

A5.6v Mediterranean infralittoral mussel beds

Summary

Infralittoral mussel beds on rocky and soft bottoms comprised of either the horse mussel *Modiolus barbatus* or the common mussel *Mytilus galloprovincialis/edulis*. Attached by byssus threads to rocks and piers, within sheltered harbours and estuaries and on rocky shores of the open coast, sometimes living in dense masses on soft bottoms mixed with pebbles wherever there are suitable surfaces for attachment.

Eutrophication resulting from discharges from the agriculture plains, heavy loads of organics from waste food and faecal matter from intensive fish farming and invasive species like the rapa whelk (*Rapana venosa*) are significant threats to this habitat. The remaining natural beds are very few, scattered through the European Mediterranean countries. Whenever these are exploited, this needs to be regulated through intervention measures (changes in the extent and amount of the extracted mussels per year). Also, a detailed mapping of the extent of the natural mussel beds is lacking and should be a priority for the countries that host this habitat.

Synthesis

In past centuries, natural mussel beds covered a large part of the infralittoral zone in suitable areas, especially the areas close to river mouths and sheltered bays. The intensive exploitation of the mussel beds along with the cultivation and the introduction of non-native species for cultivation has resulted in a dramatic historical decline. There is a lack of information on past trends in quality but future decline is predicted in response to climate change, diseases and non-native species interaction.

Expert opinion is that this habitat should be assessed as Endangered because of its historical decline for both the EU 28 and EU 28+.

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Endangered	A3	Endangered	A3

Sub-habitat types that may require further examination

None.

Habitat Type

Code and name

A5.6v Mediterranean infralittoral mussel beds

No characteristic photographs of this habitat currently available.

Habitat description

Infralittoral mussel beds on rocky and soft bottoms comprised of either the horse mussel *Modiolus barbatus* or the common mussel *Mytilus galloprovincialis/edulis*. Attached by byssus threads to rocks and piers, within sheltered harbours and estuaries and on rocky shores of the open coast, sometimes living in dense masses on soft bottoms mixed with pebbles wherever there are suitable surfaces for attachment. The diet of mussels consists of phytoplankton and detritus filtered from the surrounding water. More frequently they can be found close to river mouth areas. There are three distinct habitat components; the interstices within the mussel matrix; the biodeposits beneath the bed; and the substratum afforded by the

mussel shells themselves. A diverse range of epibiota and infauna often exists in these parts of the habitat.

Indicators of quality:

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

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

Characteristic species:

Dense aggregations of the mussel *Mytilus galloprovincialis/edulis* or of the bearded horse mussel *Modiolus barbatus*. The mussels are often encrusted with barnacles and/or bryozoans. Gastropod molluscs such as species of the families Muricidae (e.g. *Hexaplex trunculus*, *Stramonita haemastoma*) feed on the mussels or on the bryozoans while polychaetes of several genera, crawl within the crevices looking for food. Copepods also live in the assemblage.

Classification

EUNIS (v1405):

Level 4. A sub-habitat of Infralittoral Biogenic Reefs (A5.6).

Annex 1:

1170 Reefs

MAES:

Marine - Marine inlets and transitional waters

Marine - Coastal

MSFD:

Shallow sublittoral rock and biogenic reef

EUSEaMap:

Shallow photic rock or biogenic reef.

IUCN:

12.1 Rocky shoreline

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

No

Justification

This is not a common habitat of the infralittoral zone in the Mediterranean.

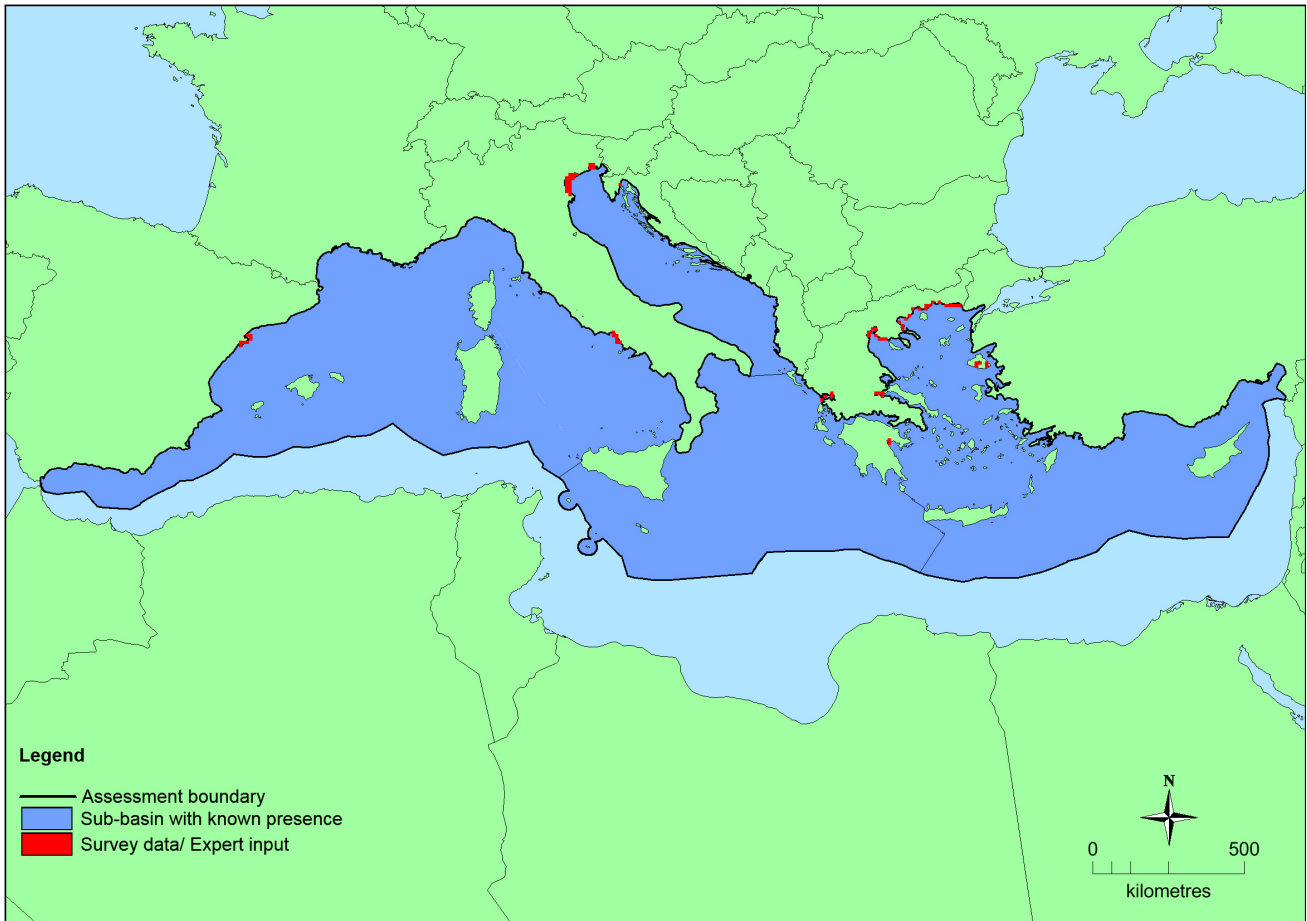
Geographic occurrence and trends

Region	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
<i>Mediterranean Sea</i>	Aegian-Levantine Sea: Present Ionian Sea and the Central Mediterranean Sea: Present Western Mediterranean Sea: Present	Unknown Km ²	Decreasing	Unknown
<i>Black Sea</i>	Black Sea: Present	Unknown Km ²	Unknown	Unknown
<i>North-East Atlantic</i>	Greater North Sea: Present	Km ²	-	-
<i>Baltic Sea</i>	Gulf of Bothnia: Present Baltic Proper: Present	Km ²	Unknown	-

Extent of Occurrence, Area of Occupancy and habitat area

	Extent of Occurrence (EOO)	Area of Occupancy (AOO)	Current estimated Total Area	Comment
<i>EU 28</i>	1,031,556 Km ²	73	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.
<i>EU 28+</i>	1,031,556 Km ²	73	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



This map has been generated based on expert opinion. 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 may not indicate the full distribution of the habitat.

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

The majority of this habitat is likely to be hosted by the EU 28 within the Mediterranean.

Trends in quantity

In the past centuries, natural mussel beds in the infralittoral zone, covered a large part of the coastal zone, especially the areas close to river mouths, closed bays and other suitable areas. The intensive exploitation of the mussel beds along with the cultivation and the introduction of non-native species for cultivation have driven this habitat to a dramatic decline - in some cases the extinction as a natural bed.

- 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 as the EOO of this habitat exceeds 50,000 km² .
- 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 as the EOO of this habitat exceeds 50,000 km² .

Trends in quality

There is a lack of information on trends in quality of this habitat in the Mediterranean although it is believed to have decreased.

- Average current trend in quality

EU 28: Unknown

EU 28+: Unknown

Pressures and threats

Intensive agriculture can decrease water column quality and result in eutrophication as discharges from the agriculture plains flow in the sea. Intensive fish farming in nearby areas can lead to degradation and loss of mussel beds due to the heavy loads of organics from waste food and faecal matter. Low oxygen concentration and bacterial mats are additional pressures in these situations. Invasive species like the rapa whelk (*Rapana venosa*) is another significant threat. The low physical connectivity of the existing rare mussel beds can cause genetic depression.

List of pressures and threats

Biological resource use other than agriculture & forestry

Marine and Freshwater Aquaculture

Fishing and harvesting aquatic resources

Pollution

Pollution to surface waters (limnic, terrestrial, marine & brackish)

Marine water pollution

Invasive, other problematic species and genes

Invasive non-native species

Natural System modifications

Other ecosystem modifications

Natural biotic and abiotic processes (without catastrophes)

Biocenotic evolution, succession

Interspecific faunal relations

Reduced fecundity/ Genetic depression

Conservation and management

The remaining natural beds are very few, scattered through the European Mediterranean countries. Whenever these are exploited, this has to be regulated through intervention measures (changes in the extent and amount of the extracted mussels per year). Also, a detailed mapping of the extent of the natural mussel beds is lacking and should be a priority for the countries that host this habitat.

List of conservation and management needs

Measures related to wetland, freshwater and coastal habitats

Restoring/Improving water quality

Restoring coastal areas

Measures related to marine habitats

Restoring marine habitats

Measures related to spatial planning

- Establish protected areas/sites
- Establishing wilderness areas/allowing succession
- 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 urban areas, industry, energy and transport

- Urban and industrial waste management

Measures related to special resource use

- Regulating/Managing exploitation of natural resources on sea

Conservation status

Annex 1:

1170: MMED XX

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

This habitat has the capacity to recover its typical characteristics and functionality relatively rapidly (within 10 years) if the reasons for the degradation are addressed. Seeding of mussel beds can be considered as an intervention to enhance recovery rates.

Effort required

10 years
Naturally and through intervention

Red List Assessment

Criterion A: Reduction in quantity

Criterion A	A1	A2a	A2b	A3
EU 28	unknown %	unknown %	unknown %	>70 %
EU 28+	unknown %	unknown %	unknown %	>70 %

In the past centuries, natural mussel beds in the infralittoral zone, covered a large part of the coastal zone, especially the areas close to river mouths, closed bays and other suitable areas. The intensive exploitation of the mussel beds along with the cultivation and the introduction of non-native species for cultivation have driven this habitat to a dramatic decline. Expert opinion is that the historical decline is likely to have exceeded 70%. This habitat has therefore been assessed as Endangered under criteria A3 and Data Deficient for all other criteria for 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 Mediterranean. Past declines have occurred and this is predicted to continue in the future although the distribution of the habitat is such that the identified

threats are unlikely to affect all localities at once. The precise extent is unknown however as EOO >50,000km² and AOO > 50 this exceeds the thresholds for a threatened category on the basis of restricted geographic distribution. This habitat has therefore been assessed as Least Concern under criteria B.

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 %

Even if there are no data (past and present) about the abiotic and/or biotic quality of the Mediterranean infralittoral mussel beds, future decline is predicted due to climate change, diseases and non-native species interaction. This cannot be quantified at the present time therefore 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

No quantitative analysis has been carried out to assess the risk of ecosystem collapse for this habitat. It is therefore 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	DD	DD	DD	EN	LC	LC	LC	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD
EU28+	DD	DD	DD	EN	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
Endangered	A3	Endangered	A3

Confidence in the assessment

Low (mainly based on uncertain or indirect information, inferred and suspected data values, and/or limited expert knowledge)

Assessors

D. Poursanidis.

Contributors

S.Gubbay and N.Sanders.

Reviewers

N.Dankers.

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References

Abada-Boudjema, Y M. and Dauvin, J.C. 1995. Recruitment and life span of two natural mussel populations *Perna perna* (Linnaeus) and *Mytilus galloprovincialis* (Lamarck) from the Algerian coast. *Journal of Molluscan Studies* 61: 467-481.

Airoldi, L., Bacchiocchi, F., Cagliola, C., Bulleri, F. and Abbiati, M. 2005. Impact of recreational harvesting on assemblages in artificial rocky habitats. *Marine Ecology Progress Series* 299: 55-66.

Airoldi, L. and Beck, M.W. 2007. Loss, status and trends for coastal marine habitats of Europe. *Oceanography and Marine Biology Annual Review* 45: 345-405.

Askew, C. 1987. *Shellfish cultivation in Greece*. FI:DP/GRE/85/002, Field Document 6, November 1987. Food and agriculture organization of the United Nations.

Benovic, A. 1997. *The history, present condition, and future of the molluscan fisheries of Croatia*. In: *The history, present condition, and future of the molluscan fisheries of north and Central America and Europe, vol 3, Europe*. MacKenzie, C.L. Jr, Burrell, V.G. Jr, Rosenfield, A. and Hobart, W.L. (Eds.). NOAA Technical Report NMFS 129. US Department of Commerce. pp 217-226.

Ceccherelli, V.H. and Rossi, R. 1984. Settlement, growth and production of mussel *Mytilus galloprovincialis*. *Marine Ecology Progress Series* 16: 173-184.

Chintiroglou, C., Damianidis, P., Antoniadou, C., Lantzouni, M. and Vafidis, D. 2004. Macrofauna biodiversity of mussel bed assemblages in Thermaikos Gulf (northern Aegean Sea). *Helgoland Marine Research* 58: 62-70.

Cinar, M.E., Katagan, T., Kocak, F., Ozturk, B., Ergen, Z., Kocatas, A., Onen, M., Kirkim, F., Bakir, K., Kurt, G., Dagli, E., Acik, S., Dogan, A. and Ozcan, T. 2008. Faunal assemblage of the mussel *Mytilus galloprovincialis* in and around Alsancak Harbour (Izmir Bay, eastern Mediterranean) with special emphasis on alien species. *Journal of Marine Systems* 71: 1-17.

D'Anna, G., Giaccone, G. and Riggio, S. 1985. Lineamenti bionomici dei banchi di mitili di Balestrate (*Sicilia occidentale*). *Oebalia* 11: 389-399. (In Italian.)

EUNIS habitat type hierarchical view [online]. Available at:

<http://eunis.eea.europa.eu/habitats-code-browser.jsp> (Accessed: December 2015).

Galleni, L., Tongiorgi, P., Ferrero, E. and Salghetti, U. 1980. *Stylochus mediterraneus* (Turbellaria):

- Polycladida), predator on the mussel *Mytilus galloprovincialis*. *Marine Biology (Berlin)* 554: 317-326.
- Karalis, P., Antoniadou, C. and Chintiroglou, C. 2003. Structure of the artificial hard substrate assemblages in ports in North Aegean Sea (Thermaikos Gulf). *Oceanologica Acta* 26: 215-224.
- Katsikatsou, M., Anestis, A., Portner, H.O., Vratisstas, A., Aligizaki, K. and Michaelidis, B. 2012. Field studies and projections of climate change effects on the bearded horse mussel *Modiolus barbatus* in the Gulf of Thermaikos, Greece. *Marine Ecology Progress Series* 449: 183-196.
- Peharda, M., Richardson, C.A., Mladineo, I., Sestanovic, S., Popovic, Z., Bolotin, J. and Vrgoc, N. 2007a. Age, growth and population structure of *Modiolus barbatus* from the Adriatic. *Marine Biology* 151: 629-638.
- Ramon, M., Cano, J., Pena, J.B. and Campos, M.J. 2005a. Current status and perspectives of mollusk (bivalves and gastropods) culture in the Spanish Mediterranean. *Boletim do Instituto Espanol de Oceanografico* 21: 361-373.
- Rius, M. and Zabala, M. 2008. Are marine protected areas useful for the recovery of the Mediterranean mussel populations? *Aquatic Conservation Marine and Freshwater Ecosystems* 18(5): 527-540. (doi:10.1002/aqc.887).
- Tsuchiya, M. and Bellan-Santini, D. 1989. *Vertical distribution of shallow rocky shore organisms and community structure of mussel beds (Mytilus galloprovincialis) along the coast of Marseille, France.* *Mesoge/e* 49, 91-110.
- Zavodnik, D. 1997. Non-conventional seafood sources at the eastern Adriatic sea markets. In: *Thousand years from first mention of fisheries in Croats (in Croatian)*. Finka, B. (Ed.). Croatian Academy of Arts and Sciences, Zagreb. pp 637-656.