Department of Primary Industries
Department of Regional NSW

NSW Stock Status Summary – 2023/24

Estuary Cockle (*Anadara trapezia*)

Assessment Authors and Year

Chick, R.C. 2024. Stock assessment report 2023/24 – Estuary General Fishery (Hand Gathering) – Estuary Cockle (*Anadara trapezia*). NSW Department of Primary Industries. Fisheries NSW, Port Stephens Fisheries Institute. 42 pp.

Stock Status

Current stock status	On the basis of the evidence contained within this assessment, Estuary Cockle are currently assessed as **undefined**.

Importantly, this classification is made understanding that available but limited data from commercial fishing logbook returns is highly uncertain, shows a distribution of catch, supporting the 45 t TAC for 2022/23 in the NSW Estuary General Fishery – Hand Gathering (Estuary Cockle; EGHG Fishery), to estuaries other than key estuaries (by total catch) and to unknown areas and patterns of catch in some key estuaries consistent with uncontrolled serial depletion and likely depleting or depleted local stocks. These estuary scale inferences derived from available data generally contrast with State-wide measures that compose the aggregate of available, finer scale data.

Stock structure & distribution

Genetic population structure is an important variable to understand, supporting good fishery management and sustainable and productive harvests. Limited contemporary information exists describing the genetic population structure of Estuary Cockles. Yardin (1997) studied genetic variation in the Estuary Cockle and sampled from populations within NSW and Victoria. Using available genetic techniques of the time, Yardin (1997) identified significant differences in the genetic structure of populations among the sites sampled and differences at finer spatial scales within the estuaries sampled. Yardin (1997) concluded that there was a complex population structure, likely supported by discrete ecological processes and the ability of larvae to remain together through to settlement. Current studies (Taylor et al. 2021) are characterising single nucleotide polymorphisms (SNPs) to support a more current understanding of population genetics of Estuary Cockles among NSW estuaries. Preliminary results suggest that the samples from Burrill Lake could have some population structure among sites, but there is no structure evident within or among the other estuaries sampled. These results suggest a more genetically homogeneous stock than the earlier studies of Yardin (1997). Further, Taylor et al. (2021) are characterising basal population parameters (size structure, age, growth mortality, reproduction) and investigating their spatial and temporal variation. This work is expected to extend through 2026, with preliminary results being made available to inform development of the stock assessment and management of NSW Estuary Cockle resource.

Scope of this assessment

This stock status summary presents information and results from the most recent assessment of the NSW Estuary Cockle (Chick 2024) that aimed to: 1) provide a summary of information regarding stock structure and biology of the Estuary Cockle; 2) summarise available fishery statistics and additional data sources to inform the assessment and aid in the determination of a Total Allowable Catch (TAC) for the 2024/25 fishing season; 3) assess and determine the biological status of the stock NSW; 4) outline information and data limitations and uncertainty in

the assessment; and 5) provide comment on the strategic direction for future research and assessment. Assessment of the NSW Estuary Cockle is based on a weight-of-evidence approach, as the current understanding of stock structure and available data do not support a reliable model-based stock assessment.

Biology

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 Estuary 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, Gribben et al. 2009).

Fishery statistics

Catch information

Commercial

Total annual reported commercial catches of Cockles increased from <1 t to >80 t between 1984/85 and 1993/94, peaked at 93.4 t in 1991/92 and declined to 30–55 $t.yr^{-1}$ between 1994/95 and 2001/02. From 2002/03 to 2008/09, annual catches averaged 25 $t.yr^{-1}$, with the lowest annual catch of 16.3 t recorded in 2008/09. From 2009/10 to 2017/18, annual reported commercial catches generally increased from about 30 $t.yr^{-1}$ to levels among historical highs and ≥70 $t.yr^{-1}$, harvested by ~10 fishers (Figure 1). In 2018/19, t he year immediately preceding the implementation of a TAC, total reported catch was 51.5 t, harvested by 10 authorised fishers. Importantly, for assessment purposes, from 2013/14 to 2018/19, the annual catch and percent of total catch with no reported hourly effort ($effort_{hr}$) increased substantially (Figure 1). Between 2016/17 and 2018/19, the percentage of reported catch with no $effort_{hr}$ was >50% for each year. In 2019/20, this dropped to 9%, returned to 55% and 34% in 2020/21 and 2021/22, respectively, and in 2022/23 was <1%. Importantly, total reported catch in 2022/23 was 26.5 t compared with the 2022/23 TAC of 45 t and quota usage reports indicating 98% of the quota being reportedly used (i.e. 44.1 t DPI unpublished; (Figure 1). This level of reporting is similar to that reported in 2021/22 (Chick 2022), with catch reporting from 2021/22 remaining relatively unchanged in 2023 from that reported in 2022. Since 2019/20, together the reported catch data and quota usage data indicate an average of 37% (range 34% - 40%) of reported used quota is not reported in logbooks. As such, it is highly unlikely that fisher monthly logbook returns of daily fishing activity (i.e. reported data including catch and effort) presented in this report, accurately represent the total levels of catch and effort and there is high uncertainty if derived fishery-dependent measures are representative of the broader fishery and used to assess fishery performance and stock status for the 2022/23 fishing period. It is also important to note that the pattern of change in levels of annual reported catch, effort and CPUE for the State-wide fishery are not consistent with patterns at finer spatial scales (estuaries)

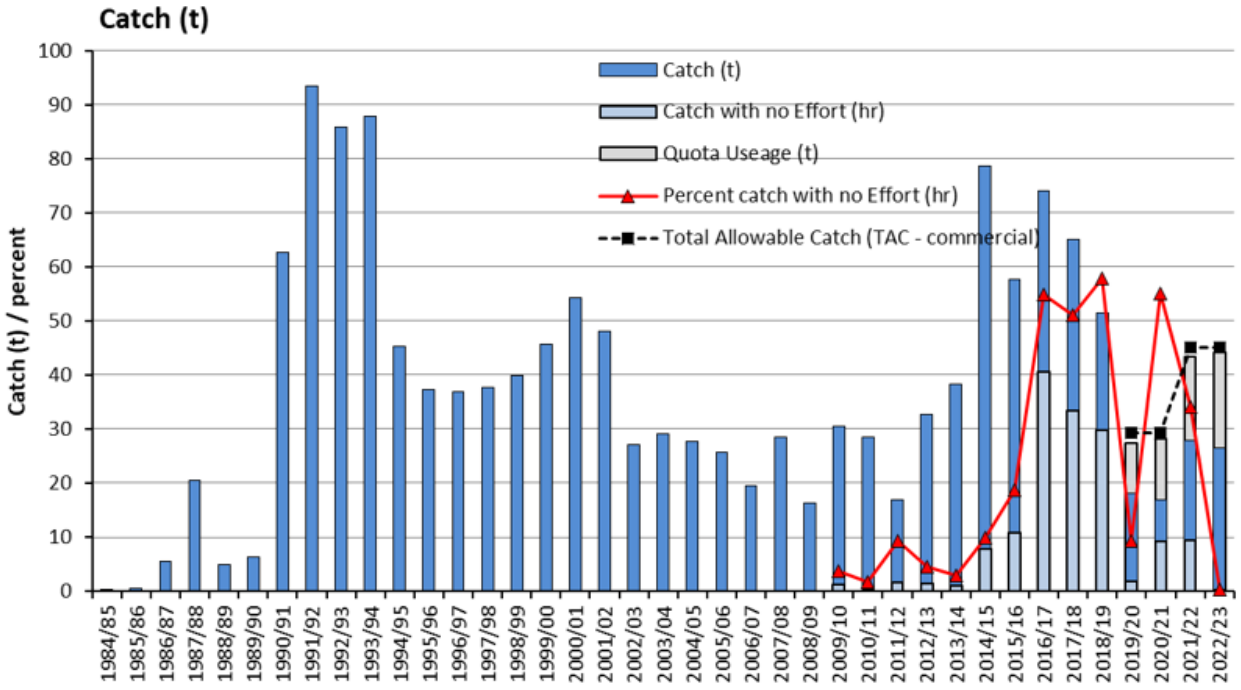

Figure 1. Annual commercial catch (t), catch with no reported effort$_{hr}$ (t), quota usage (t) and Total allowable catch (TAC), from 1984/85 to 2022/23.

Since at least 2010/11, the spatial distribution of annual commercial catches has been dominated by catches from five estuaries located within Regions 4, 6 and 7, with the very recent exception of distribution in 2021/22 and 2022/23, where ~22% and 60% of the annual reported catch, respectively was from 'Other' or unspecified estuaries. Since 2021/22 at least one of the top five estuaries has not contributed more than ~40% of the total annual reported catch. Further, 2022/23 is the first year since 2009/10 that no catch has been reported from Merimbula Lake (noting 60% of the reported catch has not had spatial data reported and 40% of used quota is not reflected in logbook catches). Spatial distribution of catch among estuaries through time has not been consistent. In fact, patterns of catch distribution through time continue to support the hypothesis of population serial decline. Peaks in annual catch, that are between 3.5 and 2.5 times average annual catch levels since 2009/10 have occurred sequentially in Pambula Lake (2010/11), Merimbula Lake (2014/15) and Wallis Lake (2017/18). In the Shoalhaven/Crookhaven River peak catch (17.8 t in 2018/19) was ~2 times average annual catch from 2009/10 – 2022/23. Further, within 3-5 years of these historical peaks, annual catch in each Estuary has declined to at or among historically low levels. In Merimbula Lake and Wallis Lake these declines in catch have occurred whilst measures of catch rate (from data contributed to by >1 fisher) have either been maintained at or fallen below long-term average levels.

Recreational & Charter boat

Recreational fishers harvest Cockles either for personal consumption or for use as bait. Estimates of recreational catch are unknown. Information from The National Recreational and Aboriginal fishing Survey completed in 2000/01 (Henry and Lyle 2003) describes recreational and Aboriginal cultural catches of Cockles restricted to the category of 'Bivalves (other)' - consisting of clams (unspecified), Cockles (*Anadara* and *Katelysia* spp.), Cockles – mud and Cockles – unspecified). The NSW State-wide recreational fishing survey completed in 2013/14 (West et al. 2015) further limited the categorisation of recreational catch of Cockles into a more diverse category i.e. 'Other taxa'. NSW State-wide recreational fishing surveys in 2017/18, 2019/20, 2021/22 (Murphy et al. 2020, 2022, 2023, respectively) did identify Cockles as an optional self-reported species. The 2017/18 survey did record a report of a recreational harvest of Cockles, although due to the harvest of Cockles being a relatively niche recreational fishing activity the record does not support a representative sample or provide a reasonable estimate of the recreational harvest of Cockles in NSW. The 2019/20 and 2021/22 surveys did not report a recreational catch of Estuary Cockles. There is anecdotal evidence of relatively high levels of recreational harvests of Cockles

from specific NSW estuaries. As such, the State-wide recreational fishing surveys underrepresent the actual recreational harvest and is 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 such large-scale surveys.

Despite the lack of information to quantify the recreational catch and its spatial distribution, there is strong and persistent anecdotal evidence, through NSW Fisheries Compliance information (via increasing incident reports and increasing numbers of Cockle seizures from fishers exceeding bags limits – see Illegal, Unregulated and Unreported fishing) and social media postings, of relatively high and increasing levels of recreational catch at various NSW estuaries. The magnitude and/or variation in these levels of harvest have not been quantified. Further, the NSW DPI led FRDC Project 2021-003 '*Maintaining productivity and access to Estuary Cockle across sectors through improved science-based decision making*' is undertaking a pilot study to assess recreational fishing for Estuary Cockles in Lake Illawarra and Lake Macquarie, scheduled to commence in Feb. 2024.

Indigenous

Estuary Cockles are a notable species identified in Aboriginal middens in NSW (4.5% of species in middens at 13 locations in NSW), supporting the understanding that they contributed an important food source for Indigenous people in south-east Australia, at least within the last 3000 years (Schnierer and Egan, 2016). Further, descriptions of the use of Cockles as a preferred burly/bait by Aboriginal people fishing in Port Jackson, NSW are provided by Attenbrow (2010), citing records published in the late 1700's.

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 and aquaculture 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 Indigenous 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.

Cockles have been harvested by Indigenous people in the Tweed region for many generations. In a survey based in the Tweed region (Schnierer 2011; Schnierer and Egan 2016), annual catch by Indigenous fishers was estimated to be between 731 and 1810 Cockles. Based on logbook data from 2010 in the Tweed region, Cockles were listed as an important species but were not among the top 10 culturally most important species. Schnierer (2011) reports that the total effort of the Indigenous fishery in the Tweed region was 542 hours or 92 days. Cultural catch of Cockles was seen to be important in delivering benefits to the community.

Illegal, Unregulated and Unreported

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. Further, NSW Fisheries Compliance provide annual summaries of seizures of fish and invertebrates due to non-compliance. These reports indicate regular seizures of Cockles each year from 2010/11 to 2021/22 (most recent report), ranging between 8 897 and 25 110 individual Cockles. In 2021/22, 8,955 Cockles were seized due to non-compliance (link here - Fisheries compliance enforcement). Notably, during 2021/22, NSW Fisheries Compliance conducted operation 'DPI Zulu 21' between September 2021 and April 2022, targeting illegal take of cockles and whelks from Lake Illawarra.

Fishing effort information

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 (Figure 2). 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 less likely a function of the effort to catch Cockles. Rather, the peak in effort reflects changes in effort to catch other species (likely Pipis) by the same fishing method, 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. From 2009/10, the number of days fished generally increased to a recent peak of 472 days, in 2014/15, reflecting a similar peak in catch. Over the last 5-6 years $effort_{dy}$ had been decreasing substantially, reaching a 20 year low of 44 days in 2020/21. In 2021/22, $effort_{dy}$ more than doubled from 2020/21 to 118 days and in 2022/23 was 196 days (Figure 2). This this sustained increase coinciding with the quota increase from 29.2 t to 45 t, in both 2021/22 and 2022/23 (Figure 1). These figures belie the fact that 40% of the reportedly used 45 t quota, and its effort, has not been reported in logbooks.

Effort (hr; $effort_{hr}$) has changed substantially since 2009/10 (Figure 2). Importantly, between 2016/17 and 2018/19, and in 2020/21, the percent of reported catch with no reported $effort_{hr}$ was >50% for each year, and in 2021/22 that percentage was 34% (Figure 2). To provide a more probable estimate of recent $effort_{hr}$ per year for reported catch, average annual $hours.day^{-1}$, from records with hours reported, was multiplied by reported annual days fished (Figure 2). 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 ~1700 hr in 2014/15. In 2018/19, estimated $effort_{hr}$ was ~950 hr (i.e. about double the reported $effort_{hr}$). More recently, estimated effort more closely reflects reported effort (Figure 2). Despite this, it remains inaccurate given the discrepancy between reported catch and used quota.

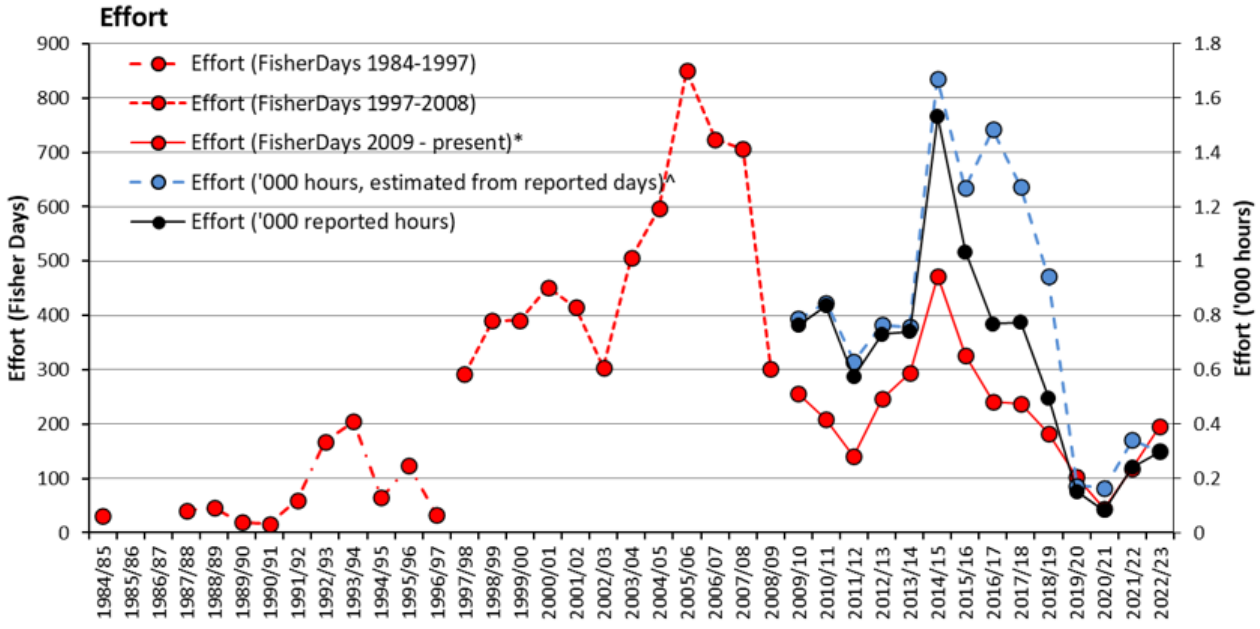

Figure 2. Total annual commercial effort (days and hours) fishing for Estuary Cockles from 1984/85 to 2022/23.

Catch rate information

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. Nonetheless, $CPUE_{dy}$ fluctuated substantially between 1984/85 and 1994/95, ranging between 9 and 151 kg.day^{-1}, with low rates possibly reflecting drivers of catch and effort other than abundance (as described for $effort_{dy}$; Figure 3). $CPUE_{dy}$ increased from 77 kg.day^{-1} in 1997/98, to 116 kg.day^{-1} in 2001/02, then decreased each year until 2006/07, reaching 24 kg.day^{-1}. Relatively low $CPUE_{dy}$ throughout the early to mid-2000s is likely a function of EGHG days fished being allocated to relatively low catches of Estuary Cockle per month, where Cockles and other species (likely Pipis) were caught by the same method in the same month, in addition to likely reductions in Estuary Cockle abundance preceding years of historically high periods of harvest. So, changes in catch rate are complicated by challenges in defining targeted fishing effort and any changes in abundance during this time. From 2009/10 to 2022/23 $CPUE_{dy}$ has not changed significantly and despite moderate increases in the average catch from 115 kg.day^{-1} (2009/10) to >150 kg.day^{-1}, over the last 4 years these measures of average annual $CPUE_{dy}$ are associated with substantial variation and do not consistently represent patterns at finer spatial scales (i.e. estuaries) (Figure 3).

Average catch per hour ($CPUE_{hr}$) increased substantially in 2019/20, to about 200 kg.hr^{-1} and coinciding with the introduction of the TAC and the effort reporting of some fishers who had irregularly reported effort within the previous 3-4 years. Prior to 2019/20, $CPUE_{hr}$ had averaged ~44 kg.hr^{-1} (range 28 – 51 kg.hr^{-1}). Notably, average measures of $CPUE_{hr}$ are associated with substantial variation that has increased in recent years with fewer active fishers (Figure 3) and as fishery operations have changed either coincident with or in response to share management and the TAC. Further, possible erroneous reporting of very small quantities of effort for the reported catch are contributing to the high State-wide levels of $CPUE_{hr}$ and their high variability.

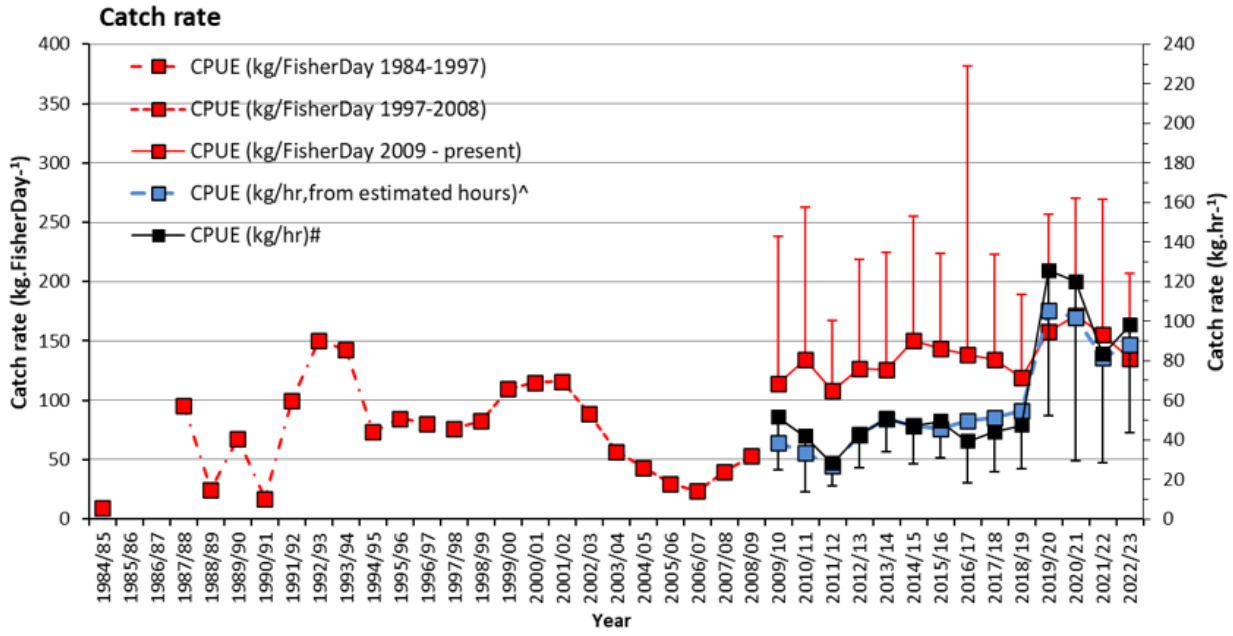

Figure 3. Average annual catch rate (kg.hr^{-1} and kg.FisherDay^{-1}, plus or minus one standard deviation) from 1984/85 to 2022/23.

Stock Assessment

Stock Assessment Methodology

Year of most recent assessment:

2024 (using data to the end June 2023)

Assessment method:

Assessment of the NSW Estuary Cockle is based on a weight-of-evidence approach. This is done as the current understanding of stock structure and available data do not support a reliable model-based stock assessment.

Main data inputs:

- Catch (commercial, NSW EGHG Fishery) (t) – 2009/10 to 2022/23
- CPUE (commercial, NSW EGHG Fishery) (kg.hr-1) – 2009/10 to 2022/23
- Catch (NSW Recreational Fishery) (t) 2000/01, 2013/14, 2017/18, 2019/20, 2021/22

Data interpreted at state-wide and estuary scales.

Key model structure & assumptions:

NA – no model-based quantitative assessment approach was used.

Sources of uncertainty evaluated:

General data limitations and uncertainty was considered in the weight-of-evidence approach.

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

Since 2009/10, commercial fishery statistics from mandatory logbook reporting in the NSW EGHG Fishery – Estuary Cockles, are incomplete and reported data have high levels of uncertainty including discrepancies between quota usage and catch from logbooks, logbook catch with no complementary effort data and inaccurate spatial reporting. The scale of these problems is atypical for other species logbook returns in the NSW EGHG Fishery. Uncertainty in these data is further exacerbated by fewer active commercial fishers contributing to fishery-dependent data since 2017/18. Of these fishers, some (active since at least 2009/10) have either inconsistently or not reported effort for a number of years or have, more recently (within the last 2-3 years) regularly reported relatively very low (seemingly erroneous) levels of effort (≤1 hr) for levels of catch that previously had reported substantially greater effort. These data are not excluded from the limited data available, yet they substantially influence measures of catch rate, and result in more recent measures substantially greater than those previously reported. Similarly, these inconsistencies and associated uncertainties are continued, and often magnified at the estuary scale. Since at least 2009/10 the majority (>90%) of annual catch has been from five NSW estuaries (Chick 2024), with the exception of reporting in 2021/22 and 2022/23, where 78% and 40% of catch was reported to these five estuaries, respectively. However, patterns of catch and effort within these five estuaries do not reflect patterns at the whole fishery scale. It is unlikely that logbook returns of daily fishing activity i.e. catch and effort, accurately represent total levels and there is high uncertainty surrounding the representativity of derived fishery-dependent measures (e.g. catch rate) to assess fishery and stock performance.

There are no recreational or Indigenous cultural fishing data available to quantify the levels of harvest from these fishing 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 Estuary Cockles, particularly at a local scale.

Similarly, it is not possible to quantify the level of IUU catch. The level of IUU fishing, or its detection varies throughout the spatial distribution of the stocks, with evidence of high and increasing IUU catch at local scales over relatively short periods of time (DPI unpublished data).

Factors other than fishing, including environmental factors, likely affect changes in the abundance and biological functioning of Estuary Cockles through time, and at spatial scales that likely vary through time. There are a variety of studies that have investigated the effects of environmental changes on Estuary Cockles, including heavy metal contamination and freshwater influx. Further, it is likely that environmental factors would affect the productivity of these populations through time. Understanding the interaction of these factors with the effects of fishing will be important in informing the role of fishing in influencing the abundance of Estuary Cockles. Further, market

disruption as a consequence of the COVID-19 pandemic and other associated social impacts (FAO 2021) are not well known and the impact of these extraneous factors on this assessment has not been assessed.

Status Indicators - Limit & Target Reference Levels

Biomass indicator or proxy	None specified in a formal harvest strategy This assessment used a weight-of-evidence approach, with data including: • Nominal $CPUE_{hr}$ (state-wide and estuary) • Nominal $CPUE_{dy}$ (state-wide)
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: • Catch (state-wide and estuary)
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 status of the NSW Estuary Cockle stock remains classified as **undefined**, both in terms of the levels of biomass depletion and fishing mortality.

Importantly, this classification is made understanding that available but limited data from commercial fishing logbook returns show a distribution of catch, supporting the 45 t TAC for 2022/23, to estuaries other than key estuaries (by total catch) and to unknown areas (as 60% of reported catch in 2022/23 did not have accurate spatial reporting), patterns of catch in some key estuaries consistent with serial depletion and likely depleting or depleted local stocks. These estuary scale inferences derived from available data generally contrast with State-wide measures that compose the aggregate of available, finer scale data.

The classification is consistent with the Status of Australian Fish Stocks (SAFS) framework (Piddocke et al. 2021), adopted to inform NSW stock status determinations from 2018, and that of previous assessments (Chick 2018, 2020–2023). The assessment has been, and remains reliant on fishery-dependent data (i.e. logbook reported fishing activity) including daily catch and effort and derived measures, and spatial reporting to areas defined in the logbook (Estuary Name or Code, Grid and Site code), or accurate and precise latitude and longitude). There are no quantitative, relative or absolute measures of recreational fishery activity for NSW Estuary Cockles or trends in IUU fishing. Similarly, despite Estuary Cockles being an important species for many groups of Indigenous people and contributing an important food source for 1000’s of years, there is little quantitative information to describe recent spatial and temporal trends in harvest.

A weight-of-evidence approach has been taken to assess NSW Estuary Cockle. This evidence includes:

i) a limited understanding of biology and stock structure, assuming populations function biologically at a local (estuary) scale;

ii) high uncertainty in the commercial fishery data, particularly over the last 6-7 years (including no reported catch for an average of 37% of the reportedly used quota in 2019/20, 2020/21 (29.2 t TAC) and 2021/22, 2022/23 (45 t TAC); logbook returns of reported fishing activity with no efforthr reported for an annual average of 31% and 29% of the reported catch over the last 5 and 10 years, respectively; and, in 2022/23, 44% of commercial fishery daily records had inadequate spatial reporting);

iii) the discontinuous time series of commercial effort data over the history of the fishery;

iv) fishery-dependent, estuary-scale data, available from 2009/10, are noisy (low number of fishers) and incomplete. Despite this, patterns of reported data in some of the top estuaries (by catch) support an inference of serial depletion and depleting or depleted local stocks. This inference is further supported by reported catch in 2021/22 and 2022/23, in 'Other' estuaries or not reported to a required spatial reference (notably ~6 t from Tuross River, incorrectly allocated to the Clyde River in 2021/22 reporting; and ~15 t in 2022/23 without spatial description i.e. 44% of daily records). Together with generally low levels, or no catch from key estuaries, despite most recent levels of CPUEhr at or above long-term averages, these changes in the distribution of catch continue to support the inference that Estuary Cockle populations from key estuaries are unable to support the sustainable harvest of the 45 t TAC (reduced to 35 t in 2023/24) and there is increasing uncertainty related to the distribution of commercial catches;

v) anecdotally, substantial, yet unquantified levels and distribution of recreational catch;

vi) unknown levels of Indigenous cultural fishing; and

vii) unquantified levels of illegal, unregulated and unreported fishing.

These lines of evidence identify substantial uncertainty in interpreting change in possible fishery and stock performance indicators, and limited confidence in inferring change in biomass and fishing mortality, and hence determination of a stock status other than undefined.

Stock Assessment Result Summary

Biomass status in relation to Limit	NA – no biomass limits has been set. Weight-of-evidence provided is insufficient to support an understanding of the level or trend in biomass.
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 insufficient to support an understanding of the level or trend in fishing mortality.
Fishing mortality in relation to Target	NA – no fishing mortality target has been set.
Current stock status	**Undefined**

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.

Stakeholder engagement

EGHG Fishery stakeholders were invited to participate in online presentations of EGHG Fishery assessments for Pipi, Cockles, Beachworms and Nippers. Issues raised, relevant to the assessment of EGHG Fishery species generally and some specific to Estuary Cockles included those related to: catch and catch reporting, market demand influencing catch volume and distribution, biological issues and observations, fisheries management and IUU fishing and extraneous factors, including environmental (direct and indirect impacts). Detailed descriptions of these issues are outlined in the assessment report (Chick 2024).

Qualifying Comments

Since the regular production of stock assessment reports (Chick, 2018), uncertainties and limitations in the reported commercial fishery data have been highlighted and these remain the primary source of uncertainty in the assessment and for the determination of an undefined stock status. That substantial uncertainties and limitations continue in the reporting of commercial fishery data in 2022/23, it is unlikely that stock status will change within the next 3-5 years, if the assessment relies solely only on commercial fishery data. It is only through continued and more reliable, thorough, and timely reporting of commercial fishery data, and/or the development of alternate data sources that regularly and reliably inform the assessment (e.g. fishery independent data) that a stock status determination will change, and only after a sufficient time-series of such data has built. Given statements from the NSW Total Allowable Fishing Committee (TAFC 2023) including “Any increase in the TACC cannot be contemplated given the highly uncertain stock assessment.”, the onus is on fishing business owners to ensure complete and accurate logbook data are recorded and reported, to reduce uncertainty in the assessment, support a stock status determination other than undefined, and allow for an increase in the total allowable commercial catch (TACC), subject to the considerations of the TAFC.

A precautionary interpretation of the available data - including, persisting low catches in historically important estuaries and data in 2021/22 and 2022/23 demonstrating a high and increasing proportion of commercial catch from ‘Other’ estuaries, or from ‘unknown’ (not reported) areas, compounded by suspected high (yet unquantified) levels of recreational harvest at local scales, and reported IUU harvest - supports the inference that stocks in key estuaries remain unable to support the catch contribution they previously made to historical catch levels. Continued uncertainty, and particularly increased levels of uncertainty may support further precautionary approaches to the management of Estuary Cockles. Precautionary harvest levels are below those demonstrably capable of being sustained whilst supporting an ongoing stock status of ‘sustainable’, informed by reliable indicators and reference levels of biomass and fishing mortality. Quota usage reports since 2019/20 indicate ~96% of the TAC is being harvested each year, including 97% and 98% of the 45 t determined for 2021/22 and 2022/23, respectively. However, the time series of uncertain and unreported data that continues and necessitates the stock status of ‘undefined’ (both in terms of the level of biomass and fishing mortality), by definition, indicates there is insufficient information to reliably inform a status of sustainable.

DPI Fisheries is leading the research project ‘Maintaining productivity and access to Estuary Cockle across sectors through improved science-based decision making’ (FRDC 2021-003). The project includes objectives to define stock structure, characterise basal population parameters (size structure, age, growth mortality, reproduction) and characterise spatial and temporal patterns in biomass and recruitment and undertake a pilot study to assess recreational fishing in Lake Illawarra and Lake Macquarie. Outputs from this project will reduce some important knowledge gaps to inform an assessment. Further, these outputs will inform investment opportunities for fishery stakeholders to secure an ongoing data monitoring and assessment strategy that would support an assessment to determine a stock status, other than undefined, and inform a harvest strategy. Such a strategy would describe objectives and define levels of stock and fishery performance and provide transparency and greater certainty in management decisions to meet the objectives of the strategy, including data requirements, TACC determination and recreational harvest controls (e.g. bag limits), and likely increase the value of the resource (and associated shares in the commercial fishery).

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