

Assessment Authors and Year

Smoothey, AF. 2023. NSW Stock Status Summary 2022/23 – Pink Ling (*Genypterus blacodes*). NSW, Department of Primary Industries, Fisheries. 15 pp.

Stock Status

Current stock status	On the basis of the evidence contained within this assessment, Pink Ling are currently assessed as sustainable .
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Stock structure & distribution

Pink Ling (*Genypterus blacodes*) are distributed around the south of Australia from the central NSW coast to southern Western Australia, including Tasmania. Pink Ling is a deep-water species commonly associated with muddy bottoms on the continental shelf and upper slope at depths of 200–900 m. Clear and persistent differences in size and age composition (Morison et al. 2013) and differences in trends in Commonwealth commercial catch rates indicate the existence of different stocks east and west of South Cape, Tasmania (147° East) but no genetic differences have been identified between these areas (Daley et al. 2000; Ward et al. 2001; Patterson et al. 2022). The differences in biological characteristics and catch-rate trends have led to Pink Ling being assessed as separate stocks east and west of longitude 147°E since 2013, yet managed under a single TAC, with management arrangements in place to constrain fishing on eastern stocks to the eastern catch limit (Patterson et al. 2022). The eastern Pink Ling stock, described for the Commonwealth assessment, is associated with Commonwealth fishing zones 10, 20 and 30 (with catches from Zone 60 assigned to Zone 30; Cordue 2015). The assessment summarised here is that for eastern Pink Ling only, unless otherwise stated in the text. The assessment is detailed in Cordue (2018 and 2022) and summarised in Patterson et al. (2022).

Biology

Pink Ling are demersal species that inhabit the continental shelf and slope waters around the south of Australia. They grow to a maximum length of 1.6 m and an age of about 26 years. Males and females have been recorded to mature at about 40–46 cm and 50–58 cm total length (TL), respectively. Spawning occurs during late winter and early spring. Pink Ling are believed to be serial spawners, releasing egg batches in a floating gelatinous mass each spawning event with females producing around 333 000 eggs per spawning event, depending on the body size (AFMA, 2022).

Scope of this assessment

The fishery scientific assessment summarised in this report is considered adequate to meet the legislative requirements for supporting a total allowable catch (TAC) determination for the stocks of NSW Pink Ling. This determination is based on the Commonwealth Assessment that is

commissioned by the Australian Fisheries Management Authority (AFMA) and published as ‘eastern Pink Ling’ in the ‘Pink Ling (*Genypterus blacodes*)’ section of the Fishery Status Reports by the Australian Bureau of Agricultural and Resource Economics and Sciences, (Patterson et al. 2022). The Commonwealth assessment references quantitative stock assessments for Pink Ling, including those for eastern Pink Ling in 2018 (Cordue 2018) and a recent update in 2021 (Cordue 2022).

The structure of this stock status summary is consistent with a format to inform a species status determination against criteria for the Status of Australian Fish Stocks reports (SAFS; www.fish.gov.au). It does not attempt to replicate the detail of the Commonwealth assessment but cites key information from that assessment. Assessment of the status of the stock of Pink Ling that is fished by commercial and recreational fishers in New South Wales (NSW) is principally based on the modelling and assessment done for this species by the Commonwealth of Australia. The primary mechanism for controlling the harvest of Pink Ling in the Southern and Eastern Scalefish and Shark Fishery (SESSF) is through the allocation of an Annual Total Allowable Catch (TAC). Determination of annual TACs for the Commonwealth SESSF is based on the SESSF Harvest Strategy Framework (HSF) (AFMA, 2017) that derives from the Commonwealth Fisheries Harvest Strategy Policy (HSP) (DAFF, 2007).

The Commonwealth assessment of the Pink Ling stock evaluates stock status relative to Limit and Target Reference Points prescribed in the HSF/HSP. The Tier 1 assessment uses a statistical catch-at-length and catch-at-age model. The model provides retrospective and prospective estimates of biomass (the latter for alternative TACs) and generates, through harvest control rules, a Recommended Biological Catch (RBC). The intention of this process is to move the stock biomass toward and maintain it around the Target Reference Point.

This assessment of the status of Pink Ling, in waters under NSW jurisdiction, comprises:

- (1) a summary of the most recent Commonwealth stock assessment for Pink Ling (Cordue 2022) and current determinations of status based on criteria specified by the Commonwealth and also those used for the Status of Australian Fish Stocks (SAFS);
- (2) the rationale by which the Commonwealth assessment for Pink Ling is considered to be relevant and valid for determining the status of the Pink Ling stock fished within NSW jurisdiction (Appendix 1);
- (3) information that may inform the determination of the 2023-24 NSW TAC for Pink Ling in the Ocean Trap and Line – Line East Fishery, Line Easter (Appendix 2). This is done in the absence of: (i) a formal NSW harvest strategy for this species/fishery; and (ii) a formal resource sharing agreement between NSW and the Commonwealth.

FISHERY STATISTICS

Catch information

Commercial

Fishery statistics underpinning the Commonwealth assessment and summarised here from Patterson et al. (2022) and references therein. Within the Commonwealth, eastern and western stocks of Pink Ling are assessed separately but managed under a single TAC, with management arrangements in place to constrain fishing on eastern stocks to the eastern catch limit (Patterson et al. 2022). Descriptions of NSW fishery statistics are provided in Appendix 2 of this report and the changes in NSW commercial fishery reporting requirements and sources of NSW commercial fishery data are discussed.

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The catch information underpinning the Commonwealth assessment is summarised from Patterson et al. (2022).

Eastern and western catches of Pink Ling increased from the start of the fishery in about 1977, reaching a peak of 2,412 t in 1997 (Figure 1a). From 1997 to 2001, catches declined steadily to about 1,800 t in 2004, despite TACs continuing to increase. From 2004-05 to 2013-14, Pink Ling catches were limited by the TAC (Figure 1b). Since 2013-14, catches have been stable at around 800 to 1,000 t.

In the 2021-22 fishing season, Commonwealth-landed catch was 817.1 t, based on CDRs, with 46% of the catch from the east. Discards and state catches were not available for 2021-22 assessment. However, weighted averages of the previous four calendar years (2017 to 2020) estimated discards and state catches of 20.2 t and 54.4 t, respectively in the east and 6.4 t and 0.4 t, respectively, in the west (Althaus et al 2021). For the 2021-22 fishing season, total catch and discards were estimated to be 450.5 t in the east.

Figure 1a Pink Ling annual catches (Commonwealth Trawl Sector, Scalefish Hook Sector and states combined) and discards, 1977 to 2020 (from Patterson et al. 2022).

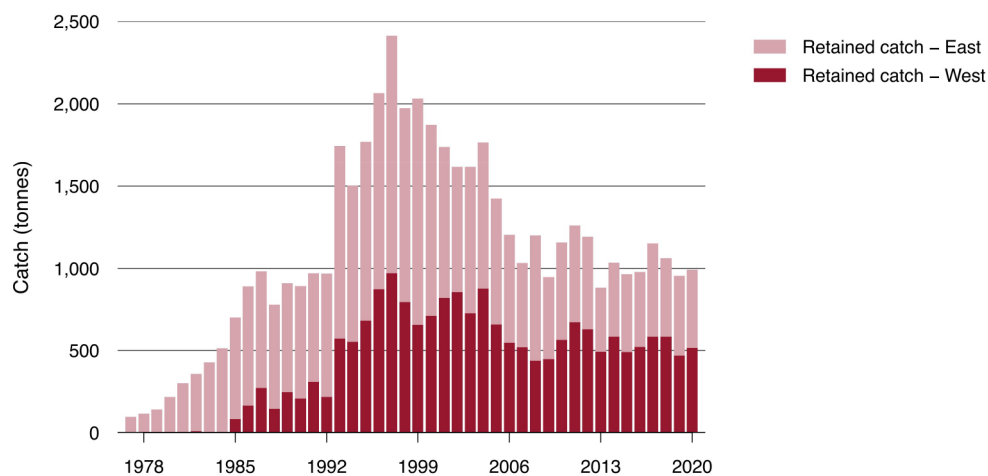
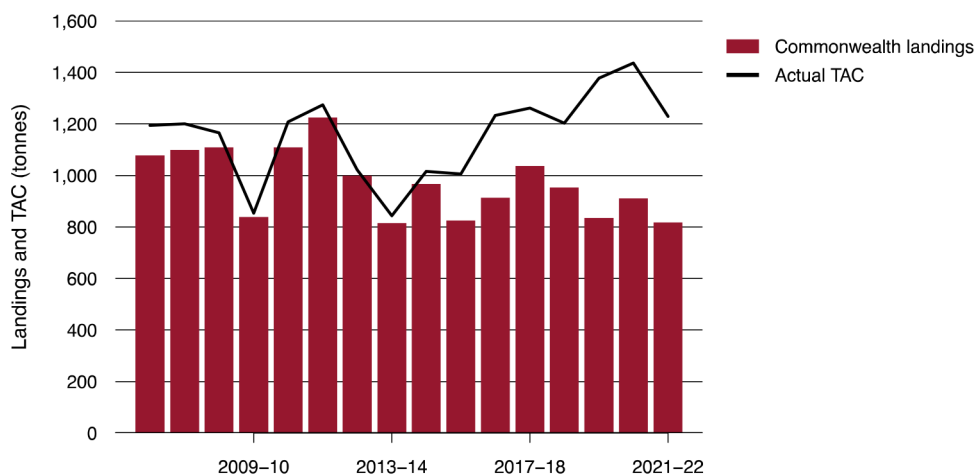


Figure 1b Pink Ling seasonal landings (SESSF) and TACs, 2006-07-2021-22 fishing season (from Patterson et al. 2022).



Recreational & Charter boat

The Commonwealth assessment does not, at present, include estimates of Pink Ling catches by the recreational sector. The model is conditioned on commercial catch data alone. Neither does the process by which the Commonwealth TAC is calculated from the RBC account for recreational catch. There are reports of increasing recreational catch. Surveys of the catches in NSW by NSW-resident recreational fishers during 2013/14 and by 1-3 year licence holders in 2017/18 and 2019/20 did not detect any catches of Pink Ling (West et al, 2015; Murphy et al. 2020, 2022). Similarly, State-wide operators within the nearshore charter fishery landed two Pink Ling during the 2017/18 survey period (Hughes et al. 2021).

Therefore, catches of Pink Ling by recreational fishers in NSW are negligible, relative to the magnitude of commercial catches. Thus, the omission of recreational catch from the model and Commonwealth assessment has little effect on the assessment outcome of the Pink Ling.

Indigenous

The Commonwealth assessment does not, at present, include estimates of Pink Ling catches by Aboriginal fishers. As for recreational catch, any catches by Aboriginal fishers in recent history are assumed to be negligible, relative to the magnitude of commercial catches.

Illegal, Unregulated and Unreported

The level of Illegal Unregulated and Unreported (IUU) fishing has not been quantified.

Fishing effort information

N/A.

STOCK ASSESSMENT

The assessment for Pink Ling is based on a Commonwealth Tier 1 assessment (AFMA 2017 i.e. a quantitative model-based assessment). Despite the lack of genetic variation found between eastern and western pink ling (Daley et al. 2000; Ward et al. 2001), the differences in biological characteristics and catch-rate trends have led to Pink Ling being assessed as separate stocks east and west of longitude 147°E since 2013. Because of the complexities in controlling catch of the stock, Pink Ling is managed under a harvest strategy that estimates projections of stock response to various levels of catch and the risk of those catches reducing biomass below the limit reference point. This approach is taken while pursuing targets for the western stock and trying to rebuild the eastern stock (Patterson et al. 2022).

A new Tier 1 assessment was done in 2021 (Cordue 2022) updating catch, discards, CPUE, age and length data. Similar to the 2018 assessments, SERAG identified that the values of natural mortality had greatest influence on estimated stock status for both the eastern and western stocks. SERAG agreed again to use the model-estimated natural mortality from the west as a fixed value in the eastern assessment.

Estimated spawning stock biomass in 2021 was estimated to be 34% of the unfished level for the eastern stock (Figure 2). Estimates of spawning stock biomass for both stocks were highly dependent on values of natural mortality, with biomass ranging from 22% to 36% of the unfished

level under high and low values of natural mortality in the east. These estimates led to an RBC of 410 t (95% CI 130-630 t) in the east for the 2022-23 fishing season (Cordue 2022) and 470 t in 2023-24. Projections of stock responses to various constant-catch scenarios (Table 1) suggested that for catches up to 500 t in the east the likelihood that the stock was below the LRP by 2024 or 2031 was $\leq 1\%$ and time to rebuild to the TRP was ≤ 17 years. SERAG recommended that a 3-year MYTAC of 381 t be set for the eastern stock, using the average east RBCs (457 t) from the 2021 assessment and a combined TAC of 1,565 t (AFMA 2022).

Stock Assessment Methodology

Year of most recent assessment:

2021 (Cordue 2022)

Assessment method:

Commonwealth Tier 1, Integrated quantitative stock assessment (AFMA 2017; Commonwealth of Australia 2003, 2017)

Main data inputs:

The 2021 assessment was an update of the 2018 assessment with no significant changes to data inputs other than addition of new data (catch, CPUE, length and age frequencies).

Catch – Commonwealth trawl and non-trawl (autoline) sectors; total NSW commercial catches (other state catches were small, within rounding error and ignored). Catch histories were revised for 2016 to 2018 (compared to the 2018 assessment) and catches for 2019 and 2020 were added, with catches in 2020 assumed to be the same in 2021.

Commonwealth discard estimates and landing multipliers were applied to data due to Commonwealth trip limits implemented during 2013 and 2014 (no limit; 50 kg; and 250 kg trip limit)

Standardised CPUE – Commonwealth trawl sector, including 'period effect' for trip limit periods

Updated assessment in 2018 removed 'period effect' and included discard ratio to tow by tow data prior to CPUE standardisation

Length-frequency data by fishing method, zone and depth (various years from 1998)

Conditional age-length data by fishing method

Age frequencies data by fishing method

Key model structure & assumptions:

Tier 1 – Integrated quantitative stock assessment (AFMA 2017; Commonwealth of Australia 2003, 2017)

Sources of uncertainty evaluated:

Model sensitivities were investigated (after Cordue 2022) including:

- M=0.2: Reference model with M=0.2
- M=0.23 (Base): Reference model with M=0.23
- Est. M (Ref): The reference model where M is estimated using the posterior from the western assessment

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- M=0.28: Reference model with M=0.28
- Unf. M: Reference model but a uniform prior on M
- Period CPUE: Using the trawl CPUE indices where period effects were estimated and M estimated
- Per. M=0.23: As for “Period CPUE” but with M=0.23
- Linkall CPUE: Using the trawl CPUE where all vessels were used as linking vessels and M estimated
- No FIS: The reference model but with no FIS indices or length frequencies

Status Indicators - Limit & Target Reference Levels

Biomass indicator or proxy	Depletion of spawning biomass (model estimated)
Biomass Limit Reference Point	B_{20} (20% of pre-exploitation spawning biomass) B_{20} ($0.2B_0$) – $<B_{20}$: no targeted fishing, rebuilding strategy will be developed (AFMA 2017)
Biomass Target Reference Point	B_{48} (48% of pre-exploitation spawning biomass)
Fishing mortality indicator or proxy	Fishing mortality (model estimated) Risk of overfishing i.e. low risk of $SSB < B_{20}$ under future catch scenarios run through base case – implied from Patterson et al. 2022 (despite catches $>$ RBCs)
Fishing mortality Limit Reference Point	Not specified within the risk profile outlined (Patterson et al. 2022)
Fishing Mortality Target Reference Point	F_{40} (Fishing mortality rate that achieves B_{40})

Stock Assessment Results

Pink Ling (eastern) spawning stock biomass (SSB) estimates from Tier 1 assessment (integrated quantitative stock assessment; AFMA 2017; Commonwealth of Australia 2007, 2017) and predicted biomass as a proportion of unfished biomass (B_0) at constant-catch scenarios with performance indicators (future SSB, probability estimates of being below the limit and year of SSB being at target reference point) are presented in Figure 2.

The 2021 Tier 1 Commonwealth assessment (Cordue 2022) summarised from Paterson et al. (2022) states:

The spawning stock biomass of Pink Ling (eastern) at the beginning of 2021 is estimated to be 34% ($0.34SB_0$) of the unfished level (SB_0). This was below the target reference point of $0.48SB_0$, but above the limit reference point of $0.20SB_0$ (Figure 2). The eastern stock is, therefore, classified as **not overfished**.

For the 2021-22 fishing season, total combined catch and discards were estimated to be 898.5 t, which is below the combined RBC of 1,710 t. The total fishing mortality for eastern

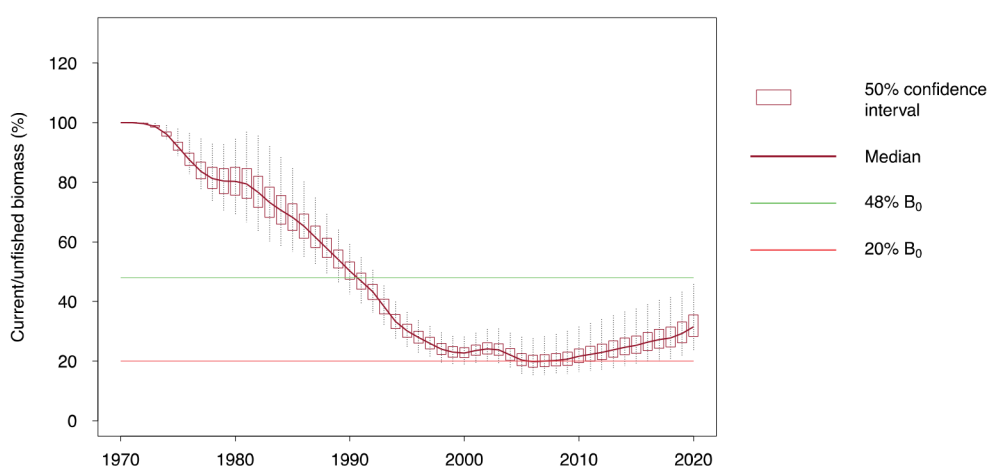
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Pink Ling was estimated (using the catch ratio from logbooks) to be 450.5 t, which is above the RBC of 260 t from the 2018 assessment and 410 t from the 2021 assessment. Although total fishing mortality of eastern Pink Ling was above the RBC, the probability of the biomass being depleted to below $0.2B_0$ in 2024 at that mortality level (~450 t), is below 0.05% (Cordue 2022). Furthermore, the eastern stock is expected to be rebuilt to the target reference point ($0.48SB_0$), with at least a 50% probability before 2050 for catches between 400 and 500 t per year. The stock is, therefore, classified as **not subject to overfishing**.

Figure 2 Estimated spawning stock biomass for eastern Pink Ling, 1970 to 2020 (Cordue 2022, cited in Patterson et al. 2022).



Note: B_0 Unfished biomass.

Table 1 Base-case 2021 stock assessment performance indicators for eastern Pink Ling, showing stochastic projections at a range of future constant catches (Cordue 2022, cited in Patterson et al. 2022).

Annual catch (t)	B_{2024}/B_0	B_{2031}/B_0	Probability $B_{2024} < 0.2B_0$	Probability $B_{2031} < 0.2B_0$	Rebuild year
0	0.47	0.75	0	0	2025
400	0.40	0.51	0	0	2030
475	0.39	0.46	0	0.01	2035
500	0.38	0.45	0.01	0.01	2038
550	0.37	0.42	0.01	0.02	>2055
600	0.36	0.38	0.01	0.05	>2055
650	0.36	0.36	0.02	0.08	Never
700	0.34	0.32	0.03	0.16	Never
750	0.34	0.29	0.04	0.23	Never

Notes: B_0 Unfished biomass. B_{year}/B_0 Predicted biomass ratio in given year. $B_{year} < 0.2B_0$ Biomass below 20% of B_0 in given year. Rebuild year is the projected year for rebuilding to 48% of B_0 .

Stock Assessment Result Summary

Biomass status in relation to Limit	Performance measure above Limit – Spawning stock biomass estimated at $0.20SB_0$ in the 2018 assessment (Cordue 2022 and Patterson et al. 2022)
Biomass status in relation to Target	Performance measure below Target Reference Point of B_{48} ($0.48SB_0$)
Fishing mortality in relation to Limit	N/A
Fishing mortality in relation to Target	N/A
Current SAFS stock status	Sustainable
Current Commonwealth stock status	Not overfished Not subject to overfishing

Fishery interactions

There are interactions between the Commonwealth Trawl and Auto Lining Fisheries and other commercially fished, by-catch and other species, including threatened and endangered species. Various management and mitigation measures are in place to address many of these issues (AFMA 2018)

The Commonwealth Trawl Fishery interacts with other commercial and non-commercial bycatch and discard marine species, a range of endangered threatened and/or protected species and marine habitats (AFMA 2014; Wayte et al. 2007).

Qualifying Comments

Supplementary information relevant for to the interpretation of the assessment is provided in Appendix 1 and 2.

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Appendix 1

Reliability and Relevance of the Commonwealth Assessment to assessment of stock status in NSW

The current Commonwealth assessment of Pink Ling could adequately inform the decision process for an NSW TAC determination, given that the stock of eastern Pink Ling fished in Commonwealth and State jurisdictions is considered a single biological stock, it is reasonable that NSW use the Commonwealth assessment as the basis for determining stock status in NSW. Further, the commercial landings data used in the model include landings data from NSW.

The benefits of adopting Commonwealth assessments include the application of processes exposed to broad review, including by management, science and industry representatives within the Commonwealth fishing sector, as well as observers from other stakeholder groups (e.g. NSW DPI Fisheries). The Commonwealth assessments have not, however, been developed to provide specific outputs for jurisdictions other than the Commonwealth and do not necessarily include or apply data at resolutions more applicable to alternate jurisdictions. Therefore, applying these assessments to inform NSW total allowable catch (TAC) determinations is done understanding that there are limitations in the data used and the application of the data to a scale other than that to which the assessment was applied.

In addition, applying the assessment of Pink Ling from the Commonwealth to inform the status of NSW Pink Ling and reliably inform management decisions for this species assumes (among other issues) that the assessment represents the same population(s) being harvested by these fisheries. Support for this assumption is provided by the 2020 determination of the stock structure of Pink Ling for the 2020 SAFS reports as a biological stock at the scale of eastern Australia, including Commonwealth waters to which the Commonwealth assessment applies and NSW waters.

NSW and Commonwealth SESSF catch rates

Trends in standardised catch rates (CPUE) for eastern Pink Ling taken by setline in the Ocean Trap and Line, Line East fishery operating within NSW jurisdiction (Figure 7a, b) are generally consistent with indices of abundance based on spawning stock biomass trends in Commonwealth Trawl Sector and Scalefish Hook Sector (Figure 2). However, there is uncertainty in NSW standardisation and therefore, interpretation should be done with caution because the accuracy of reported hook deployments has not been validated (i.e., large number of fishing trips report the similar number of hooks). Both sources of data, show increasing trends in abundance between 2010 and 2021. This suggests that the component of the stock in NSW waters is exhibiting similar dynamics (with respect to abundance) to the component of stock under Commonwealth jurisdiction and this is consistent with the assumption of a single biological stock.

Appendix 2

NSW catch statistics and additional information relevant to TAC setting in NSW

The commercial fishery data presented in this section of the report includes total Pink Ling catch landed in NSW from 1976/77 to present and catches reported from the NSW Ocean Trap and Line - Line East (OTLLE) from 2009/10. Information presented in figures and table below is summarised by financial year (July–June). These data are provided as supplementary information to the assessment and to help inform the NSW total allowable catch determination. NSW commercial fishery records have not been consistently reported throughout the history of the fishery. Catch

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from 1976/77 to 1996/97 (inclusive) includes catch from outside current NSW waters (i.e. Commonwealth catches). Total catch from 1997/98 is restricted to waters in NSW jurisdiction. From 1993 landing Pink Ling was prohibited in the NSW Ocean Trawl Fishery.

State-wide fisheries catch

Annual total catch of Pink Ling demonstrated a substantial increase from the mid-1970s, catches peaked in excess of 500 t in 1984/85 and ~450 t in 1993/94, with a trough in 1988/89 of ~230 t (Figure 1a and b). For three years from 1997/98, reported catches of Pink Ling in NSW were greater than 40 t.yr⁻¹. Over the proceeding 9 years, from 2000/01 to 2008/09, annual catches were <25 t.yr⁻¹ (range 9.2 t – 24.6 t) and averaged ~16 t.yr⁻¹. Between 2008/09 and 2009/10, the total annual catch increased ~25 t to 48.2 t and since 2009/10 annual catches have remained above 40 t.yr⁻¹. Since 2009/10, the highest catch of Pink Ling was 68.8 t, landed in 2016/17. Total catch in 2021/22 was 62.7 t (Figure 3). Annual landings of Pink Ling in NSW, on average, are less than 16.7% of the total annual catches landed in the Commonwealth (SESSF Commonwealth Trawl Sector, SESSF Gillnet, Hook and Trap Sector and South East Non-Trawl Fishery, Figure 4).

Pink Ling are landed almost exclusively in the OTLLE endorsement (2009/10-2021/22 ≥ 97.2%, range 40.3-68.5 t.yr⁻¹; Figure 5), and within the OTLLE, almost exclusively by the setline demersal fishing method (2009/10-2021/22 > 90.5%; range 30.8-66 t.yr⁻¹; Figure 6).

Additional information relevant to TAC setting in NSW

1. The Pink Ling TAC for the May 2021-April 2022 fishing season was set at the 8-year maximum catch of 67.7 tonnes.
2. The IAP recommended that the initial allocation of quota shares for Pink Ling be calculated based on 20% on the proportion of access shares held + 80% on recorded landings for an individual fishing business in the Ocean Trap & Line – Line East Share Class over the selected criteria period 2009/2010 to 2016/2017 (inclusive), but with the “worst catch year” for each business removed (https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/832464/Ocean-Trap-and-Line-IAP-Final-Report.pdf).
3. Statistics describing landings of Pink Ling from NSW commercial fisheries may inform determination of a NSW TAC that is consistent with the development of an inter-jurisdictional resource sharing policy.
4. Landings of 62.7 t were reported against a NSW TAC of 67.7 t in 2021/22.
5. In 2021/22 fishing period approximately 12.76 t of quota was held by fishing business that reported nil landings of Pink Ling. However, if you consider fishers that did not use their allocated quota, yet transferred it to other fishers, the result is 5.5605 t.
6. 28.70.t (42.4%) of the 2022/23 Pink ling TAC (67.7 t) was taken at 17th January 2023.
7. SERAG (November 2021) recommended a 3-year MYTAC with RBCs for the eastern stock based on the outputs of the MCMC analysis. AFMA set a notional eastern catch limit of 428 t for the 2021-22 fishing season.

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Figure 3 Annual catch (t) of Pink Ling from all fishing methods reported from NSW from 1997/98 to 2021/22.

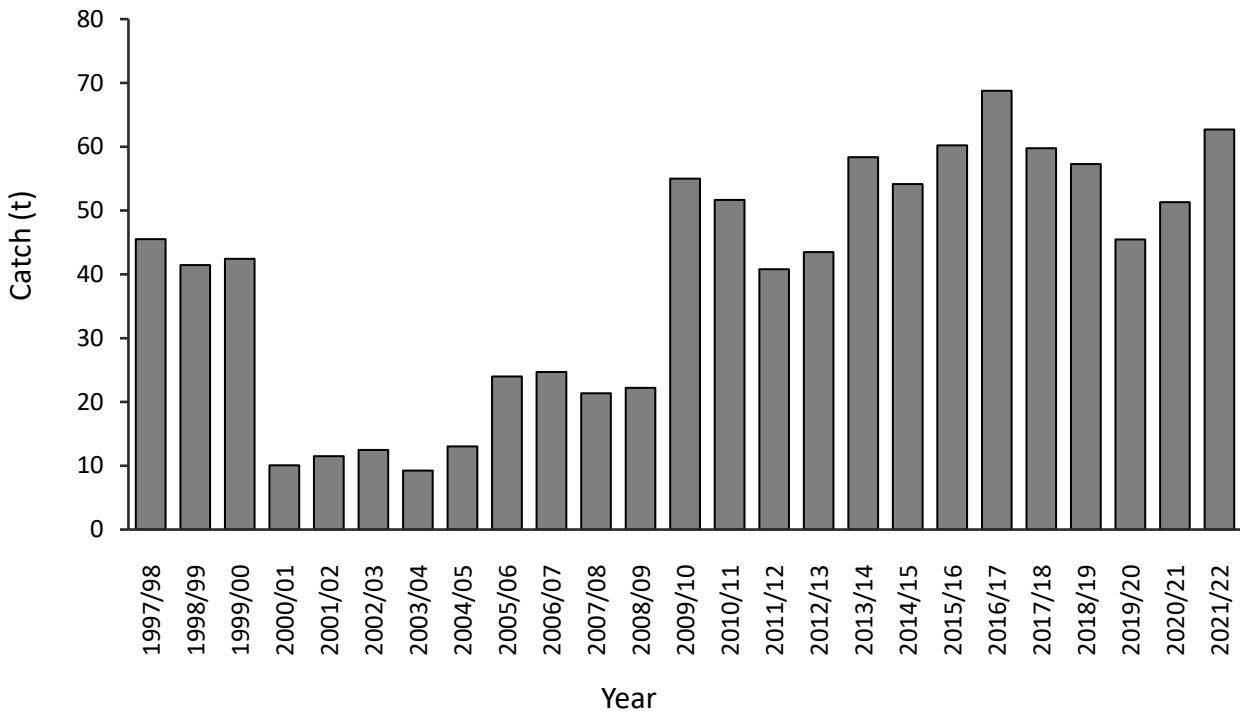
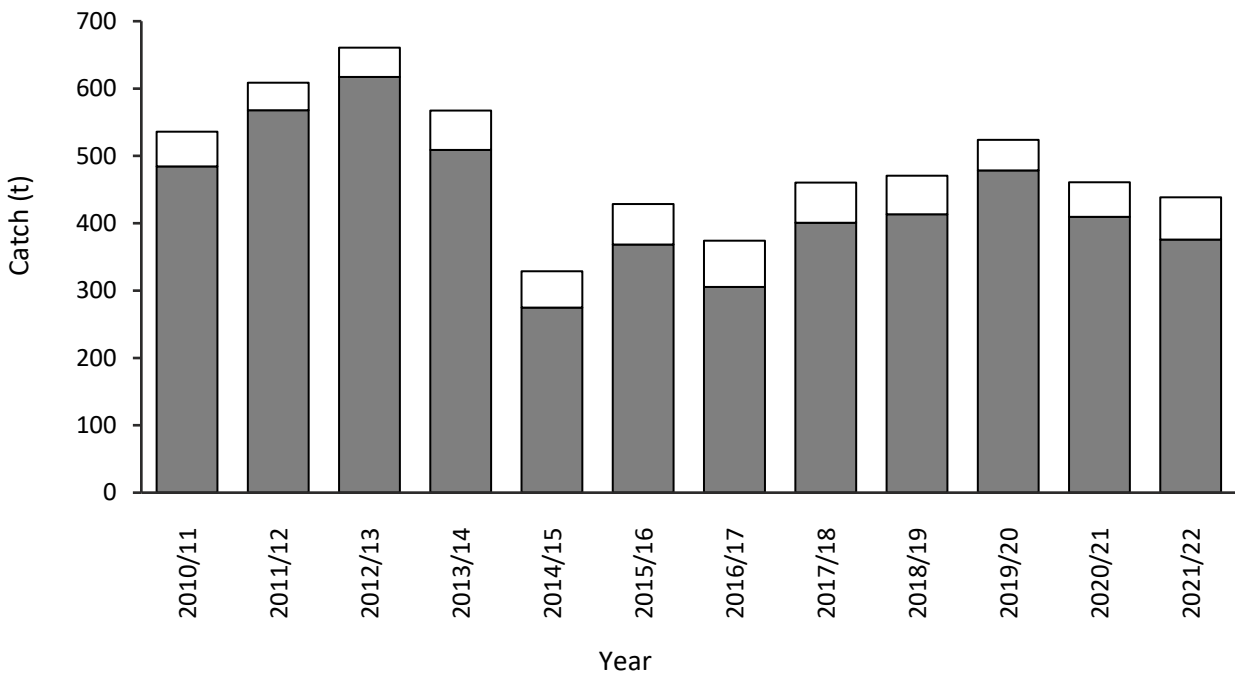


Figure 4 Annual landed catch (t) of the eastern stock of Pink Ling from the Commonwealth (dark grey, SESSF Commonwealth Trawl Sector, SESSF Gillnet, Hook and Trap Sector & South East Non-Trawl Fishery) and all fishing methods reported to NSW (white) from 2010/11 to 2021/22.



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Figure 5 Annual catch (t) of Pink Ling in NSW Ocean Trap and Line - Line East (grey) and all other endorsement codes (black) from 2009/10 to 2021/22.

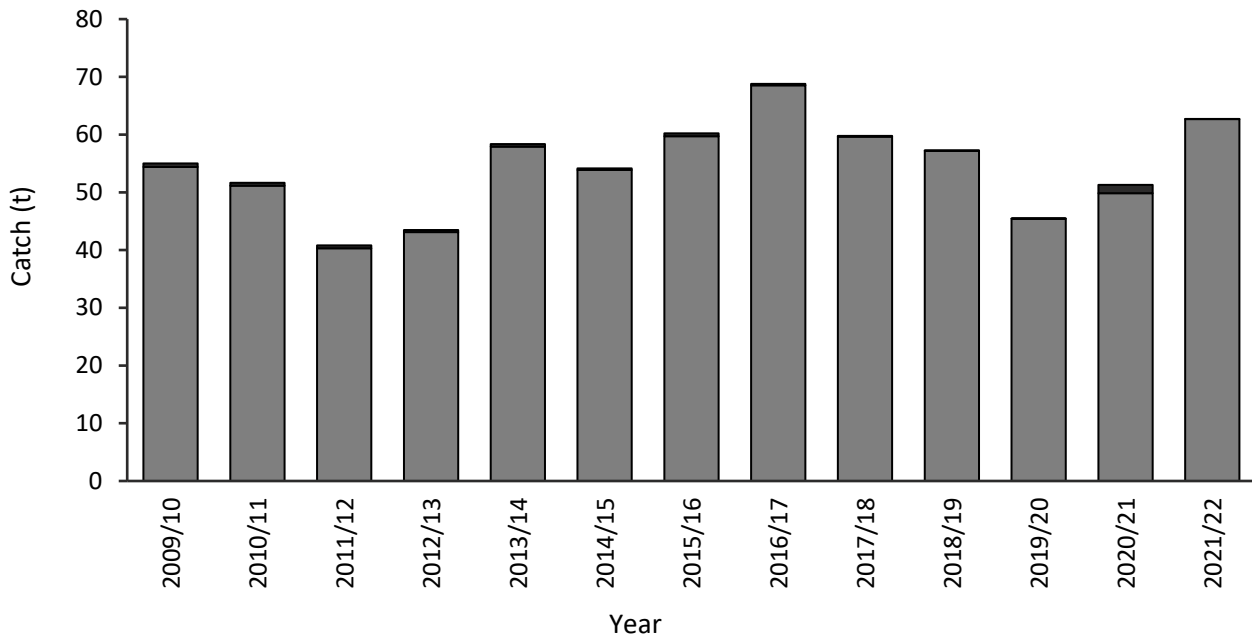
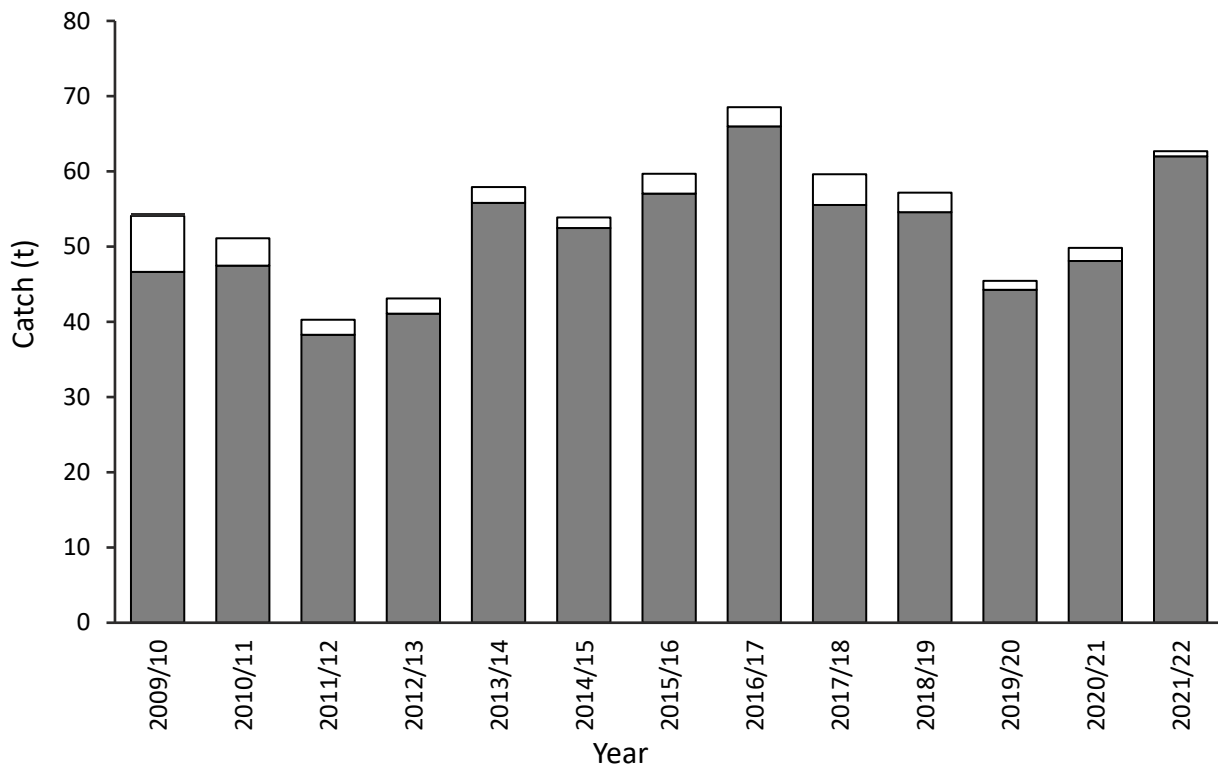


Figure 6 OTLLE – fishing methods - Annual catch (t) of Pink Ling in NSW Ocean Trap and Line - Line East (OTLLE) by setline (grey columns; demersal (STD), trotline (TTL) and unspecified setline (ST)), dropline (white columns; DPL), and other methods (black columns) from 2009/10 to 2021/22.



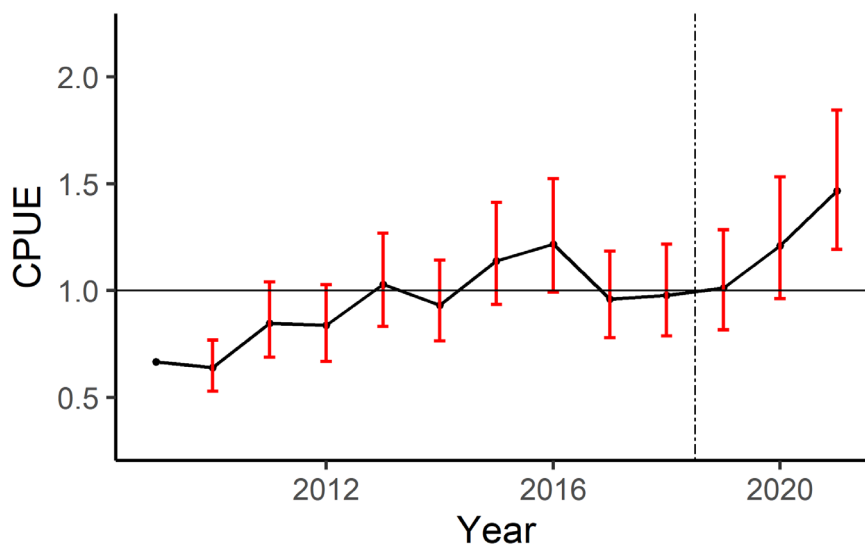
Stock Status Summary – 2022/23



NSW Stock Status Summary – Pink Ling (*Genypterus blacodes*)

Figure 7 (a) Standardised commercial catch rates (CPUE kg.hook⁻¹, solid blackline line with red error bars) of Pink Ling using setline in the OTLLE from 2009/10 to 2021/22, (b) Fit of linear regression model to standardised catch rates with standard error of the regression line shown (grey shading) for Pink Ling using setline in the OTLLE from 2009/10 to 2021/22. Dashed vertical line indicates transition to quota management.

(a)



(b)

