Stock Status Summary – 2023/24

NSW Stock Status Summary - Eastern Sea Garfish (*Hyporhamphus australis*)

Assessment Authors and Year

Stewart, J. 2024. NSW Stock Status Summary 2023/24 – Eastern Sea Garfish (*Hyporhamphus australis*). NSW Department of Primary Industries. Fisheries. 11 pp

Stock Status

Current stock status	On the basis of the evidence contained within this assessment, Eastern Sea Garfish are currently assessed as Sustainable.

Stock Structure and Distribution

Eastern Sea Garfish *Hyporhamphus australis* is endemic to Australia and a member of the teleost family Hemiramphidae. Distributed from approximately Moreton Bay in Queensland to Eden in NSW, including Lord Howe and Norfolk Islands, they are considered a single biological stock based on genetic evidence (Riley et al., 2023).

The data presented in this summary relate to the NSW part of the Eastern Australia stock.

Biology

Eastern Sea Garfish are elongate, marine, surface-dwelling fishes with the lower jaw much longer than the upper. They are multiple batch spawners in late spring and early summer (November-December) on the south coast of NSW and in winter and spring (June-October) on the north coast (Hughes and Stewart, 2006). They produce relatively large eggs (~2.5 mm diameter) that are covered with filaments of 5-10 mm long that allow them to attach to floating or benthic vegetation. Batch fecundity increases linearly with fish length up to approximately 3,500 eggs. Eastern Sea Garfish mature at ~21 cm fork length (measured from the tip of the upper jaw) and at 1 year of age. They have been reported to attain approximately 40 cm fork length and 6 years of age (Stewart and Hughes, 2007; Broadhurst et al., 2018), with females growing faster and attaining larger sizes than males (Stewart and Hughes, 2007).

Catch Trends

Commercial

The commercial fishery for Eastern Sea Garfish in NSW is part of the Ocean Hauling Fishery and uses garfish hauling nets to target schools of fish. These garfish hauling nets are designed to fish the surface layers and can be used either from boats or the shore; however the majority of fishers are currently boat-based (Stewart et al., 2005). NSW is the only jurisdiction to record commercial catch. Landings of garfish in southern Queensland are not reported to a species level; however landings of Eastern Sea Garfish in that state are thought to be minor.

Commercial landing records from NSW are available from 1940/41 and were accessed through the Departments 'H-Catch' database. Records are known to be complete from 1984/85; however records between 1969/70 and 1983/84 are known to be incomplete (Pease and Grinberg, 1995) but by an unknown amount.

NSW commercial landings peaked at approximately 280 tonnes (t) in 1992/93 (Fig. 1). Since that time landings have fluctuated but have declined overall to an average of approximately 30 t p.a. during the 5 years to 2022/23 (noting that logbook records for 2022/23 were likely incomplete when this summary was obtained during January 2024). The majority of the catch is reported by the Ocean Haul Fishery (Fig. 2).

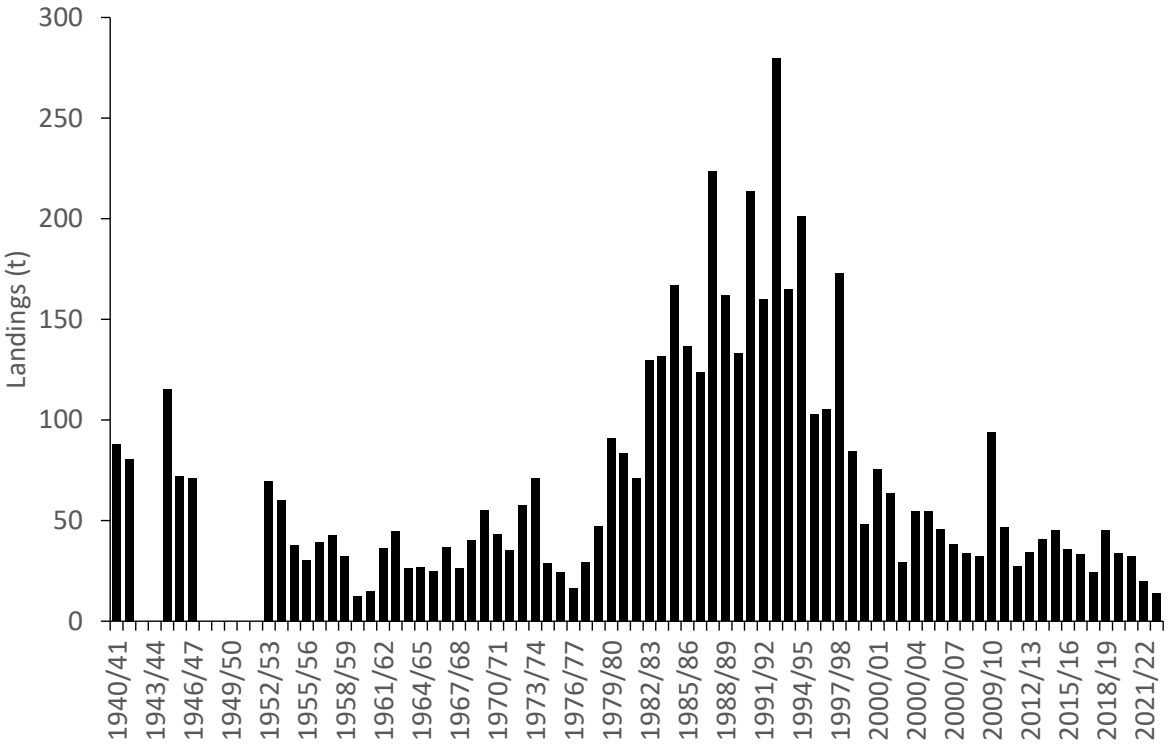

Figure 1. Commercial landings of Eastern Sea Garfish for NSW from 1940/41 to 2022/23. Note that data are missing for several years during the 1940s..

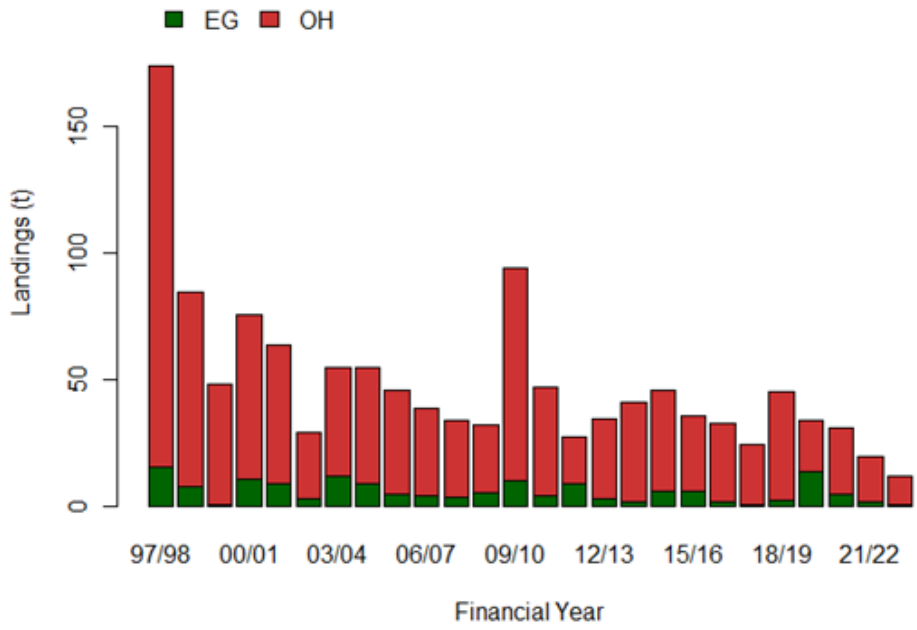

Figure 2. Landings by Fishery of Eastern Sea Garfish in NSW for years 1997/98 to 2022/23. EG = Estuary General; OH = Ocean Haul.

Recreational and Indigenous

There are no reliable estimates of the recreational harvest of Eastern Sea Garfish. Recreational fishers are known to catch Eastern Sea Garfish using small, baited hooks and by dip-netting; however harvest is believed to be negligible in comparison to commercial landings. There has been no reported harvest of Eastern Sea Garfish in Charter boat logbooks in recent years.

There are no data on Aboriginal harvest.

Fishing effort trends

Fishing effort towards Eastern Sea Garfish is difficult to estimate prior to 1997 as fishers were not required to directly associate catch of a species with the method used to catch them. Logbook forms used between 1990 and 1996 did not associate species catch with days of effort or fishing method, and prior to 1990 it was only possible to determine species catch per month. Since 2009/10 fishing effort in terms of days fished and the number of shots each day have been reported through the mandated fisher logbooks.

Annual effort in terms of days fished using boat-based methods when Eastern Sea Garfish were reported have ranged between 243 and 77 since 2009/10. Only 77 days were reported during 2021/22, but that increased to just over 100 days during 2022/23 (Fig. 3). This level of effort is substantially less than the reported annual days fished of more than 800 during the early 2000s (Broadhurst et al., 2018).

The number of boat-based shots (net deployments) has declined from approximately 1,200 during 2009/10 (when this metric was first included in the logbook) to a low of 136 during 2021/22 (Fig. 4).

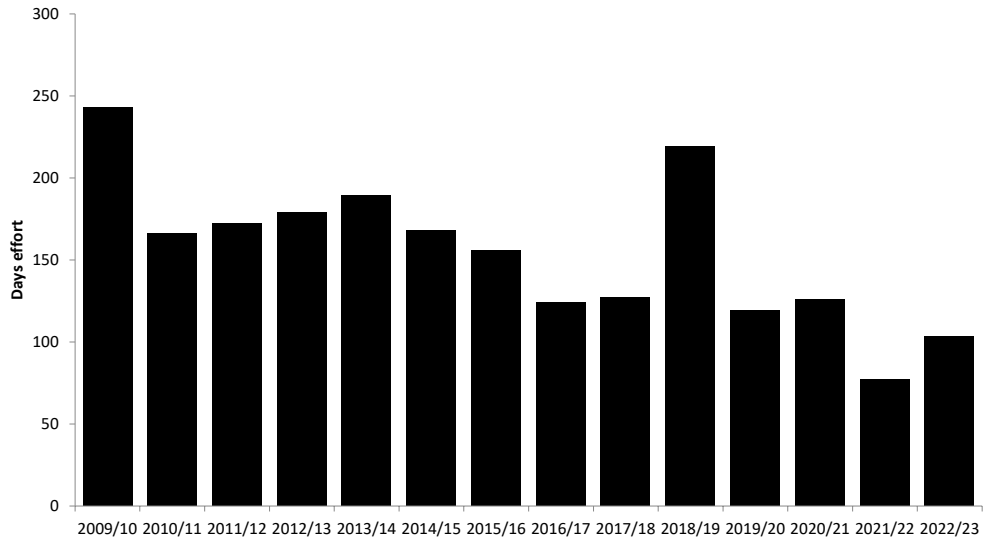

Figure 3. Annual reported days fished using boat-based garfish nets 2009/10 to 2022/23.

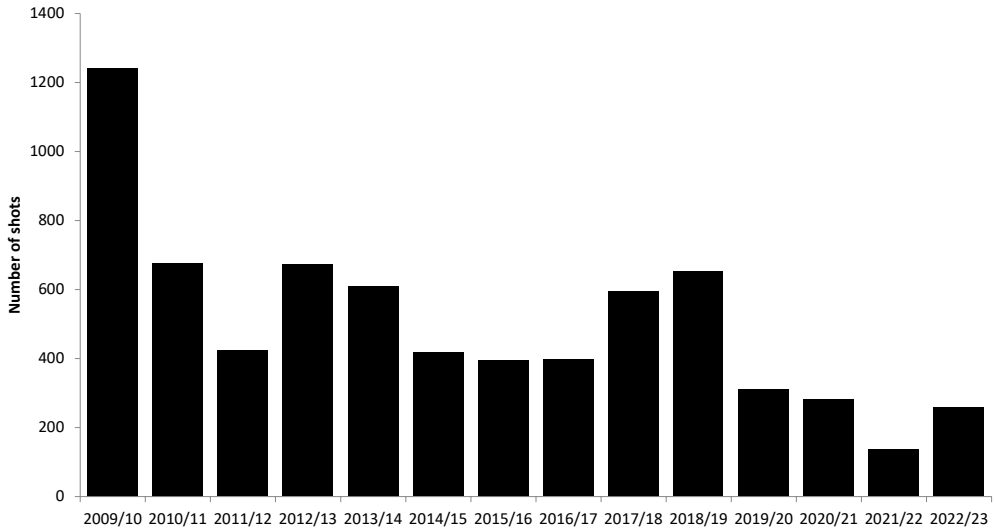

Figure 4. Annual reported boat-based net deployments (shots) 2009/10 to 2022/23.

Catch rate trends

Three different series of catch and effort data were analysed:

1. Monthly aggregated catch per day fished between 1997/98 and 2022/23. This enabled a time-series to span the 2009 change in logbooks.

2. Daily reported catch per day between 2009/10 and 2022/23. These data are based on daily event reporting.

3. Catch per shot between 2009/10 and 2022/23. These data were only available since implementation of the current logbook in 2009.

Catch rates were standardized for year, month, authorized fisher and latitude (one degree band) of landings for 1997/98 to 2022/23 using the monthly aggregated data. Catch rates were standardized for year, latitude (one degree band), fisher, and month for 2009/10 to 2022/23 using the daily reported logbook data for both days fished and number of shots. Standardisation was done using the r-package 'cede' (v. 0.0.4, Haddon, 2019).

Standardised catch rates based on aggregated monthly data for ocean boat-based garfish hauling indicate a substantial increase through time (Fig. 5). The large jump in 2009/10 coincides with a change in logbook, but also with an unusually productive year when approximately 100 t were landed.

Standardised catch rates based on daily logbook data differed slightly between catch per days fished and catch per shot (Figs. 6, 7). Catch per day from daily reporting showed a similar pattern from 2009/10 to the monthly aggregated data, including lower catch rates during 2017/18 and a slightly declining trend during the past 3 to 4 years. Standardised catch rates in terms of catch per shot indicated a low during 2017/18 before increasing steadily until 2021/22 and declining again during 2022/23 (Fig. 6).

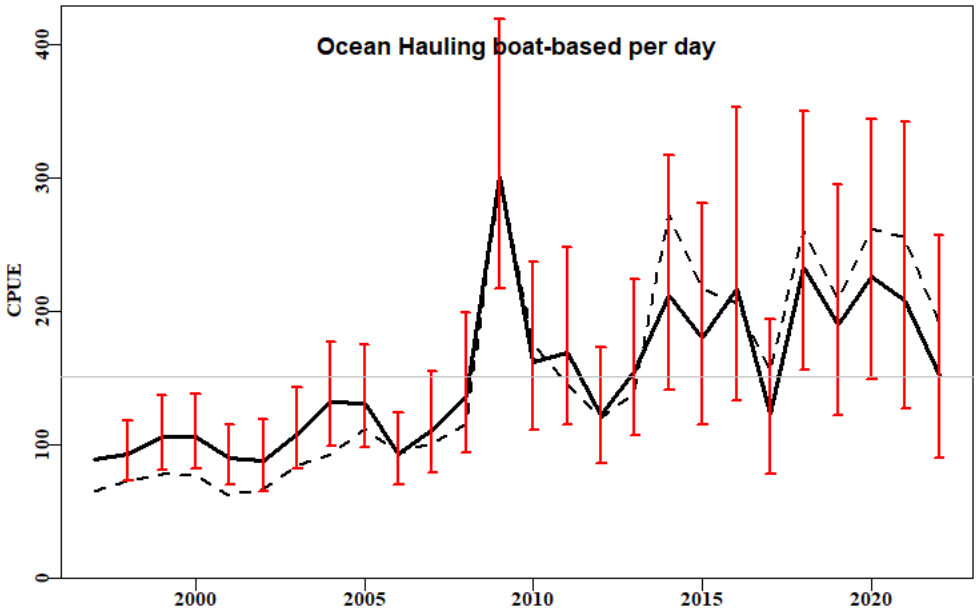

Figure 5. Standardised catch rate (kg/day) for Eastern Sea Garfish taken by boat-based ocean haul fishers 1997/98 to 2022/23. Dotted line is the raw catch rate, solid black line is the standardized catch rate with red bars indicating 95% confidence intervals.

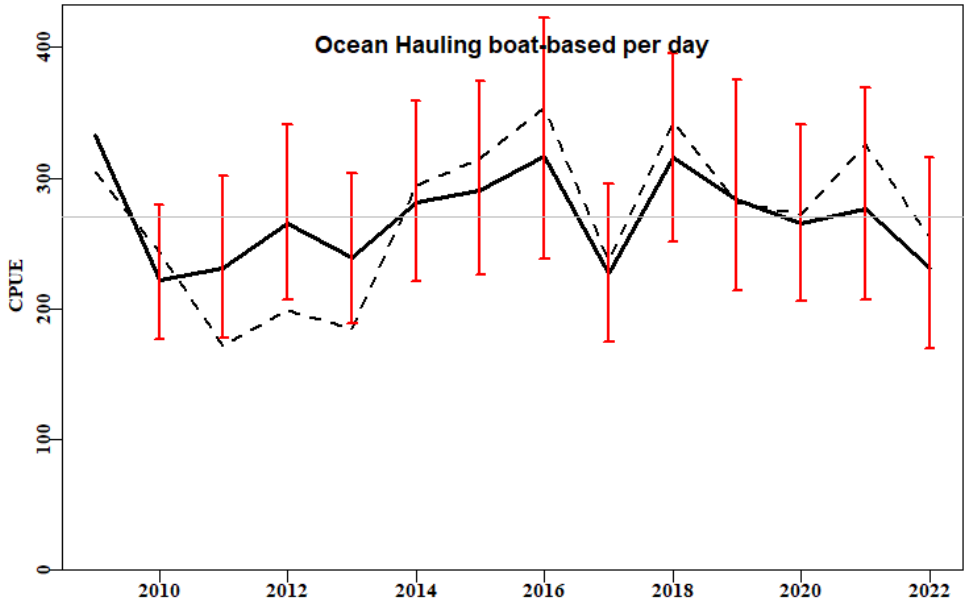

Figure 6. Standardised catch rate (kg/day) for Eastern Sea Garfish taken by boat-based ocean haul fishers 2009/10 to 2022/23. Dotted line is the raw catch rate, solid black line is the standardized catch rate with red bars indicating 95% confidence intervals.

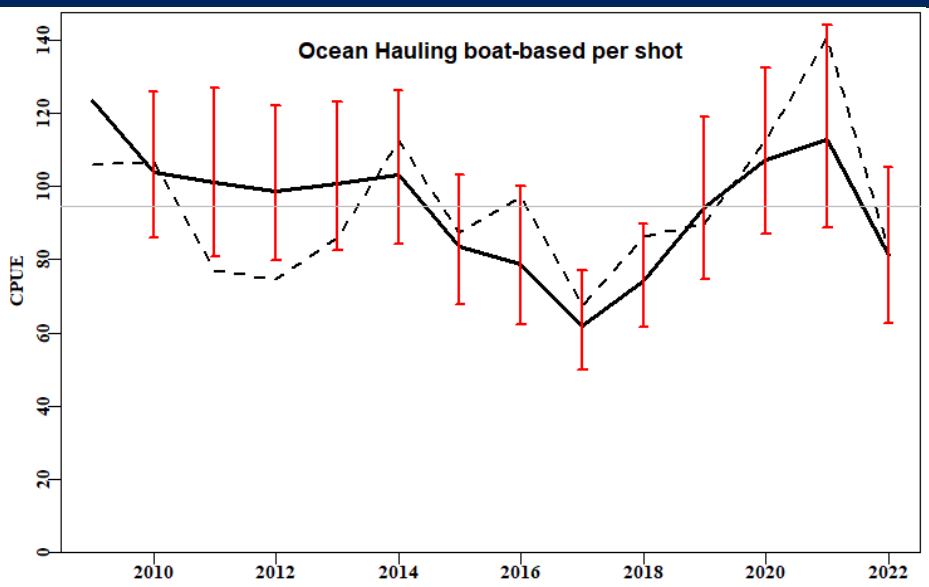

Figure 7. Standardised catch rate (kg/shot) for Eastern Sea Garfish taken by boat-based ocean haul fishers 2009/10 to 2022/23. Dotted line is the raw catch rate, solid black line is the standardized catch rate with red bars indicating 95% confidence intervals.

Stock Assessment Methodology

Year of most recent assessment	2024 on data up to and 2022/23.
Assessment method	Age-structured population model described by Broadhurst et al. (2018).
Main data inputs	Age composition in the landed catch 2004/05 to 2020/21. Annual landed catch from garfish hauling nets 2004/05 to 2022/23. Annual fishing effort (days) using garfish hauling nets 2004/05 to 2022/23. Average weight for each age group each year.
Key model structure and assumptions	Age structured model. Catch and effort data represent relative abundance. Age composition data is representative of the fishable stock.
Sources of uncertainty evaluated	None.

Status Indicators and Limits Reference Levels

Biomass indicator or proxy	Biomass and recruitment estimates from population model.
Biomass Limit Reference Level	None specified; however trends through time are assessed.
Fishing mortality indicator or proxy	Fishing mortality estimated from model.
Fishing mortality Limit Reference Level	Fishing mortality is less than natural mortality.

Stock Assessment Results Summary

Estimated biomass and recruitment of Eastern Sea Garfish have increased considerably since the stock was assessed as being overfished during the early 2000s, and in 2020/21 the model estimated biomass was approximately 192 t (95% CI 162 to 235 t) (Fig. 8).

Recruitment has been variable, with peaks evident in 2008/09 and 2013/14, 2017/18 and 2018/19 (Fig. 9).

The spawning stock biomass has been relatively stable at between 97 and 130 t since 2013/14 and was estimated at approximately 97 t during 2022/23 (Fig. 10).

The model indicated that fishing mortality dropped below the estimated natural mortality level in 2009/10 and has remained there since, with fishing mortality on juveniles (age-group 0) very low (Fig. 11). Natural mortality was

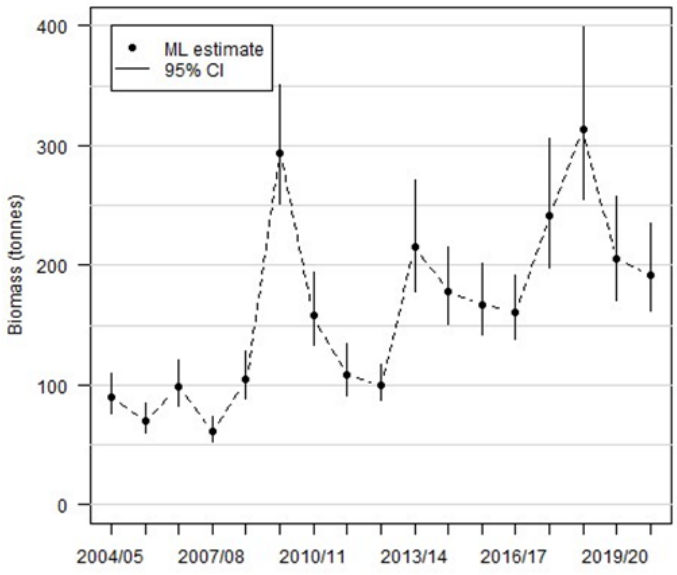

Figure 8. Estimated biomass of Eastern Sea Garfish (95% confidence intervals) between 2004/05 and 2020/21.

estimated to be 0.62.

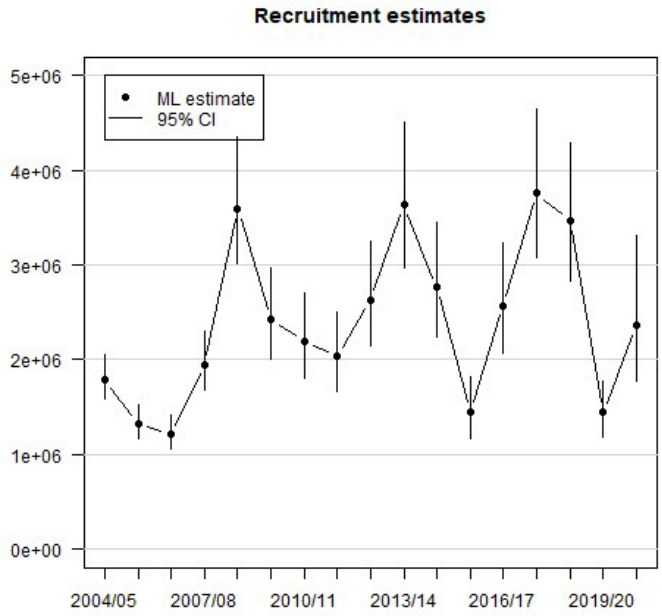

Figure 9. Estimated recruitment of Eastern Sea Garfish (95% confidence intervals) between 2004/05 and 2020/21.

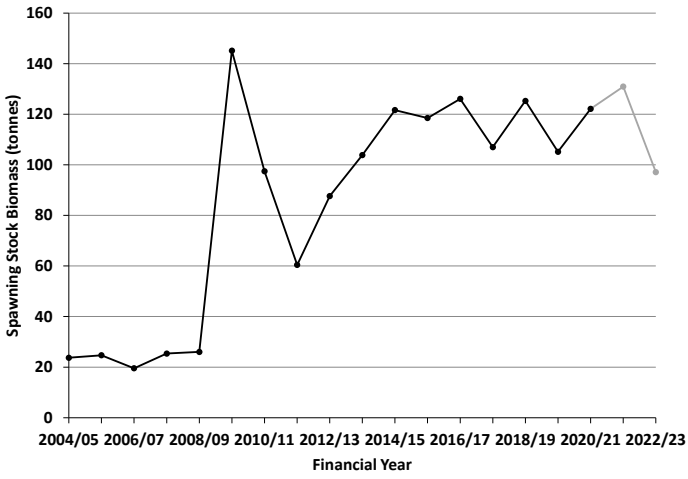

Figure 10. Estimated spawning stock biomass of Eastern Sea Garfish between 2004/05 and 2022/23. Black line is model estimated. Grey line is estimated from correlation with catch rate.

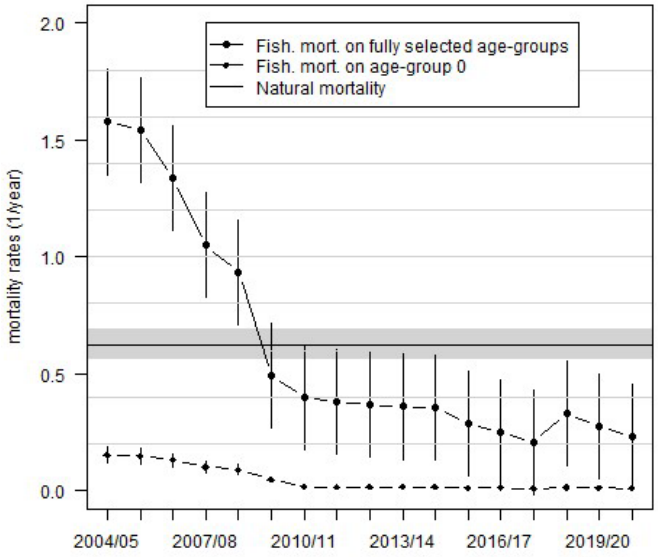

Figure 11. Estimated fishing and natural mortalities (±2× SD; vertical lines or shaded area) for Eastern Sea Garfish between 2004/05 and 2020/21.

Biomass status in relation to Limit	Substantial (approximately five-fold) increases in spawning stock biomass since the stock was assessed as being overfished during the early 2000s suggests recovery and that recruitment is unlikely to be limited.
Fishing mortality in relation to Limit	Fishing mortality has been well below natural mortality since 2008/09.
Previous SAFS stock status	Overfished in NSW assessments 2002/03 to 2012/13. Fully Fished in NSW assessments 2013/14 to 2014/15. Sustainable (2018) Sustainable (2020)
Current SAFS stock status	The stock in NSW is not considered to be recruitment impaired. The current level of fishing mortality is unlikely to cause the biological stock to become recruitment impaired. On the basis of the evidence provided above, Eastern Sea Garfish is classified as a sustainable stock.

Qualifying Comments

The stock assessment for Eastern Sea Garfish has limitations due to the population model utilized. The population model (Broadhurst et al., 2018) starts in 2004/05 as it was developed based on routine annual age composition monitoring. As such the model does not account for historical extractions from the population and cannot estimate a level of depletion from an unfished state. The fishery during 2004/05 was roughly 55 t (approximately 47 t through boat-based garfish hauling) and was based on a 'depleted' stock. Recent biomass estimates from the population model have ranged between approximately 160 t and 300 t, however landings during the late 1980s and early 1990s sometimes exceeded 200 t p.a., peaking at 280 t during 1992/93, implying that the available biomass was substantially larger during that period. It is clear that extracting that level of catch was unsustainable. Potential biases from using the shortened and recent time series by Broadhurst et al. (2018) and Kienzle et al. (2021) to estimate current biomass and fishing mortalities and subsequently MSY and fishing levels to attain MSY, need to be acknowledged. In addition, the simplistic approach within the population model of estimating abundance using catch divided by reported boat-days does not account for variation normally incorporated when calculating standardised catch rates.

References

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