A5.62 Mussel beds (*Mytilis edulis*) on Atlantic sublittoral sediment

Summary

Sublittoral mussel beds of the common mussel *Mytilus edulis* are found in a variety of situations ranging from sheltered estuaries and marine inlets to open coasts and offshore areas, in fully marine or sometimes variable salinity conditions in the outer regions of estuaries. It has a wide geographical range extending from the Atlantic coast of Ireland to the southern North Sea. There are three distinct habitat components: the interstices withn the mussel matrix; the biodeposits beneath the bed; and the substratum afforded by the mussel shells themselves. All three components often contain a diverse range of epibiota and infauna.

The main pressures and threats to this habitat are from the targeted mussel fisheries but damage is also caused by shrimp fisheries, invasive species, and effects associated with climate change such as the timing of spat falls and survivability of predators. Mussel seed collected from wild sublittoral beds by bottom dredging, also has both a direct and indirect effect.

Management of the wild commercial mussel fishery is key to the conservation of this habitat. This includes controls on the removal of seed stock, the level of fishing effort and locations where fisheries are permitted. Regulation of discharges to the marine environment which result in nutrient enrichment that affects the condition and viability of this habitat is also a beneficial management tool.

Synthesis

This habitat has a wide geographical distribution and is not limited to a few locations. Trends can be difficult to distinguish as there can be very large annual variations influenced by the success of spatfalls, and weather conditions such as storm events and starfish predation which can rapidly wipe out subtidal mussel beds. An analysis of trends in this habitat should distinguish between naturally occurring and cultivated beds but data are typically from the latter which are commercially exploited.

Given the reported decrease in recruitment (spat falls) across Europe since the 1980s and that the largest extent of this habitat is in the southern North Sea where there have been substantial losses, the data suggest that overall the extent of this habitat is decreasing.

This habitat has declined in quality in some parts of its range over the last 50 years but the overall situation is unclear. For example, there has been an extremely heavy impact on spat from commercial fishing which decreases habitat structure and density directly, and also causes changes in the species composition to include the non-native oyster (*C.gigas*), *Ensis, Mya* and *Marenzelleria,* but this is not the case throughout the range of this habitat in the North East Atlantic region.

The overall assessment is that this habitat is Near Threatened for both the EU 28 and EU 28+ on the basis of decline in quantity over the last 50 years.

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Near Threatened	A1	Near Threatened	A1

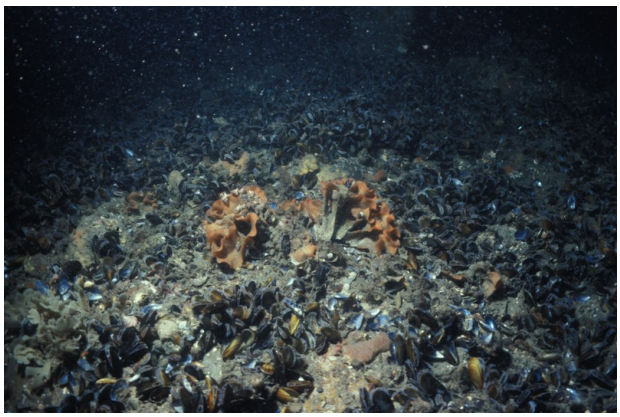
Sub-habitat types that may require further examination

None.

Habitat Type

Code and name

A5.62 Mussel beds (*Mytilis edulis*) on Atlantic sublittoral sediment



Bed of *Mytilus edulis* in an area of soft sediment. A colony of the Ross coral *Pentepora foliceae* is also visible. Porthysgadan, Wales (© S.Fowler/JNCC).

Habitat description

Sublittoral mussel beds of the common mussel *Mytilus edulis* may be sublittoral extensions of littoral reefs or exist independently. They beds are found in a variety of situations ranging from sheltered estuaries and marine inlets to open coasts and offshore areas, in fully marine or sometimes variable salinity conditions in the outer regions of estuaries. They may occupy a range of substrata, although due to the accumulating and stabilising effect such communities have on the substratum muddy mixed sediments are typical. There are three distinct habitat components: the interstices withn the mussel matrix; the biodeposits beneath the bed; and the substratum afforded by the mussel shells themselves.

All three components often contain a diverse range of epibiota and infauna. The mussel matrix may support sea cucumbers, anemones, boring clionid sponges, ascidians, crabs, nemerteans, errant polychaetes and flatworms. The biodeposits attract infauna such as sediment dwelling sipunculids, oligochaetes, and polychaetes while epizoans may use the mussels shells themselves as substrata.

Indicators of Quality:

Both biotic and abiotic indicators have been used to describe marine habitat quality. These include: the presence of characteristic species as well as those which are sensitive to the pressures the habitat may face; water quality parameters; levels of exposure to particular pressure, and more integrated indices which describe habitat structure and function, such as trophic index, or successional stages of development in habitats that have a natural cycle of change over time.

There are no commonly agreed indicators of quality for this habitat, although particular parameters may have been set in certain situations e.g. protected features within Natura 2000 sites, where reference values have been determined and applied on a location-specific basis.

The overall quality and continued occurrence of this habitat is, however, largely dependent on the presence of *Mytilus edulis* which creates the biogenic structural complexity on which the characteristic associated communities depend. The density and the maintenance of a viable population of this species is a key indicator of habitat quality, together with the visual evidence of presence or absence of physical damage. Monitoring programmes may include measures of biomass, coverage, length frequency distribution, a condition index for the mussels (a ratio between biomass versus shell length) and descriptions of the structure of a bed including vertical height profile, thickness and type of accumulated sediment, coverage and biomass of macroalgae.

Characteristic species:

Characterised by *Mytilus edulis*. In the subtidal, dense mussel beds can form on the upper faces of tide-swept sediment dominated substrates, to the exclusion of almost all other species compared to the surrounding sediments. The common starfish *Asterias rubens* is often locally abundant as it feeds on mussels, along with other predators such as the crabs *Necora puber*, *Carcinus maenas*, *Maja squinado* and *Cancer pagurus*. Anemones such as *Sagartiogeton undatus*, the dahlia anemone *Urticina equine* and the daisy anemone *Cereus pedunculatus* can be found on gravel patches and amongst the mussels themselves. The hydroid *Kirchenpaueria pinnata* and others characteristic of strong tides and a little scour, such as *Sertularia argentea* and *Tubularia indivisa*, may also be present. Ascidians such as *Molgula manhattensis* and *Polycarpa* spp. can also feature on subtidal mussel beds, particularly in silty conditions. Other characterising infaunal species may include the amphipod *Gammarus salinus* and oligochaetes of the genus *Tubificoides*. The polychaetes *Harmothoe* spp., *Kefersteinia cirrata* and *Heteromastus filiformis* are also important. Epifaunal species in addition to the *M. edulis* include the whelks *Nucella lapillus* and *Buccinum undatum,* the common starfish *Asterias rubens* the spider crab *Maja squinado* and the anemone *Urticina felina*.

Classification

EUNIS (v1405):

Level 4. A sub-habitat of 'Atlantic circalittoral biogenic habitat' (A5.6).

Annex 1:

1170 Reefs

MAES:

Marine - Marine inlets and transitional waters

Marine - Coastal

MSFD:

Shallow sublittoral rock and biogenic reef

Shallow sublittoral coarse sediment and shallow sublittoral mixed sediment

Shallow sublittoral sand

Shallow sublittoral mud

EUSeaMap:

Shallow photic rock or biogenic reef

Shallow aphotic rock or biogenic reef

Shallow sands

Shallow muds

Shallow coarse or mixed sediments

IUCN:

9.2 Subtidal rock and rocky reefs

9.5 Subtidal sandy mud

Does the habitat type present an outstanding example of typical characteristics of one or more biogeographic regions?
No

Justification
Mussel (*M.edulis*) beds are widely distributed across the North East Atlantic region but tend to be scared on subtidal sediment. This habitat - mussel beds on sublittoral sediment - is therefore unusual and is thus not considered an outstanding example of the typical characteristics of the North East Atlantic region.

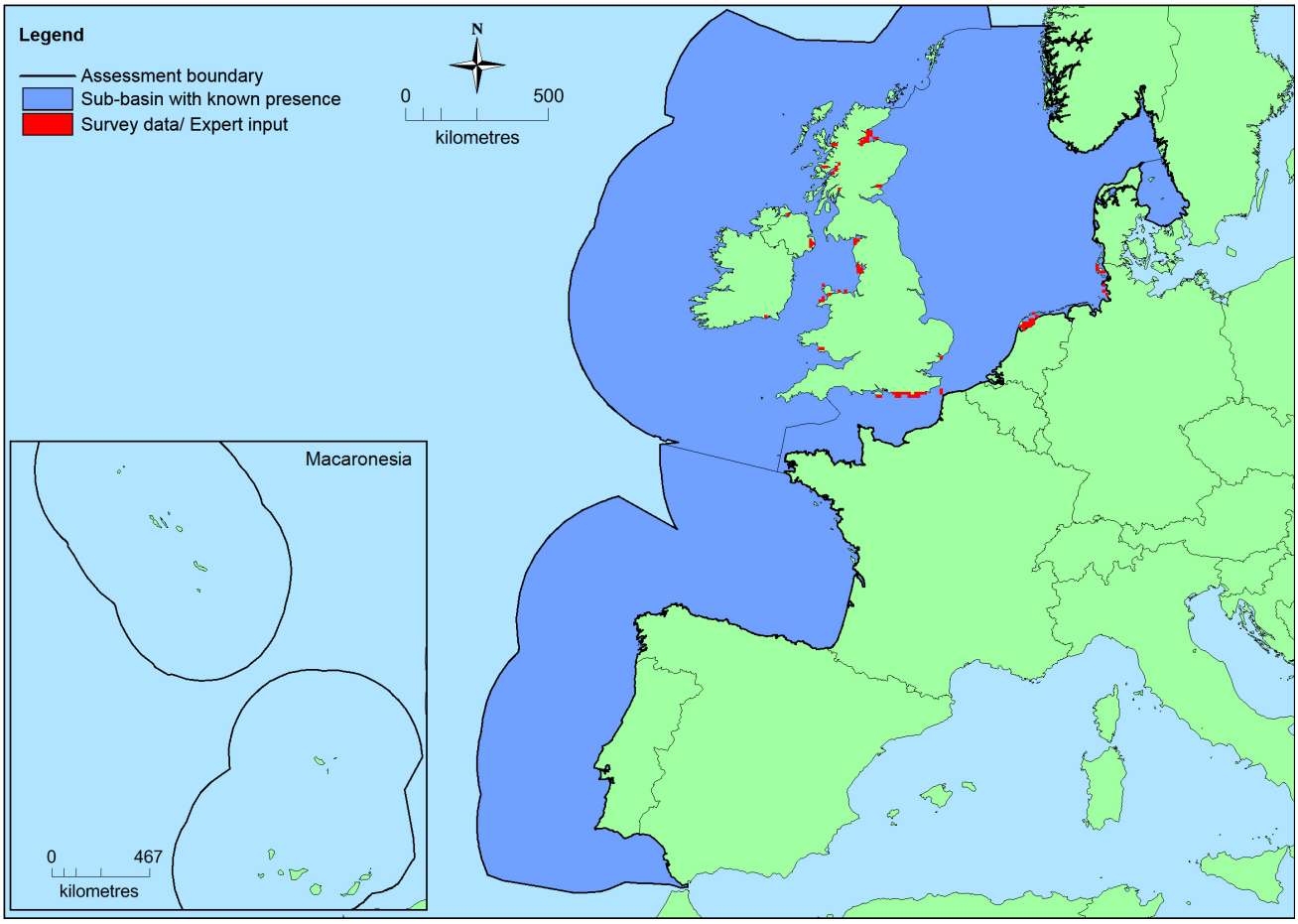
Geographic occurrence and trends

Region	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
North-East Atlantic	Bay of Biscay and the Iberian Coast: Present Celtic Seas: Present Kattegat: Present Greater North Sea: Present	Unknown Km^2	Decreasing	Unknown

Extent of Occurrence, Area of Occupancy and habitat area

	Extent of Occurrence (EOO)	Area of Occupancy (AOO)	Current estimated Total Area	Comment
EU 28	560,102 Km^2	90	Unknown Km^2	EOO and AOO have been calculated on the available data. Although this data set is known to be incomplete the figures exceed the thresholds for threatened status.
EU 28+	560,102 Km^2	>90	Unknown Km^2	EOO and AOO have been calculated on the available data. Although this data set is known to be incomplete the figures exceed the thresholds for threatened status.

Distribution map



There are insufficient data to provide a comprehensive and accurate map of the distribution of this habitat. This map has been generated using EMODnet data from modelled/surveyed records for the North East Atlantic (and supplemented with expert opinion where applicable) (EMODnet 2010). EOO and AOO have been calculated on the available data presented in this map however these should be treated with caution as expert opinion is that this is not the full distribution of the habitat.

How much of the current distribution of the habitat type lies within the EU 28?

This habitat occurs in the EU 28+ (e.g. Norway, Isle of Man, Channel Islands). Percentage hosted by EU 28 is therefore less than 100% but there is insufficient information to establish the proportion.

Trends in quantity

There can be very large annual variations in the extent of this habitat as a result of the success of spatfalls, and according to weather conditions such as storm events. Dramatic declines in this habitat can also occur as a result of starfish predation which can rapidly wipe out subtidal mussel beds. Such variations are well illustrated by historical records and also 20 years of survey data for the Wadden Sea which show changing patterns and abundance of the sublittoral mussel beds.

An analysis of trends in this habitat should distinguish between naturally occurring and cultivated beds but data are typically from the latter which are commercially exploited. In Germany there has been an estimated decline of between 30-70% in the sublittoral Wadden Sea beds. In the Netherlands 80% of the sublittoral beds are removed each year, typically mussels that have had 2 years growth for commercial fisheries which are therefore the main impact. There is a lack of data on trends in the extent of this habitat elsewhere.

Given the reported decrease in recruitment (spat falls) across Europe since the 1980s and that the largest extent of this habitat is in the southern North Sea where there have been substantial losses, the data

suggest that overall the extent of this habitat is decreasing.

- Average current trend in quantity (extent)
  EU 28: Decreasing
  EU 28+: Decreasing
- Does the habitat type have a small natural range following regression?
  No
  Justification
  This habitat does not have a small natural range being reported from locations as widely separated as southern Ireland and the Wadden Sea.
- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  No
  Justification
  This habitat does not have a small natural range being reported from locations as widely separated as southern Ireland and the Wadden Sea.

Trends in quality

An analysis of trends in this habitat should distinguish between naturally occurring and cultivated beds as there are distinct differences in density, total biomass and species richness of the macrozoobenthos communities, but data are typically from the latter which are commercially exploited.

Changes in species composition within the habitat over the last 50 years have been identified in the Netherlands, (western Wadden Sea) for example. Here species such as the non-native oyster (*C.gigas*), *Ensis, Mya* and *Marenzelleria,* which were not present in 1982 were recorded when beds were re-surveyed in 2008 and there were also changes in the abundance of deposit feeders such as *Macoma balthica* and *Peringia ulvae.* However in spite of these relatively large shifts in community composition in terms of individual species, there was no indication of change in the community composition in terms of feeding group biomass.

Wild beds have more soft substrate species compared with cultured beds which have more hard substrate species. Commercial mussel fisheries have had an extremely heavy impact on spat, and decreased habitat structure and density of mussels directly, with the density in fished plots remaining lower when resurveyed after one year.

- Average current trend in quality
  EU 28: Unknown
  EU 28+: Unknown

Pressures and threats

The main pressures and threats to this habitat are from the targeted mussel fisheries but damage is also caused by shrimp fisheries, invasive species, and effects associated with climate change such as the timing of spat falls and survivability of predators. Mussel seed is collected from wild sublittoral beds by bottom dredging, and this activity has both a direct and indirect effect. The cohesion of mussel beds depends directly on the attachment strength of the mussel byssal threads. When byssal thread attachments are disrupted, individuals or groups of mussels from the matrix are dislodged and disturbance gaps are formed. Subsequent expansion of this disruption may result from a variety of factors including both physical and biological processes.

List of pressures and threats

Biological resource use other than agriculture & forestry

Fishing and harvesting aquatic resources

Professional active fishing
Benthic or demersal trawling

Human intrusions and disturbances

Other human intrusions and disturbances
Shallow surface abrasion/ Mechanical damage to seabed surface

Invasive, other problematic species and genes

Invasive non-native species

Climate change

Changes in biotic conditions

Conservation and management

Management of the wild commercial mussel fishery is key to the conservation of this habitat. This includes controls on the removal of seed stock, the level of fishing effort and locations where fisheries are permitted. In the Netherlands and Germany efforts are also underway to switch from collection of spat by dredging to use of seed collectors (ropes, nets, poles), with the aim of eliminating the bottom fishery within the next 10 years. In France and Spain the use of seed collectors has been standard practice for decades. Closures of collecting areas to enable recovery of stocks and the associated habitat are also needed, as well as regulation of discharges to the marine environment which result in nutrient enrichment that affects the condition and viability of this habitat.

List of conservation and management needs

Measures related to wetland, freshwater and coastal habitats

Restoring/Improving water quality

Measures related to marine habitats

Other marine-related measures

Measures related to hunting, taking and fishing and species management

Regulation/Management of fishery in marine and brackish systems
Specific single species or species group management measures

Conservation status

Annex 1:

1160: MATL U2, MMAC FV

When severely damaged, does the habitat retain the capacity to recover its typical character and functionality?

There is a good capacity for this habitat to recover following damage. The time taken will depend on the occurence and frequency of good spatfalls and natural events such as storm damage and the presence of predators.

Blue mussels are sessile, attached organisms that are unable to repair significant damage to individuals. They do not reproduce asexually and therefore the only mechanism for recovery from significant impacts is larval recruitment to the bed or the area where previously a bed existed. Recruitment is often sporadic, occurring in unpredictable pulses, but persistent mussel beds can be maintained by sporadic or relatively low levels of recruitment.

Effort required

10 years
Naturally

Red List Assessment

Criterion A: Reduction in quantity

Criterion A	A1	A2a	A2b	A3
EU 28	25 %	unknown %	unknown %	unknown %
EU 28+	25 %	unknown %	unknown %	unknown %

A substantial decline in the extent of this habitat has been reported from some areas (e.g. between 30-70% in the German Wadden Sea). Excluding changes in managed beds from this analysis, the expert opinion is that overall this habitat has probably declined by at least 25% over the last 50 years. The habitat is therefore assessed as Near Threatened under criteria A for both the EU 28 and EU 28+.

Criterion B: Restricted geographic distribution

Criterion B	B1				B2				B3
	EOO	a	b	c	AOO	a	b	c	
EU 28	>50,000 Km^2	Yes	Yes	No	>50	Yes	Yes	No	No
EU 28+	>50,000 Km^2	Yes	Yes	No	>50	Yes	Yes	No	No

This habitat has a large natural range in the North East Atlantic region The precise extent is unknown however as EOO >50,000 km^2 and AOO >50, this exceeds the thresholds for a threatened category on the basis of restricted geographic distribution.This habitat is subject to a continuing decline in its spatial extent but its distribution is such that the identified threats are unlikely to affect all localities at one. This habitat has therefore been assessed as Least Concern under criterion B for both the EU 28 and EU 28+.

Criterion C and D: Reduction in abiotic and/or biotic quality

Criteria C/D	C/D1		C/D2		C/D3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %
EU 28+	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %

Criterion C	C1		C2		C3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %
EU 28+	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %

Criterion D	D1		D2		D3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	unknown %	unknown%	unknown %	unknown%	unknown %	unknown%
EU 28+	unknown %	unknown%	unknown %	unknown%	unknown %	unknown%

This habitat has declined in quality in some parts of its range over the last 50 years but the overall situation is unclear. For example a substantial reduction of more than 80% of beds with more than 50% collapsed has been reported for the German Wadden Sea. In the Dutch Wadden Sea non-native species that were not present in 1982 have subsequently been reported in mussel beds although in terms of overall biomass there was no significant change in the main feeding groups. Spat collection from subtidal beds to support commercial mussel fisheries has also been shown to affect density and structure even though the mussel bed may subsequently recover. This habitat has been assessed as Data Deficient under criteria C/D.

Criterion E: Quantitative analysis to evaluate risk of habitat collapse

Criterion E	Probability of collapse
EU 28	unknown
EU 28+	unknown

There is no quantitative analysis available to estimate the probability of collapse of this habitat type.

Overall assessment "Balance sheet" for EU 28 and EU 28+

	A1	A2a	A2b	A3	B1	B2	B3	C/D1	C/D2	C/D3	C1	C2	C3	D1	D2	D3	E
EU28	NT	DD	DD	DD	LC	LC	LC	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD
EU28+	NT	DD	DD	DD	LC	LC	LC	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Near Threatened	A1	Near Threatened	A1

Confidence in the assessment
Medium (evenly split between quantitative data/literature and uncertain data sources and assured expert knowledge)

Assessors
North East Atlantic Working Group: S. Gubbay, N. Dankers, K. Fürhaupter, G. Saunders, H. Tyler-Walters, F. Otero-Ferrer, J. Forde, R. Haroun Tabraue, N. Sanders

Contributors
E. Bastos and the North East Atlantic Working Group: S. Gubbay, N. Dankers, K. Fürhaupter, G. Saunders, H. Tyler-Walters, , F. Otero-Ferrer, J. Forde, R. Haroun, N. Sanders.

Reviewers
S.Wells.

Date of assessment
06/08/2015

Date of review
13/01/16

References

Connor, D.W., Allen, J.H., Golding, N. *et al.* 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 JNCC. [online] Peterborough: ISBN 1 861 07561 8. Available

at: http://jncc.defra.gov.uk/pdf/04_05_introduction.pdf. (Accessed: 30/08/2014).

Drent, J. & Dekker, R. 2013. *How different are subtidal Mytilus edulis L. communities of natural mussel beds and mussel culture plots in the western Dutch Wadden Sea*? NIOZ Report, IMARES, p.90.

Dekker, R. & Drent, J.2013*. The macrozoobenthos in the subtidal of the western Dutch wadden Sea in 2008 and a comparison with 1981-82*. NIOZ-Report, IMARES.

European Environment Agency. 2014. *EUNIS habitat type hierarchical view*. Available at: http://eunis.eea.europa.eu/habitats-code-browser.jsp (accessed 07/042015).

Hiscock, K., Harris, R. & Lukey, J. 2006. *Nationally Important Marine Features and Biodiversity. Action Plan Marine Priority Habitats and Species.* Report to the Joint Nature Conservation. Committee from the Marine Biological Association. Plymouth: Marine Biological Association. JNCC Contract F90-01-892.Peterborough, Joint Nature Conservation Committee, JNCC Report No. 506.

Holt, T. J., Rees, E. I., Hawkins, S. J. & Seed, R. 1998. *Biogenic reefs (Volume IX). An overview of dynamic and sensitivity characteristics for conservation management of marine SACs.* Liverpool: UK Marine SACs.

Kennedy, R. 2008. *Benthic Biotope classification of subtidal sedimentary habitats in the Lower River Suir candidate Special Area of Conservation and the River Nore and River Barrow candidate Special Area of Conservation* (July 2008). Available at: http://www.npws.ie/sites/default/files/publications/pdf/Kennedy_2008_NPWS_Subtidal_Surveys.pdf. (Accessed: 07/04/2015).

Maddock, A. (Ed) 2008. Blue Mussel beds on sediment. UK Biodiversity Action Plan Priority Habitat Descriptions.Available at: http://www.jncc.gov.uk/page-5155. (Accessed: 07/04/2015).

Mainwaring, K., Tillin, H. & Tyler-Walters, H. 2014. *Assessing the sensitivity of blue mussel beds to pressures associated with human activities.* Peterborough: Joint Nature Conservation Committee, JNCC Report No. 506.

Smaal, A., Graeymeersch, J., Jansen, J. et al. 2012. *Sublittoral mussel beds in the Dutch Wadden Sea; natural dynamics, fishery impacts and options for restoration*. Available at: http://www.waddenacademie.nl/fileadmin/inhoud/pdf/01-Waddenacademie/symposium_november_2012/presentations_22_november_2012/Smaal_22-11-2012_ISWSS_Leeuwarden.pdf. (Accessed: 07/05/2015).