Stock status summary

The fishery scientific assessment summarised in this report and considered adequate to meet the legislative requirements for a Total Allowable Catch (TAC) determination for NSW Pink Ling is that 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. 2017; hereinafter referred to as the Commonwealth assessment).

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. Where data are unavailable or considered insufficient to reliably inform the SAFS criteria the summary has been populated with 'NA', rather than removing the criteria. This format has been maintained to transparently represent the data available and highlight areas where supplementary information, alternate data sources or analyses may be required to improve the assessment and determination of species status into the future.

Biology and stock structure

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 bottom on the continental shelf and upper slope at depths of 200–900 m.

Pink Ling can 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.

Clear and persistent differences in size and age composition and differences in trends in Commonwealth commercial catch rates indicate the existence of different stocks east and west of South Cape, Tasmania (147° East) (Morison et al. 2013) but no genetic differences have been identified between these areas (Ward et al. 2001; Patterson et al. 2017).

Stock status and assessment method

The Commonwealth assessment classifies the Eastern Pink Ling stock as not overfished and not subject to overfishing (Patterson et al. 2017). This assessment is a Commonwealth Tier 1 assessment (AFMA 2017), i.e., a quantitative model-based assessment (Cordue 2015, cited in Patterson et al. 2017).

Pink Ling (Eastern) were assessed against the SAFS criteria in 2014 and 2016 and are scheduled for SAFS assessment again in 2018. Status determination in 2014 and 2016 was **undefined** and **sustainable**, respectively. Status determination for 2018 has yet to be finalised at the time of publication of this report.

Fishery statistics summary

Fishery statistics presented in this report are restricted to those used to inform the Commonwealth assessment and are summarised here from Patterson et al. (2017) 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. 2017). 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 in this report is that for Eastern Pink Ling only, unless otherwise stated in the text. The assessment is detailed in Cordue (2015) and summarised in Patterson et al. (2017). Data sources in the assessment are catch histories from Commonwealth trawl and non-trawl (autoline) sectors and total NSW commercial catches (other state catches were small, within rounding error and ignored). Commonwealth discard estimates and landing multipliers were applied to data because Commonwealth trip limits were implemented during 2013 and 2014 resulting in three defined time periods in which there was no limit, a 50 kg limit or a 250 kg trip limit. Commonwealth catches were split by month within fishing method from 2013 (inclusive), allowing corrections to be applied to the three different trip limit periods. Other data were standardised trawl catch per unit effort (CPUE) (including 'period effect' for trip limit periods), length-frequency data by fishing method, zone and depth, and age–length data (Cordue 2015).

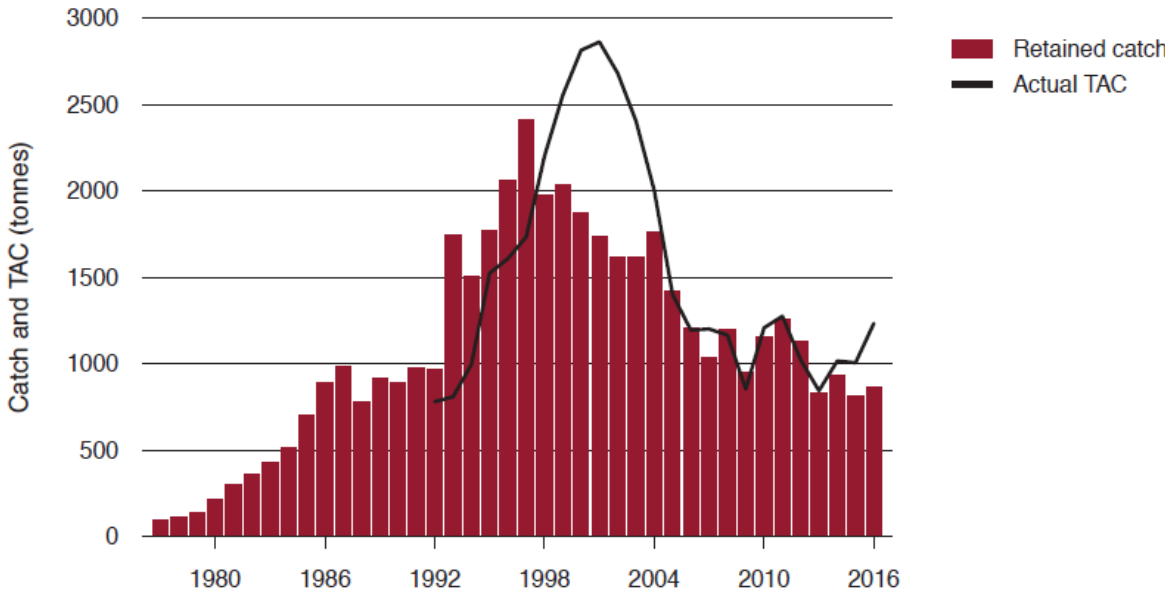
Catch information

The catch information below is summarised from Paterson et al. (2017).

Combined eastern and western catches of Pink Ling increased steadily from the start of the fishery in about 1977 to reach a peak of 2,412 t in 1997 (Figure 1). Despite TACs continuing to increase from 1997 to 2001, catches declined steadily to about 1,800 t in 2004. From 2004/05 to 2013/14, Pink Ling catches were limited by the TAC. Commonwealth landed catch in the 2016/17 fishing season was 912.5 t. The weighted average discards between 2012 and 2015 were 32.4 t (Thomson and Upston 2016).

Pink Ling is significantly under-reported in logbooks. According to AFMA catch disposal records, 912 t was landed in 2016/17, while only 765 t was reported in logbooks. This makes it difficult to assess the total level of fishing mortality, because logbook data provide information on the split in catch between the eastern and western stocks. In the preparation of catch data used for assessments, logbook data are scaled up to match the data in AFMA's catch disposal records. As a result, any under-reporting in logbooks does not necessarily bias stock assessments. Nonetheless, it will be important to address this discrepancy to reduce uncertainty in assigning status determinations in the future.

Catch information



Notes: TAC Total allowable catch. Data for 2014 to 2016 do not include state data.
Source: Cordue 2013; Australian Fisheries Management Authority catch disposal records (2014 to 2016 catch data)

Figure 1 Pink Ling annual catches (Commonwealth Trawl Sector, Scalefish Hook Sector and states combined, except catches 2014–2016 inclusive) and fishing season total allowable catch (TAC) 1977–2016 (from Patterson et al. 2017).

Recreational and Indigenous

Inclusion of recreational catch has been raised as an issue for consideration in Commonwealth assessments (SESSF RAG 2017). However, catches of Pink Ling outside the commercial fishing sector are likely negligible.

Illegal Unregulated and Unreported

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

Spawning stock biomass

Pink Ling (Eastern) spawning stock biomass (SSB) estimates from Tier 1 assessment (integrated quantitative stock assessment; AFMA 2017; Commonwealth of Australia 2007, 2017) and constant-catch scenarios and performance indicators (future SSB, probability estimates of being below the limit and year of SSB being at target reference point) is presented in Figure 2 and Table 1 (from Patterson et al. 2017).

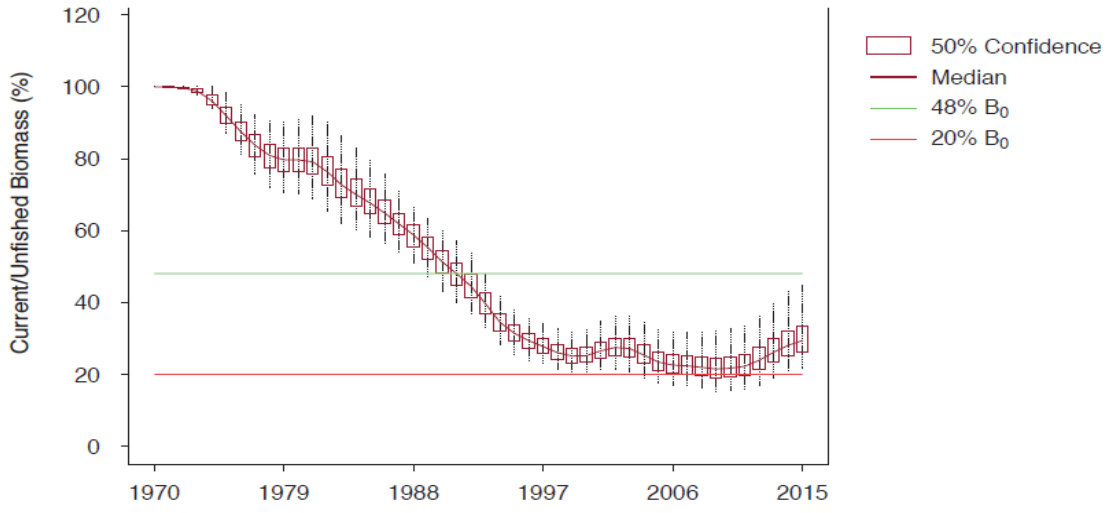
Text summarised from Paterson et al. (2017):

Spawning stock biomass

The Cordue (2015) assessment estimated the eastern stock biomass in 2015 to be $0.30B_0$ (Figure 2). This produced recommended biological catches (RBCs) for the 2016/17 fishing season of 250 t for the east. Constant-catch scenarios were run for the eastern stock and indicated that catches in excess of 550 t led to a greater than 10 per cent probability of Eastern Pink Ling declining to below the limit reference point by 2022; catches greater than 500 t increase the time taken to rebuild the stock to the management target ($0.48B_0$; Table 1).

The 2015 assessment indicated that the biomass of the Eastern Pink Ling stock is around 30 per cent of the unfished biomass and increasing. It also indicated that the Eastern Pink Ling stock had a very low (1 per cent) probability of being below the limit reference point in 2015. Eastern Pink Ling is considered as **not overfished**.

Recent catches of Eastern Pink Ling have exceeded the RBCs produced by the 2013 and 2015 stock assessments. However, the use of a generic control rule that produces these RBCs was considered unnecessary to provide management advice on TACs when a risk analysis was available, as has been the case for the 2013 and 2015 assessments that have been used to set TACs since the 2014/15 fishing season. Catch of Eastern Pink Ling reported in logbooks in the 2016/17 fishing season was 338 t. According to projections from the 2015 stock assessment, there is little risk to the stock over the next few years of removals up to 550 t per year. The base-case projections suggested that the stock could be rebuilt to the target reference point (B_{48}, i.e., $0.48B_0$) within one mean generation time (8.8 years). If two mean generation times are allowed for the rebuild, total removals can be 400–500 t per year. Consideration of recent fishing mortality against the constant-catch scenarios run as part of the 2013 and updated 2015 stock assessments indicates that, as a separate stock, Eastern Pink Ling is considered as **not subject to overfishing**.



Source: Cordue 2015

Figure 2 **Estimated spawning stock biomass for Eastern Pink Ling, 1970 to 2015 (Cordue 2015, cited in Patterson et al. 2017).**

Spawning stock biomass

Table 1 Base-case 2015 stock assessment performance indicators for Eastern Pink Ling, showing stochastic projections at a range of future constant catches (Cordue 2015, cited in Patterson et al. 2017).

Annual catch (t)	B_{2017}/B_0	B_{2022}/B_0	Probability $B_{2017}<0.2B_0$	Probability $B_{2022}<0.2B_0$	Rebuild year
0	0.38	0.63	0	0	2020
300	0.35	0.48	0.01	0	2023
400	0.33	0.43	0.02	0.01	2026
500	0.31	0.38	0.04	0.04	2036
550	0.30	0.35	0.07	0.08	>2050
600	0.29	0.32	0.09	0.13	>2050
700	0.27	0.17	0.15	0.28	>2050

Notes: B_{2017}/B_0 Predicted biomass ratio in 2017. B_{2022}/B_0 Predicted biomass ratio in 2022. $B_{2017}<B_0$ Biomass below 20 per cent B_0 in 2017. $B_{2022}<0.2B_0$ Biomass below 20 per cent B_0 in 2022. **Rebuild year** is the projected year for rebuilding to 48 per cent B_0.
Source: Cordue 2015

Stock assessment methodology

Year of most recent assessment	2015 (Cordue 2015)
Assessment method	Commonwealth Tier 1, integrated quantitative stock assessment
Main data inputs	Catch – Commonwealth trawl and non-trawl (autoline) sectors; total NSW commercial catches (other state catches were small, within rounding error and ignored) (Cordue 2015) 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) (Cordue 2015) Standardised CPUE – Commonwealth trawl sector, including 'period effect' for trip limit periods (Cordue 2015) Length-frequency data by fishing method, zone and depth (various years from 1998 see Cordue 2015) Conditional age–length data by fishing method (various years

Stock assessment methodology

see Cordue 2015)

Age frequencies data by fishing method (various years see Cordue 2015)

Main data inputs (rank)[†] — All main data inputs: assumed minimum rank 2 (medium quality)

Key model structure and assumptions — Tier 1 – Integrated quantitative stock assessment (AFMA 2017; Commonwealth of Australia 2003, 2017)

Table describing model structure (Source: Cordue 2015)

Model years	1970-2015	Stock status assessed mid-year 2015
Biomass parameterisation	B_0	Estimated parameter. R_0 is derived.
Recruitment parameterisation	Haist, lognormal prior, sigmaR = 0.7	Also, a moderate penalty on year class strengths (YCS) averaging to 1.
YCS estimated (i.e., recruitment deviations)	East: 1969-1977, 1983-2010 West: 1975-2010	Cohorts 1978-1982 in the east were not well sampled and their YCS were assumed to equal 1.
Steepness	0.75	As used in 2012. A conservative value – it may be higher. Fixed.
Maturity	Logistic at age: a_{50} = 5 yr, ato95 = 2 yr	Approximates the length-based curve used in the 2012 assessment. Fixed.
Trawl selectivities	Three blocks in the east: 1970-99, 2000-2006, 2007-2015. Two in the west: 1970-	Estimated in the model. Timing of blocks indicated by events and confirmed by
	2006, 2007-2015. Double normal at age, same for males and females.	data analysis. Separate male and female selectivities in a sensitivity.
Non-trawl selectivities	Logistic at age, same for males and females.	Estimated in the model. Separate male and female selectivities in a sensitivity.
Growth	Separate male and female von Bertalanffy	Estimated in the model.
Length-weight relationship	a 2.93e-9 b 3.139	Fixed at 2012 assessment values. (cm to tonnes)

Sources of uncertainty evaluated — Model sensitivities were investigated (after Cordue 2015), including:

- fixed mortality, *M* (low = 0.2, medium = 0.24, high = 0.28), low and high sigmaR (0.5, 0.8)
- alternative maturity ogives (shifted up or down one year)
- a tighter coefficient of variation on the CPUE indices (10%)
- double the effective sample sizes on the age and length frequencies, sex-specific selectivities and inclusion of the fishery independent survey indices
- 2014 trawl age frequency
- the exclusion of the period effects in the CPUE indices

[†] 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 limit reference levels	
Biomass indicator or proxy	SSB (AFMA 2017; Commonwealth of Australia 2007, 2017)
Biomass limit reference level	B_{20} ($0.2B_0$) – <B_{20}: no targeted fishing, rebuilding strategy will be developed (AFMA 2017)
Fishing mortality indicator or proxy	Risk of overfishing i.e. low risk of SSB < B_{20} under future catch scenarios run through base case – implied from Patterson et al. 2017 (despite catches > RBCs)
Fishing mortality limit reference level	Not specified within the risk profile outlined (Patterson et al. 2017)
Target reference level	B_{48} ($0.48B_0$) (AFMA 2017)

Stock assessment results	
Biomass status in relation to limit	Performance measure above limit - SSB estimated at $0.30B_0$ in 2015 and increasing (Crodue 2015 and Patterson et al. 2017)
Fishing mortality in relation to limit	Not subject to overfishing (Patterson et al. 2017). '…projections from the 2015 stock assessment, there is little risk to the stock over the next few years of removals up to 550 t per year. The base-case projections suggested that the stock could be rebuilt to the target reference point (B_{48}) within one mean generation time (8.8 years). If two mean generation times are allowed for the rebuild, total removals can be 400–500 t per year. Consideration of recent fishing mortality against the constant-catch scenarios run as part of

Stock assessment results	
	the 2013 and updated 2015 stock assessments indicates that, as a separate stock, Eastern Pink Ling would be classified as not subject to overfishing.' (Patterson et al. 2017)
Previous SAFS stock status	2014 SAFS status – **undefined** 2016 SAFS status – **sustainable**
Current SAFS stock status	Pink Ling to be assessed in 2018, status not yet determined

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)

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