Stock status summary

Information provided in this section represents summaries consistent with informing a species status determination against criteria for the Status of Australian Fish Stocks (SAFS; www.fish.gov.au/). Where data are unavailable or insufficient to reliably inform those criteria the summary has been populated with 'NA', rather than removing the criteria. This format has been maintained to transparently represent the data available and highlight areas where alternate data sources or analyses may be required to improve species status determination into the future.

Biology and stock structure

Estuary Cockles (*Anadara trapezia*, hereinafter referred to as 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 (Dixon 1975, cited in Yardin 1997). They are sedentary as adults, typically spawning in late summer (Hadfield and Anderson 1988). Larvae develop in the plankton for up to six weeks, with likely active dispersal (larval behaviour affecting dispersal; Yardin 1997). Recruitment of Cockles is positively influenced by the presence of conspecific adults

Yardin (1997) describes significant differences in the genetic structure of populations of Cockles at all geographic scales (<100 m to 100s km). Further, despite the high potential for gene flow through larval dispersal and panmixis at small and large scales, there is a high degree of genetic 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. Therefore, applying management strategies that assume broad-scale biologically functional populations may lead to the depletion of local populations (Yardin 1997).

Stock status and assessment method

On the basis of the evidence provided the NSW Estuary Cockle stock is classified as **undefined**.

A weight-of-evidence approach has been taken to assess the Estuary General Hand Gathering Fishery (EGHG) – Estuary Cockles.

Current understanding of Cockle stock structure indicates that there is a complex of populations, with local processes acting to restrict mating relationships and patterns of gene flow, such that functional biological populations are likely to operate at a local scale. Together with a discontinuous time series of commercial fishery effort data, spatially discrete (estuary-scale) catch and effort series and substantial, but unknown levels and distribution of annual recreational catch, the assessment method adopted is a weight-of-evidence approach.

Fishery statistics summary

Information presented in figures and tables below is summarised by fiscal year (July to June). Reference to 'year' refers to the first year of a fiscal year unless otherwise stated. For example, 2010 refers to the fiscal year 2010/11.

Prior to 1997/98, effort units (days) were not linked to catch on fishers' monthly catch returns. Effort (days) during this period is attributed only where a single fishing method was reported each month. Further, between 1997/98 and 2008/09 (inclusive) fishers reported monthly catch and effort (days). From 2009/10, monthly reports of daily catch and effort (hours) have been required. From 2009/10 to present effort (days) is derived from the number of distinct fishing dates entered on daily catch returns for each fisher in each month where the method was reported and the species was harvested in that month, irrespective of whether the species was reported on those days.

Catch information

Commercial

Total annual reported commercial catches of Cockles increased from <20 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. Since 2009/10, annual reported commercial catches have generally increased from about 30 $t.yr^{-1}$, to recent annual harvests in excess of 70 $t.yr^{-1}$ (Figure 1). In 2016/17, total reported catch was 73.5 t, harvested by eight fishers. Notably, the reported levels of annual catch with no reported hourly effort ($effort_{hr}$) have increased substantially within the last 3 years (Figure 1). Further, the patterns of change in the levels of annual catch for the state-wide fishery are not consistent with patterns of catch at smaller spatial scales.

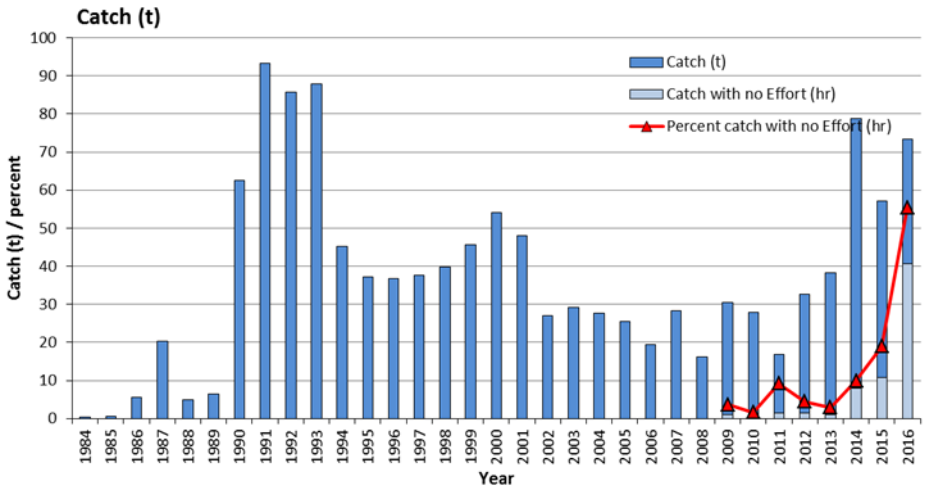

Figure 1 Annual reported commercial catch (t) of Estuary Cockle, catch with no reported effort (hours) and percent of catch with no reported effort (hours) from 1984/85 to 2016/17.

Catch information

Recreational and Indigenous

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.

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 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. The extent, frequency and the change in either, for any IUU fishing has not been documented.

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.

$Effort_{dy}$ increased from <50 days (1984/85–1990/91) to 205 days in 1993/94, before declining to <50 days again in 1996/97. In 1997/98, the number of days fished was 292 and $effort_{dy}$ increased 55% to 452 in 2000/01, decreased 33% in the following two years to 304 days before increasing substantially each year to the maximum recorded level of 850 days in 2005/06, and subsequently declining each year to a low of 302 days in 2008/09 (Figure 2). The substantial changes in days fished between 1996/97 and 2008/09 was concurrent with changes to commercial fishery reporting requirements from previous years. In 2009/10, $effort_{dy}$ was 188 days, again concurrent with the introduction of changes in commercial fishery reporting, with fishers required to report hours spent hand gathering per fishing day and reporting to finer spatial scales. Since 2009/10, the number of days fished increased to a recent peak, in 2014/15, of 531 days, reflecting levels of catch. In the last 2 years $effort_{dy}$ has declined, and in 2016/17 $effort_{dy}$ was 299 days (Figure 2).

Effort in reported hours fished ($effort_{hr}$) has changed substantially since 2009/10, averaging 887 hours (range 574–1532 hours). Importantly, within the last 3 years the level of not

Effort information

reporting effort$_{hr}$ per fishing activity has increased, and in 2016/17, about 55% of the reported catch had no effort$_{hr}$ reported. To provide a more probable estimate of recent effort$_{hr}$, average annual hours.day^{-1}, from records with hours reported, was multiplied by reported annual days fished. These data suggest hours harvesting Cockles has increased in recent years to about 1500 hr.yr^{-1} (Figure 2).

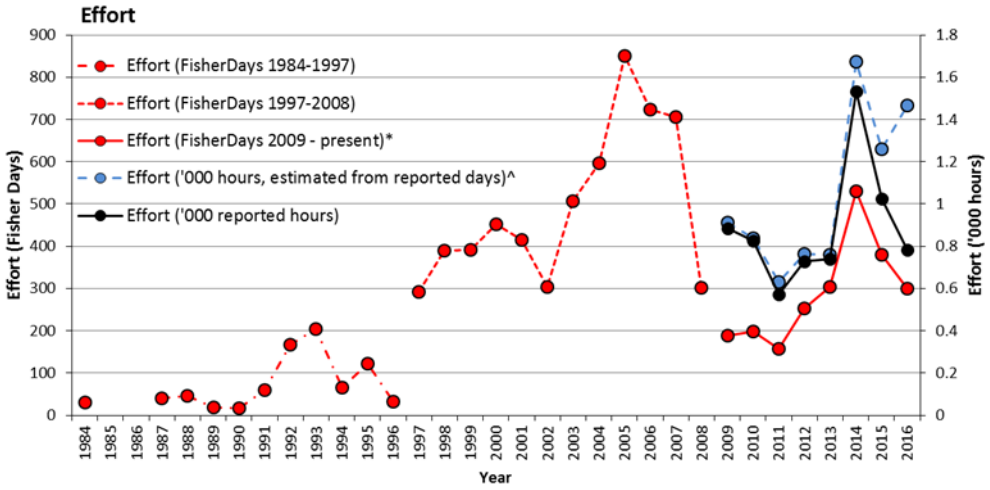

Figure 2 Annual reported commercial effort in units of FisherDays (1984/85 to 2016/17) and hours (2009/10 to 2016/17). Note: changes in reporting requirements limit consistent interpretation of the effort (FisherDays) time series.

Recreational and Indigenous

There are no data describing the recreational fishing effort expended in harvesting Cockles.

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 Fisher-Day (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 150 kg.day^{-1}. 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}. In 2008/09, CPUE$_{dy}$ was 53 kg.day^{-1}. Since 2009/10, CPUE$_{dy}$ has been relatively stable, averaging 132 kg.day^{-1} (range 107–148 kg.day^{-1}), excluding the most recent year, 2016/17 where CPUE$_{dy}$ was 211 kg.day^{-1}, the highest CPUE$_{dy}$ on record and >50 kg.day^{-1} above any previously reported level (Figure 3).

Catch rate information

$CPUE_{hr}$ has been calculated as the average of daily $CPUE_{hr}$, 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, annual estimates of $CPUE_{hr}$ decreased 39%, from 44 kg.hr^{-1} to 27 kg.hr^{-1}, before returning to levels >40 kg.hr^{-1} in the years following. Since 2012/13, $CPUE_{hr}$ has been stable above 40 kg.hr^{-1}, with exception to that in 2016/17, affected by substantial non-reporting of $effort_{hr}$, and should more likely be about 50 kg.hr^{-1}, as indicated by the alternate $CPUE_{hr}$ level (Figure 3).

As for fishery-wide catch, changes in the levels of effort and $CPUE_{hr}$ are not necessarily consistent with patterns of $CPUE_{hr}$ at smaller spatial scales.

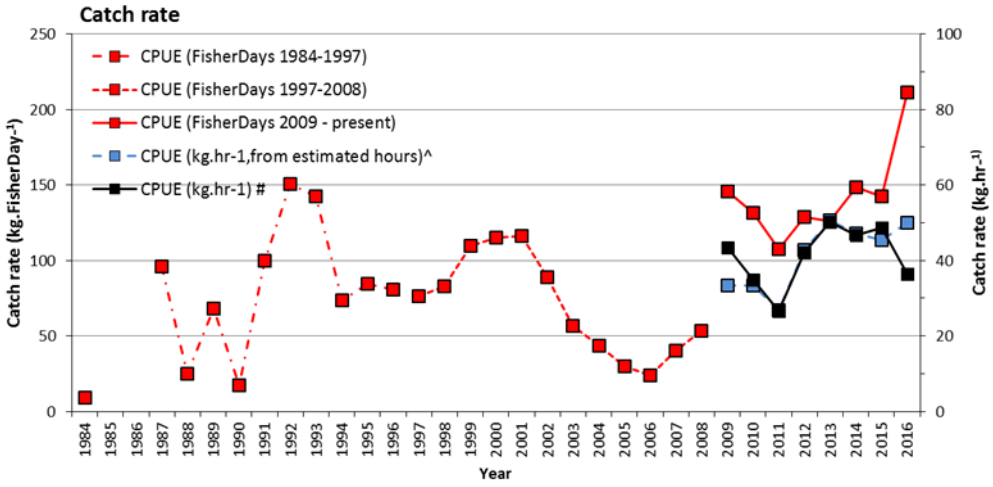

Figure 3 Annual reported commercial catch rate of Estuary Cockle (kg.FisherDay^{-1} from 1984/85 to 2016/17 and kg.hr^{-1} from 2009/10 to 2016/17). Note: changes in reporting requirements limit consistent interpretation of the catch per FisherDay time series.

Stock assessment – list of indicators

Year of most recent assessment	2018 – undefined
Assessment method	Weight of evidence (review of indicators)
Main data inputs	Catch – 1984/85 to 2016/17 $CPUE_{dy}$ – kg.FisherDay^{-1} 2009/10 to 2016/17 $CPUE_{hr}$ – kg.hr^{-1} 20009/10 to 2016/17

Stock assessment – list of indicators	
Main data inputs (rank) †	Catch – 1984/85 to 2016/17: (medium quality), long historical time series, but some reporting changes and likely misreporting, limited quality control/error validations $CPUE_{dy}$ – $kg.FisherDay^{-1}$ 1984/85 to 2016/17: (low quality) compromised by significant reporting changes and inaccuracies in effort data $CPUE_{hr}$ – $kg.hr^{-1}$ 2009/10 to 2016/17: (medium 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 model-based quantitative assessment approach was used
Sources of uncertainty evaluated	Known or likely uncertainties in the key indicators were taken into consideration in ranking data inputs to these indicators, and in reaching a conclusion regarding stock status based on the relative weighting of these indicators

† 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
Biomass limit reference level	NA – no biomass limits or targets have been set
Fishing mortality indicator or proxy	NA

Status indicators and limits – reference levels	
Fishing mortality limit reference level	NA – no fishing mortality limit has been set
Target reference level	NA – no fishing mortality target has 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	NA – not a SAFS reported species
Current SAFS stock status	NA – not a SAFS reported species

Fishery interactions

For the purpose of assessment within NSW, fishery interactions here provide some comment on the possible dynamics within the NSW EGHGF and other fisheries accessing Estuary Cockle populations.

Within the EGHGF, fishing businesses have had equal access to Pipi, Beachworm, Estuary Cockle and Nipper populations throughout the state. This will change with the allocation of shares and the share link to catch quota from 2018/19. Since 2009/10, ≤9 fishing businesses within the EGHGF have been active in the annual harvest of Cockles, and within the last 5 years new fishers have become active in the fishery.

References

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