Stock Status Summary 2021

NSW Stock Status Summary – Estuary Cockle (*Anadara trapezia*)

Assessment Authors and Year

Chick, R.C. 2021. NSW Stock Status Summary 2020/21 – Estuary General Fishery (Hand Gathering) – Estuary Cockle (*Anadara trapezia*). NSW Department of Primary Industries. Fisheries NSW, Port Stephens Fisheries Institute. 13 pp.

Stock Status

Current stock status	On the basis of the evidence contained within this assessment, Estuary Cockle is currently assessed as **Undefined** for the NSW component of the stock.

Biology and stock structure

A review of the common name for this species, by the Australian Fish Names Committee (an accredited Australian Standards Development Organisation) has implemented a change in the agreed common name to 'Sydney Cockle' (as at 6 May 2020). Until this new common name is incorporated it into systems within the reporting frameworks and reference material relating to *A. trapezia*, for commercial and recreational fishers in NSW the name 'Estuary Cockle' will be used for *A. trapezia* in this report.

Cockles are dioecious, broadcast spawning, bivalve molluscs that form a large component of the macroinvertebrate infauna assemblage in large parts of low-energy estuarine environments throughout the Australian east coast, from Cairns in northern Queensland to the south-eastern regions of Victoria (Dixon 1975, cited in Yardin 1997), and form a small population near Albany in Western Australia (Kendrick and Wilson 1959, cited in Yardin 1997; Yardin and Richardson 1996).

Cockles are sedentary as adults, typically spawning in late summer, coinciding with increases in water temperature and food availability (Hadfield and Anderson 1988). Larvae develop in the plankton for up to six weeks, with likely active dispersal (larval behaviour affecting dispersal; Yardin 1997). Cockles are more abundant in unvegetated (bare) habitat than in sediment inhabited by seagrass (Wright et al. 2007). Recruitment of Cockles is positively influenced by the presence of conspecific adults, with recruits showing a preference to settle on adult conspecifics than on alternate substrates provided by locally occurring vegetation (seagrass). However, recruit survival in vegetated habitat is greater than on adults in bare habitat, likely because the vegetation provides a refuge from predation (Gribben and Wright 2006).

Yardin (1997) studied genetic variation in the Estuary Cockle (*A. trapezia*) and sampled from populations across macro (1000 km), intermediate (within estuaries) and micro (within patches - 50 m to 6 km – within estuaries) scales within NSW and Victoria, from Tweed River estuary, Wallis Lake, Hawksbury River, Burrill Lake and Corinella (Western Port Bay, Victoria). Yardin (1997) identified significant differences in the genetic structure of populations at all geographic scales (including at scales <100s m), concluding that, despite

the high potential for gene flow through larval dispersal and panmixis at small and large scales, there is a high degree of heterogeneity among populations, even at a local scale, and the complex population structure is likely supported by discrete ecological processes and the ability of larvae to remain together through to settlement. Given this understanding of population structure, Yardin (1997) commented that management strategies that assume broad-scale biologically functional populations may lead to the depletion of local populations.

The scale of assessment is made at the jurisdictional level (state-wide).

Stock Status

On the basis of the evidence provided the NSW Estuary Cockle stock is classified as **undefined**, both in terms of the level of biomass and fishing mortality. Importantly, this classification is made at the state-wide fishery level and is primarily due to a lack of reported commercial fishery data in recent years and whilst understanding that available but limited data from some estuaries indicate possible serial depletion and likely depleting or depleted local stocks.

A weight-of-evidence approach has been taken to assess the EGHG Fishery – Estuary Cockle. This includes: i) The current understanding of Estuary Cockle stock structure indicating there are a complex of populations, with functional biological populations likely to operate at a local (estuary) scale and there is a paucity of data describing the fisheries biology and population dynamics of NSW Estuary Cockles; ii) Commercial fishery data are of increasingly poor quality over the last 4-5 years (i.e. monthly catch returns of daily fishing activity with no $effort_{hr}$ reported or, as is the case in 2019/20, no reporting of ~40% of the allocated, and reportedly used, 29.2 t TAC); iii) Fishery-dependent spatially discrete (estuary scale) data, available from 2009/10, that are noisy (low number of fishers) and incomplete, and the discontinuous time series of commercial fishery effort data over the history of the fishery; iv) anecdotally substantial, yet unquantified levels and distribution of recreational catch; v) unknown levels of Indigenous cultural fishing; and vi) unquantified levels of regular illegal, unregulated and unreported fishing. These lines of evidence identify substantial uncertainty in identifying and interpreting change in possible fishery and stock performance indicators, and limited confidence in inferring change in biomass and/or fishing mortality through time, and hence determination of a stock status other than undefined.

Fishery statistics summary

State-wide catch records incorporate three periods of reporting i.e. prior to 1997/98, from 1997/98 to 2008/09 and from 2009/10 to present (Appendix 1 of Chick 2021). These changes affect the consistency of the data series and have implications on interpretation of changes in these metrics through time. The interpretation of effort in FisherDays ($effort_{dy}$) and associated metrics is particularly problematic, with changes to reporting requirements and challenges in accurately allocating daily effort among species within a multi-species fishing method and particularly for Estuary Cockles where catch reporting has been inaccurate and erratic in recent years. CPUE series merged across changes in catch reporting arrangements (1996/97 to 1997/98 or 2008/09 to 2009/10) may not be an accurate representation of changes in catch rate across these years. Further, in 2016/17, 2017/18, 2018/19 and

2019/20 ~9%, 15%, 9% and 2% of commercial catch records were reported to invalid spatial references or not reported to a spatial reference. These records were allocated to an estuary based on the catch history of the reported fisher where that history indicated the fisher or business had only ever fished in one estuary. Effort (in hours) has not been reported for a substantial number of records in recent years. As such, and to generate a likely series of effort (hours), an 'estimated hours' time-series was generated from 2009/10 to present. Annual estimated effort (hr) is the product of $Effort_{dy}$ and average daily hours calculated from catch records with hours reported. Further, additional checks on reported data from 2009/10 identified opportunities to complete data fields, such as authorised fisher, and more accurately represent available data. The data presented in this report updates that of previous reports.

$CPUE_{hr}$ has been calculated as the average of daily $CPUE_{hr}$, excluding records with zero catch or effort and where daily reported $CPUE_{hr}$ was <10 and >200 $kg.hr^{-1}$. These rules have resulted in the exclusion of about 25% of all daily records since 2009/10 and between 4% and 53% of daily records in any individual year. Further, due to the substantial proportion of commercial records not reporting effort in recent years, the alternate $CPUE_{hr}$ series was generated from estimated hours and applied to total reported catch. Information presented in figures and tables in this report are summarised by fishing period (July to June), unless otherwise stated.

Catch Information

Commercial catch

Total annual commercial catches have been as high as 93 t, commonly >35 $t.yr^{-1}$ and within the last 5 years exceeded 65 $t.yr^{-1}$, with catch in 2018/19 being 51 t. The majority (>90%) of annual catches have come from five NSW estuaries. However, patterns of catch and effort within these estuaries vary through time and do not reflect patterns at the fishery scale. In 2019/20, reported total catch was 17.9 t, with the level of catch within estuaries being similar to recent years in one estuary (Lake Illawarra), substantially below catches of recent years in two estuaries and no catch reported in Shaolhaven/Crookhaven River or Pambula Lake. Importantly, ~95% of the 2019/20 TAC (29.2 t), for commercial harvest, was reportedly used (NSW DPI Fisheries 2020). Together, the reported catch data (17.9 t) and quota usage data (~27.6 t) indicate ~40% of the TAC has not been reported in logbooks. Therefore, it is unlikely that logbook returns of daily fishing activity (e.g. catch and effort), presented in this report, accurately represent the total catch and other fishery-dependent measures used to assess fishery performance and stock status for the 2019/20 fishing period.

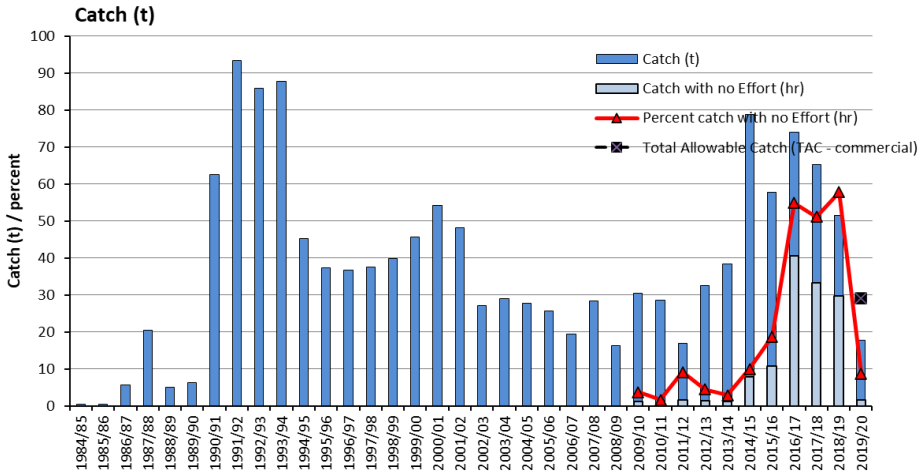

Figure 1 Annual commercial catch (t) of Estuary Cockle from 1984/85 to 2019/20, catch with no reported effort (hours) and percent of catch with no reported effort (hours), from 2009/10 to 2019/20.

Recreational catch

Recreational fishers harvest Cockles either for personal consumption or for use as bait. Estimates of recreational catch are unknown. In The National Recreational and Indigenous Fishing Survey completed in 2000/01 (Henry and Lyle 2003) and the state-wide NSW recreational fishing survey completed in 2013/14 (West et al. 2015), the harvest of Cockles was restricted to the categories 'Bivalves (other)' and 'Other taxa' respectively. In 2017/18 (Murphy et al. 2020) indicates a recreational catch of 10 kg. There is anecdotal evidence of relatively high levels of recreational harvests of Cockles from specific NSW estuaries. As such, this state-wide estimate underrepresents the actual recreational harvest and is likely a function of this species being a relatively niche species for recreational fishers and highlights some of the challenges these types of species pose for large scale surveys.

Indigenous cultural catch

The benefits (and costs) of fishing generally and professional fishing to the cultural, broader social, health, wellbeing and economic value to Indigenous people and communities are substantial (Voyer et al. 2016). Schnierer and Egan (2012) described a case study in NSW of the impact of management changes on the viability of Indigenous commercial fishers and the contribution commercial fishing makes to Indigenous communities. Included in this case study are estimates of the contribution Indigenous commercial fishers make to Indigenous communities, including the contribution of between 5% - 20% of their annual commercial catch. The contribution made to Indigenous communities by commercial fishers was, on average, 9.8% of annual catch and the contribution from broader Indigenous commercial fishers was greater than that made by fishers in the EGHG Fishery, with this being a consequence of hand gathering being a "…traditional skill that is widely practiced by coastal families so they can fulfil their own needs." (Schnierer and Egan 2012). Moreover, Schnierer and Egan (2012) report substantial harvests of hand gathered species (principally Pipi) by Aboriginal fishers that were either not reported in commercial catch records, or reported as 'other' species and went unrecorded as species specific catches and were utilised for personal and community use.

Schnierer (2011) and Schnierer and Egan (2016) describe the estimated annual harvest of Cockles from Indigenous fishers in the northern NSW Tweed region as between 731 and 1810 Cockles, further noting that Cockles were listed as important but not among the top 10 culturally most important species. In addition, Schnierer and Egan (2016) report Indigenous catch of Cockles representing 4.5% of the species occurring in Aboriginal middens at 13 locations along the NSW coast.

Illegal, Unregulated, Unreported (IUU) catch

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

There are anecdotal reports of IUU fishing occurring at the scale of estuaries, related to commercial fishers misreporting and recreational fishers exceeding bag limits or fishing without a licence. NSW DPI Fisheries Compliance reports indicate regular seizures of Cockles due to non-compliance.

Effort information

Commercial

Effort in FisherDays ($effort_{dy}$) prior to 2009/10 is a problematic data series with changes to reporting requirements and challenges in accurately allocating daily effort among species within a fishing method.

Effort in days fished ($Effort_{dy}$) increased from <50 days (1984/85–1990/91) to 205 days in 1993/94, before declining to <50 days again in 1996/97. During this period fishers were required to report their catch monthly and effort (days) by gear type, not linked to catch unless only a single gear type was used and then not linked to species catch. Therefore, prior to 1997/98 total $effort_{dy}$ reported within the EGHGF cannot be allocated to a species catch and is the total $effort_{dy}$ reported by the EGHG fisher for each month where one method was reported, and the species of interest was also reported in that month. In 1997/98, 292 days were fished. $Effort_{dy}$ increased 55% to 452 days in 2000/01, decreased to 304 days over the following two years before increasing each year to the maximum recorded level of 850 days in 2005/06, and subsequently declining each year to 302 days in 2008/09. The substantial changes in days fished between 1996/97 and 2008/09 was concurrent with changes to commercial fishery reporting requirements. As such, substantial changes in $effort_{dy}$ are likely not a function of effort to catch Cockles. Rather, the peak in effort reflects changes in effort to catch other species by the same fishing methods (likely Pipis), while also harvesting Cockles in the same month. Therefore, $effort_{dy}$ reported each month by hand gathering has been attributed to each species reportedly harvested that month, including Cockles. In 2009/10, $effort_{dy}$ was 257 days. Since 2009/10, the number of days fished increased to a recent peak, in 2014/15, of 472 days, reflecting a similar peak in catch. In the last 3-4 years $effort_{dy}$ has decreased substantially. In 2018/19, $effort_{dy}$ was 182 days in 2019/20 was 101 days, which belies the fact that about 40% of the reportedly used 29.2 t quota in 2019/20 and the associate effort, has not been reported (Figure A1-2).

Effort (hr; $effort_{hr}$) has changed substantially since 2009/10. Importantly, between 2016/17 and 2018/19 the percent of catch records with no $effort_{hr}$ reported was >50% for each year. To provide a more probable estimate of recent $effort_{hr}$ per year, average annual $hours.day^{-1}$,

from records with hours reported, was multiplied by reported annual days fished. These data suggest hours harvesting Cockles increased substantially from 2013/14 and was in excess of 1200 hr.yr^{-1} in each year from 2014/15 to 2017/18, peaking at about 1700 hr in 2014/15. In 2018/19, estimated effort$_{hr}$ was about 900 hr (i.e. about double the reported effort) and in 2019/20 estimated effort was 108 hr, and whilst similar to reported effort, suffers from likely being inaccurate given the discrepancy between reported catch and used quota.

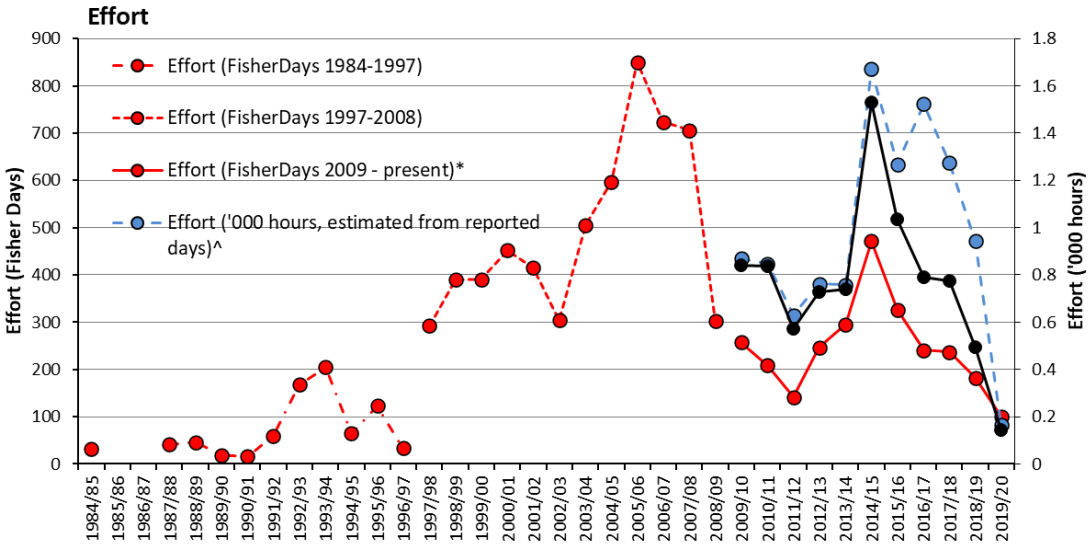

Figure 2 Annual commercial effort in units of FisherDays* (1984/85 to 2019/20) and hours^ (2009/10 to 2019/20). Note: Changes in reporting requirements limit consistent interpretation of the effort (FisherDays) time series.

*Effort (FisherDays) (a) for July 2009 to present is the sum of reported days fished from each Authorised Fisher or Fishing Business Owner (where no Authorised Fisher was reported). This is different from previous reports where for July 2009 to present FisherDays was estimated from the number of distinct fishing dates entered on daily catch returns for each fisher in each month where the method was used, irrespective of whether the species was reported on those days, to be more consistent with earlier reporting; (b) for July 1997 to June 2009, was taken from the number of days fished hand gathering, as entered on monthly catch returns; and (c) for July 1984 to June 1997, limited to catch records where only a single fishing method was entered on a monthly catch return. Therefore, joining the series of data from 1996/97 to 1997/98 or 2008/09 to 2009/10 may not be an accurate representation of changes in catch rate across these years.

^Effort ('000 hours, estimated from reported days) is the product of average annual daily hours and FisherDays.

Recreational effort

There are limited data describing the recreational fishing effort expended in harvesting Estuary Cockles.

Indigenous cultural effort

Schnierer (2011) report the total effort of Aboriginal fishers based in the Tweed region was recorded to be 542 hours or 92 days. Cultural catch of Cockles by Aboriginal people in the Tweed region has occurred for many generations and was seen to be important in delivering benefits to the community.

Catch rate information

Commercial

Catch per FisherDay ($CPUE_{dy}$) is a problematic metric to define and interpret prior to 2009/10, for reasons outlined for the $effort_{dy}$ time series. Relatively low $CPUE_{dy}$ throughout the early to mid-2000s is likely a function of EGHG days fished being allocated to relatively lower levels of Cockle catch per month, where Cockles and other species (likely Pipis) were caught by the same method in the same month, in addition to reductions in $CPUE_{dy}$ reflecting similarly declining Cockle abundance. However, the time series of annual catches suggests large biomasses had been removed from fished populations over the previous 20 years, so changes in catch rate are complicated by challenges in defining targeted fishing effort and any changes in abundance.

$CPUE_{hr}$ has been calculated as the average of daily $CPUE_{hr}$, excluding records with zero catch or effort and where daily reported $CPUE_{hr}$ was <10 and >200 $kg.hr^{-1}$. These rules have resulted in the exclusion of about 25% of all daily records since 2009/10 and between 4% and 53% of daily records in any individual year. Further, due to the substantial proportion of commercial records not reporting effort in recent years, the alternate $CPUE_{hr}$ series was generated, using estimated annual hours as the product of average annual $hours.day^{-1}$, from records with hours reported, and reported days fished per year.

From 2009/10 to 2011/12, $CPUE_{hr}$ decreased ~45%, from 51 $kg.hr^{-1}$ to 28 $kg.hr^{-1}$, before returning to levels generally >40 $kg.hr^{-1}$ in the years following. From 2012/13, $CPUE_{hr}$ has been relatively stable, and excluding data from 2019/20 has averaged 46 $kg.hr^{-1}$ and seemingly depressed by the exclusion of records with no $effort_{hr}$ reported. Notably, the decline in number of active fishers in 2019/20, and the retention of some fishers regularly reporting consistently small quantities of effort irrespective of the level of catch may further limit the reliability of $CPUE_{hr}$ as a measure of relative abundance and also the consistency of this time series of data between 2018/19 and 2019/20 and subsequent years. Importantly, and as similarly described for fishery-wide levels of catch, change in levels of fishery-wide effort and $CPUE_{hr}$ are not necessarily consistent with patterns at smaller spatial scales.

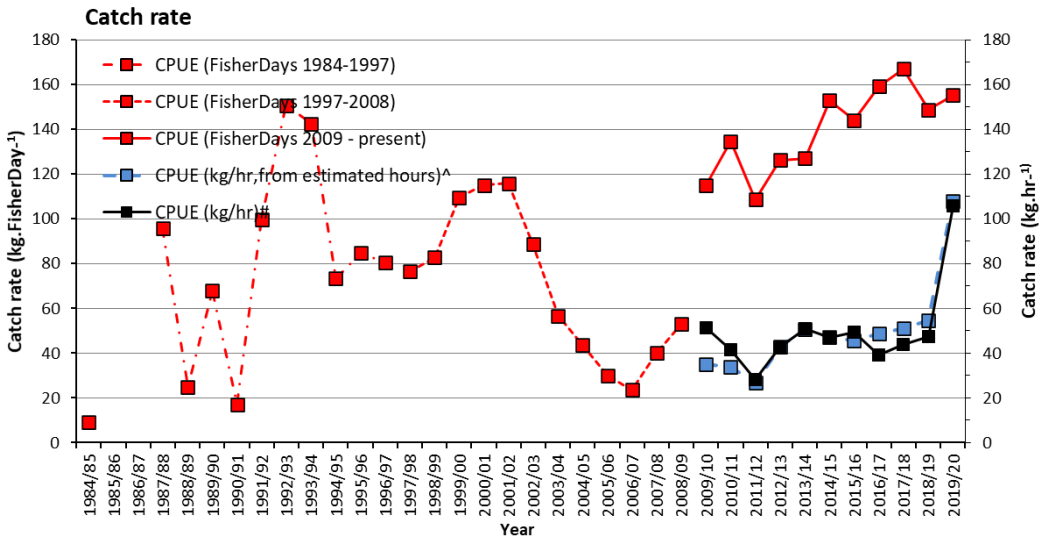

Figure 3 Annual commercial catch rate in units of kg.FisherDays^{-1}* (1984/85 to 2019/20) and kg.hr^{-1}# (2009/10 to 2019/20). Notes: i) changes in reporting requirements limit consistent interpretation of the kg.FisherDays^{-1} time series.

#CPUE (kg.hr^{-1}) calculated from average daily CPUE (kg.hr^{-1}), excluding records with no catch or no effort or catch rate <10 or >200 kg.hr^{-1}, ^CPUE (kg.hr^{-1} from estimated hours) is the quotient of annual reported catch and estimated hours.

Stock Assessment – list of indicators

Most recent assessment	2021 – data up to 2019/20 – **Undefined**
Assessment method	Weight of evidence
Main data inputs	Catch (commercial) – 1984/85 to 2019/20 $CPUE_{dy}$ – kg.FisherDay^{-1} 2009/10 to 2019/20 $CPUE_{hr}$ – kg.hr^{-1} 20009/10 to 2019/20
Main data inputs (rank)$^{+}$	Catch – 1984/85 to 2018/19: (medium quality), long historical time series, but some reporting changes and likely misreporting, limited quality control/error validations Catch – 2019/20: (low quality) compromised by significant underreporting $CPUE_{dy}$ – kg.FisherDay^{-1} 1984/85 to 2019/20: (low quality) compromised by significant reporting changes and inaccuracies in reporting (incl. effort data). $CPUE_{hr}$ – kg.hr^{-1} 2009/10 to 2019/20: (low quality) compromised by limited internal quality assurance, the small

	number and changes in active fishers per year and spatial distribution of catch.
Key model structure and assumptions	NA – no quantitative, model-based approach was used in this assessment.
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.

† 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 Limits Reference Levels

Biomass indicator or proxy	NA - no formal indicators or reference points determined
Biomass limit reference level	NA – no biomass limits or targets have been set
Fishing mortality indicator or proxy	NA – no agreed proxy of fishing mortality has been defined
Fishing mortality limit reference level	NA – no fishing mortality limit has been set
Target reference level	NA – no fishing mortality targets have been set

Stock Assessment Results – review of indicators

Biomass status in relation to limit	NA – no biomass limits or targets have been set

Fishing mortality in relation to limit	NA – no fishing mortality limit has been set
Previous SAFS stock status	Undefined (Chick 2020); not SAFS species. (NSW jurisdictional level)
Current SAFS stock status	Undefined (Chick 2021); not SAFS species. (NSW jurisdictional level)

Fishery interactions

Fishing for Estuary Cockles in the EGHG Fishery is done by hand with hand collection of individuals. There are limited, if any interactions with other fisheries.

Estuary Cockles inhabit seagrass habitat in addition to sandy/muddy substratum and there is anecdotal evidence of fishers (from all sectors) interacting with seagrass habitat. There are no recorded interactions with TEPS or other protected habitats.

Qualifying Comments

Defining the status of the Estuary Cockle resource with any level of reasonable certainty is not possible due to various issues relating to the unavailability and/or inaccuracy of available data, from all fishing sectors.

NSW catch and effort logbook data vary spatially and temporally across different eras, delineated by changes in fisher reporting requirements and other management changes that affect the continuity of these data. Commercial fishery statistics are sourced from a small number of commercial operators. Variation in the composition of fishers through time can influence differences in measures of fishery-dependent data and their use for inferring fishery performance and stock status, such that changes in these measures may not relate to biological performance of the stock. Further, the accuracy of reporting commercial fishing activity, including levels of catch and effort as well as the spatial scale of reporting can have substantial effects on patterns in these data through time and among estuaries. Change in annual catch at the whole fishery level does not reflect that at smaller spatial scales. Further, data reporting at small (estuarine) scales is highly variable and these data often suffer from poor reporting (e.g. non-reporting of effort data and ~40% of catch in 2019/20).

There are no recreational or Indigenous cultural fishing data available to reliably quantify the level of harvest or effort from these sectors. Anecdotal evidence and limited studies describing small-scale spatial and temporal patterns of fishing by some sectors of the fishery indicate that fishing activities other than commercial fishing may make a substantial contribution to the levels of fishing mortality on Cockles, particularly at a local scale.

Similarly, it is not possible to quantify the level of IUU catch.

Environmental factors likely affect changes in the abundance and biological performance of Cockles and these factors likely vary among estuaries through time. The paucity of data and

limitations and uncertainty in much of the available data disqualifies the determination of a stock status other than undefined.

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