



Stock Assessment of the Edible Mussel (*Mytilus edulis*) Beds on Fenham Flats

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Abstract

The purpose of this report is to assess and continue to monitor the state of the mussel bed on Fenham Flats. 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 the site were also calculated. Samples of mussels were collected and total shell length and weight were measured.

The mussel bed on Fenham Flats covers an area of 40 ha with a percentage cover of 59.95%. The estimated values obtained for density and total number of mussels are the lowest recorded to date suggesting the mussel population at Fenham Flats is in decline. Total biomass has remained relatively high (estimated 3947 tonnes), due to an increase in mussel size. Mean length of mussels sampled was 51.2mm and the length distribution was skewed towards larger mussels.

This report is intended to provide information relating to the health and distribution of the mussel bed on Fenham Flats in order to inform future management of the site.

Introduction

The edible mussel (*Mytilus edulis*) is widely distributed, occurring in boreal and temperate waters, in both the southern and northern hemispheres (OSPAR, 2010). *M. edulis* is tolerant of a wide range of environmental conditions (FAO, n.d.) including fluctuations in salinity (Andrews *et al.*, 2011), and therefore occurs in both marine and brackish waters (Gardner, 1996). Mussels can form dense beds (Fenton, 1978) using byssus threads to attach to the substratum (Babarro *et al.*, 2008).

M. edulis beds are 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). Threats to mussel beds include bait collection (Maddock, 2008), gathering for human consumption (Fenton, 1978), pollution (Hilgerloh, 1997), coastal development and anchoring (Maddock, 2008). It is currently unknown whether mussel beds are declining because of the aforementioned threats, due to bird predation or a combination of factors (Hilgerloh, 1997).

In 2005 the Northumberland Sea Fisheries Committee (NSFC) (now Northumberland Inshore Fisheries and Conservation Authority (NIFCA)) was approached by Natural England who requested that NSFC conduct a stock assessment survey of the mussel beds at Fenham Flats, Lindisfarne in order to consider reopening the mussel beds to commercial harvesting within the Lindisfarne National Nature Reserve. NIFCA has continued to carry out annual stock assessment surveys at the site, providing a long term record of the population dynamics of the mussel bed.

Methods

A series of surveys have been conducted on the mussel bed at Fenham Flats annually since March 2005. The 2016 survey was conducted at low water (between 09:00 and 11:30) on a spring tide on the 11th March by NIFCA staff, members and volunteers from Natural England and the Berwickshire and Northumberland Marine Nature Partnership.

Study Site

The study site is located on the mussel bed at Fenham Flats, Lindisfarne on the extensive mud-flats south of Holy Island, located within the Lindisfarne National Nature Reserve (NNR).



Figure 1. The study area, showing the mussel bed in relation to Holy Island.

Survey Methods

The perimeter of the mussel bed was walked with a handheld GPS. The information was exported into the Garmin GPS software Basecamp to map and calculate the area of the mussel bed.

The percentage cover of mussels on the mussel bed was estimated using the ‘Walker and Nicholson’ survey technique (Walker and Nicholson, 1986). Surveyors walked in a zigzag pattern across the mussel bed, in a randomly determined direction, 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 190 to 562. Percentage cover was then calculated using the following equation:

$$\text{Percentage Cover} = (\text{Number of footsteps landing on live mussels} / \text{Total number of footsteps}) \times 100$$

A mussel sample was taken at the start and end of each transect from within a 0.1m² sampling quadrat. The samples were sieved through a 6mm mesh and cleaned in intertidal pools to remove sediment. 10 quadrat samples were collected from the mussel bed, resulting in a total sample area of 1m².



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 caliper 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 the following equation:

$$\text{Mussel Density} = \frac{\text{Number of mussels per m}^2}{\text{Percentage Cover}}$$

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

$$\text{Mussel Biomass} = \frac{\text{Mussel Mass per m}^2 \times \text{Area of Mussel Bed}}{\text{Percentage Cover}}$$

Results

In March 2016, the mussel bed on Fenham Flats covered an area of 40 hectares in March 2016. A total of 384 mussels were sampled and mean length of the mussels sampled was 51.2mm. Percentage cover, density and biomass are shown in Table 1.

Table 1. Summary of results obtained during the Fenham Flats mussel survey in 2016. Showing Area, Percentage Cover, Biomass per m², Density and Total Biomass.

Area (Ha)	40
Percentage cover (%)	59.95
Biomass per square metre (kg/m ²)	5.915
Density (mussels/m ²)	230.2
Total biomass (tonnes)	2366

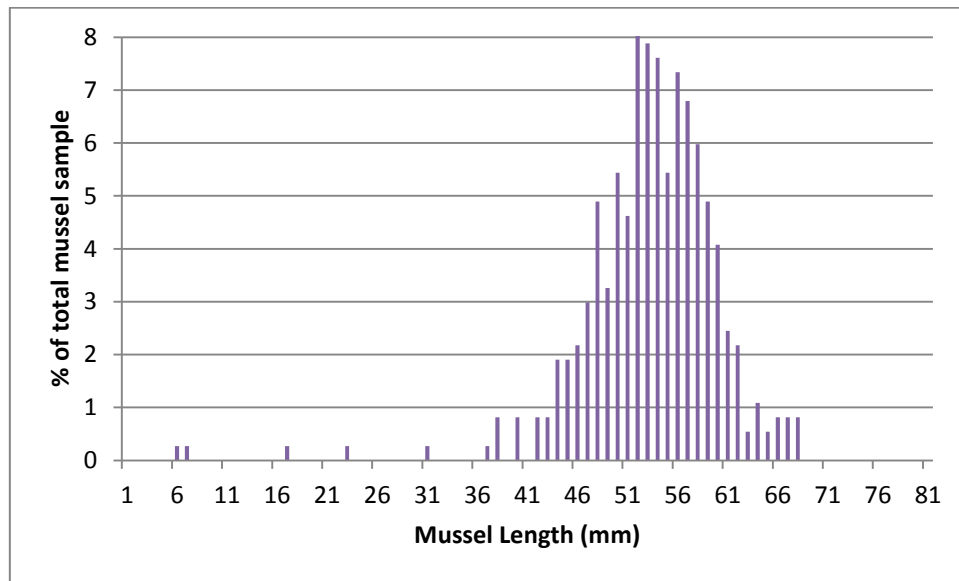


Figure 2. Length frequency distribution for the edible mussel (*Mytilus edulis*) sampled during the Fenham Flats survey in 2016.

Discussion

The total estimated number of mussels and density have decreased since 2015, the current values of 153 million mussels and 384 mussels per m² are the lowest value obtained since the survey began in 2006 (Appendix 1). These results suggest the population of mussels at Fenham Flats is declining. In declining populations, recruitment failure often occurs before adult mortality and populations can persist for decades before the population crashes (Strayer and Malcolm, 2012) therefore this declining trend may continue over future years. However, older mussels dying off may create space for future settlement, potentially increasing recruitment (NIFCA, 2015).

Despite the declines discussed above, biomass has remained relatively high due to an increase in mean mussel length (51.2mm, see Appendix 1). The length distribution for mussels was skewed towards larger sized mussels (Figure 2). The total shell lengths of 89.32% of mussels sampled in 2016 were greater than the recommended minimum size of 45mm. This value has increased from 78.37% in 2015 suggesting an ageing population. Hilgerloh (1997) suggests that dominance by larger sized mussels occurs due to large mussels growing out of the size range exploited by predators. For example, oystercatchers target mussels between 30mm and 45mm in length (Meire and Eryvnyck, 1986) therefore individuals above 45mm will exhibit lower mortality due to reduced predation. The number of smaller individuals may be lower than expected as 1) smaller mussels may escape through the 5mm mesh of the sieve and 2) recruitment may be limited at the site.

Although the results of this survey suggest a decrease in mussel density and total number of mussels at Fenham Flats, the results of previous studies have fluctuated (Appendix 1), therefore this study cannot determine if the trends discussed are as a result of recruitment failure or natural temporal variation.

Further Study

NIFCA plan to continue annual surveys of the mussel bed, however further study is needed to determine if there is a lack of recruitment at the site.

Conclusion

The purpose of this report is to provide up to date information to inform future management of the site through monitoring of the mussel bed. This study has mapped the perimeter of the mussel bed, estimated percentage cover, density and biomass, and produced a length frequency distribution of the mussels on Fenham Flats. Whilst the results indicate a dominance of larger mussels at the site, further study is needed to determine whether the population is naturally skewed towards larger individuals or whether there is a lack of recruitment at the site. NIFCA plan to continue annual surveys to monitor the mussel bed.

Acknowledgements

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Appendices

Appendix 1

Table 2. Summary of results obtained during the Fenham Flats mussel surveys between 2006 and 2016. Showing Area, Percentage Cover, Biomass per m², Density and Total Biomass, Total Number of Mussels and Mean Shell Length.

Year	Area (ha)	% Cover	Total Number of Mussels (millions)	Mean Shell Length (mm)	Density (Mussels per m²)	Biomass (per m²)	Total Biomass (Tonnes)
2006	41.527	60	220	41	321.6	4.48	1861
2007	37.18	79.81	240	45	519.5	8.39	3122
2008	36.72	78.58	431	40	921.7	12.89	4734
2009	34.43	72.1	396	34.5	837.8	9.02	3105
2010	36.28	78.41	486	34.7	1037.3	9.97	3618
2011	45.65	64.91	375	36	533.5	5.49	2510
2012	43.8	67.9	262	43.5	406.7	5.36	2349
2013	41.3	66.5	193	48.2	311.8	5.64	2330
2014	31.82	54.84	174	47.42	300.5	5.77	1838
2015	40.49	69.01	213	49.56	363.6	7.23	2928
2016	40	59.95	153	51.2	230.2	5.91	2366