A5.62 Mussel beds on Pontic circalittoral terrigenous muds

Summary

This habitat occurs on mixed circalittoral sediments – terrigenous muds - mixed with variable amounts of recent or subfossil shells, most of them belonging to the blue mussel *Mytilus galloprovincialis.* It is found offshore, typically between depths of 20 and 45 m. *Mytilus galloprovincialis* forms the biogenic reefs through the accumulation of mussel shells and aggregation of the shells by byssal threads. Over time, a hard substratum higher than the surrounding sediment is formed, on which living mussel colonies attach themselves. The reef is formed of numerous elongated patches and/or continuous ridges. Between these lay the organic-rich “Mytilus mud” formed by accumulation of mussels’ faeces and pseudofaeces. Blue mussel beds have a particularly important ecological role on soft seabeds, as they provide a hard surface in otherwise muddy areas. This attracts and supports a greater range of marine life than would otherwise be found there including seaweeds, anemones, barnacles, molluscs, crustaceans, echinoderms and polychaetes.

This habitat is present in the north and north-west Black Sea and absent from the Sea of Marmara. Historically the most significant pressure has been hypoxia caused by eutrophication which has caused the greatest reductions in quantity and quality. Since the collapse of the Soviet Union improved transboundary pollution measures have been implemented reducing this pressure. As a result stability and slow signs of recovery have been observed in both quantity and quality. Pressures caused by pollution and trawling continue to be a threat. Trawling is prohibited in many parts of the Black Sea but intense illegal activities are still recorded.

Much of the remaining habitat is within Marine Protected Areas by there are few conservation measures within these at present. River inputs are being managed in order to improve the water quality of the Black Sea. Desired measures for the future include a ban bottom trawling across the Black Sea and regulations surrounding ballast control, water quality control for Turkey (especially Istanbul), and non-EU Black Sea states.

Synthesis

This habitat is known to have almost completly covered the north-west shelf of the Black Sea between 20-60m depth, where the substrate was suitable, prior to 1965. The mussel population, and consequently the extent of this habtat has since suffered a major reduction (more than 50%) , primarily due to the effects of eutrophication. A very substantial decline in quality has also occurred over the last 50 years, estimated as an intermediate decline affecting more than 80% of the habitat.

There are data limitations which impact the reliability of the assessment. These relate to: current extent of habitats, lack of quantitative quality data and data gaps for Turkey. Quantitative data on habitat quantity and quality are available for Romania, Bulgaria, Ukraine, Crimea and Russia but expert opinion has also been used for this assessment.

Althought this habitat has a large EOO and AOO, and therefore qualifies as Least Concern under criterion B, the habitat is assessed as Endangered both at the EU 28 and EU 28+ levels because of the extent of decline in both quality and quanity over the last 50 years.

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Endangered	A1, C/D1	Endangered	A1,

Sub-habitat types that may require further examination

None.

Habitat Type

Code and name

A5.62 Mussel beds on Pontic circalittoral terrigenous muds

Mussel beds in ~30 m depth, Bulgaria (© L.Klissurov).

Mussel beds in ~30 m depth, Bulgaria (© Y.Klissurov).

Habitat description

This habitat is comprised of mixed circalittoral sediments – terrigenous muds - mixed with variable amounts of recent or subfossil shells, most of them belonging to the blue mussel *Mytilus galloprovincialis*, occurring offshore, between depths of 20 and 45 m. At these depths environmental conditions are relatively constant year-round: low light, low temperature (6-9°C), and a constant salinity of 18 ppt. *Mytilus galloprovincialis* forms biogenic reefs through the accumulation of mussel shells in time and aggregation of the shells by byssal threads. Over time, a hard substratum higher than the surrounding sediment is formed, on which living mussel colonies attach themselves. The reef is formed of numerous elongated patches and/or continuous ridges, always transverse to the prevailing bottom currents (which bring food to the filter-feeders). Between these lay the organic-rich “Mytilus mud” formed by accumulation of mussels’ faeces and pseudofaeces. The biomass of *Mytilus galloprovincialis* may vary between 200 and 1,500 g/m^2.

Among the habitats which occur on sedimentary substratum in the Black Sea, the mussel beds have the highest biodiversity, due to both extending through a wide range of depths and to providing a multitude of microhabitats suitable for a large number of species. This biogenic reef is unique through the crucial ecological role played by the great biofiltration power of the mussel beds in, which ensures the benthic-pelagic coupling and provides enhanced ecosystem resilience. The ‘mussel mud’ formed by the blue

mussels' waste is an important source of food for deposit-feeding infauna living in the sediment around the mussel beds.

The high- biodiversity mussel beds harbour various threatened species and have socio-economical importance as a habitat (breeding grounds, nurseries) and fishing area for commercially valuable species (*Psetta maeotica, Squalus acanthias,* sturgeons, *Rapana venosa*). Mussels themselves are the most popular mollusc species for human consumption around the Black Sea, and mussel beds are a source of larvae and spat for aquaculture. The habitat is present all around the coasts of Bulgaria, Romania, Ukraine, Russia and Georgia as a discontinuous belt at variable depths between 20 and 45-80 m. Historically the habitat used to be present in front of the Turkish coast as well, but was completely destroyed due to intensive bottom trawling during the last 100 years.

Indicators of quality:

Biomass, density and cover are some of potential indicators of quality for this habitat. In Romania the following thresholds have been established:

-Reduced habitat fragmentation – the area of enclaves of *Melinna palmata* muds occurring inside the habitat ≤10.5%

-Cover of living mussels inside patches ≥50%

-Median shell length of living *Mytilus galloprovincialis* inside patches ≥50 mm.

-Live biomass of *Mytilus galloprovincialis* ≥5,000 g/m^2

In Russia and Ukraine the average biomass of macrozoobenthos in 1970-1980 was more than 450 g/m^2, with a density of 350 ind/m^2. Now some decline in the number and biomass is observed. In different regions average biomass varied from 220 to 300 g/$m^{2,}$ and density 250-270 ind/m^2. Off the coast of Crimea average density and biomass of macrozoobenthos in the habitat were quite uneven as we can see from different authors: 3,700 ind/m^2 and 59 g/$m^{2,}$ respectively and 844 ind/m^2 and 227.7 g/m^2, respectively.

Characteristic species:

Blue mussel beds have a particularly important ecological role on soft seabeds, as they provide a hard surface in otherwise muddy areas. This attracts and supports a greater range of marine life than would otherwise be found there including seaweeds, anemones, barnacles, molluscs, crustaceans, echinoderms and polychaetes. The species composition of the accompanying fauna is variable and depends on the sediment matrix and depth. Between 20 and 106 species of macrozoobenthos are known to occur in the habitat, maximum number of species recorded is 131. Circalittoral *Mytilus galloprovincialis* beds harbour a diverse range of epibiota and infauna:

-cnidarians: *Actinithoe clavata*

-sponges: *Dysidea* sp.

-molluscs: *Lepidochitona cinerea, Abra alba, Calyptraea chinensis, Retusa truncatella, Nassarius nitidus, Gouldia minima, Pitar rudis, Acanthocardium paucicostatum, Rapana venosa*

-polychaetes: *Terebellides stroemi, Aonides paucibranchiata, Melinna palmata, Capitella capitata, C. minima, Eumida sanguinea, Glycera alba, Hediste diversicolor, Heteromastus filiformis, Nephtys hombergii, Nereiphylla rubiginosa, Pectinaria koreni, Polycirrus jubatus, Polydora* spp., *Pomatoceros triqueter.*

-amphipods: *Ampelisca diadema, Orchomene humilis*

-echinoderms: *Amphiura stepanovi, Leptosynapta inhaerens*

-tunicates: *Ascidiella aspersa, Ciona intestinalis*

-elasmobranchs: *Raja clavata, Squalus acanthias*

-fish*: Acipenser gueldenstaedti, A. stellatus, Huso huso, Chelindonichthys lucernus, Mesogobius batrachocephalus, Psetta maeotica.*

Classification

This habitat may be equivalent to, or broader than, or narrower than the habitats or ecosystems in the following typologies.

EUNIS (v1405):

Level 4. A sub-habitat of A5.6 Pontic circalittoral biogenic habitat.

Annex 1:

1170 Reefs

MAES:

Marine - Coastal

Marine - Shelf

MSFD:

Sublittoral rock and biogenic reef

EUSeaMap:

Aphotic rock or biogenic reef

IUCN:

9.5 Subtidal mud

Does the habitat type present an outstanding example of typical characteristics of one or more biogeographic regions?

Yes

Regions
Black

Justification
The species present in the Black Sea are also common in the Mediterranean. However, Mussel beds in the Black Sea are unique in size and scale. For this reason that Black Sea is often referred to as the 'Mytilid Sea'. The Black Sea mussel beds play an important ecological role through benthic-pelagic coupling. They transfer pelagic energy to benthic communities which provide resilience to the Black Sea ecosystem.

Geographic occurrence and trends

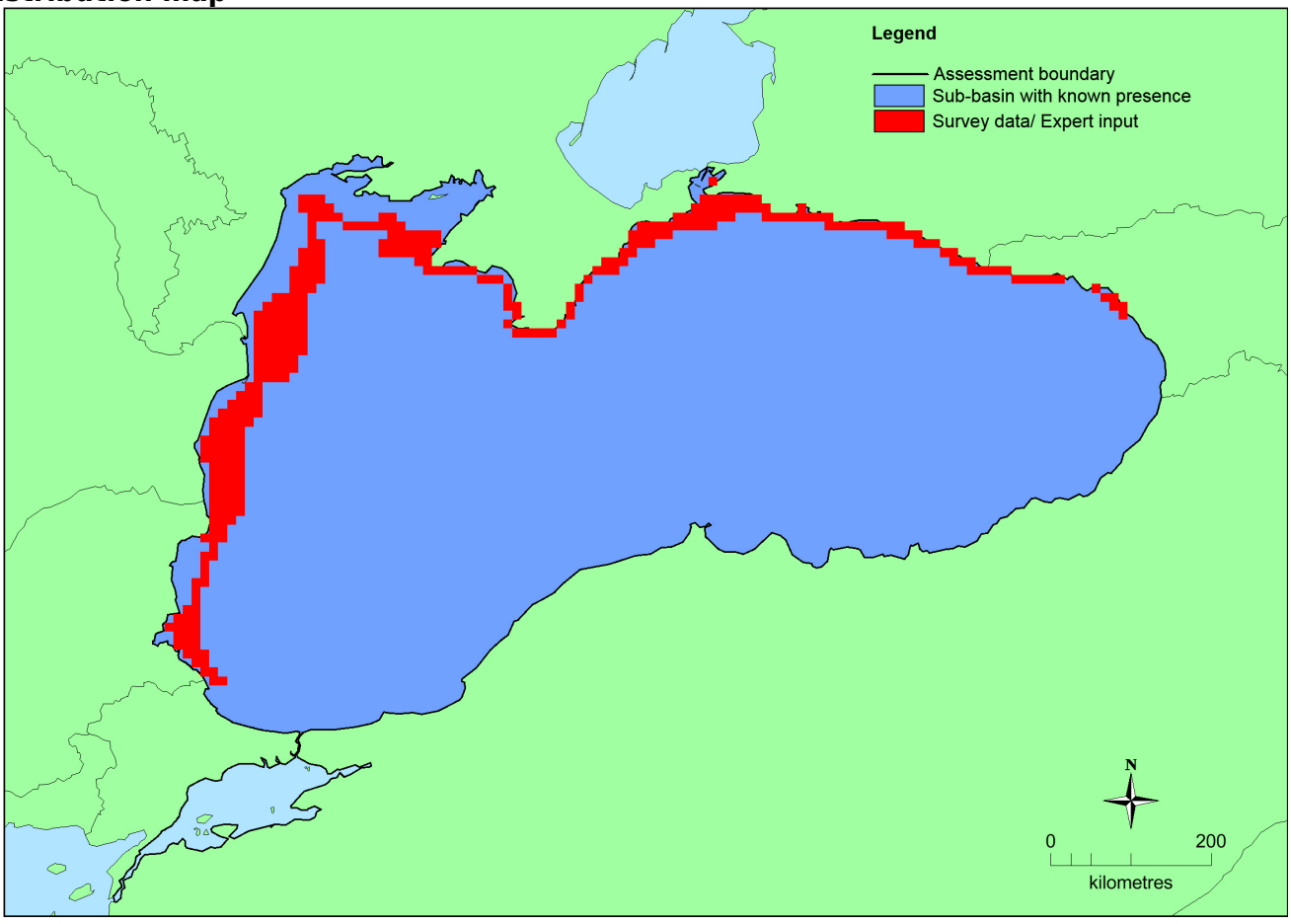
Region	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)

Region	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
Black Sea	Black Sea: Present	Unknown Km^2	Decreasing	Decreasing

Extent of Occurrence, Area of Occupancy and habitat area

	Extent of Occurrence (EOO)	Area of Occupancy (AOO)	Current estimated Total Area	Comment
EU 28	32,603 Km^2	128	Unknown Km^2	No accurate data available for the present extent of the habitat. Older data is available (e.g. Bulgaria) but extent is known to have been reduced by trawling activities so cannot be relied upon.
EU 28+	344,080 Km^2	340	Unknown Km^2	No accurate data available for the present extent of the habitat. Older data is available (e.g. Bulgaria) but extent is known to have been reduced by trawling activities so cannot be relied upon.

Distribution map



This map has been generated based on expert opinion. EOOand 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?

Around 38% of this habitat is estimated to be hosted by EU 28 in the Black Sea.

Trends in quantity

In the historic period (pre-1965) this habitat was widespread across the Black Sea. During this time there was complete coverage over the north-west shelf between the depths of 20 and 60 m.

Within the last 50 years (1965 to present day) the mussel population crashed due to eutrophication. The anoxic zone created by eutrophication also caused die back in both benthic and fish communities. In Romania the loss of approximately 50% of the habitat has been reported and a similar trend has been seen in other areas such as the Ukrainian Danube Delta where approximately 15% of the mussel beds have been lost. Damage by trawling has also decreased the extent of the habitat. Since the last hypoxia event in 1992, this habitat has been reported as stable and with some signs of recovery although very slow as only small proportion of the historic extent is now present.

In the future this habitat is expected to recover slowly. As the population grows the rate of recovery is expected to accelerate. However the recovery will only continue if water conditions remain stable and trawling restrictions are imposed. If water temperatures increase further hypoxia events could reduce the available nutrients needed to facilitate recovery.

- Average current trend in quantity (extent)
  EU 28: Increasing
  EU 28+: Increasing
- Does the habitat type have a small natural range following regression?
  Yes
  Justification
  The habitat has a small range following regression in the EU countries only. In the EU 28+ the EOO exceeds 50,000 km².The habitat has undergone an important decline in the last 50 years. This is especially true to the western Black Sea (see Trends in Quantity) however, this decline has now halted and the extent of the habitat is now stable.
- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  No
  Justification
  The north-west shelf is a large area of terrigenous muds which occupies approximately 20% of the Black Sea.

Trends in quality

In the historic period the quality of this habitat is believed to have been high. This is not supported by quantitative or qualitative data but is inferred based on the lack of pressures during this period.

In the recent past (last 50 years) the quality has decreased. This has included both biotic and abiotic changes. Quality indicators reflecting this change include: age structure of reefs, diversity of associated species and an increase in the polychaete worm *Melinna palmata.* These changes have been recorded at specific sites. At Yagorlytsky Bay the associated biocenosis has declined from 41 species to 27. At Tendrovsky Bay the biomass declined from 943 g/m^2 in the 1960s to 2 g/m^2 in the 1990s. However, signs of quality recovery have been observed in recent decades. At Yagorlytsky Bay a high number of mussel age classes was observed in 2006. This suggests an increase in quality.

In the future, the quality of the habitat is expected to slowly increase if the current conditions are maintained.

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

Pressures and threats

Eutrophication as a result of nutrient enrichment (N, P and organic matter) is the most significant historic pressure on the habitat. This has caused hypoxia events which have decreased the extent and quality of the habitat. Since the 1990s this pressure has reduced due to tighter controls on pollution in the catchment of the Danube and other rivers which enter the north-west Black Sea. Whilst this pressure is now reduced it is still a continuing threat in the current and future periods. This is especially true for non-EU countries surrounding the Black Sea which are not bound by the agreements such as the Water Framework Directive (WFD).

The habitat is highly sensitive to beam-trawling which causes habitat destruction. Trawling is largely prohibited but illegal trawling is a continuing problem throughout the Black Sea.

The habitat is sensitive to siltation. This is caused by disturbance activities (e.g. trawling, dredging, etc).

List of pressures and threats

Biological resource use other than agriculture & forestry

Professional active fishing

Pollution

Nutrient enrichment (N, P, organic matter)

Natural System modifications

Siltation rate changes, dumping, depositing of dredged deposits

Conservation and management

Much of the remaining habitat is within Marine Protected Areas but there are few conservation measures within these at present. River inputs are being managed in order to improve the water quality of the Black Sea. For EU states this is archived via the Water Framework Directive (WFD). Desired measures for the future include a ban bottom trawling across the Black Sea and regulations surrounding ballast control, water quality control for Turkey (especially Istanbul), and non-EU Black Sea states.

List of conservation and management needs

Measures related to marine habitats

Other marine-related measures

Measures related to spatial planning

Establish protected areas/sites
Legal protection of habitats and species

Measures related to hunting, taking and fishing and species management

Regulation/Management of fishery in marine and brackish systems

Measures related to special resouce use

Regulating/Managing exploitation of natural resources on sea

Conservation status

Annex 1:

1170: MBLS U1

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

No direct intervention actions are appropriate. However, improvement can be made using passive intervention (i.e. legislation). Natural recovery is possible. However, recovery to original extent will be slow due to large area previously covered by the habitat.

Effort required

20 years
Naturally

Red List Assessment

Criterion A: Reduction in quantity

Criterion A	A1	A2a	A2b	A3
EU 28	50-80 %	unknown %	unknown %	unknown %
EU 28+	50-80 %	unknown %	unknown %	unknown %

In the historic period (pre-1965) this habitat was widespread across the Black Sea. During this time there was complete coverage over the north-west shelf between the depths of 20 and 60 m.Within the last 50 years (1965 to present day) the mussel population crashed due to eutrophication. There is a lack of quantiative data however expert opinion is that there has been an overall decline of between 50-80%. This habitat has therefore been assessed as Endangered under criterion 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	No	No	No	>50	No	No	No	No
EU 28+	>50,000 Km^2	No	No	No	>50	No	No	No	No

The AOO and EOO are intrinsically small for the EU states but exceed the thresholds for threatened status. Declines in spatial extent, abiotic and biotic quality have halted. There are no threatening processes likely to cause declines in the next 20 years but there have been significant declines in the recent past which have left the habitat in a fragile state. The distribution of the habitat is such that the identified threats are unlikely to affect all localities at once. 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	>80 %	Intemediate %	unknown %	unknown %	unknown %	unknown %
EU 28+	>80 %	Intemediate %	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 %

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 %

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%

In the EU states and the EU 28+ there has been an intermediate decline affecting >80% extent. This has occurred within the last 50 years and has affected both biotic and abiotic factors. It is not possible to decouple these. This is based on expert opinion and quantitative data available for Romania, Bulgaria and Ukraine. This habitat has therefore been assessed as Endangered under criterion C/D1.

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.Therefore the habitat type is assessed as Data Deficient under Criterion E.

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	EN	DD	DD	DD	LC	LC	LC	EN	DD	DD	DD	DD	DD	DD	DD	DD	DD
EU28+	EN	DD	DD	DD	LC	LC	LC	EN	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
Endangered	A1, C/D1	Endangered	A1,

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

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