Vision

The Eastern Inshore Fisheries and Conservation Authority will lead, champion and manage a sustainable marine environment and inshore fisheries, by successfully securing the right balance between social, environmental and economic benefits to ensure healthy seas, sustainable fisheries and a viable industry.

Review of the cockle fishery Total Allowable Catch and rationale for potential changes

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Introduction of the TAC as a management tool

The use of an annual Total Allowable Catch (TAC) was first introduced as a management measure for The Wash cockle fishery in 1998. Prior to this introduction, the management measures for this fishery were generally limited to spatial closures to protect juvenile stocks and the use of a daily vessel quota to restrict landings. Whereas these measures had been sufficient to maintain the sustainability of previous hand-worked fisheries, they proved inadequate for effectively managing the hydraulic suction dredge fishery after dredges were introduced in The Wash in 1986. This was due to the greater efficiency of the equipment enabling the cockle densities to be fished to much lower levels than was previously possible. Because daily quotas were not an effective control on the overall exploitation, an annual quota system was devised that would limit harvests to a set proportion of the available stock.

Allocation of the annual TAC was based on a "rule of thirds", the basic principle being the fishery would be given a third of the available stock, while the birds received one third and the remaining third was to ensure the sustainability of the stock. In these calculations, only adult cockles (e.g. those that had attained a size of 14mm width) were considered.

Following its introduction, the utilisation of the TAC helped to improve sustainability of the cockle fishery and brought greater stability within the fishery from one year to the next. However, in the early 2000's conservation bodies questioned the scientific reasoning presented by a "rule of thirds" approach because it did not take into account actual bird numbers and, critically, whether a third of the stock was sufficient to satisfy their feeding requirements in years when stocks were low. Bird food models were, therefore, developed for The Wash to help better understand bird behaviours and their food requirements. Also during that period, a SSSI target of 24,000 oystercatchers was set for The Wash. Using the information gained from the bird food model, in conjunction with the SSSI target, enabled a shellfish biomass threshold to be calculated for the birds' feeding requirements. SSSI targets also introduced minimum thresholds to help maintain sustainability of the cockle stocks. These included a minimum threshold of 11,000 tonnes total cockle stock and 3,000 tonnes adult cockle stock. These thresholds and the bird food model were formally introduced into the cockle fishery management during the development of the Wash Shellfish Policies in 2008.

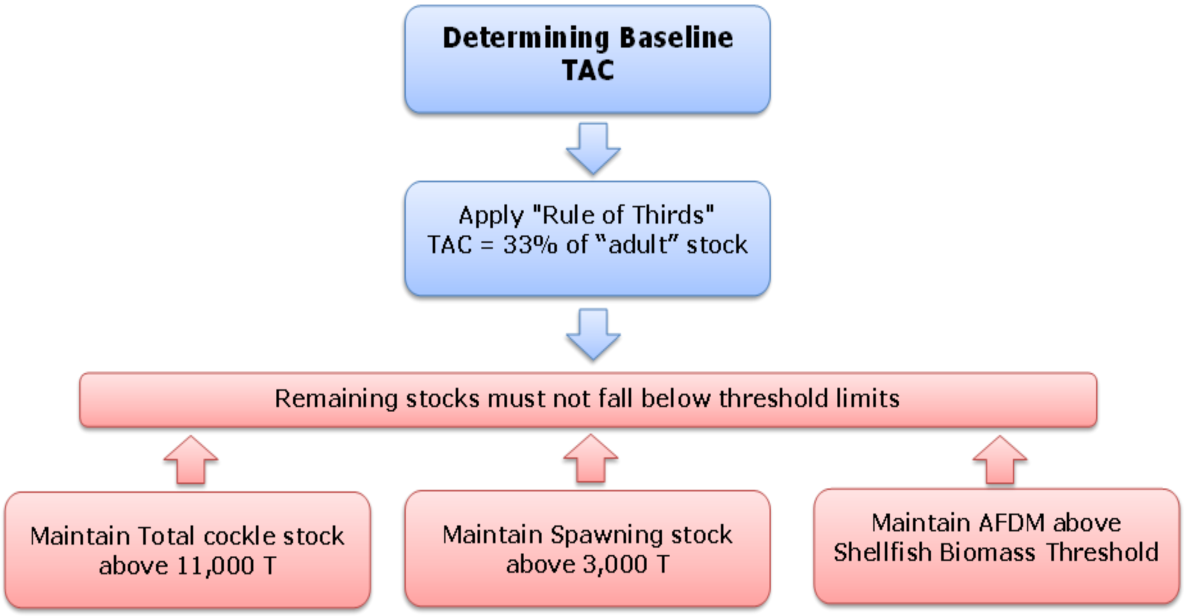

Figure 1 – TAC calculation and minimum conservation thresholds that apply in determining the size of annual cockle fisheries. (N.B. Shellfish biomass threshold for AFDM includes cockle and mussel stocks).

Impact of Atypical Mortality

Cockle mortality in The Wash tends to be high, whether as a result of predation, severe weather and/or storms or "ridging-out" caused by over-crowding. In 2008, however, significant cockle mortalities were seen that had different symptoms to the above causes. Here, cockles were observed to be unburied on the sands, gaping, weak and exhibiting slow response times. In the absence of an obvious cause, the die-offs were termed "atypical" mortality and have continued to occur each year since. Usually only a low percentage of the population appear moribund each day, but deaths continue through the summer and autumn period, resulting in a high cumulative mortality rate. It is impossible to isolate these "atypical" mortalities from other causes of mortality to determine how much cockle stock has been lost since 2008 specifically to atypical mortality, but losses during the three-year period between 2008 and 2010 alone were estimated to be 26,000 tonnes. By comparison, cockle landings during that same period were only 5,914 tonnes. During 2016, when cockle stocks were exceptionally high, losses were estimated to be 18,000 tonnes compared to 8,600 tonnes harvested, even though the fishery was targeted at vulnerable areas to minimise losses. Due to such high losses, atypical mortality has had a profound impact on both fishery management and fishing practices.

The cause of atypical mortality has recently been attributed by Cefas to a previously unrecorded *Marteilia* protozoa. It may also be linked to the cockles' spawning behaviour as individuals appear most vulnerable as they reach spawning size (approximately 14mm width). This preponderance for mortalities among larger individuals has resulted in a noticeable change to the cockle population demographics.

The average proportion of adult cockles within the population has declined since 2008 from 55.7% adult cockle biomass for the period 2000-2007, to 47.3% for the period 2008-2023. It has also resulted in a shift in the age structure of the population, from populations supporting several year-class cohorts to a situation in which the populations are now dominated with either a single or two young cohorts. These changes have had significant impacts on the fishery. Because the TAC is calculated as a third of the adult stock biomass, the reduction in the proportion of adult cockles has resulted in a reduction in the TAC in terms of the total stock. Of more significance, the loss of these older cohorts has meant the fishery can no longer effectively target purely larger cockles as it previously had, but have had to shift to targeting younger, smaller cockles. The management of the fishery has also adapted to the mortalities by actively focusing fisheries towards stocks that are considered vulnerable (to atypical mortality) before they die. This has meant targeting cockles that are on average a year younger than was the case previously.

While a necessary response for managing the fishery when faced with such high mortalities, targeting younger cockles is far from ideal. The reduction in older cohorts has reduced the resilience of the population and resulted in fewer cohorts for the fishery to target. This has placed a much greater reliance on successful annual settlements to support successive fisheries. Fortunately, since 2004 good settlements have been more frequent and regular than previously occurred, helping the cockle population to sustain the mortalities. Looking at the stock dynamics, the regularity of these settlements that have been occurring in a roughly 2-year cycle, might actually be driven by the mortalities and the resultant domination by Year-0 and Year-1 cohorts[1]. The year following a successful settlement, the stocks are dominated by Year-0 cockles that are too young to spawn, plus widespread low densities of Year-2 and older cockles. These Year-0’s appear less vulnerable to atypical mortality and survive to the following spring, when they become part of a dominant Year-1 cohort. By this stage, the older cockles that were present the previous year have generally died. The dominant Year-1 cohort spawns in late spring producing another successful settlement in the summer, but then succumbs to atypical mortality. As this cycle continues, the population alternates between stocks that are dominated by either Year-0 or Year-1 cohorts (see figure 2).

[1] When referring to age cohorts, these ages refer to the cockles at the time of the spring surveys, so a Year-0 cockle is one that settled the previous summer and is not yet a year old. However, come summer, these year-0 cockles will become Year-1 and a new settlement of Year-0’s will occur.

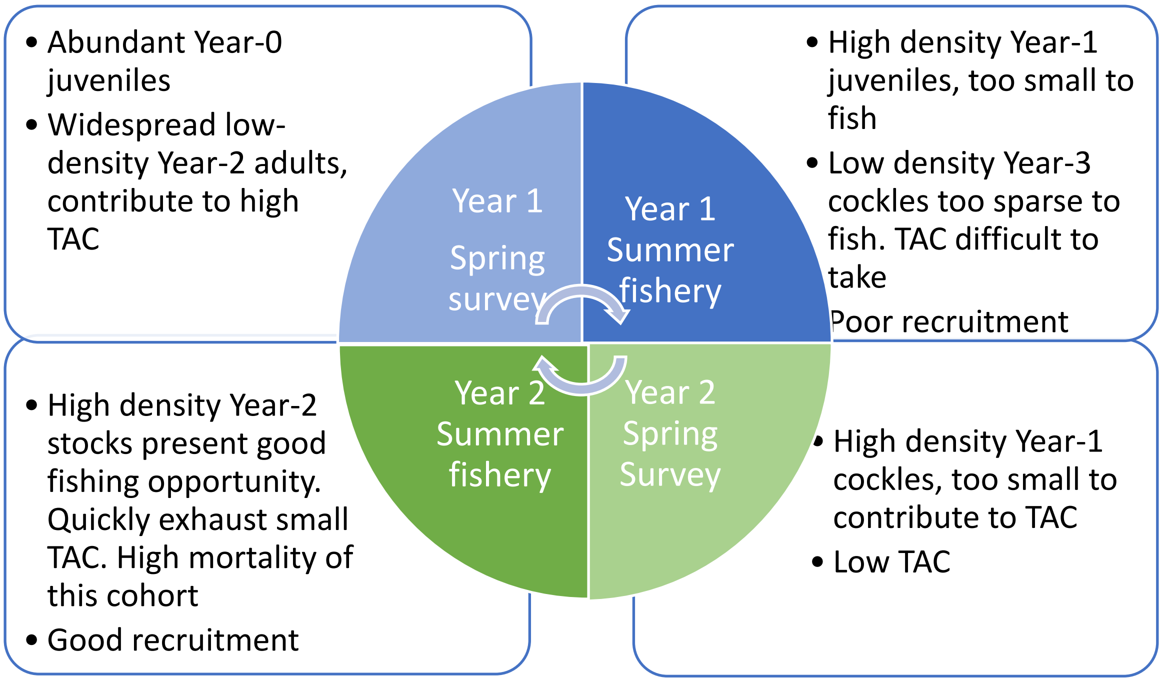

Figure 2 – Two-year cycle of cockle populations seen in The Wash since 2004

<u>Current issue with how the TAC is calculated</u>

As described above, the TAC was developed to restrict the impact that highly efficient dredge fisheries could have on the sustainability of the cockle stocks. The introduction of the TAC was ten years prior to atypical mortality first being observed in The Wash, when the cockles tended to live longer and as a consequence the population supported a broader demographic of age cohorts. This provided greater resilience to the fisheries, that generally had adequate populations of larger cockles to target from their available TAC. The current two-year cycle seen in figure 2, however, does not enable a good alignment between the abundance of fishable stocks and the size of the TAC.

At the time of the spring surveys in Year-1 of figure 1, there are high densities of Year-0 juvenile cockles that had settled the previous summer. In addition to these are surviving Year-2 adult cockles that are generally present in densities that are too sparse to fish, but because of their size, contribute to a relatively large TAC. This tends to lead to a situation in which the fishery has a large TAC but few stocks of fishable density to target – the Year-0 cockles (which by summer have become Year-1's) being too small and the Year-2 cockles (which by then have become Year-3's) being too sparse. Where Year-0 cockles have settled among the older cohorts, the older cockles often ridge out and die as competition for space increases. Juvenile cockles are also often disturbed, or even landed, by fishermen targeting the adult cockles among them.

At the time of the spring surveys in Year-2, because the older cohorts have generally died over the course of the previous summer, the stocks tend to be dominated by high density patches of Year-1 cockles. At the time of the survey, these tend to be smaller than 14mm width, so do not contribute towards the TAC. By summer, however, when these have become Year-2's, many will have reached a fishable size and present a good fishery resource. Having spawned during the early summer, the majority of this cohort will be vulnerable to atypical mortality, so mortalities tend to be high. Ideally the fishery would target the most vulnerable beds before they are lost, but with a small TAC, the opportunity is lost.

For the reasons described above, therefore, the existing method of calculating the TAC (1/3rd of adult cockle biomass) no longer reflects well with the availability of fishable stocks. During years when the resultant TAC is too small, good fishing opportunities are poorly exploited, often leaving cockles to die, while during years when the TAC is too high, efforts by fishermen to achieve the TAC can lead to heavier pressure on the beds, potential disturbance of juvenile cockles and occasional requests for faster-growing beds of juvenile stocks to be opened in autumn. The disparity between the size of the TAC and fishable stocks highlights that the existing method of calculating the TAC is no longer suitable. This review seeks to improve the balance between the size of the TAC the abundance of the available stock.

<u>Rationale for adopting an alternative approach for calculating the TAC</u>

When the dredge fishery was open, the TAC was a critical tool for preventing over-exploitation of the cockle fishery. There has not been a dredge fishery since 2008, however, so the requirement for a TAC is not as critical. Further, since 2008, additional minimum thresholds have been introduced that maintain stocks above conservation targets (see figure 1). With these safeguards in place, there is scope for adjusting the way in which the annual TAC is calculated with minimal risk to the protected conservation features of The Wash.

The main problem with the current method of calculating the TAC is that it is entirely dependent upon the size of the adult cockle population. Not only has the proportion of adult cockles declined since 2008 due to the effects of atypical mortality, these larger cockles are no longer the main target of the fishery due to their reduced densities. A proposed remedy for the situation, therefore, is to change the TAC calculation from the existing 1/3rd adult biomass to a calculation based on a proportion of the total stock. Looking at survey data for the period 2000-2023, the current method of calculation has generated a total TAC for the period of 95,625 tonnes. If during this same period a figure of 1/6th total biomass had been used for the calculating the TAC instead, the total TAC would have been 95,316 tonnes. Long-term, these figures are remarkably similar suggesting a change to using 1/6th total stock would be appropriate and not lead to the size of the TAC escalating significantly.

On first glance, adopting a system that allows the inclusion of juvenile cockles into the calculation gives the impression that more small cockles will be targeted by the fishery than under the current system. In reality, however, this approach should improve parity between the sizes of the available stock and the TAC without significantly increasing the amount of juvenile cockles targeted. This is because the industry has already needed to adjust to the change in stock dynamics resulting from atypical mortality by targeting smaller cockles before they die. Instead, the greater parity that would be achieved under the new system should actually encourage better fishing practices and reduce potential disturbance of Year-0 juvenile stocks.

After using the same calculation for many years, there could also be concern that the change in approach could lead to either large inflation or loss in TAC. As mentioned above, however, the long-term difference in allocated TAC between the two methods is surprisingly small. Based on cockle stock figures for the period 2000-2023, the current method has resulted in an average annual TAC of 3,984 tonnes. During the same period, a TAC based on 1/6th total stocks would have produced an average of 3,971 tonnes. The difference between the figures generated by the two approaches widens when the figures are broken down into periods pre- and post- atypical mortality, as shown in table 1. The existing system based on 1/3rd adult stocks benefited the fishery pre-2008, but a system based on 1/6th total stock benefits the current situation post-2008. Nevertheless, due to the overall reduction in stocks as a result of the high annual mortalities, even under the proposed system, the average TAC would still be lower than that produced by the current system pre-2008.

Table 1 - Average TAC figures for the periods prior to and after atypical mortality, using the two approaches

Period	1/3 adult	1/6 total
2000-2007	4506	3900
2008-2022	3724	4007

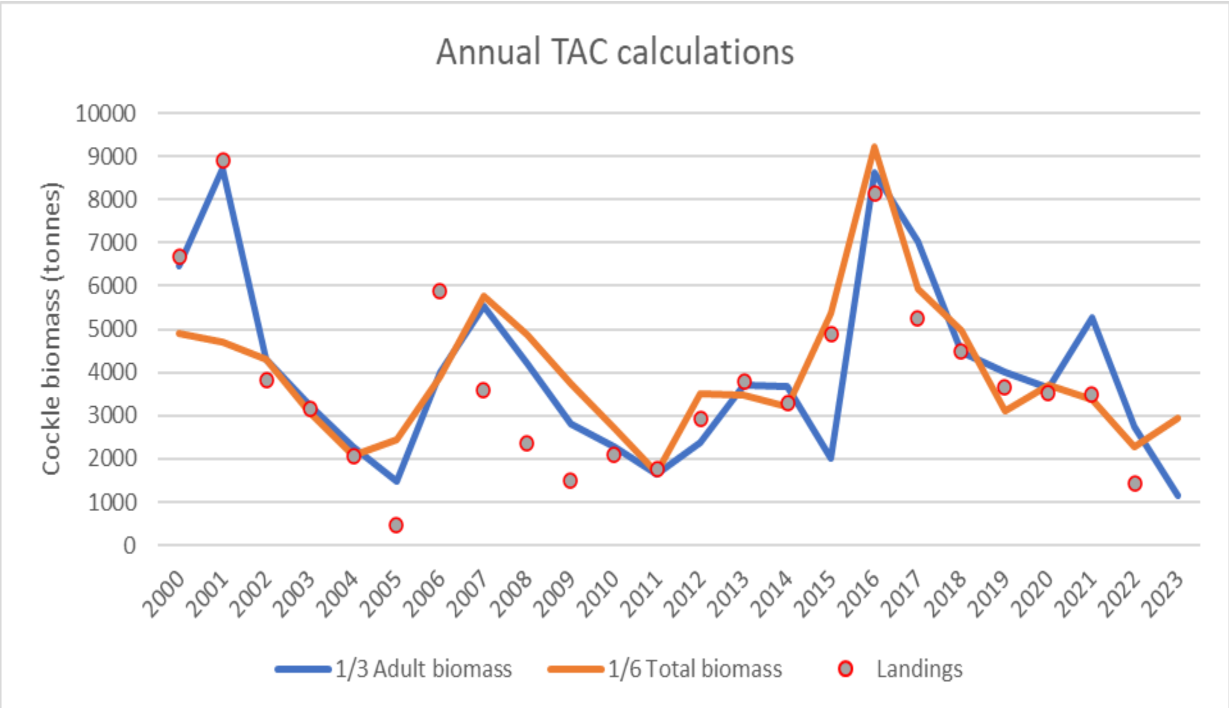

Figure 3 – The size of annual TAC's based on 1/3rd adult and 1/6th total stock approaches, and annual cockle landings

Figure 3 compares the size of the annual TAC's that would be produced by both approaches. Barring three years when there were large differences between the biomass of adult and juvenile cockles, the two approaches produce a broadly similar TAC. This shows most years there are no large-scale differences between the two approaches that would result in a concerning increase or loss in the size of the TAC should the new approach be used. Using the proposed approach, however, these differences would act to positively align the size of the TAC with the availability of fishable cockle stock.