

## Assessment Authors and Year

Johnson, D.D. 2023. NSW Stock Status Summary 2022/23 – Spanner Crab (*Ranina ranina*). NSW Department of Primary Industries, Fisheries. 9 pp.

## Stock Status

Current stock status	On the basis of the evidence contained within this assessment, Spanner Crab are currently assessed as <b>sustainable</b>
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## Stock structure & distribution

DNA analysis indicates that Spanner Crabs on the east coast of Australia comprise a single biological stock (Brown et al. 1999). The East Coast Spanner Crab stock is shared between Queensland (Qld) and New South Wales (NSW); with Qld accounting for the largest harvest (~85 per cent based on 2019 reported harvest). This stock assessment report provides a determination of stock status of the NSW component of the East Coast Spanner Crab biological stock. To understand connectivity and patterns of larval supply in eastern Australia, Lagrangian particle tracking methods were used to simulate larval transport around the key Spanner Crab fishing regions in Qld and NSW (Schilling et al. 2022). Correlations between catch-per-unit-effort and the proportion of total harvest taken within the NSW fishery and predicted lagged larval settlement combined with the limited predicted survival of larvae spawned in NSW suggest that the NSW fishery is heavily subsidised by the Qld spawning stock (Schilling et al. 2022).

## Biology

The occurrence of ovigerous females in a large-scale, stratified, randomized survey of exploited populations of Spanner Crabs off the east coast of Australia identified their reproductive period to be around December each year (Kennelly 1992, Kennelly & Scandol 2002). Estimates of Spanner Crab growth parameters from previous studies are inconsistent, absolute age-length relationships and age at recruitment are still poorly understood (Brown et al. 2008).

## FISHERY STATISTICS

### Catch information

#### Commercial

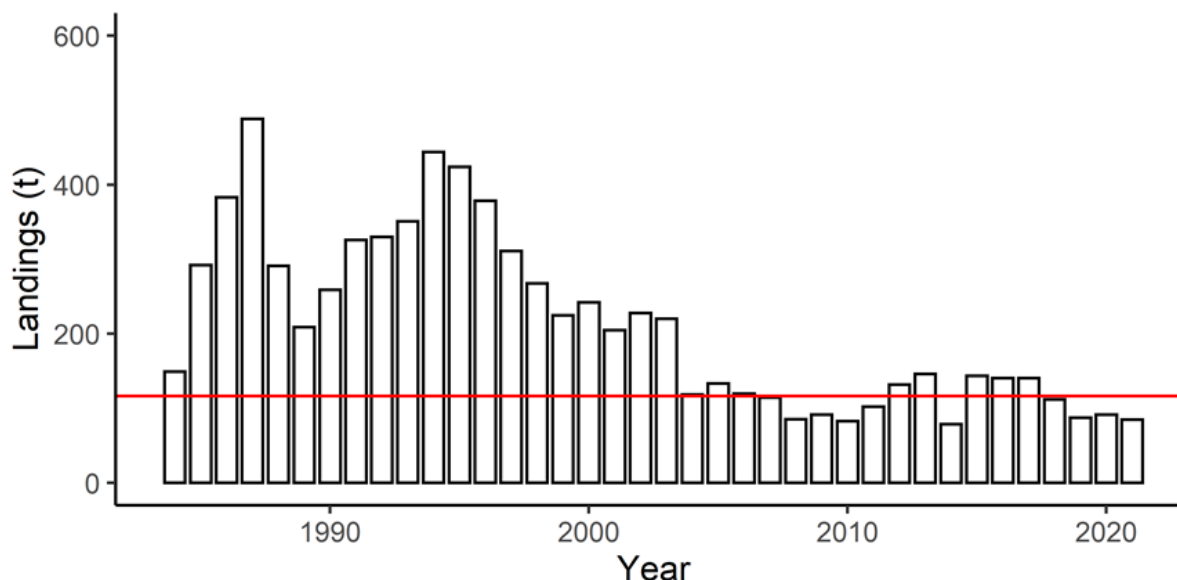
Total annual reported commercial catches of Spanner Crabs rapidly increased from 150 t to 487 t between 1984/85 – 1987/88, and then ranged between 209 t and 444 t from 1989/90 to 1994/95. From 1995/96 (423.6 t) to 1999/2000 (224.5 t) catches consistently declined (Fig. 1). Catches exceeded 200 t from 2000/02 to 2003/04 and then declined to lowest annual reported landings of 79 t in 2014/15. Total reported commercial landings of Spanner Crab constrained by a TAC of 169 t in 2018/19 and 2019/20 were 111.7 t and 87.9 t, respectively (Fig. 1). Reported landings for 2020/21 and 2021/22 were 93.2 t (quota usage 98.6 t) and 84.9 t (quota usage 95.5 t), respectively (TAC 135 t).

# Stock Status Summary – 2022/23



## NSW Stock Status Summary – Spanner Crab (*Ranina ranina*)

**Figure 1.** Annual reported commercial catch (t) from 1984/85 – 2021/22. Red line represents 10-year average catch (2011/12 – 2021/22).



### Recreational & Charter boat

Recreational catches in NSW are unknown. The most recent recreational survey completed in New South Wales did not report the capture of any Spanner Crabs (Murphy et al. 2020). However, the survey methodology is potentially too broad to pick up species, such as Spanner Crabs, which tend to be caught by 'niche' fisheries.

### Aboriginal cultural fishery

Aboriginal cultural catches are unknown.

### Illegal, Unregulated and Unreported

The level of Illegal Unregulated and Unreported (IUU) fishing is unknown.

### **Fishing effort information**

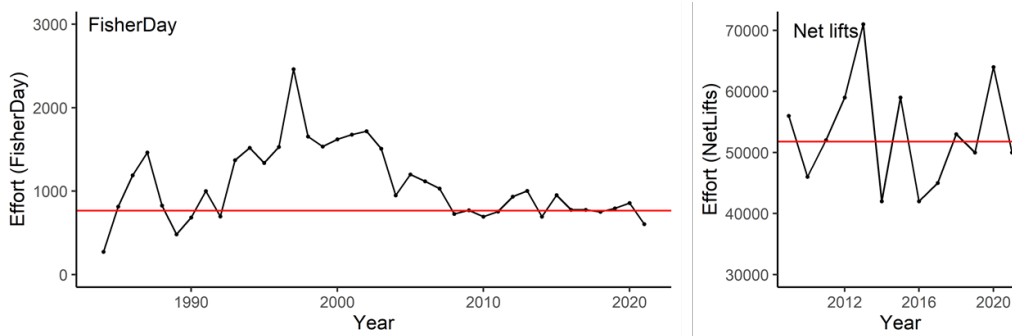
Reported effort (days) increased from less than 300 days in 1984/85 to a historical peak of 2,462 days in 1997/98 then declined to less than 700 days in 2014/15 (Fig. 2). In response to revised management arrangements in the fishery, effort decreased from 892 days in 2015/16 to 673 and 654 days in 2018/19 and 2019/20, respectively. Following the introduction of daily reporting (2009/10) fishers have been required to report number of net-lifts per fishing day. From a minimum of 46,400 net-lifts in 2010/11, effort increased to 70,900 net-lifts in 2013/14 and was 49,900 net-lifts in 2019/20 (Fig. 2). In 2020/21, reported days effort (787) and net-lifts (66,120) were approximately 17% and 33% greater than 2019/20. In 2021/22, reported days effort (606) and net lifts (49,994) declined and were approximately 25% lower than 2021/22.

# Stock Status Summary – 2022/23



## NSW Stock Status Summary – Spanner Crab (*Ranina ranina*)

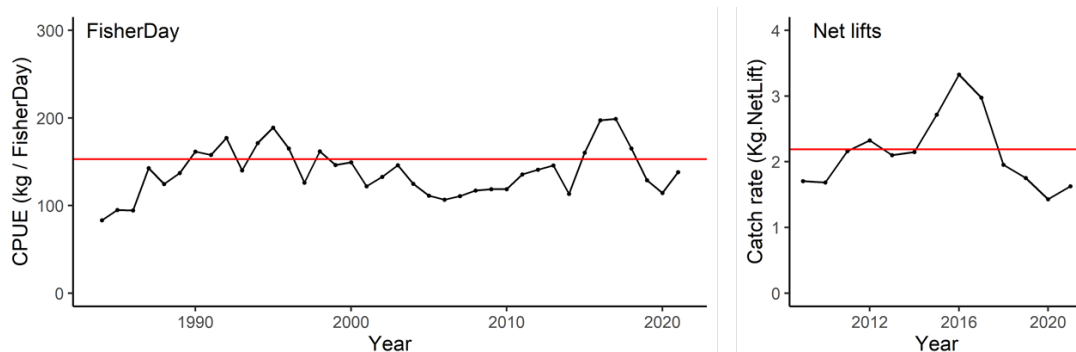
**Figure 2.** Annual reported commercial effort in units of FisherDays (1984/85 – 2020/21) and net lifts (2009/10 – 2020/21). Red line represents 10-year average (2011/12 – 2020/21).



### Catch rate information

Standardised catch rates (Stock assessment section) are the most reliable index of relative abundance for Spanner Crabs. Nominal catch rates are presented to allow comparisons between the initial period of commercial exploitation in NSW and current catch rates. Nominal catch rates (CPUE; catch/ effort) of Spanner Crabs were greater than long-term averages from 2016/17 to 2018/19 (Fig. 3). CPUE increased from less than 100 kg.FisherDay<sup>-1</sup> (1984/85 - 1986/87) to a maximum of 205 kg.FisherDay<sup>-1</sup> in 2016/17 (Fig. 3). From a minimum of 1.7 kg.net-lift (kg.NL<sup>-1</sup>), CPUE increased to 2.7 kg.NL<sup>-1</sup> in 2015/16 and was at a historical peak of 3.3 kg.NL<sup>-1</sup> in 2016/17 (Fig. 3). In 2020/21, CPUE<sub>dy</sub> (114.3 kg) and net lift (1.41 kg) were approximately 10% and 20% lower than CPUE<sub>dy</sub> (128.8 kg) and CPUE<sub>nl</sub> (1.81 kg) in 2019/20. However, in 2021/22 both CPUE<sub>dy</sub> (138.19 kg) and CPUE<sub>nl</sub> (1.63 kg) were greater than 2020/21.

**Figure 3.** Annual reported catch rate in units of FisherDay (1984/85 – 2021/22) and net-lift (2009/10 – 2021/22). Red line represents 10-year average (2011/12 – 2021/22).



## STOCK ASSESSMENT

### Stock Assessment Methodology

Year of most recent assessment:

2023

Assessment method:

A weight-of-evidence approach was used for the most recent stock assessment of Spanner Crab in NSW waters. It incorporated the results from two different analyses; i) standardised catch rates from the commercial fishery; ii) nominal catch rates of total, legal and undersize Spanner Crabs from annual NSW fishery-independent surveys (2005-2022) in number of crabs per groundline. and iii) standardised catch rates of legal-sized and undersize Spanner Crabs from annual NSW fishery-independent surveys (2005-2022).

### Main data inputs:

The following raw data inputs were used in analyses:

- Reported commercial catch (kg) and effort (days) derived from fisher-reported monthly records (1984/85 – 2021/22);
- Commercial catch (kg) and effort (net-lifts) derived from fisher-reported daily records (2009/10 – 2021/22);
- Catch-rate (Number of crabs per groundline) from fishery-independent surveys (2005 – 2022) in NSW.

### Key model structure & assumptions:

#### Standardised catch rates from the commercial fishery (sCPUE);

Spanner Crab standardised catch rates were predicted from generalised linear models (GLM). The GLM statistical modelling provided an estimate of mean catch rates that were corrected for a variety of variables that bias raw data. The importance of individual model terms was assessed formally using F statistics by dropping individual terms from the full model. Explanatory model terms considered different catch rates between fishing years, seasons, individual fisher operations, their transformed fishing effort (the number of net-lifts, which was a function of the number of ground-lines used, nets per ground-line and ground-line lifts per day; log or cube root scale), the spatial locations of catches based on 6 x 6 min latitude and longitude grids (O'Neill 2018).

Commercial catch rates were predicted from the model 'year' term using R procedures for prediction (R Development Core Team 2017), which provided the annual abundance estimates standardised to the mean number of net-lifts per fisher-day.

#### Standardised catch rates from fishery-independent surveys (FIS);

NSW standardised catch rates of legal-sized crabs were predicted from generalised linear models. The survey GLM response variable consisted of the number of legal-sized crabs per ground-line . Explanatory model terms included the interaction between calendar years plus the log of the number of net hours (i.e., soak time) per ground-line (see O'Neill et al., 2022 for full description).

### Sources of uncertainty evaluated:

Known or likely uncertainties in the key indicators were taken into consideration in ranking of the quality of key indicators, and in reaching a conclusion regarding stock status.

## Status Indicators - Limit & Target Reference Levels

Biomass indicator or proxy	<p>NA – no biomass limits has been set. This assessment used a weight-of-evidence approach, with data including:</p> <ul style="list-style-type: none"> <li>• Standardised catch rates from the commercial fishery in kg per day and net lift</li> </ul>
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	<ul style="list-style-type: none"> <li>Nominal catch rates of total, legal and under-size Spanner Crabs from FIS in number of crabs per groundline.</li> <li>Standardised catch rates of legal Spanner Crabs from annual FIS.</li> </ul>
Biomass Limit Reference Point	None specified in a formal harvest strategy.
Biomass Target Reference Point	None specified in a formal harvest strategy.
Fishing mortality indicator or proxy	None specified in a formal harvest strategy. This assessment used a weight-of-evidence approach, with data including: <ul style="list-style-type: none"> <li>Catch (state-wide)</li> </ul>
Fishing mortality Limit Reference Point	None specified in a formal harvest strategy.
Fishing Mortality Target Reference Point	None specified in a formal harvest strategy.

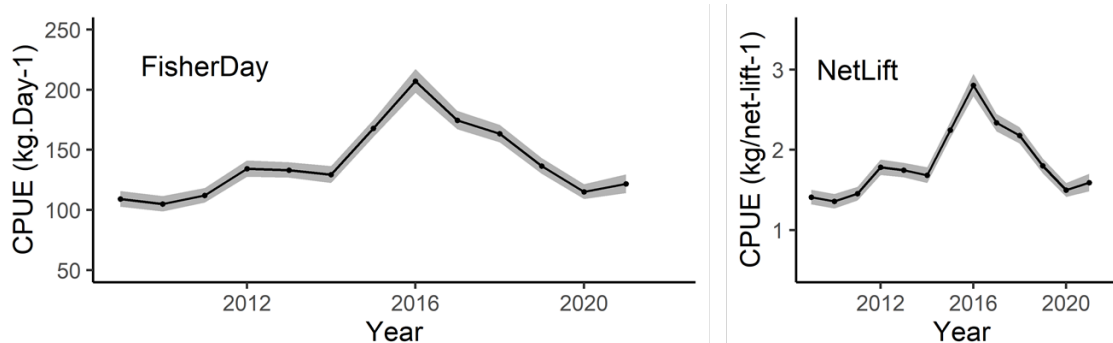
## Stock Assessment Results

The NSW stock of Spanner Crab is classified as **sustainable**.

### Standardised commercial catch rates (sCPUE)

When compared to the historical peak of sCPUE in 2016/17 (205.8 kg.FisherDay<sup>-1</sup>), sCPUE in 2018/19 (163.4 kg.FisherDay<sup>-1</sup>) and 2020/21 (115.2 kg.FisherDay<sup>-1</sup>) declined by ~20 and ~40%, respectively (Fig. 4). Similarly, standardised catch rate per net lift (kg.NL<sup>-1</sup>) reached a peak of 2.80 kg.NL<sup>-1</sup> in 2016/17, after which it declined to 1.800 kg.NL<sup>-1</sup> and 1.499 kg.NL<sup>-1</sup> in 2019/20 and 2020/21, respectively (Fig. 4). In 2021/22 standardised catch per net lift increased to 1.590 kg.NL<sup>-1</sup>. The observed decline in standardised catch rates indicates a decline in crab abundance over the last five years. The decline in abundance is further reflected by an increase in the mean number of net-lifts reported per fisher-day for a period with declining landings. From the historical peak of sCPUE (2016/17), the mean number of net-lifts reported per fisher day has increased from ~60 to >80 in 2020/21.

**Figure 4.** Standardised commercial catch rate in kg.FisherDay<sup>-1</sup> + net lifts (left) and kg.NetLift<sup>-1</sup> (right). Grey shading represents 95% confidence limits.

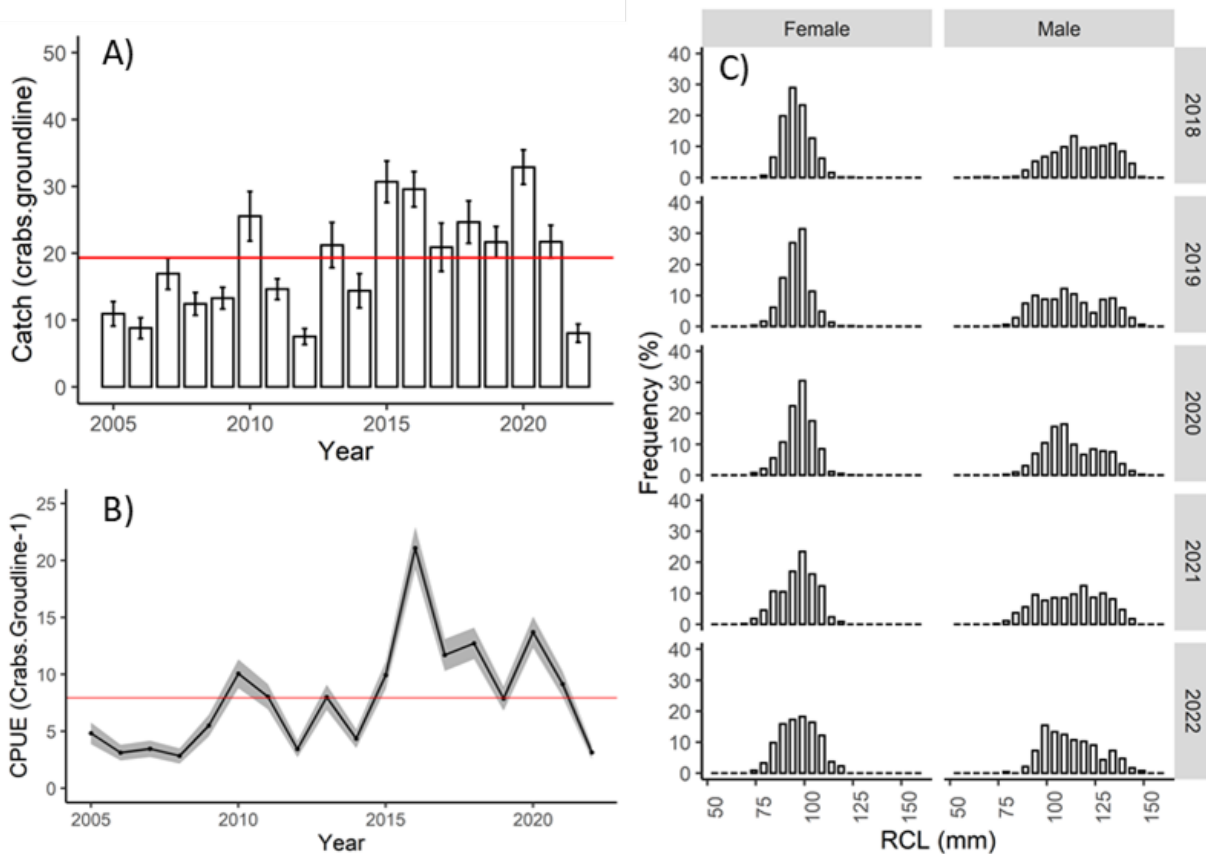


### NSW fishery-independent survey (FIS)

During the 2022 FIS, catch rates of total (legal + undersize) Spanner Crabs from the four NSW survey sites combined (8.1 crabs.Groundline<sup>-1</sup>) were below long-term average catch rates of 18.6 crabs.Groundline<sup>-1</sup> (Fig. 5A). Catch rates of legal-sized crabs reached a peak in 2016 (22.2 crabs.Groundline) after which they declined and fluctuated around the mean from 2017 to 2021 (Fig. 5B). Standardised catch rates of legal-sized crabs during the most recent survey (2022) were below long-term averages.

Fishery-independent survey results in both NSW and Qld indicate that male Spanner Crabs are generally larger than females with a high proportion of crabs above minimum legal size (MLS) being males (Fig. 5C). The proportion of female crabs protected by the legal-size limit (93 mm orbital carapace length = 100 mm rostral carapace length) in NSW ranged between 70 and 85% in 2016 and 2019, respectively. The NSW FIS reported increased catches of small male crabs (<MLS) in 2014 and 2015 prior to the historical peak in catches rates of legal-sized crabs from the NSW FIS and fishery in 2016/17. However, during the 2022 survey only small numbers of undersized male crabs were recorded in NSW FIS catches (Fig. 5C).

**Figure 5.** A) Mean FIS catch rates (number.Groundline<sup>-1</sup> ± SE) of total crabs, red line is the average mean of catch rate (2005 – 2022), B) Standardised catch rate of legal crabs and 95% confidence limits (grey shading); and C) length-frequency distribution of female and male Spanner Crabs (2018 - 2022). Carapace-length refers to distance between centre spine and mid carapace base (Rostral carapace length – RCL, applied in Qld).





## Stock Assessment Result Summary

Biomass status in relation to Limit	NA – no biomass limits has been set. Weight-of-evidence provided is sufficient to support an understanding that the biomass of Spanner Crabs is at a level sufficient to ensure that on average, future levels of recruitment are adequate.
Biomass status in relation to Target	NA – no biomass target has been set.
Fishing mortality in relation to Limit	NA – no fishing mortality limit has been set. Weight-of-evidence provided is sufficient to support an understanding that fishing mortality is at a level to avoid the stock being recruitment impaired.
Fishing mortality in relation to Target	NA – no fishing mortality target has been set.
Current SAFS stock status	Sustainable (Roelofs et al. 2021)
Current Queensland stock status	Sustainable

## Fishery interactions

Injury and fatality to vertebrate marine life caused by entanglement is listed nationally as a Key Threatening Process under the Environment Protection and Biodiversity Conservation Act 1999. There has been a small number of reported interactions between Spanner Crab fishing gear and Humpback Whales (OceanWatch 2019). Due to the selective nature of fishing gear used in the fishery, bycatch and discarding of non-target species is minimal.

## Qualifying Comments

Larval settlement and survival patterns presented in Schilling et al. 2022 suggests that the East Coast biological stock is highly likely to be supported by larvae spawned within the northern half of the available fishing area. Correlations between CPUE (sCPUE and FIS) and the proportion of total harvest taken within the NSW fishery and predicted lagged larval settlement combined with the limited predicted survival of larvae spawned in NSW suggest that the NSW fishery is heavily subsidised by the Qld spawning stock (Schilling et al. 2022). Status of the Qld Spanner Crab stock is assessed relative to limit and target reference points prescribed in the harvest strategy/management procedure (Campbell et al. 2016, QDAF 2020). The management procedure followed a process of a baseline quota and performance targets for standardised catch rates with range intervals. The stock performance indicators are the average fishery and survey standardised catch rates in the most recent two completed calendar years. In 2017, it was identified that the base quota of 1, 631 tonnes was not effectively constraining harvest and decisions rules were not adjusting the TAC in response to declining indicators. In response, Queensland Department of Agriculture and Fisheries (QDAF) declared a TAC of 847 tonnes for the 2018/19 fishing season

(90% of the reported 2017 harvest of 941 tonnes). The purpose of the reduced TAC was to restrict total fishing mortality and increase protection on the spawning stock. In 2020, the Qld fishery was assessed against a revised harvest strategy (QDAF 2020) relative to target reference points of 1.33 kg.NL<sup>-1</sup> (CPUE<sub>targ</sub> 95% of the 2006 - 2010 average) and 10.490 legal-sized crabs per groundline (FIS<sub>targ</sub> 95% of the 2006 - 2010 average). The performance indices were below target in 2021 with the average of the commercial (0.600) and survey indices (0.631) less than 1 (0.616). Despite the pooled index being less than 1 and below the previous year's index (0.636), the calculated TACC decrease based on the proportional change between indexes in 2020 and 2021 (~3.3%, 28 t) was within the minimum change buffer (50 t) specified with the harvest strategy resulting in no change to the TACC for 2022. No catch, effort or catch-rate series from NSW were included in the 2021 Qld assessment.

The following conclusions can be drawn on the status of the NSW Spanner Crab fishery and biological stock supporting recruitment in NSW;

- Given the small proportion of total landings taken in NSW (<15% with revised Qld TAC of 847 t), it is unlikely that fishing of this part of the stock is having a detrimental effect on the entire East Coast stock.
- For the period 2019/20 to 2021/22 standardised commercial catches rates from the NSW fishery indicate a decline in Spanner Crab abundance to the lowest levels since 2012/13. Similarly, standardised catch rates of legal-sized crabs and undersize crabs from NSW FIS in 2022 were below average.
- Standardised catch rates from the Qld commercial fishery and FIS have been below the target reference points in the Qld harvest strategy from 2018 -2021 (O'Neill et al., 2022).

Being able to estimate the total fishing mortality is fundamental to understanding the dynamics of the Spanner Crab population, estimating and setting appropriate annual catch limits and managing the fishery sustainably. Previous studies investigating mortality of undersize, discarded Spanner Crabs reported significant rates of mortality due to disentanglement: 60 - 70% of crabs with one or more dactyli removed died within 50 days, whilst 100% of crabs which lost whole limbs (after being pulled off nets) died after eight days (Kennelly et al. 1990). To evaluate the effects that mortality due to disentanglement may have on the Spanner Crab population, it may be necessary to quantify rates of discarding and estimate annual fishery-wide discard rates. Management actions to remove or reduce mortalities may provide the opportunity to increase fishery production.

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