Stock Status Summary – 2021

NSW Stock Status Summary – Stout Whiting *(Sillago robusta)*

Assessment Authors and Year

Hall, K.C. 2021. NSW Stock Status Summary 2020/21 – Stout Whiting (*Sillago robusta*). NSW Department of Primary Industries, Fisheries. 11 pp.

Stock Status

Current stock status	On the basis of the evidence contained within this assessment, Stout Whiting is currently assessed as **sustainable** for the NSW component of the stock.

Stock Structure

Stout Whiting is a tropical species that occurs in ocean waters to a depth of 70 m from south-western Western Australia, around the northern coastline to central NSW on the east coast. There is strong evidence that Stout Whiting on the east coast are a separate sub-species from populations along the northern and western Australian coasts (Dixon et al. 1987). More recent molecular analyses of Stout Whiting samples from Queensland locations suggest that biological sub-stocks of the east coast stock are unlikely to exist (Ovenden and Butcher 1999). Therefore, Stout Whiting in southern Queensland and northern NSW are considered a single eastern Australia biological stock for assessment purposes (Roelofs and Hall 2018).

On the basis of this evidence, assessment of the stock status of Stout Whiting is presented at the biological stock level – Eastern Australia.

The data presented in this summary relate to the NSW part of the stock (reproduced from Hall 2021).

Stock Status – New South Wales

Catch Trends – Commercial Fisheries

Annual commercial catches of Stout Whiting in NSW state waters (following adjustment for species misreporting in northern NSW) steadily declined during the 2000s from 479 t in 2002 to 245 t in 2009. Since then catches have remained relatively steady around a 10-year average catch of 243 t. In 2019, an estimated catch of 231 t was reported after two years of slightly lower catches in 2017 and 2018 (Fig. 1). A basket total allowable catch (TAC) of 1,189 t for combined Eastern School Whiting and Stout Whiting was introduced in May 2019 for waters north of Barrenjoey Point. This TAC was reduced to 898 t in May 2020 in response to the Eastern School Whiting stock status changing to ‘depleting’ (Hall 2020; Mapstone et al. 2020). Most of commercial catch of Stout Whiting from NSW waters is taken by prawn trawlers of the Ocean Trawl Fishery (Fig. 2) in northern NSW (ocean zones 1 and 2, Fig. 3).

The Stout Whiting stock is also targeted by commercial Danish seine and trawl vessels of the Queensland Finfish (Stout Whiting) Trawl (T4) Fishery in southeastern Queensland waters from Fraser Island south to the NSW border (Fig. 4). On average, 80% of the total commercial harvest is taken in Queensland and 20% in NSW (Roelofs and Hall 2018). Queensland commercial catches were 1,026 t in 2017, 1041 t in 2018 and 1,105 t in 2019 (Wortmann 2020), with recent TACs (of 1,106 t in 2017, 2018 and 2019) almost fully caught.

Stout Whiting are also taken as by-catch by the Queensland East Coast Otter Trawl (T1) Fishery, which primarily targets Eastern King Prawns in offshore waters (O'Neill and Leigh 2014). While these trawlers are not permitted to retain Stout Whiting and catches are not included in logbook reporting, discard mortalities have been estimated and included in previous stock simulation modelling (e.g.,O'Neill and Leigh 2014).

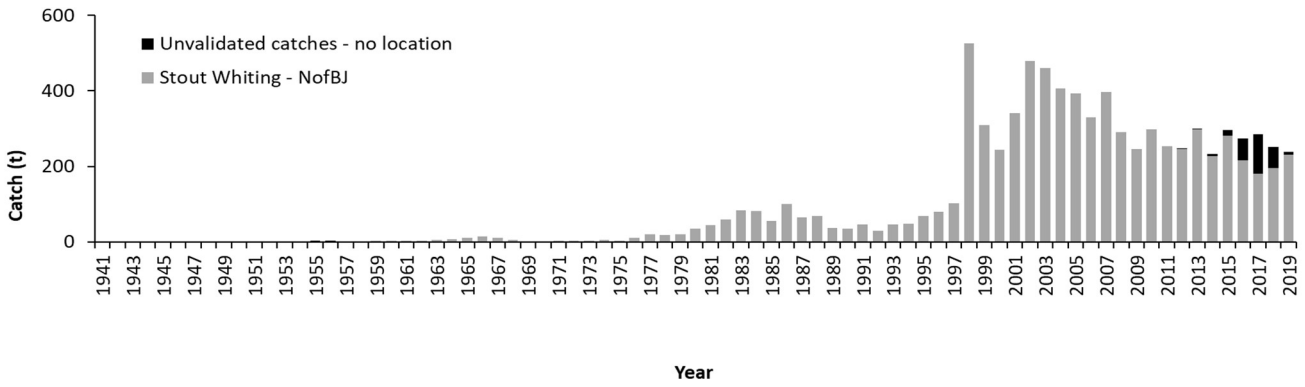

Figure 1. Annual adjusted commercial catches (tonnes) of Stout Whiting for NSW state waters north of Barrenjoey Point (NofBJ) (1941–2019). Catches have been adjusted for species misreporting in northern NSW and only oceanic 'mixed whiting' catches have been included for historical data.

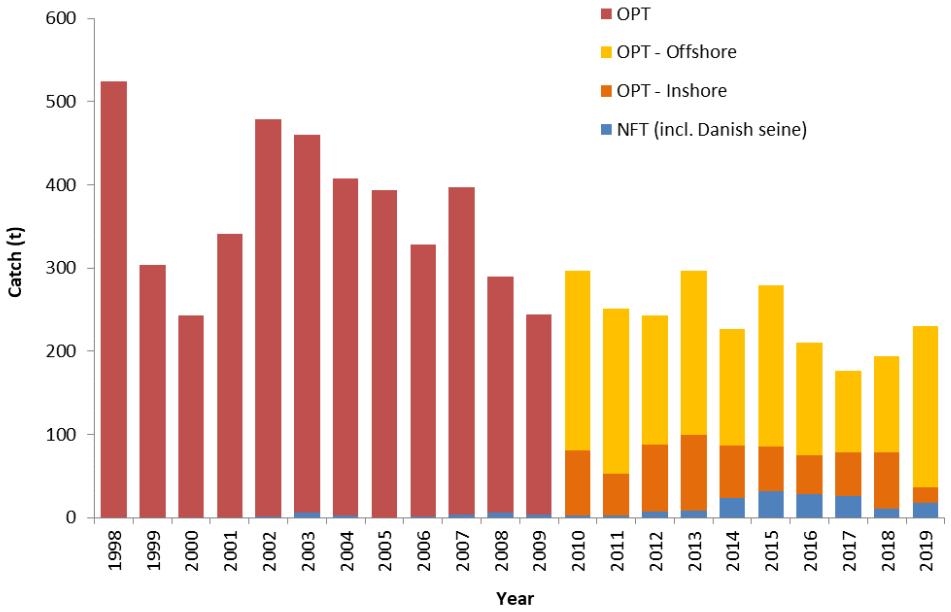

Figure 2. Annual adjusted commercial catches (tonnes) of Stout Whiting for NSW waters (1998–2018) for different sectors and endorsements of the NSW Ocean Trawl Fishery. OPT = Ocean Prawn Trawl, NFT = Northern Fish Trawl.

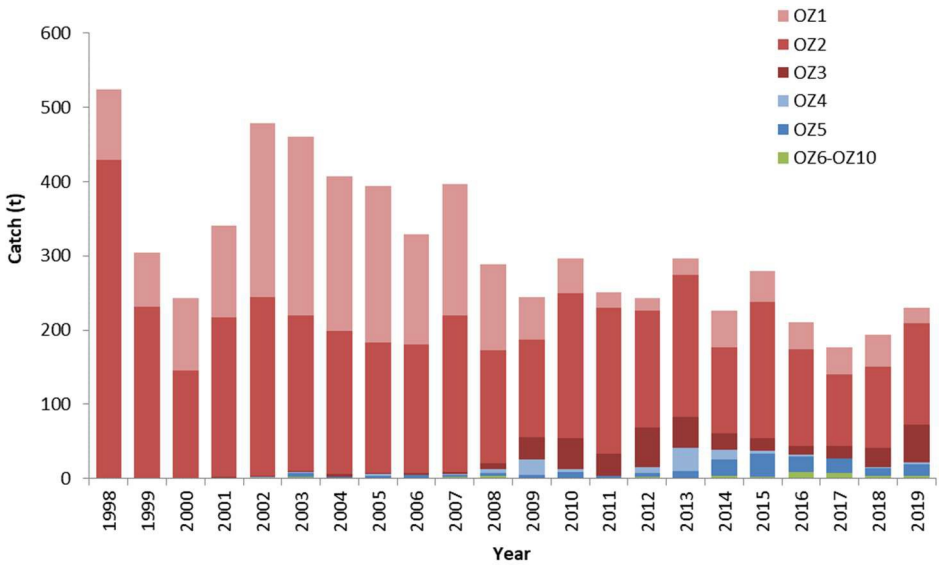

Figure 3. Annual adjusted commercial catches (tonnes) of Stout Whiting for the NSW Ocean Trawl Fishery in each ocean zone (OZ, 1 degree latitude) from north to south along the coastline (1998–2019). Catches in OZ6–OZ10 have been aggregated for confidentiality reasons.

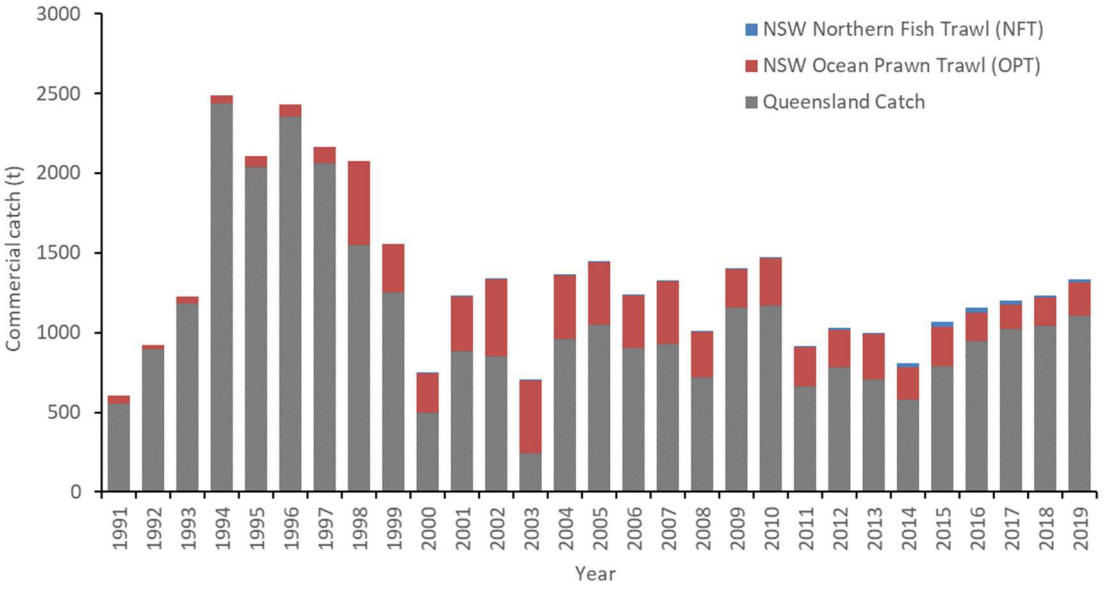

Figure 4. Annual commercial catches (tonnes) of Stout Whiting for the NSW Ocean Trawl Fishery sectors relative to those reported for the Queensland Finfish (Stout Whiting) Trawl Fishery (1998–2019). Queensland data sourced from O'Neill et al. (2002), QFish Online Database (DAF 2020) and Wortmann (2020).

Catch Trends - Recreational and Indigenous

The most recent estimate of the recreational harvest of combined Trawl Whiting in NSW was approximately 10,933 fish or around 1.54 t during 2017/18 (Murphy et al. 2020). This estimate was based on a survey of Recreational Fishing Licence (RFL) Households, comprised of at least one fisher possessing a long-term (1 or 3 years duration) fishing licence and any other fishers resident within their household. The equivalent estimated recreational harvest in 2013/14 was approximately 50% larger at around 21,152 fish (Murphy et al. 2020). Relative to the commercial catch, these recreational catches are negligible, comprising approximately 0.1% of the total harvest from NSW waters in 2013/14 (Hall 2020). There are no data on aboriginal harvest, but these catches are also assumed to be negligible.

Fishing Effort Trends – Commercial Fisheries

Commercial fishing effort for Stout Whiting was collected as number of days fished on monthly records prior to July 2009 and as numbers of hours fished per daily event after July 2009. To form a longer time series of effort, recent daily events were re-aggregated, with effort in days fished estimated from the number of fishing events entered for each fisher in each month where Stout Whiting was reported on at least one day; and were adjusted for multi-day trips reported as a single fishing event by dividing the total number of hours by 12 (after catch data had been adjusted for Trawl Whiting species composition).

In the prawn trawl sector, reported effort for Stout Whiting declined rapidly from around 8,000 days fished and 80,000 trawl hours in the early 2000s to 4,015 days fished and 38,966 hours trawled in 2009 (Fig. 5). Since then effort has declined more gradually to an estimated 3,108 daysfished and 32,023 hours trawled in 2019. Therefore, most of the decline in effort occurred prior to the catch reporting change in 2009.

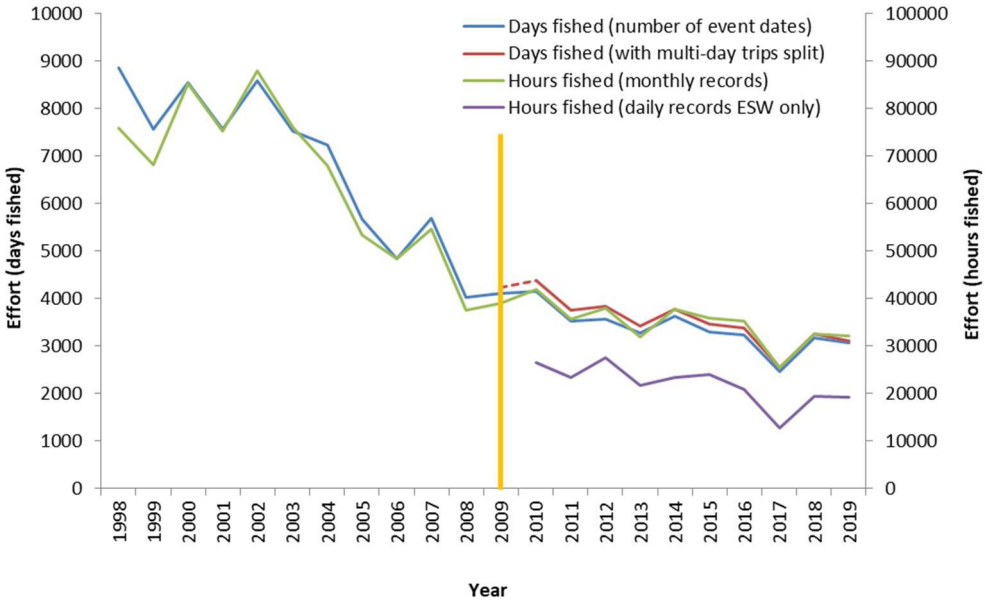

Figure 5. Annual adjusted effort (days and hours fished) for prawn trawl fishers that reported landing Stout Whiting on at least one day in each month. The gold vertical line indicates the change from monthly to daily catch reporting.

Catch Rate Trends - Commercial Fisheries

Monthly catch rates (catch-per-unit-effort, CPUE, in kg per day fished) for Stout Whiting taken by the prawn trawl sector were compiled from monthly records between 1998 and 2009 and re-aggregated daily records between 2010 and 2019. Catch rates were standardized for month, ocean zone and vessel using the r-package 'cede' (Haddon 2018). Continuity of the time series across the catch reporting change in July 2009 must be interpreted with caution when combined in single series, and has been analysed as two separate shorter series for comparison. Daily catch rates (CPUE in kg per hour trawled) were also compiled from daily fishing event records from 2010 to 2019 and standardised for month, ocean zone, vessel and capture depth (taken from the mean depth of the reported c-square).

The mean monthly catch rates of Stout Whiting taken by the prawn trawl sector rapidly declined from 1998 to 2000 to more than 50% below the long-term average, then steadily increased and have remained above or near the 22-year average since 2006 (Fig. 6). This suggests the stock in northern NSW may have initially declined following the peak catches in the late 1990s, but has since recovered. Trends in recent daily catch rates decreased from 2010 to 2012, spiked in 2015 and have returned to levels near the 10-year average over the last 3 years (Fig. 6). In 2019, there was a considerable increase in daily catch rates above the long-term average.

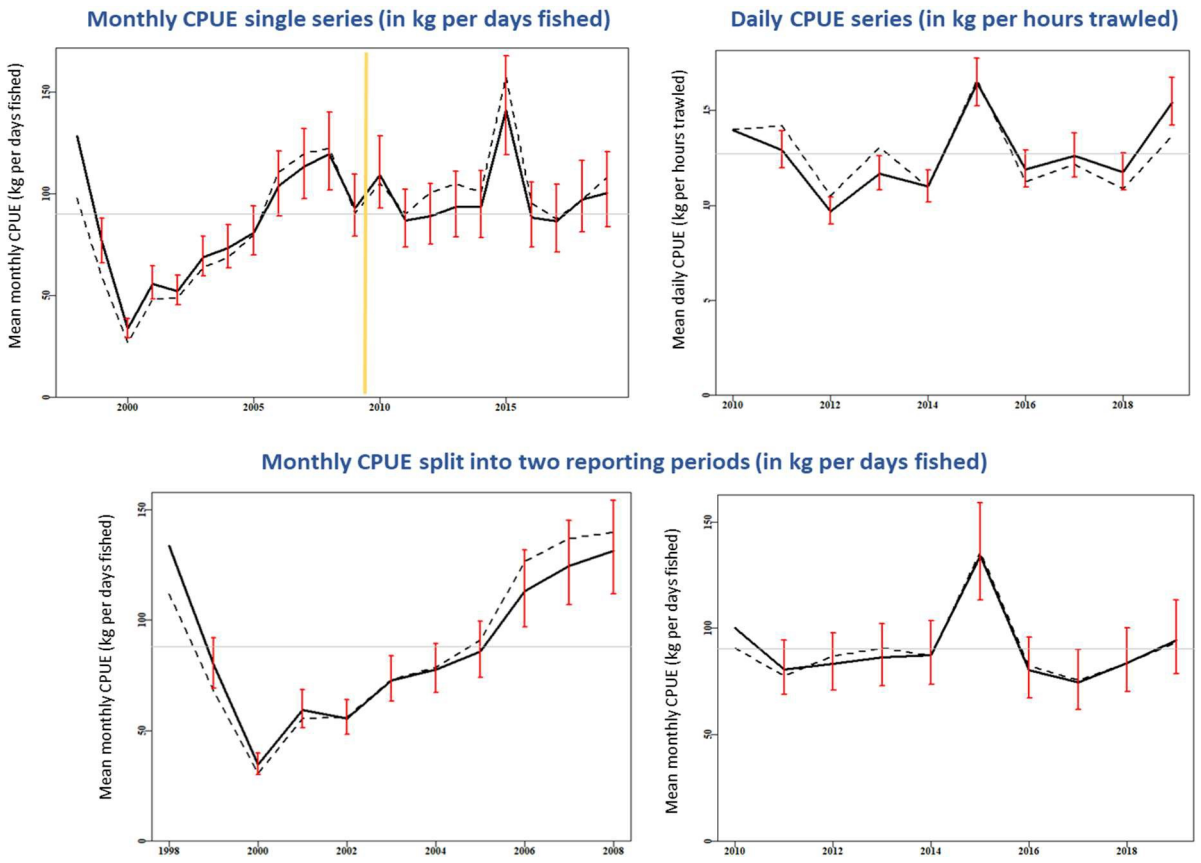

Figure 6. Mean standardised catch rates (catch-per-unit-effort, CPUE) of Stout Whiting for the prawn trawl sector in the NSW Ocean Trawl Fishery, estimated from monthly records (1998–2009) and re-aggregated daily records (2010–2019) in kg per days fished (top left and bottom) and from daily fishing event records in kg per hours trawled (top right). The dashed and solid lines indicate the nominal and standardised mean CPUE (± 95% confidence intervals), respectively; the gold vertical line indicates the change from monthly to daily catch reporting and the grey horizontal line indicates the long-term averages for each series.

Stock Assessment Methodology

Year of most recent assessment	2020, stock assessment by Fisheries Queensland, Department of Agriculture and Fisheries to inform TAC determination in 2021 (Wortmann 2020). The last population biomass modelling assessment of the Queensland part of the biological stock was completed in 2014 (O'Neill and Leigh 2014), and for the entire eastern Australian biological stock in 2004 (O'Neill et al. 2002; O'Neill et al. 2005).
Assessment method	A range of assessment methods have been applied in different years, including: catch-rate standardisation and analyses (all years); catch-curve analyses to produce annual survival estimates (2015 and 2016); and stock simulation modelling using a statistical catch-at-age model (2014 and 2004).
Main data inputs	Commercial landings – reported annual catch, taken from fisher logbooks for the Queensland T4 sector (1990–2019) and NSW OTF (1998–2019). Estimated discards and rates – reported discard weights for the Queensland T4 sector (1990–2016) and estimated by-catch for the Queensland T1 Eastern King Prawn trawl sector from reported boat-days of effort (1991–2013). Discard estimates from NSW waters have not been included in Queensland stock assessments. Commercial catch rates – reported annual catch-and-effort data for two fleets – Queensland T4 mixed Danish seine and otter trawl fleet in catch-per-hour and catch-per-shot from daily records (1990–2019); NSW OTF prawn trawl fleet (otter trawl) in catch-per-day from monthly records (1998–2019). Length compositions – random samples of two 5kg boxes from every fishing trip by vessels in the Queensland T4 fleet (1991–2016); length frequencies are statistically re-weighted by region. Proportions-at-age data – from sectioned otoliths collected from fish sampled for length compositions from the Queensland T4 fleet (1991–2016).
Key model structure and assumptions	Several modelling approaches were applied in different years as complimentary lines of evidence to inform stock status and TAC determination. These have included: 1. Catch-rate standardisation and analyses (e.g., Wortmann 2020). *Assumptions*: annual catch rates are a relative index of abundance and not unduly influenced by other factors that are not accounted for through standardisation. 2. Catch-curve analyses to produce annual survival estimates from annual length–age structure data (e.g., O'Neill and Leigh 2015).

	Assumptions: very dependent on the availability of a sound estimate for natural mortality (M), which in the absence of alternative information, is generally assumed to remain constant across years. 3. Stock simulation modelling using a statistical catch-at-age model (e.g., O'Neill and Leigh 2014). *Assumptions*: the standardised catch rate is proportional to abundance; the selectivity of fleets, rate of natural mortality and growth (mean size-at-age) are constant over time; selectivity is logistic for all fleets; and average annual recruitment follows a Beverton–Holt stock–recruitment relationship with log-normal deviations.
Sources of uncertainty evaluated	Many and varied sensitivities were evaluated for each of the above assessment methods in different years; refer to the original sources for details. In the most recent 2020 assessment, the sensitivity of standardised CPUE trends to different factors and TAC estimates to different target reference periods and adjustment transformations were assessed (Wortmann 2020).

Status Indicators and Limit Reference Levels

Biomass indicator or proxy	None specified in a formal harvest strategy for the NSW part of the stock. In the interim, for the purposes of this stock assessment a weight-of-evidence approach was used, which included: the ratio of harvested to unfished biomass estimated every 3–5 years through Queensland stock simulation modelling (DPIF 2007); and in interim years, standardised CPUE-based reference points.
Biomass Limit Reference Level	None specified in a formal harvest strategy for the NSW part of the stock. In the interim, for the purposes of this stock assessment the following were selected: 20% of the estimated unfished biomass for the limit reference point (Blim) and 48% of the estimated unfished biomass as the target reference point (Btarg), in line with the *Harvest Strategy Framework for the Commonwealth Southern and Eastern Scalefish and Shark Fishery* (AFMA 2017); and current catch rates were assessed relative to long-term averages.
Fishing mortality indicator or proxy	None specified in a formal harvest strategy for the NSW part of the stock. In the interim, for the purposes of this stock assessment a weight-of-evidence approach was used, which included: total mortality estimates (or estimated survival rates - ratio of abundance between older and younger age groups) from

	Queensland age-based catch-curve analyses (DPIF 2007); and fishing mortality estimates from catch-curve analyses of age structures from NSW commercial catches in interim years.
Fishing mortality Limit Reference Level	None specified in a formal harvest strategy for the NSW part of the stock. In the interim, for the purposes of this stock assessment the following were selected: the fishing mortality corresponding to 20% of estimated unfished biomass for the limit reference point (Flim) and the fishing mortality corresponding to when the stock is at 48% of estimated unfished biomass for the target reference point (Ftarg), in line with the *Harvest Strategy Framework for the Commonwealth Southern and Eastern Scalefish and Shark Fishery* (AFMA 2017); and current fishing mortality estimates were assessed relative to past levels.

Stock Assessment Results

Biomass status in relation to limit	The stock simulation modelling in 2014, suggested that the exploitable biomass of Stout Whiting in the eastern Australian stock was slightly above the level for maximum sustainable yield, MSY (B_{2013}/B_{MSY} = 1.07) (O'Neill and Leigh 2014). This suggests the stock had recovered from earlier estimates of biomass depletion in 2002 and 2004 that were below the level for MSY (O'Neill et al. 2002; O'Neill et al. 2005). The assessment in 2014, estimated a MSY of 1,363 t for the Queensland T4 sector, but the economic proxy for profitable yield recommended a more conservative harvest of about 850 t. Standardised catch-rate analyses in the most recent Queensland assessment in 2020 suggest that after a substantial decline between 2010 and 2016, the catch rates for the Queensland part of the stock had increased above the long-term average in 2019 and 2020 (Wortmann 2020). Standardised catch rates from NSW data up to and including 2019 (this report), have also been above or near the long-term average over the last 3 years and suggest that the stock is unlikely to be recruitment impaired.
Fishing mortality in relation to limit	The Queensland catch-curve analyses in 2016 suggested that estimated survival rates had recently increased following particularly low survival rates between 1993 and 2003 (O'Neill and Leigh 2015). This suggests that recent fishing pressure was unlikely to cause the biomass of Stout Whiting to become recruitment impaired. Historical estimates of F relative to M derived using catch-curve analyses of NSW commercial catch samples (data from 2005–2007) suggested that F was more than twice that of M and

	exploitation rates were greater than 0.7 (Gray et al. 2017). However, the representativeness of the underlying sampling has been questioned. No recent estimates of F are available due to similar concerns about the representativeness of current port-monitoring sampling.
Previous SAFS stock status	Stout Whiting was assessed as a **sustainable stock** under the SAFS framework in 2016 and 2018 and for the NSW part of the stock in 2019.
Current stock status	The most recent assessments indicate that Stout Whiting CPUE indices in both Queensland and NSW waters have remained above or near the long-term averages and that the stock is not considered to be recruitment impaired. Recent catches have remained below RBC estimates, which indicates that the level of fishing mortality is unlikely to cause the stock to become recruitment impaired. On the basis of the above evidence, Stout Whiting is currently assessed by NSW DPI as a **sustainable stock**.

Qualifying Comments

- Although the Queensland stock assessments for Stout Whiting include only limited NSW data (catches and catch-rate data), the biological parameters selected for the models are appropriate for the NSW part of the stock.
- Therefore, outcomes from these assessments are considered relevant for determining stock status and informing TACC determination in NSW waters. The inclusion of greater NSW data in future assessments will help to improve their relevance over time.
- The Queensland stock assessments suggest that the exploitable biomass of Stout Whiting was previously depleted to near the limit reference level in the early 2000s following large commercial harvests during the 1990s, and that the stock has since recovered to a more sustainable level.
- The species has been subject to catch quota controls in Queensland fisheries since 1998, which has likely aided this recovery. Fisheries data from NSW also suggest that the input controls used to manage the commercial OTF proved effective at reducing effort levels and consequently fishing pressure on Stout Whiting between 1998 and 2016.
- The increased uncertainty in commercial catch data from northern NSW, caused by the overlapping species distribution with Eastern School Whiting and ongoing species misreporting, should be considered when interpreting the results of stock assessments.
- Temporal and spatial variation in discard rates of trawl whiting in NSW waters differ from those in other jurisdictions and are likely to change again in response to the quota introduction in NSW. These form another source of uncertainty in the NSW harvest data that are not adequately accounted for in past assessments.
- Regional variation in trends in NSW catch rates and catches of both species suggest that some finer-scale population dynamics in response to exploitation may be occurring.
- Potential influence of catch-reporting changes on commercial catch rates (especially during the transition from monthly to daily reporting around July 2009) limits the application of longer CPUE time series as an index of relative abundance in NSW waters.

- Ongoing misreporting of multi-day trips as single fishing events further compromise the accuracy of current NSW catch-rate data.
- Data assessed in this report date only as far back as 1941. Trawl fishing in NSW waters is known to have occurred since at least 1920. Before the export markets in SE Asia developed for these species, they were considered trash fish and possibly had high discard mortality even though they were not retained in large quantities until the 1970s. Any potential historical discard mortality has not been considered in this stock assessment.

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