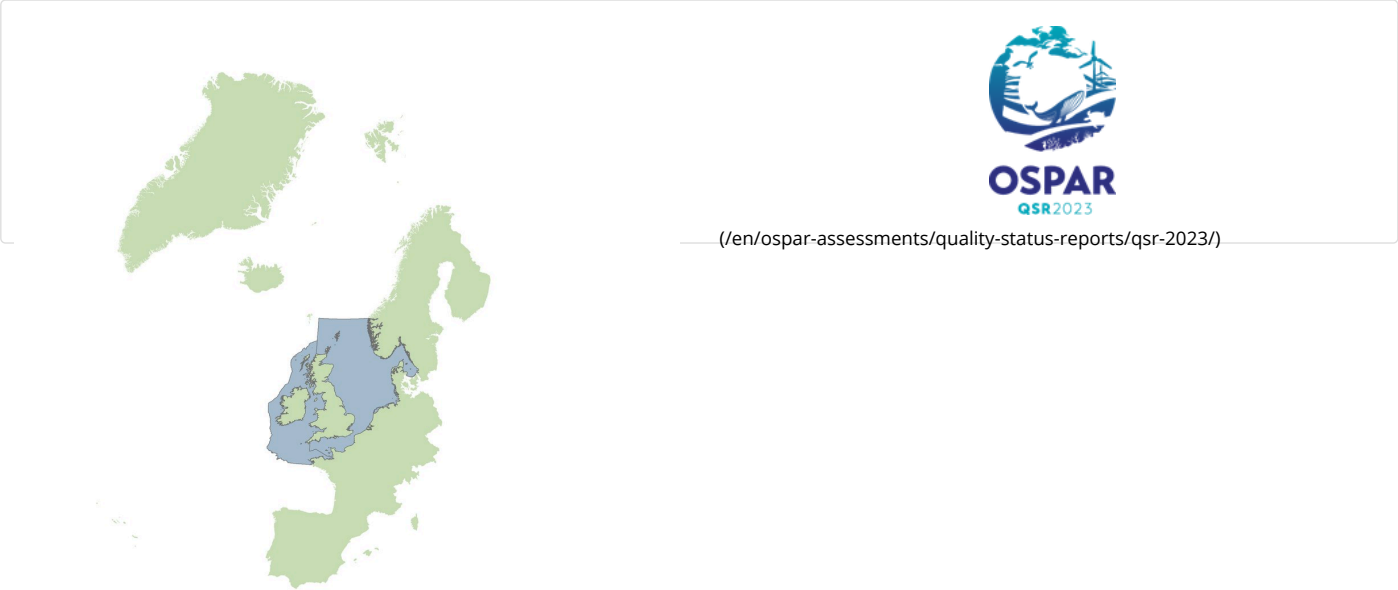


Status Assessment 2023 - Intertidal Mytilus Edulis Beds on Mixed and Sandy Sediments

Intertidal mussel beds, which have been severely impacted by human activities in the past, have recovered in the international Wadden Sea, but are still decreasing in other parts of OSPAR Region II (Sweden, Scotland), or have disappeared (Region II, France). Pacific oysters are a threat (competition for food) but also help increase the extent of mixed mussel/oyster beds by providing shelter. Other threats are climate change (DE, NL, SE), fisheries and exploitation (SE), pollution (DK) and habitat loss or degradation (N-IR, SE, DE).



								Previous OSPAR status assessment	Status assessment		⊕ Table Legend
Assessment of status		Distribution		Extent		Condition		Previous OSPAR status assessment	Status assessment		⊕ Method of Assessment
Region	I	NA		NA		NA		NA	NA		
	II	2,5	*	2,5	*	4,5	*	•	Poor	2,5	
	III	?	5	*	5	?	5	•	?	5	
	IV	NA		NA		NA		NA	NA		
	V	NA		NA		NA		NA	NA		

Assessment of threats		Habitat loss or degradation through physical damage *		Diseases/neobiota, including the invasive Pacific oyster (Crassostrea gigas)		Habitat degradation through smothering & siltation		Pollution		Removal of target species for fisheries and cascading effects on food-webs		Changes in genetic integrity		Change in tidal current regimes		Habitat loss or alteration caused by infrastructure development		Climate change		Threat or impact (conclusion based on the above rows)	
Region	I	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
	II	?	(↑ DE) 4,5	?		4,5	(↑ SE)	?	1,3	?	(↑ SE, NO)	?	?	?	?	?	?	?	4,5	5	
	III	?	1,2,3,5	?	5	?	5	↔	1,3	NA		?	?	?	?	?	?	5	?	5	
	IV	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
	V	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	

Confidence

Medium

Background Information

Year added to OSPAR List: 2004 https://qsr2010.ospar.org/media/assessments/p00358_case_reports_species_and_habitats_2008.pdf
(https://qsr2010.ospar.org/media/assessments/p00358_case_reports_species_and_habitats_2008.pdf)

Key criteria that led to the listing:

- **Decline:** Significant declines in the extent and biomass of mussel beds have been reported in the OSPAR Area, particularly in Region II.
- **Rarity:** Intertidal beds are now rare in some parts of their former range in the Wadden Sea.
- **Sensitivity:** *Mytilus edulis* is tolerant to wide fluctuations in natural variables. Mussel beds are (potentially) affected by climate change, fisheries, non-indigenous species, phytoplankton blooms, excessive levels of silt and inorganic detritus and anthropogenic chemicals.
- **Ecological significance:** Mussel beds are important in sediment dynamics of coastal systems, as food source for birds and as habitat for a large number of species including serving as essential fish habitats.
- **Key pressures affecting intertidal mussel beds are (QSR 2010):** Climate changes; Hazardous substances; Oil pollution; Nutrient and organic enrichment; Habitat damage; and Habitat loss.

Last status assessment and brief outcome: In the UK, the species is considered to be overexploited, but not in actual decline. Mussel beds in the Wadden Sea showed a slow recovery or decline in the past 10 years, depending on the area (OSPAR Commission 2015a).
<https://www.ospar.org/documents?d=7376> (<https://www.ospar.org/documents?d=7376>)

Geographical Range and Distribution

Intertidal *Mytilus edulis* beds on mixed and sandy sediments are specific to the OSPAR Maritime Area. The majority are found in the Wadden Sea area (Denmark, Germany, the Netherlands) and in UK waters, although they are also present along the coast of Iceland, Sweden and Ireland (OSPAR 2016).

Method of assessment: 1,2,3,4

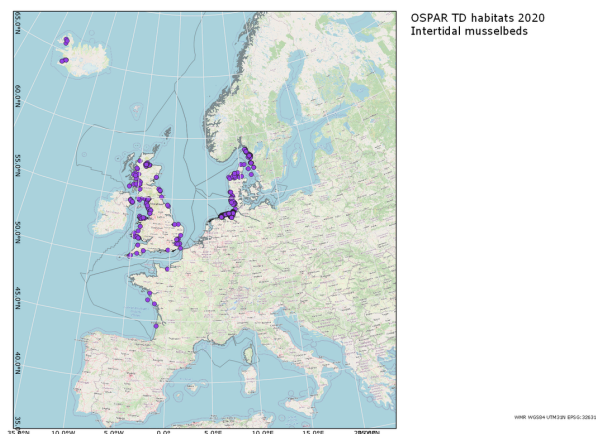


Figure 1: Distribution of *Mytilus edulis* beds (data OSPAR). (<https://jncc.gov.uk/our-work/marine-habitat-data-product-ospar-threatened-and-or-declining-habitats/>) as submitted to OSPAR in 2020 (the maps is a combination of point data and polygons)

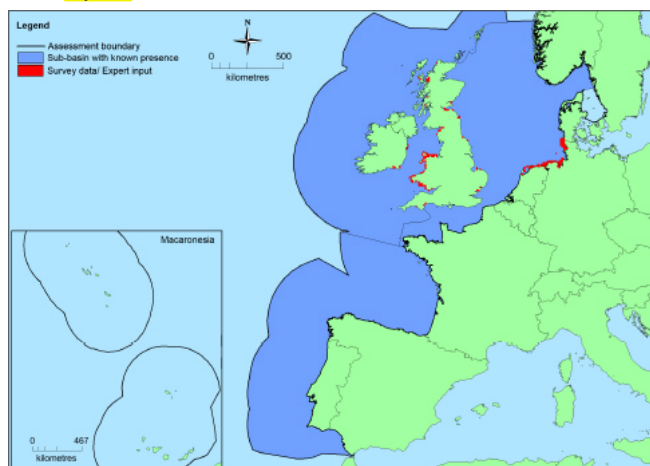


Figure 2: Distribution of *Mytilus edulis* beds, based on EMODnet and supplemented with expert opinion. The map was considered to contain insufficient data to be accurate (EU Red List report 2016: Gubbey and Dankers 2016)

Extent

In the Wadden Sea (Denmark, Germany, the Netherlands), this habitat has suffered from a significant decline in the extent and biomass, both historically and in recent decades (Gubbey & Dankers, 2016). In the German and Dutch part, systematic aerial and ground truthing surveys provide annual data. In Germany, an increase in the extent of mussel/oyster beds area was observed in recent years. In the Netherlands, the extent is now considered in a good state, with large variations.

For Denmark, no recent data are available. For UK waters, also few national monitoring data are available (Baden *et al.*, 2021), although local declines are reported for Scotland (Cook *et al.*, 2016). The overall decline over the last 50 years (NE Atlantic) is estimated to be >50% (Gubbey & Dankers, 2016; Baden *et al.*, 2021) and the habitat is listed as endangered on the EU red list of habitats (Gubbey & Dankers, 2016). The extent in the EU28 (28 EU countries) is calculated to be 584 502 km² (Gubbey & Dankers, 2016) (Figure 2).

Method of assessment: 1,2,3,4

Condition

The condition of mussel beds concerns e.g., the size, age and species composition. In the Wadden Sea, protection measures have enabled more natural development of mussel beds (Folmer *et al.*, 2017). Half of the beds now consist of a mix of Pacific oysters and native blue mussels. In parts of the German Wadden Sea however, there are hardly any beds which consist only of mussels. There is nonetheless a great variation in dominance by either species. Oyster and mixed beds have a much lower hazard rate than pure mussel beds and can easily result in larger future beds (Van der Meer *et al.*, 2019). In other areas in the Wadden Sea, and along the coast of e.g., south-east England and Kattegat (Sweden), mixed beds occur but with lower oyster abundances than in the Wadden Sea. The structure of mussel beds may also be affected by fishing away larger predators leading to increased predation by mussel-eating predators (Christie *et al.*, 2020), especially crawling ones (Meister, 2022). In Norway and Sweden, no data on weakened mussel conditions are available, the mussel beds just decrease in distribution and in extent.

Method of assessment: 2,4

Threats and Impacts

The dominant reasons for the decline of *Mytilus* populations are overfishing of mussel banks (Wadden Sea, late 1980s) and climate change effects such as changes in temperature, salinity, extreme weather events, higher abundance of predators and infectious agents (Baden *et al.*, 2021). Other threats are pollution, trophic cascading effects due to overfishing and invasive species. Pacific oysters are a threat (competition for food) but also help increase the extent of mixed mussel/oyster beds by providing shelter.

Measures that address key pressures from human activities or conserve the species/habitat

OSPAR Recommendation 2015/1 (OSPAR Commission 2015b) includes 12 measures and actions to be implemented by the Contracting Parties. According to the implementation highlights (OSPAR 2016), the level of engagement was 75%, resulting in e.g.:

1. Germany, Sweden, and the UK have national legislation in place;
2. Denmark, France, Germany, Sweden, and the UK undertake monitoring programmes;
3. Management measures are in place in Denmark, Germany, Netherlands, Sweden and the UK;
4. MPAs have been designated in Denmark, Germany, Netherlands, Sweden, and the UK;
5. Germany and the UK undertake awareness raising activities.

Specific measures are e.g., restriction of seabed disturbing fisheries including the transition of mussel seed harvesting from seabed to hanging cultures in the Wadden Sea.

Conclusion (including management considerations)

In Sweden mussel beds are declining. The only mussel bed in France, Region II, has disappeared after 2015. Within Scotland there have been multiple reports of declines in blue mussel populations. Management in the Dutch Wadden Sea has resulted in the removal of mussel fisheries. Currently, the extent and biomass of (mixed) mussel beds are stable. Maintaining the current protection measures is advised to allow natural development of mussel beds and mussel/oyster reefs. It would be advisable to reassess the status of this habitat in 6 years, and to invest in harmonised monitoring and data collection.

Knowledge Gaps

Brief knowledge gaps:

- Regular international harmonised monitoring of *Mytilus* spp. (including application of innovative techniques such as remote sensing by means of satellites and drones).
- Knowledge on the degree of hybridisation between *Mytilus* spp.
- Effects of climate change on interaction between mussels and birds, and on population variability of mussels and oysters.
- Knowledge on critical factors for recovery success, including of effects of protective refuges for plantigrade larvae, and effects of Pacific oyster on survival.
- Environmental Assessment Criteria for all heavy metals in mussels should be developed (OSPAR 2017).

Extended text Knowledge gaps:

Environmental Assessment Criteria for all heavy metals in mussels should be developed (OSPAR 2017).

Baden *et al.*, (2021) define the following knowledge gaps:

- regularly monitoring the spatiotemporal distribution of *Mytilus* spp. using internationally standardized programmes all over the North Atlantic is lacking.
- knowledge on the degree of hybridization between *Mytilus* spp. is lacking; hybridization is thoroughly investigated in many areas, but not, for example, in Sweden.
- for *Mytilus* larval stages, there is insufficient understanding of the degree of predation from invasive species such as *Mnemiopsis* and *Crassostrea* and to what extent the massive establishment of *Crassostrea* in the littoral zone has prevented new settlement of *Mytilus*.
- studies on the dependence of plantigrade larvae access to seagrass and suitable macroalgae are needed since these might constitute a protective refuge before final settlement on natural or various artificial substrates.
- in-depth studies on how climate change has affected the overall interaction between mussels and birds are essential to understand the impact on mussel populations.
- multidisciplinary studies will be of critical importance to identify factors responsible for the losses of *Mytilus* populations.

Wadden Sea QSR recommendations (Folmer *et al.*, 2017):

- More systematic and trilateral harmonised monitoring of blue mussels and Pacific oysters is recommended, so that understanding and modelling of population dynamics and spatial distributions can be improved.
- Harmonisation may be supported by the application of innovative techniques such as remote sensing by means of satellites and drones.
- Include systematic monitoring of larvae and spat of blue mussels and Pacific oysters so that population variability and future response to climate change can be modelled.
- Improved knowledge of the interplay of the intertidal and subtidal populations is expected to help understand the development of both intertidal and subtidal populations.
- Adapt the data collection of mussel beds and oyster reefs such that it fits in the context of their current and future communities.
- More information of the role of fisheries and seals by removal of top predators leading to trophic cascading effects (such as mesopredator release) is also needed (Christie *et al.*, 2020).

Method used

Assessment carried out by Wageningen Marine Research (Bos, Tamis) based upon:

- a literature review and;
- a questionnaire sent to experts from all relevant contracting parties
- Additional comments of CPs

References

Sheet reference:



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