A5.613 *Serpula vermicularis* reefs on very sheltered muddy sand

Summary

This habitat is primarily composed of large clumps of the calcareous tubes of the tubeworm *Serpula vermicularis*, typically attached to stones on muddy sediment in very sheltered conditions in sealochs and other marine inlets. Reef aggregations of the calcareous tube dwelling worm *Serpula vermicularis* are a rarely-occurring habitat only presently recorded from sea lochs/loughs of the west coasts of Scotland and Ireland. The factors that result in the formation of the calcareous reef structure remain unknown, but substrate, fjordic topography and hydrography are all thought to be important contributors. Where they occur, they constitute a considerable modification of the local substrate resulting in increased biodiversity, through the provision of enhanced habitat complexity.

All of the existing reef locations in Scotland are designated features and are protected under the Habitats Directive. The habitat occurs in three locations in Ireland, but the recent status of the habitat in only one location is currently known. Two of the three locations in Ireland are afforded protection under the Habitats Directive. The calcareous reef structures are present in relatively shallow waters and are vulnerable to physical damage, either natural (storm damage/wave action) or anthropogenic (demersal fishing using trawls and dredges, creeling, anchoring). Changes in water quality (siltation, eutrophication or other chemical change) may also affect reef integrity. The serpulid reefs in Loch Creran and Loch Teacuis are managed, with fishing exclusions and vessel mooring controls in place. Appropriate Assessments for all plans and projects are required.

Synthesis

There are only three locations in Scotland and three locations in Ireland where this habitat has been reported to have been historically present in the Atlantic region. Reef in at least two locations in Scotland have undergone severe deterioration to the point where the habitat no longer exists. The remaining Scottish reefs are known to have sustained considerable damage within the last five years, although the cause of the damage is uncertain.

This habitat has a restricted distribution (EOO <20,000 km^2, AOO <20 and is found in less than 5 locations). There has been a decline in its spatial extent and biotic and abiotic quality in some locations over the last 50 years. The precise extent of these changes cannot be quantified at the present time, although it is known to have been 100% in at least one location. There is uncertainty over whether the decline is likely to continue. The quality of the reef structures has been reduced within the last five years in at least two locations but the percentage as a proportion of total habitat area is unknown.

This habitat has been assessed as Endangered for both the EU 28 and EU 28+ because it has a restricted geographic distribution and is only present in a few locations. Due to human activities or stochastic events in an uncertain future, it is capable of becoming Critically Endangered or Collapsed within a very short time period.

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Endangered	B1(c)/B2(c)/B3	Endangered	B1(c)/B2(c)/B3

Sub-habitat types that may require further examination

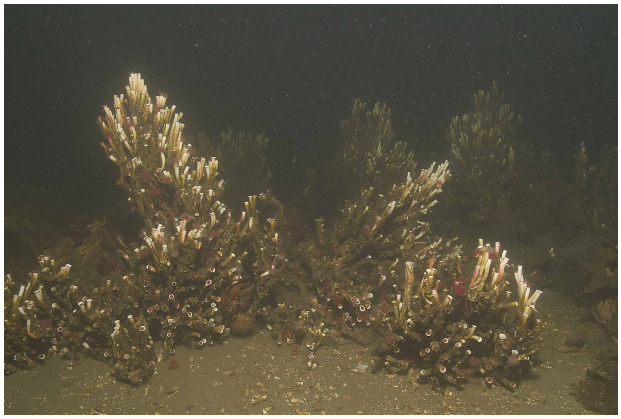
None.

Habitat Type

Code and name

A5.613 *Serpula vermicularis* reefs on very sheltered muddy sand

Serpula vermicularis aggregations on muddy sand in Loch Creran, Argyll, Scotland (© G.Saunders).



Serpula vermicularis aggregations on muddy sand in Loch Creran, Argyll, Scotland (© G.Saunders).

Habitat description

This habitat is primarily composed of large clumps of the calcareous tubes of the tubeworm *Serpula vermicularis*, typically attached to stones on muddy sediment in very sheltered conditions in sealochs and other marine inlets. *S. vermicularis* is a marine worm that makes a hard, calcareous tube 4-5 mm in diameter and up to 150 mm long. The worms feed by extending their feeding fans from the ends of the tubes. The feeding fans are about 2cm across and range in colour from white through orange to bright red. In most cases the worms are solitary with the base of the tube attached to stones or shells, and the feeding end growing up into the water. True reefs such as those in Loch Creran can be up to 3 m across, although typically only 1 metre in diameter, and 0.75 m high. Aggregations typically form in areas of muddy sand on any available hard substratum such as bedrock, boulders, stones, shells, kelp holdfasts and man-made substrates.

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 *Serpula vermicularis* 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.

Characteristic species:

S. vermicularis reefs act as a substratum for a wide variety of other organisms. These include numerous sessile organisms such as boring, encrusting sponges and massive sponges, ascidians and hydroids, the serpulid *Pomatoceros triqueter*, spirorbid and other tube worms, numerous encrusting bryozoans, the anemone *Metridium senile*, and numerous bivalves such as *Monia patelliformis*, *Modiolus modiolus*, *Chlamys distorta*, *C. varia* and *Aequipecten opercularis* (though many of the pectinids may only be

temporary inhabitants). In shallow water dense growths of the red alga *Phycodrys rubens* may occur on the reefs. Mobile inhabitants which have been reported to be present include numerous crab and other crustacean species, the urchins *Echinus esculentus* and *Psammechinus miliaris*, the brittle star *Ophiothrix fragilis*, the starfish *Asterias rubens*, and the whelk *Buccinum undatum*.

A rich associated biota attached to the calcareous tube may include *Esperiopsis fucorum*, thin encrusting sponges, and the ascidians *Pyura microcosmus*, *Ascidiella aspersa, Ascidia mentula, Dendrodoa grossularia* and *Diplosoma listerianum; P. microcosmus* being particularly common on broken or collapsed reefs. The echinoderms *O.fragilis* and *P.miliaris* and the queen scallop (*A.opercularis*) are also found throughout this biotope.

Over 2,500 animals have been counted on a single reef, comprising over 70 different species.

Classification

EUNIS (v1405):

Level 5. A sub-habitat of 'Polychaete worm reefs in the Atlantic infralittoral zone' (A5.61) and '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

EUSeaMap:

Shallow photic rock or biogenic reef

Shallow aphotic rock or biogenic reef

IUCN:

9.4 Subtidal sandy

9.5 Subtidal sandy-mud

9.6 Subtidal muddy

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

No

Justification

This habitat occurs in Scottish sea lochs and Irish sea loughs and has only been observed on the western coasts of both countries. While the tube-forming species *Serpula vermicularis* is common throughout the north-east Atlantic, the aggregation of large numbers of living individuals forming reef structures is rare and has only been documented from six discrete locations in the Atlantic region (3-4 remaining in 2015). The growth of the reefs substantially increase local biodiversity by providing hard substrata and refuge options in the increased habitat complexity, where only a sedimentary habitat previously existed. The cause of the unusual reef-forming habit remains unknown, but is likely to be related to the fjordic topography causing restricted water movement *via* a combination of sills and narrows, together with the specific sedimentary and hydrological characteristics of the lochs/loughs.

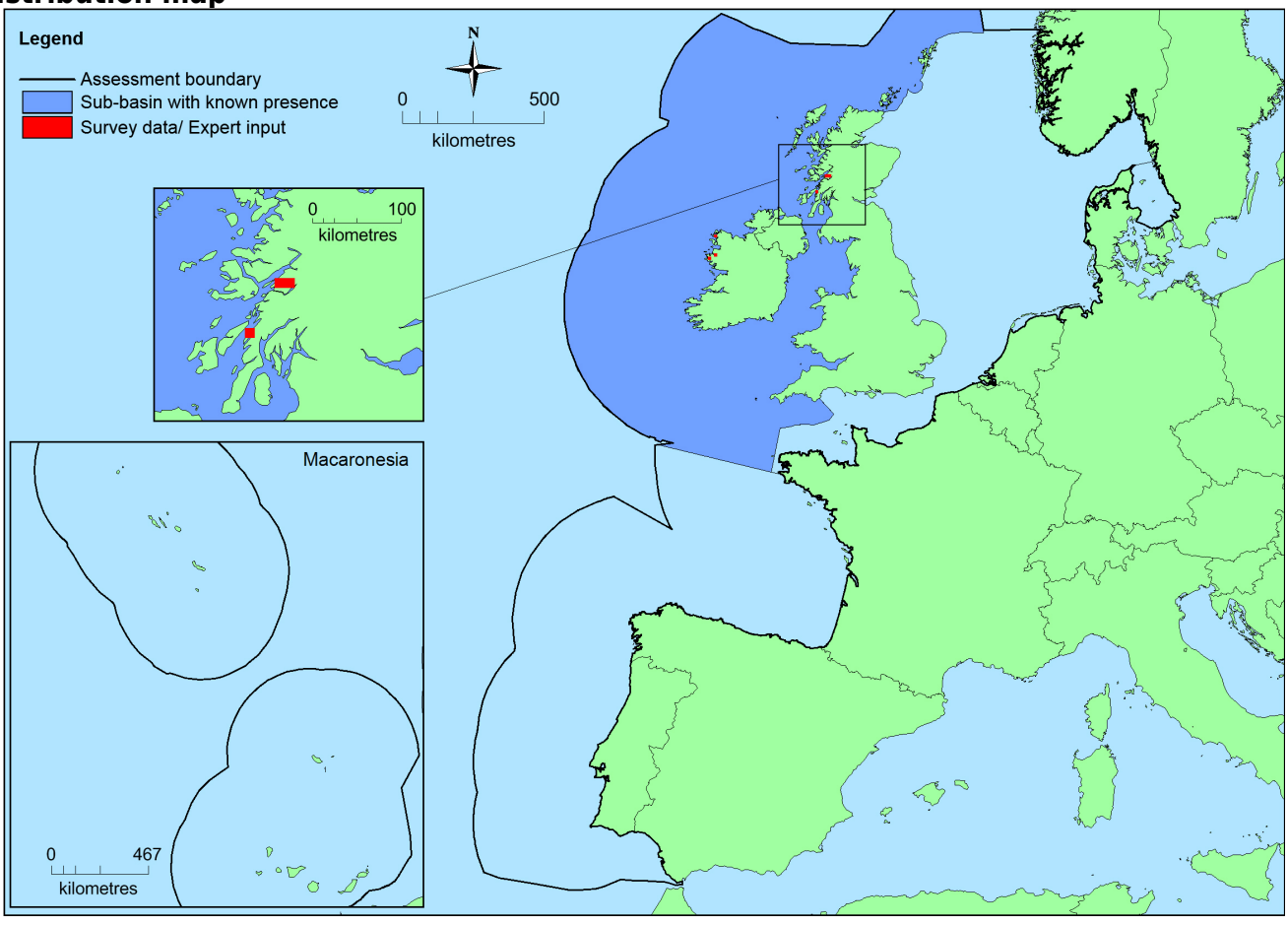
Geographic occurrence and trends

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	Celtic Seas: 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	22,762 Km^2	7	Unknown Km^2	
EU 28+	22,762 Km^2	7	Unknown Km^2	

Distribution map



This map has been generated from expert knowledge originating from *in situ* observations of the occurrence this habitat. *S. vermicularis* reefs may exist in other remote locations, but have so far evaded detection. Note also that the reef occurrence in Loch Teacuis, Scotland has been removed on the basis

of reported loss in 2014.

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

100% of this habitat is believed to be hosted by the EU 28 at the present time.

Trends in quantity

UK: Living reefs observed in Loch Sween, Scotland in 1975 were recorded as absent in the 1980s and this absence was confirmed in surveys undertaken in 1993, 1994 and 1997 (i.e. indicating no recovery). Recent surveys (SNH, 2015; SNH, in prep) have indicated that the known remaining reefs in Lochs Teacuis and Creran have been damaged, with almost all of the reef previously observed in Loch Teacuis absent in 2015. The cause (either natural or anthropogenic) and scale of the damage in Loch Creran is currently unclear.

Ireland: There are no data on changes in area for this habitat. Habitat area is taken from Bosence (1979), subsequently revised in Minchin (1987) which indicated that reef coverage in Ardbear Lough was a quarter of the total sublittoral extent of the Lough (0.37 km^2). The area of the Killary Harbour reef has not been calculated, although it is likely to be very small. More recently, an area of serpulid reef has been reported to be present in Blacksod Bay, Co. Mayo (MERC, 2008). The area for this is taken from maps reproduced in the Mullet/Blacksod Bay Complex SAC Conservation Objectives (NPWS, 2014).

- Average current trend in quantity (extent)
  EU 28: Decreasing
  EU 28+: Decreasing
- Does the habitat type have a small natural range following regression?
  Unknown
  Justification
  As the nature and cause of the decline of the reefs in Scotland is currently unclear, it is not possible to establish whether the decline is continuing. There are currently no data on Irish serpulid reef extent.
- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  Yes
  Justification
  While the species is widely distributed throughout the North East Atlantic, the reef-forming habit of *Serpula vermicularis* is unusual and restricted to only a very few locations on the west coasts of Scotland and Ireland. The reason for the aggregative behaviour remains unknown, but is likely to be linked to the substrate and hydrographical characteristics of some of the sea lochs/loughs in these areas.

Trends in quality

Recent survey work (report in prep) on this habitat in Scotland is likely to indicate substantial degradation in Loch Creran and a complete loss of the habitat in Loch Teacuis due to possible storm damage. In 2005 a side-scan sonar survey recorded reef damage incurred by fishing gear (assumed to be scallop dredges) amounting to 0.45 ha or 10.9% of the living reef at a single location (Rubha Mor) in Loch Creran. Other types of damage (e.g. vessel moorings have also been documented in the same publications. The degree of recovery since the initiation of measures to exclude such activity in Loch Creran is unknown, but is likely to be completely eclipsed by the recent damage. There are little or no recent data on the three locations at which this habitat occurs in Ireland. Recreational diving video and photographic images from 2011 and 2013 indicates that the Ardbear Lough (Salt Lake) reefs are still present. A 2005 observation from Killary Harbour, however, reported live *S. vermicularis*, but mass mortality of most of the other benthic species in the locality. A 2008 report indicates that the *Serpula* reef habitat in Blacksod Bay "did not appear to be under any immediate threat and from potentially impacting activities".

- Average current trend in quality

EU 28: Decreasing
EU 28+: Decreasing

Pressures and threats

Scotland: Extensive, relatively recent (past 10 years) physical damage in both Loch Creran and Teacuis has been recorded in surveys undertaken in 2014/15, with Loch Teacuis observed to have lost almost all of the serpulid reef habitat. The cause of this damage has been tentatively assigned to unusually intense storm events, but this has yet to be confirmed. Fishing pressures are considered to be minor and occur only rarely since the establishment of protection of the Loch Creran reefs under the Habitats Directive. Note also that, within Loch Creran, effluent from a (now non-operational) kelp processing plant and yacht mooring also contributed to past reef damage and loss.

Ireland: No information is available on current or past pressures in respect of the Irish reefs.

List of pressures and threats

Biological resource use other than agriculture & forestry

Intensive fish farming, intensification
Professional active fishing
Benthic dredging

Pollution

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

Geological events, natural catastrophes

Storm, cyclone

Conservation and management

This habitat occurs within Marine Protected Areas and in some cases (e.g. Loch Creran, Scotland, and Ardbear Lough/Salt Lake, Ireland) they are a protected feature within the MPA. The serpulid reefs in Loch Creran and Loch Teacuis are managed, with fishing exclusions and vessel mooring controls in place. Appropriate Assessments for all plans and projects are required.

List of conservation and management needs

Measures related to marine habitats

Other marine-related measures
Restoring marine habitats

Measures related to spatial planning

Other spatial measures
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

Conservation status

Annex 1:

1170: MATL U2, MMAC FV

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

Unknown. Reef structures have been observed to regenerate after natural collapse events through the settlement and growth of new individuals. Existing serpulid tubes, if remaining intact and alive, have the capacity to gradually re-orientate to a favourable feeding position after toppling or collapse. In some instances, however, notably in Loch Sween, no recovery has been observed at all and attempts to experimentally re-introduce aggregations from Loch Creran have been unsuccessful.

Effort required

10 years
Unknown

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 %

This habitat is known to have declined in extent over the last 50 years. There are estimates of habitat loss in some locations (100% in Loch Sween, Scotland since 1975, and at least a 18.5% loss since 1975 across the three known locations in Scotland). With no quantitative data for loss of the habitat in the North East Atlantic region as a whole, it is not possible to give an overall assessment of the scale of the loss. No estimates have been made of potential future loss of this habitat. This habitat has been assessed as Data Deficient 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	22,762 Km^2	Unknown	Unknown	4	7	Unknown	Unknown	4	Yes
EU 28+	22,762 Km^2	Unknown	Unknown	4	7	Unknown	Unknown	4	Yes

This habitat has a restricted distribution (EOO <20,000 km^2, AOO <20 and is found in less than 5 locations). There has been a decline in its spatial extent and biotic and abiotic quality in some locations over the last 50 years. The precise extent of these changes cannot be quantified at the present time, although it is known to have been 100% in at least one location. There is uncertainty over whether the decline is likely to continue. The processes causing reef damage are unknown but suspected to be unusual storm activity, therefore climate change might be a potential future pressure. This habitat has been assessed as Endangered under criterion B1(c), B2(c) and B3 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%

Quality of the reef structures (ability to support other species) has been reduced within the last five years in at least two locations. The extent affected is difficult to determine, but incorporates two locations representing a total affected area of at least 1.282 km^2. The amount of total affected area as a proportion of total habitat area is unknown. Experts consider there to be insufficient data on which to assess 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	DD	DD	DD	DD	EN	EN	EN	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD
EU28+	DD	DD	DD	DD	EN	EN	EN	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	B1(c)/B2(c)/B3	Endangered	B1(c)/B2(c)/B3

Confidence in the assessment

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

Assessors

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Contributors

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Reviewers

J.Forde & S.Gubbay.

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29/07/2015

Date of review
17/12/16

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