NSW Stock Status Summary – 2021

Beachworms *(Onuphidae)*

Assessment Authors and Year

Chick, R.C., Barnes, T. C. and Fowler, A. M. 2021. Stock Assessment Summary 2020/21 – Estuary General Fishery (Hand Gathering) – Beachworms (*Onuphidae*). NSW Department of Primary Industries. Fisheries NSW, Port Stephens Fisheries Institute. 14 pp.

Stock Status

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

Beachworms are polychaete worms in the family Onuphidae. In NSW, they are predominantly *Australonuphis teres* (stumpy or kingworm) and are harvested for bait from wave-exposed intertidal sandy beaches. Their distribution ranges from South Australia to Queensland (Dakin et al. 1952; Paxton 1979), with the main populations of *A. teres* between Lakes Entrance in Victoria to Maroochydore in Queensland. Other species of beachworms that occur in NSW and that are recognised as different species by fishers include *A. parateres* (slimy) and *Hirsutonuphis mariahirsuta* (wiry or white headed wiry), but they are less abundant than kingworms (or stumpies) (Paxton 1996).

A genomic study on *A. teres*, sampled from hierarchically nested spatial scales along 900 km of NSW coast, identified six genetic groups with no clear geographic pattern to their distribution, suggesting considerable gene flow among populations (Padovan et al. 2020; Appendix 2). Little is known about the genetic structure of the other species of beachworms but, as they also adopt a broadcast spawning life history (Paxton 1986), with larval distribution a function of oceanographic processes and likely larval behaviour, it is highly probable they represent broad, interconnected populations. For the purposes of this assessment it is assumed that beachworms in NSW constitutes a single multi-species stock or management unit.

Beachworms are dioecious i.e. separate male and female individuals. Sexual maturity is reached at 42 cm in length for *A. teres*, and 39 cm for *A. parateres* and they are presumed to be repeat spawners throughout their lifespan (Paxton 1979). Mature gametes have been observed throughout the year, with *A. teres* containing >100,000 eggs in the middle third of their body (Paxton 1986). As the size of beachworms increases, the number of gamete-bearing segments and fecundity also increases. Paxton (1979) described mature oocytes of *A. teres* to be 250–260 µm in diameter and uniformly light green, whereas those of *A. parateres* are 260–280 µm in diameter and cream coloured. Beachworms are broadcast spawners. Spawning occurs throughout the year (Paxton 1986) with possible reproductive peaks in February and October (Fielder and Heasman 2000). Ontogenetic changes in morphology have been observed throughout juvenile development of various onuphid species, but not in detail for beachworms (Paxton 1986).

Although beachworms lose their eye spots after their juvenile stage, adults have a powerful gustatory sense responding to the stimulus of food in seawater (Chapman 1915). It is this sense that renders them susceptible to capture because they surface in response to use of burley bags. They spend most of their time in vertical, non-permanent, mucus-lined burrows, but actively move towards food sources horizontally in the sand (Paxton 1979). They consume bivalves, crustaceans and seaweeds (Paxton 1979). Notably, Dakin et al. (1952) documented that beachworms eat another commercially important species, Pipi. Beachworms do not emerge from the sand to take bait when there are large amounts of wrack in the area that overwhelms other scent cues (Clarke 1975).

Rates of growth of beachworms have not been recorded, but Paxton (1979) found *A. teres* grew up to 100 cm and *A. parateres* grew up to 300 cm in length. The smallest beachworms that have been collected were 30 mm in length (Paxton 1979). Independent surveys of *A. teres* from along the NSW coast included beachworms between 91 and 954 mm long and ranging in age from <1 year to 9 years old (unpublished, see Appendix 2). Population size structure appeared to be normally distributed, with individuals weighing between <1 g and 35.5 g (Appendix 2).

Little is known about the population dynamics and ecology of beachworms. Due to the dynamic nature of high-energy sandy beaches (McLachlan and Brown 2006), populations of beachworms are expected and found to be spatially and temporally variable. Polychaetes are a dominant macroinvertebrate on many sandy beaches and can alter their behaviour according to seasonal and tidal conditions (Schlacher et al. 2008). Although not supported by quantitative sampling, Paxton (1979) observed that *A. teres* lives where more wave action occurs, with *A. parateres* preferring more sheltered areas, and small *A. teres* living higher on the shore than larger individuals. Anecdotal evidence, from irregular observations from divers, indicates large kingworms occur at ocean depths >1.5 m and >200 m offshore.

The abundance of beachworms is extremely patchy within beaches, with dense patches (>15 m^{-2} or >190 $g.m^{-2}$) interspersed by large areas of few worms (Appendix 2). Anecdotal evidence also suggests that, at the scale of beaches, the size and abundance of beachworms varies considerably from year to year. Although it is recognised that sandy beach systems are highly dynamic, there is scope to improve independent survey designs (e.g. stratification of sampling areas) to better assess beachworm population dynamics. Physical attributes of beaches may be correlated with spatial patterns of commercial catch distribution, and the inclusion of physical attributes as co-variables may be useful to improve the precision and accuracy of estimates of beachworm population size.

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

Stock Status

On the basis of the evidence provided the NSW stock status of beachworms is classified as **sustainable**.

Consistent with previous assessments, a weight-of-evidence approach has been taken to assess the stock status of NSW beachworms. The sustainable classification for NSW Beachworms is supported by: i) patterns of catch and catch rate from across the fishery and within key regions; ii) reduced knowledge gaps regarding population size and structure and commercial size structure from ongoing research (Appendix 2 in Chick et al. 2021); and iii) outputs from a catch-MSY model assisted catch-only assessment, indicating that current biomass is depleted to 31% of maximum biomass (confidence interval 6% – 49%) and maximum sustainable yield (CI lower bound of MSY was 8.9 t; Appendix 3, in Chick et al. 2021).

However, this classification has been determined at a reduced level of certainty from that of the previous assessment. In 2019/20, decreased levels of catch and catch rate in the fishery, particularly in Regions 3 and 4 (that have consistently supported >50% and >25% of the total annual catch, respectively), and the persistence of low and decreasing levels in Region 1 (>10% of the total catch) indicate levels of fishable biomass have declined. Further, persistence of these patterns in Region 1, which are principally derived from one beach (Kingscliff), indicate a decreasing biomass exposed to ongoing levels of fishing mortality that are too high. These recent (2019/20) data are generally inconsistent with most of the trends in these measures observed up to the end of the 2018/19 fishing period, that were interpreted as positive indicators of fishery performance and stock status. Moreover, estimates of recreational catch indicate decreasing levels of retained catch from 2000/01 to 2017/18. An alternate and more negative classification of stock status would be made if there was continuation of declining trends or persistence of levels of commercial fishery standardised catch rate (kg.hr 1) substantially below long-term average levels over multiple years, and particularly if these patterns were consistent across multiple regions.

Fishery statistics summary

NSW catch records incorporate three periods of commercial fishery reporting i.e. prior to 1997/98, from 1997/98 to 2008/09 and from 2009/10 to present (see Appendix 1 in Chick et al. 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.

Catch was available to be reported by number of worms between 1997/98 and 2008/09, and a conversion factor of 50 worms to the kilogram was used to infer levels of catch in weight during this period where actual weight was not reported. In all other years, catch was reported by weight. Current data describing the mean weight of beachworms suggests this conversion factor over-represents the individual weight of beachworms and therefore the magnitude of the catch during this period. However, it is also possible that the average weight of beachworms has changed through time, such that the conversion factor employed reflected the correct weight per worm at that time.

Further, commercial fisher data from 2009/10 includes daily reporting to ‘c-squares’ or a ‘Grid Code’ consisting of a 5x5 nm grid overlaid on NSW, allowing identification of fisher data to spatial scales at this resolution. For this EGHG Fishery – Beachworm stock assessment report, this spatial reporting code has been utilised to allocate reported commercial fishing information (e.g. catch and effort) to Regions and Beaches. Misreporting of the Grid Code by commercial fishers in any year has been small (<5% of all records). Finally, a small percentage (<1%) of annual data have not had effort (hours) reported.

Nominal and standardised catch rates are presented. Nominal catch rate ($kg.hr^{-1}$) was calculated as the average of daily CPUE ($kg.hr^{-1}$), excluding records with catch >10 $kg.day^{-1}$ and effort =0 or >10 $hrs.day^{-1}$ and resulted in the exclusion of ≤5% of annual daily records within last 5 years. Catch rates (StdCPUE $kg.hr^{-1}$) were standardised using general linear models in the R package 'cede' (v. 0.0.4, Haddon 2018). Variables used were Year, Month of capture and Authorised Fisher. The variable Beach was also considered and excluded due to too few data points through time. Data were natural log-transformed prior to analysis. Model residuals were visually inspected for adherence to normality and trends in catch rates were compared to those generated using generalised linear models using the gamma distribution with a log link. Minimal differences were observed between the two standardisation methods; therefore, the general linear models were retained.

Notably, for the 2019/20 fishing period, a state-wide TAC for the commercial fishery of 7.7 t (i.e. 8 year average total catch from 2009/10 to 2016/17) was implemented for the EGHG Fishery – Beachworm. The TAC for the commercial fishery was increased to 8.5 t for the 2020/21 fishing period (NSW TAFC 2020; not reported in this assessment). Prior to the implementation of a TAC, management controls were implemented to assist with the transition to a share managed, TAC and individual transferable quota (ITQ) system. A state-wide interim total commercial access level (ITCAL) of 21.6 t was implemented in 2015/16, with Regional catch limits applied that summed to the state-wide ITCAL (DPI Fisheries 2014). The information presented in figures and tables below is summarised by financial year (July to June).

Catch Information

Commercial catch

Peak catches were recorded from 1994/95 to 2004/05, during which time there was some reporting of catch by number with total catch converted using an estimate of an average weight of a commercially harvested beachworm. Even taking a more conservative estimate of beachworm weight than has been reported previously, it is likely catches were substantially higher during this time than in more recent years.

State-wide fishery catch increased between 1984/85 and 1996/97 during an apparent developmental phase in the fishery, reaching a peak >35 t in 1996/97 (Figure 1). From 1997/98 catch generally decreased from >20 $t.yr^{-1}$ to about 10 $t.yr^{-1}$ between 2006/07 – 2009/10. The pattern of declining annual catches continued from 2009/10, where 11.3 t was reported (noting this was the time of transition to the current reporting system) to 2015/16 (~5.5 t). Since 2015/16, catches have averaged about 6 $t.yr^{-1}$ including a total catch of 7.3 t in 2018/19 (the last year prior to implementation of a TACC). Total catch in 2019/20 was 5.4 t, the lowest catch since 1984/85 and 2.3 t below the 2019/20 TAC. Importantly, these relatively recent (since 2009/10) patterns of change in catch for the state-wide fishery are not necessarily consistent with patterns at smaller spatial scales.

Since 2009/10, catches of beachworms have been reported from all regions defined within the EGHG Fishery (Regions 1-7). Regions 3 and 4 support about 80% of the annual harvest. With Regions 1 and 6 contributing consistent annual catches of 5-10% and Region 7, more recently irregular ~2%. Commercial fishing in Regions 2 and 5 has been limited to 3-4 years since 2009/10, with total annual catch contributions commonly <1%. In Region 1, levels of catch and standardised catch rate have been declining and levels in 2019/20 are among the lowest levels recorded since 2009/10, with fewer active fishers (2-3) in recent years than 10 years ago (Figure 2 and Figure 5). Region 3 supports the majority of the fishery catch (average 58% over the last 5 years). Catch in Region 3 recently increased to ~4 $t.yr^{-1}$ and at standardised catch rates substantially above the long-term average(Figure 2 and Figure 5). However, $StdCPUE_{hr}$ in 2019/20 declined substantially from that in the previous year, below the long-term average and to the lowest level since 2009/10. Since 2009/10, levels of annual catch in Region 4 (~25% of total catch over the last 5 years) have been variable but generally decreasing since 2012/13. In 2019/20, catch in Region 4 was 1 t, the lowest level since 2009/10. Standardised catch rates have been generally stable and within 95% confidence intervals of the long-term average, and above the long-term average in 2017/18 and 2018/19. In 2019/10, $StdCPUE_{hr}$ returned to a level consistent with the long-term average, from those recent highs. In Region 6, levels of catch have been relatively low but consistent, averaging ~5% of total catch over the last 5 years. $StdCPUE_{hr}$ has been stable or marginally increasing and within 95% confidence intervals of the long-term average since 2009/10 (Figure 2 and Figure 5).

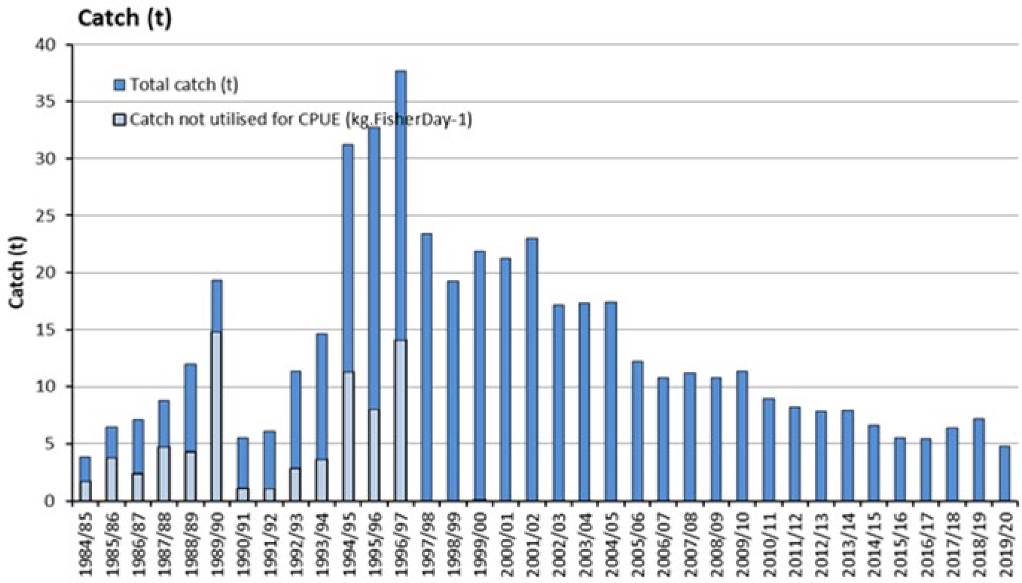

Figure 1 Annual commercial catch (t) of beachworms and catch not allocated to fishing days (for the purpose of calculating catch rate (kg.day^{-1}), from 1984/85 to 2019/20.

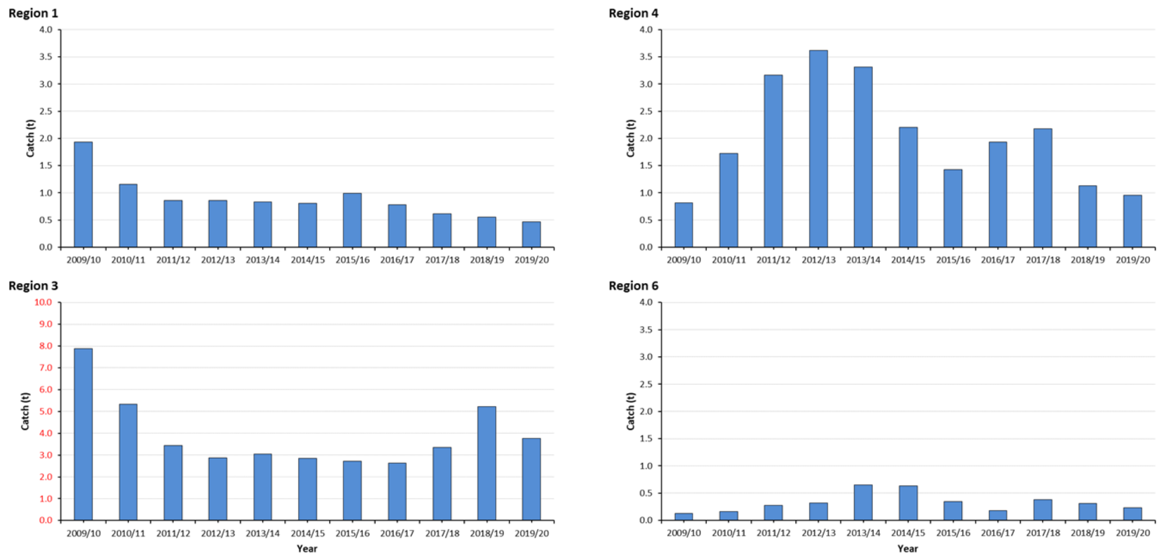

Figure 2 Region – Annual catch (t) of Beachworms from 2009/10 – 2019/20 for the top four regions (by catch).

Recreational catch

Recreational fishers either catch beachworms or purchase commercially caught beachworms for bait. In NSW, recreational fishers with a recreational fishing licence (unless exempt) may take up to 20 worms (or part thereof) per day. Estimates of recreational catch (total number retained) are available from the National Recreational and Indigenous Fishing Survey (2000/01, Henry and Lyle 2003) and NSW state-wide surveys (2013/14, West et al. 2015; and 2017/18, Murphy et al. 2020).

In 2000/01, the recreational harvest (kept numbers) was estimated to be 285,663 ± 72,697 worms (mean ± SE). At an average weight of 10 g (as defined for the conversion of commercial numbers of beachworms to weight), the 2000/01 estimate equates to a total recreational harvest of ~2.9 ± 0.7 $t.yr^{-1}$. In 2013/14 and 2017/18 the state-wide survey estimated the retained recreational catch of beachworms at 239,085 ± 85,662 and 54,046 ± 26,247 beachworms (i.e. ~2.4 ± 0.9 $t.yr^{-1}$ and ~0.5 ± 0.3 $t.yr^{-1}$), respectively. However, corrections made to the 2013/14 survey outcomes, to account for differences in survey designs, indicate there was less of a decline in recreational catch between the two times (2013/14: 1.5 t ± 0.8 t; Murphy et al. 2020). Notably, beachworm estimates from surveys in 2013/14 and 2017/18 were from a low sample size and the estimate from 2013/14 was associated with relatively high standard error (i.e. >40%; Murphy et al. 2020). Estimates of recreational catch from the raw survey outputs represent 13%, 30% and 8% of the reported commercial catch for those years, respectively.

Indigenous cultural catch

The benefits (and costs) of fishing and professional fishing to the cultural, broader social, health, wellbeing and economic value to Indigenous people and communities are substantial (Voyer et al. 2016). A synthesis of catch composition from Indigenous cultural fishing in NSW indicated that there are at least 18 species in the Estuary General Fishery that overlap with Indigenous fisheries (Schnierer and Egan 2016). Further, 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. The contribution made to Indigenous communities by Indigenous 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. In a survey based in the Tweed region, annual catch of beachworms by Indigenous fishers was estimated at between 1,869 and 4,350 worms (Schnierer 2011). Based on an average weight of 10 g, the catch from Aboriginal fishers in the Tweed region in NSW is estimated at <0.5 $t.year^{-1}$. Schnierer (2011) described beachworms as among the top 10 culturally most important species but they consisted of less than 5% of the total cultural catch in terms of total numbers of species.

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 beaches, related to minor incidents in both the commercial and recreational fishing sectors. The extent, frequency and the change in either, for any IUU fishing has not been published.

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. Estimated $effort_{dy}$ has generally reflected that of catch over the history of the fishery. It has increased from 945 FisherDays in 1984/85 to a peak of 7,442 FisherDays in 1996/97. Noting that during this period fishers were required to report their catch monthly and effort (in days fished) by gear type, not linked to catch unless only a single gear type was used and then not linked to species catch within a gear type. 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 EGHG fishers for each month where one method was reported. From 1997/98 to 2008/09, $effort_{dy}$ generally decreased from >6,000 fisher days to about 4,000 fisher days. Since 2009/10, $effort_{dy}$ continued to decline and had stabilised at about 2,000 fisher days.yr^{-1} between 2012/13 and 2018/19. In 2019/20, 1578 fisher days were estimated, the lowest $effort_{dy}$ since 1984/85. Similarly, effort in hours fished ($effort_{hr}$) generally declined from >10,000 hours in 2009/10 to stabilise at about 6,000 hours.yr^{-1} between 2015/16 and 2018/19 before a substantial decline to the lowest level of about 4,000 hours in 2019/20.

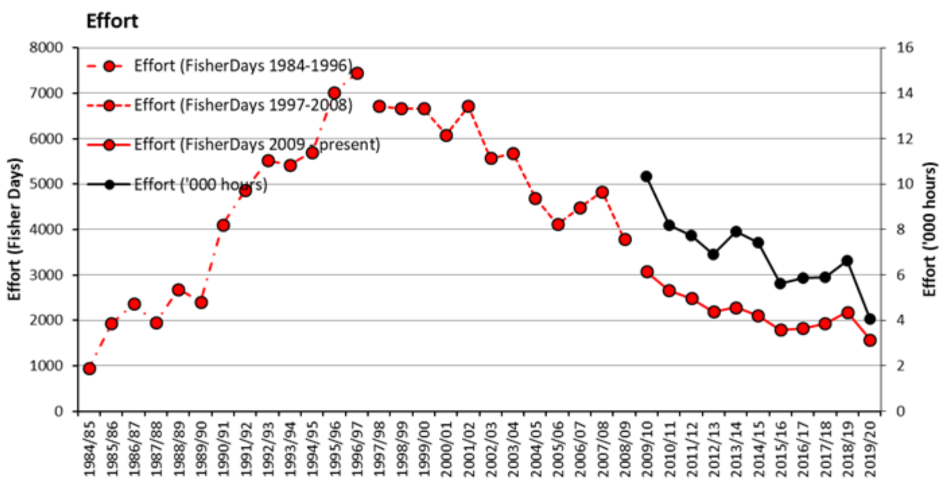

Figure 3 Annual reported commercial effort in units of FisherDays* (1984/85 to 2019/20) and hours (2009/10 to 2019/20). Note: changes in reporting requirements limit consistent interpretation of the effort (FisherDays) time series.

*Effort (FisherDays) (a) for July 2009 to present 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 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 dots 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) only available from 2009/10. Effort was adjusted where daily records reported <10 kg catch and effort reported as 0 or >10 hrs per day, using daily average CPUE and reported catch.

Recreational effort

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

Indigenous cultural effort

Data for Indigenous cultural fishing effort for Ghost Nipper are limited. 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 bait including beachworms was also seen to be important in delivering economic benefits to the community (Schnierer 2011).

Commercial

Catch per FisherDay ($CPUE_{dy}$) is a difficult indictor to interpret prior to 2009/10, for reasons outlined for the catch and $effort_{dy}$ time series. Nonetheless, $CPUE_{dy}$ was relatively low but highly variable (between 1 and 2.9 $kg.day^{-1}$) from 1984/85 to 1993/94. From 1994/95 to 2019/20, $CPUE_{dy}$ has generally remained between 3-3.5 $kg.day^{-1}$, except between 2005/06 and 2008/09 when it declined to a 14 year low of 2.3 $kg.day^{-1}$ in 2007/08. Since 2009/10, $CPUE_{dy}$ has generally decreased but remains above 3 $kg.day^{-1}$. Catch per hour ($CPUE_{hr}$) from 2009/10 to 2019/20 has averaged 1 $kg.hr^{-1}$ but increased steadily, and by 32% between 2014/14 and 2018/19 concurrent with relatively low levels of total catch prior to and during these years. In 2019/20, $CPUE_{hr}$ declined ~20% from previous record high levels in the previous year, to among the lowest levels since 2009/10. With this decline similar to that in effort and total catch. These fishery wide patterns have been driven by those in Regions 3 and 4, and are not necessarily consistent with patterns in other regions.

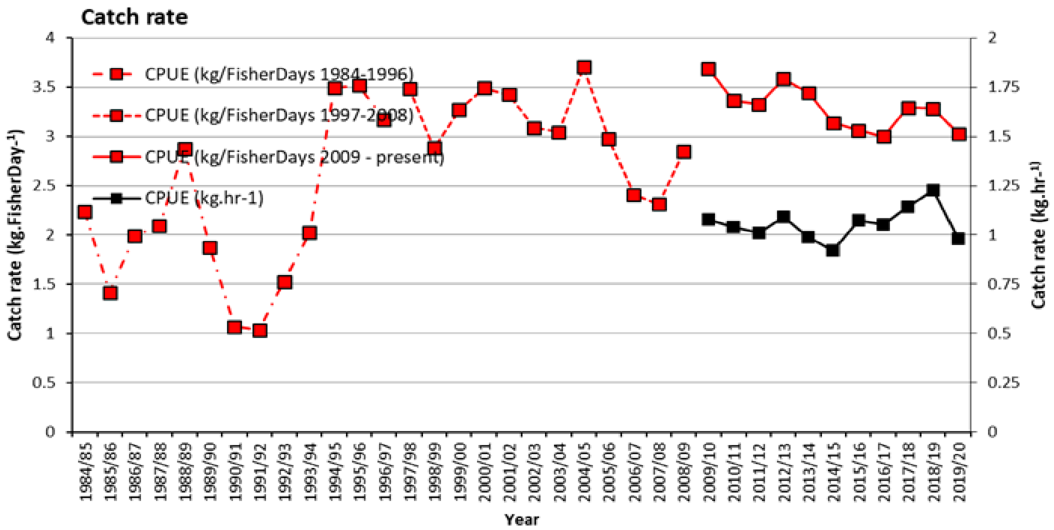

Figure 4 Annual commercial catch rate in units of $kg.FisherDays^{-1*}$ (1984/85 to 2019/20) and $kg.hr^{-1\#}$ (2009/10 to 2019/20). Note: changes in reporting requirements limit consistent interpretation of the catch rate ($kg.Fisher Day^{-1}$) time series.

#Catch rate (kg.hr^{-1}) nominal - calculated from average daily CPUE (kg.hr^{-1}), excluding records with catch >10 kg.day^{-1}; and/or adjusted effort =0 or >10 hrs.day^{-1} (excludes ≤5% of annual daily records within last 5 years). Data only available from 2009/10.

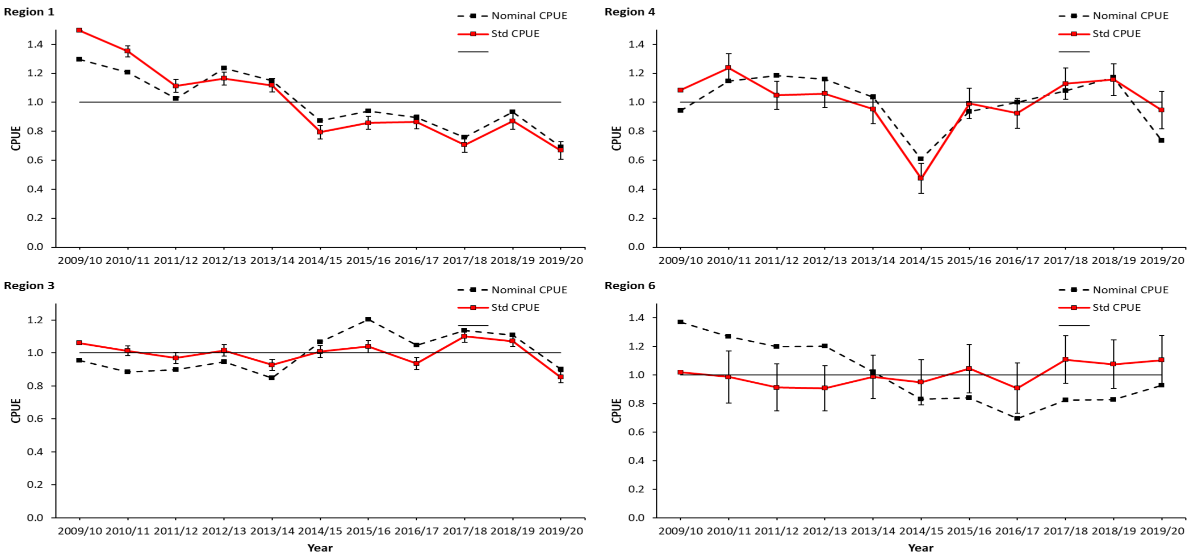

Figure 5 Region – Standardised commercial catch rates (kg.hr^{-1}; red lines with 95% confidence intervals) and nominal catch rates (dashed black lines) scaled to the 10 year average catch rate for the region (horizontal solid black line)

Stock Assessment – list of indicators

Most recent assessment	2021 – data up to 2019/20 – **Sustainable**
Assessment method	Weight of evidence - including standardised catch rates and Catch-MSY assessment
Main data inputs	Catch (commercial) – 1984/85 to 2019/20 Catch (recreational) – 2000/01, 2013/14, 2017/18 $CPUE_{dy}$ – kg.FisherDay^{-1} 2009/10 to 2018/19 Standardised $CPUE_{hr}$ – kg.hr^{-1} 20009/10 to 2019/20
Main data inputs (rank)†	Catch (commercial) – 1984/85 to 2018/19: (medium quality), long historical time series, but some reporting changes and likely misreporting, limited quality control/error validations Catch (recreational) – 2000/01, 2013/14, 2017/18 (medium quality), different survey methods add uncertainty to comparisons $CPUE_{dy}$ – kg.FisherDay^{-1} 1984/85 to 2018/19: (low quality) compromised by significant reporting changes and inaccuracies in effort data.

	$CPUE_{hr}$ – $kg.hr^{-1}$ 2009/10 to 2018/19: (medium quality) relatively short time series, some misreporting, some quality control/error validations.
Key model structure and assumptions	Weight-of-evidence – incl. standardised CPUE ($kg.hr^{-1}$); a catch MSY model assisted catch-only assessment (as a line of evidence). 1. Standardised catch rates R package 'cede' (v. 0.0.4, Haddon 2018). *Assumptions*: that annual catch rates are a relative index of abundance and not unduly influenced by other factors that are not accounted for through standardisation. 2. Catch-MSY model-assisted catch-only assessment (Martell and Froese, 2013) using the 'simpleSA' package in R (Haddon et al. 2018).This uses population productivity (*r*) and carrying capacity (*K*) parameters of an underlying Schaefer production model, applied to total annual catches, to estimate the ranges in biomass and harvest rate that could have resulted in the annual catches. *Assumptions*: Estimated ranges of the population growth rate parameter (r) and carrying capacity (*K*) of the stock are pre-determined through an assumed resilience; the underlying population biomass model is very generic and simplistic, with parameters that remain constant through time; the model outcomes are quite dependent on the lower bound of *r* selected (Martell and Froese 2013). 'Resilience' was set to low in the Catch MSY model specification, which allows for a possible range in population growth rate (*r*) of 0.1 - 0.6.
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. Catch-MSY - constant catch scenarios on the 5-year projections of estimated biomass and harvest rate trajectories.

† 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	Sustainable (2020); not SAFS species. (NSW jurisdictional level)
Current SAFS stock status	Sustainable (Chick 2021); not SAFS species. (NSW jurisdictional level)

Fishery interactions

Fishing for Beachworms in the EGHG Fishery is done by hand with hand collection of individuals. There are limited, if any interactions with other fisheries and no recorded interactions with TEPS or protected habitats.

Qualifying Comments

NSW catch and effort logbook data vary spatially and temporally across different eras, delineated by changes in catch reporting requirements and management changes.

Inconsistencies in the methodology to estimate recreational fishing catch through time provides some uncertainty around the direct comparison of estimates from different times.

Factors other than fishing, including land-based effects and other environmental factors, may affect change in the abundance and productivity of beachworms and are not considered in this assessment.

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