

Assessment Authors and Year

Hall, K.C. 2023. NSW Stock Status Summary 2022/23 – Sand Whiting (*Sillago ciliata*). NSW Department of Primary Industries, Fisheries NSW, Coffs Harbour. 14 pp.

Stock Status

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| Current stock status | On the basis of the evidence contained within this assessment, Sand Whiting is currently assessed as Sustainable for the NSW component of the stock. |
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Stock structure & distribution

The Sand Whiting (*Sillago ciliata*) occurs along the east coast of Australia, from Cape York in Queensland to Victoria, and including eastern Tasmania. It is also found in New Caledonia and Papua New Guinea (MacKay, 1992). Tagging studies indicate adult fish move between estuaries, but the stock structure across the species distribution is unknown (Gray, 2023). Stock assessment and management currently occur at a jurisdictional level, with most of the catch landed in Queensland and NSW, where the species is most abundant (Roelofs *et al.*, 2021).

The data presented in this summary relate to the NSW jurisdiction.

Biology

The Sand Whiting occurs in estuaries, coastal embayments and inshore marine waters adjacent to beaches, and prefers bare sandy habitats (Gray *et al.*, 1996, 2011). Sand Whiting feeds primarily on bottom dwelling invertebrates, particularly polychaete worms, crustaceans and molluscs taken by fossicking through the sand (Burchmore *et al.*, 1988). The species reaches a maximum length of 46 cm fork length (FL) (Gray, 2023). Juveniles grow reasonably quickly, taking about 2 years to reach 25 cm fork length (FL) after which growth slows (Ochwada-Doyle *et al.*, 2014). Growth rates also vary significantly with latitude and water temperature (Stocks *et al.*, 2011). Females grow slightly faster, attain larger maximum sizes and mature at a significantly larger size (19 cm FL) and older age (1.6 years) than males (at 17 cm FL and 1.1 years) (Ochwada-Doyle *et al.*, 2014). Although the maximum reported age is 16 years (from otolith increments, Gray *et al.*, 2000) or 22 years (from scale increments, Cleland, 1947), most fish landed in commercial fisheries are aged 2–5 years for hauling gears and 3 to 10 years for meshing gears (Gray *et al.*, 2000).

Spawning occurs in the lower reaches of estuaries and in coastal waters near river mouths during spring and summer (Burchmore *et al.*, 1988; Ochwada-Doyle *et al.*, 2014). Larvae then enter estuaries, with the small juveniles preferring shallow water, particularly along sandy shores and also in and around seagrasses and mangroves (Gray *et al.*, 1996). After spawning, adults may either remain in estuarine waters or migrate along ocean beaches (Gray, 2023).

FISHERY STATISTICS

Catch information

Commercial

Annual commercial catches of Sand Whiting in NSW state waters are available from 1952/53 to 2021/22 (Fig. 1). Catches steadily increased from 50.8 t in 1952/53 to a peak of 229.4 t in 1982/83 and then remained above 130 t until 2007/08. Since 2008/09, catches have steadily decreased to record the lowest catches in five decades of 54 t in 2021/22 (Fig. 1). The biggest decrease in catches followed the introduction of recreational fishing havens in 30 estuaries in 2006.

Most of commercial catch of Sand Whiting from NSW waters is taken by hauling and mesh netting sectors of the Estuary General Fishery (EGF) (Figs 2 and 3). Catches in both sectors remained fairly stable between 1997/98 and 2007/08, with the hauling sector taking approximately two thirds of the total EGF catch. However, since 2008/09 catches in the mesh netting sector have decreased slowly, while those of the hauling sector have undergone greater declines (Fig. 3).

The relative proportions of commercial catch taken in different regions and estuaries have varied temporally for both the hauling and mesh netting sectors of the EGF (Figs 4 and 5). For the hauling sector, catches from region 4 have consistently accounted for a large proportion of the total catch; whereas catches from region 2 and 6 were historically important, but have gradually decreased over time. Similar trends are evident in mesh-netting catches, with region 4 dominating and catches in region 2 gradually declining over time, but catches in region 6 show a reverse trend, increasing and remaining steady in recent years. Most of the commercial catch is taken from 10 main estuaries.

Sand Whiting are also targeted by commercial net fishers in Queensland, with catches on average much larger than those taken in NSW. The total commercial catch in Queensland averaged 277 t between 1990 and 2016 (McGilvray and Hall 2018). However, recent catches have also been smaller, with only 74 t reported in 2021/22 (Moffitt *et al.*, 2023).

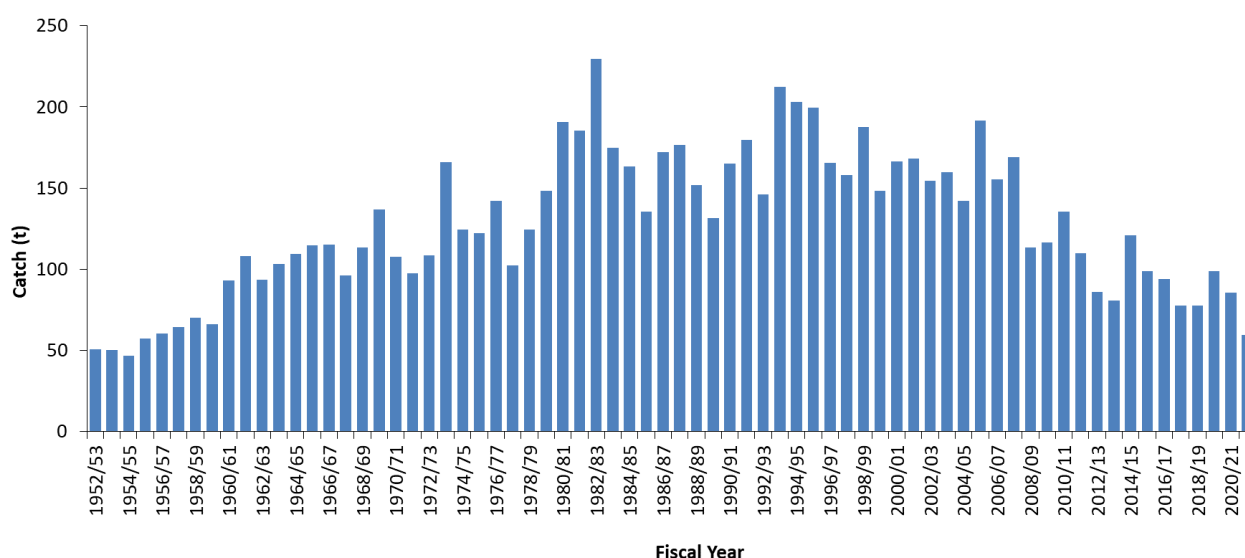


Figure 1. Annual commercial catches of Sand Whiting in NSW waters from 1952/53 to 2021/22 for all fishing methods.

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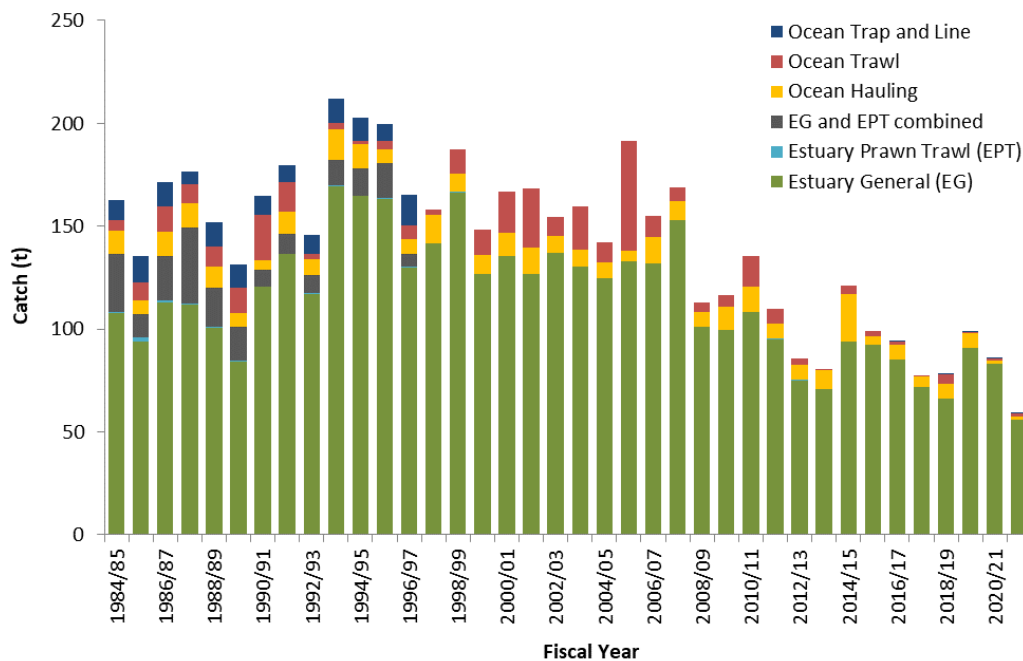


Figure 2. Annual commercial catches of Sand Whiting by fishery in NSW waters from 1984/58 to 2021/22.

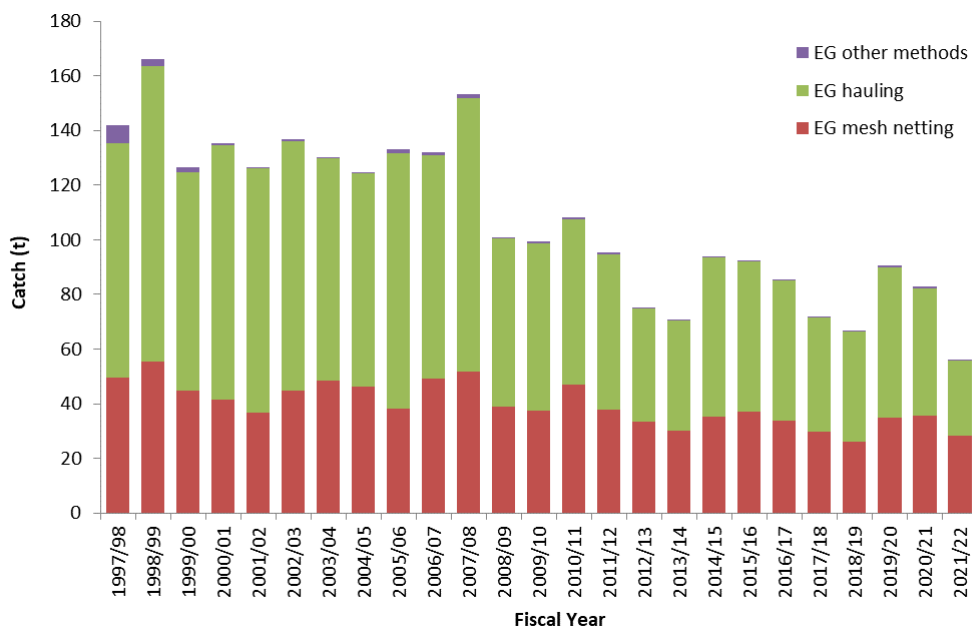


Figure 3. Annual commercial catches of Sand Whiting by the hauling and mesh netting sectors of the NSW Estuary General Fishery from 1997/98 to 2021/22.

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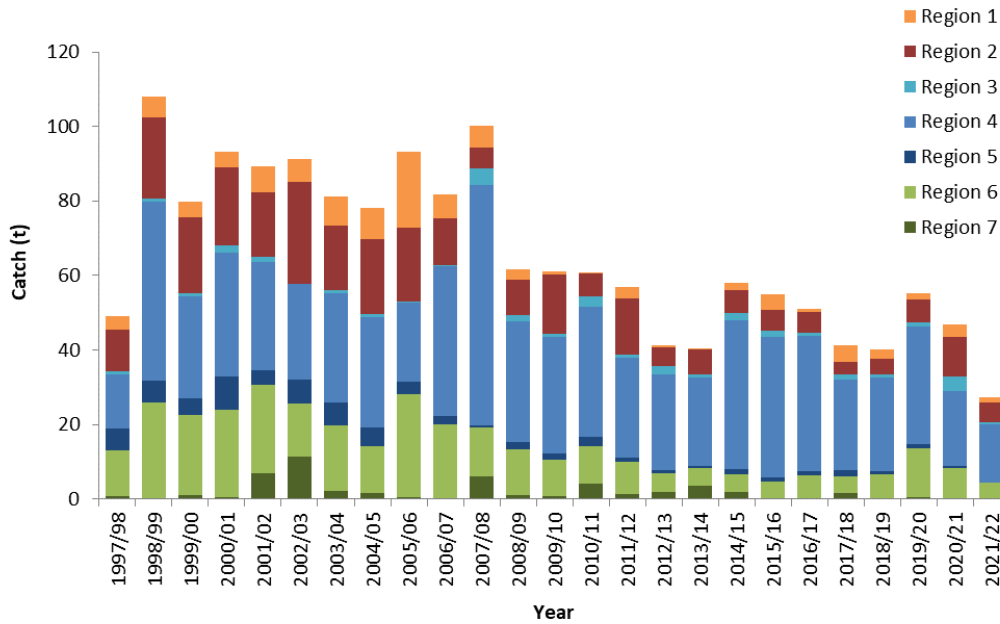


Figure 4. Annual commercial catches of Sand Whiting by the hauling sector in different regions of the NSW Estuary General Fishery from 1997/98 to 2021/22.

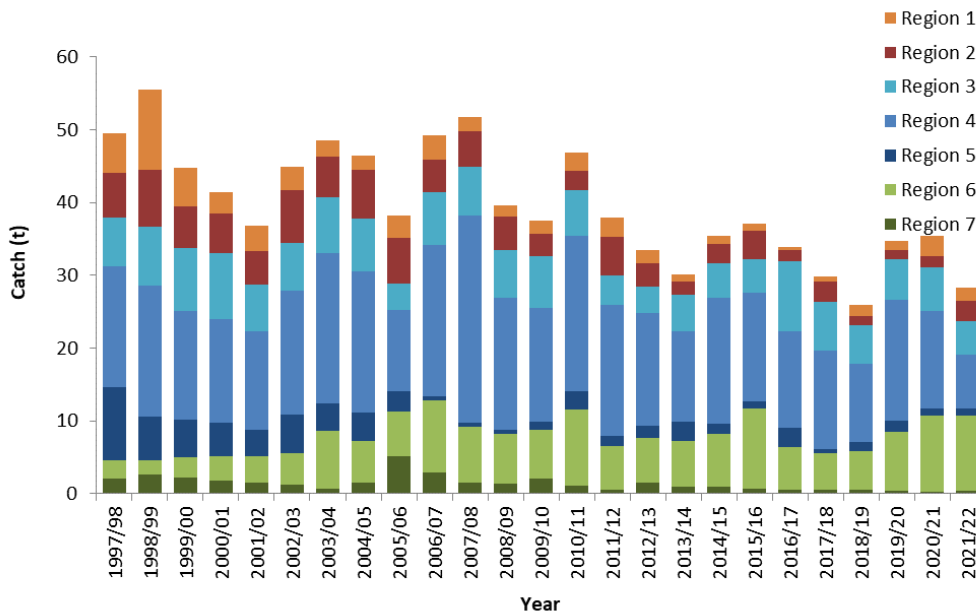


Figure 5. Annual commercial catches of Sand Whiting by the mesh netting sector in different regions of the NSW Estuary General Fishery from 1997/98 to 2021/22.

Recreational & Charter boat

The most recent estimate of the recreational harvest of Sand Whiting in New South Wales was approximately 165,755 fish or around 46.1 t during 2019–20 (Murphy *et al.*, 2022). This estimate was based on a survey of Recreational Fishing Licence (RFL) Households, comprised of at least one fisher possessing a long-term (1 or 3 years duration) fishing licence and any other fishers resident within their household. The equivalent estimates from previous surveys were 172 941 fish in 2013–14 and 120,831 fish in 2017–18, which suggests catches have recently increased following a declining trend (Murphy *et al.*, 2020). Relative to the commercial catch, these recreational catches comprised approximately 46.3% of the total harvest from NSW waters in 2013/14 (West *et al.*, 2015).

Aboriginal cultural fishery

A survey of Aboriginal cultural fishing in the Tweed River catchment identified Sand Whiting as one of the top 10 most important species numerically in catches, which was estimated to account for 14.2% of the total finfish catch (Schnierer & Egan, 2016). Total catches in the region were estimated to range between 2,085–4,940 Sand Whiting per annum (Schnierer, 2011). Statewide estimates of the annual Aboriginal harvest of Sand Whiting in NSW waters are unknown, but are assumed to be significant.

Illegal, Unregulated and Unreported

The amount of illegal, unregulated and unreported catches of Sand Whiting in New South Wales are unknown.

Fishing effort information

Commercial fishing effort for Sand Whiting was collected as number of days fished on monthly records prior to July 2009 and as numbers of daily fishing events after July 2009. To form a longer time series of effort, recent daily events were re-aggregated, with effort in days fished estimated from the number of fishing events entered for each fisher in each month where Sand Whiting was reported on at least one day.

Nominal effort levels (in total number of days fished) over the past 11 years have been well below historical levels (Fig. 6). In 2021/22, effort was 7,171 days for mesh netting and 762 days for hauling compared with peaks of 23,093 and 8,012 days, respectively, in 1999/00 and 1998/99, respectively. Changes in catch reporting from monthly to daily records in July 2009 significantly altered effort distributions and account for some of the rapid decrease in effort in 2009/10 for each time series (refer to Hall 2020 for a detailed analyses of the error distribution changes).

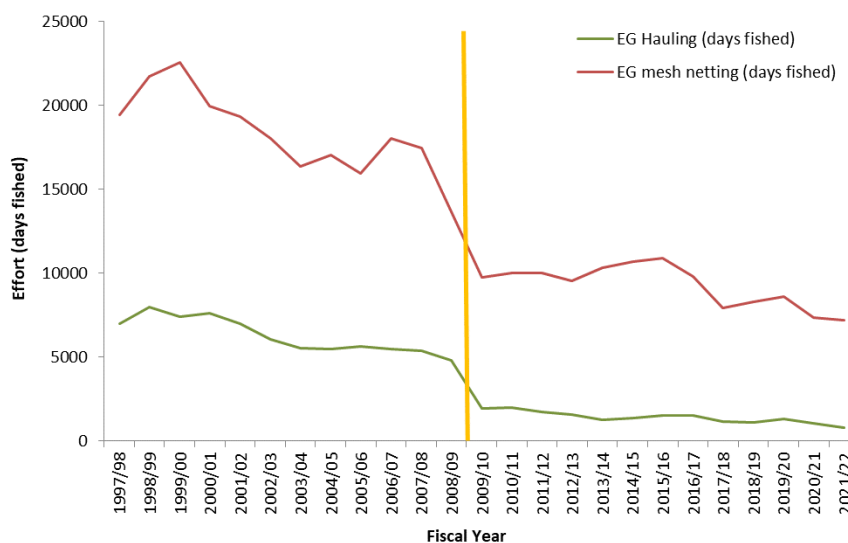


Figure 6. Annual effort (in days fished) for the hauling and mesh netting fishers of the NSW Estuary General Fishery that reported landing Sand Whiting on at least one day in each month. The gold vertical line indicates the change from monthly to daily catch reporting.

STOCK ASSESSMENT

Stock Assessment Methodology

Year of most recent assessment:

2023

No quantitative joint stock assessment of the entire biological stock is undertaken.

Assessment method:

A weight-of-evidence approach was used for this stock assessment of Sand Whiting in NSW waters. It incorporates the results from four main analyses:

1. Historical commercial catch and effort data for all sectors;
2. NSW recreational fishing surveys from five periods;
3. Standardised catch rates for the two main commercial fishing sectors, mesh netting and hauling in the EGF, pooled across all estuaries; and
4. Size and age-structure data spanning over 50 years.

Main data inputs:

Commercial catch and effort data – for all NSW commercial fisheries by fiscal years (1952/53–2021/22).

Recreational catches – estimated annual catches from four periods – national recreational and indigenous fishing survey (2000/01) and NSW recreational fishing surveys (2013/14, 2017/18, 2019/20 and 2021/22).

Commercial catch rates historical – reported annual CPUE data for the hauling and mesh netting sectors of the EGF by calendar years in kg per days fished (1984/85–2008/09) from monthly records – standardised.

Commercial catch rates recent – reported annual CPUE data for the hauling and mesh netting sectors of the EGF by calendar years in kg per shot and kg per fishing event, respectively (2009/10–2021/22) from daily records – standardised.

Mean length data – from commercial catch samples collected via port monitoring (1961/62–2019/20, with missing years).

Length compositions – from commercial hauling and meshing catch samples of the EGF collected via port monitoring (1997/98–2019/20, with missing years).

Age structures from sectioned otoliths collected during port monitoring at various locations along the NSW coast (2007/08–2019/20, with missing years).

Key model structure & assumptions:

The CPUE standardisations and analyses assume that the annual catch rates are a relative index of abundance and are not unduly influenced by other factors that are not accounted for through standardisation.

Catch rates were standardised for the influences of different months, estuary regions, fishing businesses and net length (mesh netting records only).

Sources of uncertainty evaluated:

None were assessed.

Status Indicators - Limit & Target Reference Levels

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| Biomass indicator or proxy | None specified in a formal harvest strategy. In the interim, the trend in commercial catch rates of the hauling and mesh netting sectors of the EGF were selected as indices of relative abundance. |
| Biomass Limit Reference Point | None specified in a formal harvest strategy. In the interim, current catch rates were assessed relative to long-term averages of each time series. |
| Biomass Target Reference Point | None specified. |
| Fishing mortality indicator or proxy | None specified in a formal harvest strategy. In the interim, the trend in annual total commercial fishing effort for the hauling and mesh netting sectors of the EGF were selected as indicators of relative fishing pressure. |
| Fishing mortality Limit Reference Point | None specified in a formal harvest strategy. In the interim, current fishing effort levels were compared against historic levels. |
| Fishing Mortality Target Reference Point | None specified. |

Stock Assessment Results

Standardised catch-rate analyses

Historical catch rates (catch-per-unit-effort, CPUE) in kg per day fished for Sand Whiting taken by hauling and mesh netting in the EGF were compiled from monthly records between 1998 and 2009 and 1985 and 2009, respectively. Historical catch rates were standardized for month, estuary region and fishing business using the r-package 'rforcue' (Haddon, 2023). Continuity of the time series across the catch reporting change in July 2009 is considered invalid because of significant changes in effort reporting. Recent catch rates in kg per shot for hauling and kg per day for mesh netting were also compiled from daily fishing event records from 2010 to 2022 and standardised for month, estuary region, fishing business and net length (the last for mesh netting only).

The mean standardised catch rates of Sand Whiting have been consistently lower for mesh netting relative to hauling (Figs. 7 and 8), despite the two sectors operating in similar estuaries and regions. Monthly catch rates of both sectors increased historically from 2000 to 2006 for hauling and from 1986 to 1995 and again from 2000 to 2008 for mesh netting. Catch rates in both sectors then decreased in the early 2010s followed by another period of increasing rates. Recent catch rates over the last three years have been above-average.

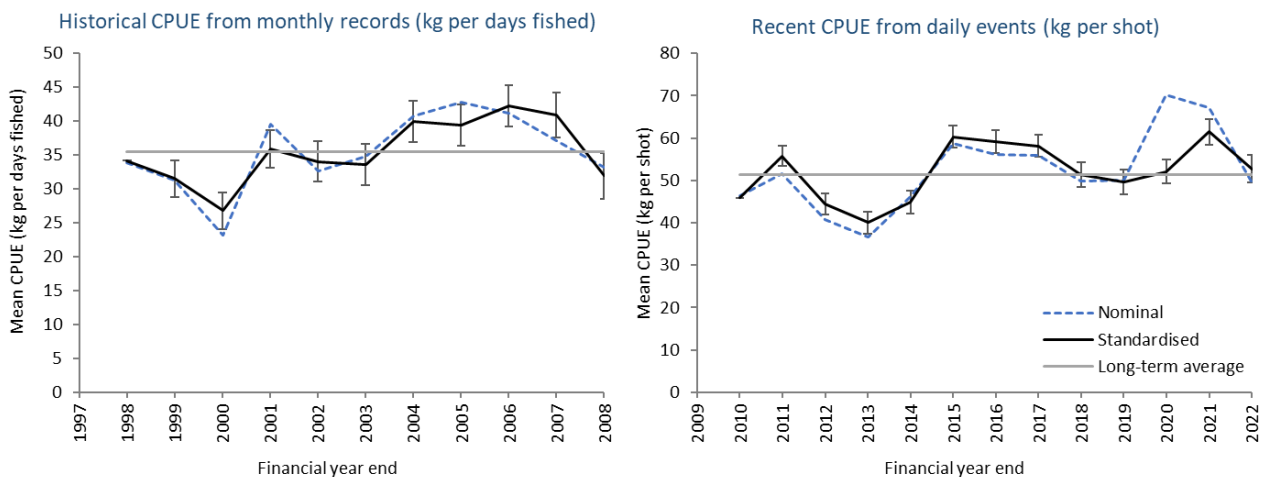


Figure 7. Mean standardised catch rates (catch-per-unit-effort, CPUE) of Sand Whiting for the hauling sector of the NSW Estuary General Fishery, estimated from monthly records (1998–2009) in kg per days fished (left graph) and daily fishing event records (2010–2022) in kg per shot (right graph). The dashed and solid lines indicate the nominal and standardised mean CPUE, respectively; and the grey horizontal line indicates the long-term averages for each series.

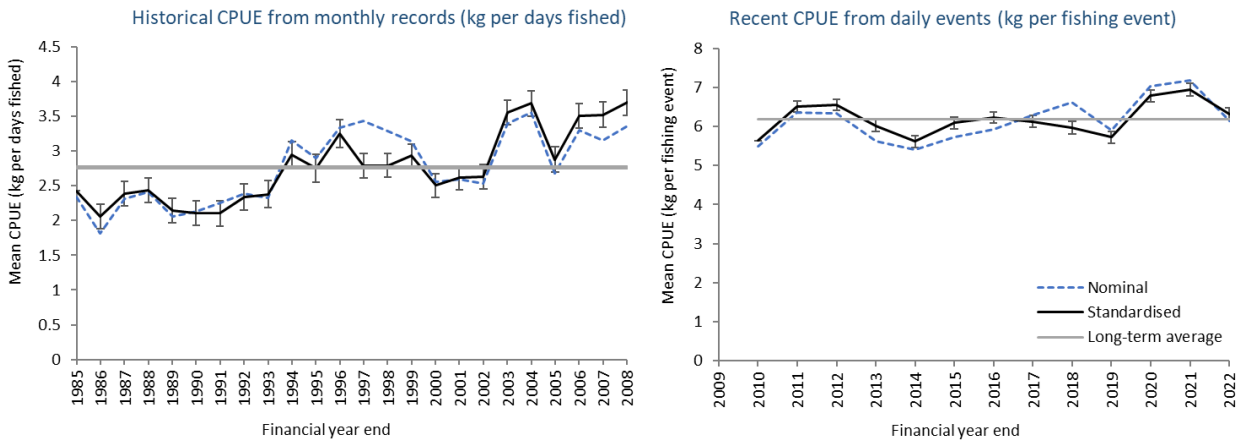


Figure 8. Mean standardised catch rates (catch-per-unit-effort, CPUE) of Sand Whiting for the meshing sector of the NSW Estuary General Fishery, estimated from monthly records (1998–2009) in kg per days fished (left graph) and daily fishing event records (2010–2022) in kg per fishing event (right graph). The dashed and solid lines indicate the nominal and standardised mean CPUE, respectively; and the grey horizontal line indicates the long-term averages for each series.

Size and age-structures

The mean lengths and length frequencies of Sand Whiting sampled from NSW commercial catches have varied little over the 50-year period for which the historical data span (Figs 9 and 10). Data were pooled with respect to fishing methods for samples collected between 1961/62 and 1992/93 and separated according to EGF hauling and meshing sectors since 1997/98. Available age data from sectioned otoliths sampled from fish landed in commercial catches have also remained stable since 2007/08, with a good representation of older fish in all years, particularly among meshing samples that select for larger fish (Fig. 11).

No attempt to estimate mortality from catch-curve analyses of fishery-dependent age structures was attempted given the dome selectivity of both fishing gears likely influencing the number of older fish in samples. Historical estimates from age structures derived from fishery-independent survey gears that sampled more evenly across all year classes indicated that the rate of fishing mortality was likely to be less than that of natural mortality (Ochwada-Doyle *et al.*, 2014).

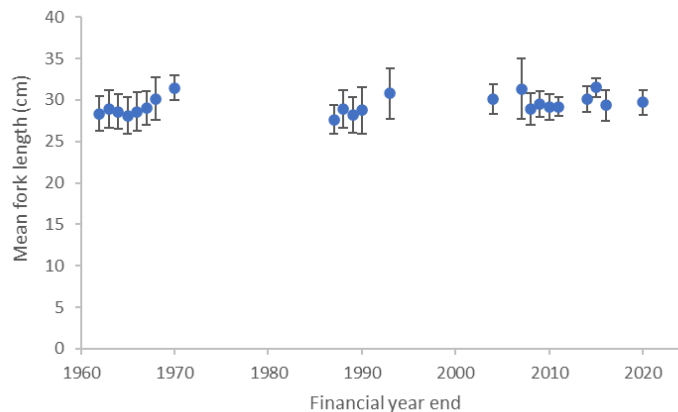


Figure 9. Mean length (\pm SD) of Sand Whiting sampled from commercial fishing catches (all methods pooled) (1961/62–2019/20).

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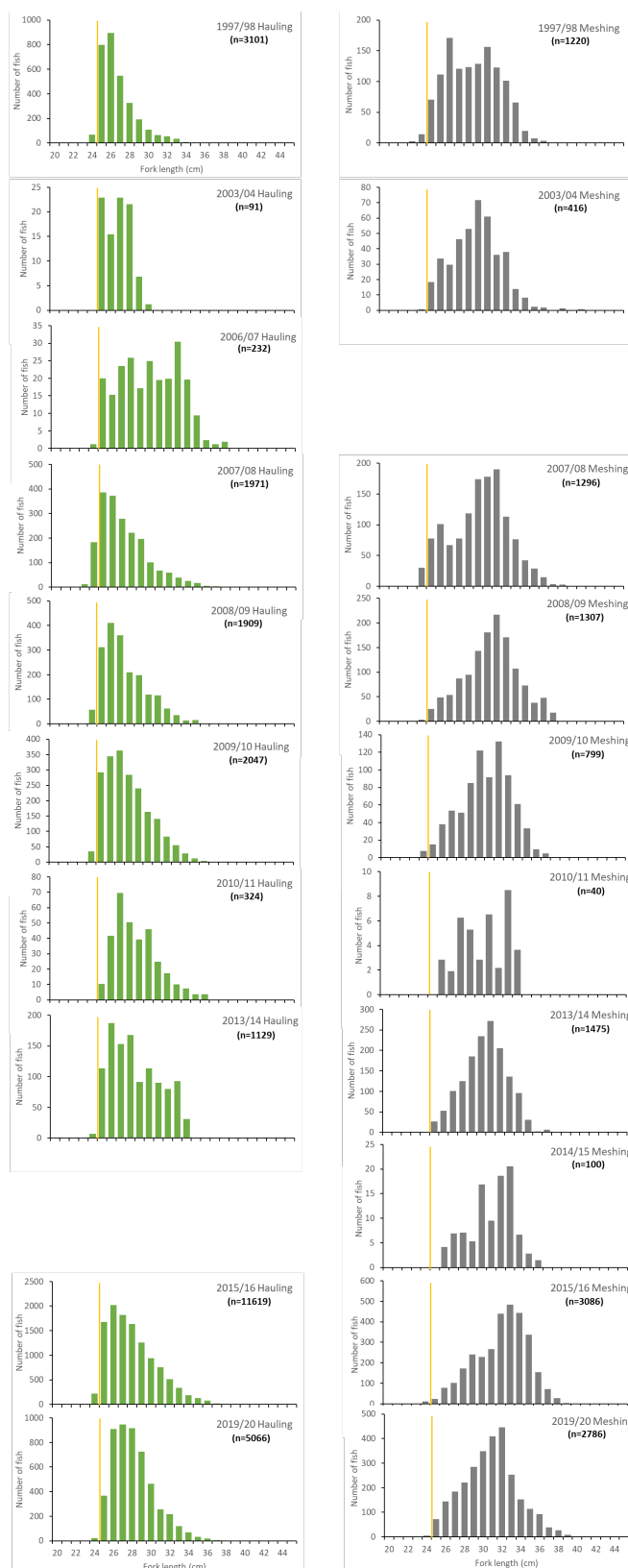


Figure 10. Length frequency distributions of Sand Whiting for the hauling (left graphs) and meshing (right graphs) sectors of the NSW Estuary General Fishery collected during port monitoring and weighted according to sample sizes and distribution of commercial catches across regions (2003/04–2019/20).

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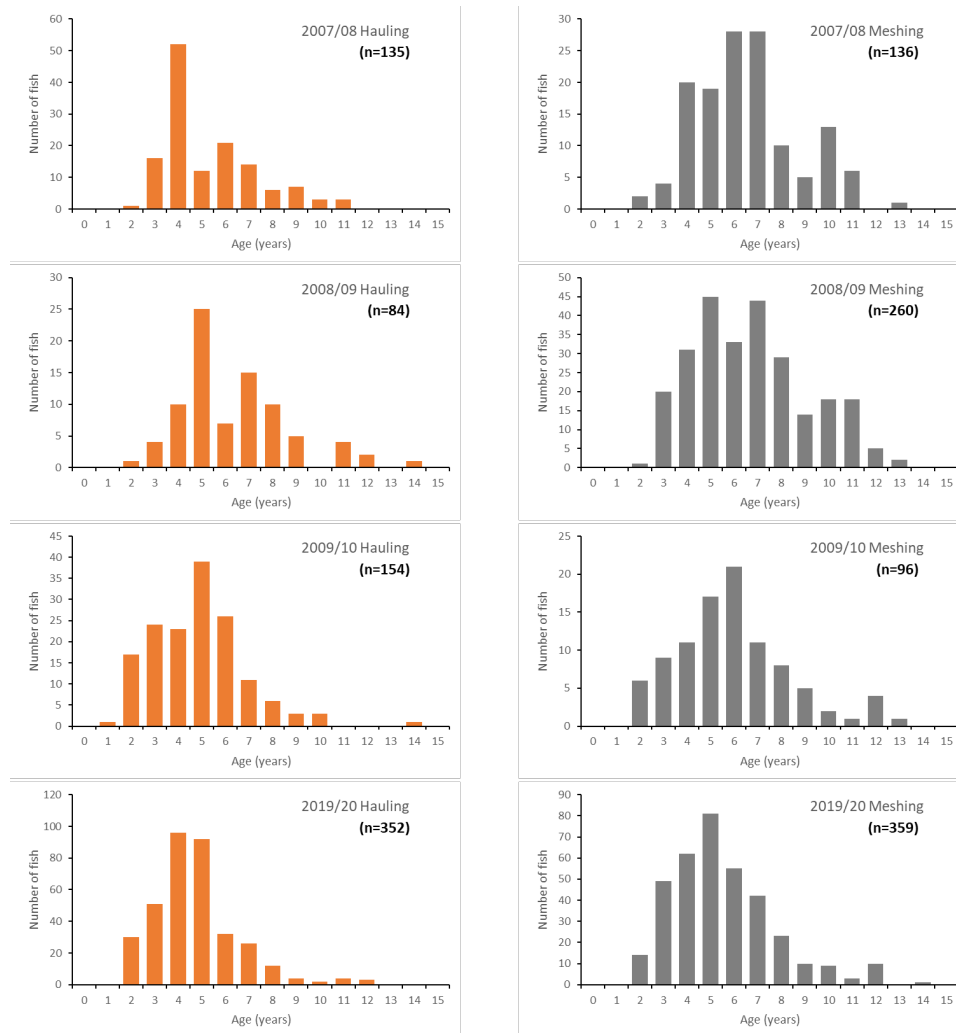


Figure 11. Age structures of Sand Whiting in samples from hauling (left graphs) and meshing (right graphs) catches of the NSW Estuary General Fishery collected during port monitoring (2007/08–2019/20).

Stock Assessment Result Summary

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| <p>Biomass status in relation to Limit</p> | <p>The recent decreases in catches have coincided with similar declines in effort, such that the standardised commercial catch rates for both the hauling and mesh netting sectors, while variable, have remained near long-term averages over the last 13 years, and have been above-average over the last 3 years for both sectors. Longer-term catch rates must be interpreted with caution due to the potential influence of catch reporting changes on effort distributions in July 2009.</p> <p>The length compositions of the commercial landings have been relatively stable since the late-1960s (although the time-series has many missing years).</p> <p>The weight of evidence indicates that the biomass of the stock is unlikely to be depleted and that recruitment is unlikely to be impaired.</p> |
| <p>Biomass status in relation to Target</p> | <p>Not assessed.</p> |
| <p>Fishing mortality in relation to Limit</p> | <p>Nominal effort levels (in total number of days fished) over the past 13 years have been well below historical levels. Although changes in catch reporting from monthly to daily records in July 1997 significantly altered effort distributions and account for some of the historical decrease. The minimum legal length for both commercial and recreational fishers (270 mm TL), and spatial closures in New South Wales estuaries also reduce fishing pressure on the spawning stock.</p> <p>Historical estimates of mortality from catch curves indicate that the rate of fishing mortality was likely to be less than that of natural mortality.</p> <p>The weight of evidence indicates that the current level of fishing pressure is unlikely to cause the stock to become recruitment overfished.</p> |
| <p>Fishing mortality in relation to Target</p> | <p>Not assessed.</p> |
| <p>Current SAFS stock status</p> | <p>On the basis of the evidence above, Sand Whiting is currently assessed as a Sustainable stock.</p> |

Fishery interactions

The EGF is a diverse multi-species, multi-method fishery that is permitted to operate in 76 of the approximately 150 estuarine systems along the NSW coastline. It operates according to Fisheries Management (Estuary General Share Management Plan) Regulation 2006 which was subject to a detailed risk assessment in an environmental impact statement (EIS) for the fishery undertaken during fisheries management strategy development (NSW Fisheries 2001). An updated threat and risk assessment for all components of the NSW marine estate was completed in 2017 (Fletcher and Fisk 2017). The EGF was considered a moderate threat to species and communities protected under the NSW Fisheries Management Act 1994 and Biodiversity Conservation Act 2016. Compulsory logbook reporting of all interactions with ETP species was mandated in 2005 and these are reported annually to the Department of Environment and Energy (NSW DPI, 2017).

Qualifying Comments

- Overall, the data collated in this stock assessment suggest that the input controls used to manage effort in the commercial EGF have proved effective at reducing effort levels between 1997/98 and 2021/22 and consequently fishing pressure on Sand Whiting.
- The potential influence of catch reporting changes on commercial catch rates (especially during the transition from monthly to daily reporting around July 2009) limits their application as an index of relative abundance.
- In particular, pronounced decreases in effort are evident in 2009/10 that are likely influenced by the catch reporting changes and a single time series of monthly catch rates spanning this period is not recommended for this species.
- Size and age structures of the commercial catches have remained constant over a long time period, but these are likely to be influenced by the size selectivity of the fishing gears.
- Fishing mortality estimates derived from fishery-independent age structure data are quite dated for a relatively short-lived species.
- A move towards population biomass estimation using an integrated age-structured model is recommended for future Sand Whiting stock assessments to make better use of the fishery-dependent length and age data available.

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