Stock Assessment of the Blue Mussel (*Mytilus edulis*) Beds at Lindisfarne 2024

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Summary

The aim of this report as in previous years is to provide information of the health and distribution of the *Mytilus edulis* beds at Fenham Flats and Holy Island Sands. The perimeter of the mussel bed was mapped, and percentage cover of mussels was estimated using the ‘Walker and Nicholson’ technique. Biomass, density and total number of mussels at each mussel bed were also calculated, with samples of mussels were collected, and total shell length and weight were measured.

Key results:

- Percentage cover at Fenham Flats and Holy Island in 2024 were the lowest recorded for each site since surveys began, 3.7% and 3.3% respectively.
- The estimated values obtained for density, biomass and total number of mussels have decreased significantly compared to the 2023 surveys at both sites.
- Mean mussel length at Fenham Flats has continued to follow an increasing trend, whereas mean mussel length at Holy Island was lower than in previous years, exhibiting a pattern of decline.

Introduction

The blue mussel (*Mytilus edulis*) is a filter-feeding bivalve mollusc consuming phytoplankton, and other particulate organic matter. It can be found on a variety of substrata in the intertidal zone of boreal and temperate waters, in both the southern and northern hemispheres (OSPAR, 2010). The blue mussel often accumulates to form beds and can tolerate a wide variety of environmental conditions including fluctuations in salinity, oxygen, temperature, and desiccation (Andrews et al., 2011). Mussels can form dense beds (Fenton, 1978) using byssus threads to attach to the substratum (Babarro *et al.,* 2008) and can be considered a biogenic reef. The dense beds which occur in both fully saline and estuarine waters form natural reefs or biogenic reefs which enhance biodiversity (Gardner, 1996). Mussel beds are included in the OSPAR (Annex V) list of threatened and declining species and habitats and are also listed as a Habitat of Principle Importance under the Natural Environment and Rural Communities Act, 2006.

In 2005, the Northumberland Sea Fisheries Committee (NSFC) (now Northumberland Inshore Fisheries and Conservation Authority (NIFCA)) was approached by Natural England (then English Nature) who requested that NSFC conduct a stock assessment survey of the mussel beds at Fenham Flats, Lindisfarne in order to consider re-opening the mussel beds to commercial harvesting within the Lindisfarne National Nature Reserve. The beds were harvested for several years, before meat quality was deemed insufficient, and harvesting was discontinued in 2010. NIFCA has continued to carry out annual surveys at the site, providing an annual and unique long-term record of the population dynamics of the mussel bed.

NIFCA has a long-term record of the population dynamics of the mussel bed at Fenham Flats and the results from recent years have shown a decrease in mussel bed density. The results over time also show an increase in mean mussel size with the largest value recorded to date observed in 2015. Further study was deemed essential to determine if the trends discussed are because of recruitment failure, natural temporal variation, or local factors specific to the Fenham Flats site. NIFCA therefore decided to expand the 2018 mussel surveys to include two additional sites, Holy Island Sands and St Cuthbert's, to compare the results from Fenham Flats with other nearby mussel beds. The mussel beds were partly surveyed in 2018 because of tides. Only Holy Island Sands was deemed comparable (similar underlying substrate and functionally displaying 'bed' characteristics i.e., aggregated mussels) to Fenham Flats mussel bed, therefore this site has been surveyed annually since 2018.

Methods

A series of surveys have been conducted on the mussel bed at Fenham Flats and Holy Island Sands annually since March 2006 and March 2018 respectively. The survey was conducted at low water during spring tides on the 12th and 13th March 2024 by NIFCA officers.

Study Sites

Fenham Flats

Fenham Flats is located on the extensive mudflats south of Holy Island, located within the Lindisfarne National Nature Reserve (NNR) (Figure 1).

Holy Island Sands

Holy Island Sands is located within the shallow, semi-enclosed embayment between the western side of Holy Island and the mainland (Figure 1). This study site is relatively small compared to the neighbouring mussel bed area at Fenham Flats. This site appears to be an important feeding area for a number of nationally important bird species, similar to Fenham Flats, that feed on the mussel beds.

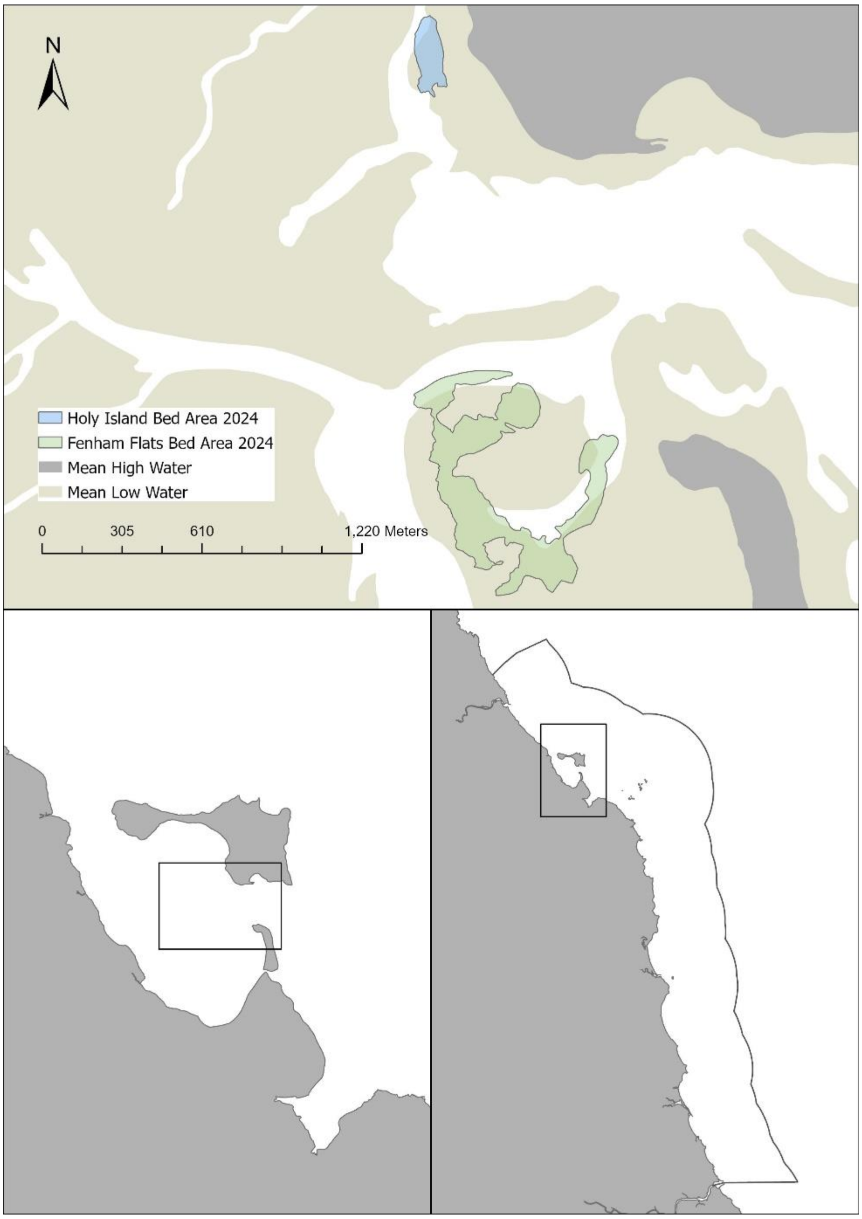


Figure 1: Fenham Flats and Holy Island mussel beds in 2024

Survey Methods

Two Inshore Fisheries & Conservation Officers (IFCOs), one of whom has previously walked the perimeter, walk the perimeter with a handheld GPS. Confidence in the accuracy of the area is low as the area of the mussel bed is often difficult to define and is becoming increasingly difficult as the trend of overall decline continues. There is no WFD definition of what constitutes a mussel bed so it can be subjective to define mussel bed area. The information previously collected was exported as a GPX file from the GPS using the Garmin GPS software Basecamp and then imported into ARC GIS to map and calculate the area of the mussel bed.

The percentage cover of mussels on the mussel beds were estimated using the 'Walker and Nicholson' survey technique (Walker and Nicholson, 1986). Surveyors walked in a zigzag pattern across the mussel beds, in randomly determined directions, recording the proportion of footsteps landing on live mussels. The total number of steps was selected at random at the start of each transect and ranged from 47 to 372 at Fenham Flats and 80 to 156 at Holy Island. Percentage cover was then calculated using the following equation:

$$Percentage\ Cover\ = \frac{Number\ of\ footsteps\ landing\ on\ live\ mussels}{Total\ number\ of\ footsteps} \times 100$$

A sample was taken at the start and end of each transect from within a 0.1m² sampling quadrat. Location of the quadrats was recorded using a handheld GPS. The samples were sieved and cleaned in intertidal pools to remove sediment (Figure 2). The number of mussels per $1m^2$ was later calculated so that further calculations could be compared between sites.

Figure 2: Surveyors using the methodology employed for the Fenham Flats mussel bed survey.

The samples were processed removing dead shells and debris from the living mussels. Total shell lengths of all the mussels sampled were then measured (to the nearest millimetre) using a Vernier calliper and divided into the following size groups: <45mm, 45-54mm and >54mm. The total weight (in grams) of mussels in each size category was also recorded for each sample. The density of mussels on the mussel bed was then calculated using the following equation:

$$Mussel\ Density\ (number/m^2)\ = \frac{Number\ of\ mussels\ per\ m^2\ x\ Percentage\ Cover}{100}$$

The total biomass of mussels on the mussel bed was then calculated using the following equation:

$$Mussel\ Biomass\ (g/m^2)\ = \frac{Total\ mussel\ weight\ per\ m^2\ x\ Percentage\ Cover}{100}$$

$$Mussel\ Stock\ Biomass\ (tonnes) = \frac{Area\ of\ bed\ (m^2) \times\ Mussel\ biomass\ (g/m^2)}{1\ 000\ 000}$$

The estimated total number of mussels was also calculated using the following equation:

$$Number\ of\ Mussels\ = Mussel\ Density\ (number/m^2)\ \times Area\ of\ bed\ (m^2)$$

Results

For the surveys in 2024, a total of 13 samples (all mussel material – live, dead, empty shells – in a $0.1m^2$ sampling quadrat) were taken from the Fenham Flats mussel bed, with a total of 18 live mussels sampled. For Holy Island, 8 samples were taken, containing 14 live mussels. A summary of the survey results for Fenham Flats and Holy Island can be seen in Table 1 and Table 2.

Table 1: Results for the Fenham Flats mussel survey between 2006 and 2024.

Year	Bed area (ha)	Average % cover	Total number of mussels (millions)	Mean shell length (mm)	Mussel density (no./m^2)	Biomass (g/m^2)	Total biomass (tonnes)
2006	41.53	60	133.6	41	321.6	4,480	1,861
2007	37.18	79.81	193.2	45	519.5	8,396	3,122
2008	36.72	78.58	338.5	40	921.7	12,895	4,734
2009	34.43	72.1	288.5	34.5	837.8	9,020	3,105
2010	36.28	78.41	376.4	34.7	1037.3	9,974	3,618
2011	45.65	64.91	243.6	36	533.5	5,498	2,510
2012	43.8	67.9	178.1	43.5	406.7	5,364	2,349
2013	41.3	66.5	128.8	48.2	311.8	5,642	2,330
2014	31.82	54.84	95.6	47.42	300.5	5,776	1,838
2015	40.49	69.01	147.3	49.56	363.6	7,232	2,928
2016	44.9	59.95	115.1	51.2	230.2	5,916	2,654
2017	42.9	58.61	58.4	55.5	145.9	4,822	2,068
2018	39.7	54.8	62.2	50.76	156.61	4,336	3,141
2019	46	41.8	31.0	57.83	67.3	2,503	1,151
2020	52.66	42.9	15.1	59.95	28.74	971	511
2021	46.58	43.47	13.6	44.67	29.12	828	386
2022	46.58*	17.39	2.1*	47.35	4.43*	149	70*
2023	48.10	4.37	0.2	48.32	0.52	19	9
2024	20.81	3.67	0.1	52.89	0.51	20	4

*calculated using 2021 bed area

Table 2: Results for the Holy Island mussel survey between 2018 and 2024.

Year	Bed area (ha)	Average % cover	Total number of mussels (millions)	Mean shell length (mm)	Mussel density (no./m^2)	Biomass (g/m^2)	Total biomass (tonnes)
2018	3.11	90	8.58	35.15	276.0	3,749	116.58
2019	4.04	66	5.07	48.08	125.4	2,314	93.48
2020	4.02	75	4.31	48.29	107.25	2,072	83.3
2021	3.59	59	2.52	40.64	70.31	1,188	42.66
2022	3.41	70	0.86	42.02	25.2	496	16.92
2023	3.01	11.5	0.06	46	1.88	40	1
2024	2.53	6.27	0.03	35.79	1.10	17	0.43

Bed Area

With the continued decline of the mussel beds at Fenham Flats and Holy Island, there is increasing uncertainty with the accuracy of bed area estimates. Despite the uncertainty with the accuracy of bed area estimations, there was a significant and very noticeable decline in the bed area at Fenham Flats in 2024 when compared to 2023 (Table 1 and Figure 3), which has fallen by around 57%. A similar decline has been observed at Holy Island since the peak bed area in 2019, with the bed area in 2024 16% lower than that observed in 2023 (Table 2 and Figure 4).

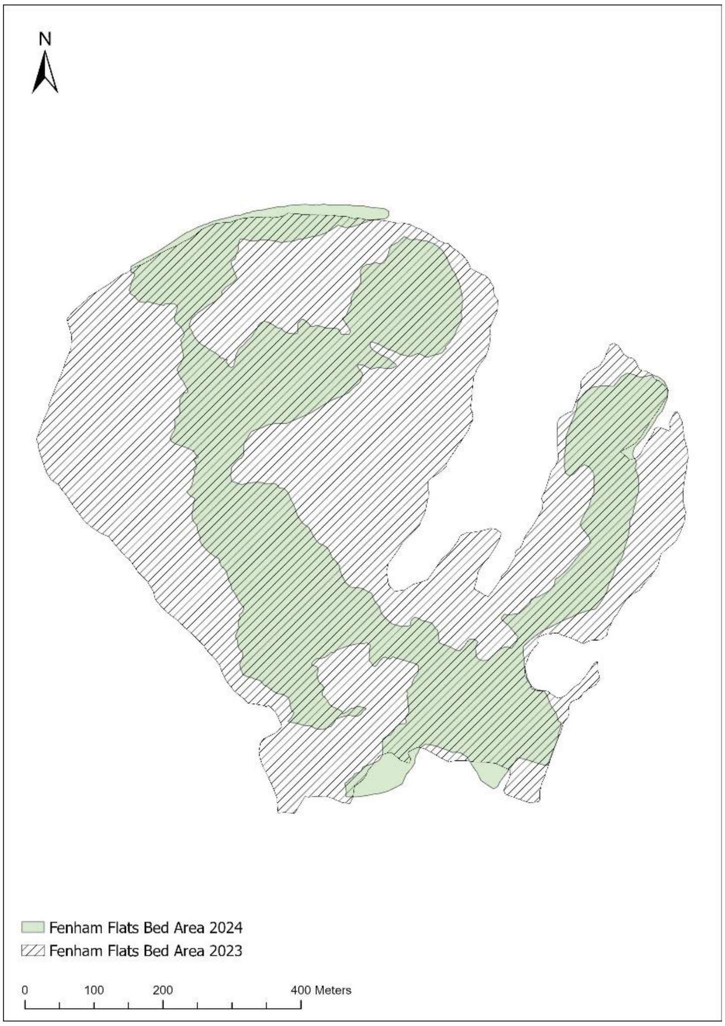


Figure 3: Fenham Flats estimated bed area from the 2023 and 2024 surveys.

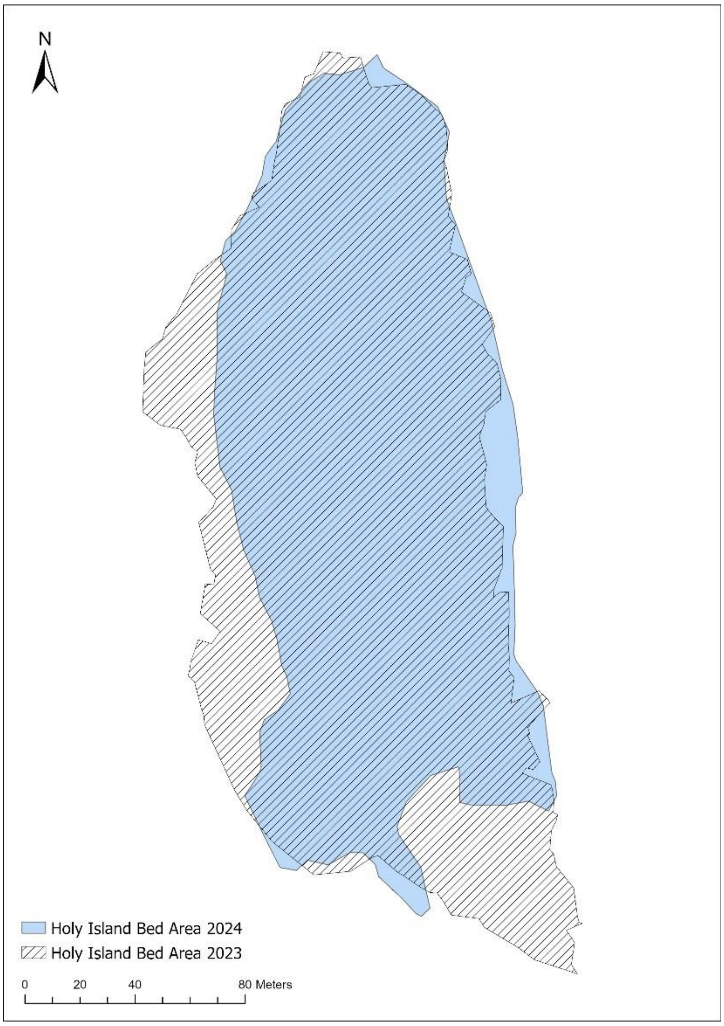
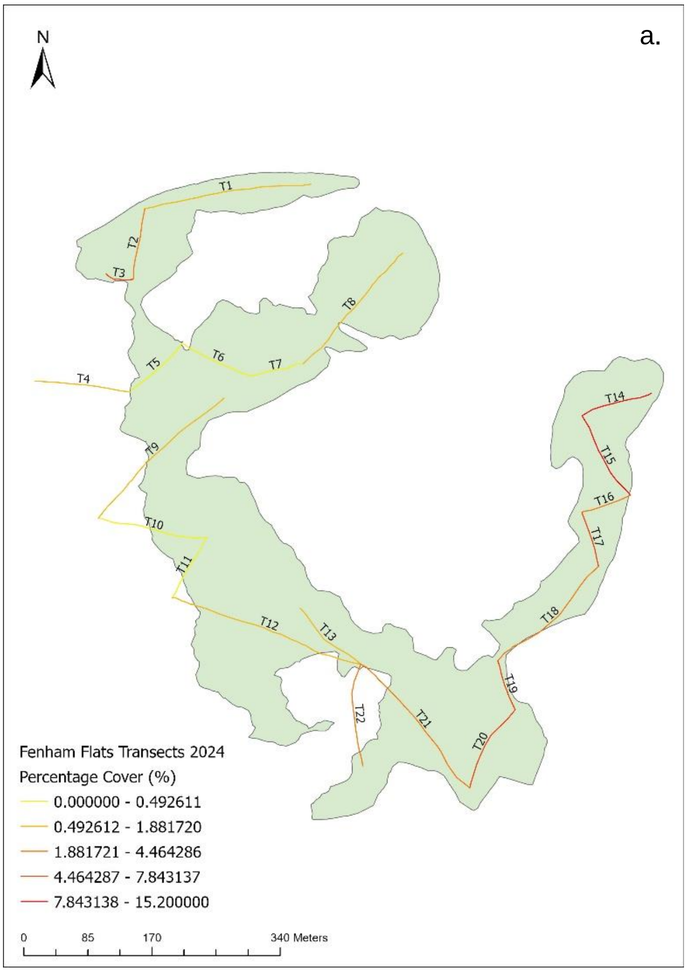
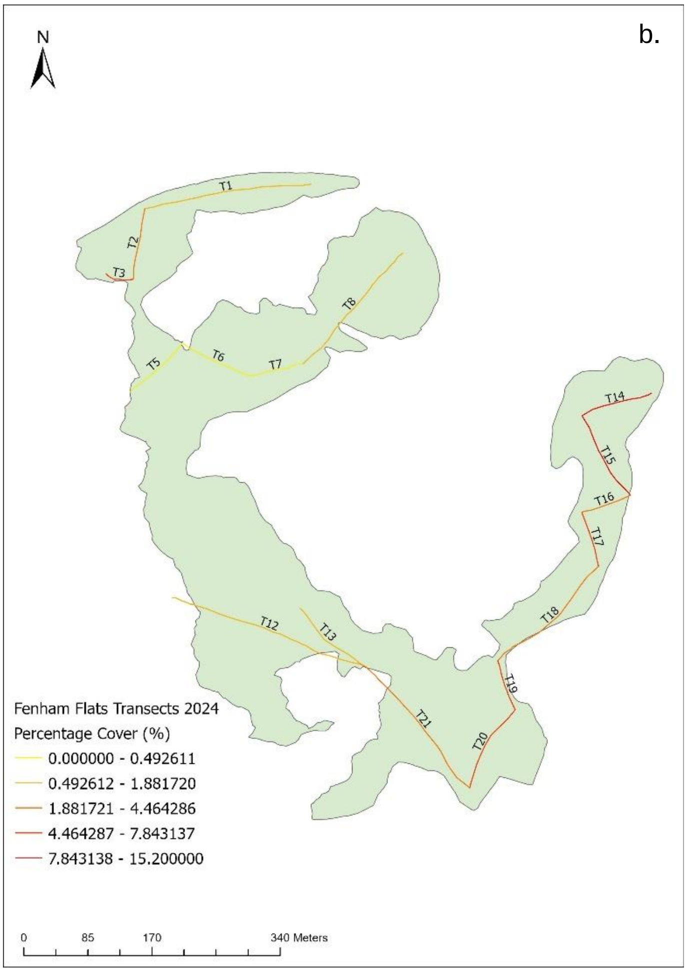


Figure 4: Holy Island estimated bed area from the 2023 and 2024 surveys.

Percentage Cover

Due to the difficulties with classifying the bed area, 5 transects at Fenham Flats were either entirely or partially outside of the estimated bed area (Figure 5a, Figure 6b & Table 3). These transects were subsequently removed from the analysis. Percentage cover across the Fenham Flats mussel bed was highly variable (0-15.2%), with higher percentage cover observed in the southeast area of the bed. The Holy Island mussel bed also displayed similar variation across the site (1-15.3%), although no clear pattern in percentage cover distribution was observed (Figure 7 & Table 4). Percentage cover for both Fenham Flats and Holy Island were lower in 2024 than that observed in 2023, falling from 4.37% to 3.67% and 11.5% to 6.27% respectively (Table **1**, Table **2** & Figure 8). Both mussel beds have shown a clear trend of decline, with a significant decline at both sites noted in the 2023 survey.





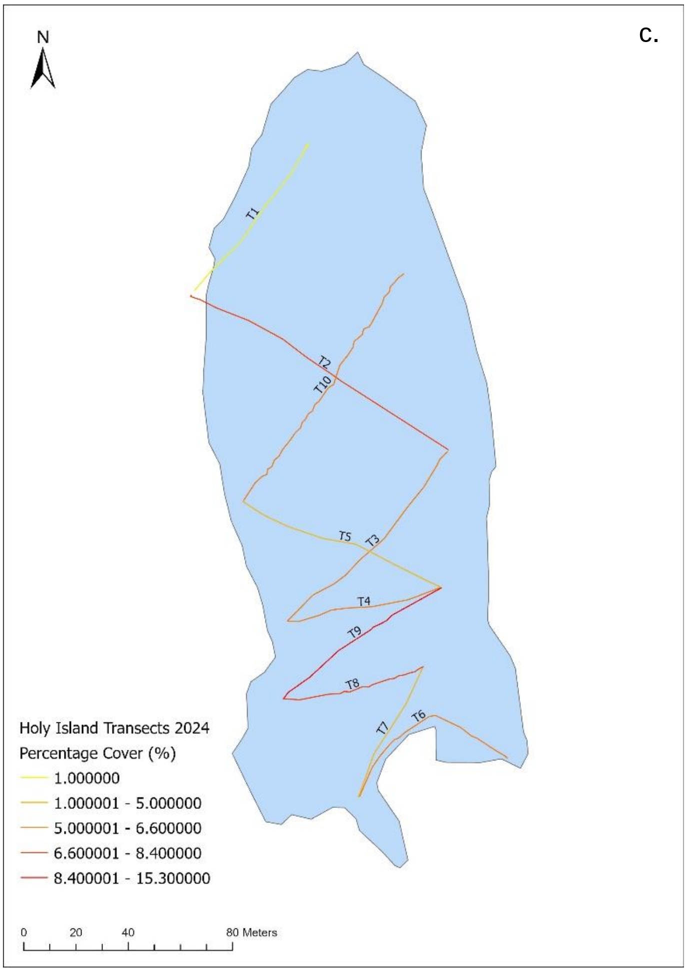


Figure 5a: Percentage cover recorded over the transects walked throughout the Fenham Flats mussel bed in 2024.

Figure 6b: Transects used as part of the analysis of the percentage cover of the Fenham Flats mussel bed in 2024.

Figure 7c: Percentage cover recorded over the transects walked throughout the Holy Island mussel bed in 2024.

Table 3: Percentage cover estimates from transects across the Fenham Flats mussel bed in 2024, highlighting the transects removed from the analysis and percentage cover estimations for the bed.

Transect Number	Percentage Cover	Comments
T1	0.7%	
T2	4.5%	
T3	6.4%	
T4	1.2%	Removed from analysis, outside of bed.
T5	0%	
T6	0%	
T7	0%	
T8	0.7%	
T9	0.7%	Removed from analysis, partially outside of bed.
T10	0.5%	Removed from analysis, partially outside of bed.
T11	0%	Removed from analysis, partially outside of bed.
T12	1.9%	
T13	1.3%	
T14	15.2%	
T15	13.7%	
T16	3.6%	
T17	7.8%	
T18	2.8%	
T19	6.8%	
T20	6.3%	
T21	3.1%	
T22	3.7%	Removed from analysis, outside of bed.

Table 4: Percentage cover estimates from transects across the Holy Island mussel bed in 2024.

Transect Number	Percentage Cover	Comments
T1	1%	
T2	8.4%	
T3	6.6%	
T4	6%	
T5	5%	
T6	5.5%	
T7	1.1%	
T8	7.5%	
T9	15.3%	
T10	6.4%	

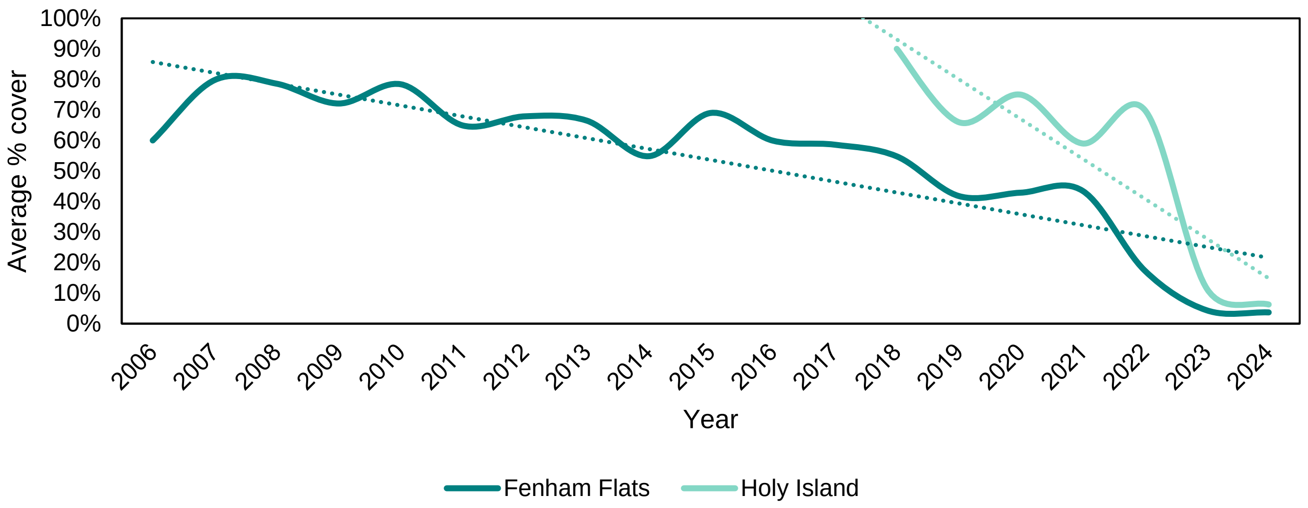


Figure 8: Average percentage cover estimates for Fenham Flats and Holy Island for the years they have been surveyed, with trendlines highlighting their associated declines.

Mussel Density

Mussel density for the Fenham Flats mussel bed peaked in 2010, at around 1,037 mussels/m^2, however since then density has declined significantly, to 0.5 mussels/m^2 in 2024, although this is a similar figure to that estimated as part of the 2023 surveys. A similar trend is observed in the Holy Island mussel bed data. With a decline in density from the beginning of the surveys in 2018 of 276 mussels/m^2 to 1.1 mussels/m^2 in 2024 (Table **1**, Table **2** & Figure 9). This is a decline of 99.6% for both Fenham Flats and Holy Island since their respective peaks.

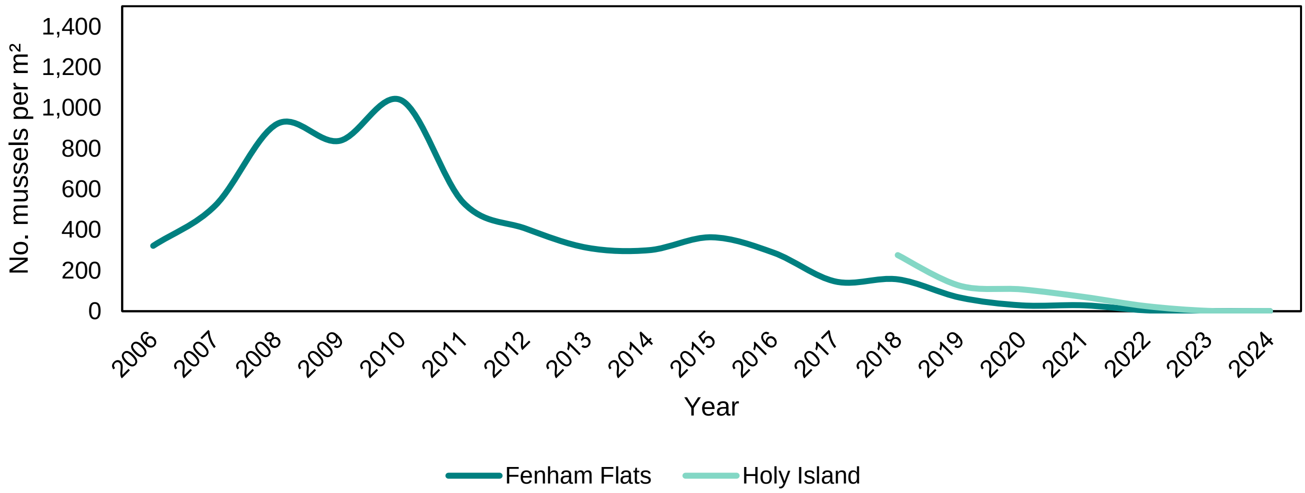


Figure 9: Mussel density estimates for Fenham Flats and Holy Island for the years they have been surveyed

Length Frequency

Despite the survey at Fenham Flats commencing in 2006, length frequency data was only available from 2013. In 2024, 18 mussels were collected from 13 sampling sites at Fenham Flats and 14 mussels were collected from 8 sampling stations at Holy Island. Both sites displayed a bimodal distribution in mussel size (Figure 10 & Figure 11), although given the low numbers found at each site, a true understanding of the population distribution is difficult to determine. At both mussel beds, mussels were found in lower frequencies than the 5-year averages.

At Fenham Flats, the samples were dominated by the >54mm size class in 2024, accounting for 61% of the mussels sampled (Figure 12), whereas those sampled at Holy Island were typically in the smaller size classes where 79% of those sampled were <54mm (Figure 13). At Fenham Flats there has been a consistent trend in recent years of evidence of poor recruitment at the site, with the population dominated by larger individuals. Conversely, at Holy Island, there appears to be better evidence of recruitment at the site, with relatively larger numbers of mussels found <15mm, yet fewer larger mussels present.

Due to the low number of mussels in the samples at both sites, spatial patterns of size distribution are difficult to determine and are subject to a degree of uncertainty. Despite this, from the 2024 survey at Fenham Flats, most of the mussels in the samples came from the southernmost areas of the bed, with the larger sizes (>54mm) more commonly found here as well (Figure 14). This differs from previous years, where the northernmost areas of the site were more densely populated. No such trend of distribution was recorded at the Holy Island mussel bed, with no clear pattern emerging from the data (Figure 15).

Diverging trends in mean mussel length were observed, with an increasing trend found at Fenham Flats and a decrease in mean mussel size observed at Holy Island (Figure 16). Mean mussel size in 2024 increased to 52.9mm from 48.3mm in 2023 at Fenham Flats, whereas meal mussel length fell from 46mm in 2023 to 35.79mm in 2024 at Holy Island. Due to the low number of mussels sampled at both mussel beds, there is increased uncertainty with these trends, however the results from 2024 do conform to previously observed trends in the data.

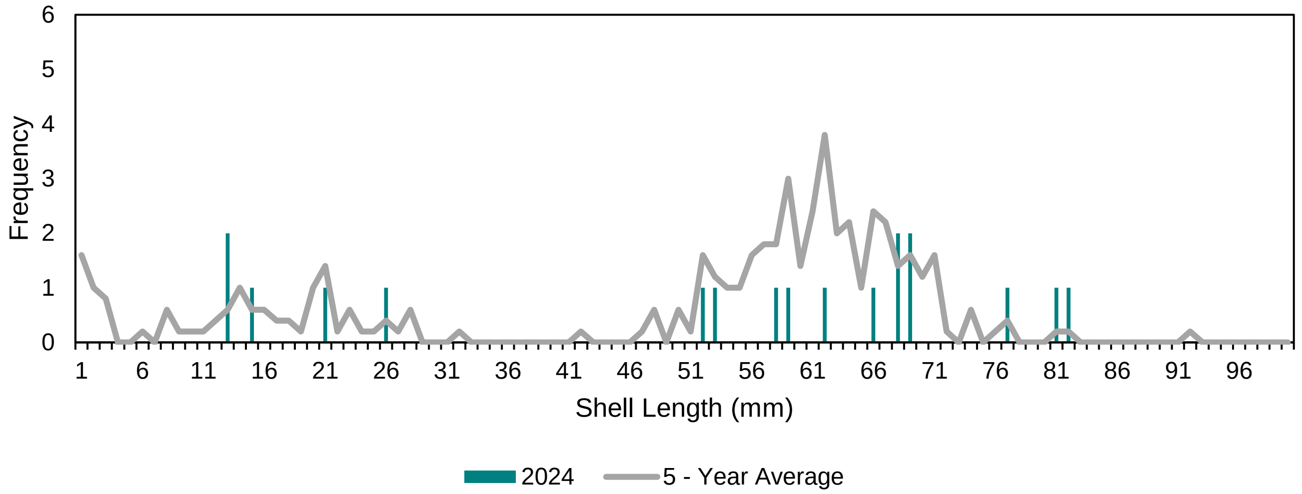


Figure 10: Length frequency (number of individuals in each mm size class) for mussels sampled in the 2024 survey of Fenham Flats, as well as the 5-year average frequency for the mussel bed.

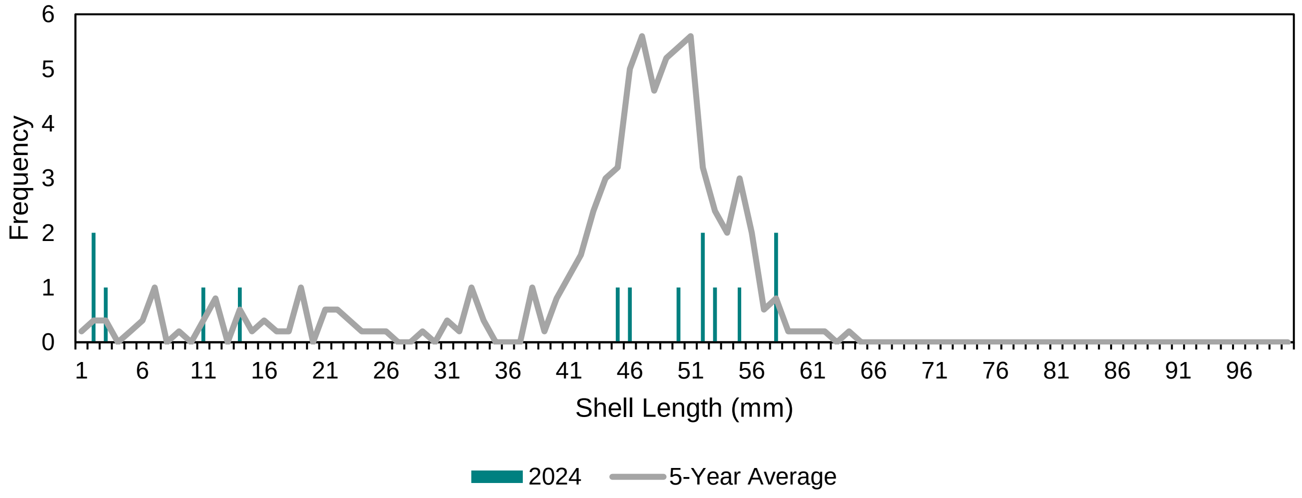


Figure 11: Length frequency for mussels sampled in the 2024 survey of Holy Island, as well as the 5-year average frequency for the mussel bed.

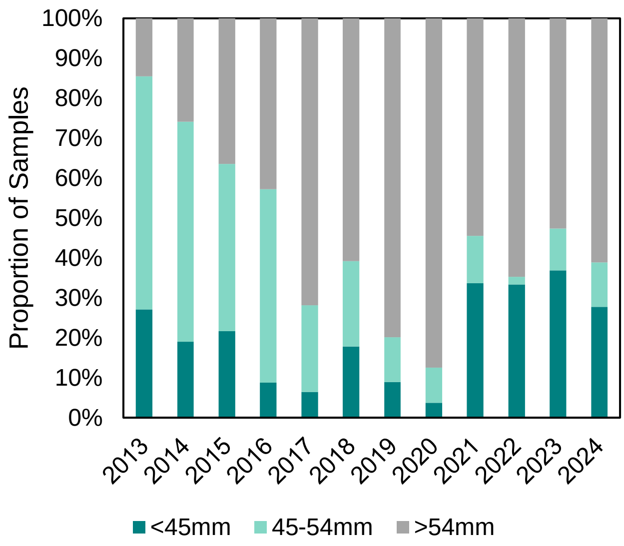


Figure 12: Proportion of the <45mm, 45-50mm and >50mm size classes at Fenham Flats.

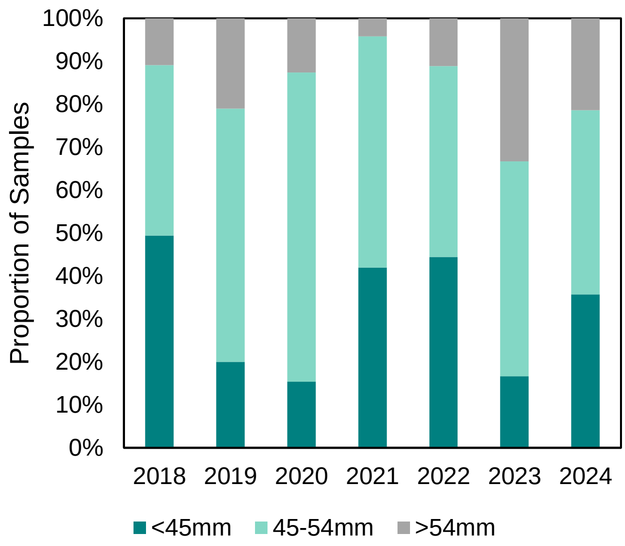


Figure 13: Proportion of the <45mm, 45-50mm and >50mm size classes at Holy Island.

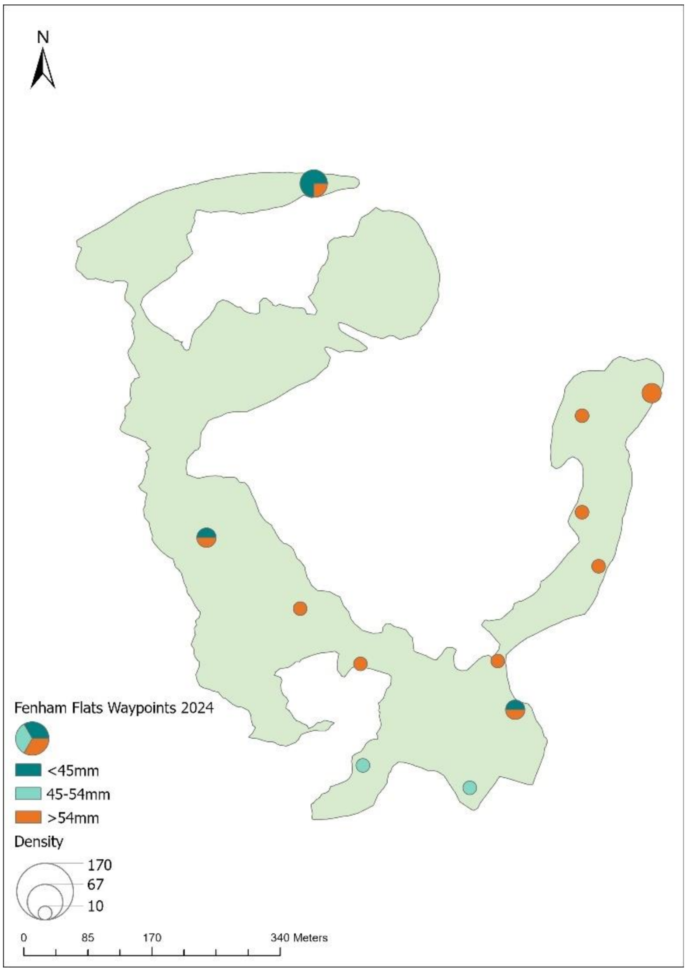


Figure 14: A breakdown for individual sample sites and the proportional percentages of the <45mm, 45-50mm and 50mm size classes at Fenham Flats. These points have also been proportionately scaled by the density/m^2 recorded at each sample site.

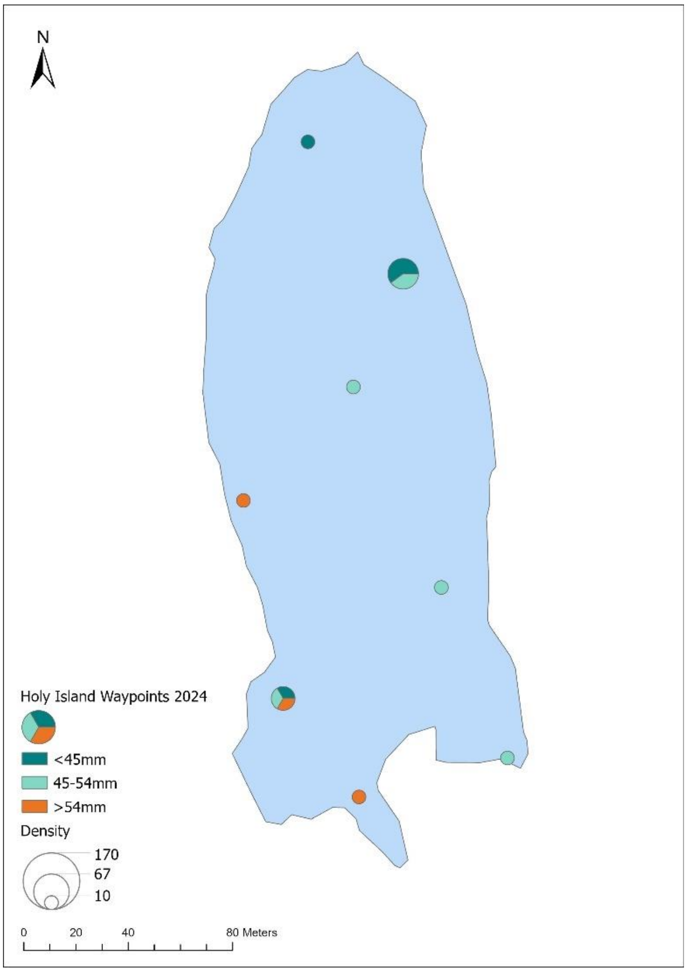


Figure 15: A breakdown for individual sample sites and the proportional percentages of the <45mm, 45-50mm and 50mm size classes at Holy Island. These points have also been proportionately scaled by the density/m^2 recorded at each sample site.

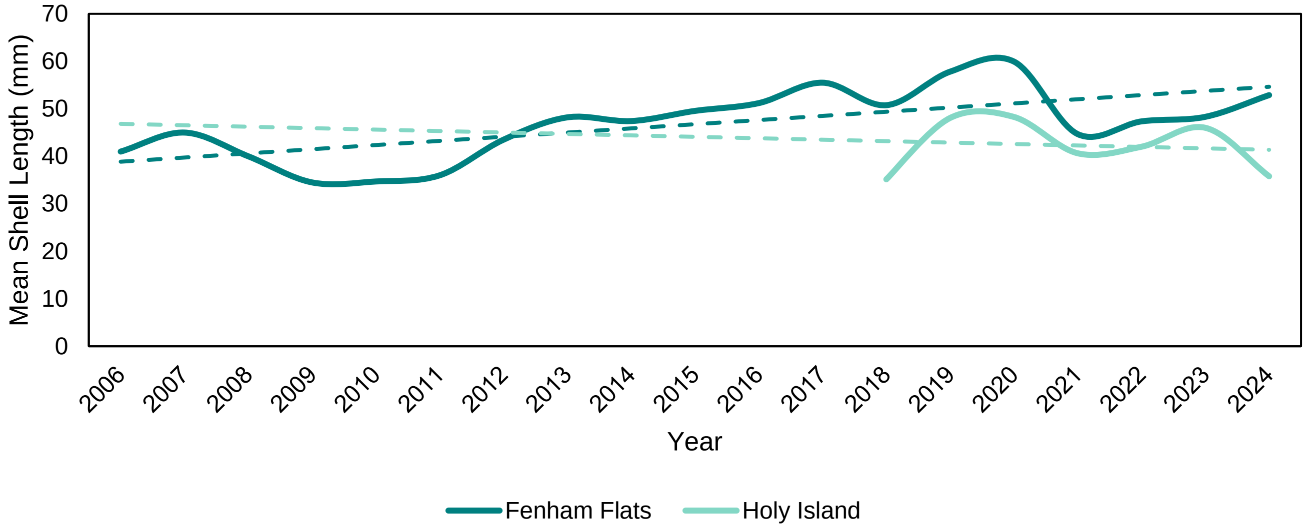


Figure 16: Mean mussel shell length found during the surveys at Fenham Flats and Holy Island.

Mussel Stock

Due to lower confidence in the bed area estimates in 2024, particularly at Fenham Flats, there is increased uncertainty in the accuracy of the mussel stock analysis. The beds at both Fenham Flats and Holy Island do however still appear to display a continued trend of stock decline from their respective peaks (Figure 17 & Figure 18). At Fenham Flats in 2024, total biomass has fallen by 99.9% since the peak in 2008, and by 99.6% at Holy Island from the peak in 2018.

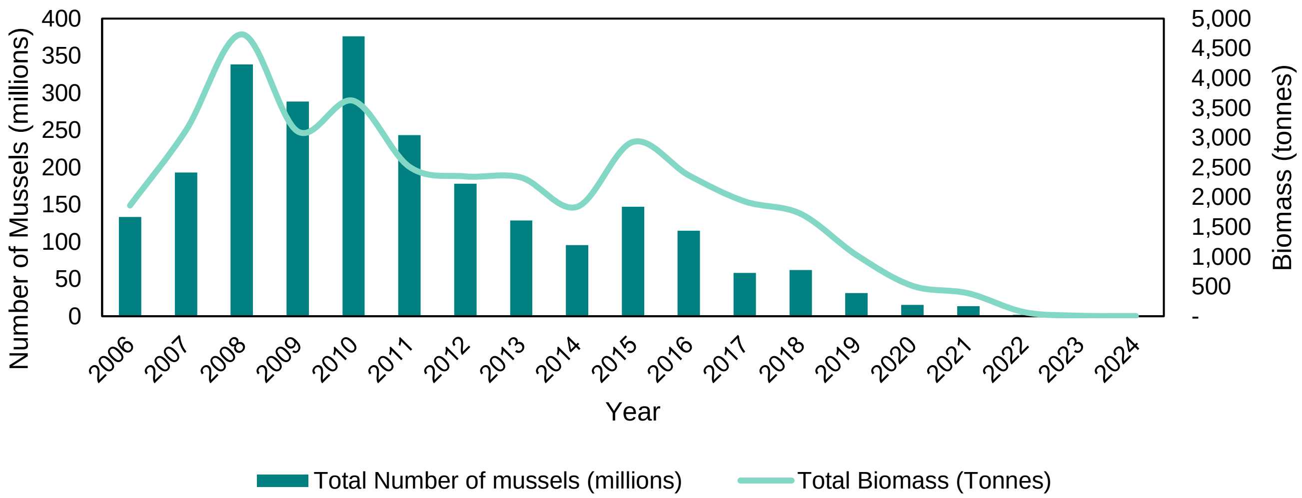


Figure 17: Mussel quantity and biomass estimates for Fenham Flats.

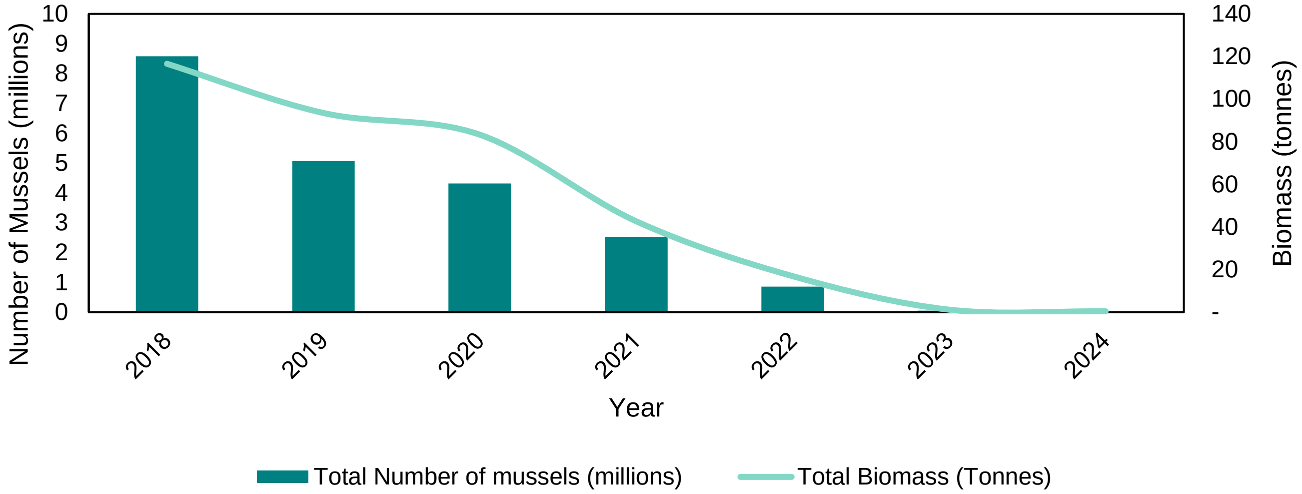


Figure 18: Mussel quantity and biomass estimates for Holy Island.

Discussion

Bed Area

Due to the current sparse nature of the mussel bed at Fenham Flats, it is becomingly increasingly difficult to accurately determine the extent of the mussel bed. Similar issues are also encountered at the Holy Island bed; however this site is easier to classify at present, but there are concerns that if current trends of decline continue, there may be similar issues encountered at this site. To ensure consistency between years and increase confidence with the data, IFCOs that have previously walked the bed are tasked with this aspect of the survey. We will continue to assess the suitability of this methodology going forward for both sites. The significant decline in bed area observed at Fenham Flats in 2024 is however likely indicative of the overall condition of the mussel bed, with all other metrics collected pointing to a further notable decline, the decline at Holy Island is similarly likely to indicate a decline in overall condition of the mussel bed.

Percentage Cover

Across both mussel beds, percentage cover was highly variable, with the distribution of percentage cover not conforming to any trend displayed by the previous surveys at each site. Due to percentage cover estimates not relying upon accurate bed area calculations, there is more confidence associated with these estimations. Historically at Fenham Flats, typically higher percentage cover was observed at the north of the bed, whereas the 2024 survey highlighted a contradictory pattern in percentage cover distribution. It is unclear why this is; however, we will monitor this going forward. With no human collection pressure at either site due to a prohibition on bait collection in the area under the Lindisfarne National Nature Reserve Byelaw, 1999, biotic factors may be driving the overall decline of the mussel beds. A study by Newcastle University has found that percentage cover of mussel beds in the Lindisfarne area show a significant negative correlation with PBDE154 a polybrominated diphenyl ether (a banned flame retardant) and dieldrin and endrin (banned pesticides). These bio contaminants may be affecting M. edulis populations at Lindisfarne due to increased storm events, but it is unclear if this is seasonal (Richardson, 2021). The Environment Agency as part of the Water Framework Directive monitors Holy Island water quality but there were some classification item changes and after 2019 the above biocontaminants (PDBEs) cannot be analysed temporally. Further investigation of this potential relationship would be beneficial considering the rapid decline of the mussel beds in recent years.

Mussel Density

With the continued decline in mussel density at both mussel beds, and subsequent almost total absence of mussels, there is concern about the viability of these beds going forward. Water quality and pollution could be influencing the mussel population at the site (Hilgerloh, 1997), with predation, water temperature and climate change also potentially attributing to the changes observed (Dent, 2019). Mussel beds have been found to be highly sensitive to a human induced pressures in a marine environment including introduction or spread of invasive species (including Pacific oysters), habitat structural changes (including bait colleting) (Fenton 1978; Maddock 2008) and/or physical loss (JNCC, 2014). Collection of mussel for bait is unlikely to be a factor affecting this mussel bed because the activity is prohibited, and there is no collection of mussel for consumption from these beds. Another potential driver of the decline may be the proximity to an aquaculture site for pacific oyster (*Magallana gigas*), particularly the Fenham Flats mussel bed, which has been in operation since 2007. The presence of this site may have introduced a led to increased competition for resources, with both *M. gigas* and *M. edulis* being filter feeders. Studies have found that in areas of low flow rates, the presence of oysters has led to a decline in native mussel populations (Joyce *et al.,* 2019). The ecological impacts of invasive species can be severe, but are generally viewed as highly unpredictable, however invasive species are often associated with higher consumption rates than comparative native species, with these higher per capita metrics predicting ecological impacts (Dick *et al.* 2013). *M. gigas* has previously been reported to consume mussel veligers, which may have caused a decrease in recruitment at these sites (Joyce *et al*., 2019). The population of M. gigas at the local aquaculture setup has anecdotally been reported as doing very well. The introduction of this factor of resource competition to the site may have led to an increasingly rapid decline in the mussels as the oyster farm has increased in scale. Despite this, the 2024 survey did highlight some potential evidence of recruitment at the Holy Island mussel bed, although the quantities found in the samples were low and therefore any trends are difficult to extrapolate from the data. The potential impact of the Pacific oysters being present should be looked at in more detail given the decreases recorded for both Fenham Flats and Holy

Island mussel beds. Other pressures may include water pollution from historically used pesticides (Richardson, 2021; Hilgerloh, 1997), coastal development and anchoring (Maddock, 2008). At this site, there are ongoing issues with water quality that have caused macroalgal blooms, this change in nutrient loading at the site was not seen as a significant to the mussel bed but only 4 years of data was used so by collecting more information a better picture can be created for why there is a significant decline in area.

Anecdotal evidence, as well as NIFCA survey data, suggests that mussel beds throughout the northeast have seen a decline overall. Historically, northeast beds were more widespread, with a sudden reported decline in 2009, from which they have never fully recovered. This has been seen elsewhere in the UK, for example, populations in the Wash and in Scotland have reportedly decreased in abundance at ~54% of the sites surveyed between 2002-10 and 2014-15. This was the largest decline of any intertidal species recorded (Burrows *et al.*, 2014/15). *M. edulis* beds have also been included in the OSPAR (Annex V) list of threatened and declining species and habitats and are listed as a UK biodiversity action Plan (BAP) Priority Habitat (Maddock, 2008).

Length Frequency

In 2024, the Holy Island mussel bed displayed a bimodal distribution, with pattern of distribution observed in the Fenham Flats data, despite previous surveys finding a similar bimodal distribution at this site. The proportion of size classes could indicate some concerns with recruitment failure, juvenile survival and suitable habitat availability with higher proportions of larger sized mussels dominating the bed at Fenham Flats. Size-specific predation may play an important role at the mussel beds. Past studies found eider and oystercatchers (both important species at Holy Island Sands) favour smaller sized (10mm – 45mm) (Hamilton *et al.*, 1999, Meire and Ervynck, 1986), therefore individuals above 45mm will exhibit lower mortality due to reduced predation. This would explain the lack of mussels within this size range at Holy Island. The larger mussels dominating the population at Fenham Flats may be a result of the mussels growing out of the size range exploited by predators (Hilgerloh, 1997).

Previous reports for this site have highlighted potential issues with spat settlement resulting in a lack of recruitment at the site, resulting in a larger, ageing population. Fewer ‘medium’ sized mussel in the 20-40mm size class range have also been described for mussel beds in the Wash. One hypothesis is that there is a mismatch in timings between a mussel first spawn and nutrient availability. Mussel have been reported to time spawning activity with higher levels of nutrient availability (Myrand *et al.,* 2000). Smaller mussel must put a larger proportion of energetic reserves into reproduction than larger mussel. If the nutrients are not available to replenish depleted reserves this could cause die-off of smaller adult size classes. Larger mussels do not expend the same proportion of energy and so may be able to survive with fewer nutrients post spawning. This would support the trend seen at the site for both frequency of mussels, as well as the proportional estimates of size classes sampled during surveys. Additionally, competition by pacific oysters in the immediate adjacent farm may lead to reduced nutrient (feeding on zooplankton and phytoplankton in the water column) availability with interspecific predation by pacific oysters of mussel veligers further reducing recruitment.

Mussel Stock

As highlighted earlier in this report, the difficulties with bed area estimation in 2024, particularly at Fenham Flats, make analysis of the mussel stock with significant confidence difficult. That being said, it is reasonable to infer some confidence in the mussel stock estimations for both sites with overall mussel abundance estimates significantly lower than in previous years and have displayed an increasing rate of decline. A decline is typically indicative of a population that has had poor recruitment in previous years, which is surprising following recent numbers of juveniles at both Fenham Flats and Holy Island, and as such the population is dying at a greater rate than it is being stocked. Declines in extent and biomass of mussel beds have also been recorded in other areas of the Greater North Sea including in Germany, Denmark and the Netherlands (OSPAR, 2010).

Declines are being recorded on both beds suggesting similar impacts are experienced at both sites. The Holy Island survey began as a comparative survey due to concerns in the declines at Fenham Flats, if mussels at Holy Island Sands were found to be healthy while Fenham Flats continued to decline, causes of decline at Fenham Flats could be narrowed down to very localised issues. However, the declines recorded at Holy Island, plus the declines reported elsewhere in the UK suggest the cause(s) of decline are more far reaching and widespread.

Further Study

NIFCA intends to continue the annual surveys of the mussel beds at Lindisfarne to identify any trends in the status of the population and will assist with and contribute to any further work investigating the cause of the observed declines, however surveys may be adapted into inspections without the removal of samples due to the low numbers of mussel present on the beds. The subjective nature of assessing and determining the extent of the mussel bed was hoped to be addressed with a project led by Newcastle University, aiming to use an unmanned aerial vehicle (UAV or drone) to determine whether this method is effective at surveying intertidal habitats such as mussel beds. Initial results were promising and could indicate mussel bed extent through multispectoral analysis. Despite this, it is not feasible for NIFCA to survey the Fenham Flats mussel bed using a drone, as the height the drone is required to fly at to accurately map out the mussel bed is impractical and would take too much time to map out the bed area with any degree of accuracy. This method could be used to survey the Holy Island mussel bed, but further work is required to improve its effectiveness and suitability for this survey.

Conclusion

Similar to other mussel beds found within the NIFCA district, the Lindisfarne mussel beds of Fenham Flats and Holy Island have continued to exhibit a pattern of decline across all of the metrics collected during the annual mussel survey. The cause of this decline is still unknown, however future surveys will aim to continue to monitor these trends and will guide further investigation into the driver of this decline.

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