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**Stock Assessment of the  
Littoral Mussel (*Mytilus edulis*) Beds  
on Fenham Flats (Holy Island)**

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## INTRODUCTION

The edible mussel (*Mytilus edulis*) is one of the most common shore animals and can be found all around the coast of the British Isles<sup>1</sup>. They also form vast beds on sand, mudflats and in estuaries. Mussels attach themselves to rocks, pebbles and other mussels by secreting silky threads known as byssus threads. They filter feed on plankton and organic matter in the water column<sup>2</sup>.

In 2005 the then Northumberland Sea Fisheries Committee (NSFC) (now Northumberland Inshore Fisheries and Conservation Authority (NIFCA) was approached by Natural England who requested that NSFC conduct an annual 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 Nature Reserve. NSFC subsequently conducted a stock assessment survey of the natural population of mussels (*Mytilus edulis*) on the large bed located on Fenham Flats, adjacent to Holy Island. The survey was assisted by Dr Jane Lancaster the then officer for the Berwickshire and North Northumberland Coast European Marine Site, who had extensive experience surveying mussel beds for the Cumbria Sea Fisheries Committee. The survey considered a number of parameters including overall dimensions of the site, percentage coverage, total population and weight of the mussels, and possible sustainable harvest weight for any commercial venture.



Mussel beds looking North towards Holy Island

On submitting the results of the 2005 survey to Natural England they subsequently permitted one individual to harvest mussel based on a quota, this individual harvested mussels for a number of years but was unable to make it a viable commercial concern. When commercial harvesting of mussels on the site ceased NSFC continued to carry out annual stock assessment surveys of the site, thus providing a long term record of population dynamics of the site.

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<sup>1</sup> Hendrick, V. J., Foster-Smith, R. L. & Davies, A. J. (2011)

<sup>2</sup> Dr. Harvey Tyler-Walters (2008).

## METHOD

The mussel bed on Fenham Flats was surveyed at low water (between 09:00 and 11:30) on a spring tide on 23<sup>rd</sup> March 2015 (previous surveys having been carried out on spring tides every March since 2006, see NIFCA website for reports). The outer edges of the bed and the transects were mapped using the tracking facility of a hand-held GPS.

The percentage cover of mussels on the bed (i.e. the proportion of the bed covered by patches of mussels) was estimated using the method developed by the Department of Environment, Food and Rural Affairs (DEFRA)<sup>3</sup>. Percentage cover was determined by pacing over the beds in zigzag lines and recording the proportion of footsteps that landed on mussels as opposed to bare sediment. The length of each transect line was determined and varied from 90 paces to 300 paces. The direction of each transect line was chosen in the field to satisfy three criteria: that the transects should remain within the constraints of the bed, the zigzag pattern should effectively cover all of the bed and within these two constraints the direction should be random. Since commencing surveys of the site, other survey methods have generally been adopted, notably using the Dutch Wand<sup>4</sup> method but it was felt that for consistency the “Walker and Nicholson” method was the most appropriate method.



Collecting a mussel sample

At the end of each transect a 0.1m<sup>2</sup> sampling quadrat was placed at random on the nearest patch of mussels. All material within this tenth of a metre patch was gathered and sieved through a 5mm mesh to remove sediment. After sieving and the removal of stones and debris, the contents of each quadrat was transferred to a bag and taken back to the lab for measurement and further analysis. Ten quadrat

<sup>3</sup> Walker, P. and Nicholson, M. D. (1986)

<sup>4</sup> McGrorty, S., Clarke, R. T., Reading, C. J. and Goss-Custard, J. D. (1990)

samples were taken from the mussel bed at Fenham Flats thus giving a total 1m<sup>2</sup> of mussels.

The samples were processed back at the lab as soon as practical after collection to ensure as little weight loss from the mussel shells as possible. The samples were first sorted to separate any stones, debris or dead shells from the living mussels, before being weighed to the nearest gram. The shell lengths of all the living mussels in each sample were recorded to the nearest millimetre (mm).

The proportion and weight of total commercially sized mussels in each sample were also recorded. At present no minimum landing size exists for mussels on the Northumberland coast. In order to estimate the size of the commercial stock, estimates were based on two different minimum landing sizes; 55 mm and 45 mm. (The minimum landing size being defined as all mussels over 45 mm, or over 55 mm).

The information on the GPS was down loaded onto GPSU software and this software was used to calculate the area of the mussel bed (in hectares and square metres).



Mature mussel

The estimate density (number of mussels/m<sup>2</sup>) and biomass per m<sup>2</sup> of all mussels on the bed, was then calculated by multiplying the total sample collected in the 1 m<sup>2</sup> by the overall size of the mussel beds. The total commercial biomass was then calculated by multiplying the biomass/m<sup>2</sup> of mussels greater than 45mm and 55 mm by the overall size of the mussel beds. These sizes were chosen to remain in line with areas of the UK that have minimum size limits for mussels.<sup>5</sup>

The maximum sustainable yield (maximum tonnage of mussels that should be removed) or total allowable catch (TAC) was also calculated. The maximum sustainable yield chosen is 33% of the exploitable stock (above minimum landing sizes) (Table 9) which is the typical proportion used in many UK bivalve fisheries<sup>6</sup>. The TAC was calculated for a MLS of both 45 mm and 55 mm. The recommended TAC was then further assessed using **Standard Deviation at the 95% confidence level as part of the precautionary approach to management.**

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<sup>5</sup> SEAFISH responsible sourcing guide 2009

<sup>6</sup> CEFAS Shellfish News 23, Spring/Summer 2007

## RESULTS

The Fenham Flats mussel bed was found to occupy an area of **31.82 hectares** which is the lowest recorded size to date; in previous years the size of the bed has fluctuated between 34 hectares and 45.65 hectares<sup>7</sup>. Within this mussel bed mussels were found to occupy 54.84%, which is the lowest percentage coverage to date (Appendix 1: Table 1). In previous years % coverage has been up to 78%<sup>8</sup>.

The mean biomass per square metre was estimated at 10.532kg, while in previous years this has varied between 7.5kg and 16.4kg (see mussel reports on NIFCA web site). The mean density was estimated at 548 mussels/m<sup>2</sup>, while in previous years this has varied between 469 mussels/m<sup>2</sup> to 1323 mussels/m<sup>2</sup><sup>9</sup>. From these figures the total tonnage of mussel biomass in 2014 was calculated to be 3351 tonnes which is the slightly down from the 2013 estimate of 3503 tonne but well below the estimate of 6022 tonnes in 2008.



Mussel sample being cleaned

The total population of mussels in 2014, estimated at 174 million, is also down from the 193 million in 2013 which at the time was the lowest on record; the highest estimate was a population of 486 million in 2010<sup>10</sup>.

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<sup>7</sup> Mussel surveys on NIFCA website

<sup>8</sup> Mussel surveys on NIFCA website

<sup>9</sup> Mussel surveys on NIFCA website

<sup>10</sup> Mussel surveys on NIFCA website

## DISCUSSION

This stock assessment has revealed that in March 2014, there was an estimated 3351 tonnes of mussel biomass within the 31.82 hectare mussel beds on Fenham Flats. These are both the lowest values on record since the survey began. The fact that the biomass per m<sup>2</sup> remains relatively high is attributable to the increase in the size of the individual specimens, as mussels below 45mm contribute less than 4% to the total weight.

While recruitment to the beds has occurred over the last year, the overall estimated number of mussels has fallen from 193 million in 2013 to 174 million, with the highest estimate of the population of 486 million made in 2010<sup>11</sup>. The new recruits now account for 13% of the population. This suggests that it is the older mussels that are dying off; likely to be the result of an ageing population. The decline in the number of mature mussels however may create space for future spat settlement and thus aid future recruitment.

With regards to the recruitment of juveniles, particularly below 25mm in size, 72 individuals were recorded per m<sup>2</sup> in 2014; in the 2013 survey only 3 individuals were recorded, in contrast to previous years when upwards of 200 individuals have been recorded in this size range<sup>11</sup>. The presence of juveniles is promising, but for the long term sustainability of the beds, good spat settlement is required for the next few years. It is not known why there has been a good spat settlement on the beds in 2014 but this could be down to the quantities of mussels in the 45-55mm range that were recorded in 2013 and again in 2014.

The peak in the 45-55mm size range (Fig. 1) does not appear to have altered much since 2013<sup>11</sup>, possibly indicating that growth rates are reduced above this size. This confirms to a degree that mussels in this size range are made up of multiple year classes (possibly 3 years or more). This is supported by the general lack of juveniles for the past few years while the size distribution of adult mussels has remained relatively constant.

While this site is currently not being harvested, it is estimated that an annual commercial quota for the bed could be set at 1072 tonnes, assuming a minimum size of 45mm or 416 tonnes using 55mm+ (Table 3). These figures are based on 33% of the total of commercial sized mussels on the beds. Commercial sized mussels (>45mm) accounted for 81% of mussels on the beds in 2014 (Table 2), which is higher than in previous years.

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<sup>11</sup> Mussel surveys on NIFCA website

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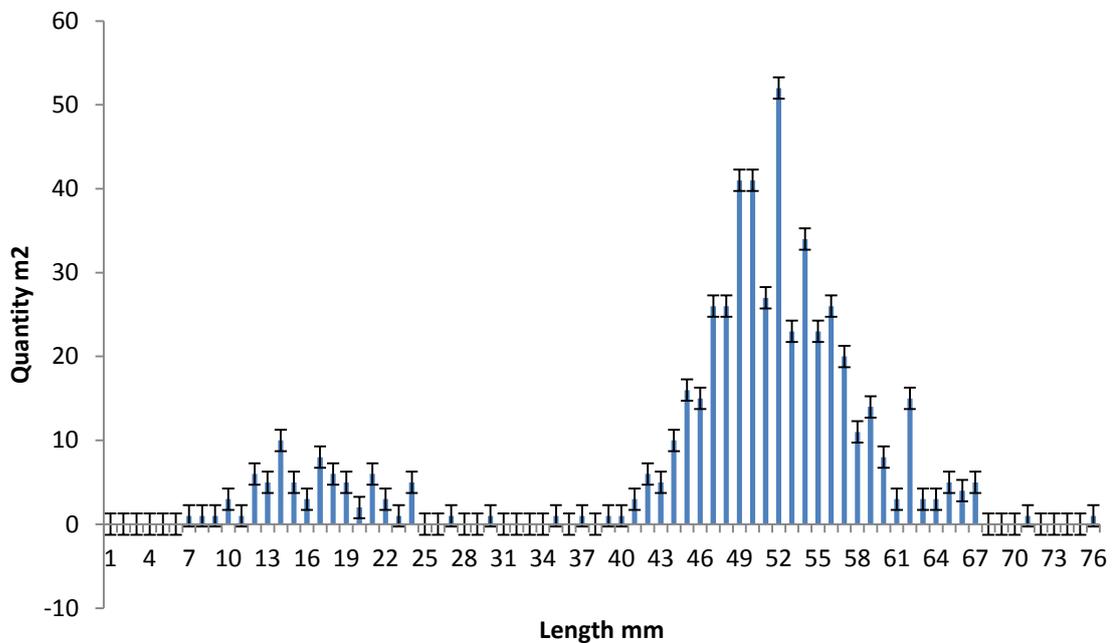
## Appendix 1

**Table 1:**  
Physical parameters of the mussel bed 2014

Area (Ha)	31.82
Percentage cover	54.84
Biomass per square metre (kg/m <sup>2</sup> )	10.532
Density (mussels/m <sup>2</sup> )	548
Total biomass (tonnes)	3351

**2014:** The size of the mussels found in the sample ranged from 7mm to 76mm (Fig. 1) with a mean length of 47.42mm (Table 2). The length distribution graph (Figure 1) revealed only 1 major peak that is spread over a significant size range from 40mm and 60mm; this could represent more than one year class. The graph also shows a minor peak in the 10mm to 25mm; this is likely to represent one year class which have been recruited since 2013 when few mussels below 20mm were seen.

**Figure 1:**  
Mussel distribution 2014 including standard error bars



**Table 2:**

**Mean length of mussels and percentage above minimum landing size (MLS) 2014**

<b>Parameter</b>	
Mean shell length (mm)	47.42
Percentage of commercial sized mussels using MLS 45 mm	81%
Percentage of commercial sized mussels using MLS 55 mm	26%

**Table 3:**

**Commercial biomass of mussel bed with different minimum landing sizes**

**2014:** By using these two MLS's it was estimated that there were 3218 tonnes or 1050 tonnes of commercially sized mussels on this bed. This gives a total allowable catch (TAC) of either 1072 tonnes or 416 tonnes depending on the minimum landing size used.

<b>Parameter</b>	<b>MLS 45 mm</b>	<b>MLS 55 mm</b>
Commercial biomass (g/m <sup>2</sup> )	1011	393
Commercial density (mussels/m <sup>2</sup> )	444	142
Commercial tonnage (tonnes)	3218	1050
Commercial number (millions of mussels)	141	45
TAC (33% of exploitable stock) (tonnes)	1072	416