



Queensland commercial stout whiting (*Sillago robusta*) fishery: recommended total allowable catch for 2021

August 2020



Queensland
Government

This publication has been compiled by J. Wortmann of Fisheries Queensland, Department of Agriculture and Fisheries

Enquiries and feedback regarding this document can be made as follows:

Email: info@daf.qld.gov.au

Telephone: 13 25 23 (Queensland callers only)
(07) 3404 6999 (outside Queensland)

Monday, Tuesday, Wednesday and Friday: 8 am to 5 pm, Thursday: 9 am to 5 pm

Post: Department of Agriculture and Fisheries GPO Box 46 BRISBANE QLD 4001 AUSTRALIA

Website: daf.qld.gov.au

Interpreter statement



The Queensland Government is committed to providing accessible services to Queenslanders from all culturally and linguistically diverse backgrounds. If you need an interpreter to help you understand this document, call **13 25 23** or visit daf.qld.gov.au and search for 'interpreter'.

© State of Queensland, 2020.

The Queensland Government supports and encourages the dissemination and exchange of its information. The copyright in this publication is licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Under this licence you are free, without having to seek our permission, to use this publication in accordance with the licence terms.



You must keep intact the copyright notice and attribute the State of Queensland as the source of the publication.

Note: Some content in this publication may have different licence terms as indicated.

For more information on this licence, visit creativecommons.org/licenses/by/4.0.

The information contained herein is subject to change without notice. The Queensland Government shall not be liable for technical or other errors or omissions contained herein. The reader/user accepts all risks and responsibility for losses, damages, costs and other consequences resulting directly or indirectly from using this information.

Summary

Stout whiting form a single biological stock in Queensland and New South Wales. This assessment analysed the Queensland commercial harvest and effort to calculate standardised catch rates. The stout whiting catch rates have increased since 2016 to above the 30 year average. Since 2017, the total allowable commercial catch (TACC) for Queensland has been 1106 tonnes (t).

Based on the trends in the standardised catch rates, nine recommended total allowable commercial catch options are presented for consideration by Fisheries Queensland managers and the fishery working group (Table 1).

Table 1: Recommended 2021 TACC (t) for the Queensland stout whiting fishery

Target reference point	TACC (t)		
	conservative estimate	estimate	least conservative estimate
1 (relative to fishing years 2010–2015)	1123	1131	1157
2 (relative to fishing years 1991–2020)	1142	1160	1217
3 (relative to fishing years 2011–2020)	1162	1192	1284

1 Introduction

In Queensland, stout whiting (*Sillago robusta*) are caught by Danish seine and fish otter-trawl methods between Sandy Cape and the Queensland–New South Wales border. Other than the T_4 fishing sector, no other sectors are licenced to retain stout whiting that are caught as by-catch. The Queensland commercial fishing sector is identified by a T_4 symbol and currently operated by two licensed vessels. The stout whiting T_4 sector is managed by limiting vessel participants and total allowable commercial catch (TACC) between water depths of 20–50 fathoms. As part of a management trial, a permit was issued between 2017 and 2020 that allowed the T_4 operators to fish within 20 fathoms. The T_4 sector is managed and monitored separately to the trawl-whiting (stout and eastern school whiting) vessels operating in New South Wales. The T_4 sector is also managed separately to the much larger otter-trawl sectors that target eastern king prawns along Australia’s east coast.

Since 2007 the quota was adjusted annually in response to changes in standardised catch rates and fish catch-at-age frequencies (Table 1.1). Since 2015, when the age sampling ceased, the TACC was set based on information from the standardised catch rate analysis. The standardised catch rate analysis was used to set the TACC for 2016 (O’Neill et al. 2016) and 2017 (Wortmann et al. 2016). Both reports were published in 2016, with data in O’Neill et al. (2016) up to the end of May 2015 and data in Wortmann et al. (2016) up to the end of March 2016. Since 2017 the TACC for Queensland has been 1106 tonnes (t). The TACC has not been adjusted since 2017.

Table 1.1: Recent history of annual quota changes

Calendar year	TACC (t)	Catch (t)
2007	1250	930
2008	1350	721
2009	1450	1158
2010	1500	1170
2011	1500	664
2012	1400	784
2013	1350	704
2014	1150	581
2015	1150	787
2016	1090	945
2017	1106	1026
2018	1106	1041
2019	1106	1105
2020	1106	725

Method 1 in O'Neill et al. (2016) and Wortmann et al. (2016) adjusted the following year's TACC based on the previous year's TACC. In 2020, Fisheries Queensland undertook a retrospective analysis and supported Method 1 as being most appropriate for the T_4 fishery based on the following:

- Historically, Method 1 has been used for the quota setting process
- There is minimal risk as the TACC will be reset by a stock assessment every 3 years, and in the interim years the annual TACC would be adjusted using Method 1 outputs
- The harvest strategy will utilise “hockey stick rules” taking a precautionary approach in setting the TACC until a biomass of 60% is achieved

The aim of this document is to present harvest and standardised catch rates for the Queensland commercial stout whiting fishery for the period January 1991–May 2020, and the estimated Queensland TACC for 2021 using Method 1. Results from this study will provide input data for a stock assessment model.

2 Methods

Data sources included in this study are detailed in Table 2.1.

Table 2.1: Data used in this analysis

Data	Years	Source
Commercial	January 1991–May 2020	CFISH—Logbook data collected by Fisheries Queensland
Wind	January 1991–May 2020	bom.gov.au—Bureau of Meteorology
Lunar	January 1991–May 2020	O'Neill et al. (2014)—continuous daily luminous scale of 0 (new moon) to 1 (full moon)
Seasonality	January 1991–May 2020	Mariott et al. (2014)—seasonal patterns of catch rates corresponding to autumn, winter, spring and summer periods

New data in this analysis since Wortmann et al. (2016) were:

- Commercial harvest data for April 2016–May 2020
- Wind speed and direction for standardised catch rates up to May 2020
- Standardised catch rates up to May 2020.

Fishing year was defined as the months from July to June. For example, the months starting from July 2019 to June 2020 were labelled as the 2020 fishing year, with July being the first fishing month and June being the twelfth fishing month.

Harvest data were all stout whiting caught and retained by the T_4 fishing sector.

For standardised catch rates, data from CFISH logbooks were filtered to obtain daily catch records of stout whiting for each fishing operation. A fishing operation was defined by a vessel, fishing method and owner to account for changes in vessel ownership or fishing method. Catch record data were included or excluded based on the following criteria:

- Excluded catch over multiple fishing days (491 out of 63670 records, 0.8%, 30 out of 30950 t, 0.001%)
- Included catch in 30' by 30' logbook grids from w33 to w38 (Fig 2.1, 63479 out of 63670 records, 99.7%, 30202 out of 30264 t, 99.8%)
- Excluded catch for fishing operation 3 (28 records in fishing year 2000, 7 (1 record in fishing year 1997 and 5 records in 1998), 14 (26 records in 1991) and 15 (46 records in 1991 and 9 records in 1992)
- Included records for net shots of zero stout whiting catch (114 out of 11128 records, 1%)

Catch rates of stout whiting were analysed by fishing year and zones between water depths of 20–50 fathoms (Figure 2.1, Table 2.2). An area weighted approach was used to calculate the overall Queensland commercial catch rate.

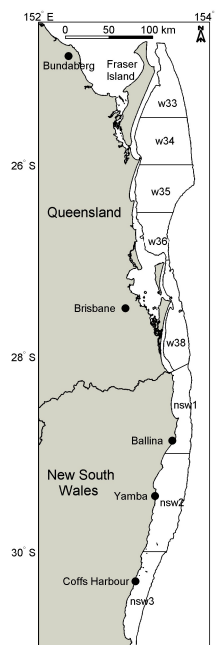


Figure 2.1: Map of the east Australian stout whiting fishery analysis zones

Table 2.2: Zone definitions for catch rate standardisation

30 by 30 minute logbook grid	Zone	Name
w32, w33, x32, x33	w33	Fraser Island waters
w34, x34	w34	Fraser Island waters
w35, x35	w35	Sunshine Coast to Double Island Point waters
w36, x36	w36	Caloundra waters
w37, w38, w39, x37, x38, x39	w38	Stradbroke Islands and Gold Coast waters

The catch rate model was a hierarchical generalized linear model (HGLM), (Appendix 1 of O'Neill et al. (2016)). This model was used because the T_4 fleet is small (there were only 2–5 vessels fishing per year) and the HGLM model allowed for unequal variances between vessels and the random occurrence of zero catch. Factors (daily data) in the catch rate standardisation were:

- seasonality (Appendix A)
- fishing year (from logbooks)
- zone (from logbooks)
- fishing operation (from logbooks)
- hours fished (from logbooks)
- lunar (Appendix A)
- water depth (from logbooks)
- fishing experience (Appendix A)
- wind speed and direction (Appendix A)
- the use of sonar (Appendix A).

Standardised catch rates were calculated in the statistical software GenStat (VSN International 2019). Catch rates were in kilograms per boat day and were scaled relative to the overall mean catch rate for 1991–2020.

The TACC was given by:

$$TACC_{k+1} = \min(TACC_k \times \theta_{k+1}, 1363) \quad (2.1)$$

$$\theta_{k+1} = \left(\frac{\bar{I}}{I_{target}} \right)^{\frac{1}{\alpha}} \quad (2.2)$$

where

- $TACC_k$ is the total allowable commercial catch in year k
- 1363 was the Maximum Sustainable Yield (MSY) in tonnes estimated in O'Neill et al. (2014). This value is treated as a maximum for quota due to data uncertainty and literature recommending quotas be set below MSY (O'Neill et al. 2016)
- \bar{I} is the indicator, from the average of the Queensland commercial catch rates in years k and $k - 1$
- I_{target} is the target reference point:
 1. target 1 = an average standardised catch rate of 1.0 from the fishing years 2010–2015 from O'Neill et al. (2016) and Wortmann et al. (2016).
 2. target 2 = a long term mean of 1.0 across all years 1991–2020
 3. target 3 = an average standardised catch rate of 1.0 from the last ten years 2011–2020 reflective of the lifespan of stout whiting

- $x = 1, 2, 3$ adjusts the TACC according to the linear, square-root or cube-root transformation. The cube-root transformation ($x = 3$) is the strongest to mitigate variance and limit the magnitude of quota change (the conservative estimate) whereas the linear transformation ($x = 1$) is the least conservative method.

3 Results and discussion

Two vessels fished for stout whiting since 2013. In the 2020 fishing year, 1180 t were harvested (Figure 3.1a). Annual landings averaged 1179 t for the fishing years 2018–2020, which was also the maximum harvest in the last ten years. Harvests illustrated by calendar years are summarised in (Figure 3.1b).

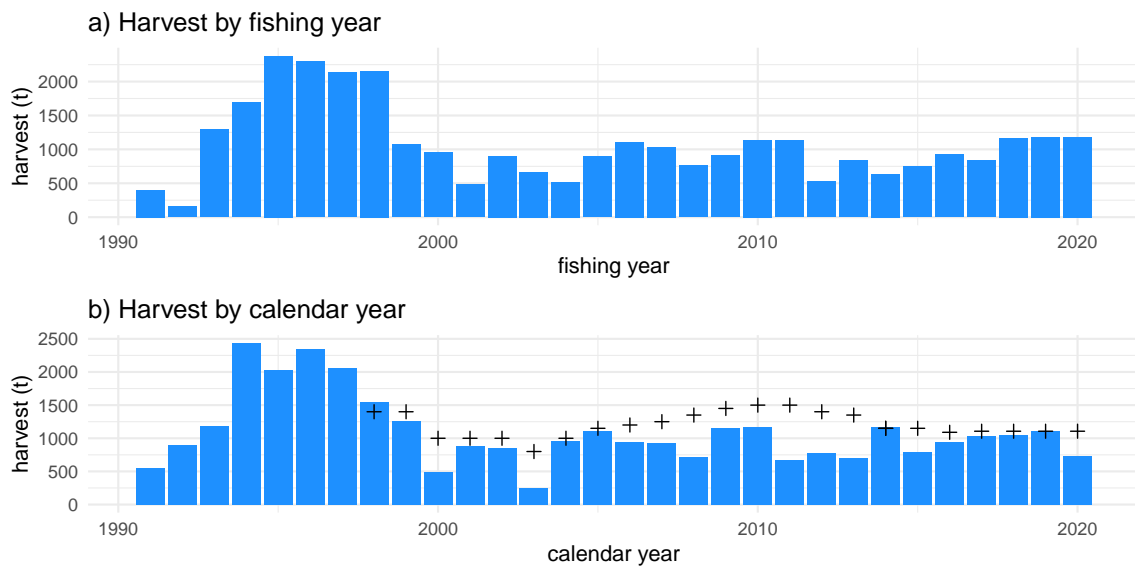


Figure 3.1: Reported commercial T_4 harvest in Queensland January 1991–May 2020—TACC settings are shown on subplot b

From 2011–2020, most of the effort (days fished) was in the ‘w38’ fishing zone (offshore waters from around the Stradbroke Islands and Gold coast; Figure 3.2). Prior to the year 2000, the bulk of the fishing effort was focused in the Sunshine Coast to Double Island Point waters (zone ‘w35’) (Figure 3.2). This pattern then shifted north to Fraser Island waters (zones ‘w33’ and ‘w34’) from 2001–2010 and then to southern waters (zone ‘w38’) 2011–2020. Fishing for stout whiting was closed in zone ‘w38’ between 2001 and 2009.

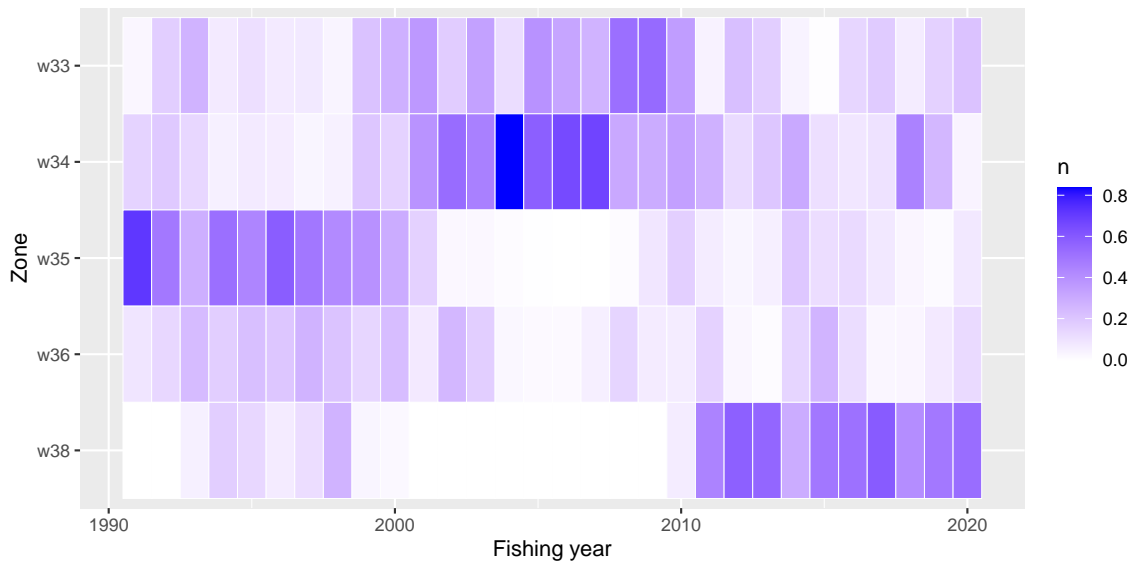


Figure 3.2: Proportion of boat-days for the Queensland fishery in Queensland waters January 1991–May 2020

The addition of a factor for zone adjusted catch rates down from the reported-observed catch rates from 2015 onwards (Figure 3.3). The parameter estimate from the catch rate model for zone w38 was high, indicating that if there was fishing in this zone, then the annual catch would be high. The catch rate standardisation model assumed an average spatial pattern of fishing, thus in the later years, when most fishing was in zone w38 (Figure 3.2), the model adjusted catch rates down. The addition of fishing experience adjusted catch rates up in the years before 1997 and adjusted catch rates down in the years from 2014 onwards. The effect of sonar is only seen in years before 1997 as it was completely adopted by 2000. In early years with no sonar it would have been harder to find fish, thus catch rates were adjusted upwards.

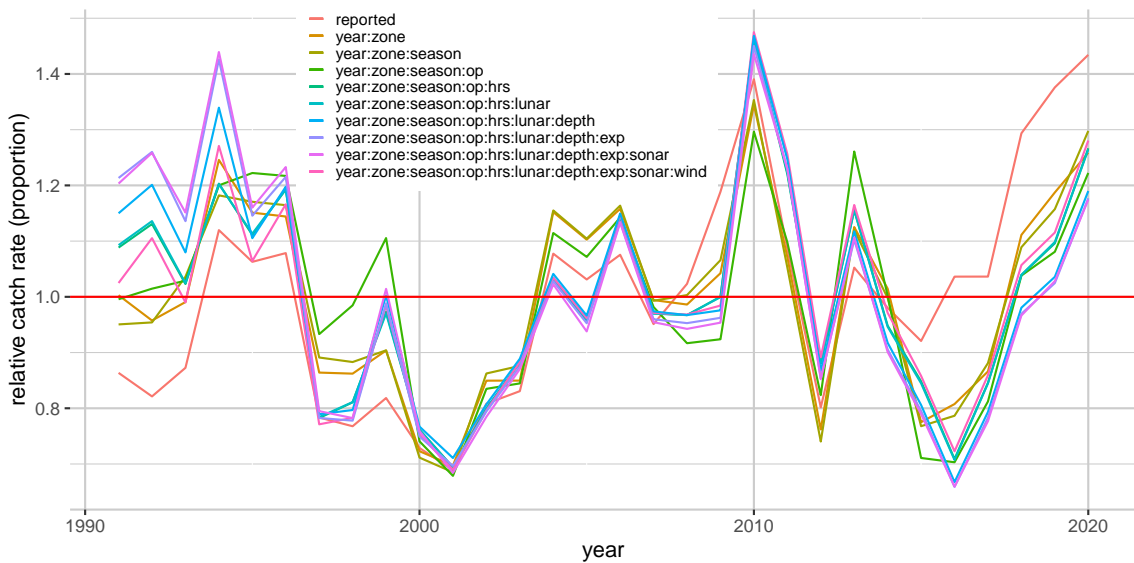


Figure 3.3: Influence of each factor in the commercial standardised catch rates for stout whiting in Queensland January 1991–May 2020—in the legend ‘op’ is fishing operation, ‘hrs’ is hours fished and ‘exp’ is fishing experience

The 2020 catch rate index was above the long term mean (Figure 3.5) and fishing zones w33–w36 exhibited increasing catch rates in recent years (Figure 3.4). Catch rate diagnostics are in Appendix A.

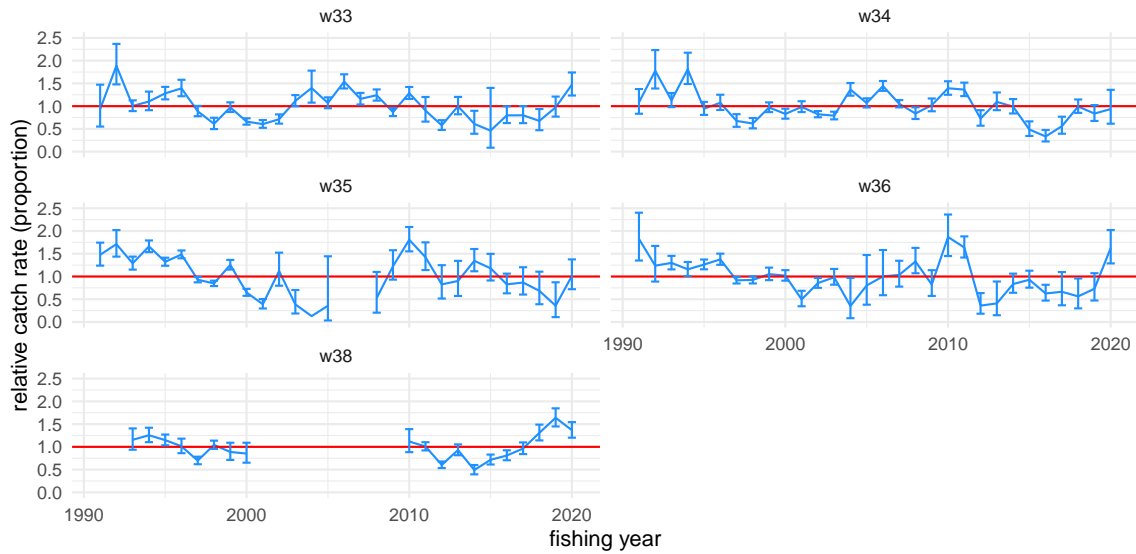


Figure 3.4: Annual relative standardised catch rates and 95% confidence interval for each zone of the Queensland stout whiting fishery January 1991–May 2020

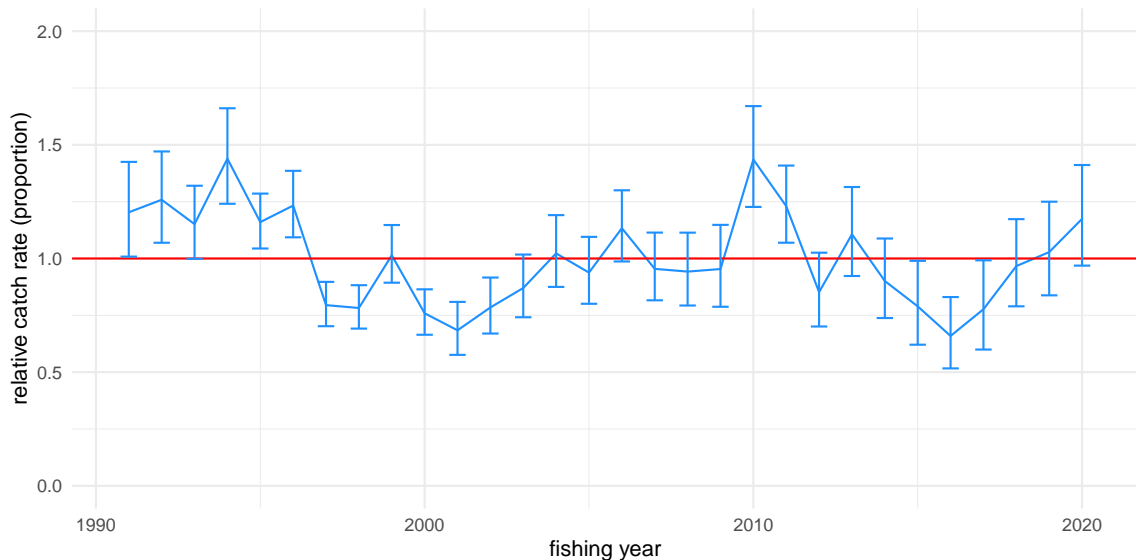


Figure 3.5: Annual relative standardised catch rates and 95% confidence interval for the Queensland stout whiting fishery January 1991–May 2020

The calculations of the 2021 TACC covered a range of settings outlined in Table 1. The estimated 2021 TACC increased from the 2020 TACC of 1106 t by between 17 and 178 t, giving an estimated TACC for 2021 of between 1123 and 1284 t. Uncertainty in the TACC estimates should be considered as they were sensitive to the data inputs and assumptions.

The proposed harvest strategy for the Queensland stout whiting fishery will consist of a stock assessment (due 2021) that will be run every three years. The aim of the stock assessment is to inform the

setting of the TACC so that the fishery achieves or maintains a biomass of 60%. In the years between stock assessments, the quota calculations from this study will be used to guide the TACC setting.

References

- Mariott, Ross J., Michael F. O'Neill, Stephen J. Newman, and Craig L. Skepper (2014). "Abundance indices for long-lived tropical snappers: estimating standardized catch rates from spatially and temporally coarse logbook data". In: *ICES Journal of Marine Science: Journal du Conseil* 71.3, pp. 618–627. URL: <http://icesjms.oxfordjournals.org/content/71/3/618.full.pdf>.
- O'Neill, Michael F. and George M. Leigh (2014). *Queensland Stout Whiting fishery: Commercial quota setting 2014*. Tech. rep. Brisbane: Department of Agriculture and Fisheries.
- (2016). *Stout Whiting Fishery Summary: Queensland total allowable catch for 2016*. Tech. rep. Brisbane: Department of Agriculture and Fisheries. URL: era.daf.qld.gov.au/5200/ (visited on 06/09/2016).
- VSN International (2019). *Genstat for Windows 20th Edition*. Type: Computer Program. VSN International, Hemel Hempstead, UK. URL: Genstat.co.uk.
- Wortmann, Joanne and Michael F. O'Neill (2016). *Stout Whiting Fishery Summary: Commercial quota setting for 2017*. Tech. rep. Brisbane: Department of Agriculture and Fisheries. URL: era.daf.qld.gov.au/5199/ (visited on 06/09/2016).

A Appendix - Standardised catch rates

Wind direction and strength data were sourced by Fisheries Queensland from the Bureau of Meteorology (bom.gov.au). The wind data were from representative coastal weather stations (Table A.1).

Table A.1: Weather stations used for zones

Station number	Station name	Zone
40068	Double Island Point Lighthouse	w33, w34
40043	Cape Moreton Lighthouse	w35, w36
40764	Gold Coast Sedgeway	w38

The recorded measures of wind speed (km hour^{-1}) and direction (degrees for where the wind blew from) in each latitude band were converted to an average daily reading based on recordings between 6 am and 6 pm. From this data the north-south (NS) and east-west (EW) wind components were calculated:

$$NS = \text{wind speed} \times \cos(\text{wind direction}) \quad (\text{A.1})$$

$$EW = \text{wind speed} \times \sin(\text{wind direction}) \quad (\text{A.2})$$

where wind speed was in km hour^{-1} and wind direction was converted to radians.

The wind components were used to test their effect on catch rates for different wind directions and strengths. The component functions considered the BOM defined wind directions as degrees measured clockwise from true north.

The influence of lunar phase on catch rates was tested by the addition of a sinusoidal luminance (lunar) pattern as described by using a continuous daily luminous scale of 0 (new moon) to 1 (full moon) through-

out the lunar cycle. A lagged response of catch rates to lunar phase was assessed using a covariate (lunar advance) which advanced the luminance measure seven days (approximately $\frac{1}{4}$ lunar period). The two variables were modelled together to estimate the variation of catch according to the moon phase (i.e. contrasting waxing and waning patterns of the moon phase).

Six trigonometric functions modelled an average monthly pattern of catch (Mariott et al. 2014):

$$s_1 = \cos\left(\frac{2\pi d_y}{T_y}\right), s_2 = \sin\left(\frac{2\pi d_y}{T_y}\right) \quad (\text{A.3})$$

$$s_3 = \cos\left(\frac{4\pi d_y}{T_y}\right), s_4 = \sin\left(\frac{4\pi d_y}{T_y}\right) \quad (\text{A.4})$$

$$s_5 = \cos\left(\frac{6\pi d_y}{T_y}\right), s_6 = \sin\left(\frac{6\pi d_y}{T_y}\right) \quad (\text{A.5})$$

where

- d_y was the cumulative day of the year
- T_y was the total number of days in the year (365 or 366)

Using sine and cosine functions together identified the seasonal patterns of catch rates corresponding to autumn, winter, spring and summer periods.

Fishing experience was calculated to follow an exponential learning curve:

$$\log\left(\frac{v_y}{1 + v_y}\right) \quad (\text{A.6})$$

where v_y was the cumulative number of at-sea fishing days divided by 365.25.

The increase in experience was assumed sharpest in the initial fishing years, then levelling out to a limit.

The use of sonar was filled in manually. The fishery had 2–5 vessels per year so the information was obtainable.

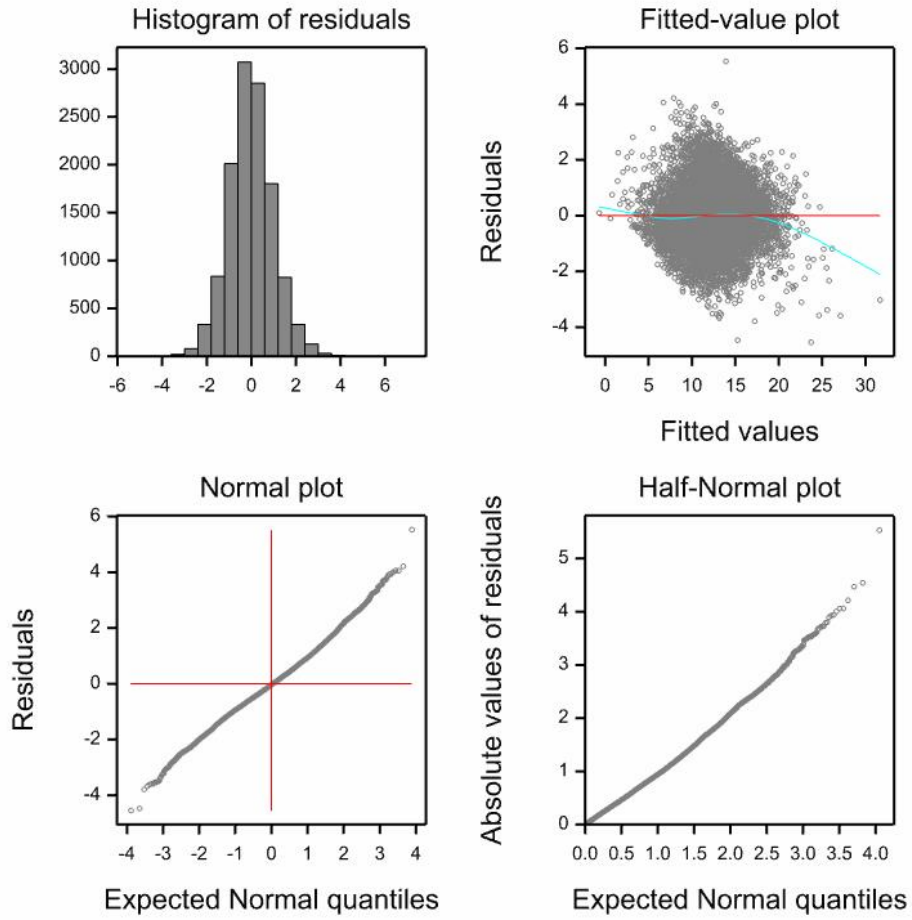


Figure A.1: Residual checking plots for the hierarchical generalized linear model (HGLM) analysis