

# Blue Mussel (*Mytilus edulis*) Inspection Report

## Blyth 2025

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## Summary

Annual surveys of the Blyth estuary mussel bed were conducted in March 2025. Since 2015 the perimeter of the mussel bed has been mapped, and percentage cover of mussels estimated using the MarinX ‘Dutch Wand’ survey technique. Live mussel samples collected in previous years were not collected this year for the first time due to concerns regarding the limited number of mussels remaining on the bed therefore it was not possible to determine density, biomass, or length frequency of mussel, however the 2025 survey revealed a continuation of long-term decline.

Key results:

- Overall bed area and percentage cover have steadily reduced, with the most pronounced loss occurring between 2024 and 2025.
- Overall bed area decreased by 77% from 27,310 m<sup>2</sup> in 2015 to 6,405 m<sup>2</sup> in 2025.
- Average percentage cover fell to 12% overall in 2025, compared with 37% in 2015.
- Sector analysis showed widespread reduction in bed area including a complete loss of sector seven.
- Sector two is no longer classed as a mussel bed with only 1 live mussel found.
- Recruitment was minimal: no spat was observed in 2025, and seed mussels (30–45 mm) were confined to sector one but at low density and only 5% estimated percentage cover.

The findings highlight that the mussels beds are under severe stress, with evidence suggesting that reduced adult mussel cover and unsuitable settlement habitat is limiting spat settlement and survival. The original drivers of decline are still unclear however potential drivers include, environmental factors, industrial contamination, historic unsustainable levels of bait collection and sediment disturbance from dredging.

Broader regional declines have been documented across the North Atlantic by many experts. Current conditions suggest the Blyth mussel beds may not be self-sustaining and are at risk of local extinction. In their current condition the mussel at Blyth would not meet the OSPAR habitat definition of an intertidal mussel bed found on mixed and sandy sediments.

NIFCA will continue annual inspections, along with supporting local and national partners to investigate the roles of contaminants, pathogens, and pharmaceuticals in mussel health. Restoration initiatives and collaborative research are underway to address knowledge gaps and explore options for recovery.

## Introduction

The blue mussel (*Mytilus edulis*) is a filter-feeding bivalve mollusc consuming phytoplankton, and other particulate organic matter. It is found on a variety of substrata in the intertidal zone of boreal and temperate waters, in both the southern and northern hemispheres (OSPAR, 2014). The blue mussel can accumulate to form beds and is tolerant of a wide variety of environmental conditions including fluctuations in salinity, oxygen, temperature, and desiccation (Andrews et al., 2011). Mussels can form dense beds 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. The OSPAR definition for intertidal blue mussel habitats specifies a minimum of 30% percentage cover to be classified as a mussel bed (OSPAR, 2010; Stounberg et al., 2024).

Blue mussel beds are declining in Northumberland and across the UK, but the causes remain unclear and may vary by region with some mussel beds in Teesside doing well in comparison to Northumberland. To address this, a mussel bed restoration network has been established to share knowledge, identify research gaps, and understand the drivers of decline.

## Blyth

In late 2014, the Northumberland Inshore Fisheries and Conservation Authority (NIFCA) received reports of increased bait collection activities in and around the mussel beds on the Blyth estuary. Due to the site's significance for protected bird species and public concerns, NIFCA initiated monthly stock assessment surveys of the mussel beds from March 2015 to February 2016, and has continued to conduct annual surveys in March/April since then. There are multiple historical records and anecdotal information about scarcity of mussel in the Blyth estuary from the early 1900s to present day, attributed to hand gathering and river dredging (Lebour, 1906).

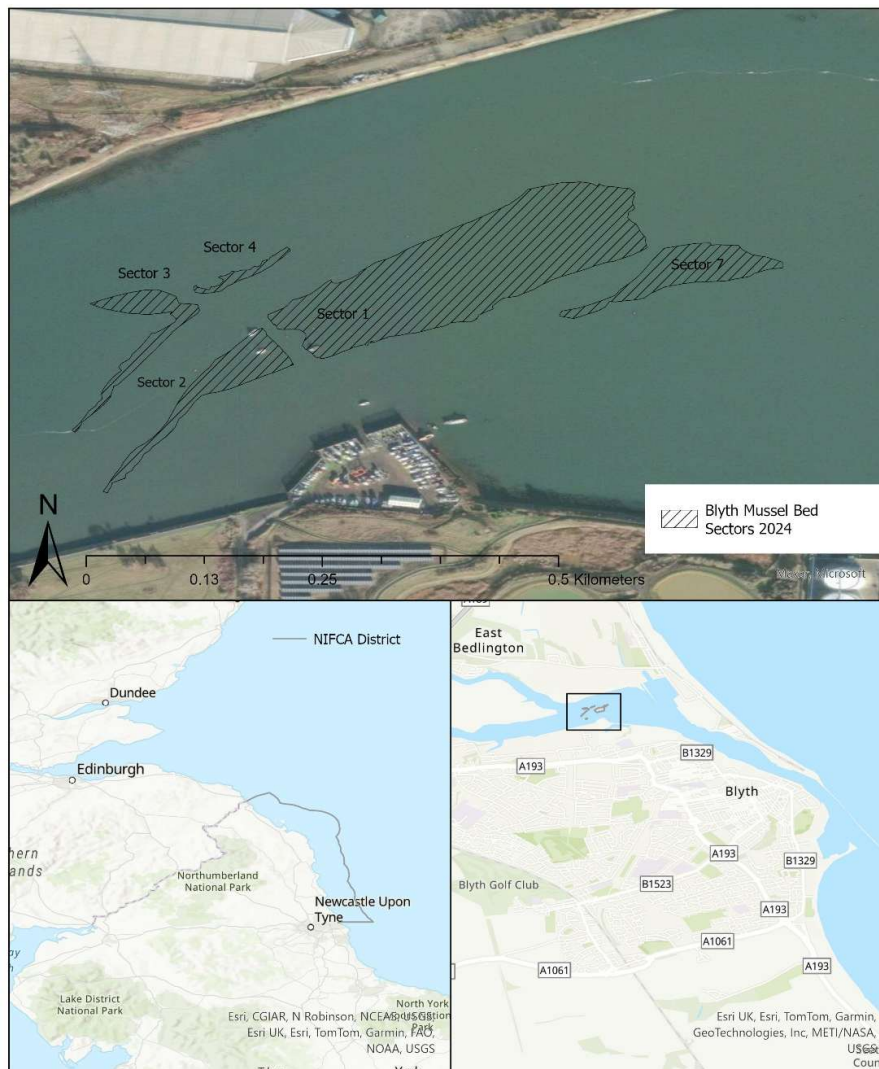
In 2024 the Blyth mussel beds exhibited continued declines, prompting a change in methodology for 2025 to preserve the remaining mussel. Due to significant biomass reduction, stock assessment now involves a walkover inspection of the bed perimeter and estimated percentage cover. Previous assessments are available on the NIFCA website.<sup>1</sup>

## Blyth Estuary

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<sup>1</sup> <https://nifca.gov.uk/about-us/publications/>

The Blyth estuary (Figure 1) is part of the Northumberland Shore Site of Special Scientific Interest (SSSI) which includes most of the coastline between the Scottish border and the Tyne Estuary and Northumberland Marine SPA. The intertidal mudflats of the estuary provide important low-water feeding grounds and high-water roosting grounds for large numbers of overwintering waders including oystercatcher, ringed plover, lapwing, dunlin, redshank and turnstone. Eider duck, knot, curlew and terns (sandwich and common) also use the estuary during the summer.



**Figure 1 - The Blyth Estuary mussel beds in 2024**

## Methods

Walkover inspections were conducted at low water during spring tides from the 30<sup>th</sup> of March to the 1<sup>st</sup> of April 2025 by NIFCA officers.

## **Survey Methods**

In previous years mussel samples were collected for analysis for density, total biomass and length frequency (Harvey, 2020; Boon, 2020; Harvey et al., 2024). Due to the declines of blue mussel, no samples were collected for such analysis in 2025. Percentage cover was estimated using the MarinX ‘Dutch Wand’ technique in addition to the estimated bed area by walking the perimeter of the beds.

## **NIFCA Mussel Inspection Protocol**

### **Perimeter**

Two Inshore Fisheries & Conservation Officers (IFCOs), one of whom has previously walked the perimeters of each sector of the Blyth mussel beds, walk the perimeter with a handheld GPS. Confidence in the accuracy of the area is low as the area of the mussel beds 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 collected was exported as a GPX file from the GPS using the Garmin GPS software Basecamp and then imported into ARCPPro to map and calculate the area of the mussel bed. Prior to the survey the bed itself was classified as the same area from the 2024 surveys as a guide (Boon et al., 2024).

To determine the extent of the bed scattered mussels were included as they are often ignored if their density is greatly below that of the main bed. If a mental assessment judges them to contain significant numbers of mussels, and the main bed has a low density, they are included. Similarly with isolated patches, if they are a long way from the bed and contain few mussels they are ignored, if they are close and contain high numbers of mussels they are included. If they are distant but contain significant numbers of mussels, they had their perimeter measured separately.

### **Percentage cover**

Typical transects “zig-zagging” of the bed was conducted to get appropriate coverage of the bed area and percentage cover is estimated using the traditional methods for each bed:

### **MarinX ‘Dutch Wand’ technique**

The percentage cover of mussels on the mussel bed was estimated using the MarinX ‘Dutch Wand’ survey technique (McGrorty et al., 1990). Surveyors walked in a zigzag across the mussel bed, in a randomly determined direction. The Dutch wand (a 4ft bamboo cane with an 11cm ring attached to the end) was placed out to one side every three steps and the result of either a ‘hit’ (if the ring contained live mussels) or a ‘miss’ (if the ring did not contain live mussels) was recorded. Percentage cover was then calculated using the equation:

$$\text{Percentage Cover} = \frac{\text{Number of Hits}}{\text{Number of Hits} + \text{Number of Misses}} \times 100$$

### Bed Condition Assessment

The bed condition was assessed during the transects for percentage cover at intervals along each transect, or where the bed conditions changed. Officers noted a way point on their GPS, took an image and noted down the bed criteria as detailed below :-

- presence of seed mussel
- size of seed mussel (<15 mm, 15-30 mm, 30-45 mm)
- estimated percentage cover of seed mussel
- density of seed mussel
- presence of size mussel
- density of size mussel
- density of size mussel (high/medium/low)
- size of mussels, mixed or uniform
- presence of dead shell
- estimated percentage cover of dead shell

## Results

A summary of the overall survey results since the mussel beds began being surveyed in Blyth, can be seen in Table 1 including results from 2025.

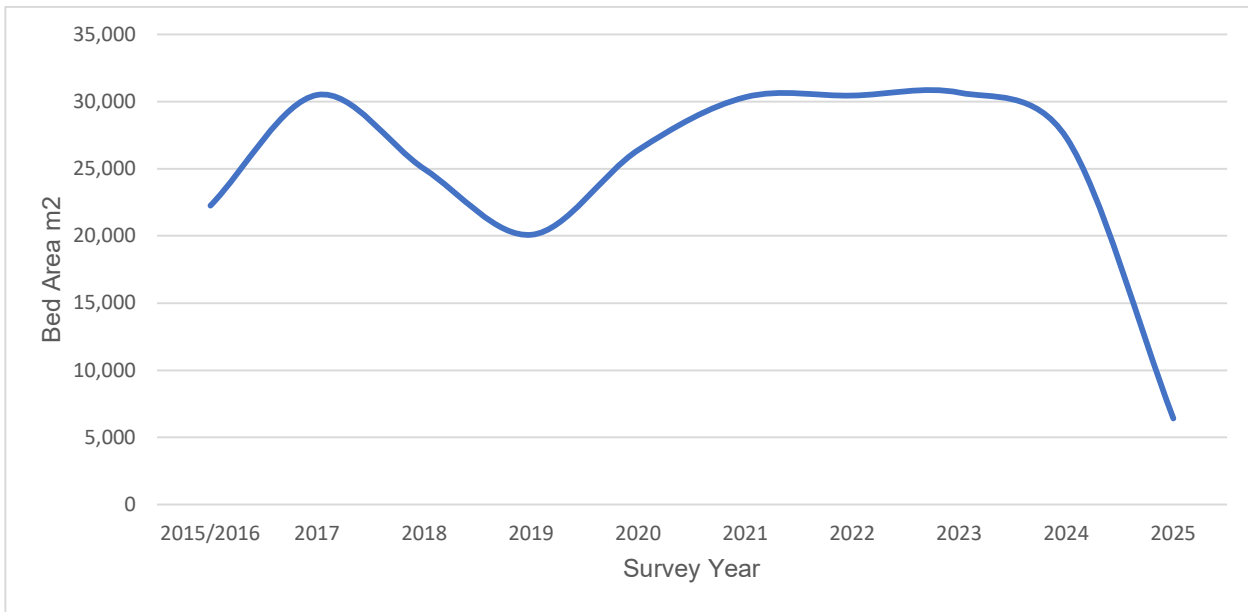
**Table 1:** Results for the overall bed area for all sectors Blyth mussel survey between 2015 and 2025

Year	Bed area (m <sup>2</sup> )	Average % cover	Mean shell length (mm)	Mussel density (no./m <sup>2</sup> )	Biomass (kg/m <sup>2</sup> )	Total Weight (g)
<b>2015/2016</b>	22,247	35%	41	111	N/A	17
<b>2017</b>	30,499	31%	38	118	N/A	6650
<b>2018</b>	24,980	36%	32	396	N/A	1680
<b>2019</b>	20,080	37%	35	286	N/A	831
<b>2020</b>	26,410	30%	38	399	N/A	964
<b>2021</b>	30,330	24%	30	109	1.26	1394
<b>2022</b>	30,444	17%	37	55	0.76	855
<b>2023</b>	30,661	16%	49	22	0.45	509
<b>2024</b>	27,310	9%	42	20	0.33	530
<b>2025</b>	6,405	12%	N/A	N/A	N/A	N/A

### Bed Area

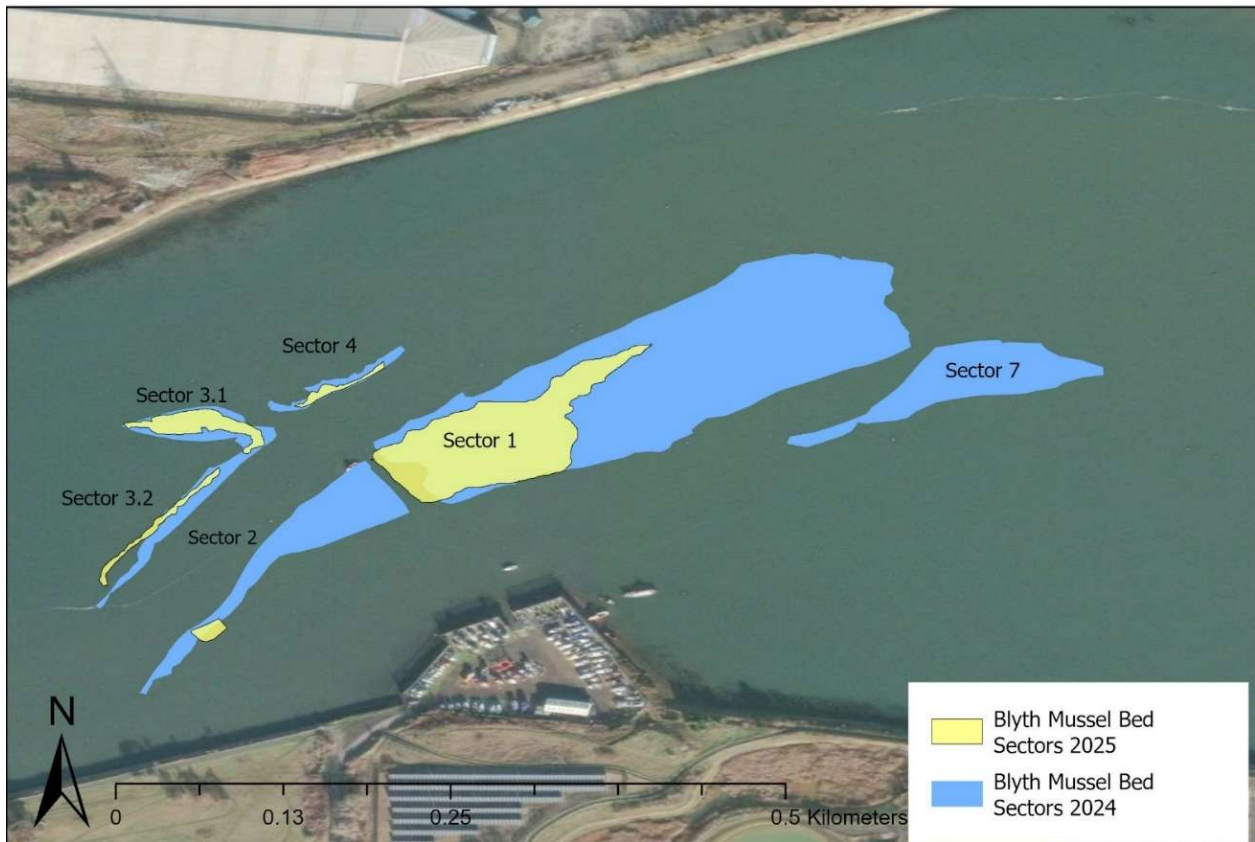
Since surveys commenced in 2015 the overall mussel beds at Blyth have experienced a continuous decline (Table 1). This has resulted in increased uncertainty regarding the accuracy of

bed area estimates due to the patchy distribution of mussels in each sector. Despite the uncertainty surrounding estimates, there has been a significant and clearly observable reduction in the overall bed area compared to previous years (Figure 2).

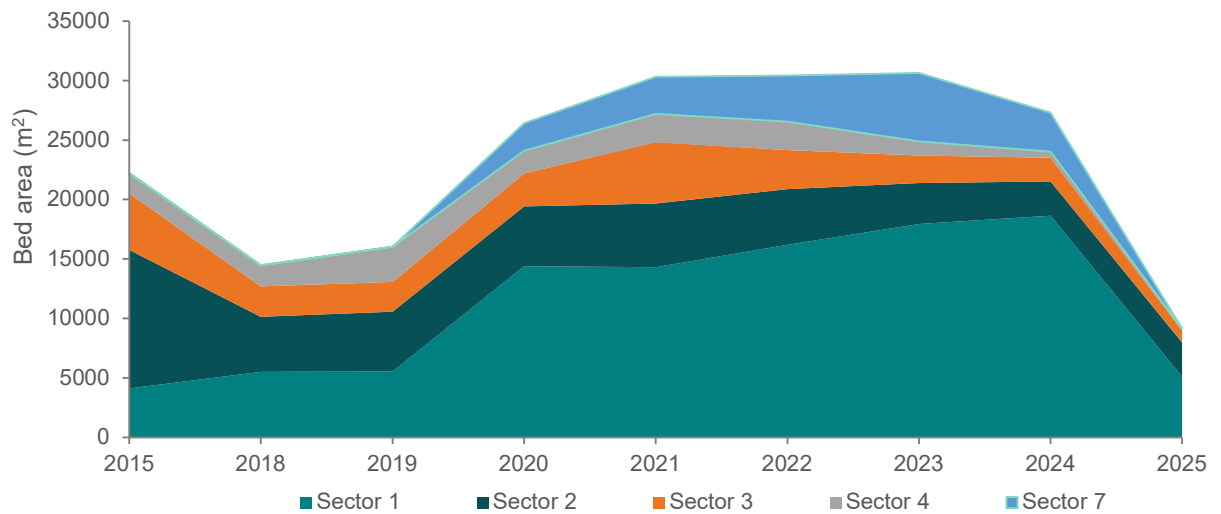


**Figure 2** – Overall bed area in the Blyth estuary from 2015 – 2025

Overall bed area has reduced by 77% since 2024 from 27,312 m<sup>2</sup> to 6,405 m<sup>2</sup> in 2025. All sectors surveyed have reduced in overall area since 2024. Sector one experienced a 73% decrease in bed area, reducing from 18,636 m<sup>2</sup> in 2024 to 5,117 m<sup>2</sup> in 2025. Sector two saw a 95% decrease in bed area from 2,888 m<sup>2</sup> to 144 m<sup>2</sup>. Sector three a 51% decrease when combining areas 3.1 (710 m<sup>2</sup>) and 3.2 (271 m<sup>2</sup>) from 2,016 m<sup>2</sup> in 2024 to 982 m<sup>2</sup> in 2025. Sector four experienced a 66% decrease from 483 m<sup>2</sup> to 163 m<sup>2</sup> and Sector seven suffered a complete loss of the bed that was previously estimated to be around 3,288 m<sup>2</sup> in 2024 and is now absent from the 2025 surveys. Figure 3 shows the reduction in each sector of the mussel bed since 2024 and Figure 5 the overall reduction in each sector from 2015 to 2025.



**Figure 3** – Comparison of The Blyth Estuary Mussel bed area and perimeters by sector in 2024 and 2025

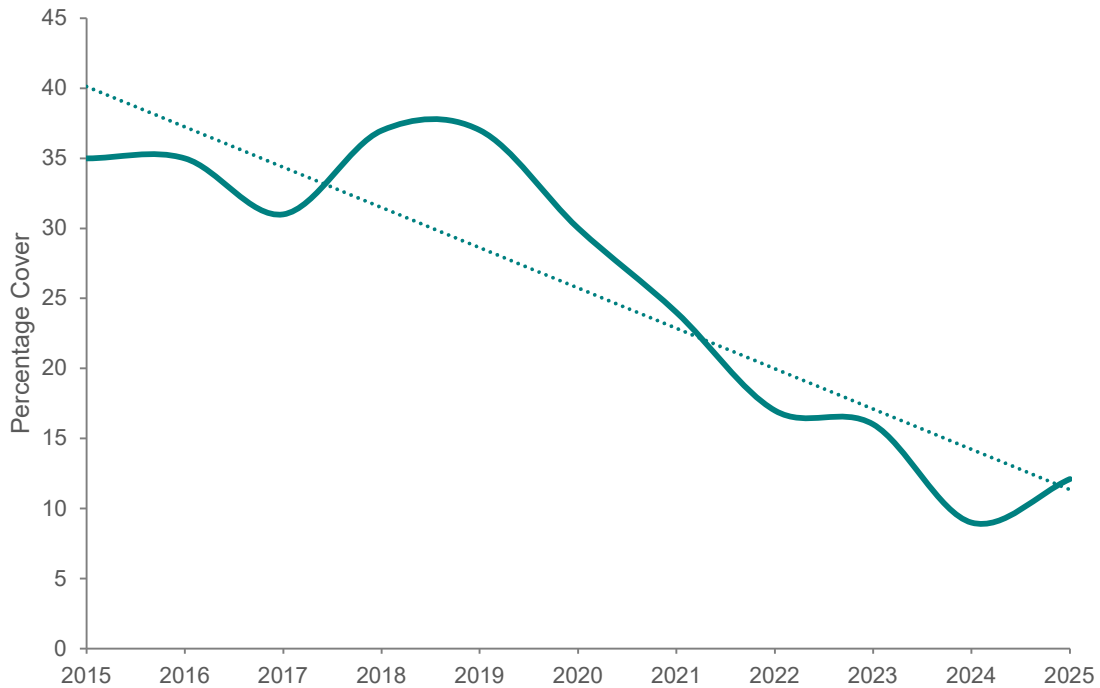


**Figure 4** – Bed area in remaining sectors of The Blyth Estuary Mussel bed from 2015 - 2025

## Percentage Cover

### Overall

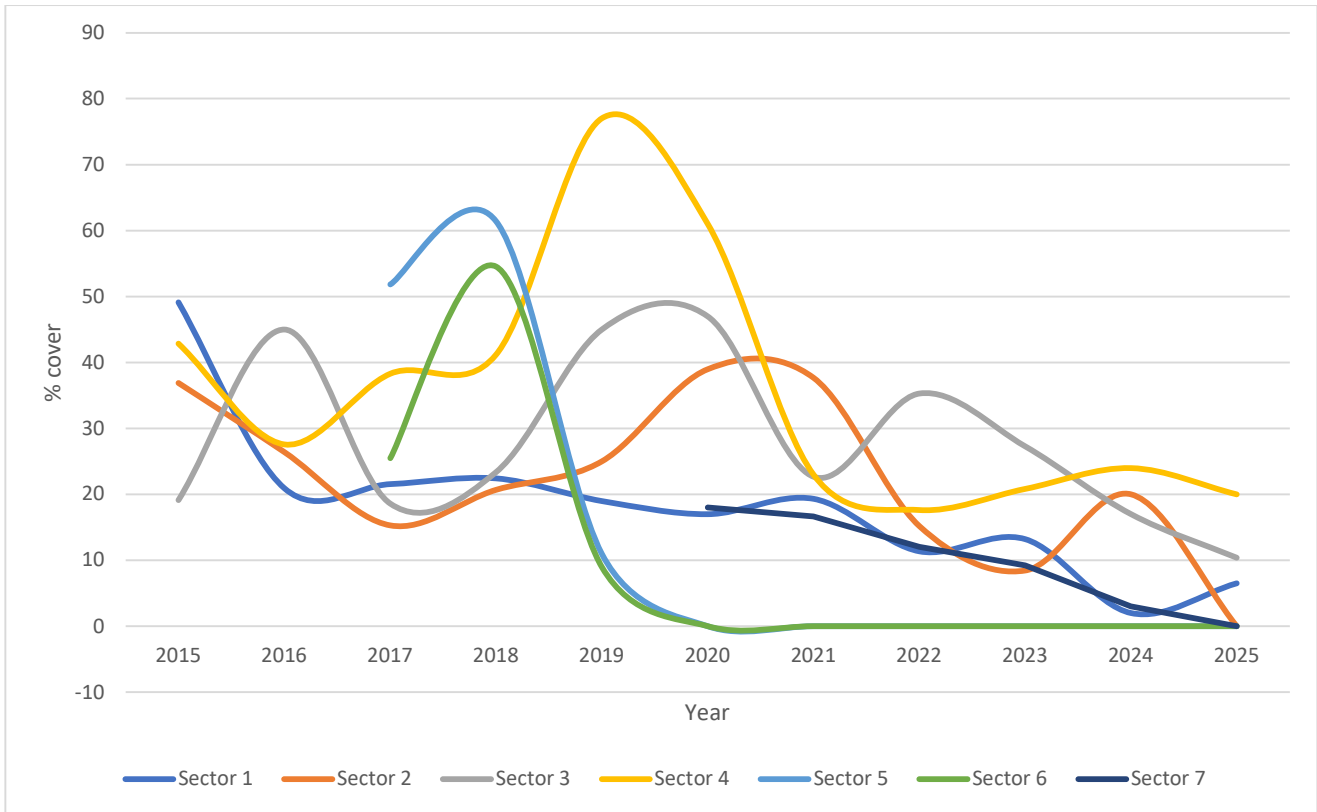
From 2015 to 2024 the average overall percentage cover of the mussel bed at Blyth has been in significant decline from 37% cover in 2015 to 12% in 2025 (Figure 5).



**Figure 5** - Average percentage cover estimates for Blyth, for the years they have been surveyed, with trendline highlighting the decline.

### By sector

Percentage cover varied both between and within sectors across the Blyth estuary. Figure 5 shows the changes in percentage cover per sector at Blyth from 2015 onwards and Figure 6 shows changes in percentage cover across all sectors from 2024 to 2025.



**Figure 6** – Percentage cover by sector from 2015 to 2025

All sectors have steadily declined since 2015, with percentage cover at or below 20% in every sector by 2025. In 2025, sector one exhibited a slight increase in percentage cover, although its overall percentage cover has decreased from 50% in 2015.

**Table 2** - Percentage cover from transects across the Blyth mussel bed in 2024 and 2025 per sector.

Sector Number 2025	Percentage cover per sector 2024	Percentage cover per sector 2025
Sector 1	2%	6%
Sector 2	20%	0%
Sector 3.1	17%	17%
Sector 3.2		3%
Sector 4	24%	20%
Sector 7	3%	0%

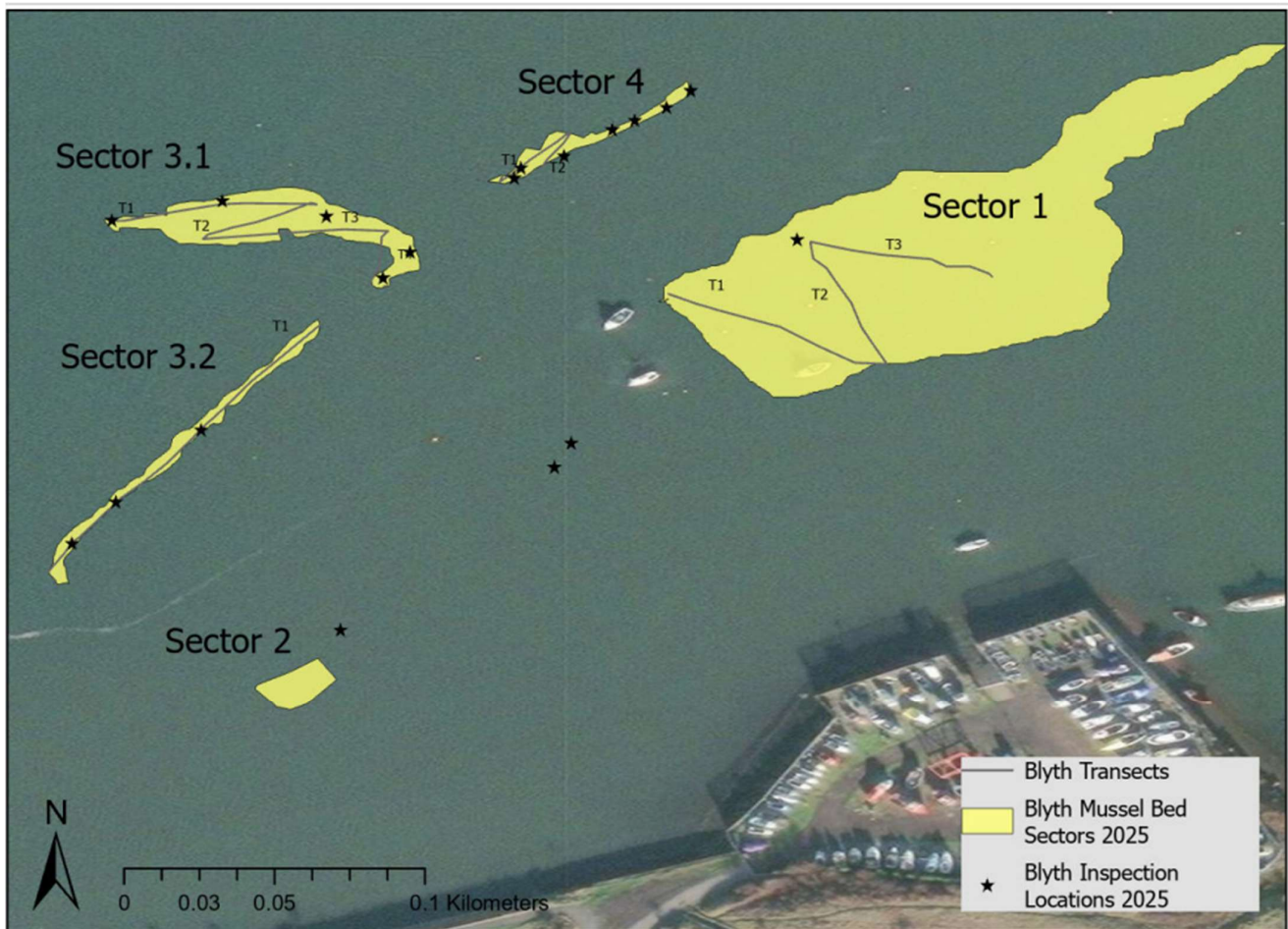
Percentage cover from transects taken in sectors two and seven has decreased from 20% and 3%, respectively, to 0%. In sector two, only one live mussel was recorded; while this population has fluctuated over time, 2025 marks its most significant decline. Sector seven is now absent entirely, this bed was first identified in 2020 and its percentage cover has steadily declined over the past five years.

In 2025, sector three was split into two sectors, 3.1 and 3.2 due to perceived loss of connectivity. Percentage cover remained steady at 17% in the northern sector (3.1) from 2024–2025 but dropped sharply to 3% in the southern sector (3.2).

Sector four percentage cover stayed steady from 2024 to 2025 declining only by 4%, this sector has fluctuated over the years since 2015 peaking at 77% in 2018 the highest cover of all sectors since surveys began. Sector four experienced a marked decrease from 2019 to 2021, after which its levels have remained relatively constant.

This indicates that the beds do not satisfy the OSPAR habitat definition for mussel beds, as mussel densities are below the required threshold of 30% cover, both within individual sectors and across all sectors.

Figure 7 shows the Blyth mussel bed sectors mapped in 2025 and the locations of transects used to assess percentage cover. Star symbols mark the bed inspection locations, which correspond to the data and images in Table 3.








**Figure 7** - Blyth Estuary sectors with transects 2025

## Bed Inspections

Table 3 provides a summary of the bed inspection results for each sector in 2025. Inspections were conducted across all sectors with the exception of sector seven, which is no longer present. Transects were conducted on all sectors other than sector 1. Sectors 1, 3.1, 3.2, and 4, contained uniformly sized live mussels; Sector 2 was not included as only one mussel was found there. Density of mussel was recorded as 'low' for all sectors other than sector 2 which was 'very low'. Seed mussel (30-45mm) was observed only in sector 1 and was absent in all other sectors. Dead mussel shell was present in every sector, with estimated coverage ranging from 10% in Sector two to 50% in sector 1. Sector 1 had approximately 50% dead mussel shell on mixed mud and gravelly sediment. Sectors 3 and 4 were predominantly mud and pebbles, whereas sector 2, with the lowest estimated dead shell cover (10%), featured more pebbles and stone than muddy sediment. While sector 2 was assessed, only a single live mussel was observed and a small proportion of dead mussel shell was dispersed on the sediment. The area surveyed in 2025 consists entirely of dead shells and stones; consequently, no transects were undertaken.

**Table 3** - Blyth Estuary inspection criteria results for sectors 1–4

Criteria	Sector 1	Sector 2	Sector 3.1	Sector 3.2	Sector 4
Transects	Yes	No	Yes	Yes	Yes
Seed mussel Present	Yes	No	No	No	No
Size of seed mussel	30-45mm	N/A	N/A	N/A	N/A
Estimated % cover of seed mussel	5%	0%	0%	0%	0%
Density of seed mussel	Patchy	N/A	N/A	N/A	N/A
Presence of size mussel	Yes	Yes	Yes	Yes	Yes
Density of size mussel	Low	Very Low	Low	Low	Low
Size of mussels (mixed/uniform)	Uniform	Only 1 mussel recorded	Uniform	Uniform	Uniform
Dead shell present	Yes	Yes	Yes	Yes	Yes
Estimated % cover of dead shell	50%	10%	35-40%	15%	40%
Images					
Description	Dead shell on mud and gravel with 30+ live mussels and a low density of seed mussel.	Dead shell and pebbles with only 1 live mussel. Cockles, barnacles and periwinkles.	Patchy areas of size mussel on mud and pebbles with cockles and barnacles.	Patchy areas of size mussel on mud and pebbles with cockles, barnacles and periwinkle.	Patchy areas of size mussel on mud and pebbles with cockles, barnacles and periwinkle.

## Discussion

Overall the mussel bed area at Blyth has continued to decline since surveys began in 2015 with a steep decline from 2024 to 2025 with the mussel bed becoming increasingly sparse.

Consequently, it is difficult to accurately determine the extent of the mussel bed as the majority of the bed area appears to be dead shell with very few live mussel. Since 2024, the bed area has decreased in all surveyed sectors, although there was an increase in the proportion of juvenile (spat) and medium sized mussels in 2023 this has not led to an increase in mussels at the site.

This demonstrates that the beds fail to meet the OSPAR criteria for classification as mussel bed habitats, given that mussel densities are below 30% cover both within each sector and across all sectors. This means that the mussel at Blyth has not met the OSPAR criteria since 2020.

### **Lack Of Recruitment**

Recruitment in mussel populations is known to be sporadic, occurring in unpredictable pulses (Seed & Suchanek, 1992), which is the case in the Blyth estuary in surveyed years, with higher recruitment occurring roughly every two years. However, in 2025 only sector one had 30-45mm seed mussel present at around 5% cover and no spat was observed on the beds. Spat mussels are known to preferentially settle among established adult mussel populations, and studies have demonstrated their avoidance of soft substrata which is present in some sectors of the estuary. Consequently, the reduction in adult mussel cover in the estuary may be a contributing factor to the absence of spat observed in 2025 and the general decline of the mussel beds (McGrorty et al., 1990).

Persistent mussel beds are thought to be maintained by relatively low levels of sporadic recruitment (Mainwaring Tillin H. & Tyler-Walters H., 2014; McGrorty et al., 1990) and sporadic recruitment has been observed in recent years in the estuary. In 2021 surveys showed high proportions of larval settlement and juvenile mussel (<5mm) across all sectors, followed by a reduction of spat in 2022 (Harvey, 2022). In 2023 there was no spat observed but juvenile mussels were present and their estimated percentage cover had reduced from 25% in 2021 and 2022 to just 4% in 2023 (Harvey & Smart, 2023). In 2024 spat had increased from 2023 (Harvey et al., 2024) however in 2025 no spat was observed at all. This suggests that juvenile mussels may not be surviving in the estuary and unable to grow into mature mussels that would become spawning stock. Recruitment does not appear to be able to counter the causes of decline and sustain the populations of mussel in the Blyth estuary suggesting they may be approaching a critical threshold for survival.

Walkover inspections began in 2025 and these record the data listed in the methodology section, including images and descriptions of sediment types for each surveyed sector. In sector two the lack of mussels observed may be due to loss of preferred settlement habitat for spat. In a sheltered estuary like the Blyth the preferred habitat would be established mussel beds. However, the decline of adult mussels combined with the presence of softer sediment may mean spat is struggling to settle as effectively on mud and sandy sediments as byssal threads may be covered by sediment therefore inaccessible (McGrorty et al., 1990). At the Blyth estuary the majority of the sediment is muddy in all sectors apart from sector two.

Historically at Blyth, greater percentage coverage has been recorded in the northern sections of the bed, specifically in sectors three and four. The 2025 data indicate that this pattern persists, with a marked reduction or complete loss of coverage in the southern sectors. It is not known why this pattern occurs and would require complex modelling techniques to investigate the hydrodynamics of the estuary.

### **Anthropogenic Impacts**

Bait collection of mussels occurs in the estuary in addition to digging for worms on muddy sediment near the mussel beds and collection of peeler crabs from tyres. The most recent reported sightings of mussel collection occurring upstream of the surveyed mussel beds. However, there is little evidence from regular NIFCA patrols to the estuary that high levels of mussel collection still occurs on the beds surveyed as there is very little mussel remaining to exploit. NIFCA monitor the estuary and have in place a voluntary 'Blyth Estuary Bait Collection Code of Conduct' however, it is not clear if this is followed or not. At this current time, any level of collection may impact the remaining population. It remains unclear whether other factors are contributing to the overall decline of the mussel beds, or if collection activities have reduced populations to levels from which recovery is not possible.

Anecdotal evidence suggests that development of the northern bank of the harbour and maintenance dredging activity taking place over the years may have impacted the hydrology of the river, shifting and potentially redistributing sediments, but there is no proven link. In May 2025 NIFCA officers observed a small mussel bed consisting of mature mussels downstream of The Blyth harbour office building, which was absent on a follow-up inspection in August. The change in the mussel bed's presence may be related to ongoing river dredging activities. Further surveys could help determine if additional mussel beds have formed further downstream.

Anecdotal evidence, as well as IFCA survey data, suggests that mussel beds throughout Northumberland and further afield have seen a decline overall. Historically, mussel beds in Northumberland were more widespread and have gradually been lost over the years. A study by Lebour from 1906 showed widespread mussel beds in all of the estuaries in Northumberland although the Blyth appeared to have similar problems as today with hand gathering pressure from fishermen, smothering from sediment and dredging.

A Newcastle University project in 2021 used Environment Agency data on water quality and mussel contaminants to better understand the causes of decline, and found significant correlations with the biocontaminants PBDE154 (a flame retardant), Dieldrin and Endrin (banned organochlorine pesticides) at the Lindisfarne mussel beds though the Blyth was not analysed (Richardson, 2021). Given the remote location of Lindisfarne compared to the industrial Blyth estuary, it is likely there is more contamination of the mussels in the Blyth which could be having an impact. Further work is ongoing with regards to pathogens and the effects of chemicals and pharmaceuticals that may be present in the water contributing to the health of the mussel beds at Blyth and other areas.

Preliminary results were shared from a joint study in 2024 by The Roslin Institute, St Abbs Marine Station and Natural England, where mussel faeces from populations in Teesside, Blyth, Lindisfarne, The Firth of Forth, The Cromarty Firth and Shetland were evaluated with eDNA and whole genome sequencing to identify parasites and pathogens potentially affecting mussel health (Chapuis et al., 2025) Results revealed the presence of *Klebsiella quasipneumoniae* in all declining populations of blue mussel. However, there was no indication of its pathogenicity on mussels and may be associated with water quality. Other bacterium found in mussels in The Blyth were *Tenacibaculum todarodis*, *Polaribacter pectinis*, and flavobacteriaceae bacterium uj101 all belonging to the flavobacterium family, some of which are implicated in fish mortality but again there is no evidence of mortality of shellfish exposed to these bacteria (Pellizer M, 2022).

### **Regional and Historical Mussel Health**

In contrast to the declines in the Blyth estuary, blue mussels of all size classes, including spat are abundant in the Royal Quays Marina in the River Tyne, growing well on the floating pontoons and hard structures present there. The marina is controlled by a lock gate so it is more of an enclosed system for the mussel larvae to circulate in. It has some freshwater input from two outfall pipes that may be providing additional nutrient rich water for the mussels.

In the UK, on the East coast of England, die-offs in The Wash have been observed since 2010. However, 2023 and 2024 saw a biomass increase potentially linked to increased rainfall and sewage input. In Scotland, a study (Burrows et al., 2025) has shown the decline of intertidal blue mussels on rocky shores mainly along the southwestern and southeastern coasts, only finding healthy populations on the exposed island coasts of Orkney and Shetland. There is another ongoing study in Scotland into the decline of blue mussel beds on muddy sediments that is currently unpublished.

Overall there has been a gradual decrease in the population of blue mussels in the North Atlantic region, with considerable variation across different localities (Baden et al., 2021). Declines in extent and biomass of mussel beds has been observed in the Greater North Sea including in Germany, Denmark and the Netherlands (OSPAR, 2023).

The reason for the decline of the mussel beds at Blyth are still unknown and likely to be multifactorial, however it is clear that juvenile mussels have been unable to settle and grow successfully on the beds, most likely due to their sparse nature and lack of adult mussel. It is possible that the remaining mussel beds could be lost altogether in the coming years.

## Further Study

NIFCA intends to continue the annual inspections of the mussel beds at Blyth. Future mussel surveys looking at factors such as biomass, length frequency and density are unlikely to resume unless there is a substantial increase in the mussel population at Blyth.

A national expert group, led by The Tees River Trust, is working to identify evidence gaps related to blue mussel decline in the UK and explore restoration possibilities. These efforts are hoped to benefit the Blyth and Lindisfarne mussel beds.

In September 2025, Natural England and NIFCA collected a small sample of mussels from the Blyth, Lindisfarne and Royal Quays Marina to analyse tissue for the presence of selected pharmaceuticals with results expected in 2026. (Chapuis et al., 2025).

## Conclusion

Similar to other mussel beds found within the NIFCA district, the Blyth mussel beds have continued to exhibit a pattern of decline across all of the metrics that were assessed in 2025. The cause of this decline is still unknown, however future studies locally and more widely will assist in monitoring these trends and will guide further investigation into the drivers of this local decline.

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