Stock status summary

Information provided in this summary constitutes a review of stock structure and indicators consistent with informing a species status determination using a weight of evidence approach such as is used in the Status of Australian Fish Stocks reports (SAFS; www.fish.gov.au/). Where data are unavailable or insufficient to reliably inform those criteria, this has been indicated by 'NA', rather than removing the criteria. This has been done to clearly indicate what data were available and highlight areas where alternate or additional data sources or analyses may be required to improve species status determination in the future.

Biology and stock structure

Trypaea australiensis (Ghost Nipper, hereinafter referred to as 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 (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, and active larval dispersal exposes larvae to local and large-scale oceanographic currents outside parental estuaries, the population structure could be more complex, with estuary populations falling on a spectrum of complex population sources and sinks.

Nippers are dioecious, female-brooding, decapod crustaceans. The species has high fecundity (~2000–4000 eggs per female), size at maturity of 5–8 mm carapace length and reproductive periodicity with ovigerous females generally peaking in summer (NSW DPI #1 unpublished data; Rotherham 2004).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. Growth and mortality estimates have been investigated but with high levels of uncertainty and spatial variation (Rotherham 2004).

Stock status and assessment method

Based on the review of indicators below, the NSW Nipper stock is classified as **sustainable**.

A review of indicators (weight-of-evidence approach) was used to assess the Estuary General Hand Gathering Fishery (EGHGF) – Nippers. Current uncertainty regarding Nipper stock structure, a discontinuous time series of commercial fishery effort data, spatially discrete (estuary-scale) catch and effort series and substantial but unquantified levels of recreational catch, preclude the application of more quantitative stock assessment methods.

Fishery statistics summary

Information presented in figures and tables below is summarised by fiscal year (July – June). Reference to 'year' refers to the first year of a fiscal year unless otherwise stated. For example, 2010 refers to the fiscal year 2010/11.

Prior to 1997/98, effort units (days) were not linked to catch on fishers' monthly catch returns, complicating the calculation of catch per unit effort (CPUE). Effort (days) during this period is attributed to catches only where a single fishing method was reported each month. Between 1997/98 and 2008/09 (inclusive), fishers reported monthly catch and effort (in days). From 2009/10, monthly reports of daily catch and effort (hours) metrics have been required, improving CPUE estimation.

Catch information

Commercial

Total annual reported commercial catches of Nippers increased from <2 t to 4 t between 1984/85 and 1996/97, peaked at 8.7 t in 2003/04 and subsequently declined each year to 2.1 t in 2008/09. In 2003/04, the peak in catch reflects a small number of unusually high reported monthly catches with disproportionate effort. It is likely that these monthly catches included some misreporting of numbers of Nippers rather than weight, as was a requirement for Beachworms during this period. Since 2009/10, annual reported commercial catches have been relatively stable and have averaged 4 t (range 2.6–5.1 t). In 2016/17, total reported catch was 3.9 t (Figure 1). Patterns of change in annual catch for the state-wide fishery differ from those at smaller spatial scales (individual estuary).

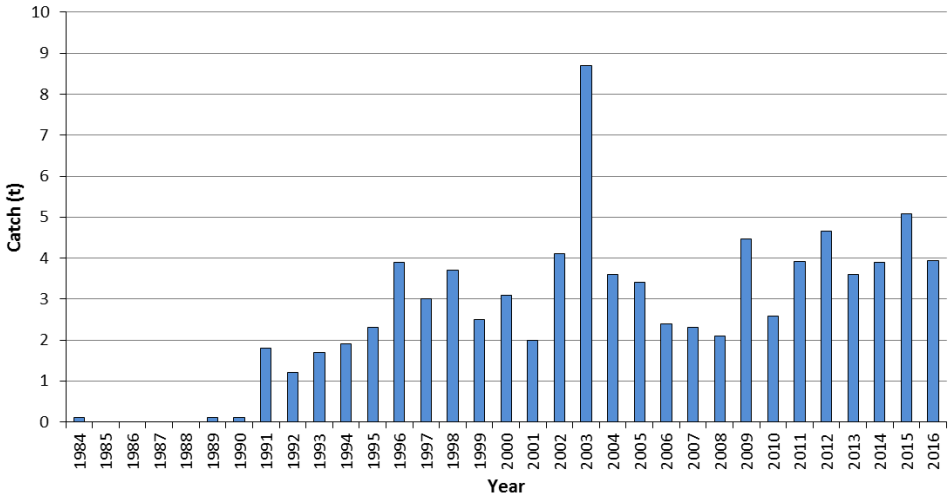

Figure 1 Annual reported commercial catch (t) of Ghost Nippers from 1984/85 to 2016/17.

Recreational and Indigenous

Recreational fishers harvest Nippers for use as bait. Estimates of recreational catch (total number retained) are available from The National Recreational and Indigenous Fishing Survey and NSW state-wide surveys (2013/14, West et al. 2015). In 2000/01, the recreational harvest (kept numbers) was estimated to be 2.5 million (±0.5 million SE). At an

Catch information

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 (± 1.4 t). In 2013/14, the state-wide survey estimated the retained recreational catch of Nippers to be 1.3 million (± 0.4 million SE; ~4 t ± 1.1 t), with about half of that catch (0.61 ± 0 0.24 million) harvested in summer (December–February), and ~0.75 million harvested from areas on the northern coast of NSW (Port Stephens to Tweed Heads). These annual estimates of recreational catch represent 372% and 110% of the reported commercial catch for those years, respectively.

Synthesis of catch composition information from Indigenous fisheries in NSW indicated that there are at least 18 species of fish and invertebrates in the Estuary General Fishery that overlap with Aboriginal fisheries (Schnierer and Egan 2016). Nippers have been harvested by Aboriginal people in the Tweed region for many generations (Schnierer 2011). In a survey based in the Tweed region, annual catch of the number of Nippers by Aboriginal fishers was estimated to be between 1,774 and 4,166 Nippers (Schnierer 2011). Based on survey logbook data from 2010 in the Tweed region, Nippers were 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 (Schnierer 2011). Cultural catch of bait including Nippers was also seen to be important in delivering economic benefits to the community.

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 scales of estuaries, principally related to recreational fishers exceeding bag limits or fishing without a licence. The quantity, spatial and temporal extent and frequency of any changes in IUU fishing have not been documented.

Effort information

Commercial

Effort in FisherDays ($effort_{dy}$) prior to 2009/10 is a problematic data series with changes to fisher reporting requirements and challenges in accurately allocating daily effort among species within a fishing method. The accuracy of effort reporting is unknown. It is possible that changes in targeting and the allocation or under-reporting of effort has occurred throughout the time of the fishery and changed as reporting requirements changed, therefore affecting the reliability of this data series and metrics derived from it (e.g. catch rate). Daily catch and effort data, required from 2009/10, has likely improved these metrics and catch rate estimates.

Reported $effort_{dy}$ increased from <100 days (over 1984/85–1990/91) to more than 450 days during the late 1990s. In 1998/99, the number of reported days fished was 497, declining

Effort information

over the following 3 years to 135 days in 2001/02 (concurrent with changes to commercial fishery reporting requirements). From 2001/02 to 2008/09, reported $effort_{dy}$ remained below 200 days, before increasing substantially to 491 days in 2009/10 (again, concurrent with the introduction of changes in commercial fishery reporting requirements). Since 2009/10, the number of days fished per year has averaged 474 days (range 402–523 days) and has remained relatively stable since 2012/13 at about 495 days. In 2016/17, $effort_{dy}$ was 460 days (Figure 2).

Effort in reported hours fished ($effort_{hr}$) has remained relatively stable since 2009/10, averaging 1767 hours (range 1484–2398 hours), with the exception of a spike of 2398 hr in 2013/14 coinciding with new entrants to the fishery—the number of fishers increased from 4 to 6—and catches coming from previously unfished estuaries. In 2016/17, $effort_{hr}$ was 1484 hours (Figure 2).

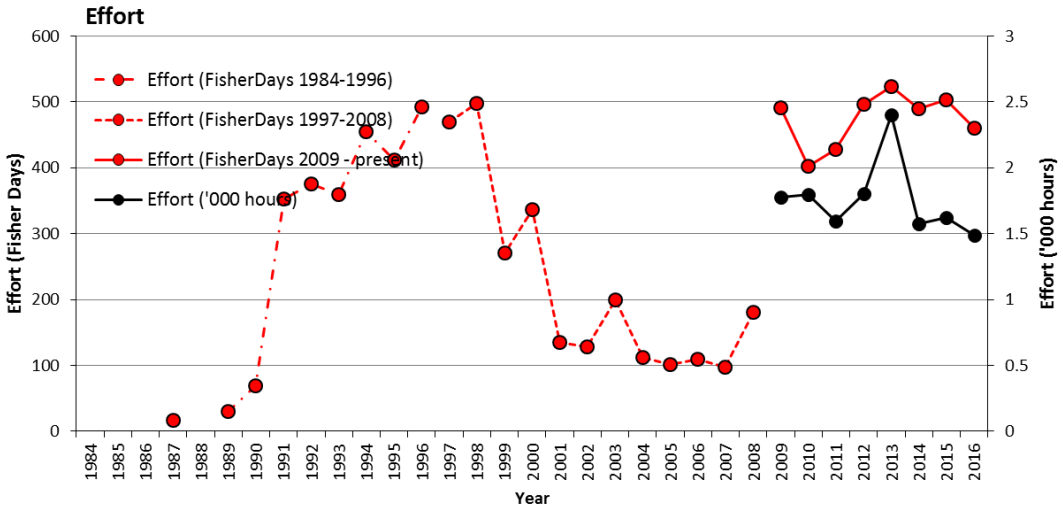

Figure 2 Annual reported commercial effort in units of FisherDays (1984/85 to 2016/17) and hours (2009/10 to 2016/17). Note: changes in reporting requirements limit consistent interpretation of the effort (FisherDays) time series.

Recreational and Indigenous

There are no data quantifying the recreational fishing effort expended in harvesting Nippers.

Nippers have been harvested by Aboriginal people in the Tweed region for many generations. Total effort of the Aboriginal fishery in the Tweed region recorded in 2010 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.

Catch rate information

Commercial

There is less uncertainty associated with the accuracy and reliability of $CPUE_{dy}$ for the current reporting period (2009/10 to present), than for previous years. This is due to differences in reporting requirements and the difficulties previously mentioned with allocating reported monthly effort to catch.

Nominal (unstandardised) $CPUE_{dy}$ increased from less than 10 kg.day^{-1} (1984/85–2000/01) to a maximum of 44 kg.day^{-1} in 2003/04 (Figure 3). From 2003/04, daily catch rate declined and in 2009/10 (the first year of current commercial fisher reporting requirements), was again below 10 kg.day^{-1}. Since 2009/10 daily catch rate has been relatively stable, below 10 kg.day^{-1}, and in the last 8 years has averaged 8.4 kg.day^{-1}. In 2016/17 the daily catch rate was 8.5 kg.day^{-1} (Figure 3).

$CPUE_{hr}$ can be calculated from 2009/10 (when fishers were required to report daily effort). Since 2009/10, annual estimates of $CPUE_{hr}$ have averaged 2.3 kg.hr^{-1} (range 1.4–3.1 kg.hr^{-1}) and remained relatively stable, with the exception of in 2010/11 and 2013/14 when $CPUE_{hr}$ was 1.4 and 1.5 kg.hr^{-1}, respectively, coinciding with small changes in the composition of fishers between years and different spatial distribution of catch between estuaries fished by these different fishers (Figure 3).

As described for state-wide levels of catch, changes in the levels of effort and $CPUE_{hr}$ across the fishery differ from patterns of $CPUE_{hr}$ at smaller, individual estuary spatial scales.

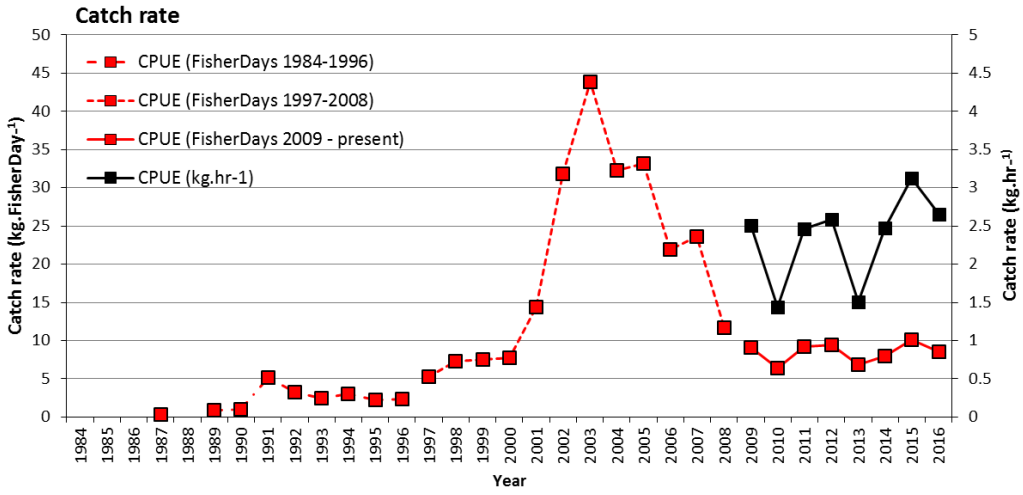

Figure 3 Annual reported commercial catch rate of Ghost Nippers (kg.FisherDay^{-1} from 1984/85 to 2016/17 and kg.hr^{-1} from 2009/10 to 2016/17). Note: changes in reporting requirements limit consistent interpretation of the catch per FisherDay time series.

Stock assessment – list of indicators	
Year of most recent assessment	2018 – **sustainable**
Assessment method	Weight of evidence (review of indicators)
Main data inputs (indicators)	Landed catch – 1984/85 to 2016/17 CPUE – kg.hr^{-1} 20009/10 to 2016/17 Recreational catch estimates in 2000/01, and 2013/14 Biomass estimates – 2015/16 and 2016/17 from fishery-independent surveys at key estuaries
Main data inputs (indicators) (rank) †	Landed catch 1984/85 to 2016/17: (medium quality), long historical time series, but some reporting changes and likely misreporting, limited quality control/error validations CPUE – kg.hr^{-1} 2009/10 to 2016/17: (medium quality) compromised by limited internal quality assurance, the small number and changes in active fishers per year and spatial distribution of catch CPUE – kg.FisherDay^{-1} 1984/85 to 2016/17: (low quality) compromised by significant reporting changes and inaccuracies in effort data Biomass estimates 2015/16 and 2016/17: (medium quality) biomass estimates are preliminary, have not been subject to rigorous quality assurance and are unpublished. These estimates are generated from data collected within a DPI Fisheries project scheduled for completion in July 2018
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	Biomass surveys – fishery-independent direct estimates of biomass for two key estuaries over two seasons. Used as an absolute index of biomass CPUE, particularly for the period 2009/10–2016/17 – used to indicate whether the biomass is likely to be increasing, decreasing or stable under current catches and effort
Biomass limit reference level	NA – no biomass limits or targets have been set However, trends in the biomass indicators were used to indicate that biomass is likely to be above a biological sustainability limit
Fishing mortality indicator or proxy	Fishing effort is the key indicator of potential fishing mortality on the stock. There have been no substantial changes in fishing gear, fishing efficiency or potential fishable area, so per-unit effort is likely to exert similar fishing pressure across the history of the fishery. This index is compromised by changes in effort reporting, particularly for effort data reported prior to 2009/10 Catch in relation to survey estimates of biomass can provide estimates of exploitation rate and fishing pressure
Fishing mortality limit reference level	NA – No fishing mortality limit have been set Estimates of natural mortality (M) can be used to estimate precautionary levels of fishing mortality (F) to apply as limits. These can be used to estimate sustainable harvest rates for given biomass estimates
Target reference level	NA – No fishing mortality targets have been set However, recent trends in effort, catch and CPUE indicate that the average effort levels (here used as a proxy for fishing pressure) in this fishery have been sustainable, and could be maintained

Stock assessment results – review of indicators	
Biomass status in relation to limit	NA – no biomass limits or targets have been set However, indicators used indicate that biomass has remained above a limit reference level that would result in recruitment impairment. It is likely that biomass is well above such a limit level
Fishing mortality in relation to limit	NA – No fishing mortality limit have been set However, fishing mortality appears to be sustainable, and below a level that would result in biomass decline
Previous SAFS stock status	NA – not a SAFS-reported species
Current SAFS stock status	NA – not a SAFS-reported species

Fishery interactions

Fishery interactions described here provide some information on the possible dynamics within the NSW Estuary General Hand Gathering Fishery (EGHGF) and with other fisheries accessing Nipper populations.

Within the EGHGF, fishing businesses have had equal access to Pipi, Beachworm, Estuary Cockle and Nipper populations throughout the state. This will change with the allocation of shares and the share link to catch quota from 2018/19. Since 2009/10, fewer than seven fishing businesses within the EGHGF have been active in the annual harvest of Nippers. Since 2015/16, two fishing businesses within the NSW Charter Fishing Activity have recorded minor activity in harvesting Nippers (total annual catch <40 kg as Nippers harvested for display).

There is a current project investigating the effects of experimental fishing activity on the persistence and population structure of Nippers, in addition to more broadly describing spatial and temporal changes in Nipper populations, including estimates of biomass (NSW DPI #1 unpublished data). This project has developed out of a need to understand the possible effects of the existing charter fishing-related activity on Nipper populations in the Tweed River area, specifically the Terranora Inlet. Charter fishing businesses in this estuary are licenced, with an active code of conduct, to facilitate Nipper fishing activities by paying members of the public. These activities are limited to defined areas and result in no landed catch (no Nippers retained), but do interact with the Nipper populations and their habitat. Preliminary results (DPI unpublished data) indicate that changes in the abundance of Nippers through time are generally consistent between areas of different levels of utilisation. However, results from structured field experiments investigating the response of

Fishery interactions

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 local populations of Nippers. The high frequency of visits to these sites by relatively large numbers of people, particularly during busy months (summer), may result in persistent decline in the local abundance of Nippers (and likely other infauna).

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