

Assessment Authors and Year

Stewart J. and Hegarty A.M, 2023. NSW Stock Status Summary 2021/22 – Teraglin – (*Atractoscion atelodus*). NSW Department of Primary Industries. Fisheries NSW. 11 pp

Stock Status

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

Teraglin (*Atractoscion atelodus*) is a distinct species that occurs only in eastern Australia and is distributed from southern Queensland to Montague Island in New South Wales. This species was formerly known as *Atractoscion aequidens* which occurs around southern Africa from Angola to South Africa (Song et al. 2017). Due to the limited latitudinal distribution along eastern-Australia and influence of the prevailing southerly flowing Eastern Australian Current, Teraglin is considered to be a single biological stock in this region – the Eastern Australia biological stock.

The data presented in this summary relate mainly to the New South Wales part of the stock; however data from Queensland are used within the stock assessment.

Biology

Teraglin has reproductive characteristics that may make it resilient to fishing, including year-round spawning and relatively early maturation at around 36 cm fork length and 1 year of age (Hegarty et al., 2021). There are also characteristics that may make it vulnerable to over-exploitation including a highly skewed female sex ratio and their schooling and voracious feeding behaviour leading to the potential for high catch rates. Recruitment in Teraglin is cyclical with strong recruitment years linked to higher rainfall (Stewart et al., 2021). Growth is reasonably fast, reaching around 40 cm fork length after only 1 year (Hegarty et al., 2022). Maximum size is approximately 100 cm total length and 9kgs (Hutchins and Swainston, 2006), with longevity in excess of 14 years (Hegarty et al., 2022). Females grow faster and to greater lengths than males (Hegarty et al., 2022).

FISHERY STATISTICS

Catch information

Commercial

Commercial landings of Teraglin in New South Wales show a long history of decline, overlaying a strong cyclical pattern (Fig. 1). Annual landings peaked at more than 200 t during the late 1950s and have been fluctuating around a mean of 21 t p.a. since 1997/98, but with consistent declines since 2016/17 to be the lowest on record at approximately 6.8 t during 2021/22. More than 95% of the reported commercial catch since 2009/10 has been from the Ocean Trap & Line Fishery, predominantly (~90% since 2009/10) using the method of handline, with the Trawl catch generally being around 2 to 9% of the total landings (Fig. 2).

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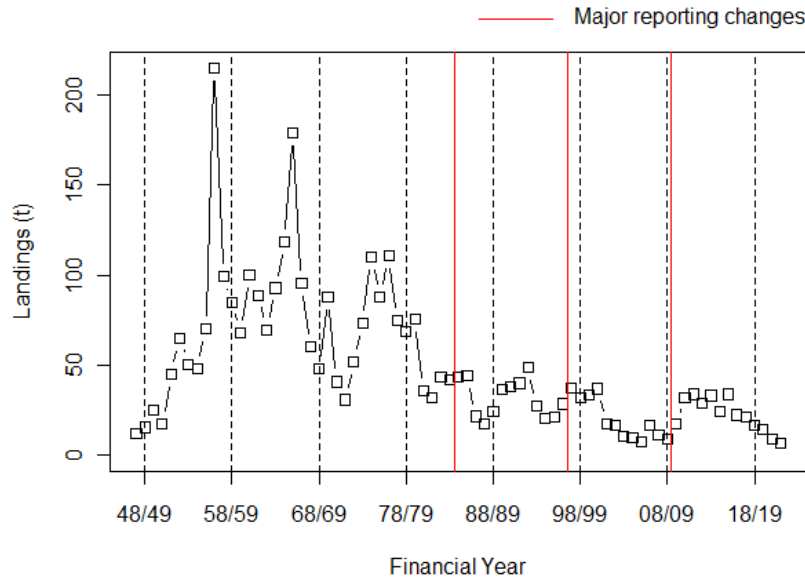


Figure 1 Commercial landings of Teraglin in New South Wales from 1947/48 to 2021/22.

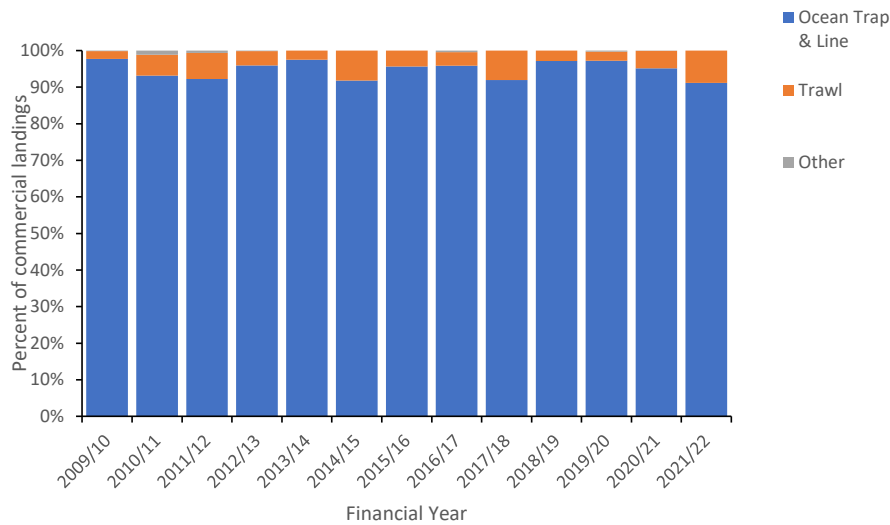


Figure 2 Commercial landings by Fishery of Teraglin in New South Wales from 2009/10 to 2021/22.

Recreational & Charter boat

The most recent estimate of the recreational harvest of Teraglin in New South Wales was made for 2019/20 and was approximately 6,400 fish (Murphy et al., 2022), that equates to roughly 9.32 t using an average weight of 1.4 kgs (NSWDPI Recreational Survey Team Unpublished data). It should be noted that these estimates are likely inaccurate and imprecise due to small sample sizes. Previous estimates were of equally low quality but were roughly 18.2 t during 2017/18 (Murphy et al., 2020), 33 t during 2013/14 (West et al., 2015) and 73 t during 2000/01 (Henry and Lyle, 2003; NSWDPI Unpublished data). While these survey results should be considered as

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coarse and are not directly comparable due to differencing sampling frames, they likely represent a considerable decline in recreational harvest since 2000/01.

Harvest by the New South Wales Charterboat fishery is included as part of the recreational fishing surveys; nevertheless, harvest reported in charterboat logbooks has ranged between around 5,000 and 15,000 fish per year since 2015/16.

Aboriginal cultural fishery

There are no data on aboriginal harvest.

Illegal, Unregulated and Unreported

There are no data on Illegal, Unregulated and Unreported harvest; however it is considered minor in New South Wales waters.

Harvest reconstruction– Eastern Australia Biological stock

Total historical harvest from the New South Wales Teraglin fishery was reconstructed by estimating recreational harvest prior to, and between, survey estimates. Hindcasting the recreational harvest prior to 2000/01 was done using estimates of recreational marine fishing effort nationally as reported by Kleisner et al. (2015) and described in Stewart and Hegarty (2020). A similar approach was used for Queensland recreational survey data that were available for 2000, 2010, 2012 and 2019. Queensland commercial data were only available from 1997 onwards, as Teraglin were not a listed species on commercial logbook in Queensland prior to this. The assumption was made that the Queensland recreational to commercial harvest ratios observed between 1997 and 2021 were the same between 1951 and 1997. We have no data to support this assumption; however given the relatively small harvest in Queensland waters compared to New South Wales waters since comparable catch records exist, it is considered any violation of this assumption would have a minor impact on the assessment results. The estimated commercial and recreational harvests in Queensland between 1997/98 and 2018/19 were almost identical (Fig. 3).

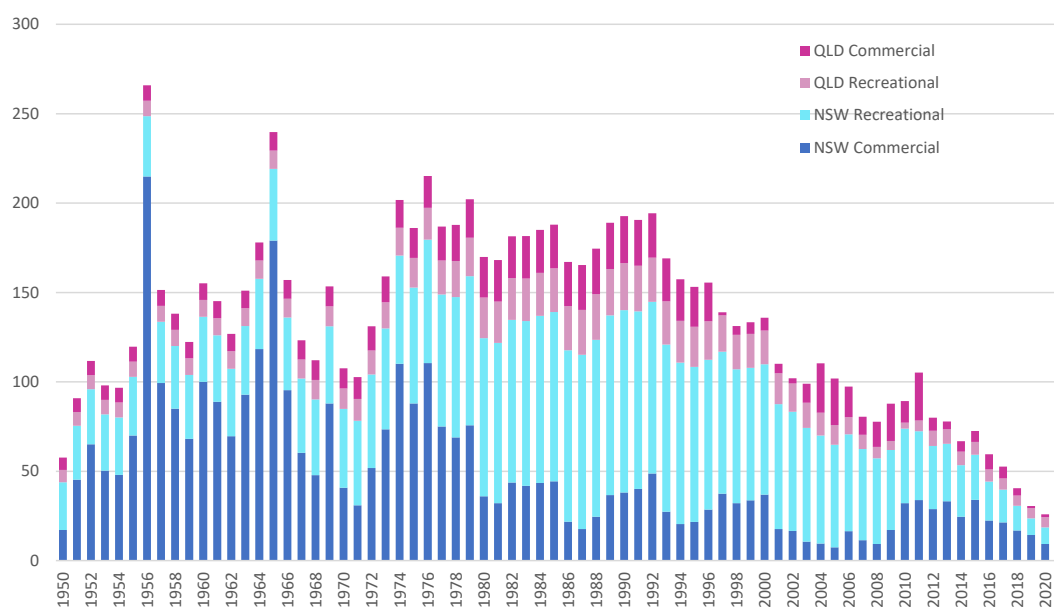


Figure 3 Reconstructed catch history from commercial and recreational fishing in New South Wales and Queensland 1950/51 to 2021/22.

Fishing effort information

Commercial fishing effort on Teraglin is difficult to estimate prior to 2009/10 as the monthly catch returns listed days fished per month by method and had no direct link to the number of days within a month that a particular species was landed. The number of days handlining reported for when Teraglin were also reported in a month have declined from nearly 4,000 during 1997/98 to approximately 1,000 in recent years (Fig. 4). More accurate estimates of fishing effort are available after 2009/10 and show that the number of days using handlining on which Teraglin were landed have been declining since 2015/16 and were at a historical low of less than 400 during 2021/22 (Fig. 5).

There has been a substantial decline in the number of days fished using the method of handlining in ocean zones 2, 3 and 5 since 2009/10 (Fig. 6).

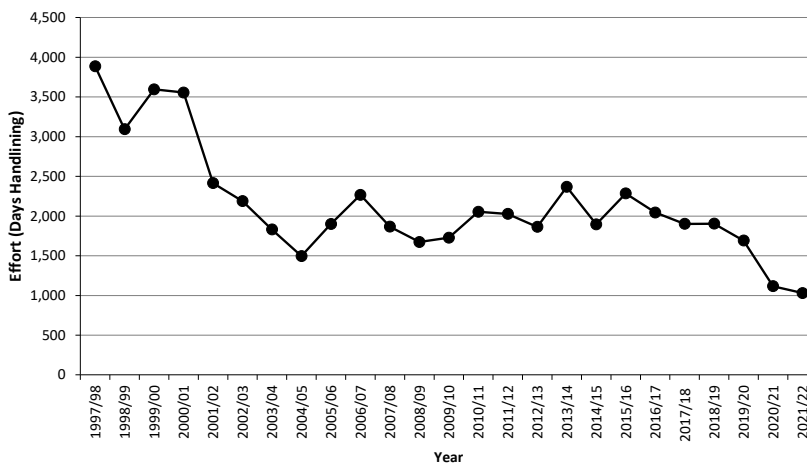


Figure 4 Annual reported days fished for months when Teraglin were landed by handlining 1997/98 to 2021/22

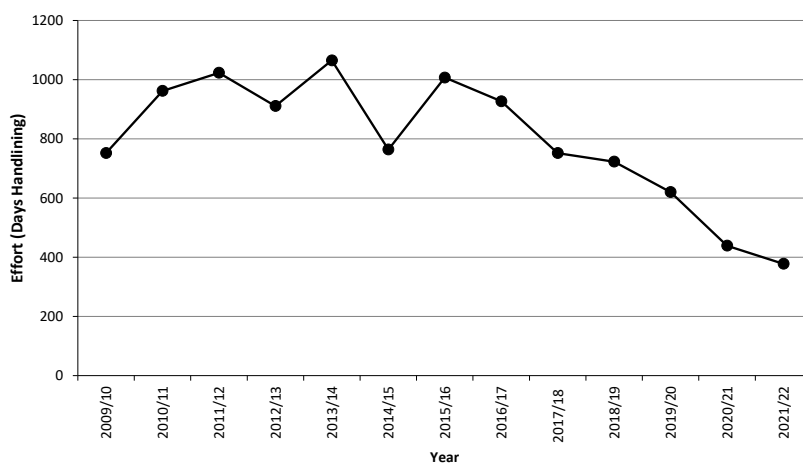


Figure 5 Annual reported days fished when Teraglin were landed by handlining 2009/10 to 2021/22.

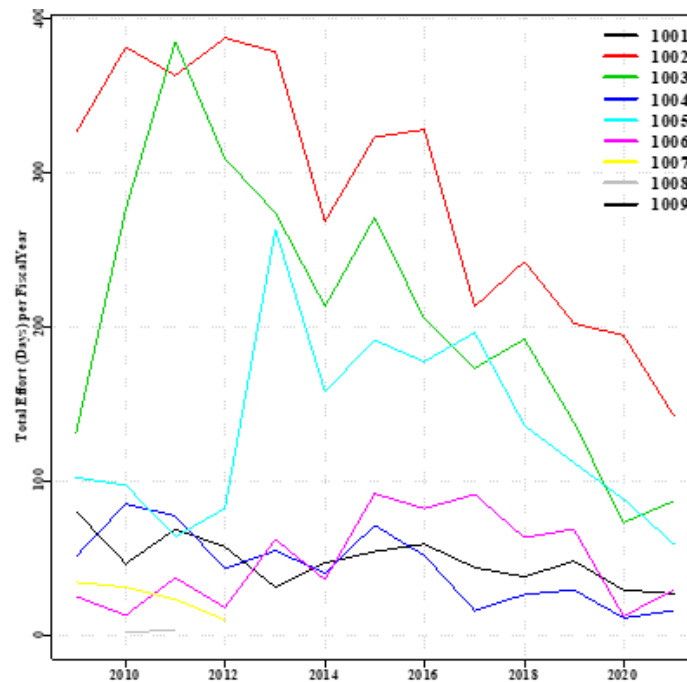


Figure 6 Annual reported days fished in a month when Teraglin were landed by handlining 2009/10 to 2021/22 by Ocean Zone.

Catch Rate information

Catch rates of Teraglin using the method of handlining were standardised using 2 series of data. Firstly, catch rates in terms of kg/day fished using the method of handlining when all days in a month using this method were included for the period 1997/98 to 2021/22. Catch rates were standardised for month, authorized fisher and latitude of landings. Standardisation was done using the r-package 'cede' Haddon et al. (2018), with outputs standardised to 1. Secondly, catch rates in terms of kg/day fished using the method of handlining were analysed for the period 2009/10 to 2021/22 using the more detailed daily data as reported. Catch rates were standardised for month, authorized fisher, latitude and depth. Standardisation was done using the r-package 'cede'.

Standardised catch rates since 1997/98 have fluctuated but show an overall decline from around 2011/12, noting an increase during 2021/22 (Fig. 7). A substantial increase in catch rates from 2009/10 coincided with a change in logbook reporting; however landings also increased substantially indicating that this increase was likely a reflection of relative abundance rather than changes in reporting. The more detailed standardised catch rates based on the daily logbook reporting since 2009/10 show a steady decline from 2015/16 before also showing a substantial increase during 2021/22 (Fig. 8). The trends in standardised catch rates since 2009/10 are very similar using both data sets (monthly and daily logbooks) and imply some confidence that the 1997/98 onwards dataset is representative of the fishery.

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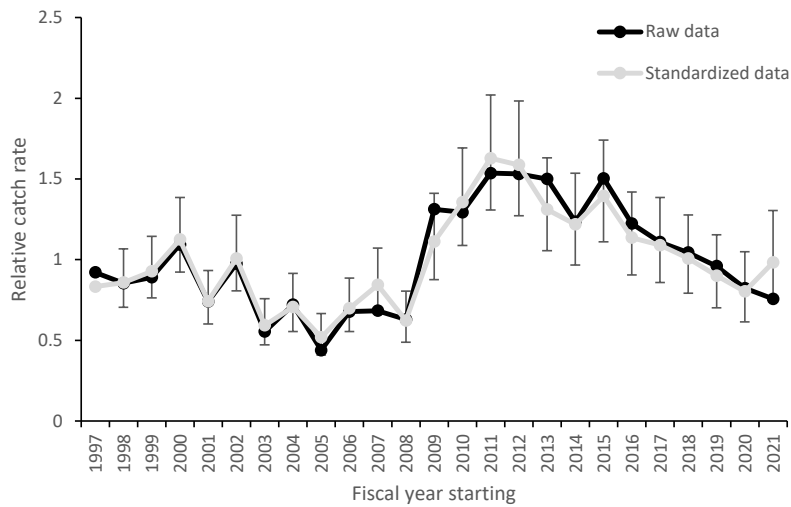


Figure 7 Standardised catch rates (kg/day handling) with standard errors in months when Teraglin were reported for the period 1997/98 to 2021/22.

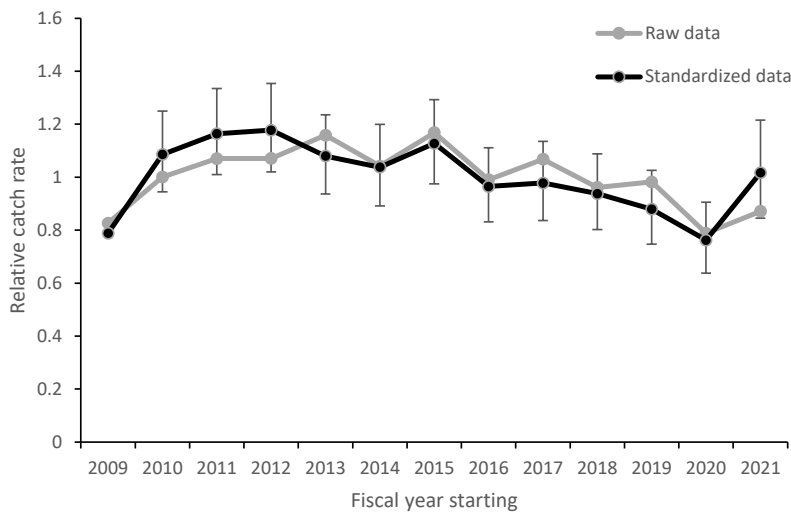


Figure 8 Standardised catch rates (kg/day handling) for the period 2009/10 to 2018/19 based on daily reporting.

Catch rate trends – Eastern Australia Biological stock

Standardised Queensland commercial catch rates for Teraglin in kg/boat day were obtained from Wortmann (2020) for 1997 to 2018. These were scaled to the geometric mean to be comparable with the New South Wales standardised catch rate series. The New South Wales and Queensland data were combined using the relative commercial catch ratios in each state in each year (Fig. 9). Catch rates for 2019 to 2021 were the New South Wales ones as standardized Queensland data was not available in these later years.



Figure 9 Standardised commercial catch rates of Teraglin for New South Wales and Queensland fisheries combined for the period 1997/98 to 2021/22.

STOCK ASSESSMENT

Stock Assessment Methodology

Year of most recent assessment:

2023

Assessment method:

A surplus production model was used that is a Bayesian state-space implementation of the Schaefer surplus production model (BSM) using the package CMSY+ (Froese et al., 2019). The BSM method relies on catch time series and (relative) abundance data, such as CPUE data. The BSM method generates estimates of the intrinsic growth rate of a population (r) along with an estimate of carrying capacity (k); from these, time series of biomass (B) and fishing mortality (F) can be computed, including the biomass (B_{MSY}) from which maximum sustainable yield (MSY) can be extracted given F_{MSY} .

Main data inputs:

Catch data was the catch reconstruction presented above (Fig. 3) from 1950/51 to 2021/22. Relative abundance was the standardized and combined Queensland and New South Wales catch rates, weighted by relative proportion of each state's estimated harvest in each year 1997/98 to 2021/22 (Fig. 9).

Resilience was set at 'Medium' based on Fishbase and the life-history parameters of Teraglin. Initial biomass depletion was set at between 0.4 and 0.8.

Sources of uncertainty evaluated:

A scenario setting resilience at 'Low' was run to examine the impact of changed parameters r and k .

Status Indicators - Limit & Target Reference Levels

Biomass indicator or proxy	Median biomass depletion level
Biomass Limit Reference Point	0.2 of unfished levels
Biomass Target Reference Point	No formal target reference point
Fishing mortality indicator or proxy	F/F_{MSY}
Fishing mortality Limit Reference Point	$F/F_{MSY} < 1$
Fishing Mortality Target Reference Point	No formal target reference point

Stock Assessment Results

The model estimated that in 2021/22 the biomass of Teraglin relative to unfished levels was 0.32 (95% CI 0.20 – 0.46) (Fig. 10). The biomass depleted steadily from the 1970s to the early 2000s and has increased slightly since that time. Maximum Sustainable Yield (MSY) was estimated to be 154 t (95% CI 124 to 205 t). The Kobe plot indicates that fishing mortality has been less than that estimated to achieve F_{MSY} for around the last 15 years (Fig. 11).

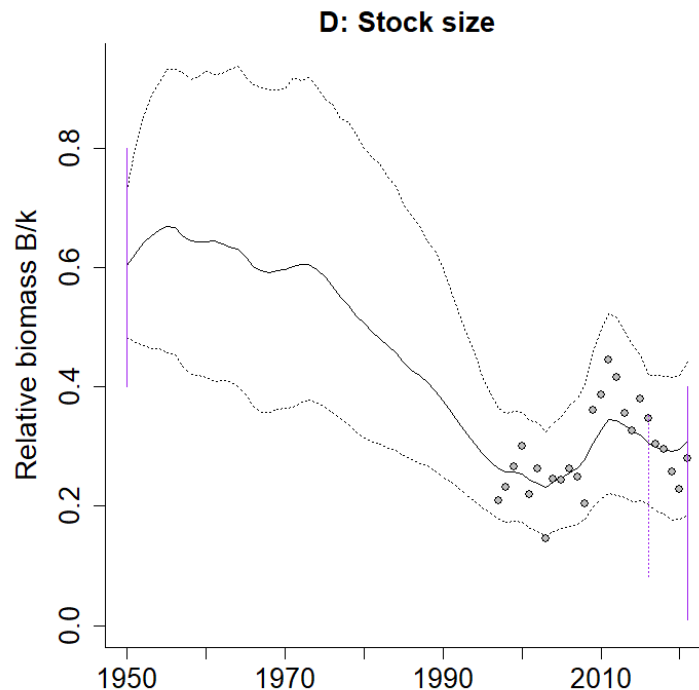


Figure 10 Model predicted biomass relative to unfished levels with approximate 95% confidence limits, for Teraglin 1950/51 to 2021/22. The vertical lines indicated the prior biomass ranges for the initial, intermediate and final years.

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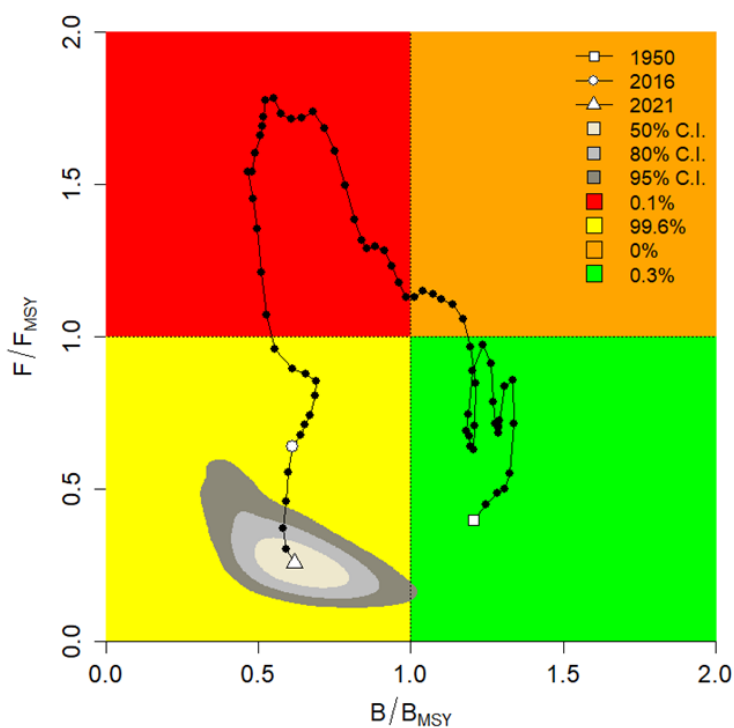


Figure 11 Kobe plot showing estimates of relative B/B_{MSY} and F/F_{MSY} for Teraglin 1950/51 to 2021/22.

The scenario using starting parameters associated with 'Low' resilience produced more pessimistic results with a depletion estimate in 2021/22 of 0.27 of unfished levels.

Stock Assessment Result Summary

Biomass status in relation to Limit	Biomass depletion in 2021/22 was estimated to be 0.32 of unfished levels and above the limit of 0.2 with a very high degree of certainty.
Biomass status in relation to Target	No formal target reference point
Fishing mortality in relation to Limit	Fishing mortality was estimated to be less than that to achieve MSY for approximately the last 15 years and in 2021/22 was estimated to be approximately 0.25 of F_{MSY} with high confidence of being below F_{MSY} .
Fishing mortality in relation to Target	No formal target reference point
Current SAFS stock status	<p>The above evidence indicates that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired.</p> <p>The above evidence indicates that the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired.</p> <p>On the basis of the evidence provided above, the entire biological stock is classified as a sustainable stock.</p>

Fishery interactions

There are no recognized fishery interactions beyond the commercial, recreational, charter and Indigenous fisheries in New South Wales and Queensland.

Qualifying Comments

The surplus production modelling has various areas of uncertainty, including assumptions made in reconstructing total harvest across all sectors back to the 1950s. Nevertheless, the model outputs suggest that a stock status of Sustainable is justified based on estimated current levels of biomass depletion and fishing mortality. There remain several worrying signs for this stock and the fisheries that exploit it. The fisheries are under-performing, with harvest declining steadily since the early 1990s, and is currently less than 15% of those levels. The size composition data for the landed commercial catch in New South Wales between the 1970s and 2013/14, as well as a single age composition from 2011/12 indicate that the fishery has been based on a truncated population since the early 2000s, with relatively few fish greater than 4 years old (Stewart and Hegarty, 2020). It is recommended that an integrated stock assessment should be done soon given the data available and ongoing concerns for the fishery.

References

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