Stock Status Summary 2021

NSW Stock Status Summary – Southern Calamari
(*Sepioteuthis australis*)

Assessment Authors and Year

Hall, K.C. 2020. NSW Stock Status Summary 2018/19 – Southern Calamari (*Sepioteuthis australis).* NSW Department of Primary Industries, Fisheries NSW, Coffs Harbour. 9 pp.

Stock Status

Current stock status	On the basis of the evidence contained within this assessment, Southern Calamari is currently assessed as **Sustainable** for the NSW component of the stock.

Stock Structure

The biological stock structure of Southern Calamari (*Sepioteuthis australis)* is complex and potentially changing across the wide southern Australian species' distribution. A molecular study using allozyme markers identified three genetic types with overlapping distributions and identified separate stocks off Western Australia, South Australia, New South Wales (NSW) and Tasmania (data were not available for Victoria) (Triantafillos and Adams 2001). In contrast, another study using microsatellite markers found little genetic differentiation between seven study sites across Western Australia, Victoria, Tasmania and South Australia (Smith et al. 2015). Tasmania was also identified as a possible important site for gene flow. Variation in life histories and studies of movement and statolith microchemistry in Tasmania suggest some localised biological stock structuring (Pecl et al. 2011).

In the absence of conclusive evidence on biological stock boundaries, assessment of stock status is presented at the jurisdictional level—Commonwealth, NSW, Victoria, Tasmania and South Australia.

The data presented in this summary relate to the NSW jurisdiction.

Stock Status – New South Wales

Catch Trends - Commercial Fisheries

Annual commercial catches of Southern Calamari in NSW state waters were consistently above 50 tonnes (t) per annum until the mid-2000s, with a peak of 145 t in 1997/98. Since 2006/07, commercial catches have been lower, at around 30–50 t per annum (Fig. 1). In 2018/19 the commercial catch of Southern Calamari from NSW waters was 30 t.

Most of commercial catch of Southern Calamari from NSW waters is taken as byproduct in the Ocean Trawl Fishery (OTF), particularly by the fish trawl sector off the central coast in ocean zones 5 and 6 (Figs 2 and 3).

Southern Calamari are also commercially harvested in larger quatities by targetted squid jigging and hauling in other southern Australian jurisdictions (Moore et al. 2018). Catches from NSW accounted for only 6.3% of the total Australian harvest of 658 t in 2017, with 466 t reported from South Australia, 123 t from Tasmania, 28 t from Victoria and a negligible amount (<1 t) from Commonwealth fisheries. Given the uncertain stock structure and unknown dispersal and adult

movement patterns it is not known what affect these large catches in southern jurisdictions might have on stocks in NSW waters at the northern end of the species' distribution.

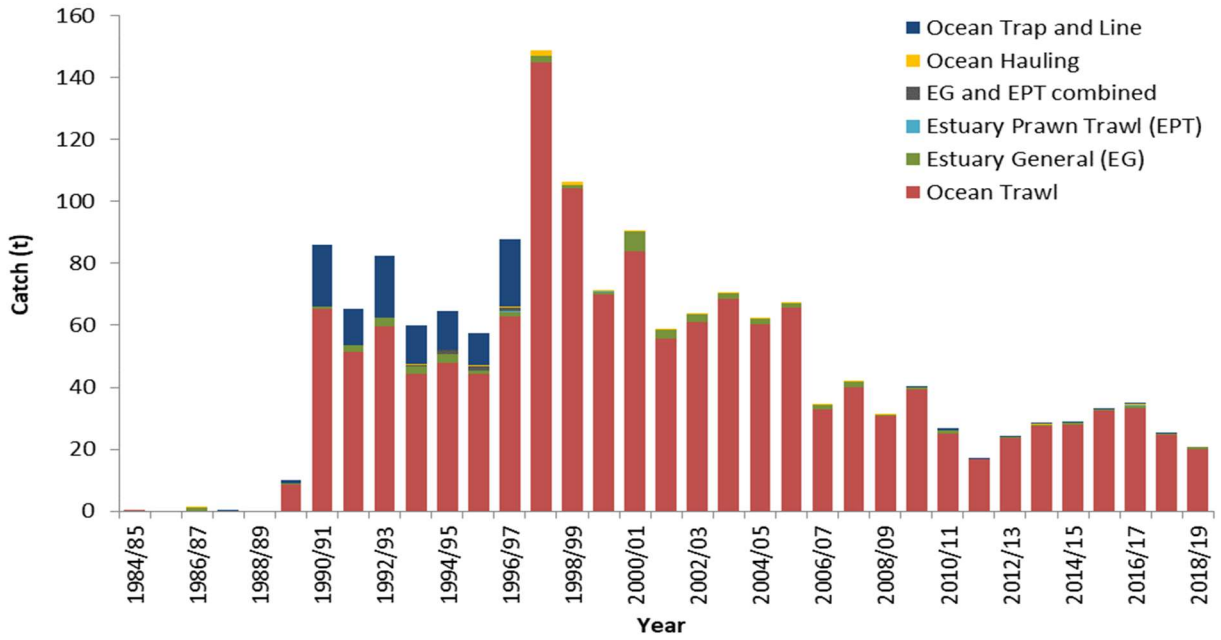

Figure 1. Annual commercial catches (tonnes) of Southern Calamari by fishery for NSW waters (1997/98–2018/19).

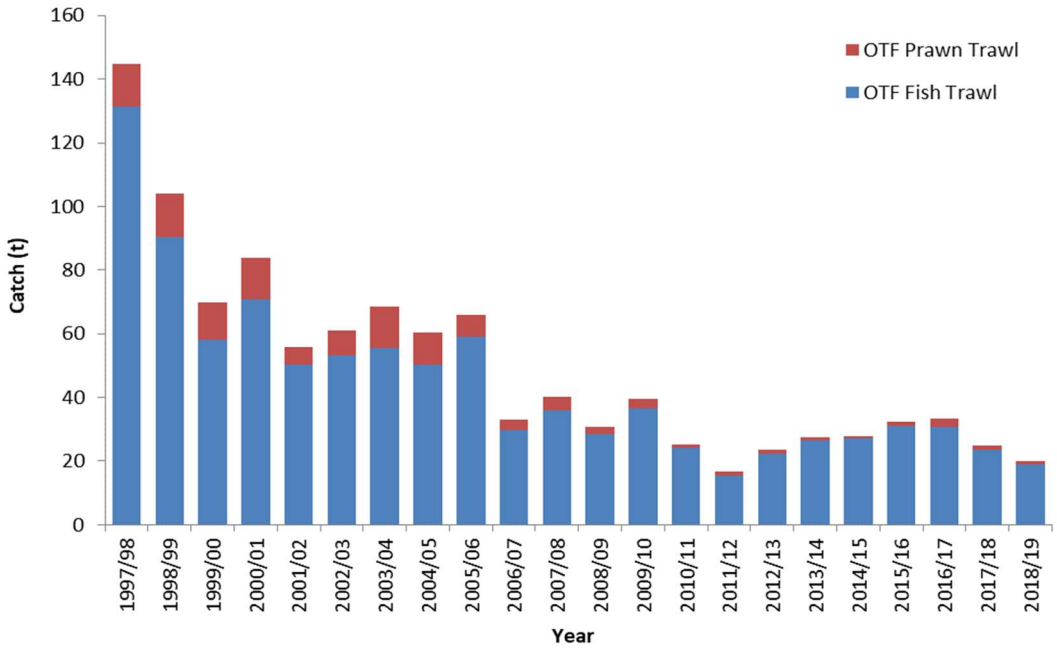

Figure 2. Annual commercial catches (tonnes) of Southern Calamari by the prawn trawl and fish trawl sectors of the NSW Ocean Trawl Fishery (1997/98–2018/19).

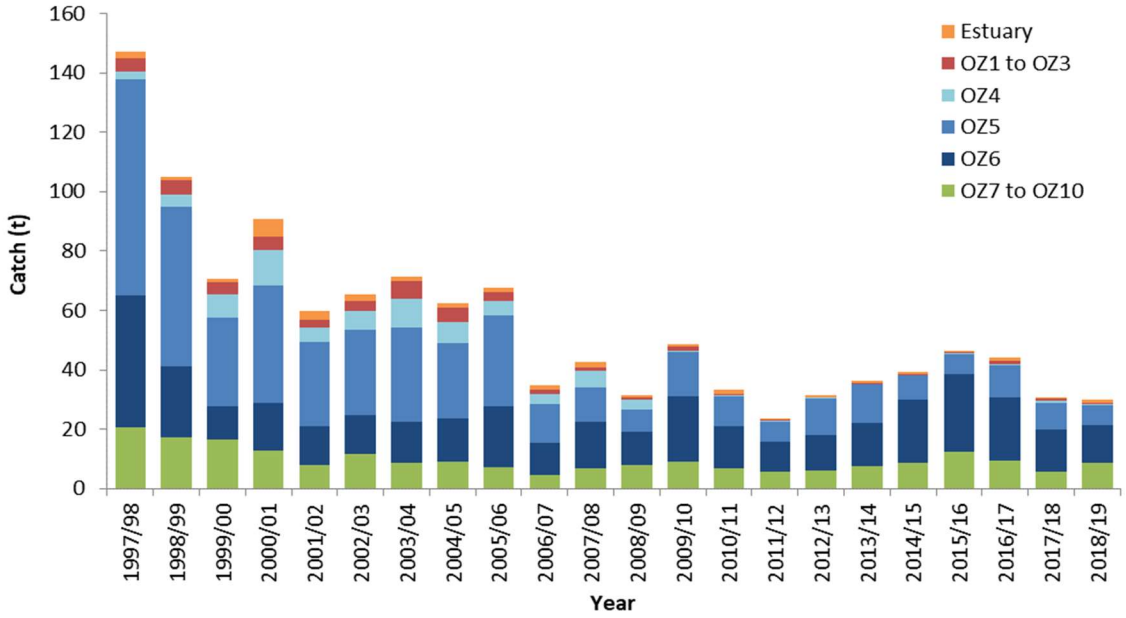

Figure 3. Annual commercial catches (tonnes) of Southern Calamari in different ocean zones and combined estuaries (1997/98–2018/19).

Catch Trends - Recreational and Indigenous

The most recent estimate of the recreational harvest of Southern Calamari in NSW was approximately 15,247 squid or around 8.5 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 14% smaller at around 13,087 squid (Murphy et al. 2020). Relative to the commercial catch, these recreational catches are small, comprising approximately 9.5% of the total harvest from NSW waters in 2013/14.

A survey of Aboriginal cultural fishing in the Tweed River catchment identified squid as a common component of the marine invertebrate catches (Schnierer and Egan 2016); however, statewide estimates of the annual Aboriginal harvest of Southern Calamari in New South Wales are unknown.

Recreational catches in other southern Australian jurisdictions tend to be larger than those from NSW, with 155 t reported from South Australia in 2013/14 and 65 t from Tasmania in 2012/13 (Moore et al. 2018).

Fishing Effort Trends - Commercial Fisheries

Commercial fishing effort for Southern Calamari 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 Southern Calamari 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.

The lower commercial landings since 2006/07 coincided with a concurrent decrease in effort in the prawn and fish trawl sectors of the OTF. In the prawn trawl sector, reported effort for Southern Calamari declined rapidly from 8,116 days fished in 1997/98 to 1,703 days fished in 2006/07. Since then effort has declined more gradually to an estimated 995 days fished in 2018/19 (Fig. 4). Therefore, most of the decline in effort occurred prior to the catch reporting change in 2009. In contrast, reported effort for Southern Calamari in the fish trawl sector has declined more gradually from 3,402 days fished in 1997/98 to 1,045 days fished in 2018/19 (Fig. 4).

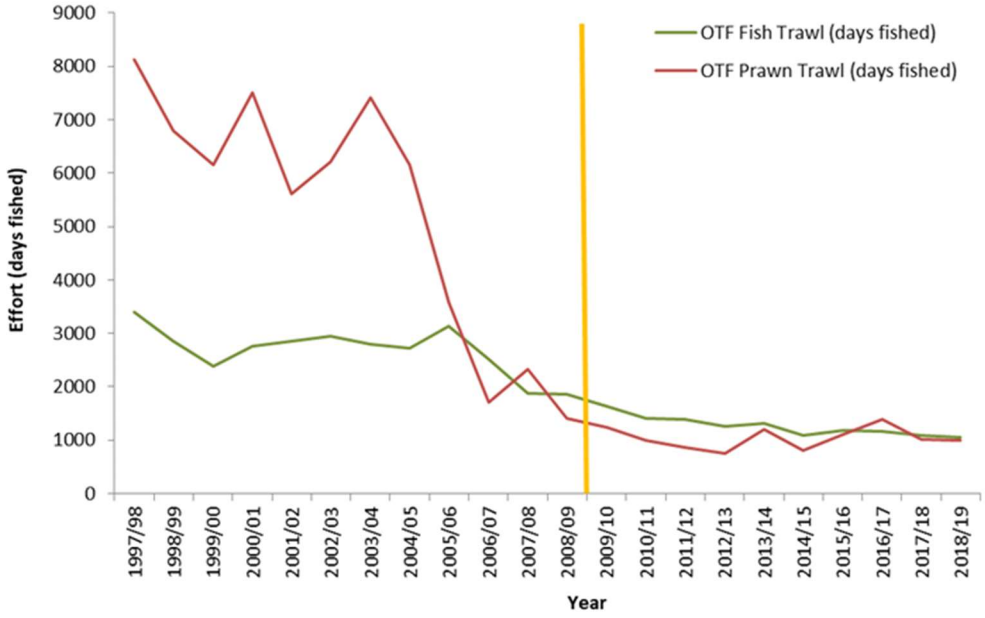

Figure 4. Annual adjusted effort (days and hours fished) for fish trawl and prawn trawl fishers of the NSW Ocean Trawl Fishery that reported landing Southern Calamari on at least one day in each month. The gold vertical line indicates the change from monthly to daily catch reporting.

Catch Rate Trends - Commercial Fisheries

Monthly catch rates (catch-per-unit-effort, CPUE in kg per day fished) for Southern Calamari taken by the fish trawl and prawn trawl sectors 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. 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 standardized catch rates of Southern Calamari have been consistently lower for the prawn trawl sector relative to the fish trawl sector (Figs 5 and 6). The two sectors operate in mostly different ocean zones, use different gears and vary in their targeted fishing practices, which would account for these differences. In particular, the prawn trawl sector fishes the northern extremity of the species distribution.

Standardised catch rates for the two sectors indicate differing historical trends, with mean monthly CPUE for the prawn trawl sector decreasing by over 80% in the early 1990s and fluctuating below the long-term average since (Fig. 5). As mentioned above, this sector fishes the northern

extremity of the species distribution, and any depletion due to fishing may have been exacerbated by possible southerly species range shifts in response to climate change.

Catch rates in the fish trawl sector show an opposing historical trend, with monthly CPUE increasing by over 80% in the early 1990s to a distinct peak of 57.4 kg per day in 1998, followed by a rapid decline by over 50% until 2002. Since then catch rates have been more stable above or near the long-term average of 26.6 kg per day (Fig. 6). Recent daily catch rates in kg per hours trawled also indicate a similar trend since 2010. The fish trawl sector accounts for most of the catch of Southern Calamari in NSW waters.

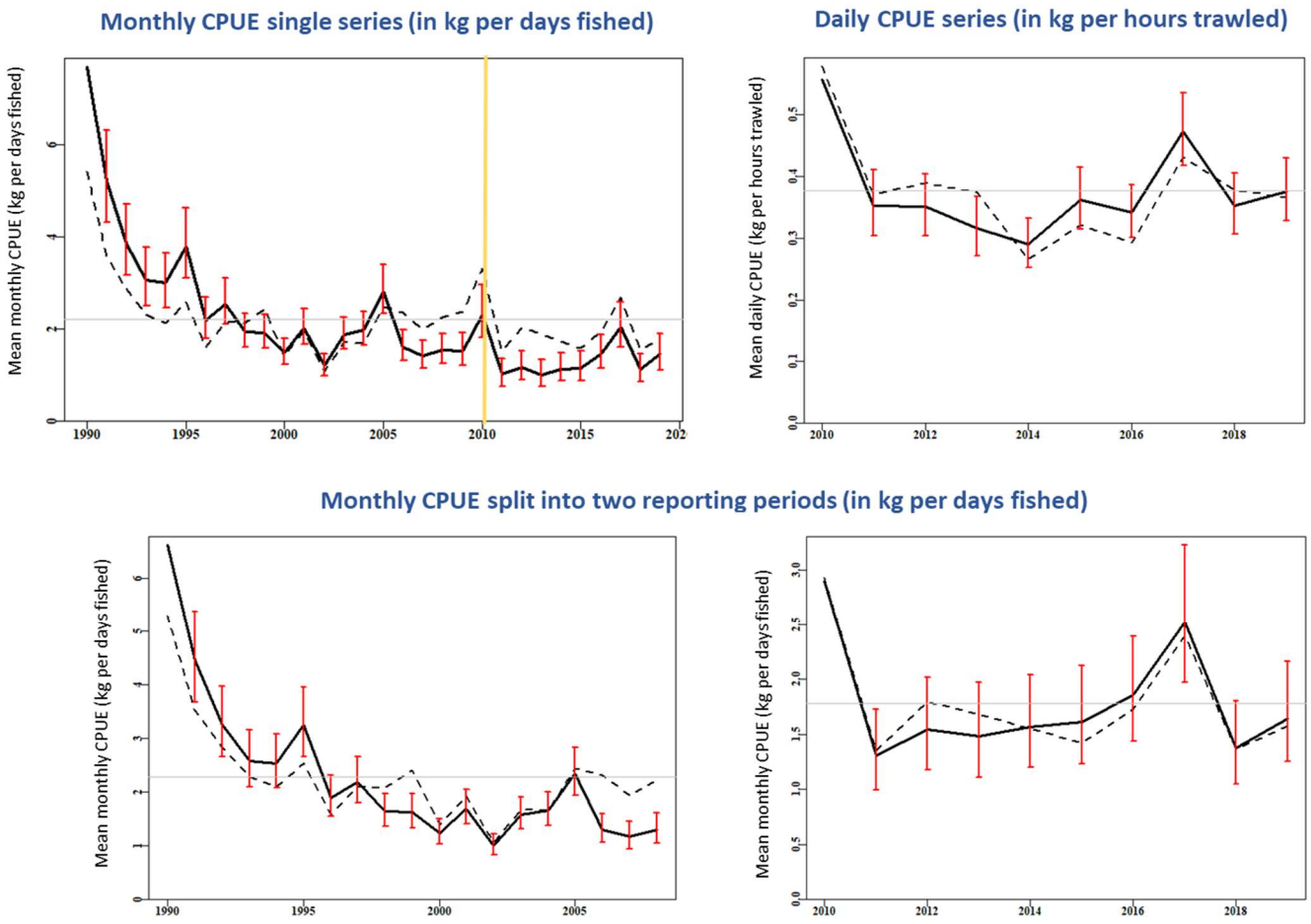

Figure 5. Mean standardised catch rates (catch-per-unit-effort, CPUE) of Southern Calamari for the prawn trawl sector in the NSW Ocean Trawl Fishery, estimated from monthly records (1990–2009) and re-aggregated daily records (2010–2019) in kg per days fished (top left and bottom) and from daily fishing event records in kg per hours trawled (top right). The dashed and solid lines indicate the nominal and standardised mean CPUE, 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.

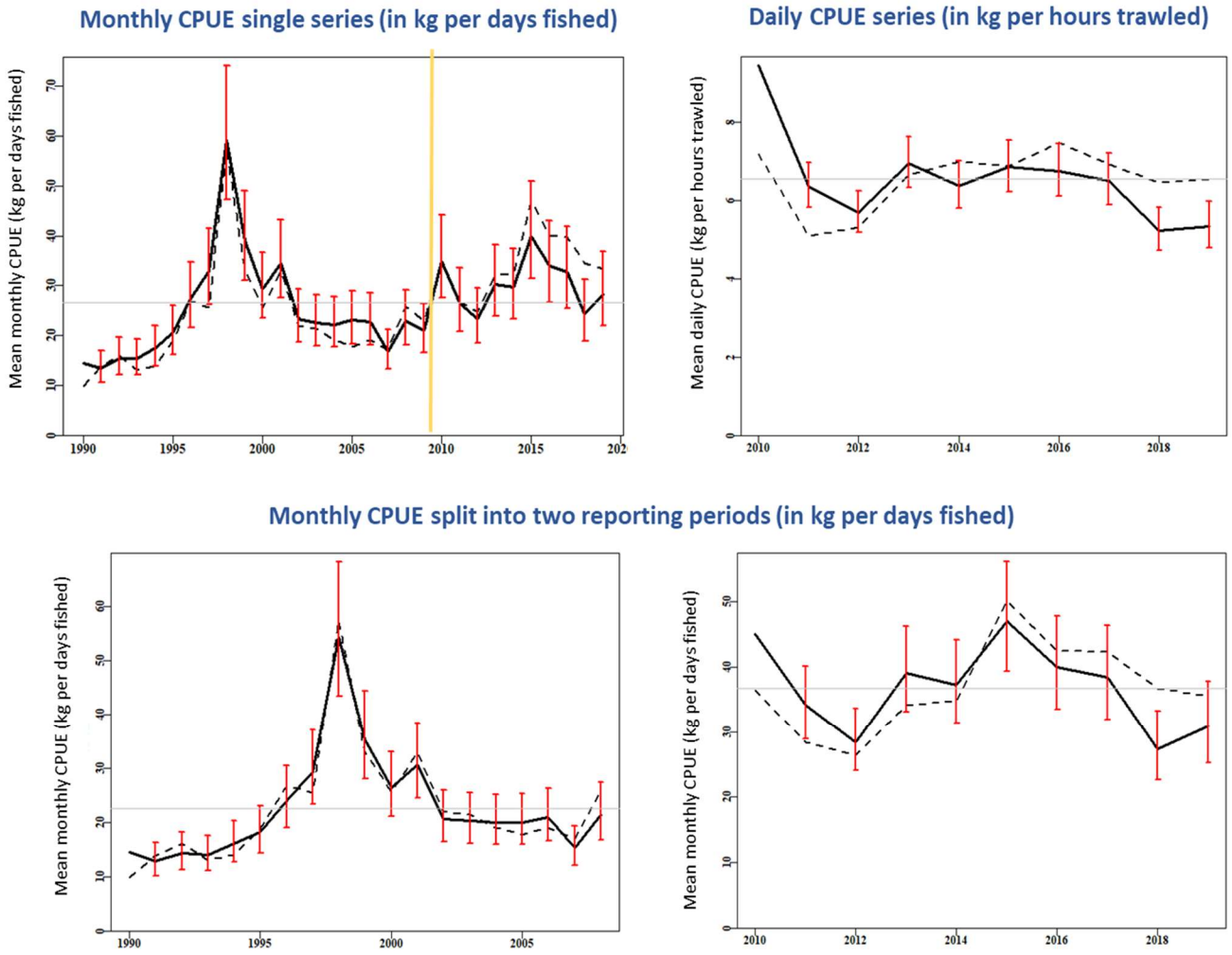

Figure 6. Mean standardised catch rates (catch-per-unit-effort, CPUE) of Southern Calamari for the fish trawl sector in the NSW Ocean Trawl Fishery, estimated from monthly records (1990–2009) and re-aggregated daily records (2010–2019) in kg per days fished (top left and bottom) and from daily fishing event records in kg per hours trawled (top right). The dashed and solid lines indicate the nominal and standardised mean CPUE, 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 No quantitative joint stock assessment of the entire biological stock is undertaken.
Assessment method	A weight-of-evidence approach was used for this stock status assessment of Southern Calamari in NSW waters. It relies on analyses of standardised catch rates for the two main fishing fleets of the OTF, fish trawl (otter trawl, excluding Danish seine) and prawn trawl (otter trawl), across all ocean zones.

Main data inputs	Commercial catch and effort data – for all NSW commercial fisheries by fiscal years (1984/85– 2018/19). Recreational catches – estimated annual catches from three periods – national recreational and indigenous fishing survey (2000/01) and NSW recreational fishing surveys (2013/14 and 2017/18). Commercial catch rates historical – reported annual CPUE data for the ocean prawn trawl and fish trawl sectors of the OTF by calendar years in kg per days fished (1990–2019) from monthly records – standardised. Commercial catch rates recent – reported annual CPUE data for the ocean prawn trawl and fish trawl sectors of the OTF by calendar years in kg per hours trawled (2010–2019) from daily records – standardised.
Key model structure and assumptions	The CPUE standardisations and analyses assume that the annual catch rates are a relative index of abundance and are not unduly influenced by other factors that are not accounted for through standardisation. Catch rates were standardised for the influences of different months, ocean zones, vessels and capture depths (daily records only). Using fishing effort as an indicator of relative fishing pressure assumes that fish catchability and fishing power have not changed significantly over the monitoring period.
Sources of uncertainty evaluated	Changes in fishing effort distribution following catch reporting changes from monthly to daily event reporting in July 2009.

Status Indicators and Limit Reference Levels

Biomass indicator or proxy	None specified in a formal harvest strategy. In the interim, for the purposes of this assessment the trend in commercial catch rates of the ocean prawn trawl and fish trawl sectors of the OTF were selected as indices of relative abundance.
Biomass Limit Reference Level	None specified in a formal harvest strategy. In the interim, for the purposes of this stock assessment current catch rates were assessed relative to long-term averages of each time series.
Fishing mortality indicator or proxy	None specified in a formal harvest strategy. In the interim, for the purposes of this assessment the trend in annual total commercial fishing effort for the prawn trawl and fish trawl sectors of the OTF were selected as indicators of relative fishing pressure.

Fishing mortality Limit Reference Level	None specified in a formal harvest strategy. In the interim, for the purposes of this stock assessment current fishing effort levels were compared against historic levels.

Stock Assessment Results

Biomass status in relation to limit	Current standardised catch rates for the fish trawl sector have been near or above the long-term averages. Historical trends in catch rates between the fish trawl and prawn trawl sectors show opposing trends that could relate to a shift in the species distribution further south in response to climate change. The longer-term catch rates must be interpreted with caution due to the potential influence of catch reporting changes in July 2009. Aside from some possible localised depletion in northern New South Wales, the weight of evidence indicates that the biomass is unlikely to be depleted and that recruitment is unlikely to be impaired.
Fishing mortality in relation to limit	Fishing effort in both the prawn trawl and fish trawl sectors of the OTF have decreased substantially relative to historical levels in the late 1990s. The weight of evidence indicates that the current level of fishing pressure is unlikely to cause the stock to become recruitment overfished.
Previous SAFS stock status	Southern Calamari was previously assessed as a **sustainable stock** under the SAFS framework in 2018 (Moore et al. 2018).
Current stock status	On the basis of the evidence above, which includes stable trends in standardised catch rates over the last 9 years and current low levels of fishing effort, Southern Calamari is currently assessed as a **sustainable stock.**

Qualifying Comments

- Overall, the data collated in this stock assessment suggest that the input controls used to manage effort in the commercial OTF have proved effective at reducing effort levels between 1997/98 and 2018/19 and consequently fishing pressure on Southern Calamari.
- Recent stable trends in catch rates of the fish trawl sector suggest that current harvest rates are sustainable. However, some possible localised depletion of the stock in northern ocean zones needs to be monitored, as status assessments in other jurisdictions indicate that this species can be subject to localised depletions (Moore et al. 2018).
- The potential influence of catch reporting changes on commercial catch rates (especially during the transition from monthly to daily reporting around July 2009) limits their application as an index of relative abundance.

- Ongoing misreporting of multi-day trips as single fishing events further compromise the accuracy of current catch-rate data.
- Data assessed in this report date only as far back as 1990/91. Trawl fishing in NSW waters is known to have occurred since at least 1920. Even if Southern Calamari were not retained from trawling before 1990/91, they are still likely to have been caught by trawl gears as by-catch. Any potential historical discard or targeted mortality prior to 1990/91 has not been considered in this stock assessment.

References

Haddon, M. 2018. cede: functions for fishery data exploration and CPUE Standardization. R package version 0.0.4.

Moore, B., C. Green, J. Lyle, K. Hall, M. Steer, and R. Noriega. 2018. Southern Calamari *Sepioteuthis australis*. C. Stewardson, and coeditors, editors. Status of Australian Fish Stocks Reports 2018. Fisheries Research and Development Corporation, Canberra, ACT.

Murphy, J. J., F. A. Ochwada-Doyle, L. D. West, K. E. Stark, and J. M. Hughes. 2020. The NSW Recreational Fisheries Monitoring Program - survey of recreational fishing, 2017/18. Fisheries Final Report Series No. 158. NSW Department of Primary Industries, NSW.

Pecl, G. T., S. R. Tracey, L. Danyushevsky, S. Wotherspoon, N. A. Moltschaniwskyj, and B. Gillanders. 2011. Elemental fingerprints of southern calamary (*Sepioteuthis australis*) reveal local recruitment sources and allow assessment of the importance of closed areas. Canadian Journal of Fisheries and Aquatic Sciences 68:1351-1360.

Schnierer, S., and H. Egan. 2016. Composition of the Aboriginal harvest of fisheries resources in coastal New South Wales, Australia. Reviews in Fish Biology and Fisheries 26:693-709.

Smith, T. M., C. P. Green, and C. D. Sherman. 2015. Patterns of connectivity and population structure of the southern calamary *Sepioteuthis australis* in southern Australia. Marine and Freshwater Research 66:942-947.

Triantafillos, L., and M. Adams. 2001. Allozyme analysis reveals a complex population structure in the southern calamary *Sepioteuthis australis* from Australia and New Zealand. Marine Ecology Progress Series 212:193-209.