



**THE  
NORTHUMBERLAND  
SEA FISHERIES  
COMMITTEE**

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

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**Jonathan Green  
Environmental Fishery Officer**

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**With thanks for their assistance to:**

**Ms. Aisling Lannin, Berwickshire and North  
Northumberland Coast European Marine Site Officer  
(Northumberland County Council)  
and Mr. Mike Quigley, Marine Conservation Officer for  
Natural England**

## Summary 2007

1. The mussel bed on Fenham Flats was surveyed on the spring tide on 22nd March 2007.
2. The Fenham Flats mussel bed was found to occupy an area of 3.718 hectares. Within this bed, mussels were found to occupy 79.81% of the ground.
3. The mean biomass per square metre was 10.52 kg/m<sup>2</sup> and the mean density per square metre was 651 mussels/m<sup>2</sup>.
4. From these figures the total tonnage of mussel biomass was calculated to be 391.13 tonnes and the total population estimated to be 24,204,180 (24.204 million) mussels.
5. By using a minimum landing size of 55 mm it was estimated that there were 154.60 tonnes of commercial sized mussels.
6. By using a minimum landing size of 45 mm it was estimated that there were 331.85 tonnes of commercially sized mussels.
7. The maximum sustainable yield (i.e. the maximum amount of mussels that should be taken) or total allowable catch (TAC) was calculated on the basis of 33% of the commercially sized mussels. This gave a TAC of 51.53 tonnes or 110.6 tonnes depending on the minimum landing size used (55 mm or 45 mm respectively).

## Introduction

The edible mussel (*Mytilus edulis*) is one of the most common shore animals and can be found on most rocky shores in Europe. They also form vast beds on sand and 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.

A survey of the natural population of mussels (*Mytilus edulis*) on the large bed located on Fenham Flats, adjacent to Holy Island, was undertaken in order to estimate the size of the mussel stock. The objective of this stock assessment was to inform fishery managers of the size of the stock in order to allow any potential fishery to be managed in a sustainable way.

## Method

The mussel bed on Fenham Flats was visited at low water (between 08:00 and 10:00) on a spring tide on 22<sup>nd</sup> March 2007. The outer edges of the bed 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 DEFRA (Walker and Nicholson, 1986). 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 100 paces to 200 paces. The direction of each transect line was chosen in the field to satisfy three criteria: that the transect 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.

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 5 mm 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 laboratory for measurement and further analysis. Ten quadrat samples were taken from the mussel bed at Fenham Flats in total.

The samples were processed back at the laboratory as soon as practicable 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.

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 of 45 mm, or 55 mm, and above.)

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

The density (number of mussels/m<sup>2</sup>) and biomass per square metre (or biomass/m<sup>2</sup> as it will be referred to from hereafter) of all and commercial sized mussels was then calculated by raising the number and weight of mussels in the sample by 10 and then by the mean percentage cover of the bed. The total biomass and commercial biomass (in tonnes) was then calculated by multiplying the biomass/m<sup>2</sup> by the areas covered by the mussel bed.

The maximum sustainable yield (maximum tonnage of mussels that should be removed) or total allowable catch (TAC) was also calculated. The maximum sustainable yield usually chosen is 33% of the exploitable stock (above minimum landing sizes) which is the typical proportion used in most UK bivalve fisheries (CEFAS *per. com.*). The TAC was calculated for a MLS of both 45 mm and 55 mm.

## Results

The Fenham Flats mussel bed was found to occupy an area of 3.718 hectares down from 4.1527 hectares in 2006. Within this mussel bed mussels were found to occupy 79.81% of the ground up from 60.44% in 2006.

The mean biomass per square metre was 10.52 kg/m<sup>2</sup> up from 7.467 kg/m<sup>2</sup> in 2006 and the mean density per square metre was 651 mussels/m<sup>2</sup> up from 535.65 mussels/m<sup>2</sup> in 2006. From these figures the total tonnage of mussel biomass was calculated to be 391.13 tonnes up from 3101.19 tonnes 2006 and the total population estimated to be 24.20 million mussels up from 22.24 million mussels in 2006.

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

2007

Area (Ha)	3.718
Percentage cover	79.81%
Biomass per square metre (kg/m <sup>2</sup> )	10.52kg/ m <sup>2</sup>
Density (mussels/m <sup>2</sup> )	651 mussels/ m <sup>2</sup>
Total biomass (tonnes)	391.13 tonnes
Number of mussels (millions)	24 million mussels

**Table 2**  
**Physical parameters of the mussel bed**

2006

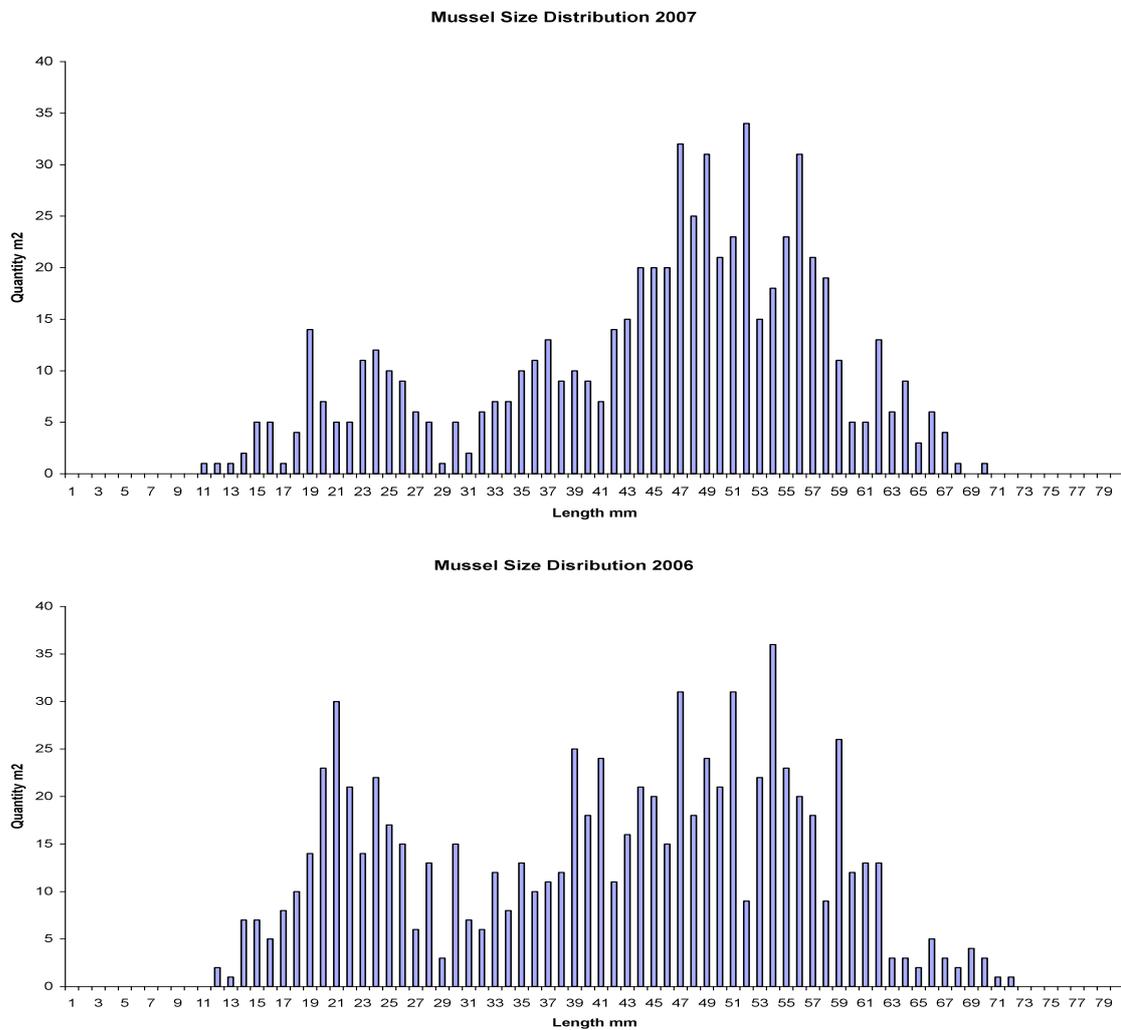
Area (Ha)	4.1527ha
Percentage cover	60%
Biomass per square metre (kg/m <sup>2</sup> )	7.468 kg/m <sup>2</sup>
Density (mussels/m <sup>2</sup> )	536 mussels/m <sup>2</sup>
Total biomass (tonnes)	310.11 tonnes
Number of mussels (millions)	22 million mussels

**2007** - The size of mussels found in the samples ranged from 11mm to 70mm (Figure 1), with a mean length of 45mm (Table 3). The length distribution graph (Figure 1) revealed

several peaks in size frequency, with peaks of mussel shell length at between 12 and 29mm; 30 and 41mm; 42 and 50 and the final peak between 51 and 70mm. The majority of mussels were between the sizes of 19mm – 27mm and particularly 42mm - 63mm.

**2006** - The size of mussels found in the samples ranged from 12mm to 73mm (Figure 2), with a mean length of 41mm (Table 4). The length distribution graph (Figure 2) revealed several peaks in size frequency, with peaks of mussel shell length at between 12 and 32 mm; 33 and 44 mm; 45 and 55 mm and the final peak between 56 and 73 mm. The majority of mussels were between the sizes of 20 mm – 28 mm and 39 mm – 63 mm.

Figure 1



**Table 3**  
**Mean length of mussels and percentage above minimum landing size (MLS)**  
 2007

<b>Parameter</b>	
Mean shell length (mm)	45 mm
Percentage of commercial sized mussels using MLS 45 mm	61%
Percentage of commercial sized mussels using MLS 55 mm	24%

**Table 4**  
**Mean length of mussels and percentage above minimum landing size (MLS)**  
 2006

<b>Parameter</b>	
Mean shell length (mm)	41mm
Percentage of commercial sized mussels using MLS 45 mm	47%
Percentage of commercial sized mussels using MLS 55 mm	22%

**2007** - By using these two MLS's it was estimated that there was 154.6 tonnes or 331.8 tonnes of commercially sized mussels on this bed. This gives a total allowable catch (TAC) of either 51.3 tonnes or 110.6 tonnes depending on the minimum landing size used.

**2006** - By using these two MLS's it was estimated that there was 140 tonnes or 227 tonnes of commercially sized mussels on this bed. This gives a total allowable catch (TAC) of either 46.7 tonnes or 75.7 tonnes depending on the minimum landing size used.

**Table 5**  
**Commercial biomass of mussel bed with different minimum landing sizes**

**2007**

<b>Parameter</b>	<b>MLS 45 mm</b>	<b>MLS 55 mm</b>
Commercial biomass (g/m <sup>2</sup> )	826.6	421.1
Commercial density (mussels/m <sup>2</sup> )	398	159
Commercial tonnage (tonnes)	331.85	154.60
Commercial number (millions of mussels)	14.8	5.9
TAC (33% of exploitable stock)	110.6	51.53

**Table 6**  
**Commercial biomass of mussel bed with different minimum landing sizes**

**2006**

<b>Parameter</b>	<b>MLS 45 mm</b>	<b>MLS 55 mm</b>
Commercial biomass (g/m <sup>2</sup> )	546.8	3369
Commercial density (mussels/m <sup>2</sup> )	263	127
Commercial tonnage (tonnes)	227.1	139.9
Commercial number (millions of mussels)	10.9	5.2
TAC (33% of exploitable stock)	74.9	46.1

### **Discussion**

This stock assessment has revealed that there is an estimated 391 tonne of mussel biomass within this 3.72 hectare mussel. This is a significant increase in biomass since 2006 when an estimated 310 tonnes of mussel biomass within this was established within a bed size of 4.15 hectare. Note that there has also been a decline in the overall area of the beds. The majority of the increase in tonnage is down to an increase in larger mussels generally over commercial size. The 2007 survey estimates that there are between 154 or 331 tonnes of commercially sized mussels depending on the minimum landing size used (55 mm and 45 mm respectively). While in 2006 only 46.1 or 74.9 tonnes of commercially sized mussels depending on the minimum landing size used (55 mm and 45 mm respectively) were available. The stock assessment has also provided information on the nature and population dynamics of this mussel bed.

The mussel bed at Fenham Flats is made up of a wide range of different sized mussels and from the size distribution information (Figures 1 & 2) it would appear that several age classes are present. Although it is still not possible from these surveys to precisely estimate the age of these mussels there is a good indication that mussels in the 11 mm to 29 mm range (thought to be 1 year old) in 2006 make up a significant proportion of the 40 mm to 54 mm mussels in 2007. This being the case, it can be deduced that many mussels reach a commercial size of over 45 mm within 2 years and a commercial size of 55 mm within 3 years. This compares reasonably favourably with farmed mussels reaching 55 mm in 2 years. If the age size relationship is accurate, then the 2008 survey (to be conducted about 10<sup>th</sup> March 2008) should result in a reduction in the 40 mm to 54 mm mussels as the 11 mm to 29 mm mussels represent a poor year class. Alternatively if the 40 mm to 54 mm size range remains strong, then it would suggest that it is taking 3 years plus for mussels to reach commercial size. The 2 year class then being represented by the peak between 29 mm and 39 mm mussels in the 2007 survey.

The fact that the majority of the mussels over 55 mm in length were covered in barnacle and pink encrusting algae also indicated that they are at least 3 years old. It is worth noting here that it will take several more years of surveying this bed before a precise estimate of age for a given shell length can be made.

Although some characteristics of this bed has appeared to be typical of mussel beds that exist in sheltered environments where the mussel bed is stable and individuals can live for many years; along the northern edge it appears to be prone to seasonal weather events. As such there have been significant changes to the size of the bed and overall numbers of mussels since the bed was first surveyed in 2005. The overall size of the bed has reduced in area from 6.04 hectares to only 4.15 hectares in 2006 and subsequently down to only 3.72 hectares in 2007, a loss of over one third. The lost portion of bed constitutes the northern edge of the bed which is the most exposed to northerly weather. The winter of 2005/06 and into the spring of 2006 saw significant and prolonged strong northerly winds which may account for much of the bed loss. The continued reduction in the bed in 2007 was again along the northern edge and is probably also down to the northerly winter weather.

The density of the mussels on the bed at 80% coverage is giving only limited opportunity for good spat settlement particularly as at present the majority of mussels are of a large size. However it should be remembered that since 2005 one third of the bed has disappeared and this may provide some opportunity for spat settlement. This area is however the most exposed to weather conditions and any spat settlement would also be potentially prone to high levels of predation particularly from birds. There has also been a reduction in densities of mussels on the remaining bed, down from 1251 mussels/m<sup>2</sup> in 2005 to only 536 mussels/m<sup>2</sup> and this rose to 651 mussels/m<sup>2</sup> in 2007.

## References

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