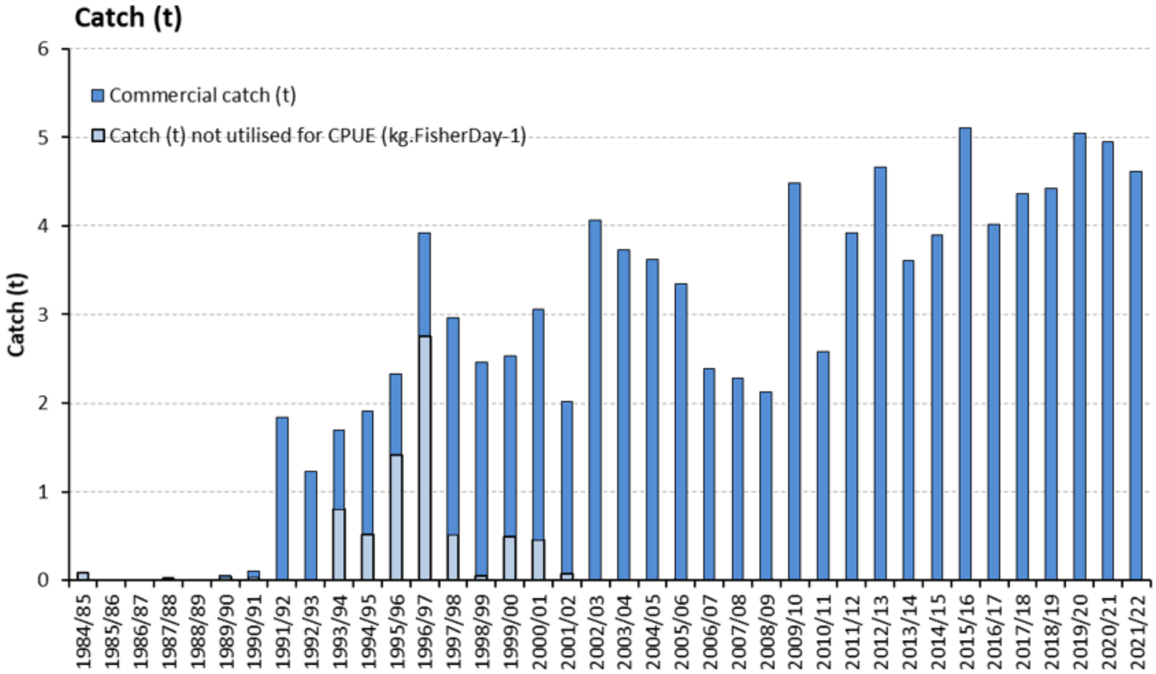

Figure 1. Total annual commercial catch (t) of Ghost Nippers from 1984/85 to 2021/22.

Recreational & Charter boat

In 2000/01, the recreational harvest (kept numbers) of nippers 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 retained harvest estimate and average weight equates to a total recreational harvest of ~7.5 t (± 1.5 t). In 2013/14, 2017/18 and 2019/20, the state-wide survey estimated the retained recreational catch of Nippers was ~1.3 ± 0.4 million; ~0.66 ± 0.16 million; and ~0.74 ± 0.16 million individuals (i.e. ~3.9 t, ~2.0 t and ~2.2 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%, 46% and 44% of the reported commercial catch for each year, 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 2019/20 state-wide survey data supports estimates of the spatial distribution of the estimated recreational catch into three Bioregions (Murphy et al. 2022) i.e. a scale larger than coastal zones available for the 2017/18 survey, as reported in Chick et al. 2021. In 2017/18, 95% of the recreational catch was harvested from Bioregions 1 and 3, with each accounting for 54% and 41% respectively. This contrasts with estimated recreational catch in 2019/20, where 75% was harvested from Bioregion 1 (Northern) and 13% and 11% being harvested from each of Bioregion 2 (Central) and 3 (Southern). Notably, Bioregion 2 (Central) includes Port Hacking, with surveys in 2017/18 indicating very little recreational fishing activity for nippers in this area.

Estimates of catch in the survey periods indicate a declining trend in recreational catch, which may be partially explained by the differences in the survey sample frame but also changes in recreational fishing activity (e.g. increasing availability and use of artificial baits and lures over the time period).

Since 2009/10, Charter Boat annual harvests of nippers have averaged ~9 $kg.yr^{-1}$ (range: 0.4 – 42 kg/yr^{-1}; no catch reported prior to 2015/16). More than 77% of the total annual catch from this fishery has been reported to the Tweed River, with 100% of the Charter Boat Fishery catch, <1 $kg.yr^{-1}$, reported from the Tweed within the last 2 years (there has been no other reported commercial catch of Nippers from this estuary). Three other NSW estuaries have reported catch of Nippers from the Charter Boat Fishery, with a total annual catches ≤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

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. 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 in many of the years from 2010/11 to 2020/21 (no public report is available for 2021/22). Annual seizures have ranged between 1363 and 8900 individual nippers (the equivalent to ~4 kg – 27 kg in any year).

Fishing 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 (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. 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. 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, matching those of catch. In 2021/22, reported effort decreased substantially and by ~90 days, to 459 $effort_{dy}$.

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 a spike in 2020/21, of 2185 hours, again coinciding with two new authorised fishers accounting for ~25% of the total hours in that year. There has also been sporadic fishing, reporting relatively high hours per day, in other estuaries. In 2021/22, $effort_{hr}$ was 1766 hours, and very similar to total hours in the two years preceding 2020/21.

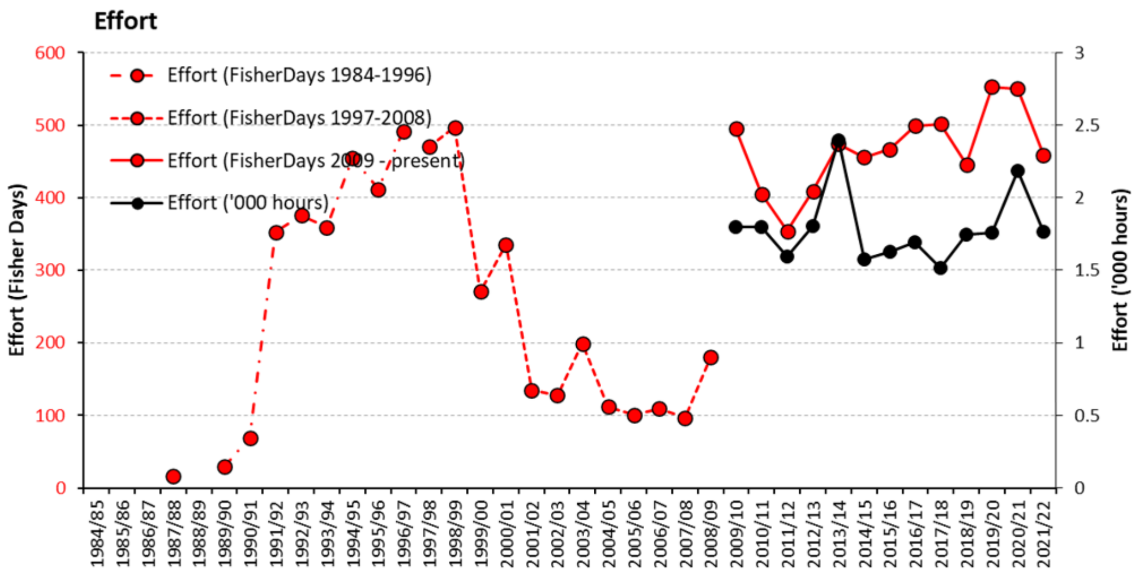

Figure 2. Total annual commercial effort on fishing for Ghost Nippers from 1984/85 to 2021/22.

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, likely due to fewer multispecies catches per month and substantially less allocated daily effort than any underlying population changes. Between 2005/06 and 2008/09, daily catch rate declined substantially, reflecting substantially lower catches and sustained levels of relatively low effort, again, more likely a function of the challenges in allocating effort to species specific catches during this period than population changes. 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 increases levels of catch and effort through the years, and has averaged ~9 $kg.day^{-1}$ (range 6.4 – 11.4 $kg.day^{-1}$). In 2021/22, the average daily catch rate was 10.0 $kg.day^{-1}$ (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 1 and Table 1). In 2021/22, $CPUE_{hr}$ was 2.6 $kg.hr^{-1}$, marginally above the long-term average. As described for the substantial changes in the hourly effort and catch series, the anomalous $CPUE_{hr}$ levels in 2010/11 and 2013/14, 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.

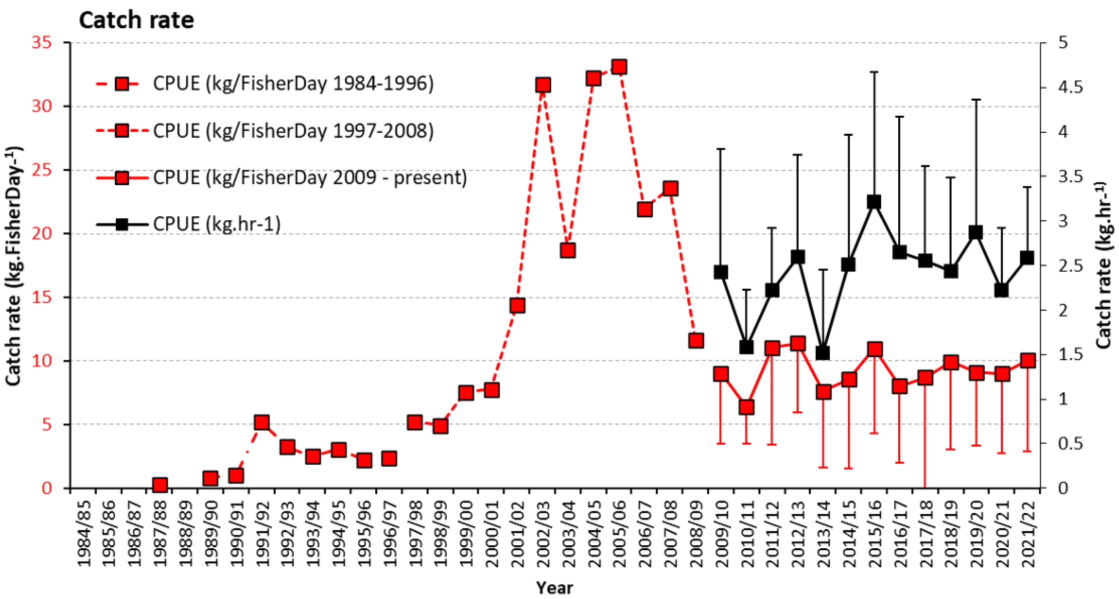

Figure 3. Average annual catch rate ($kg.hr^{-1}$ and $kg.FisherDay^{-1}$), from 1984/85 to 2021/22 (plus or minus one standard deviation, respectively, from 2009/10).

In Port Hacking, patterns of nominal ($CPUE_{hr}$) and standardised catch rate ($sCPUE_{hr}$) do not show any substantial divergence, with changes through time consistent in both series of data (Figure 4). Catch rates have generally increased since the early part of the time series from 2009/10 and were subsequently at or below the long-term average from 2009/10 to 2014/15, with those since

2014/15, having generally increased, to levels at or above the long-term average. Within the last three years, catch rates have decreased from recent historical highs, including that in 2019/20 ($CPUE_{hr}$ 3.4 $kg.hr^{-1}$), to levels about those of the long-term average. In 2021/22, $CPUE_{hr}$ and $sCPUE_{hr}$ were equivalent with the long-term average (Figure 4).

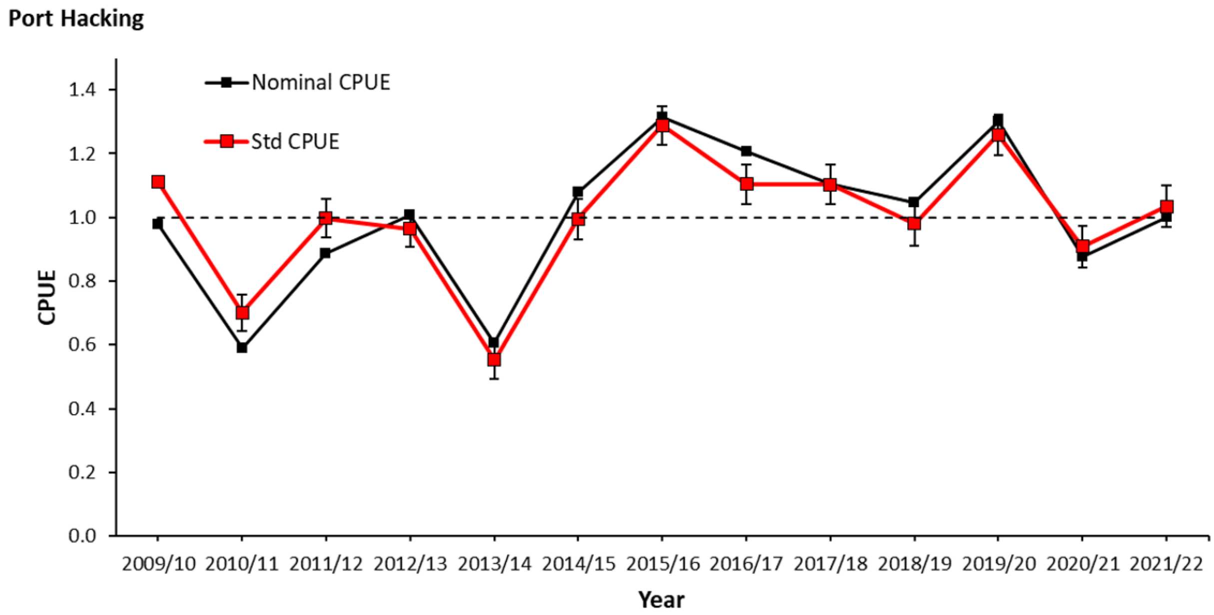

Figure 4. Port Hacking - standardised commercial catch rate (red line with 95% confidence intervals) and nominal catch rate (solid black line) scaled to the 13-year average catch rate (horizontal dashed black line) from 2009/10 to 2021/22.

STOCK ASSESSMENT

Stock Assessment Methodology

Year of most recent assessment:

2022/23 (using data to end of June 2022)

Assessment method:

A weight-of-evidence approach was used to assess the status of the NSW Ghost Nipper stock. Evidence in this approach includes: knowledge of biology and inferred stock structure and population resilience; patterns of catch, catch rate (incl. standardised catch rate) across the fishery and within key estuaries; reduced uncertainty regarding recreational catches; 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 2021/22
- Catch (recreational) (t) 2000/01, 2013/14, 2017/18, 2019/20
- Nominal (commercial) CPUE ($kg.hr^{-1}$) – 2009/10 to 2021/22
- Nominal (commercial) CPUE ($kg.day^{-1}$) – 2009/10 to 2021/22
- Standardised (commercial) CPUE ($kg.hr^{-1}$) in Port Hacking – 2009/10 to 2021/22
- 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 >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 stock abundance.

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 (commercial) $CPUE_{hr}$ (state-wide and estuary) • Nominal (commercial) $CPUE_{dy}$ (state-wide) • Standardised $CPUE_{hr}$ (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 (commercial) (state-wide and estuary scale) • Catch (recreational) (state-wide)
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 taken for this assessment and supports 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 since 2009/10; iii) catches and standardised catch rates ($sCPUE_{hr}$) from Port Hacking (the estuary that has consistently contributed a harvest >90% of the state-wide annual catch) have generally increased since 2009/10, with increasing levels of catch (>4 $t.yr^{-1}$) harvested at catch rates at or above the long-term average; iv) catches from Shoalhaven/Crookhaven River have been relatively stable since 2013/14 (albeit relatively low within the last 3-years, <100 $kg.yr^{-1}$) and recently harvested at catch rates above the long-term average; v) reduced uncertainty regarding levels of recreational catch and its spatial distribution; 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 (importantly noting that confidence in these data to support inferences of sustainable harvest declines as time between the survey and current assessment increases).

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. Charter Boat Fishing 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.

Fishery-independent surveys carried out in a number of NSW estuaries, including Port Hacking and Shoalhaven River have demonstrated a methodology and provided outputs describing estimates of biomass, with high confidence, that levels of fishing in those estuaries, for those years, was sustainable and that nipper populations appear resilient to fishing such that current levels of fishing are sustainable. However, given the likely maximum age of nippers (4-5 years) and the high variability of population size, seemingly reliant on recruitment, the likelihood that survey results from 4-6 years ago provide reliable and relevant information to current stock status is becoming increasingly uncertain.

Factors other than fishing, including global phenomena (e.g. COVID-19 and associated social impacts - FAO 2021; and climate change), large scale, state-wide disruptions (e.g. natural disasters - bushfires in 2019/20) and also, more local factors (e.g. flooding, land-use influences and environmental factors), may affect change in the abundance, catchability and productivity of nippers and/or the operations of the fishery. How these factors may influence the reliability of the available data is not well known and are not considered in this assessment beyond their acknowledgement. Influences at local scales are likely to be spatially and temporally variable. Identifying and quantifying (where possible) the likely effect of these otherwise unaccounted for factors in limiting the potential of the nipper fishery (e.g. through a risk assessment) would help inform the relative effects of fishing.

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