A5.36: Atlantic upper circalittoral fine mud

Summary

Sublittoral muds, typically occurring in moderate depths of (10-50m), either on the open coast or in marine inlets such as sealochs. The epifauna may be sparse and scattered with mounds, burrows, and tubes indicating the presence of infauna. Associated biotopes are characterised by seapens and burrowing megafauna such as the deep burrowing echiuran *Maxmuelleria lankesteri* as well as echinoderms like the heart urchin *Brissopsis lyrifera,* and brittlestar *Amphiura chiajei*.

Demersal fishing with mobile gears is a significant widespread threat to this habitat both in terms of extent and frequency of disturbance. The passage of the first trawls are the most damaging for epifauna and, depending on the frequency of demersal trawling and environmental conditions, shifts from benthic communities with large slowly reproducing species to small species with a high reproductive rate (e.g. polychaetes), is one of the reported effects. The construction and operation of offshore oil rigs and other oil installations can also cause a variety of disturbance effects such as smothering due to disposal of drill cuttings and localised disturbance of sediments. Closer inshore marine fish farms can have direct effects on mud communities, including smothering and increasing the Biological Oxygen Demand, while coastal construction of roads, bridges and barrages may affect the local hydrodynamic and sediment transport regimes of inshore enclosed areas. Nutrient enrichment leading to eutrophication can lead to changes in the structure and composition of the associated communities. There is also some evidence that shifts in community structure of the benthos have occurred in the North Sea corresponding with more widespread climatic changes.

This habitat can benefit from the regulation of the use of fishing gears that damage or disturb seabed communities. This may be achieved by spatial and temporal controls as well as gear design and deployment using fisheries management measures as well as conservation legislation in marine protected areas. Spatial planning (including zoning) can be used to address potential threats from coastal development and fish farming and the regulation of discharges and run off from agricultural land to the marine environment can be used to avoid eutrophication effects associated with nutrient enrichment.

Synthesis

This habitat has a large natural range in the North East Atlantic region being reported on the Atlantic coast of Portugal, in sealochs on the west coast of Ireland and around Scotland, as well as in the central North Sea. Some decline in habitat quantity (as a result of shifts to different sediment composition) have been recorded and there are many well documented examples of decline in quality.

Most sedimentary benthic systems on the continental shelf of Europe have been modified by fishing activities in the last 100 years, particularly by mobile demersal gears, and this habitat remains under fishing pressure. Disturbance of the substratum due to intensive fishing activities using bottom trawls or dredges can damage or modify infaunal communities, with burrowing echinoderms and bivalves being particularly vulnerable. Research suggests that some gears may also be modifying the biogeochemistry of the sediments by affecting organic matter remineralization and nutrient cycling through sediment resuspension and burial of organic matter to depth. Analysis by ICES (for the period 2009-2012) shows considerable overlap of this habitat with fishing intensity by gears which are known to have damaging effects on the epifauna and shallow infauna. More recent data for a single year (2013/2014), has revealed that just over 50% of the estimated circalittoral fine mud habitat was subject to trawling fishing pressure in the North Sea and Celtic Sea and more than 80% of the circalittoral fine mud across the North East Atlantic shelf area was likely subject to abrasion disturbance. Much the same footprint of activity is likely each year and as this type of fishing pressure has been ongoing for many decades, there has most likely been a

cumulative impact on habitat quality. Signficant effects have been observed in response to long-term chronic disturbance from otter trawling, for example, with negative effects on benthic infauna abundance, biomass and species richness with clear changes in community composition that may have far-reaching implications for the integrity of marine food webs.

Expert opinion is that there has been a very substantial reduction in quality of this habitat, most likely an intermediate decline affecting more than 80% of its extent although it is clear that in some locations there has also been a severe decline. The severity will depend on factors such as the intensity and frequency of disturbance. This habitat has therefore been assessed as Endangered for both the EU 28 and EU 28+ because of both past and likely continuing declines in quality.

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

Sub-habitat types that may require further examination

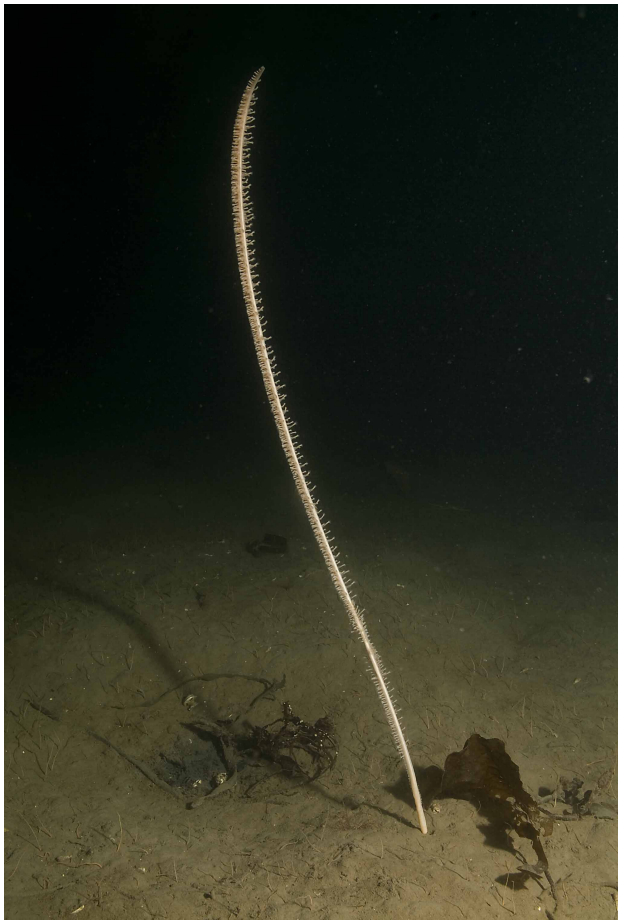
A5.361 Seapens and burrowing megafauna in circalittoral fine mud.

Habitat Type

Code and name

A5.36: Atlantic upper circalittoral fine mud

Fine mud with the seapens and *Pennatula phosphorea* and *Funiculina quadrangularis.* UK (© G.Saunders).



Fine mud habitat with the seapen *Funiculina quadrangularis.* UK (© G.Saunders).

Habitat description

Sublittoral muds, typically occurring in moderate depths of (10-50m), either on the open coast or in marine inlets such as sealochs. These may be in fully saline conditions or variability salinity (18-35ppt), moderately to extremely sheltered from wave exposure, and where there are weak or negligible tidal streams. The epifauna may be sparse and scattered with mounds, burrows, and tubes indicating the presence of infauna. Associated biotopes are characterised by seapens and burrowing megafauna, burrowing megafauna and *Maxmuelleria lankesteri,* and by the heart urchin *Brissopsis lyrifera* and brittlestar *Amphiura chiajei*.

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. Examples of indicators of damage and naturalness have been proposed for offshore deep sea muds include; the presence of typical benthic invertebrate communities and other large burrowing megafauna, the sediment composition or sedimentation rates/disturbance, the presence of the climax community including crustacean and polychaetes populations, and an absence of Beggiatoa mats. A reduction in the abundance of less sessile and fragile species and an increase in more carnivorous and scavenging species are potential indicators of disturbance.

Characteristic species:

The seapens *Virgularia mirabilis* and *Pennatula phosphorea* are characteristic of this habitat type together with the burrowing anemone *Cerianthus lloydii* and the ophiuroid *Amphiura* spp. (e.g. *A.chiajei* & *A.filiformis*). The relatively stable conditions often lead to the establishment of communities of burrowing megafaunal species, such as *Nephrops norvegicus*. Other species which may frequently be present and/or in moderate abundance include *Funiculina quadrangularis, Nephtys hystericis, Chaetozone setosa, Pagurus bernhardus, Liocarcinus depurator, Munida rugosa* and *Asterias rubens.*

Classification

EUNIS (v1405):

Level 4. A sub-habitat of ‘Atlantic circalittoral mud’ (A5.3)

Annex 1:

1160 Large shallow inlets and bays

MAES:

Marine - Marine inlets and transitional waters

Marine - Coastal

MSFD:

Shallow sublittoral mud

EUSeaMap:

Shallow mud

IUCN:

9.6 Subtidal muddy

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

Regions
Atlantic

Justification
There are extensive areas of fine mud habitat in circalittoral zones in both sheltered inlets and the deeper offshore regions of the North East Atlantic.

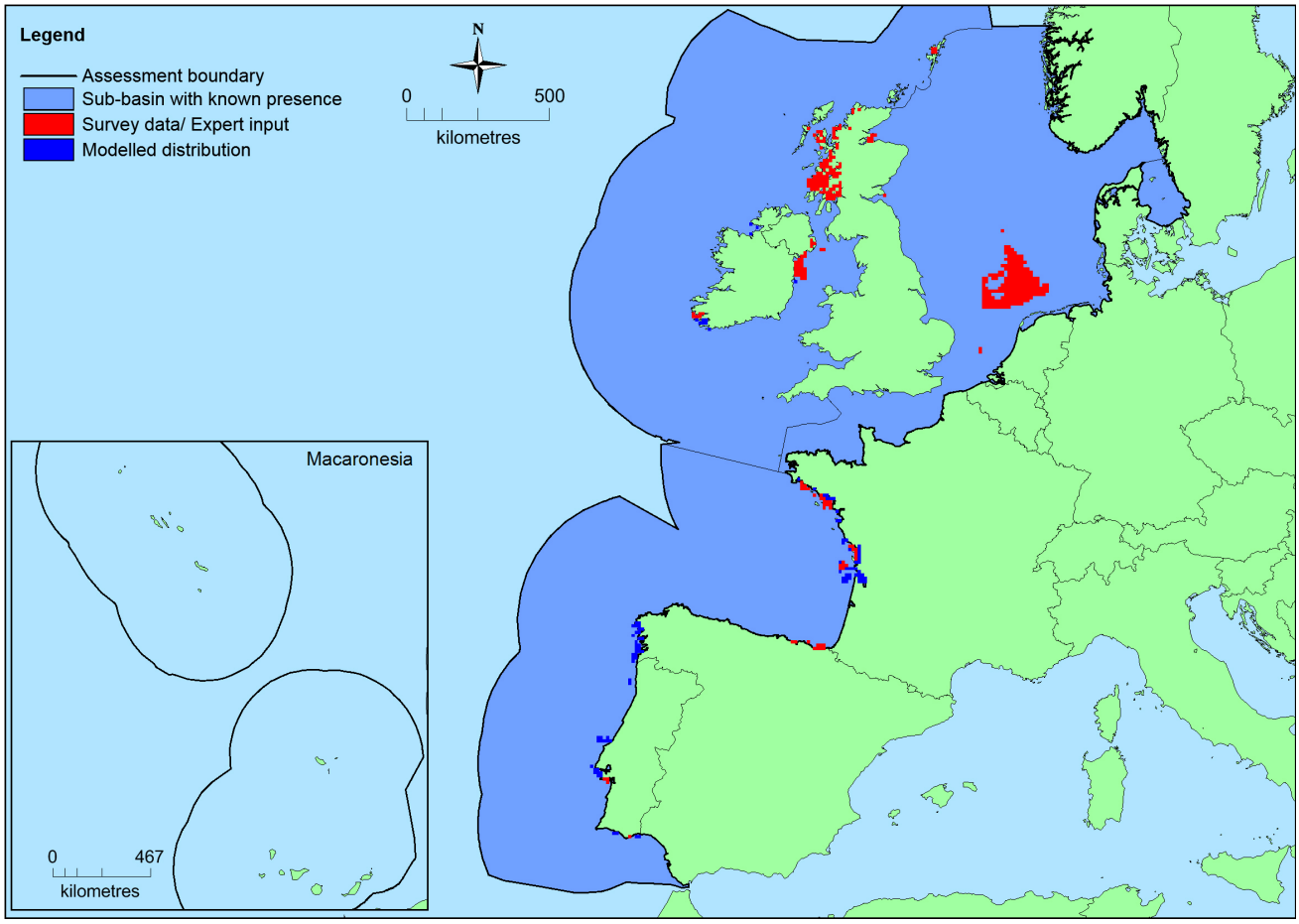
Geographic occurrence and trends

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 Greater North Sea: Present Kattegat: Present Macaronesia: Uncertain	2,902 Km^2	Unknown	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	1,720,795 Km^2	572	>2,902 Km^2	The area estimate for this habitat has been derived from a synthesis of EUNIS seabed habitat geospatial information for the European Seas but is recognised as being an underestimate.
EU 28+	>1,720,795 Km^2	>572	>2,902 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 are some estimates of the extent of this habitat in the North East Atlantic derived from modelling studies, but no widely agreed figures. Trends in quantity cannot be determined with any accuracy although some habitat loss is known to have occurred in some locations such as the shift to a less muddy substrate in the Grande Vasiere, in the Bay of Biscay.

- Average current trend in quantity (extent)
  EU 28: Unknown
  EU 28+: Unknown
- Does the habitat type have a small natural range following regression?
  No
  Justification
  This habitat has a large natural range in the North East Atlantic which includes the Atlantic coast of Portugal, sea lochs on the west coast of Ireland and around Scotland, and in the central North Sea.
- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  No

Justification
This habitat has a large natural range in the North East Atlantic which includes the Atlantic coast of Portugal, sea lochs on the west coast of Ireland and around Scotland, and in the central North Sea.

Trends in quality

The communities that characterise this habitat are believed to have been substantially changed by demersal fishing activities, especially those which target the Norway lobster *Nephrops norvegicus*. Intensively trawled sites have been documented with lower species richness and with the negative effects worst in relatively species rich, deep areas with fine grained sediments. One example, reported from an area circalittoral mud habitat in the Irish Sea, is a change in dominant species, from the brittle star *A.filiformis* whose growth is known to be inhibited by large quantities of suspended sediments such as those generated by trawling, to the less affected burrowing shrimps such as *Callianassa subterranea.*In the central and eastern parts of the Kattegat, for example, where the seabed is predominantly muddy and an important fishing area for *Nephrops*, an estimated 70-80% of the muddy seabed is affected by fisheries each year. Furthermore an estimated 41% of this is being affected by fishing gear more than twice a year and therefore considered to remain in a disturbed condition. A review of fishing intensity data over one year (2013/2014) has indicated that more than 30% of this habitat type was subject to trawling fishing pressure in the North Sea, with over 10% of this being interpreted a high or moderate pressure. When combining data for the North Sea and Celtic Sea, over 50% of this habitat type is considered to have been subject to such fishing pressure. Given the evidence that the passage of the first trawls are the most damaging for epifauna, and that, depending on the frequency of demersal trawling and environmental conditions, shifts from benthic communities with large slowly reproducing species to small species with a high reproductive rate (e.g. polychaetes), have been reported several times independently, this is likely to have been a substantial decline in quality of this habitat over at least the last 50 years. Signficant negative effects have also been observed in response to long-term chronic disturbance, for example from otter trawling. A study of otter trawl disturbance in Irish Sea,revealed negative effects on benthic infauna abundance, biomass and species richness with clear changes in community composition and possible far reaching implications for the integrity of marine food webs.

Decline in quality has also been attributed to other factors. For example, the dramatic decline of the biodiversity of soft substrates in open Danish waters observed in Kattegat between the mid-1990s and the end of the 2000s has been linked to 8-10 week period of low bottom water oxygen concentration. This is compared to the more typical short term periods of anoxia in that area.

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

Pressures and threats

Most sedimentary benthic systems on the continental shelf of Europe have been modified by fishing activities in the last 100 years, particularly by bottom trawls and dredging. In the southern North Sea fishing is thought to have long been the main ecological structuring force on the benthos. More stable habitats which are not subject to a high levels of natural variation such as muds are more sensitive to benthic fishing disturbance.

Demersal fishing principally for *Nephrops norvegicus* is a significant threat to this habitat as the use of benthic trawls both in terms of its extent and frequeny. This can result in the removal of non-target species and disturbance to the seabed. Offshore oil rigs and other oil installations can cause a variety of disturbance effects such as smothering due to disposal of drill cuttings, localised disturbance of sediments by offshore construction, anchoring and trench digging for pipelines.

Closer inshore marine fish farms may have direct effects on mud communities, including smothering and increasing the Biological Oxygen Demand of the mud. Additional effects may result from the discharges of chemicals, some of which are especially toxic to crustaceans. Near the coast the construction of roads, bridges and barrages may affect the local hydrodynamic and sediment transport regimes of inshore enclosed areas and consequently affect the substratum.

Nutrient enrichment leading to eutrophication can lead to changes in the structure and composition of the associated communities and there is evidence that shifts in community structure of the benthos have occurred in the North Sea corresponding with more widespread climatic changes.

List of pressures and threats

Urbanisation, residential and commercial development

Discharges

Biological resource use other than agriculture & forestry

Marine and Freshwater Aquaculture
Fishing and harvesting aquatic resources
Professional active fishing

Pollution

Nutrient enrichment (N, P, organic matter)

Natural System modifications

Human induced changes in hydraulic conditions
Modification of hydrographic functioning, general

Conservation and management

This habitat can benefit from the regulation of the use of fishing gears that damage or disturb seabed communities. This may be achieved by spatial and temporal controls as well as gear design and deployment using fisheries management measures as well as conservation legislation in marine protected areas. Spatial planning (including zoning) can be used to address potential threats from coastal development and fish farming and the regulation of discharges and run off from agricultural land to the marine environment can be used to avoid eutrophication effects associated with nutrient enrichment.

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 spatial planning

Other spatial measures
Establish protected areas/sites

Measures related to hunting, taking and fishing and species management

Regulation/Management of fishery in marine and brackish systems

Conservation status

Annex 1:

1160: MATL U2, MMAC FV.

Seapens and burrowing megafauna is listed as a threatened and/or declining habitat by OSPAR for Regions II and III (North Sea and Celtic Sea).

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

The frequency of incidents of damaging activity, the type of damaging activity and the predominant species, influences recovery. Studies have shown that recovery times following dredging were significantly shorter for short-lived species (<1 – 3 years), free-living and tube-dwelling species and for scavenging or opportunistic species, than for medium-lived species (3 – 10 years), burrow-dwelling species and suspension feeders. Free living species are also likely to recolonise areas more quicky that those that grow attached to the substratum and have an erect or stalked body form such as seapens. Differences in the recoverability of different species groups following fishing may result in changes in community composition and ecosystem functioning over the long term.

Effort required

10 years
Naturally

Red List Assessment

Criterion A: Reduction in quantity

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

Estimates of the area and extent of this habitat show considerable variation and are recognised as being biased and an underestimate. No assessment of trends in quantity have therefore been made. This habitat is Data Deficient 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 >50,000km^2 and AOO >50, this exceeds the thresholds for a threatened category on the basis of restricted geographic distribution. There has been a decline in the biotic quality of this habitat and the major threat (demersal fisheries) is likely to cause continuing declines in quality within the next 20 years, however, the distribution of the habitat 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	>80 %	Intermediate %	unknown %	unknown %	unknown %	unknown %
EU 28+	>80 %	Intermediate %	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%

Substantial reductions in quality in at least some parts of this habitat are known to have occurred and continue to take place (as revealed by fishing distribution and intensity maps). These effects may be apparent as changes in the associated species, biomass and abundance as well as some modification of the biogeochemistry of the sediments.

An analysis of the fishing intensity of EU trawlers (bottom otter, beam and mid-water trawls) using Automatic Identification System (AIS) ship tracking data over one year (2013/2014) shows high coverage in all European coastal waters and over the continental shelf. When combined with the modelled distribution of EUNIS marine habitat types it is possible to examine the extent of likely impact on a particular benthic habitat. For example, over this time period more than 30% of circalittoral fine mud was subject to trawling fishing pressure in the North Sea, with over 10% of this being interpreted a high or moderate pressure. When combining data for the North Sea and Celtic Sea just over 50% of this habitat type is considered to have been subject to such fishing pressure. Given that this is based on a single year of data, and that this type of pressure has been taking place for decades, it is likely to be an underestimate of the total area of this habitat which has been subject to such pressure. Signficant effects have also been observed in response to long-term chronic disturbance, for example from otter trawling with negative effects on benthic infauna abundance, biomass and species richness with clear changes in community composition.

Expert opinion is that there is likely to have been a very substantial reduction in quality of this habitat - an intermediate decline in quality affecting more than 80% of this habitat in the North East Atlantic region although it is also possible that more than 30% has been subject to a severe decline. This will depend on factors such as the intensity and frequency of disturbance. This habitat has therefore been assessed as Endangered under criteria C/D for both the EU 28 and EU 28+.

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

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

Assessors
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Reviewers
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Date of assessment
06/08/2015

Date of review
21/01/2016

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