

# Threatened habitat types in Finland 2018: the Baltic Sea

Red List of habitats

Part II: Descriptions of habitat types

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Environment Finland

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# Information provided about habitat types 1

Part 2 of the Finnish final report – Threatened Habitat Types in Finland 2018 – presents a total of 420 habitat types, that is, all of the assessed habitat types and also 6 newly described but not yet evaluated (Not Evaluated, NE) Baltic Sea habitat types. This publication contains the English translations of the descriptions and assessment justifications of 48 Baltic Sea underwater habitat types.

In addition to threatened habitat types, this publication also includes habitat types assessed as Least Concern or Data Deficient (DD). The description of each habitat type shows whether the habitat type is threatened and on what grounds, in which parts of the Finnish coastal area it occurs and by what kinds of environmental factors and species its occurrences are characterised. A distribution map and a photograph are provided for each habitat type.

The units employed in the threat status assessment are ‘habitat type’ (e.g. benthic habitats characterised by *Fucus* spp.) or an established ‘habitat complex’ consisting of multiple habitat types (e.g. coastal estuaries). Habitat type is the most common basic assessment unit, and in this introduction the above-mentioned units are referred to collectively as ‘habitat type(s)’. The habitat type descriptions feature the same structure and subheadings, which are presented below.

## Habitat type code

The habitat type code is given above the name of each habitat type. The codes are used in conjunction with habitat type names in the results and appendix tables of Part 1 and in places also in the text sections to clarify references between habitat types. The codes begin with letters indicating the main group (I = ‘Itämeri’, the Finnish name for the Baltic Sea).

## Threat status assessment table

Each habitat type description features a table showing the overall threat status and the criteria on the basis of which the IUCN Red List category was assigned (Table 1.1). The last column shows the trend for the habitat type, providing national additional information supplementing the IUCN assessment.

Table 1.1. Habitat type threat status assessment table. The example habitat type was assessed as Vulnerable (VU) in the whole of Finland and in Southern Finland and as Near Threatened in Northern Finland (please note that, in the main group of Baltic Sea habitat types, all types occur only in Southern Finland). Due to deficiency of background data, the IUCN Red List category for Northern Finland is uncertain, and the NT–VU range of category was assigned. NT was, however, regarded as most likely to be the correct category. In the assessments concerning Finland as a whole and Southern Finland, the Red List category is determined on the basis of subcriteria A3, D1 and D3. This means that the quantity of the habitat type has decreased over the historical time frame and that its quality has declined over the past 50 years as well as over the longer historical time frame. For Northern Finland, the decisive criterion is B2a(iii)b, which means a restricted area of occupancy combined with continuing biotic decline. The status of the habitat type is regarded as declining further in all of the areas examined, and hence its trend is negative.

	IUCN Red List Category	Criteria	Trend
Whole of Finland	VU	A3, D1, D3	–
Southern Finland	VU	A3, D1, D3	–
Northern Finland	NT (NT–VU)	B2a(iii)b	–

The Red List category, and any range of category, is given separately for the whole of Finland, for Southern Finland and for Northern Finland. The Baltic Sea habitat types only occur in Southern Finland, so some of the cells in the assessment table are empty and with grey background colour.

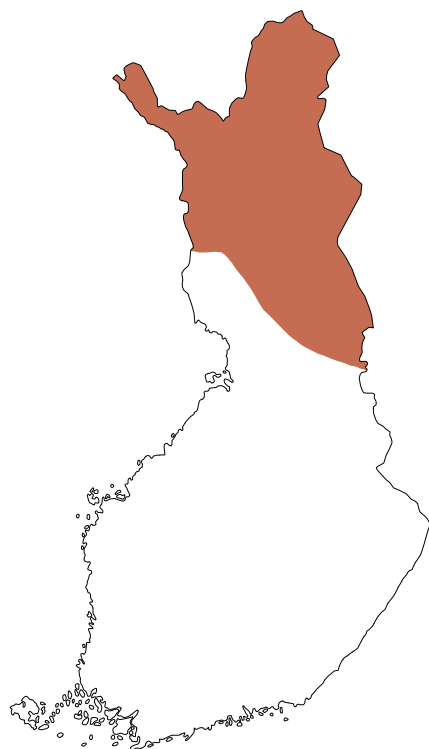


Figure 1.1. Division of Finland into subregions for the threat status assessment of habitat types. Marked in white, Southern Finland corresponds to the hemiboreal, south boreal and middle boreal forest zones and, marked in maroon, Northern Finland corresponds to the north boreal zone. All Baltic Sea habitat types occur only in Southern Finland.

The IUCN Red List category abbreviations and colours used in the assessment table are presented in Table 1.2. Threatened habitat types comprise Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) habitat types.

The 'Criteria' column of the assessment (Table 1.1) shows the assessment criteria determining the Red List category. The IUCN Red List of Ecosystems (RLE) protocol (IUCN 2015) comprises five criteria for assessing the risk of ecosystem collapse (Figure 1.2). Criteria A and B are to do with the quantity or geographic distribution of the habitat type. Criterion A examines a decline in geographic distribution reducing the ability of the habitat type to sustain its characteristic native biota. Criterion B is to do with

Table 1.2. Abbreviations and colours used in the threat status assessments of habitat types.

<b>CO</b>	Collapsed
<b>CR</b>	Critically Endangered
<b>EN</b>	Endangered
<b>VU</b>	Vulnerable
<b>NT</b>	Near Threatened
<b>LC</b>	Least Concern
<b>DD</b>	Data Deficient
<b>NE</b>	Not Evaluated
	Does not occur in the area

restricted geographic distribution subjecting habitat type occurrences to spatially explicit threats.

Criteria C and D in turn examine the functional, or qualitative, changes in the habitat type. Criterion C assesses abiotic (environmental) degradation. Criterion D examines disruption of biotic processes or interactions. So far only used for the threat status assessment of one habitat type in Finland, the fifth criterion (E) is to do with the combined effect of factors leading to the collapse of habitat types. A habitat type under assessment should be evaluated using all of the criteria for which data or expert inputs are available. The overall threat status of a habitat type is assigned as the highest category of risk obtained through any criterion.

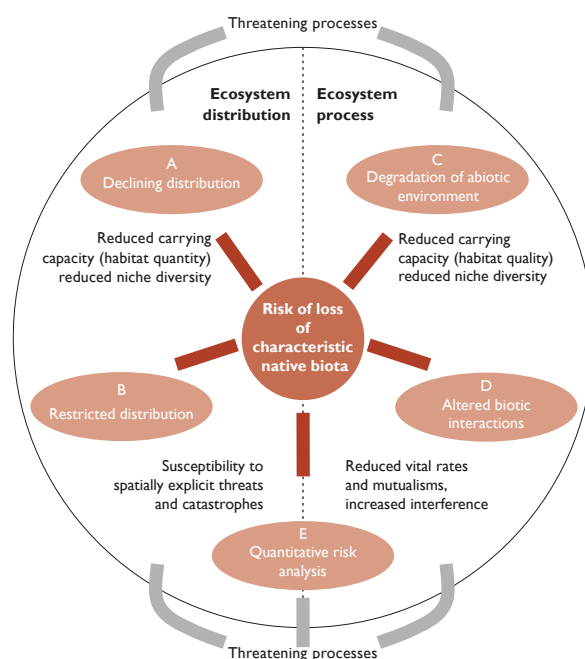


Figure 1.2. Criteria for assessing the threat status of habitat types according to the IUCN Red List of Ecosystems method (Keith et al. 2013). The application of the method and the definition of the criteria are described in greater detail in Part I of the publication.

## Description

The purpose of the description is to outline the main characteristics of the habitat type. A photograph is provided of each habitat type in this context. The description covers the most important characteristics of the habitat type, including its structural and functional characteristics and typical vegetation and species composition. The characteristics described are significant to the ecology and identification of the habitat type.

The starting point for the description is occurrences of the habitat type whose status is good and which are in their natural or in a semi-natural state and, for the main group of seminatural grasslands and wooded

pastures, occurrences that are representative (Part II, in Finnish only). If the occurrences of a habitat type have as a rule declined and cannot be easily identified based on the description of a good status, the description may provide a brief description of the features of a deteriorated occurrence.

The nomenclature of the species mentioned in the descriptions is in accordance with the nomenclature of Finnish Biodiversity Information Facility (2017) for all groups of organisms.

## Geographical variation

This section describes any significant differences in the characteristics of the habitat type between occurrences located in various parts of the coast. The characteristics of a habitat type may be somewhat different in different parts of its area of occurrence while the occurrences are still regarded as the same habitat type. Geographical variation may be related to the differences in the habitat type's species composition, species number, structural features or functional characteristics and, as regards Baltic Sea habitat types, are explained by factors including those relating to variation in salinity levels.

## Relationship with other habitat types

This describes the most important interfaces with other habitat types. The section describes any physical bordering of the habitat type on other habitat types and any gradual transition into another habitat type. If applicable, this section also describes from which other habitat type, if any, the habitat type in question has developed through ecological succession or into which habitat type it is developing as succession progresses. The section may also point out any difficulties in distinguishing between the habitat type in question and other habitat types.

## Distribution and distribution map

The current distribution of the habitat type in the different parts of the coastal area is described verbally and shown on a map. There are two types of habitat type distribution maps for the Baltic Sea habitat types. The distribution focus maps illustrate the distribution of the habitat type on a general level by marine area. The division of the marine areas is based on the HELCOM sub-basins (HELCOM 2013b). The large map symbol indicates the current focus of the occurrence in Finland and the small symbol only indicates that the habitat type occurs in the area. If the occurrences of a habitat type are distributed fairly evenly throughout the extent of occurrence, the map only features small symbols regardless of the fact that the habitat type may be common and abundant. Accordingly, the size of the symbol does not reflect the absolute quantity of the habitat type. Uncertain occurrence is indicated by a question mark on the map.

The other type of map used is the grid cell map showing the 10 km × 10 km grid cells occupied by observed, modelled or deduced current occurrences of the habitat type highlighted in colour. The grid employed is the same as that used in habitat type reporting under the Habitats Directive (EEA reference grid 2018). The background map for all of the distribution maps is based on data from the National Land Survey of Finland.

## Reasons for becoming threatened

For threatened (CR, EN and VU) and Near Threatened (NT) habitat types, the reasons that are regarded as having caused it to become threatened are listed. The reasons are listed in their assessed order of importance, starting from the most significant. The verbally expressed reason for the habitat type becoming threatened is followed in brackets by the abbreviation of the reason and by its assessed significance on a scale of 1–3 as follows: 1 – rather low significance, 2 – rather high significance and 3 – high significance.

As regards Data Deficient (DD) habitat types, the reason for the habitat type becoming threatened is not usually given in this section, but assumptions of the status of a DD habitat type and the reasons leading to the status may have been entered under 'Justification'. The reasons for habitat types becoming threatened are listed in a freer format than that in the results tables of Part 1, where the same abbreviations are used for all habitat type groups. The abbreviations and their explanations are given in Table 2.10 of Part 1. There are no reasons for Least Concern (LC) habitat types becoming threatened, and this subheading is omitted from their descriptions.

## Threat factors

The factors threatening the future preservation of the habitat type are listed for all habitat types that are regarded as facing threats. Threat factors are also presented for habitat types assessed as Least Concern (LC) and, where possible, also for Data Deficient (DD) habitat types. The threat factors are listed in their assessed order of importance, starting from the most significant. They are indicated in the same way as the reasons for becoming threatened.

## Description of habitat type collapse

This is a description of how occurrences of the habitat type are typically lost or the state in which the quality factors essential for the habitat type must be for the habitat type to be regarded as Collapsed (CO). The definition of collapse plays an essential role in the IUCN methodology (IUCN 2015). Threshold values may have been provided for the state of collapse on the basis of any quantitative data available on quality variables.



## Justification

The assessment justifications begin with the habitat type's IUCN Red List category and the criteria leading to the overall assessment. This section also provides the criterion-specific results and their justifications from A to E for all the criteria and subcriteria that were applied in the threat status assessment of the habitat type. The section describes the quantitative and qualitative development of the habitat type from the reference periods until the present day or into the future as well as the extent of occurrence and area of occupancy of the habitat type. A description of the characteristics of occurrences whose quality has declined may also be provided here. The most significant reasons for becoming threatened and threat factors are discussed in more detail.

## Reasons for change of category

This section provides a comparison of the IUCN Red List category with the category assigned in the previous assessment of threatened habitat types in Finland (Raunio et al. 2008). The assessment criteria employed in the first and second assessment of threatened habitat types differ from each other to such an extent that, for many habitat type groups, the majority of the uplistings and downlistings are caused solely by differences in criteria. As regards the Baltic Sea habitat types, their classification also changed between the first and the second assessment, so their comparison was in most cases not possible.

## Trend

This section provides an assessment of the trend of the habitat type. It indicates whether the status of the habitat type is stable or whether it is improving or declining due to the impact of current actions and threats. The trend evaluations provide national additional information supplementing the IUCN assessment and are independent of Red List categories.

## Links to administrative classifications

A brief description is provided of how each assessed habitat type corresponds to habitat types protected under legislation. For the various habitat type groups, the habitat types specified in Annex I of the EU Habitats Directive (Council Directive 92/43/EEC) and in the Finnish Nature Conservation Act (1096/1996), Forest Act (1093/1996) and Water Act (587/2011) are included. Of these, habitat types under the Habitats Directive and the Water Act apply to Baltic Sea habitat types.

Annex I of the Habitats Directive lists the habitat types that are regarded as of Community importance and whose favourable conservation status must be safeguarded through the establishment of Natura 2000 sites. A total of 68 Habitats Directive habitat types

occur in Finland (European Commission 2018a; 2018b; 2018c), and their descriptions have been published in the Natura 2000 habitats manual (Airaksinen and Karttunen 2001). The descriptions have subsequently been expanded upon (Finnish Environment Institute SYKE and Metsähallitus 2016; Finnish Environment Institute SYKE 2017). The habitat type names used in this publication are based on the Finnish Natura 2000 habitats manual, and the EU habitat type codes are given in brackets after the habitat type name.

Chapter 2, section 11 of the Water Act (587/2011) lists natural aquatic habitat types the natural state of which must not be endangered:

- coastal lagoons (flada-lakes or glo-lakes) with a maximum area of ten hectares;
- springs;
- streamlets outside the region of Lapland;
- ponds and lakes with a maximum area of one hectare outside the region of Lapland.

Åland also has its own legislation safeguarding habitat types in addition to the Habitats Directive also applying to Åland. The Åland Nature Conservation Decree (113/1998) and Forestry Decree (86/1998) list several protected habitat types and biotopes that are important for forest biodiversity. Habitat types occurring in Åland are included in the threat status assessment, but the correspondence of habitat types with habitat types safeguarded under Åland legislation is not examined in this publication.

Habitat types are defined and delimited in different ways and on the basis of different criteria in the different classification systems. Therefore, the habitat types specified in administrative classifications do not usually correspond precisely to the habitat types of this threat status assessment. Instead, there are numerous different types of cases of partial correspondence. Due to classification differences, a habitat type protected under legislation may be more extensive or more restricted in scope than the habitat type assessed here. In addition, habitat types protected under legislation are often defined in legislation in such a way as regards, for example, closeness to natural state, size of occurrence, geographical boundaries or other characteristics that only some of the habitat type occurrences meet these conditions.

Links to Habitats Directive habitat types are often difficult to describe, as their extent varies significantly. The Habitats Directive includes both small-scale vegetation types defined narrowly and very extensive habitat complexes that may contain many other Habitats Directive habitat types. This publication presents the clearest connections with administrative habitat type classifications without listing all possible links.

## Finland's responsibility habitat type

In conjunction with Finland's first assessment of threatened habitat types, the first list of Finland's habitat types of national responsibility was also compiled. In the second threat status assessment, the list was

updated with respect to some habitat type groups. Finland's habitat types of national responsibility are those whose occurrence focuses especially on Finland and for whose preservation Finland is internationally responsible. The responsibility habitat types have been divided into two groups based on the significance of their proportion of European occurrences located in Finland. Responsibility is particularly high if Finland accounts for more than 40% of the number or area of

the habitat type's representative occurrences and high if it accounts for 25–40%. The subheading 'Finland's responsibility habitat type' is omitted from habitat types not included in the responsibility habitat types.

The responsibility habitat type definitions do not always directly correspond to the classification used in the assessment. Instead, responsibility habitat types may be more extensive entities or smaller parts of classes used in the assessment.



## Baltic Sea habitat types 2

The Baltic Sea habitat types included in the threat status assessment of Finnish habitat types comprise the benthic habitat types of the littoral and deeper zones as well as the pelagic (open water) and seasonal ice habitat types. Near-shore open water areas and their biota were excluded from the assessment. The occurrence of underwater species and habitat types in the Baltic Sea is regulated in particular by salinity level, bottom type, light intensity and nutrient concentration. Light intensity and quality are materially affected by photic depth, which has been reduced due to the eutrophication trend. Exposure to wind and waves is also an important regulatory factor.

The habitat types assessed in this document are mainly based on the HELCOM Underwater Biotope and Habitat Classification System (referred to as HELCOM HUB below in the habitat type descriptions) (HELCOM 2013a). The most significant difference from HELCOM HUB is that this classification does not generally distinguish specific substrate classes. Instead, the habitat type classification is based on prevailing biota. In HELCOM HUB, benthic biotopes with a coverage of epibenthic organisms of 10% or higher are classified on the basis of the macrophytes or epifauna in question, and those with a lower coverage either on the basis of the biomass dominance of infauna or, as regards hard bottoms, on the basis of their sparse epibenthic macrocommunity. It should be noted that the habitat type classification system used in the threat status assessment of habitat types is not spatially comprehensive, which means it cannot be used as a basis for the classification of all benthic habitats. The classification does not include benthic habitats where no dominance of a species or group of species is exhibited. Therefore, for example, mixed substrates with *Fucus* spp. accounting for 35%, red algae for 35% and perennial filamentous algae for 30% of vegetation coverage are not included in any of the classified or assessed habitat type-level units.

The classification of pelagic habitat types and Baltic Sea habitat complexes is not based on the HELCOM HUB system. For pelagic habitat types, the primary classification factors are fluctuation in salinity as well as in seasonality in the various marine areas.

A total of five habitat complexes are described for the Baltic Sea. These are more extensive marine habitat entities and in part correspond to the habitat types of

the Habitats Directive in the Baltic Sea. The Directive's Baltic Sea habitat types were not examined as such in the threat status assessment of Finland's habitat types, as they were not regarded as satisfactorily covering the broader marine habitat entities. For example, small islands and islets, including their underwater parts, other than those in the outer archipelago are not included in the Directive's habitat types. The same applies to those sandy and gravel bottoms that do not form esker-like ridges. In many places it is difficult to draw the line between a Habitats Directive habitat type and a surrounding habitat with corresponding characteristics, and the approach chosen for this habitat types assessment was habitat types as determined specifically by biological variables.

The threat status assessments of Baltic Sea habitat types were in many respects based on data collected in the Finnish Inventory Programme for the Underwater Marine Environment (VELMU) but also to a significant extent on expert assessments. Most of the habitat type distribution maps provided here were generated using VELMU data. The availability of data was low especially concerning Åland. Assessment methods and baseline data are described in more detail in section 5.1 of Part 1 together with the summary of the results of the threat status assessment. Links of Baltic Sea habitat types to administrative classifications, that is, the Habitats Directive habitat types and environments to be preserved under the Water Act (587/2011) have only been included in the descriptions as regards the most important links.

### II

#### Benthic hard substrate habitats characterised by perennial algae or aquatic moss

##### II.01

#### Benthic habitats characterised by *Fucus* spp.

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>EN (VU-CR)</b>	A2a, D1	–
Southern Finland	<b>EN (VU-CR)</b>	A2a, D1	–
Northern Finland			



Isokrunni, Bothnian Sea. Photo: Heidi Arponen, Metsähallitus Parks & Wildlife Finland

**Description:** The habitat type is characterised by at least 10% coverage of perennial vegetation dominated by bladder wracks (*Fucus* spp.). As one of the most common habitat types of hard substrates in the Baltic Sea, *Fucus* communities have historically been amply studied. In habitat type-forming densities, *Fucus* can occur at depths of 0.5–10 metres and most abundantly in salinities higher than 4.5 psu. Siltation and competition with the fast-growing filamentous algae can prevent *Fucus* colonisation (Berger et al. 2003). The lower depth limit of vertical distribution of *Fucus* depends on the availability of light, whereas the upper limit is set by wave action and ice scouring. As the climate changes, however, average seawater temperatures in the Baltic are expected to rise, likely reducing the length of ice seasons and allowing algae to permanently colonise shallow bottoms (Granskog et al. 2006; BACC Author Team 2008; 2015).

The thallus of strong *Fucus* spp. individuals commonly grows to 20–60 cm, but the longest stands can reach up to 100 cm in sheltered bays. With increasing exposure and decreasing salinity, *Fucus* typically grows shorter and has fewer branches (Kalvas and Kautsky 1993; Ruuskanen and Bäck 1999). In the eastern Gulf of Finland, especially in the periphery of the archipelagos, *Fucus* growth is stunted at only 10–15 cm and there is no sexual reproduction (Kalvas and Kautsky 1993). *Fucus* spp. commonly have gas bladders, characteristic of *F. vesiculosus*, that keep the stems upright in calm waters, but these can be absent on more exposed shores.

The size of the habitat patches can range from a few square metres to several hectares. The quality of the substrate, availability of light and the nutrient conditions have the greatest effect on the size of the stands. Patch density can also vary significantly: on average, there are 21 mature shoots of *Fucus* per square metre (Korpinen and Jormalainen 2008).

*Fucus* is one of the most notable habitat-forming species on the hard bottoms of the Baltic Sea, supporting a high number of other species. In addition to other algae (such as *Cladophora glomerata*, *Pylaiella littoralis* and

*Elachista fucicola*) and invertebrates (e.g. *Gammarus* spp., *Idotea balthica*, *Cerastoderma glaucum*, *Theodoxus fluviatilis*), *Fucus* patches also provide shelter for many fish species, such as the viviparous eelpout (*Zoarces viviparus*) and the three-spined stickleback (*Gasterosteus aculeatus*) (Koivisto and Westerborn 2010; Kersen et al. 2011).

The habitat type combines the HELCOM HUB classes AA.A1C1, AA.I1C1 and AA.M1C1 (HELCOM 2013a): Baltic photic rock and boulders, coarse sediment and mixed substrate dominated by *Fucus* spp.

**Geographic variation:** Two species of *Fucus* can be found in the Finnish coastal waters: *F. vesiculosus* and *F. radicans*. *F. radicans* is primarily found in the Quark in the north, while *F. vesiculosus* is more common in the southwestern, southern and eastern waters of the Finnish coast. However, under suitable conditions they can occur side by side. Identification between the two species is difficult. The characteristic gas bladders of *F. vesiculosus* are absent in certain environmental conditions, and the short and thin growth form characteristic of *F. radicans* is not uncommon for *F. vesiculosus*, either. Both species reproduce asexually in low salinity.

The species assemblage of *Fucus* habitats also varies with salinity and exposure. For example, the blue mussel (*Mytilus trossulus*) is a common inhabitant of the *Fucus* belt in the southwestern waters, but is absent from the eastern Gulf of Finland due to low salinity. In low salinities, water mosses (e.g. *Fontinalis antipyretica*) can grow among the *Fucus* (Snoeijs-Leijonmalm et al. 2017).

**Relationships to other habitat types:** Within the vertical variation in the algal zones on rocky shores, *Fucus* habitat zones tend to occur below the shallow areas dominated by filamentous green algae and above the deeper water dominated by red algae, partially intermingling with both zones. Algal zones are increasingly overlapping due to the increased turbidity of coastal waters, and mixed habitats are common. Among *Fucus* spp., filamentous green algae as well as red algae, such as *Furcellaria lumbricalis*, *Ceramium* spp., *Coccotylus truncatus* and *Phyllophora pseudoceranooides*, occur at different coverages. In sheltered mixed bottoms, *Fucus* spp. that attach to small pebbles or detached individuals may continue their growth and form habitats with aquatic plants. Bottoms characterised by detached forms of *Fucus* are described as their own habitat type.

In classification based on biomass, the large *Fucus* almost always determines the habitat type even in a multispecies biotic community.

**Distribution:** On the Finnish coast, *Fucus* can be found from the Quark to the eastern part of the Gulf of Finland as far as the Finnish-Russian border (VELMU data 2017). The species has all but disappeared from the inner parts of the Archipelago Sea. In recent years, however, *Fucus* populations have recovered at least temporarily in many areas of the Finnish coast. The habitat type has historically been common and widespread throughout the Baltic Sea, ranging from the Kattegat to the Bothnian Bay. *Fucus* populations have been in decline on the Finnish coast as well as on the coasts of Poland, Latvia and Lithuania.

**Reasons for becoming threatened:** Increased water turbidity and abundance of filamentous algae (WEP 3), waterborne transport (WT 1).

**Threat factors:** Increased water turbidity and abundance of filamentous algae (WEP 3), shortening of ice winters and resulting competitive advantage for filamentous algae, also reduced salinity (CC 2), waterborne transport (WT 1), oil spills (CHE 1).

**Description of habitat type collapse:** A habitat type is regarded collapsed if all of its occurrences have been lost. This would result from the dominant species – *Fucus* spp. – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type. Changes in the habitat type were examined indirectly by using Secchi depth data. If eutrophication proceeds further and transparency declines so much that *Fucus* spp. are no longer able to form uniform stands, the habitat type will be classified as Collapsed (CO). The Secchi depth of 2.7 metres was used as the collapse value for transparency in the examination of qualitative decline. Benthic habitats characterised by *Fucus* spp. were also examined in accordance with the Water Framework Directive (WFD) indicator of lower growth limit of the continuous *F. vesiculosus* belt, the changes in which were used to further calculate the changes in the Ecological Quality Ratio (EQR) (Aroviita et al. 2012). In this examination, the collapse value was set at the upper limit of the WFD class ‘poor’, where the regional variation in EQRs is in the 0.2–0.35 range. This corresponds roughly to the lower growth limit being at a depth of 1–2 metres.

**Justification:** Benthic habitats characterised by *Fucus* was assessed as an Endangered (EN) habitat type due to biotic eutrophication-related changes having taken place over the past 50 years (D1) and also due to projected quantitative decline over the next 50 years (A2a).

The quantitative decline of bottoms favourable for *Fucus* spp. is estimated to be around 40% over the past 50 years and around 60% over the longer historical time frame of 100 years (A1 & A3: VU). This is due to reduced transparency and increased occurrence of fast-growing annual filamentous algae. Filamentous algae grow on exposed hard surfaces, preventing the spread of *Fucus* spp. into the area. They may also grow on *Fucus* spp., suffocating old stands. Data used to examine quantitative decline comprised modelled maps of the occurrence of

areas favourable for the bladder wrack (*F. vesiculosus*) at different times, taking historical transparency changes into account (cf. Fleming-Lehtinen and Laamanen 2012). The examination also took into account variation in wind and wave exposure and salinity but not benthic substrate, so the decline estimates are somewhat rough. Quantitative changes in the future will be affected particularly by climate change and related projected salinity decreases and reduced transparency in both southern and southwestern coastal waters (Jonsson et al. 2018). The projections of Jonsson et al. (2018) concerning changes in the occurrence of *F. vesiculosus* correspond to an estimated decline exceeding 70% over the next 50 years (A2a: EN, range of category VU–CR).

Benthic habitats characterised by *Fucus* is still quite a common and abundant habitat type (VELMU data 2017), and the extent of occurrence and the area of occupancy are above the thresholds set for Criterion B (B1–B3: LC).

The examination of abiotic changes on the basis of the above-mentioned transparency data results in assessments of change under Criterion C that are of the same magnitude as for Criterion A, that is, their relative severity is estimated to be around 40% in the next 50 years and around 60% over the historical time frame of 100 years (C1 & C3: VU). The collapse value used for the transparency variable in the examination was 2.7 metres as, on the basis of VELMU data, the occurrence of the habitat type is very low in waters with a Secchi depth of under 2.7 metres. The above-mentioned salinity and transparency projections (Meier et al. 2012; Jonsson et al. 2018) could be used as a basis for assessing the relative severity of abiotic qualitative changes in the future, too. Projections of the future are, however, uncertain. In addition, the absence of a more specific calculation method for qualitative change resulted in future abiotic changes being regarded as Data Deficient (C2a: DD).

The Water Framework Directive (WFD) indicator of ‘lower growth limit of the continuous *F. vesiculosus* belt’ was used in the examination of biotic changes. On the basis of this indicator, the relative severity of the biotic changes was assessed as being 48% over the past 50 years (D1) and 65% since the early 1900s (D3: VU). Increased eutrophication, however, has in places been found to have decreased the density of *Fucus* spp. communities already before a rise in the depth of the lower growth limit. This is why the habitat type was classified under criterion D1 as Endangered (EN, range of category VU–EN), although the calculated estimate of change at 48% would correspond to Vulnerable (VU, lower limit for EN 50%). Future biotic changes were regarded as Data Deficient (D2a: DD).

**Reasons for change of category:** Increased knowledge, change in method.

**Trend:** Declining. With the eutrophication trend continuing, the state of the habitat type is anticipated to decline further in the key occurrence areas.

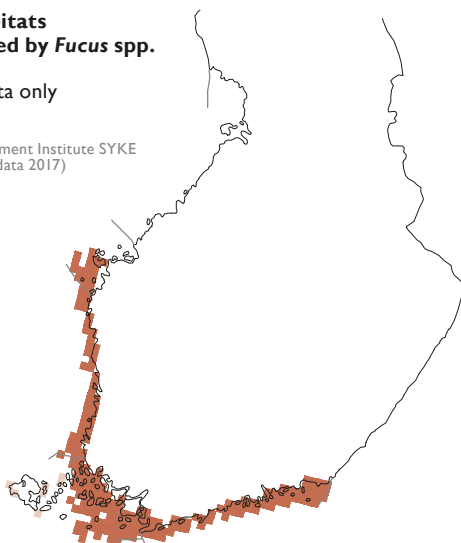
**Links to administrative classifications:** May be included in Habitats Directive habitat types *reefs* (1170) or the underwater parts of *boreal Baltic islets and small islands* (1620).

**Finland’s responsibility habitat type:** Included in the responsibility habitat type *rocky bottoms of the Baltic Sea*.

#### Benthic habitats characterised by *Fucus* spp.

Partial data only

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(Source: VELMU data 2017)



### Benthic habitats characterised by red algae

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>EN</b>	A1	–
Southern Finland	<b>EN</b>	A1	–
Northern Finland			

**Description:** The habitat type is characterised by at least 10% coverage of vegetation dominated by red algae.

The red algal zone is located below the *Fucus* zone usually at depths of 2–10 metres on the hard bottoms of the Bothnian Sea, the Archipelago Sea and the western part of the Gulf of Finland (Kostamo 2008). The dominant red algae species commonly include *Furcellaria lumbricalis*, *Ceramium tenuicorne*, *Coccotylus truncatus* and *Phyllophora pseudoceranoides*. *Polysiphonia* spp. are also prevalent. The red algal zone is relatively diverse and, for example, various brown algae (*Fucus* spp., *Battersia arctica*), blue mussels (*Mytilus trossulus*) and bay barnacles (*Amphibalanus improvisus*) are often found among red algae. The perennial *F. lumbricalis* may support filamentous epiphytic algae such as *C. tenuicorne*, *Pylaiella littoralis*, *Ectocarpus siliculosus* and *Cladophora glomerata* (VELMU data 2017). In the low-salinity conditions of the Finnish coast, most red algae occur at their periphery and reproduce almost exclusively asexually (Kostamo 2008).

*F. lumbricalis*, the largest red alga, is especially common at depths of 3–8 metres, and in clear waters it can be found down to a depth of 15 metres. Stands in turbid waters may form already at a depth of 1 metre if ice scouring does not separate the thalli from the substrate (Kostamo 2008).

*Furcellaria* torn from their substrate may drift to shallow sandy bottoms and form loose algal mats alone or mixed with *C. truncatus* and *Fucus* spp. These loose communities are most common in the southern Baltic, where they can be considered to form a separate habitat type on otherwise barren sandy and muddy bottoms. (Martin et al. 1996; Kersen et al. 2009)

Both *Furcellaria* and *C. truncatus* may also grow attached to small rocks or clams on sandy bottoms (VELMU data 2017). Regardless of substrate, red algal communities and mixed red alga-*Fucus* spp. communities on exposed rocky shores are notable spawning areas for the Baltic herring (*Clupea harengus membras*).

The habitat type combines the HELCOM HUB classes AA.A1C2, AA.A1C3, AA.I1C2, AA.I1C3, AA.M1C2 and AA.M1C3 (HELCOM 2013a): Baltic photic rock and boulders, coarse sediment and mixed substrate dominated by perennial non-filamentous corticated red algae or perennial foliose red algae. The habitat type also includes filamentous red algae-dominated parts of the HELCOM HUB classes AA.A1C5, AA.I1C5 and AA.M1C5: Baltic photic rock and boulders, coarse sediment and mixed substrate where the proportion of perennial vegetation is at least 10% and which is dominated by perennial filamentous algae.

**Geographic variation:** Almost all red algae on the Finnish coast are of marine origin. The most abundant and diverse red algal communities are found in the

outer archipelagos of the Bothnian Sea, the Archipelago Sea and the western part of the Gulf of Finland, where the waters are sufficiently clear and saline.

**Relationships to other habitat types:** On the Finnish coast, the red algal zone is limited to the *Fucus* zone or, in deeper waters, to blue mussel beds or perennial filamentous algal bottoms dominated by *Battersia arctica*. The transition from one habitat type to the next is often gradual and has no clear borders. Red algal communities often occur in the deepest waters of all macroalgal biotic communities.

**Distribution:** The red algal zone occurs almost throughout the Baltic Sea. The observations in the grid map are red algal communities located deeper than 5 metres (VELMU data 2017). The depth limit was used to differentiate the shallow-water *Ceramium tenuicorne* stands from the deeper-water red algal zones, the occurrence of which extends from the Quark to Porvoo in the Gulf of Finland. The shallow-water *C. tenuicorne* also occurs in the Bothnian Bay.

**Reasons for becoming threatened:** Increased water turbidity, increased abundance of filamentous algae and benthic siltation (WEP 3).

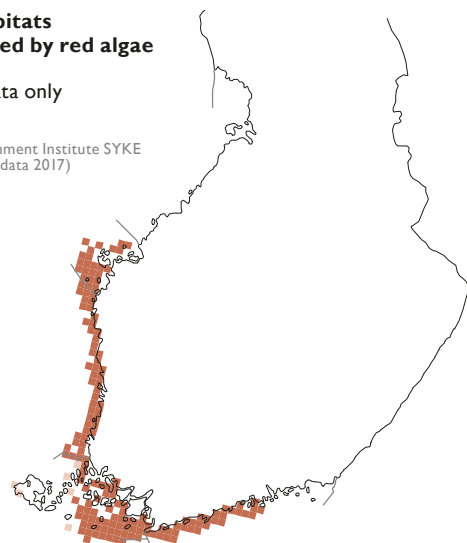
**Threat factors:** Increased water turbidity, increased abundance of filamentous algae and benthic siltation (WEP 3), reduced salinity (CC 2).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – red algae – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type. Benthic habitats characterised by red algae were also examined on the basis of the indicator ‘depth of occurrence of red algal communities’ (Monitoring Manual for Finland’s Marine Strategy 2014), the changes in which were used to further calculate the changes in the Ecological Quality Ratio (EQR). In this examination, the collapse value was set at the upper limit of the WFD class ‘poor’, where the regional variation in EQRs is in the 0.21–0.35 range (Ruuskanen 2014). This corresponds roughly to a lower growth limit at a depth of 2.6–6 metres.

### Benthic habitats characterised by red algae

Partial data only

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(Source: VELMU data 2017)





Söderbadan, western Gulf of Finland. Photo: Olli Mustonen, Metsähallitus Parks & Wildlife Finland

**Justification:** Benthic habitats characterised by red algae was assessed as an Endangered (EN) habitat type due to its quantitative decline over the past 50 years (A1).

The quantitative decline of bottoms favourable for red algal communities throughout Finland's coastal area is estimated to have averaged 50–70% over the past 50 years and 55–75% over the historical time frame of 100 years (A1: EN and A3: VU). This is due to both the increase in fast-growing filamentous algae and the reduction in water transparency. Data used comprised modelled maps of the occurrence of areas favourable for red algae at different times, taking historical transparency changes into account (cf. Fleming-Lehtinen and Laamanen 2012). The examination also took into account variation in wind and wave exposure and salinity but not benthic substrate, so the decline estimates are somewhat rough. Observations made in the Archipelago Sea of the state of red algal communities during 1994–2008 indicate an even stronger decline than estimated above (Vahteri, unpublished data). In principle, future quantitative changes could be estimated on the basis of projected changes in salinity and transparency (e.g. Meier et al. 2012; Jonsson et al. 2018), but the forecasts are uncertain and so far there are no modelling results. This is why Data Deficient (DD) was regarded as the most suitable classification under criterion A2a.

Benthic habitats characterised by red algae continues to be quite a common and abundant habitat type, and the extent of occurrence and the area of occupancy are above the thresholds set for Criterion B (B1–B3: LC).

The indicator 'depth of occurrence of red algal communities' was also used when examining biotic changes. On the basis of this variable, the relative severity of the biotic changes was assessed as being 30–50% over the past 50 years (D1: VU) and 50–70% since the early 1900s (D3: VU). Eutrophication has caused increased water turbidity, which reduces the potential growth area of red algae as they require access to light, too. The increased deposition of organic material on the seabed also results in the siltation of rock surfaces and has an adverse effect on the settlement of red algae in new areas. Future biotic changes were regarded as Data Deficient (D2a: DD).

**Reasons for change of category:** No changes.

**Trend:** Declining. With the eutrophication trend continuing, the state of the habitat type is anticipated to decline further in the key occurrence areas.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *reefs* (1170) or the underwater parts of *boreal Baltic islets and small islands* (1620).

**Finland's responsibility habitat type:** Included in the responsibility habitat type *rocky bottoms of the Baltic Sea*.



### Benthic habitats characterised by perennial filamentous algae

	IUCN Red List Category	Criteria	Trend
Whole of Finland	LC		?
Southern Finland	LC		?
Northern Finland			



Itäkarit, eastern Gulf of Finland. Photo: Ari O. Laine, Metsähallitus Parks & Wildlife Finland

**Description:** The habitat type is characterised by at least 10% coverage of perennial vegetation dominated by perennial filamentous algae. In this classification, the habitat type is additionally specified to include only communities characterised by perennial filamentous brown or green algae.

Communities characterised by perennial filamentous algae tend to be mixed habitats, and local differences are considerable. The habitat type is split into three subtypes, where the characteristic species are *Battersia arctica*, *Cladophora rupestris* and the attached form of *Aegagropila linnaei*.

Perennial filamentous algae grow attached to hard-bottom substrates, usually rock and boulders. Even small rubble can offer a base for recruitment when the conditions are suitable. The most common perennial filamentous algal species of marine origin occurring on the Finnish coast, *B. arctica* and *C. rupestris*, can be found commonly almost throughout the Baltic Sea within salinities between 3.5 and 5 psu. Both species prefer relatively clear (visibility over 5 metres) and deep waters and exposed shores. Most of the habitats dominated by *B. arctica* and *C. rupestris* are found in patches between *Fucus*- and/or red algae-dominated habitats, but especially *B. arctica*, which grows low and sparse, often dominates habitats below the main

growth zone of *Fucus* spp. (Bergström and Bergström 1999). *A. linnaei*, on the other hand, is of freshwater origin and can be found in less saline and more turbid waters than the two other species. In the Bothnian Bay, *A. linnaei* that is attached to the substrate may dominate habitats from the surface down to depth of 10 metres when the other conditions are met.

The perennial filamentous algae provide food and shelter for many invertebrates and insect larvae both alone and as part of polyspecific communities. Within stands of species such as *C. rupestris*, large numbers of the isopods *Idotea* spp. and *Jaera* spp., the amphipods *Gammarus* spp., the mussels *Mytilus trossulus* and *Cerastoderma glaucum* as well as chironomid larvae (Chironomidae) have been observed (Saarinen 2015), while *A. linnaei* stands have accommodated *Gammarus* spp. and grazing snails (Hydrobiidae, *Theodoxus fluviatilis*) (Snoeijs-Leijonmalm et al. 2017). Deeper in the species-poor *B. arctica* communities, the most common invertebrates are blue mussels (*M. trossulus*) and bay barnacles (*Amphibalanus improvisus*) (VELMU data 2017).

*B. arctica* grows in coarse tufts a few centimetres tall, attached to the deeper parts of rocky shores. It prefers the exposed shores of the outer archipelago and depths of 8–12 metres. Being a species of marine origin, its occurrence is limited to the coast between the Quark and the eastern Gulf of Finland. Due to its small size, *B. arctica* rarely dominates the biotic community when coexisting with other species, but it can, however, form a habitat type characterised by perennial filamentous algae where other species are absent (Guiry 2017; Koistinen 2017a).

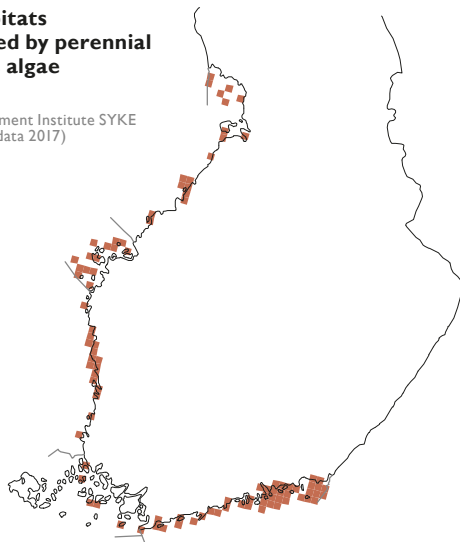
Like *B. arctica*, *C. rupestris* is most commonly found on the rocky shores of the outer archipelago, where it usually grows in small patches among the *Fucus*. *C. rupestris* grows as 3–10 cm tall coarse tufts, often in multispecies communities with *Fucus*, red algae and the blue mussel (*Mytilus trossulus*). In habitat-forming densities *C. rupestris* can be found on the Åland Islands and in the eastern Gulf of Finland below the *Fucus* belt. In the eastern Gulf of Finland, *C. rupestris* communities are notable spawning areas of the Baltic herring (*Clupea harengus membrans*).

*A. linnaei* can grow in two forms; low (0.5 cm) fur attached to hard surfaces or loose balls composed of detached, torn filaments, rolling with the waves. Both forms are perennial, but only the attached form (globular form: I3.03) is included in this habitat type. *A. linnaei* occurs throughout the coast of Finland down to a depth of 8 metres, but in habitat-forming densities it is found only in the Bothnian Bay, where the occurrence of other algal species is scarcer. Even in the Bothnian Bay, *A. linnaei* is often accompanied by the algae *Cladophora fracta*, *Cladophora glomerata*, *Ulothrix zonata*, *Batrachospermum* spp. and diatoms (Bacillariophyta) (Leinikki and Oulasvirta 1995; Yliniva and Keskinen 2010; Kurikka 2016; Essi Keskinen, pers. comm. 2017).

The habitat type combines the HELCOM HUB classes AA.A1C5 and AA.M1C5 (HELCOM 2013a): Baltic photic rock, boulder and mixed substrate dominated by perennial filamentous algae, with the exception of bottoms dominated by perennial filamentous red

### Benthic habitats characterised by perennial filamentous algae

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(Source: VELMU data 2017)



algae located deeper than 5 metres, which are in this classification included in Benthic habitats characterised by red algae.

**Geographic variation:** The dominating species in the habitat varies in different parts of the coast and according to depth. *Cladophora rupestris* forms communities with high coverages only in the eastern Gulf of Finland, whereas *Aegagropila linnaei* does so in the Bothnian Bay only. *Battersia arctica* typically forms the habitat type in the western Gulf of Finland, the Archipelago Sea and the Bothnian Sea, but only below the *Fucus* zone (Bergström and Bergström 1999; Yliniva and Keskinen 2010; VELMU data 2017).

**Relationships to other habitat types:** The habitat type tends to occur as a patchwork with habitats dominated by *Fucus* spp., red algae or annual filamentous algae, as well as *Mytilus* beds. The neighbouring habitat types rarely are clearly distinguishable from one another.

**Distribution:** The habitat type occurs throughout the Finnish coast. The occurrence of habitat-forming *Battersia arctica* is limited to the coast between the Quark and the eastern Gulf of Finland. The main areas of occurrence of *Cladophora rupestris* are the eastern Gulf of Finland and the Åland Islands. Bottoms dominated by *Aegagropila linnaei* occur in the Bothnian Bay.

The distribution map is mostly based on the diving observations in the VELMU data (2017) and is therefore not regionally comprehensive. The data from the Åland Islands is not included in the map.

**Threat factors:** –

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – perennial filamentous algae – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by perennial filamentous algae was assessed as a Least Concern (LC) habitat type (A1–A3, B1–B3).

There is no data on any quantitative changes in the habitat type, but it was assumed based on an expert assessment that its quantity is not likely to have undergone any significant changes or to change

over the next 50 years (A1–A3: LC). Occurrences of the habitat type dominated by *Cladophora rupestris* or *Battersia arctica* focus on the outer archipelago and those dominated by *Aegagropila linnaei* in the Bothnian Bay, so at least the current focus areas of the habitat type are not subjected to strong eutrophication. *B. arctica* is assumed to have declined somewhat over the past 60 years, but its occurrence varies to a great deal from year to year and there is not enough monitoring data to draw any reliable conclusions (Kiirikki 1996).

The extensive occurrence area of the habitat type stretches from the Bothnian Bay to the eastern part of the Gulf of Finland, and there is also a large number of grid cells occupied (B1–B2: LC) (VELMU data 2017). The habitat type is LC also on the basis of criterion B3.

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *reefs* (1170) or the underwater parts of *boreal Baltic islets and small islands* (1620).

**Finland's responsibility habitat type:** Included in the responsibility habitat type *rocky bottoms of the Baltic Sea*.

II.04

### Benthic habitats characterised by aquatic moss

	IUCN Red List Category	Criteria	Trend
Whole of Finland	LC		=
Southern Finland	LC		=
Northern Finland			



Vähähuituri, Bothnian Bay. Photo: Jalmari Laurila, Metsähallitus Parks & Wildlife Finland

**Description:** The habitat type is characterised by at least 10% coverage of vegetation dominated by aquatic moss.

Most water mosses in the Finnish coastal areas are originally freshwater species from the genus *Fontinalis* that have adapted to brackish water. Other common species are *Fissidens fontanus* and *Rhynchostegium riparioides*. Rarer genera among water mosses include *Drepanocladus/Sarmentypnum* spp.

Water mosses grow in exposed sites attached to hard surfaces most frequently at depths of 3–6 metres. The maximum depth of their growth is limited by the availability of light at the bottom. In shallow waters, the

occurrence of water mosses is restricted by ice scouring in winter, and the shoots regenerate annually. Water mosses propagate via spores, attach to the substrate with rhizoids and filter nutrients directly from the surrounding water.

Water mosses form multispecies communities, and *F. fontanus* often grows among *R. riparioides* shoots as occasional patches. The most common species of *Fontinalis* spp., *F. antipyretica*, occurs commonly among other water mosses, but usually grows as large individual tufts that considerably increase the biomass of the community. The number of water moss species increases from the open water towards estuaries and fresh water areas.

The habitat type combines the HELCOM HUB classes AA.A1D, AA.I1D and AA.M1D (HELCOM 2013a): Baltic photic rock and boulders, coarse sediment and mixed substrate where the proportion of perennial vegetation is at least 10% and that is characterised by aquatic moss.

**Geographic variation:** No known geographic variation.

**Relationships to other habitat types:** The habitat type typically occurs in patches on bare rocky bottoms among other benthic vegetation. In multispecies communities, water mosses rarely reach coverages sufficient for forming a habitat type.

**Distribution:** The habitat type focuses on the northern Gulf of Bothnia: the Quark and Bothnian Bay, where the salinities are sufficiently low (VELMU data 2017). Water mosses also occur in low-salinity areas in other parts of the Finnish coast, but their coverages are rarely sufficient enough for the occurrence to qualify as a habitat type.

**Threat factors:** Increased abundance of filamentous algae and benthic siltation (WEP 2).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – aquatic mosses – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type. The collapse value used for the photic depth calculated based on transparency in the examination was 3.5 metres, as the occurrence of aquatic mosses in zones shallower than this is limited by ice erosion.

**Justification:** Benthic habitats characterised by aquatic moss was classified as a Least Concern (LC) habitat type. Its quantity is not assumed to have changed over the past 50 years (A1: LC), and it is not particularly rare (B1–B3: LC). In addition, its distribution focuses on the Bothnian Bay, where abiotic changes have also been rather small (C1: LC).

The geographic area covered by aquatic moss communities is not assumed to have declined significantly since the 1960s, especially in the northern focus areas where the increased abundance of filamentous algae and benthic siltation have not been as big a problem as in southern marine areas (A1: LC). Any longer-term quantitative changes cannot be estimated (A3: DD). The only available long-term study (Pitkänen et al. 2013) does not indicate any reduction, as observations of both *Fontinalis* spp. and *Sarmentypnum/Drepanocladus* spp. have increased significantly from the 1930s–1940s to the 2000s in the Pojo Bay. Future quantitative changes cannot be estimated, either (A2a: DD).

## Benthic habitats characterised by aquatic moss

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(Source: VELMU data 2017)



The occurrence area of aquatic moss communities covers more than 100,000 km<sup>2</sup>, and the estimated minimum number of grid cells occupied is 33 on the basis of observations made in the Finnish Inventory Programme for the Underwater Marine Environment (VELMU) (VELMU data 2017). However, the number of grid cells occupied is regarded as exceeding the threshold value of 55, so the habitat type is Least Concern under Criterion B (B1–B3: LC).

Although transparency is not the most important factor affecting the occurrence of aquatic mosses, it is the only one that can be employed in attempts to estimate any qualitative changes. Historical transparency data (Fleming-Lehtinen and Laamanen 2012) indicates rather small (15%) changes in terms of relative severity over the past 50 years (C1: LC). The collapse value used for the transparency variable in the examination was 3.5 metres, as the occurrence of aquatic mosses is limited by ice erosion in zones shallower than this. Any future or longer-term historical qualitative changes cannot be assessed (C2a & C3: DD).

**Reasons for change of category:** Increased knowledge.

**Trend:** Stable.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *reefs* (1170) or the underwater parts of *boreal Baltic islets and small islands* (1620).

**Finland's responsibility habitat type:** *Benthic habitats characterised by aquatic moss* is a responsibility habitat type.

12

## Benthic soft substrate habitats characterised by vegetation

12.01

### Benthic habitats characterised by *Hippuris* spp.

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>DD</b>	A1–A3, D1–D3	–
Southern Finland	<b>DD</b>	A1–A3, D1–D3	–
Northern Finland			

**Description:** The habitat type is characterised by at least 10% coverage of perennial vegetation dominated by mare's tail (*Hippuris* spp.). The *Hippuris* species in this habitat type include three taxa: the common mare's tail *H. vulgaris*, the lance-leaved mare's tail *H. lanceolata* and the threatened fourleaf mare's tail *H. tetraphylla*. *H. vulgaris* is the most common taxon, but *H. lanceolata* or *H. tetraphylla* may also dominate *Hippuris* communities. *Hippuris* often co-occurs with other emergent or submerged macrophytes. The most common of these are *Eleocharis* spp., *Potamogeton* spp., *Stuckenia* spp., *Zannichellia* spp., and *Subularia aquatica*. *Hippuris* plants are perennial herbs with short leaves growing in whorls around solid unbranched stems that can be up to 60 cm long.

The habitat type typically occurs at the bottom of sheltered bays and estuaries in very shallow areas (0–50 cm) with muddy or sandy substrates. *Hippuris* may grow totally submerged or form emergent vegetation. They can even grow above the shoreline for short periods of time. *Hippuris* stands can also be found, for example, in small pools on seashore meadows. *Hippuris* benefit from grazing, either by domestic livestock or geese, as this prevents larger plants from suffocating it.

The habitat type is included in the HELCOM HUB class AA.H1A (HELCOM 2013a): Baltic photic muddy sediment characterised by emergent vegetation.

**Geographic variation:** No known geographic variation. The majority of the known occurrences of *Hippuris tetraphylla* and *H. lanceolata* are located in the Bothnian Bay, whereas *H. vulgaris* is also common in the Gulf of Finland (Lampinen and Lahti 2017).

**Relationships to other habitat types:** The habitat type may form gradual continuums with habitat types dominated by infauna or other vegetation. The most common habitat types in similar environments are bottoms dominated by spikerushes (*Eleocharis* spp.) and reedbeds, but grazed shores can also host seashore meadows with shallow water levels. Towards the open sea, submerged vascular plants may begin to dominate, while infaunal communities may do so in turbid water.



**Distribution:** Recent large sea inventories have produced little data on shoreline vegetation, and this habitat type is very poorly known. Even though the distribution of *Hippuris* covers the entire Finnish coastline, the distribution and frequency of this habitat type is probably much more limited. The few occurrences known to exist are located in the Bothnian Sea and the Bothnian Bay. Due to rapid land uplift, these areas offer the greatest numbers of suitable habitats for this habitat type.

**Threat factors:** Reedbed expansion (WEP 3), discontinuation of coastal grazing (OGR 2).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – *Hippuris* spp. – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by *Hippuris* spp. was assessed as a Data Deficient (DD) habitat type (A1–A3, D1–D3).



Rahja, Bothnian Bay. Photo: Manuel Deinhardt, Metsähallitus Parks & Wildlife Finland

There is no monitoring data available on *Hippuris* spp. communities. The species observation maps of the Plant Atlas show a clear decline in *Hippuris* spp. at least in southwestern and southern coastal areas (Lampinen and Lahti 2017). Reasons behind the decline include the poor competitiveness of the species, coupled with eutrophication and overgrowth relating to coastal grazing being discontinued, especially reedbed expansion. The reduction in species observations is likely to also mean a reduction in *Hippuris* spp. communities. The magnitude of the decline cannot, however, be estimated, so the habitat type is classified as Data Deficient on the basis of past and future quantitative decline (A1–A3: DD).

If very small stands of few square metres are also classified as benthic habitats characterised by *Hippuris* spp., it is highly likely that the extent of occurrence as well as the number of 10 km x 10 km grid cells occupied are above the thresholds set for Criterion B. The habitat type is Least Concern on the basis of Criterion B (B1–B3: LC).

*Hippuris* spp. may even benefit from slight eutrophication of water bodies (NatureGate 2017). Overgrowth caused by eutrophication and the discontinuation of coastal grazing has, however, resulted in the decline of weak competitors like *Hippuris* spp., but the level of decline cannot be assessed. The habitat type is regarded as Data Deficient in terms of its biotic changes (D1–D3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *coastal lagoons* (1150) and *boreal Baltic coastal meadows* (1630). May be included in the habitat type of *coastal meadows* protected under the Nature Conservation Act (1096/1996) and *coastal lagoons (fladas) and lakes created by land uplift (glo-lakes) with a maximum area of ten hectares* protected under the Water Act (587/2011).



12.02

**Benthic habitats characterised by *Potamogeton* spp. and/or *Stuckenia* spp.**

	IUCN Red List Category	Criteria	Trend
Whole of Finland	LC		=
Southern Finland	LC		=
Northern Finland			

**Description:** The habitat type is characterised by at least 10% coverage of perennial vegetation dominated by pondweeds from the genera *Potamogeton* and/or *Stuckenia*. The nine *Potamogeton* and *Stuckenia* species in the habitat type are: the fennel pondweed *S. pectinata*, the slender-leaved pondweed *S. filiformis*, the sheathed pondweed *S. vaginata*, the perfoliate pondweed *P. perfoliatus*, the various-leaved pondweed *P. gramineus*, the flat-stalked pondweed *P. friesii*, the lesser pondweed *P. pusillus*, the small pondweed *P. berchtoldii* and the grass-wrack pondweed *P. compressus*. Other common species in this habitat type are *Myriophyllum* spp., *Zannichellia* spp. and *Ranunculus* spp. Other, rarer species of the *Potamogeton* and *Stuckenia* genera may occur as well (Pip 1987; VELMU data 2017).

Both pondweed genera occur widely in freshwater and marine environments all over Europe (Pip 1987; Hämet-Ahti et al. 1998; GBIF Secretariat 2017a). The most common species throughout the coast of Finland are *S. pectinata* and *P. perfoliatus*, which form the majority of the biomass within the habitat. Both species can endure a wide range of environmental factors, and *P. perfoliatus*, especially, has a high tolerance for eutrophic and turbid waters. *S. filiformis* prevails in more open areas and higher salinities, whereas *P. gramineus* and *P. berchtoldii* prefer lower salinities. In the Bothnian Bay, *P. gramineus* and *S. filiformis* often co-occur on the gravel bottoms of the outer archipelago (Hansen and Snickars 2014; VELMU data 2017). Within the large *Potamogeton* and *Stuckenia* genera, some species are sensitive to eutrophication and turbidity. After longer periods of increased turbidity, all *Potamogeton* and *Stuckenia* species will, despite their tolerance, give way to groups more tolerant of eutrophication, such as *Myriophyllum* spp. and *Ceratophyllum demersum*.

Environmental factors cause variation both in the species composition and structure of communities dominated by *Potamogeton* spp. and/or *Stuckenia* spp. In more open areas and on sandy bottoms, short shoots of both genera dominate, accompanied by species like *Zannichellia* spp., *Ruppia* spp., *Chara aspera*, *Zostera marina* and *Tolypella nidifica*. In sheltered bays *Potamogeton* spp. and *Stuckenia* spp. grow larger and their accompanying species usually belong to the genera *Ranunculus*, *Myriophyllum* and *Chara*.

Both monospecific and polyspecific vascular plant communities provide food and shelter for many invertebrate and insect species. Sessile epifauna are seldom found in the habitat type, but grazing snails, insect larvae and crustaceans are typical inhabitants. In more exposed areas, molluscs and crustaceans

dominate the macrofauna, whereas insect larvae are more common in more sheltered areas (Van Vierssen 1983; Hansen 2010). The inhabiting communities are similar to the *Zannichellia* and *Ruppia* habitat types under comparable environmental conditions (Hansen et al. 2008).

The habitat type partly corresponds to the HELCOM HUB classes AA.H1B1, AA.I1B1, AA.J1B1 (HELCOM 2013a): Baltic photic muddy, coarse and sandy sediments dominated by pondweed (*Potamogeton perfoliatus* and/or *Stuckenia pectinata*).

**Geographic variation:** The dominance of *Stuckenia pectinata* declines in the Bothnian Bay, and species such as *Potamogeton gramineus* and *P. pusillus* become more abundant (Hultén and Fries 1986; VELMU data 2017).

**Relationships to other habitat types:** The habitat type may gradually transform into bottoms dominated by infauna or other vegetation, depending on the prevailing environmental factors. As eutrophication increases, more tolerant species, such as *Myriophyllum* spp. and *Ceratophyllum demersum*, become more common in the habitat type (Hansen et al. 2012; Hansen and Snickars 2014).

**Distribution:** The habitat type occurs frequently along the entire coast of Finland (VELMU data 2017). However, the dominant species can vary both temporally and spatially. Generally more exposed areas are dominated by *Stuckenia filiformis*, whereas the more sheltered areas lean towards the domination of *S. pectinata* and *Potamogeton perfoliatus* (Hansen et al. 2012).

**Threat factors:** Increased turbidity (WEP 2), waterborne transport (WT 1).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – *Potamogeton* spp. and/or *Stuckenia* spp. – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

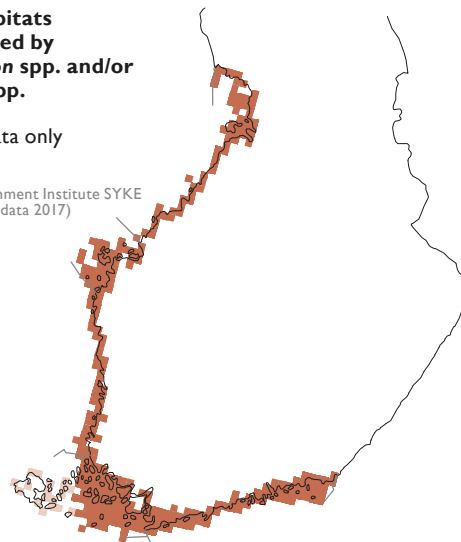
**Justification:** Benthic habitats characterised by *Potamogeton* spp. and/or *Stuckenia* spp. was assessed as a Least Concern (LC) habitat type (A1, A2a, B1–B3, C1, C2a).

There is no monitoring data on benthic habitats characterised by pondweed, but their quantity is concluded as having remained stable or increased

**Benthic habitats characterised by *Potamogeton* spp. and/or *Stuckenia* spp.**

■ Partial data only

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(Source: VELMU data 2017)



(A1: LC). Pondweeds form a large and diverse group whose species tolerate a variety of environmental conditions and, to some extent, also withstand eutrophication fairly well (Hansen 2012; Hansen and Snickars 2014). In the examination of the longer time frame, their quantitative changes were regarded as Data Deficient (A3: DD). The habitat type is not believed to face any significant quantitative decline in the future (A2a: LC). The projected potential changes in salinity would affect the occurrence of marine species, but *Potamogeton* spp. and *S. pectinata* withstand low salinity levels, too, so any reductions in salinity are unlikely to reduce their quantity.

The extent of occurrence and the area of occupancy as well as the number of locations are above the thresholds set for Criterion B. The habitat type is Least Concern on the basis of Criterion B (B1–B3: LC).

Increases in water nutrient levels and turbidity are likely to have boosted the competitiveness of tall and fast-growing species of the group in relation to other vascular plants, and this competitive advantage is likely to remain in place in the near future (C1 & C2a: LC). In strongly eutrophicated areas, pondweed stands may, however, have suffered from the overgrowth of filamentous algae. Pondweed stands may be suffocated both by filamentous algae growing on them and by drifting algal mats (Berglund et al. 2003). It is possible that the species composition of *Potamogeton* and *Stuckenia* spp. communities has changed and is changing due to eutrophication, dredging and leisure boating, but the degree of the changes cannot be assessed (D1–D3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Stable.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *sandbanks which are slightly covered by sea water all the time* (1110), *coastal lagoons* (1150) and *large shallow inlets and bays* (1160). May be included in *coastal lagoons (fladas) and lakes created by land uplift (glo-lakes) with a maximum area of ten hectares* protected under the Water Act (587/2011).

12.03

#### Benthic habitats characterised by *Ranunculus* spp.

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>NT</b> (NT–VU)	A1	=
Southern Finland	<b>NT</b> (NT–VU)	A1	=
Northern Finland			

**Description:** The habitat type is characterised by at least 10% coverage of perennial vegetation dominated by species from the genus *Ranunculus*. The four *Ranunculus* species in the habitat type are *R. baudotii*, *R. schmalhauseni*, *R. circinatus* and the rarer *R. confervoides*. Other common species in the habitat type include *Potamogeton* spp., *Stuckenia* spp., *Callitriche* spp., *Myriophyllum* spp., *Zannichellia* spp. and *Ruppia* spp. (Van Vierssen 1982; Hansen et al. 2012; VELMU data 2017).

Species of the genus *Ranunculus* occur widely in both freshwater and marine environments all over Europe (Hämet-Ahti et al. 1998). Compared to other habitat types dominated by vascular plants, the habitat type

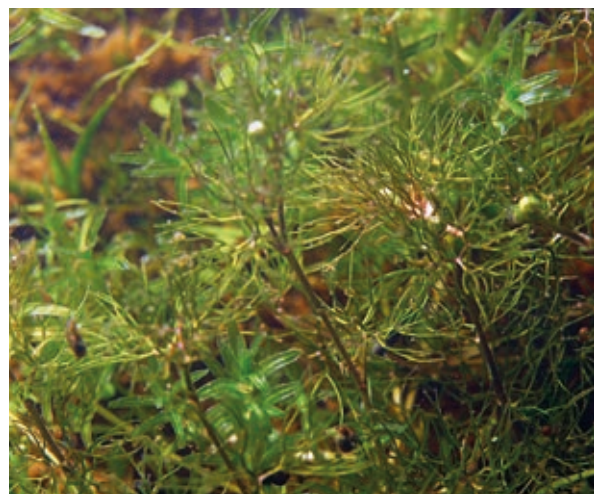
dominated by *Ranunculus* spp. is more abundant in very sheltered bays with muddy bottoms (Munsterhjelm 1997; Lumbreras et al. 2009; Hansen et al. 2012; Hansen and Snickars 2014). Within the genus *Ranunculus*, *R. baudotii* favours higher salinities compared to the other species. *R. confervoides* may dominate *Ranunculus* habitat types mainly in the Bothnian Bay. *R. circinatus* is the most flexible in its habitat requirements (Hansen and Snickars 2014; VELMU data 2017).

*Ranunculus* spp. are relatively tolerant of turbidity and eutrophication, but if these circumstances continue, *Ranunculus* eventually lose in competition to *Potamogeton* spp., *Stuckenia* spp. and *Myriophyllum* spp. (Lumbreras et al. 2009; Hansen and Snickars 2014). Both monospecific and polyspecific vascular plant communities provide food and shelter for many invertebrate and insect species. Sessile epifauna are seldom found in the habitat type, but grazing snails, insect larvae and crustaceans are typical inhabitants. In more exposed areas, molluscs and crustaceans dominate the macrofauna, whereas insect larvae are more common in more sheltered areas (Van Vierssen 1982; Hansen 2010). The inhabiting communities are similar to the *Potamogeton* and/or *Stuckenia* habitat types under comparable environmental conditions (Hansen et al. 2008).

The habitat type combines the HELCOM HUB classes AA.H1B6, AA.I1B6 and AA.J1B6 (HELCOM 2013a): Baltic photic muddy, coarse and sandy sediments dominated by *Ranunculus* spp.

**Geographic variation:** The most common species within the genus *Ranunculus* forming a habitat type are *R. baudotii* and *R. schmalhauseni*. *R. circinatus* is not found in the Bothnian Bay, while *R. confervoides* is more common in that region than in other marine areas (VELMU data 2017).

**Relationships to other habitat types:** The habitat type may gradually transform into bottoms dominated by infauna or other vegetation. As eutrophication increases, more tolerant species, such as *Myriophyllum* spp. and eventually *Ceratophyllum demersum*, become more common in the habitat type (Hansen et al. 2012; Hansen and Snickars 2014).



Maasarvi, Bothnian Bay National Park. Photo: Pekka Lehtonen, Metsähallitus Parks & Wildlife Finland

**Distribution:** The habitat type occurs here and there along the entire coast of Finland (VELMU data 2017). The dominant species can vary both temporally and spatially. In general, *Ranunculus* habitat types are fairly common, but are declining in the most eutrophic areas.

**Reasons for becoming threatened:** Increased turbidity (WEP 3), dredging (WHC 1), waterborne transport (WT 1).

**Threat factors:** Increased turbidity (WEP 3), dredging (WHC 1), waterborne transport (WT 1).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – *Ranunculus* spp. – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by *Ranunculus* spp. was assessed as a Near Threatened (NT) habitat type due to a quantitative decline over the past 50 years (A1).

There is no suitable monitoring data, but bottoms dominated by *Ranunculus* spp. are estimated to have declined by 20–30% due to eutrophication, as reduced transparency has narrowed their potential growing area (A1: NT, range of category NT–VU). The habitat type may have decreased in quantity also due to dredging and waterborne transport. Future quantitative changes cannot be forecast, and any possible longer-term historical changes cannot be assessed, either (A2a & A3: DD).

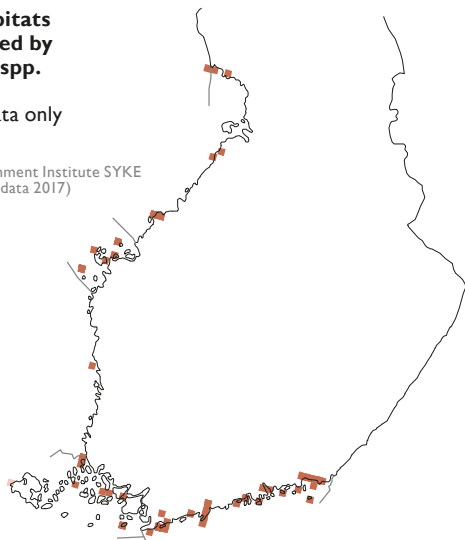
The geographic distribution of benthic habitats characterised by *Ranunculus* spp. stretches throughout the coastal area of Finland, and the estimated minimum number of 10 km x 10 km grid cells occupied is around 40 on the basis of observations made in the Finnish Inventory Programme for the Underwater Marine Environment (VELMU) (VELMU data 2017). The total number of grid cells occupied is regarded as exceeding the threshold of 55 cells, so the habitat type is Least Concern on the basis of Criterion B (B1–B3: LC).

Reduced transparency has degraded the habitat type's abiotic conditions, which is likely to be reflected in biotic quality, too. Species that can tolerate eutrophication, such as *Myriophyllum* spp., *Potamogeton* spp. and *Stuckenia pectinata*, can compete better than

#### Benthic habitats characterised by *Ranunculus* spp.

Partial data only

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*Ranunculus* spp. In addition, both epiphytic filamentous algae and drifting algal mats can suffocate *Ranunculus* spp. stands (Berglund et al. 2003). The majority of *Ranunculus* spp. communities live in marine areas that are at least to some extent enclosed and for which there is no monitoring data available concerning transparency trends. It is therefore impossible to more specifically assess qualitative changes, not even indirectly, and the habitat type is regarded as Data Deficient in terms of its abiotic as well as biotic changes (C1–C3, D1–D3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Declining. With the eutrophication trend continuing, the state of the habitat type is anticipated to decline further in the key occurrence areas.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *sandbanks which are slightly covered by sea water all the time* (1110), *coastal lagoons* (1150) and *large shallow inlets and bays* (1160). May be included in *coastal lagoons (fladas) and lakes created by land uplift (glo-lakes) with a maximum area of ten hectares* protected under the Water Act (587/2011).

12.04

#### Benthic habitats characterised by *Zannichellia* spp. and/or *Ruppia* spp.

	IUCN Red List Category	Criteria	Kehitysuunta
Whole of Finland	NT (NT–VU)	A1	–
Southern Finland	NT (NT–VU)	A1	–
Northern Finland			

**Description:** The habitat type is characterised by at least 10% coverage of perennial vegetation dominated by species from the genera *Zannichellia* and/or *Ruppia*. The species in the habitat type include *Z. major*, *Z. palustris*, *R. maritima*, and *R. spiralis*. Other common species in the habitat type are *Potamogeton* spp., *Stuckenia* spp., *Zostera marina* and *Tolypella nidifica*.

Both genera occur widely in freshwater and brackish environments all over Europe (Van Vierssen 1982; 1983; Hämet-Ahti et al. 1998, GBIF Secretariat 2017b; 2017c). Compared to habitat types dominated by other vascular plants, the habitat type dominated by *Zannichellia* spp. and/or *Ruppia* spp. occurs more frequently in slightly exposed areas and on sandy bottoms (Munsterhjelm 1997; Hansen and Snickars 2014).

Environmental factors cause variation both in the species composition and structure of communities dominated by *Zannichellia* spp. and *Ruppia* spp. On more open sandy bottoms, short shoots of both genera dominate, accompanied by *Chara aspera*, *Stuckenia filiformis* and *Z. marina*. In more sheltered bays, shoots of individual *Zannichellia* spp. and *Ruppia* spp. plants grow taller and the accompanying species usually belong to, for example, the genera *Potamogeton*, *Stuckenia* and *Callitriche*. Both monospecific and polyspecific vascular plant communities provide food and shelter for many invertebrate and insect species. Sessile epifauna are seldom found in the habitat type, but grazing snails, insect larvae and crustaceans are typical inhabitants. In more exposed areas, molluscs and crustaceans





Skyttelskär, western Gulf of Finland. Photo: Olli Mustonen, Metsähallitus Parks & Wildlife Finland

dominate the macrofauna, whereas insect larvae are more common in more sheltered areas (Van Vierssen 1982; Hansen 2010). The inhabiting communities are similar to the *Potamogeton* and/or *Stuckenia* habitat types under comparable environmental conditions (Hansen et al. 2008).

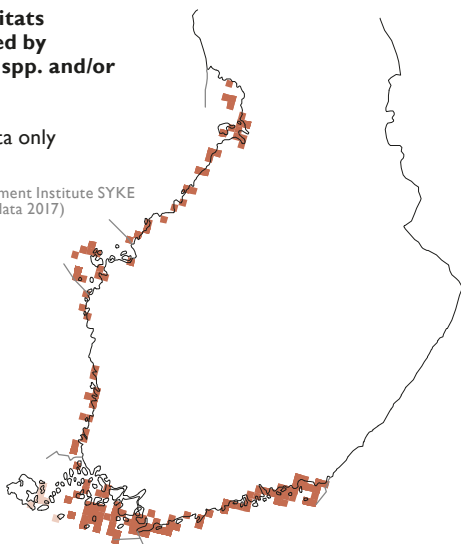
The habitat type combines the HELCOM HUB classes AA.H1B2, AA.I1B2, AA.J1B2, AA.M1B2 (HELCOM 2013a): Baltic photic muddy, coarse, sandy sediment and mixed substrate dominated by *Zannichellia* spp. and/or *Ruppia* spp.

**Geographic variation:** The only species present in the Bothnian Bay is *Zannichellia major*. The other species occur abundantly across the rest of the Finnish coast (VELMU data 2017).

**Benthic habitats characterised by *Zannichellia* spp. and/or *Ruppia* spp.**

Partial data only

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(Source: VELMU data 2017)



**Relationships to other habitat types:** The habitat type may gradually transform into bottoms dominated by infauna or other vegetation. As eutrophication increases, more tolerant species, such as *Potamogeton* spp., *Stuckenia* spp., *Myriophyllum* spp. and eventually *Ceratophyllum demersum*, become more common in the habitat type (Hansen et al. 2012; Hansen and Snickars 2014).

**Distribution:** The habitat type commonly occurs along the entire coast of Finland, but in the Bothnian Bay it consists solely of *Zannichellia major* (VELMU data 2017). The dominant species can vary both temporally and spatially. Generally, both *Zannichellia* spp. and *Ruppia* spp. occur in habitats in the outer archipelago and other more exposed areas, whereas more sheltered areas lean towards *Z. palustris* and *R. maritima* (Hansen et al. 2012).

**Reasons for becoming threatened:** Increased turbidity (WEP 3), waterborne transport (WT 1).

**Threat factors:** Increased turbidity (WEP 3), waterborne transport (WT 1).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – *Zannichellia* spp. and/or *Ruppia* spp. – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by *Zannichellia* spp. and/or *Ruppia* spp. was assessed as a Near Threatened (NT) habitat type due to a quantitative decline over the past 50 years (A1).

There is no suitable monitoring data, but *Zannichellia* spp. and/or *Ruppia* spp. communities are estimated to have decreased by around 20–30% due to eutrophication, as lower transparency has narrowed their potential growing area (A1: NT, range of category NT–VU).

*Z. major* in particular is sensitive to eutrophication and turbidity, and it is estimated to have declined over the past 50 years (Van Vierssen 1982; Pitkänen et al. 2013). Future quantitative changes cannot be projected, and any possible longer-term historical changes cannot be assessed, either (A2a & A3: DD).

The distribution range of *Zannichellia* spp. is limited to the Quark, but *Ruppia* spp. can be found all the way into the Bothnian Bay, so the habitat's distribution range covers the entire coast of Finland. There are at least 100 grid cells (10 km x 10 km) occupied on the basis of observations made in the Finnish Inventory Programme for the Underwater Marine Environment (VELMU) (VELMU data 2017). The habitat type is Least Concern on the basis of Criterion B (B1–B3: LC).

Reduced transparency has degraded the habitat type's abiotic conditions, which is likely to be reflected in biotic quality, too. Species that can tolerate eutrophication, such as *Myriophyllum* spp., *Potamogeton* spp. and *Stuckenia pectinata*, can compete better than *Zannichellia* spp. and *Ruppia* spp. In addition, both epiphytic filamentous algae and drifting algal mats can suffocate *Zannichellia* spp. and *Ruppia* spp. stands (Berglund et al. 2003). There is no monitoring data on transparency trends in the occurrence areas of benthic habitats characterised by *Zannichellia* spp. and *Ruppia* spp., i.e. marine areas that are rather shallow and close to the shore, so it is impossible to even indirectly assess qualitative changes. The habitat type is regarded as Data Deficient both in terms of its abiotic and its biotic changes (C1–C3, D1–D3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Declining. With the eutrophication trend continuing, the state of the habitat type is anticipated to decline further in the key occurrence areas.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *sandbanks which are slightly covered by sea water all the time* (1110), *coastal lagoons* (1150) and *large shallow inlets and bays* (1160). May be included in *coastal lagoons (fladas) and lakes created by land uplift (glo-lakes) with a maximum area of ten hectares* protected under the Water Act (587/2011).

12.05

#### Benthic habitats characterised by *Myriophyllum* spp.

	IUCN Red List Category	Criteria	Trend
Whole of Finland	LC		+
Southern Finland	LC		+
Northern Finland			

**Description:** The habitat type is characterised by at least 10% coverage of perennial vegetation dominated by watermilfoils from the genus *Myriophyllum*. The *Myriophyllum* spp. in the habitat type include four species, the spiked water-milfoil *M. spicatum*, the short-spiked water-milfoil *M. sibiricum*, the whorled leaf water-milfoil *M. verticillatum* and the alternate-flowered water-milfoil *M. alterniflorum*. The habitat type is most common on shallow and very sheltered muddy bottoms, but also occurs on less sheltered mixed bottoms.

*Myriophyllum* spp. are perennial vascular plants, occurring in both fresh and brackish waters. They are commonly present in most parts of the Baltic Sea on soft bottoms and can form either monocultures or mixed vascular plant communities with species such as *Potamogeton* spp., *Stuckenia* spp. and *Ranunculus* spp. (Rosqvist et al. 2010). *Myriophyllum* spp. thrive in sheltered and nutrient-rich waters. The species have long and flexible stems, and in shallow waters they can grow tall enough to reach the surface. Under favourable conditions, *Myriophyllum* stands can cover the entire water column from the bottom sediment up to the surface. The species grow attached to the sediment and have relatively low tolerance to water movement. In the long run, the increased turbidity caused by eutrophication will impair the growth of *Myriophyllum* spp. (Hämet-Ahti et al. 1998; Leinikki et al. 2004).

In vascular plant communities of shallow bays, competition for habitat use may be intense. Under favourable conditions, the fast-growing *Myriophyllum* spp. can form such thick monocultures that other species of vascular plants may not find the space and nutrients to coexist (Madsen et al. 1991). Like all vascular plant communities, *Myriophyllum* spp. stands provide food and shelter for many invertebrate and insect species as well as for juvenile fish (Hansen et al. 2008).

*Myriophyllum* species may coexist in the same habitats with other macrophytes, but also occur as their own habitat type. *M. spicatum* also tends to form dense monocultures (Madsen et al. 1991). Of the two most common species, *M. spicatum* and *M. sibiricum*, the latter has a slightly better tolerance to eutrophic circumstances.

The habitat type partly corresponds to the HELCOM HUB classes AA.H1B3, AA.J1B3 and AA.M1B3 (HELCOM 2013a): Baltic photic muddy, sandy sediments and mixed substrate dominated by watermilfoil (*Myriophyllum spicatum* and/or *M. sibiricum*).

**Geographic variation:** No known geographic variation. *Myriophyllum verticillatum* may dominate the bottoms of bays that have the lowest salinity and are the most sheltered.

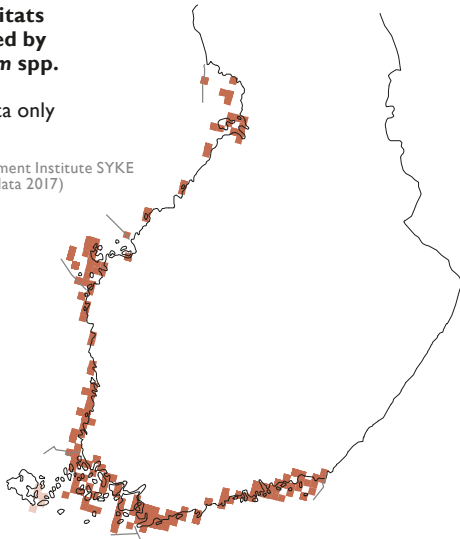


Gammelflidan, Quark. Photo: Pekka Lehtonen, Metsähallitus Parks & Wildlife Finland

### Benthic habitats characterised by *Myriophyllum* spp.

Partial data only

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(Source: VELMU data 2017)



**Relationships to other habitat types:** The habitat type may gradually transform into bottoms dominated by infauna or by other vegetation. As eutrophication increases, more tolerant species, such as *Najas marina* and eventually *Ceratophyllum demersum*, become more common in the habitat type (Hansen et al. 2012; Hansen and Snickars 2014).

**Distribution:** The habitat type occurs commonly along the entire coast of Finland (VELMU data 2017).

**Threat factors:** –

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – *Myriophyllum* spp. – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by *Myriophyllum* spp. was assessed as a Least Concern (LC) habitat type (A1–A3, B1–B3, C1–C3).

There is no monitoring data on bottoms dominated by *Myriophyllum* spp., but their quantity is concluded as having increased (A1 & A3: LC). *Myriophyllum* spp. benefit from eutrophication and often gain ground in areas such as inlets and bays disturbed by dredging or boat traffic, as they can reproduce easily from pieces of stem and their growth rate is rapid (e.g. Eriksson et al. 2004; Tiensuu 2009). For these reasons, the habitat type is not expected to decline significantly in the future, either (A2a: LC).

*Myriophyllum* spp. communities occur throughout the Finnish coast and there is a large number of 10 km x 10 km grid cells occupied by them (VELMU data 2017). The extent of occurrence as well as the area of occupancy are above the thresholds set for Criterion B (B1–B2: LC). The habitat type is LC also on the basis of subcriterion B3.

*Myriophyllum* spp. communities thrive in nutrient-rich water, so eutrophication is not likely to have had much of an adverse effect on them. Despite transparency having on the whole declined in the Baltic Sea over the past 50 years, the impact on this habitat type's abiotic conditions has not been especially pronounced, nor is the situation expected to deteriorate significantly in the future (C1–C3: LC).

Eutrophication is likely to have caused species composition changes in *Myriophyllum* spp. communities, too, but more specific data on such changes is not available. The habitat type is regarded as Data Deficient in terms of biotic quality changes (D1–D3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Improving. *Myriophyllum* spp. benefit from eutrophication.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *sandbanks which are slightly covered by sea water all the time* (1110), *coastal lagoons* (1150) and *large shallow inlets and bays* (1160). May be included in *coastal lagoons (fladas) and lakes created by land uplift (glo-lakes) with a maximum area of ten hectares protected under the Water Act* (587/2011).

12.06

### Benthic habitats characterised by Charales

Benthic habitats characterised by Charales are further divided into two subtypes (I2.06.01 and I2.06.02). The habitat type group is characterised by at least 10% coverage of perennial vegetation dominated by charophytes (Charales).

Charophytes typically grow on shallow, soft bottoms from sheltered bottoms of bays to moderately exposed shores (Schubert and Blindow 2003). The species composition and structure vary so greatly according to substrate and exposure that the habitat type is further divided into two subtypes to better illustrate this variation. Exposed charophyte communities, characterised by the rough stonewort *Chara aspera*, typically occur on sandy bottoms. The other subtype tends to occur in sheltered muddy habitats; the charophyte species are more diverse, and they often grow in layers. However, there is a continuum from the exposed to the most sheltered charophyte communities in terms of the dominating species, structure and the accompanying species.

Charophytes include species from four genera: *Chara*, *Nitella*, *Nitellopsis* and *Tolypella*. These are considered algae despite their growth form being similar to vascular plants (cf. *Equisetum* and *Ceratophyllum*). They attach to soft sediments with root-like rhizoids. Dense stands of charophytes have several effects on their environment: they stabilise sediments, bind nutrients and improve water quality (Blindow et al. 2002; Appelgren and Mattila 2005). Charophytes can also produce substances that inhibit the growth of planktonic algae and cyanobacteria (Berger and Schagerl 2003).

Many charophytes also grow in fresh water and may be dominant in oligotrophic, calcareous lakes, where the most common species are *Nitella* spp., *C. globularis* and *C. virgata*. Calcareous lakes in the Åland archipelago or pools that have been cut off from the sea also feature *C. tomentosa* (Cedercreutz 1936).

The habitat type group combines the HELCOM HUB classes AA.H1B4, AA.I1B4, AA.J1B4 and AA.M1B4 (HELCOM 2013a): Baltic photic muddy, coarse, sandy sediments and mixed substrate dominated by Charales. Additionally, charophyte meadows have been observed growing also on hard clay in the Bothnian Bay.



Isokari, Bothnian Sea. Photo: Heidi Arponen, Metsähallitus Parks & Wildlife Finland

12.06.01

#### Exposed benthic habitats characterised by Charales

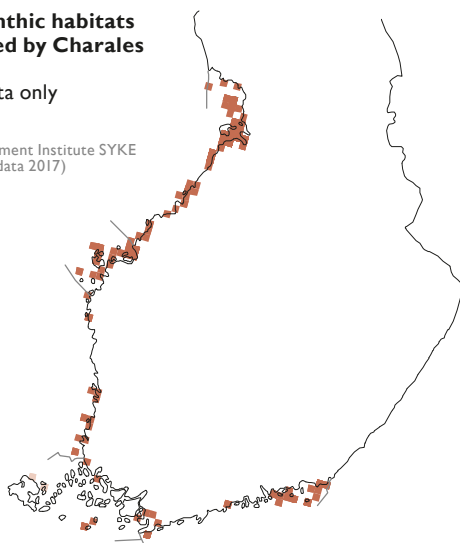
	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>NT</b>	A1	=
Southern Finland	<b>NT</b>	A1	=
Northern Finland			

**Description:** The habitat subtype is characterised by mainly sandy or coarse substrates and the vegetation is dominated by the low-growing rough stonewort *Chara aspera*. It is the most common of all charophyte

#### Exposed benthic habitats characterised by Charales

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species and can endure a wide range of environmental factors. *C. aspera* most commonly forms habitat types specifically on moderately exposed sandy shores, where it can be accompanied by sparse occurrences of *C. baltica*, *C. canescens*, *C. globularis* and *Tolypella nidifica* as well as the vascular plants *Ruppia maritima* and low-growing *Stuckenia pectinata* (Tolstoy and Österlund 2003; Leinikki et al. 2004; Mäkinen et al. 2008; Catherine and Riggert Munsterhjelm, pers. comm. 2017).

**Geographic variation:** No known significant geographic variation. The composition of accompanying species may vary according to salinity and substrate. For example, the brackish-water species *Chara baltica* and *C. canescens* do not survive in the northernmost and easternmost parts of the Finnish coast.

**Relationships to other habitat types:** The most common habitat types occurring in the vicinity are habitats dominated by *Zostera marina*, *Zannichellia* spp. and/or *Ruppia* spp.

**Distribution:** The habitat subtype is common as patches along the entire coast of Finland (VELMU data 2017). Individual habitat patches are usually small in size but can, however, form long and narrow strips along the Finnish coast.

**Reasons for becoming threatened:** Increased turbidity, increased abundance of filamentous algae and benthic siltation (WEP 3), waterborne transport (WT 2), dredging (WHC 2).

**Threat factors:** Increased turbidity, increased abundance of filamentous algae and benthic siltation (WEP 3), waterborne transport (WT 2), dredging (WHC 2).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have

been lost. This would result from the dominant species – charophytes – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Exposed benthic habitats characterised by Charales was assessed as a Near Threatened (NT) habitat type due to a quantitative reduction over the past 50 years (A1).

Exposed benthic habitats characterised by Charales with sandy or coarse substrates were assessed to have declined by 20–30% over the past 50 years (A1:NT). There is no actual monitoring data. Instead, the assessment is based on development that has taken place in the Pojo Bay and the Ekenäs–Tvärminne–Täktom archipelago in particular (Pitkänen et al. 2013; Riggert and Catherine Munsterhjelm, pers. comm. 2016). Increased turbidity caused by eutrophication, waterborne transport, and accumulation of solids on the bottom and on plants, hamper the growth of charophytes and provide stronger plants with a competitive advantage (Rosqvist et al. 2010). In addition, currents caused by waterborne transport can damage charophytes. Charophyte communities on more exposed sandy, coarse or clay substrates have, however, suffered less than communities of more sheltered sites. For example, the rough stonewort *Chara aspera*, which is common on sandy bottoms, has only declined by a few per cent over the course of some 70 years in the Pojo Bay (Pitkänen et al. 2013). In the Gulf of Bothnia, occurrences of the habitat type may have been destroyed quite extensively by dredging carried out due to land uplift.

However, the habitat type also occurs abundantly in areas where the extent of dredging has been relatively small. Future quantitative changes cannot be forecast, and any possible longer-term historical changes cannot be assessed, either (A2a & A3: DD). The habitat type occurs throughout the Finnish coastal area. The extent of occurrence and the area of occupancy as well as the number of locations are above the thresholds set for Criterion B. The number of 10 km × 10 km grid cells occupied is at least around 80 (VELMU data 2017). The habitat type is Least Concern on the basis of Criterion B (B1–B3: LC).

The biotic quality of exposed charophyte communities on sandy and gravel substrates could potentially be studied by investigating and projecting concentrations of organic matter in sand. The siltation of sandy bottoms is likely to be a negative change for charophytes. Such data does not exist, however, so the habitat type was regarded as Data Deficient in terms of its biotic changes (D1–D3: DD).

**Reasons for change of category:** Change in classification.

**Trend:** Stable.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *sandbanks which are slightly covered by sea water all the time* (1110) and *large shallow inlets and bays* (1160).

**Finland's responsibility habitat type:** Included in the responsibility habitat type *benthic habitats characterised by Charales*.

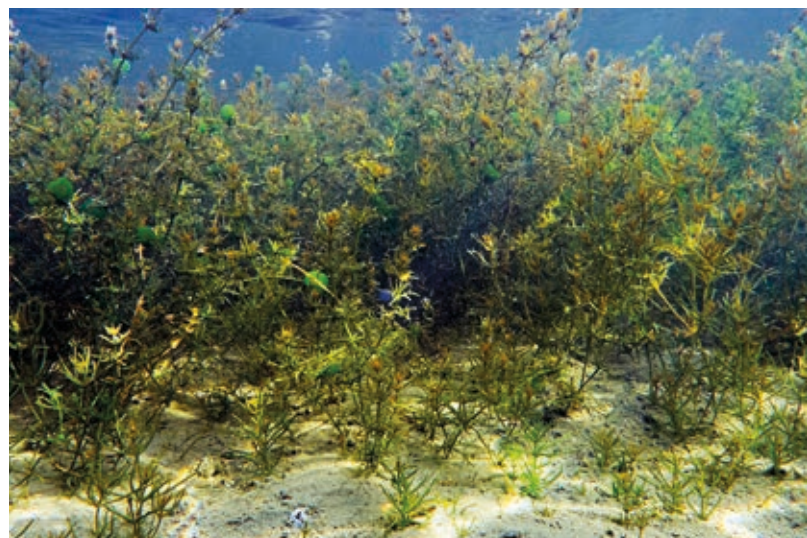
12.06.02

### Sheltered benthic habitats characterised by Charales

	IUCN Red List Category	Criteria	Trend
Whole of Finland	VU	A1	–
Southern Finland	VU	A1	–
Northern Finland			

**Description:** This habitat subtype is characterised by a mainly muddy substrate possibly mixed with small amounts of sand or gravel. The dominant charophyte species tend to be larger than the ones in more open sites. The habitat subtype occurs in very sheltered locations, and the species composition may follow the different stages of bay isolation (Munsterhjelm 2005). In sheltered sites, the coral stonewort *Chara tomentosa*, the rough stonewort *C. aspera* and the Baltic stonewort *C. baltica* may form dense meadows. In the least saline meadows, *C. globularis* and *Nitella* spp. can also be found (Schubert and Blindow 2003; Mäkinen et al. 2008). Other common accompanying species include *Najas marina*, *Stuckenia pectinata* and *Myriophyllum spicatum* (HELCOM Red List Biotope Expert Group 2013a; Catherine and Riggert Munsterhjelm, pers. comm. 2017). Polyspecific layered meadows in fladas and glo-lakes (coastal lagoons) are considered an indicator of undisturbed coastal lagoon development (Appelgren and Mattila 2005).

Sheltered bays with charophyte meadows provide food and shelter for many fish, such as the northern pike (*Esox lucius*), the European perch (*Perca fluviatilis*) and the roach (*Rutilus rutilus*), in addition to which the bays provide a habitat for many invertebrates and insect larvae. The most common species include snails (*Valvata* spp., *Lymnaea* spp., *Bithynia tentaculata*), isopods (*Idotea* spp., *Asellus aquaticus*) and gammarids (Amphipoda). In less saline waters, the larvae of insects such as chironomids (Chironomidae) and mayflies (Ephemeroptera) also commonly occur (Mäkinen et al. 2008; Hansen et al. 2012; HELCOM Red List Biotope Expert Group 2013a; VELMU data 2017; Catherine and Riggert Munsterhjelm,

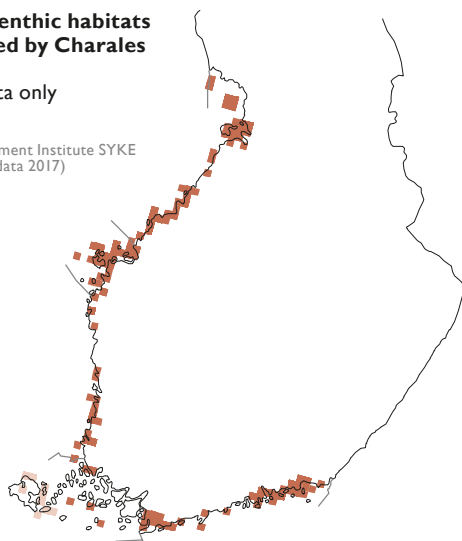


Kuutsalo, eastern Gulf of Finland. Photo: Petra Pohjola, Metsähallitus Parks & Wildlife Finland

### Sheltered benthic habitats characterised by Charales

Partial data only

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pers. comm. 2017). Both invertebrates as well as fish seem to prefer stands of large branched plants, such as *C. tomentosa* and *C. baltica* (Snickars 2008; Snickars et al. 2009; Hansen et al. 2011; 2012).

**Geographic variation:** The species composition of the habitat subtype may vary according to salinity and wave exposure as well as both regionally and locally.

**Relationships to other habitat types:** The habitat subtype often occurs in fladas and glo-lakes (coastal lagoons) and may occur, for example, in small openings among the common reed (*Phragmites australis*). Sheltered habitats characterised by Charales usually gradually transform into bottoms dominated by vascular plants.

**Distribution:** The habitat type occurs along the entire coast of Finland (VELMU data 2017).

**Reasons for becoming threatened:** Increased turbidity, reedbed expansion, increased abundance of filamentous algae and benthic siltation (WEP 3), waterborne transport (WT 2), dredging (WHC 2).

**Threat factors:** Increased turbidity, reedbed expansion, increased abundance of filamentous algae and benthic siltation (WEP 3), waterborne transport (WT 2), dredging (WHC 2).

**Description of habitat type collapse (CO):** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – charophytes – being lost or reduced to such an extent that would no longer be any habitats classified as this habitat type.

**Justification:** Sheltered benthic habitats characterised by Charales occurring on muddy and clay substrates was assessed as a Vulnerable (VU) habitat type due to its quantitative decline over the past 50 years (A1).

Charales meadows on muddy or clay substrates were assessed to have declined by 30–50% over the past 50 years (A1: VU). The quantitative decline was assessed as being even stronger than this in the Pojo Bay and Ekenäs–Tvärminne–Täktom archipelago, where the reduction in Charales communities of sheltered and soft-bottom sites was estimated to have been up to 50–80% since the 1960s (Riggert and Catherine Munsterhjelm, pers. comm. 2016). Reasons for this have included dredging, boat traffic, coastal construction and eutrophication. A characteristic species of sheltered

inlets and bays, the coral stonewort (*Chara tomentosa*) is highly sensitive to eutrophication and water movement (e.g. Eriksson et al. 2004; Munsterhjelm et al. 2008; Henricson et al. 2006). At the nationwide level, a milder decline estimate was provided as the impacts of eutrophication have not been as severe in the Gulf of Bothnia as they have in the Gulf of Finland and the Archipelago Sea. Future quantitative changes cannot be projected, and any possible longer-term historical changes cannot be assessed, either (A2a & A3: DD).

The habitat type occurs throughout the Finnish coastal area. The extent of occurrence and the area of occupancy as well as the number of locations are above the thresholds set for Criterion B. The number of 10 km x 10 km grid cells occupied is at least around 90 (VELMU data 2017). The habitat type is Least Concern on the basis of Criterion B (B1–B3: LC).

The species composition of the habitat type has become less diverse over an extensive area, which means negative changes have taken place in biotic quality. The relative severity of the changes cannot, however, be assessed and future projections in particular are not possible, so the habitat type was regarded as Data Deficient in terms of its biotic changes (D1–D3: DD).

**Reasons for change of category:** Change in method.

**Trend:** Declining. With the eutrophication trend continuing, the state of the habitat type is anticipated to decline further.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *coastal lagoons* (1150) and *large shallow inlets and bays* (1160). May be included in *coastal lagoons (fladas) and lakes created by land uplift (glo-lakes) with a maximum area of ten hectares* protected under the Water Act (587/2011).

**Finland's responsibility habitat type:** Included in the responsibility habitat type *benthic habitats characterised by Charales*.

12.07

### Benthic habitats characterised by *Najas marina*

	IUCN Red List Category	Criteria	Trend
Whole of Finland	NT (LC–NT)	AI	–
Southern Finland	NT (LC–NT)	AI	–
Northern Finland			

**Description:** The habitat type is characterised by perennial vegetation coverage of at least 10% dominated by the spiny naiad (*Najas marina*). The habitat type also covers the endangered *N. tenuissima*, which is very rare in brackish water. Other species in the habitat type include the rough stonewort *Chara aspera*, the coral stonewort *C. tomentosa* and the fennel pondweed *Stuckenia pectinata* (Hansen 2012; Hansen and Snickars 2014).

*N. marina* occurs commonly along the Finnish coastline, its distribution extending just north of the Quark. The species is rarer in the Bothnian Bay. It prefers relatively clear water and salinity between 3 and 4 psu. As a morphologically fragile species, it is usually found in extremely sheltered areas in water less than 1 metre deep, such as at the bottoms of fladas (coastal lagoons).

It also thrives in small openings among the common reed (*Phragmites australis*) (Hämet-Ahti et al. 1998; Berglund et al. 2003; Issakainen et al. 2011).

Like other vascular plant communities, *N. marina* stands provide food and shelter for many invertebrate and insect species. *N. marina* tolerates turbidity and nutrients relatively well compared to, for example, Charales as well as some *Potamogeton* and *Stuckenia* species occurring in the same areas. Fast-growing plants, however, can drive *N. marina* into a narrowing growth zone, among the common reed or very near the shoreline. *N. tenuissima*, which is very rare in the coastal area, requires very low salinity and is more sensitive to competition than *N. marina*, possibly partly due to its smaller size (Issakainen et al. 2011).

The habitat type combines the HELCOM HUB classes AA.H1B5 and AA.J1B5 (HELCOM 2013a): Baltic photic muddy and sandy sediments dominated by spiny naiad (*Najas marina*).

**Geographic variation:** The dominant species in the habitat type is usually *Najas marina*. The endangered *N. tenuissima* has been found only in a few locations in the eastern Gulf of Finland. Otherwise, there is no known geographic variation.

**Relationships to other habitat types:** As eutrophication increases, the habitat type may gradually transform into bottoms dominated by more tolerant species, such as *Ceratophyllum demersum*, and finally to unvegetated bottoms dominated by bivalves and/or insect larvae (Hansen et al. 2012).

**Distribution:** *Najas marina* habitats occur along the entire Finnish coastline, except for the northern parts of the Bothnian Bay. The habitats are usually found in water so shallow that they are difficult to survey. The habitat is likely more common than the available data suggests (Hämet-Ahti et al. 1998; Lampinen and Lahti 2017; VELMU data 2017).

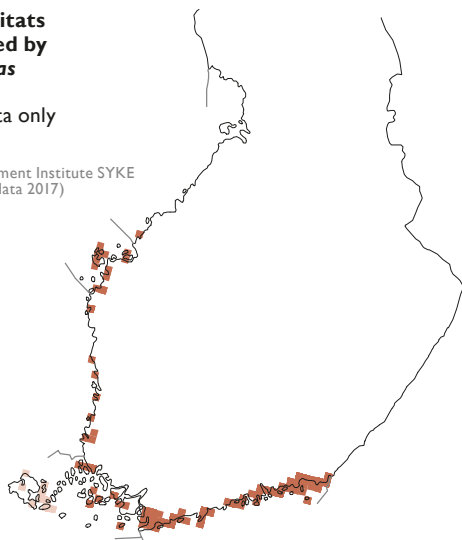
**Reasons for becoming threatened:** Reedbed expansion (WEP 3), dredging (WHC 2), discontinuation of coastal grazing (OGR 2), waterborne transport (WT 1).

**Threat factors:** Reedbed expansion (WEP 3), dredging (WHC 2), discontinuation of coastal grazing (OGR 2), waterborne transport (WT 1).

#### Benthic habitats characterised by *Najas marinas*

Partial data only

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(Source: VELMU data 2017)



Kuutsalo, eastern Gulf of Finland. Photo: Petra Pohjola, Metsähallitus Parks & Wildlife Finland

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – *Najas marina* – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by *Najas marina* was assessed as a Near Threatened (NT) habitat type due to a quantitative decline over the past 50 years (A1).

*N. marina* is known to thrive even in highly eutrophic areas (Hansen and Snickars 2014), but its quantity was assessed to have declined somewhat, most likely by around 20–30%, over the past 50 years mainly due to reedbed expansion, dredging and coastal construction (A1: NT, range of category LC–NT). Future quantitative changes cannot be projected, and any possible longer-term historical changes cannot be assessed, either (A2a & A3: DD).

The habitat type has been observed in around 55 grid cells of 10 km x 10 km (VELMU data 2017), but all in all the number of grid cells occupied is believed to be well above the threshold of 55 grid cells. The extent of occurrence is also above the thresholds set for subcriterion B1. The habitat type is Least Concern on the basis of Criterion B (B1–B3: LC).

*N. marina* is quite tolerant of eutrophication, but eutrophication is likely to have resulted in changes at least in its accompanying species. In the Archipelago Sea and other areas suffering the most from eutrophication, stands of *N. marina*, too, are likely to have become sparser and declined due to issues including being gradually submerged in sediment. The severity of the qualitative changes cannot, however, be assessed (D1–D3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Declining due to eutrophication.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *coastal lagoons* (1150) and *large shallow inlets and bays* (1160). May be included in *coastal lagoons (fladas)* and *lakes created by land uplift (glo-lakes)* with a maximum area of ten hectares protected under the Water Act (587/2011).

12.08

**Benthic habitats characterised by *Zostera marina***

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>VU</b>	AI, BI, 2a(ii,iii)b	–
Southern Finland	<b>VU</b>	AI, BI, 2a(ii,iii)b	–
Northern Finland			

**Description:** The habitat type is characterised by perennial vegetation coverage of at least 10% dominated by the common eelgrass (*Zostera marina*). The habitat type typically occurs on moderately exposed sandy sediments at depths of 1–8 metres (Boström 2001; Boström et al. 2002; 2004). To a lesser extent the habitat may also be found on muddy and coarse sediments and mixed substrates (den Hartog 1970). The availability of light sets the lower limit of *Z. marina* beds (Backman and Barilotti 1979), whereas the upper limit is set by wave action and ice erosion.

*Z. marina* may grow as individual shoots, monocultural communities or intermixed with other vascular plants. Common species to co-occur with *Z. marina* beds include *Ruppia* spp., *Zannichellia* spp., *Stuckenia pectinata*, *Potamogeton perfoliatus*, *Myriophyllum spicatum*, *Tolypella nidifica* and *Chara aspera* (Granlund 1999; Boström and Bonsdorff 2000). On sandy and mixed substrates, typical associates also include small quantities of *Chorda filum* attached to small stones and filamentous brown algae such as *Ectocarpus siliculosus* or *Pylaiella littoralis* (Oulasvirta and Leinikki 1995; Granlund 1999).

*Z. marina* leaves are long (20–100 cm) and slim (2–4 mm), and the shoot density ranges from 50 to 1,000 shoots/m<sup>2</sup> (Boström and Bonsdorff 1997). *Z. marina* beds offer three-dimensional structures on sandy bottoms that otherwise tend to be bare. As both mono- and polyspecific communities, they provide food and shelter for many invertebrates that could not survive in open habitats (Boström and Bonsdorff 1997; 2000; Boström et al. 2002). The root-rhizome complex of *Z. marina* binds sediment, and the diverse infaunal community is dominated by oligochaetes, polychaetes (e.g. *Hediste diversicolor*), amphipods (e.g. *Corophium volutator*) and the Baltic tellin (*Macoma balthica*). Other groups of animals that live on and among *Z. marina* leaves include the

juvenile cockles *Cerastoderma glaucum* and *Parvicardium hauniense*, grazing snails (*Hydrobia* spp.), amphipod and isopod crustaceans (*Gammarus* spp., *Idotea* spp.), seaslugs (*Tenellia adpersa*, *Limapontia capitata*) and pipefishes (*Syngnathus typhle*, *Nerophis ophidion*) (Boström and Bonsdorff 1997; 2000; Boström et al. 2002).

In the northern Baltic Sea, *Z. marina* undergoes mainly or exclusively asexual reproduction. These subpopulations of *Z. marina* may differ genetically from the *Z. marina* populations elsewhere in the Baltic Sea (Olsen et al. 2004).

The habitat type combines the HELCOM HUB classes AA.H1B7, AA.I1B7, AA.J1B7 and AA.M1B7 (HELCOM 2013a): Baltic photic muddy, coarse, sandy sediments and mixed substrates dominated by common eelgrass (*Zostera marina*).

**Geographic variation:** No geographic variation is known for the *Zostera marina* habitat. *Z. marina* beds are presumably less dense in the more marginal areas of their distribution. However, very little is known about the precise borders and marginal areas of the occurrences of *Z. marina* in the Finnish distribution area (e.g. Boström 2001; Boström et al. 2006a; 2006b).

The *Z. marina*-dominated communities in the northern Baltic Sea differ from the corresponding Atlantic variant in species composition. The *Z. marina* beds on the Finnish coast often harbour marine aquatic plants (*Z. marina*, *Ruppia maritima*) as well as aquatic plants of fresh or brackish waters such as *Zannichellia*, *Potamogeton* and *Stuckenia*. Similar intermixed beds of macrophytes also occur in the southern Baltic Sea (Eggert et al. 2006; Selig et al. 2007a; 2007b; Steinhardt and Selig 2007).

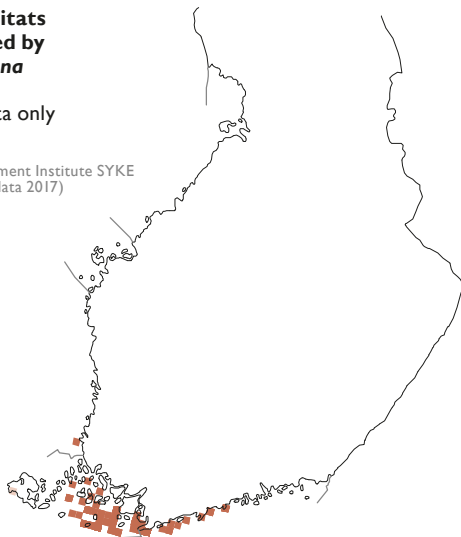
**Relationships to other habitat types:** The *Zostera marina* habitat may form a patchwork with other habitat types, e.g. bottoms dominated by *Potamogeton*, *Stuckenia* and *Ruppia* and/or *Zannichellia*. Bottoms dominated by *Mya arenaria* and *Bathyporeia pilosa* may also occur in these areas.

**Distribution:** The distribution of the habitat type is limited by the salinity requirement of *Zostera marina*, which is about 5 psu (Boström et al. 2003). The distribution

**Benthic habitats characterised by *Zostera marina***

Partial data only

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(Source: VELMU data 2017)



Högholmen, western Gulf of Finland. Photo: Linda Jokinen, Metsähallitus Parks & Wildlife Finland



extends to the Rauma region in the Gulf of Bothnia in the north and to the Sipoo region in the Gulf of Finland in the east (VELMU data 2017). The habitat type is common on the exposed sandy bottoms of south-western Finland. It can also occur on sand-gravel and as smaller patches on other mixed substrates (Boström 2001). The size of the habitat type patches varies considerably, ranging from a few hundred square metres up to several hectares (Boström et al. 2003). In the Archipelago Sea, the largest occurrences coincide with massive sand formations and moraines, while smaller patches of *Z. marina* beds are usually found in the middle and inner archipelago (Boström et al. 2006a; 2006b).

**Reasons for becoming threatened:** Increased turbidity and increased abundance of filamentous algae (WEP 3), dredging (WHC 1), anchorage (WT 1).

**Threat factors:** Increased turbidity and increased abundance of filamentous algae (WEP 3), lower salinity (CC 2), dredging (WHC 1), anchorage (WT 1), oil spills (CHE 1), reduced genetic diversity (OTF 1).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – *Zostera marina* – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type. The habitat type's changes were examined indirectly using Secchi depth data. If eutrophication accelerates further and transparency is reduced so much that *Z. marina* is no longer able to form uniform stands, the habitat type will be classified as Collapsed. Collapse would also result from a drop in salinity below 5 psu in coastal waters at suitable depths.

**Justification:** Benthic habitats characterised by *Zostera marina* was assessed as a Vulnerable (VU) habitat type on the basis of a quantitative reduction over the past 50 years as well as on the basis of the small sizes of its extent of occurrence and the area of occupancy (A1, B1 & B2).

Over the past 50 years, benthic habitats characterised by *Z. marina* are assessed to have declined by 30–50% due to the eutrophication of the Baltic Sea, i.e. in practice the increased turbidity and increased abundance of filamentous algae (A1: VU). Examination of geospatial data conducted using Secchi depth data showed a reduction of up to 60% over the period, but no corresponding changes have been detected in the only monitored occurrence (Boström et al. 2002). Since there is, however, a commonly verified correlation between transparency and the occurrence depth of *Z. marina* (e.g. Olesen 1996; Boström et al. 2014), the habitat type is assumed to have declined clearly in terms of quantity but less than implied by the examination of geospatial data. Any possible longer-term quantitative changes in benthic habitats characterised by *Z. marina* cannot be assessed (A3: DD).

Potential future reductions in salinity level (Meier 2015) would cause sizable changes in Finland's *Z. marina* communities or even destroy them altogether. Future quantitative changes were, however, regarded as Data Deficient (A2a: DD). *Z. marina* communities may be susceptible to major changes also for reasons other than

those relating to salinity. For example, on the western coast of Sweden, *Z. marina* communities declined by 58% over a period of only 10–15 years starting from the 1980s (Baden et al. 2003). In Denmark a wasting disease caused by a marine slime mould caused the temporary loss of a significant proportion of the country's *Z. marina* populations in the 1930s (Rasmussen 1977).

The geographic distribution of *Z. marina* communities in Finland is 23,000–25,000 km<sup>2</sup> and the number of grid cells of 10 km x 10 km occupied is estimated to be less than 50. Due to the adverse effects of eutrophication, the habitat type is regarded as being continuously declining in terms of its abiotic as well as biotic characteristics, and its decline is projected to continue in the future, too. The habitat type is classified as Vulnerable (VU) on the basis of subcriteria B1 and B2 (B1,2a(ii,iii)b; B3: LC).

The biotic quality of the habitat type could be examined on the basis of data on issues such as shoot density of *Z. marina*, abundance of filamentous algae or composition of accompanying species. Eutrophication is likely to have caused changes in these factors that can be regarded as harmful. As it is not possible to assess the scale of these changes, the habitat type was assessed on the basis of biotic quality factors as Data Deficient regarding both the past and the future (D1–D3: DD).

**Reasons for change of category:** Change in method.

**Trend:** Declining due to eutrophication.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *sandbanks which are slightly covered by sea water all the time* (1110), *large shallow inlets and bays* (1160) and the underwater parts of *Baltic esker islands* (1610).

**Finland's responsibility habitat type:** *Benthic habitats characterised by Zostera marina* is a responsibility habitat type.

12.09

Benthic habitats characterised by <i>Eleocharis</i> spp.			
	IUCN Red List Category	Criteria	Trend
Whole of Finland	LC		=
Southern Finland	LC		=
Northern Finland			

**Description:** The habitat type is characterised by perennial vegetation coverage of at least 10% dominated by spikerushes (*Eleocharis* spp.). The vegetation may grow either submerged or as emergent plants. The habitat type occurs mainly on muddy or sandy bottoms very close to the shoreline.

The most common species within the genus *Eleocharis* forming a habitat type is *E. acicularis*. It is a low-growing (2–10 cm) aquatic plant, which may form large stands with the help of their rootstocks or stolons. It grows in shallow waters at depths of 0–2 metres. Other common species in this habitat type are *E. palustris*, *E. uniglumis* and *E. mamillata*, which grow emergent. Other plants that often co-occur with spikerushes include several species of vascular plants such as the common reed (*Phragmites australis*) and *Hippuris* spp. (Niina Kurikka, pers. comm. 2017).



Maasarvi, Bothnian Bay. Photo: Pekka Lehtonen, Metsähallitus Parks & Wildlife Finland

The habitat type combines the HELCOM HUB classes AA.H1B8 and AA.J1B8 (HELCOM 2013a): Baltic photic muddy and sandy sediments dominated by spikerush (*Eleocharis* spp.).

**Geographic variation:** No geographic variation.

**Relationships to other habitat types:** The habitat type occurs in areas that border the land and the sea, and is thus restricted by two very different surrounding environments. On the land side, the habitat is often limited by the common reed (*Phragmites australis*), whereas in the sea it gradually changes to habitats dominated by various submerged vascular plants.

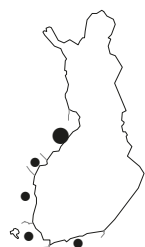
**Distribution:** The habitat type probably occurs as small patches along the entire Finnish coastline, but larger areas are concentrated in the Bothnian Bay.

**Threat factors:** Reedbed expansion (WEP 2), discontinuation of coastal grazing (OGR 2).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – *Eleocharis* spp. – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by *Eleocharis* spp. was assessed as a Least Concern (LC) habitat type (A1, B1–B3).

There is no monitoring data available on bottoms dominated by *Eleocharis* spp. Communities dominated by *Eleocharis* spp. can be found in shallow waters, and their quantity may have been reduced to some extent by reedbed expansion caused by eutrophication and the discontinuation of coastal grazing. On the coast of the Gulf of Bothnia, new suitable substrate is likely to be created continuously by land uplift, and the total quantity of benthic habitats characterised by *Eleocharis* spp. is not assessed to have reduced significantly over the past 50 years (A1: LC). Future quantitative changes



cannot be forecast, and any possible longer-term historical changes cannot be assessed, either (A2a & A3: DD).

If even small stands are classified as benthic habitats characterised by *Eleocharis* spp., it is highly likely that the extent of occurrence and the area of occupancy are above the thresholds set for Criterion B. The habitat type is Least Concern on the basis of Criterion B (B1–B3: LC).

**Reasons for change of category:** New habitat type.

**Trend:** Stable.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *coastal lagoons* (1150) and *boreal Baltic coastal meadows* (1630). May be included in *coastal lagoons (fladas) and lakes created by land uplift (glo-lakes) with a maximum area of ten hectares* protected under the Water Act (587/2011).

12.10

**Benthic habitats characterised by floating-leaved plants**

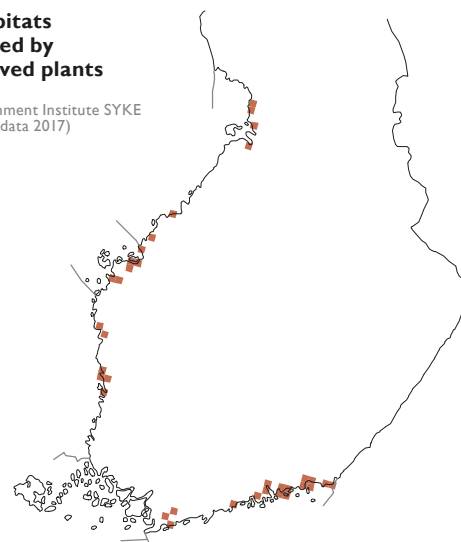
	IUCN Red List Category	Criteria	Trend
Whole of Finland	LC		=
Southern Finland	LC		=
Northern Finland			

**Description:** The habitat type is characterised by perennial vegetation coverage of at least 10% dominated by species with floating leaves. The species in the habitat type include the yellow water-lily *Nuphar lutea*, the European white water-lily *Nymphaea alba*, as well as *Potamogeton natans*, *Persicaria amphibia* and *Sparganium emersum*, *S. angustifolium* and *S. natans*. Other common species are *Myriophyllum* spp., *Stuckenia pectinata*, *Potamogeton* spp., *Callitriche* spp., *Alisma* spp. and *Utricularia* spp., which may coexist (VELMU data 2017).

All the species included in the habitat type occur widely in freshwater and brackish environments. The habitat type occurs mainly in very sheltered soft-bottom bays and especially river estuaries with a water depth of less than 4 metres. Many of the species in the habitat type tolerate salinity poorly. There is considerable

**Benthic habitats characterised by floating-leaved plants**

© Finnish Environment Institute SYKE (Source: VELMU data 2017)





Björkö, Archipelago Sea. Photo: Heidi Arponen, Metsähallitus Parks & Wildlife Finland

variation in the maximum length for different species (50 cm–3 metres). Some of the photosynthetic cellular mass is located below the surface, and the plants grow their stem long enough for their leaves to reach the water surface to float and photosynthesise. Therefore the habitat type is relatively tolerant to turbid waters caused by eutrophication (Hämet-Ahti et al. 1998; Mossberg and Stenberg 2003).

The habitat type provides food and shelter for many invertebrate species and insect larvae. In low salinities and shallow waters, the fauna is similar to that in lakes and ponds and is dominated by insect larvae (Meriläinen 1989; Sutela et al. 2012). Sessile infauna, excluding *Hydra* spp., are seldom found in communities dominated by floating-leaved vascular plants, but grazing snails, insect larvae and crustaceans are common. The inhabiting communities are similar to the *Potamogeton* and/or *Stuckenia* habitat types under comparable environmental conditions (Hansen et al. 2008).

No corresponding HELCOM HUB classes (HELCOM 2013a).

**Geographic variation:** No known geographic variation.

**Relationships to other habitat types:** On the seaward side, the habitat type may be bordered by bottoms dominated by species including *Potamogeton* spp., *Stuckenia* spp., *Myriophyllum* spp., *Zannichellia* spp. and *Ruppia* spp. In shallow shore waters, species such as the common reed (*Phragmites australis*), bulrushes (*Typha* spp.), club-rushes (*Schoenoplectus* spp.) and spikerushes (*Eleocharis* spp.) become more common (VELMU data 2017).

**Distribution:** All the species typical of the habitat type are abundant along the entire coast of Finland in low salinities and, likewise, in inland waters (Hämet-Ahti et al. 1998; Mossberg and Stenberg 2003; VELMU data 2017). In the Baltic Sea, the habitat is most common in

the river estuaries of the Bothnian Bay and the eastern Gulf of Finland (VELMU data 2017). The data from the Åland Islands is not included in the map.

**Threat factors:** Dredging (WHC 2), eutrophication (WEP 2).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – floating-leaved plants – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by floating-leaved plants was assessed as a Least Concern (LC) habitat type (A1–A3, B1–B3).

The habitat type is mainly found at river estuaries and in inner parts of sea bays with very low salinity levels, and there is no monitoring data on it. The habitat type is likely to focus on the Bothnian Bay and the river estuaries of the eastern parts of the Gulf of Finland (Essi Keskinen and Maiju Lanki, Metsähallitus, pers. comm. 2017). Floating-leaved plants react in various ways to eutrophication, but most are tolerant to increased nutrient levels, so the quantity of the habitat type is not assumed to have reduced or to reduce significantly in the future (A1–A3: LC).

On the basis of observations made in the Finnish Inventory Programme for the Underwater Marine Environment (VELMU), the habitat type's extent of occurrence is around 120,000 km<sup>2</sup> and the number of 10 km × 10 km grid cells occupied 35 (VELMU data 2017), but the total number of grid cells occupied is believed to be well above the threshold of 55 grid cells. The habitat type is Least Concern on the basis of Criterion B (B1–B3: LC).

The habitat type does not suffer from slight eutrophication but, with the eutrophication trend

continuing, it is possible that the species composition within the habitat type will change towards species that are more tolerant of more turbid and nutrient-rich waters. The relative severity of biotic changes that may have taken place in the past or may take place in the future cannot be assessed, so the habitat type is Data Deficient as regards Criterion D (D1–D3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Stable.

**Links to administrative classifications:** May be included the Habitats Directive habitat types *estuaries* (1130) and *coastal lagoons* (1150). May be included in *coastal lagoons (fladas) and lakes created by land uplift (glo-lakes) with a maximum area of ten hectares* protected under the Water Act (587/2011).

I3

### Benthic habitats characterised by unattached vegetation

I3.01

#### Benthic habitats characterised by unattached *Fucus* spp.

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>DD</b>	A1–A3, B1–B3	?
Southern Finland	<b>DD</b>	A1–A3, B1–B3	?
Northern Finland			

**Description:** The habitat type is characterised by stable aggregations of unattached or loosely attached *Fucus* spp. The original HELCOM HUB classes (HELCOM 2013a) recognise only the completely unattached *Fucus*, but the loosely attached *Fucus*, which may occur on soft sediments, are also included in this classification. Other perennial vegetation covers less than 10%, and aggregations of unattached or loosely attached vegetation cover at least 10% of the seabed. *Fucus* spp. dominate the vegetation.

The habitat type occurs under sheltered or moderately exposed conditions in the photic zone. It has mainly been found on sandy, coarse and muddy substrates. The lower salinity limit of the habitat type is the same as for attached *Fucus*, i.e. at least 4.5 psu (HELCOM 2013a).

Very little is known about this habitat type on the Finnish coast. Based on recent field observations from Finland and abroad, unattached *Fucus* aggregations in the Baltic Sea could be divided into four subtypes: 1) floating unattached aggregations of *Fucus*, often entangled with common reed (*Phragmites australis*); 2) *Fucus* aggregations loosely attached to soft-bottom sediment and consequently remaining in their usual standing position; 3) unattached pieces of *Fucus* lying on the sea floor, drifting slightly with currents and 4) entangled balls composed of unattached pieces of *Fucus* rolled up by currents. There are individual sightings of unattached and loosely attached *Fucus* spp. aggregations mainly from the southern and southwestern coast of Finland, but there is currently little information on their stability (Heidi Arponen, Metsähallitus, pers.

comm. 2017; Ellen Schagerström, pers. comm. 2017). The formation of unattached aggregations requires specific conditions: both abundant attached *Fucus* stands nearby as well as favourable currents that bring detached *Fucus* to the accumulation area, where they continue to grow.

Unattached and loosely attached *Fucus* aggregations can vary greatly in surface area, from patches of just a couple square metres to areas of several hundred square metres. Under suitable conditions, unattached *Fucus* may keep growing either in an upright position towards the surface (*Fucus* loosely attached to the bottom) or by growing the thallus in all directions (unattached entangled balls).

Communities of unattached *Fucus* form a three-dimensional habitat, which provides food and shelter for fish and many invertebrate species. (Cf. German occurrences, von Oertzen 1968). However, no data from the Finnish coast on the associated species community currently exists. The underlying sediment of unattached *Fucus* beds may also periodically become anoxic, which weakens the *Fucus* as well as the biotic community it supports.

The habitat type combines the HELCOM HUB classes AA.H1Q1, AA.H1Q2, AA.I1Q1, AA.I1Q2, AA.J1Q1, AA.J1Q2, AA.M1Q1 and AA.M1Q2 (HELCOM 2013a): Baltic photic muddy, coarse, sandy sediments and mixed substrates dominated by stable aggregations of unattached *Fucus* spp. (typical and dwarf forms).

**Geographic variation:** No known geographic variation.

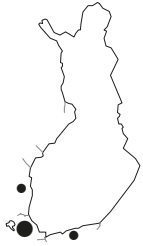
**Relationships to other habitat types:** The habitat type is regionally related to communities of attached *Fucus* and has been found near these communities. Unattached *Fucus* often accumulate in shallow bays on



Östervik, Archipelago Sea. Photo: Heidi Arponen; Metsähallitus Parks & Wildlife Finland

sandy and/or soft sediments with submerged vascular plant and infaunal communities. The differences between these habitats usually depend on the regional variation on the coverage of *Fucus* aggregations, and the transition from one habitat type to the next tends to be gradual.

Two subtypes are recognised in the HELCOM listing (2013a): aggregations of typical forms and of dwarf forms of *Fucus* spp. Aggregations of both morphological types probably occur on the Finnish coast, but more detailed information on their prevalence and occurrence is not available.



**Distribution:** The habitat type probably occurs in the same coastal areas where the attached form of *Fucus* spp. is common. The unattached form has been found in the Bothnian Sea, the Archipelago Sea and the western Gulf of Finland. However, the observations are so scarce and scattered that it is not justified to present an estimate on how common that habitat type is.

**Threat factors:** Abundance of filamentous algae, increased turbidity and seafloor anoxia (WEP 3), dredging (WHC 2), reduced salinity (CC 1).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from unattached *Fucus* spp. being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by unattached *Fucus* spp. was assessed as a Data Deficient habitat type (A1–A3, B1–B3: DD).

There is very little data on the habitat type, with only scattered observations available, and its quantitative changes are not known (A1–A3: DD). There is no monitoring data on the habitat type but, with eutrophication progressing, the abundance of filamentous algae, turbidity and seafloor anoxia are likely to have had adverse effects on the occurrences of this habitat type, too. Dredging may also be a threat to the habitat type in sheltered bays where unattached aggregations may be washed away by water currents changed by dredging (Ellen Schagerström, pers. comm. 2017). Climate change may also have a negative impact on the habitat type through the lowering of salinity or acceleration of eutrophication caused by warming.

The habitat type's geographic distribution is smaller or in the same magnitude as that of benthic habitats characterised by *Fucus* spp., but its distribution pattern is not known. With there being only a few known occurrence sites (VELMU data 2017; Heidi Arponen, pers. comm. 2017), it is not possible to estimate the total number of grid cells occupied. The habitat type is also Data Deficient on the basis of Criterion B (B1–B3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *coastal lagoons* (1150), *large shallow inlets and bays* (1160) and *boreal Baltic narrow inlets* (1650). May be included in *coastal lagoons (fladas) with a maximum area of ten hectares* protected under the Water Act (587/2011).

Benthic habitats characterised by unattached <i>Ceratophyllum demersum</i>			
	IUCN Red List Category	Criteria	Trend
Whole of Finland	LC		+
Southern Finland	LC		+
Northern Finland			



Raisionlahti, Archipelago Sea. Photo: Rami Laaksonen

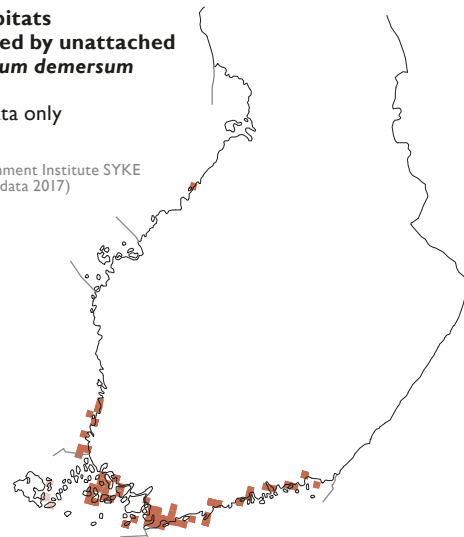
**Description:** The habitat type is characterised by stable aggregations of unattached or loosely attached plant communities dominated by the rigid hornwort *Ceratophyllum demersum*. The habitat type occurs mainly in shallow, very sheltered muddy bays and less frequently on mixed bottoms in sheltered bays of the outer archipelago.

*C. demersum* is a rootless macrophyte that can grow up to 50 cm tall. It can grow very fast and absorbs nutrients directly from the surrounding water. In the Baltic Sea, *C. demersum* rarely forms flowers. Instead, it reproduces from shoot fragments torn afloat. It can cope with scarce light and is often found growing in sheltered bays, even partially buried in the bottom sediment. As is common for vascular plants in shallow bays, *C. demersum* thrives in mixed communities, often accompanied by *Stuckenia pectinata* and *Myriophyllum*

#### Benthic habitats characterised by unattached *Ceratophyllum demersum*

Partial data only

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(Source: VELMU data 2017)



spp., both of which tolerate nutrients well (Leinikki et al. 2004; Hansen et al. 2012). Due to its high tolerance of nutrients and murky waters, *C. demersum* is often the last plant species that still inhabits eutrophic coves before all vegetation suffocates (Hansen and Snickars 2014).

Under favourable conditions, *C. demersum* can grow extremely fast, even covering the entire water column with its biomass. Both monospecific or polyspecific communities of *C. demersum* provide food and shelter for many species of fish and invertebrates such as insect larvae.

In addition to the common *C. demersum*, another species of the genus *Ceratophyllum*, the soft hornwort *C. submersum*, has migrated to Finland. The species has so far been found in the Åland Archipelago and off the coast of Espoo (Lampinen and Lahti 2017; Kurtto and Helynranta 2017; VELMU data 2017).

The habitat type combines the HELCOM HUB classes AA.H1Q4 and AA.M1Q4 (HELCOM 2013a): Baltic photic muddy sediment and mixed substrate dominated by stable aggregations of unattached rigid hornwort (*Ceratophyllum demersum*).

**Geographic variation:** No known geographic variation.

**Relationships to other habitat types:** The habitat type may gradually transform into bottoms dominated either by other macrophytes or unvegetated bottoms characterised by infauna. The most common habitat types characterised by infauna in these shallow areas are dominated by polychaetes, the Baltic tellin (*Macoma balthica*) or chironomids (cf. Hansen et al. 2012).

**Distribution:** The habitat type occurs commonly along the southern and southwestern coast of Finland, and more rarely in the Bothnian Bay (VELMU data 2017). *Ceratophyllum demersum* thrives in shallow bays in both fresh and brackish waters, excluding exposed areas.

**Threat factors:** –

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the rigid hornwort (*Ceratophyllum demersum*) being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by unattached *Ceratophyllum demersum* was assessed as a Least Concern (LC) habitat type (A1–A3, B1–B3, C1–C3).

There is no monitoring data on *C. demersum* communities, but their quantity is concluded as having increased (A1 & A3: LC). *C. demersum* benefits from increased nutrient levels in water bodies and tolerates increased turbidity better than many other vascular plants. The habitat type is not believed to reduce significantly in the future, either (A2a: LC).

The extent of occurrence and the area of occupancy are above the thresholds set for Criterion B. The habitat type is Least Concern on the basis of Criterion B (B1–B3: LC).

*C. demersum* communities thrive in nutrient-rich water, so eutrophication is unlikely to have had much of an adverse effect on them. Despite the overall reduction in transparency in the Baltic Sea over the past 50 years, the impact has not been too noticeable in the habitats

of *C. demersum*, and the situation is not believed to turn significantly worse in the future (C1–C3: LC).

**Reasons for change of category:** New habitat type.

**Trend:** Improving. With eutrophication continuing, *Ceratophyllum demersum* will gain a competitive advantage against other macrophytes.

**Links to administrative classifications:** May be included in the Habitat Types Directive habitat types *estuaries* (1130), *coastal lagoons* (1150), *large shallow inlets and bays* (1160) and *boreal Baltic narrow inlets* (1650). May be included in *coastal lagoons (fladas) and lakes created by land uplift (glo-lakes) with a maximum area of ten hectares* protected under the Water Act (587/2011).

13.03

#### Benthic habitats characterised by unattached aggregations of *Aegagropila linnaei*

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>DD</b>	A1–A3, B2	?
Southern Finland	<b>DD</b>	A1–A3, B2	?
Northern Finland			

**Description:** The habitat type is characterised by stable aggregations of unattached plant communities dominated by the lake ball *Aegagropila linnaei*.

The habitat type is relatively rare on the coast of Finland and usually occurs in shallow bays typically with muddy or sandy bottom sediments (VELMU data 2017). The loose-lying algae spheres continue to grow and therefore need light for photosynthesis (Boedeker et al. 2010; Koistinen 2017b). Initially, *A. linnaei* grows as a filamentous alga attached to hard surfaces, occurring down to a depth of 8 metres, but the algae balls that have torn off from the original substrate accumulate in the mouths of bays and twist into spherical aggregations which continue their growth if the conditions are favourable (Boedeker et al. 2009; Boedeker et al. 2010). Based on surveys in recent years, the unattached *A. linnaei* communities on the Finnish coast seem to cluster especially in relatively sheltered



Larsmo, Bothnian Bay. Photo: Suvi Saarnio, Metsähallitus Parks & Wildlife Finland

bays (VELMU data 2017). Possible infauna related to the habitat type is unknown.

There is no corresponding HELCOM HUB Level 6 class, but the habitat type is included in the Level 5 classes AA.H1Q and AA.J1Q (HELCOM 2013a): Baltic photic muddy and sandy sediments characterised by stable aggregations of unattached perennial vegetation.

**Geographic variation:** No known geographic variation.

**Relationships to other habitat types:** The habitat type mostly occurs in relatively sheltered areas with no stable vegetation or wave action to wash the unattached *Aegagropila linnaei* drifting on the bottom to the open sea. When moving into even more sheltered areas, stable vegetation may gradually replace the *A. linnaei* community. Possible relationships to habitats characterised by infauna are unknown.

**Distribution:** The habitat type is found at low incidence along the entire coast of Finland, with the exception of the Archipelago Sea (VELMU data 2017). The habitat type is most common in the Gulf of Finland and the Bothnian Bay. The data from the Åland Islands is not included in the map.

**Threat factors:** Drifting filamentous algal mats (WEP 2).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from unattached lake ball (*Aegagropila linnaei*) aggregations being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

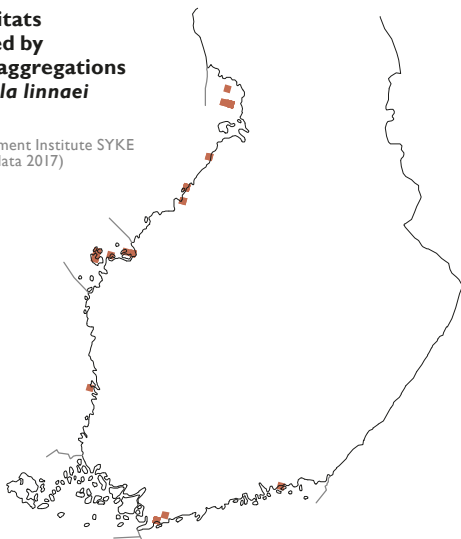
**Justification:** Benthic habitats characterised by unattached aggregations of *Aegagropila linnaei* was assessed as a Data Deficient (DD) habitat type (A1–A3, B2).

The habitat type is quite poorly known. Any quantitative changes are not known at all, so no future projections of them can be made (A1–A3: DD). The habitat type may be formed in the same areas as filamentous algal mats, in which cases the coexisting algal mass may hamper the movement and growth of the spherical aggregations of *A. linnaei*.

Based on data collected in the Finnish Inventory Programme for the Underwater Marine Environment

#### Benthic habitats characterised by unattached aggregations of *Aegagropila linnaei*

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(Source: VELMU data 2017)



(VELMU), the extent of occurrence of the habitat type exceeds 130,000 km<sup>2</sup> and the number of 10 km x 10 km grid cells occupied is 27 (VELMU data 2017). It is, however, impossible to estimate the total number of grid cells occupied, so the habitat type is for the time being classified as Data Deficient (DD) on the basis of subcriterion B2. The habitat type is Least Concern on the basis of the size of the geographical distribution and the number of occurrence sites (B1 & B3: LC).

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** May be included in the Habitat Types Directive habitat types *coastal lagoons* (1150), *large shallow inlets and bays* (1160) and *boreal Baltic narrow inlets* (1650). May be included in *coastal lagoons (fladas) with a maximum area of ten hectares* protected under the Water Act (587/2011).

14

### Benthic hard substrate habitats characterised by invertebrates

14.01

#### Benthic habitats characterised by *Mytilus trossulus*

	IUCN Red List Category	Criteria	Trend
Whole of Finland	LC		–
Southern Finland	LC		–
Northern Finland			

**Description:** The habitat type is characterized by rock, boulders or mixed substrate that is almost or completely unvegetated, and the infaunal community is dominated by blue mussels (*Mytilus trossulus*).

The *Mytilus* species living in the northern Baltic Sea is *M. trossulus*. Its current genome is a result of repeated invasions of *M. trossulus* from other oceans and a strong introgression with *M. edulis* that lives in the North Sea (Väinölä and Strelkov 2011). The shape of the mussel shell is elongated and approximately triangular and is dark blue to black in colour. The Baltic blue mussel is smaller than its marine counterparts, measuring between 1 and 4 cm (Kautsky 1982a; Westerbom et al. 2002).

*M. trossulus* is among the key species of the Baltic Sea, often growing in dense colonies that range in size from a few square metres to hectares. Mussel beds typically occur attached onto hard substrates (rock, boulders) but can also be found on sand, gravel or sometimes even on soft sediments. On loose substrates, mussels grow attached to one other. Habitats dominated by *Mytilus* typically occur at depths of 8–12 metres but can survive in both shallower and deeper waters if the environmental conditions are favourable (Westerbom and Jattu 2006; POHJE 2017). Individual *Mytilus* can be found growing on submerged plants or larger algae such as *Fucus vesiculosus*, but they do not form habitats under such conditions. The low salinity limit of dense patches of *Mytilus* colonies is approximately 5 psu, but separate individuals can be found in lower salinities (Kautsky 1982b; Westerbom et al. 2002).



Porsskär, western Gulf of Finland. Photo: Mats Westerbom, Metsähallitus Parks & Wildlife Finland

*Mytilus* habitats provide food and shelter for a number of other species. They are a source of food for, among others, the common eider (*Somateria mollissima*) and the long-tailed duck (*Clangula hyemalis*), as well as fish, including several species of Cyprinidae and the flounder (*Platichthys flesus*) (Öst and Kilpi 1997; Lappalainen et al. 2005; Westerbom et al. 2006; Borg et al. 2014). Common species found in *M. trossulus* communities include many invertebrates, such as the snails *Hydrobia* spp. and *Theodoxus fluviatilis*, *Gammarus* shrimps, *Idotea* isopods, polychaetes, nemertean worms and Platyhelminthes flatworms. Additionally, *Mytilus* beds may contain small pockets of soft sediment that provide habitats for several species typical of soft substrates such as the Baltic tellin (*Macoma balthica*), the lagoon cockle (*Cerastoderma glaucum*) and the ragworm (*Hediste diversicolor*) (Norling and Kautsky 2008; Koivisto 2011).

As a slow-moving and long-lived species, *M. trossulus* is a good indicator for water quality. *Mytilus* colonies have been estimated to filter an amount of water equal to the volume of the entire Baltic Sea in a year, binding nutrients and accumulating contaminants (Kautsky and Kautsky 2000).

*Mytilus* blue mussels release large numbers of mature sperm and eggs into the water for fertilisation. The larvae disperse, carried by currents, and eventually sink to the bottom to attach to the hard substrate. *Mytilus* habitats can only form in locations where recruits can attach on surfaces that are not already covered with sediment, sludge or filamentous algae (Vuorinen et al. 2002; Westerbom et al. 2008).

The habitat type combines the HELCOM HUB classes AA.A1E1, AA.I1E1, AA.M1E1, AB.A1E1, AB.I1E1 and

AB.M1E1 (HELCOM 2013a): Baltic photic and aphotic rock and boulders, coarse sediment and mixed substrate dominated by Mytilidae.

**Geographic variation:** The abundance and biomass of *Mytilus* communities are closely tied to seawater salinity and its fluctuations. The largest mussels in the Baltic Sea can be found in the Danish straits, and they decline in size towards the north as the salinity drops (Kautsky 1982a; Westerbom et al. 2002). The greatest densities and biomasses of *M. trossulus* in the Finnish coastal waters are found in the outer archipelago of the Archipelago Sea and the Gulf of Finland (Vuorinen et al. 2002; Westerbom and Jattu 2006). The number of individuals in communities may be greater in the southern parts of the Bothnian Sea, but such communities have lower overall biomass, as the individual mussels are smaller than those towards the south (Westerbom et al. 2002).

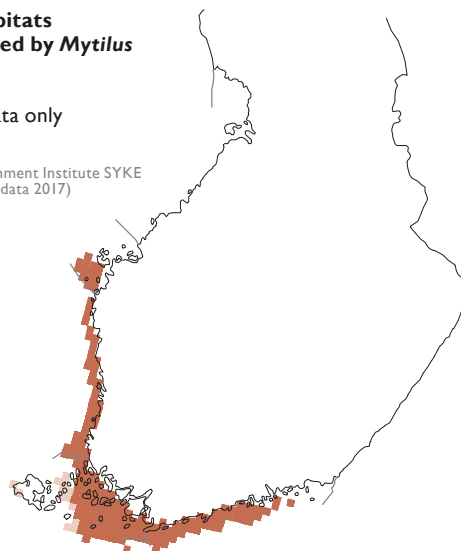
**Relationships to other habitat types:** *Mytilus trossulus* colonies commonly occur alongside communities of red algae (VELMU data 2017). The relationship can be complex: mussels compete with algae for living space, but the metabolism of the mussel colonies also provides the adjacent algae with nutrients (Kautsky and Wallentinus 1980; Kautsky and Evans 1987). In shallower waters, *M. trossulus* colonies often occur side by side with *Fucus* habitats or communities of filamentous algae. *M. trossulus* is also a common inhabitant in communities of vascular plants, such as common eelgrass (*Zostera marina*) beds (Boström and Bonsdorff 1997; Reusch 1998). The bay barnacle *Amphibalanus improvisus* and the colonial bryozoan *Einhornia crustulenta* compete with *Mytilus* in aphotic deeper waters, although the competitors never dominate the biomass. *Mytilus* beds can also form on soft bottoms where they attach to each other, creating their own habitat above the substrate. The shells of dead mussels can sometimes aggregate to form a new habitat type, shell gravel bottoms.

**Distribution:** The distribution of *Mytilus trossulus* on the Finnish coast is limited by salinity. The habitat type and the species are not present in the areas north of the Quark, the eastern parts of the Gulf of Finland or in the bays with the lowest salinities (VELMU data 2017).

#### Benthic habitats characterised by *Mytilus trossulus*

■ Partial data only

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(Source: VELMU data 2017)





However, the heavy saline water of the deep waters may extend the distribution of *Mytilus* habitats, if sufficient nutrition is available.

*M. trossulus* biomasses are greatest in the outer Archipelago Sea. They decrease both towards the Gulf of Finland and the Bothnian Sea. The numbers of individual mussels are highest in the southern Bothnian Sea and the western Gulf of Finland. In the eastern Gulf of Finland, *M. trossulus* is replaced by the freshwater invasive alien zebra mussel (*Dreissena polymorpha*) (VELMU data 2017).

**Threat factors:** Reduced salinity (CC 2), benthic siltation and possibly also the adverse effects of eutrophication received through feeding (WEP 2), competition with the bay barnacle (*Amphibalanus improvisus*) (IAS 1), adverse chemical effects (CHE 1).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from blue mussels (*Mytilus trossulus*) being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type. Collapse would also result from a drop in salinity below 5‰ in coastal waters.

**Justification:** Benthic habitats characterised by *Mytilus trossulus* was assessed as a Least Concern (LC) habitat type (A1, B1–B3).

Habitats dominated by *M. trossulus* are not believed to have declined significantly over the past 50 years (A1: LC), although the period also contains major population fluctuations. In the Gulf of Finland, the *M. trossulus* population collapsed in the 1990s and mature individuals almost disappeared from the area east of Hanko, but the population already started to recover towards the end of the decade (Mats Westerbom, pers. comm. 2016). In the inner archipelago, benthic siltation may have reduced the quantity of *Mytilus* communities to some extent. Having already arrived in the Baltic Sea in the 1800s, the bay barnacle may have affected the quantity of *Mytilus*-dominated bottoms, but the magnitude of any decline caused by competition cannot be estimated (A3: DD).

The occurrence of benthic habitats characterised by *M. trossulus* is largely linked to salinity, and a lowering of the Baltic Sea's salinity would reduce the occurrence of blue mussels on the Finnish coast. Future quantitative changes were, however, regarded as Data Deficient (A2a: DD).

The extent of occurrence of bottoms dominated by *M. trossulus* stretches at least from the Quark to the central parts of the Gulf of Finland and, based on VELMU data (2017), its size is 89,000 km<sup>2</sup>. The number of 10 km x 10 km grid cells occupied is 188 on the basis

Benthic habitats characterised by *Dreissena polymorpha*, Ulko-Tammio, eastern Gulf of Finland.  
Photo: Petra Pohjola, Metsähallitus Parks & Wildlife Finland



of VELMU observations. The habitat type is Least Concern on the basis of Criterion B (B1–B3: LC).

Eutrophication is harmful to mussels, too, regardless of them also benefitting from increased amounts of food in the water (Wołowicz et al. 2006; Maar and Hansen 2011). Mussels benefit only from a slight increase in nutrient level and only in cases where the increase in nutrients results in an increased abundance of plankton (such as *Pleurosigma* and *Gyrosigma* diatoms) on which blue mussels feed (Wołowicz et al. 2006; Maar and Hansen 2011). Climate change is expected to alter the structure of the plankton communities of the Baltic Sea (Smetacek and Cloern 2008; Maar and Hansen 2011), which may have a negative effect on blue mussel communities feeding mainly on phytoplankton (Bracken et al. 2012; Müren et al. 2005). In addition, increases in filamentous algae and in sedimentation caused by eutrophication suffocate mussel communities (Vuorinen et al. 2002; Westerbohm et al. 2008). The relative severity of the abiotic or biotic changes cannot, however, be assessed (C1–C3, D1–D3: DD).

**Reasons for change of category:** Change in method.

**Trend:** Declining. With the eutrophication trend continuing, the state of the habitat type is anticipated to decline further in key occurrence areas.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *reefs* (1170) or the underwater parts of *boreal Baltic islets and small islands* (1620).

**Finland's responsibility habitat type:** Included in the responsibility habitat type *rocky bottoms of the Baltic Sea*.

14.02

**Benthic habitats characterised by *Dreissena polymorpha***

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>NE</b>		
Southern Finland	<b>NE</b>		
Northern Finland			

**Description:** The habitat type is characterised by rock, boulders or mixed substrate that is almost or completely unvegetated, and the infaunal community is dominated by the zebra mussel (*Dreissena polymorpha*)

*D. polymorpha* is an invasive alien species from the Black Sea and the Caspian Sea area. It was first recorded in Finland in the Gulf of Finland in 1995. *D. polymorpha* attaches to hard substrates using its byssus filaments, and it filters plankton for food. Ecologically the species therefore resembles the blue mussel (*Mytilus trossulus*). *D. polymorpha* reproduces and disperses by passing through a pelagic larval stage. Its reproduction begins when the water temperature is +12 °C at the minimum (McMahon 1996). It is not known how long the reproduction period lasts in the Gulf of Finland but, based on temperature, it would begin in June and continue until the autumn. The free-swimming larvae are fairly small, only 0.3 mm at the maximum. The larval stage has been estimated to last 10 days.

Individual differences in growth rates are considerable, and based on an analysis of growth rings, the 2-year-old individuals recorded in the Gulf of Finland have been 6–10 mm in length, while the 5-year-old individuals have been 12–16 mm in length. On the Finnish coast, *D. polymorpha* generally grows to a length of about 20 mm (Valovirta and Porkka 1996; Antsulevitch et al. 2003).

The *D. polymorpha* occurrences are focused on the depths of 4–7 metres, which probably also reflects the occurrence of the habitat type. At most, 14,750 *D. polymorpha* individuals have been observed per square metre (VELMU data 2017; POHJE 2017). Other typical species on bottoms characterised by *D. polymorpha* include the colonial bryozoan *Einhornia crustulenta*, the hydroid *Cordylophora caspia* and membranous red and brown algae.

The habitat type corresponds to the HELCOM HUB classes AA.A1E2 and AA.M1E2 (HELCOM 2013a): Baltic photic rock, boulders and mixed substrate dominated by zebra mussel (*Dreissena polymorpha*).

**Geographic variation:** No known geographic variation.

**Relationships to other habitat types:** The habitat type occurs side by side at least with bottoms characterised by perennial filamentous algae.

**Distribution:** *Dreissena polymorpha* is a freshwater species, and it tolerates low salinities up to at least 4.5–5.5 psu. The occurrence of the species is restricted to the eastern part of the Gulf of Finland, and in the west it occurs as far as the Loviisa archipelago (VELMU data 2017). *D. polymorpha* becomes more abundant towards the east, and the habitat type dominated by it occurs mainly in the easternmost archipelago in semiopen areas.

**Threat factors:** Not evaluated.

**Description of habitat type collapse:** Not evaluated.

**Justification:** The habitat type is characterised by an alien species and has not been evaluated.

**Reasons for change of category:** New described habitat type, but not evaluated.

**Trend:** Not evaluated.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *reefs* (1170) or the underwater parts of *boreal Baltic islets and small islands* (1620).

**Benthic habitats characterised by *Dreissena polymorpha***

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(Source: VELMU data 2017)



### Benthic habitats characterised by *Amphibalanus improvisus*

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>NE</b>		
Southern Finland	<b>NE</b>		
Northern Finland			

**Description:** The habitat type is characterised by rock, boulders or mixed substrate that is almost or completely unvegetated, and the biomass of the infaunal community is dominated by the bay barnacle (*Amphibalanus improvisus*).

*A. improvisus* is a crustacean living attached on hard substrates. The pale shell of an individual *A. improvisus* is less than 1 cm in diameter, and the animal uses its feathery-like limbs (cirri) to catch the plankton that drifts by. The larval stage of *A. improvisus* is pelagic. After the larval stage, the animal attaches itself to the substrate and develops into an adult. Individuals can attach to any hard or tough surface, and under favourable conditions an *A. improvisus* community can cover vast areas. The occurrence of *A. improvisus* ranges from shallow shore waters to a depth of 15 metres. Where abundant, *A. improvisus* can displace other species in the habitat that attach to hard surfaces, such as blue mussels (*Mytilus trossulus*), red algae and *Fucus* spp.

The invasive alien *A. improvisus* arrived in the Baltic Sea in the mid-19th century, and it has spread to the entire Finnish coast, excluding the Bothnian Bay.

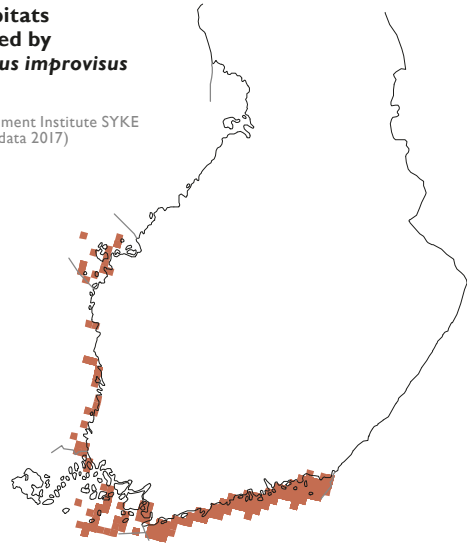
The habitat type corresponds to the HELCOM HUB classes AA.A1I1, AA.M1I1, AB.A1I1 and AB.M1I1 (HELCOM 2013a): Baltic photic and aphotic rock, boulders and mixed substrate dominated by barnacles (Balanidae).

**Geographic variation:** No known geographic variation.

**Relationships to other habitat types:** The habitat type can occur in the vicinity of other habitat types characterised by hard substrates, such as blue mussel,

### Benthic habitats characterised by *Amphibalanus improvisus*

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(Source: VELMU data 2017)



*Fucus* and red algal habitats, and the continuums between them tend to be gradual.

**Distribution:** The habitat type is common in the Gulf of Finland, and it can be found along the entire Finnish coast as far as the Quark if the salinity is high enough (VELMU data 2017). The small species rarely dominates, however, and it tends to co-occur with *Mytilus trossulus*, red algae and *Fucus*. Data for the Åland Islands was not available.

**Threat factors:** Not evaluated.

**Description of habitat type collapse:** Not evaluated.

**Justification:** The habitat type is characterised by an alien species and has not been evaluated.

**Reasons for change of category:** New described habitat type, but not evaluated.

**Trend:** Not evaluated.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *reefs* (1170) or the underwater parts of *boreal Baltic islets and small islands* (1620).



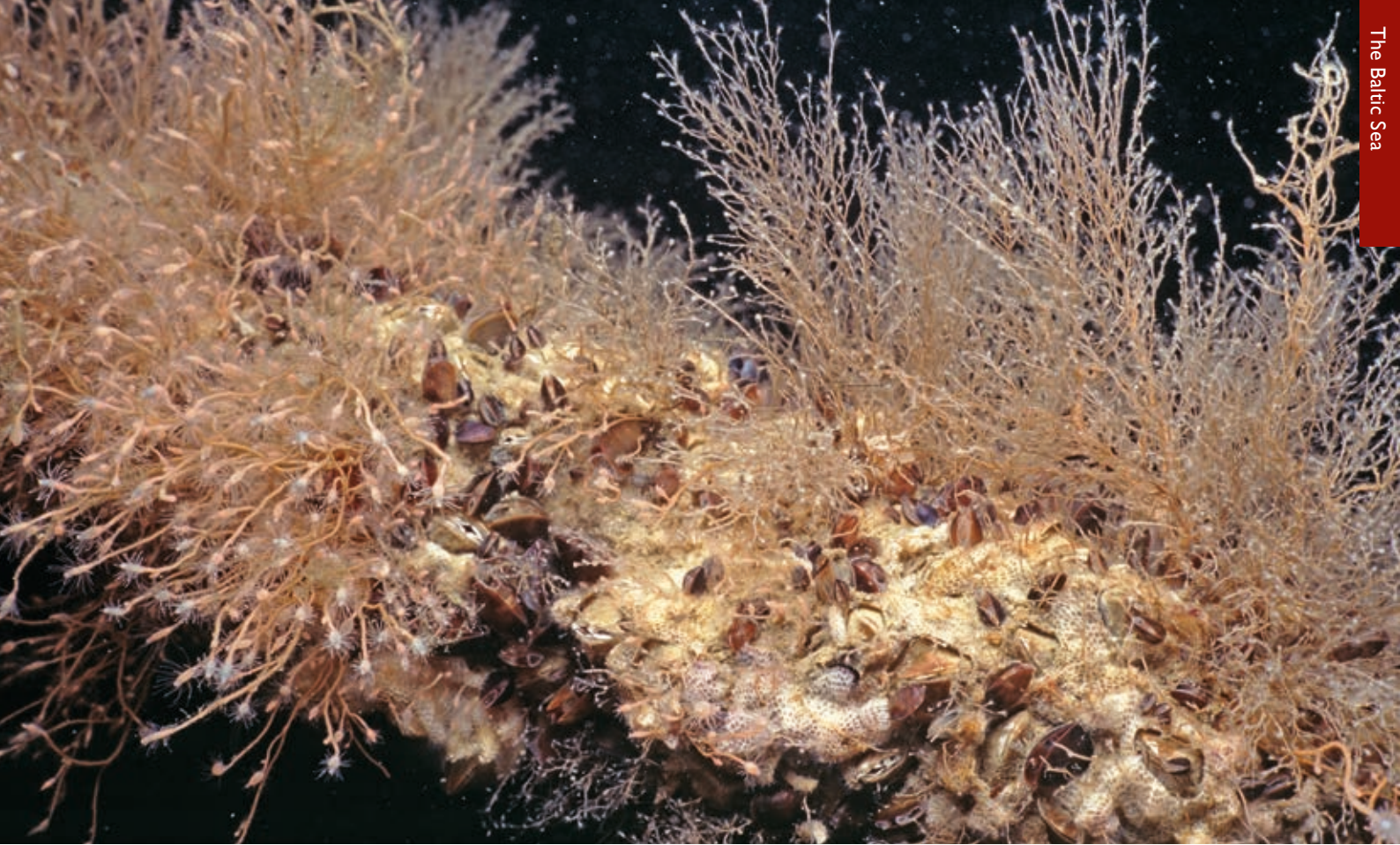
Koivuluoto, eastern Gulf of Finland. Photo: Ari O. Laine, Metsähallitus Parks & Wildlife Finland

### Benthic habitats characterised by hydroids (Hydrozoa)

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>DD</b>	A1–A3, D1–D3	?
Southern Finland	<b>DD</b>	A1–A3, D1–D3	?
Northern Finland			

**Description:** The habitat type is characterised by rock, boulders or mixed substrate that is almost or completely unvegetated, and the biomass of the infaunal community is dominated by hydroids (Hydrozoa).

Hydroids are cnidarians that attach to hard surfaces and use the stinging cells located on their tentacles to catch small zooplankton for food. Hydroids can reproduce either through the larval stage or asexually by budding. Species occurring as separate hydroids (e.g. hydroids of the genus *Hydra*) are small and do not occur in sufficient abundance to form a proper habitat



Kemiönsaari, Archipelago Sea. Photo: Visa Hietalahti

type. According to the definition of the habitat type, larger species that exist as colonies occur instead. These include *Gonothyraea lovéni* and *Cordylophora caspia*. The frequency and extent of occurrence of the habitat type is, however, insufficiently known, and it is not absolutely certain that it is indigenous in Finland. Hydrozoans forming colonies can be abundant below the photic zone and especially in locations where currents occur. Due to their delicate structure, however, they do not dominate the community if blue mussels (*Mytilus trossulus*), zebra mussels (*Dreissena polymorpha*) or bay barnacles (*Amphibalanus improvisus*) also occur in the area. Due to its quick growth, *C. caspia* at least can also colonise new artificial substrates (Laihonen et al. 1985; Jormalainen et al. 1994) and form a temporary habitat type before other species settle in.

*C. caspia* is an invasive alien species, which arrived in the Baltic Sea at the beginning of the 19th century and has since spread to the entire Finnish marine area. It is not known to what extent the original Baltic *G. lovéni* has formed stands that could be considered habitat types before *C. caspia* and *A. improvisus* arrived in Finland.

The habitat type combines the HELCOM HUB classes AA.A1G1, AA.M1G1, AB.A1G1 and AB.M1G1 (HELCOM 2013a): Baltic photic and aphotic rock, boulders and mixed substrate dominated by hydrozoans (Hydrozoa).

**Geographic variation:** No known geographic variation.

**Relationships to other habitat types:** The habitat type can occur side by side with bottoms dominated by the blue mussel (*Mytilus trossulus*) or the bay barnacle (*Amphibalanus improvisus*).

**Distribution:** The habitat type occurs at low incidence along the entire Finnish coast (VELMU data 2017).

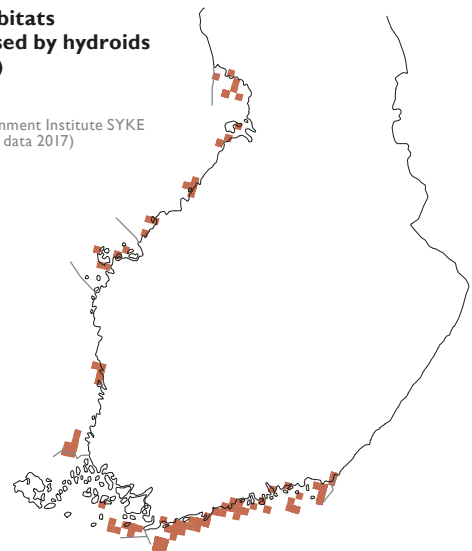
*Gonothyraea lovéni* occurs mainly in the southwestern marine areas in salinities above 4 psu. *Cordylophora caspia*, on the other hand, tolerates near-freshwater conditions, and the species occurs throughout the Finnish coast. Data for the Åland Islands was not available.

**Threat factors:** Abundance of the hydroid *Cordylophora caspia* and the bay barnacle (*Amphibalanus improvisus*) (IAS 3), benthic siltation (WEP 2).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from hydrozoans (Hydrozoa) being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

#### Benthic habitats characterised by hydrozoans (Hydrozoa)

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(Source: VELMU data 2017)



**Justification:** Benthic habitats characterised by hydroids was assessed as a Data Deficient (DD) habitat type (A1–A3, D1–D3).

There is no data on quantitative changes in the habitat type (A1 & A3: DD), and it is also somewhat uncertain whether it is indigenous in Finland. The alien hydroid species *Cordylophora caspia* was observed in the Baltic Sea already in the early 1800s, and today the species is already more common than the brackish water hydroid (Katriina Könönen and Maiju Lanki, pers.comm. 2017). Changes in salinity might affect the quantity of hydroid communities in the future, but it is uncertain how great the changes might be over the next 50 years (A2a: DD).

The habitat type is found almost throughout the Finnish coastal area (POHJE 2017; VELMU data 2017). Benthic habitats characterised by hydroids have been found at 245 points located in 73 grid cells of 10 km x 10 km. Although the total number of occurrences and grid cells occupied cannot be estimated, it is clear that the extent of occurrence and the area of occupancy are above the thresholds set for Criterion B (B1–B3: LC).

Siltation following from eutrophication has degraded the living conditions of hydroid communities, but eutrophication may also have benefitted hydroids by providing increased access to food. Biotic changes over the past 50 years and the next 50 years were regarded as Data Deficient (D1 & D2a: DD). Before the invasion of the hydroid *C. caspia* and the bay barnacle (*Amphibalanus improvisus*), there may also have been areas dominated by brackish water hydroids. It is uncertain whether any of them remain in the area. The proportion of *C. caspia* could, in principle, illustrate the biotic alterations of a hydroid community, but there are no suitable datasets for such examinations (D3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *reefs* (1170) or the underwater parts of *boreal Baltic islets and small islands* (1620).



Gammelfladan, Quark. Photo: Pekka Lehtonen, Metsähallitus Parks & Wildlife Finland

13 *Vaucheria* species have been recorded, most abundantly in the southern parts of the basin (HELCOM 2012). *V. dichotoma* is the most common species of the genus in the Baltic Sea and occurs from the southern Baltic along the coast of Sweden and up to the northern Bothnian Bay (Nielsen et al. 1995; Snoeijs 1999; Hansen et al. 2012). On the Finnish coast, the species has mainly been found in sheltered bays (Holmström et al. 2007; VELMU data 2017).

*Vaucheria* spp. thrive in cool water, and in the Baltic Sea most of their growth occurs during late autumn and winter. Identifying *Vaucheria* spp. to subgeneric levels is problematic, as their taxonomy is based on their reproductive organs, which can only sporadically be observed in the field. In the Baltic Sea, for example, *Vaucheria* individuals tend to be sterile and are therefore difficult to identify to the species level (Snoeijs 1999; Schagerl and Kerschbaumer 2009; Nemjova and Kaufnerova 2009; Koistinen 2017c).

Unlike most filamentous algae, habitats dominated by *Vaucheria* spp. are mainly found on soft bottoms, often even within reedbeds at depths of 1–7 metres (Koistinen 2017c). *Vaucheria* spp. are efficient colonisers that bind sediment grains beneath their aggregations (Snoeijs 1999; Guiry 2017). In the spray zone they can be found as small patches, but when permanently submerged, they can cover entire bays, effectively outcompeting other submerged plants. Water exchange is not possible beneath the dense 10–20 cm thick algal mats. Methane formation under these anaerobic conditions can partly elevate a dense *Vaucheria* mat and, under suitable conditions, lift it up to the surface. The phenomenon is known as “seal heads” (Snoeijs 1999). Little is known

## I5

### Benthic habitats characterised by annual algae

#### I5.01

##### Benthic habitats characterised by *Vaucheria* spp.

	IUCN Red List Category	Criteria	Trend
Whole of Finland	LC		=
Southern Finland	LC		=
Northern Finland			

**Description:** The habitat type is characterised by muddy sediment accounting for at least 90% of the substrate. The vegetation coverage is at least 10% and is dominated by *Vaucheria* spp. yellow-green algae.

*Vaucheria* is a genus of filamentous algae, commonly found on all continents (Guiry 2017). In the Baltic Sea,

about the fauna within the *Vaucheria* communities, and taking samples using traditional instruments is difficult due to the thick structure of the algal mats. Holmström et al. (2007) suggest that at least the lagoon cockle *Cerastoderma glaucum* would be found intertwined in *Vaucheria*.

When torn off their substrate, *Vaucheria* spp. may drift to new habitats and form loose algal mats that, in contrast to other filamentous algal mats, tend to settle in sheltered, shallow bays (Bergström and Bergström 1999).

The habitat type corresponds to the HELCOM HUB class AA.H1S3 (HELCOM 2013a): Baltic photic muddy sediment dominated by *Vaucheria* spp.

**Geographic variation:** No known geographic variation.

**Relationships to other habitat types:** The habitat type often co-occurs with habitat types characterised by other submerged plants. *Vaucheria* spp. are strong competitors and tolerate eutrophication relatively well, often outcompeting other submerged plants such as charophytes, *Ulva* spp., *Potamogeton* spp. and *Stuckenia* spp. in eutrophic habitats.



**Distribution:** *Vaucheria* spp. and habitats dominated by them are common throughout the shallow bays of the entire Finnish coastline (VELMU data 2017). Drifting mats of loose *Vaucheria* are typical of the Baltic Proper, the Gulf of Finland and the Gulf of Bothnia (Kautsky 1992; Bergström and Bergström 1999; Lehvo and Bäck 2001).

**Threat factors:** –

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from *Vaucheria* spp. being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by *Vaucheria* spp. was assessed as a Least Concern (LC) habitat type (A1–A3, B1–B3, C1–C3).

These communities of filamentous algae are among the habitat types that have benefitted the most from the eutrophication of the Baltic Sea. Their quantity is estimated to have been increased by eutrophication (A1 & A3: LC), and they are not anticipated to decrease significantly over the next 50 years, either (A2a: LC).

The habitat type is found throughout the Finnish coastal area and is abundant. The extent of occurrence and the area of occupancy are above the thresholds set for Criterion B (B1–B3: LC) (VELMU data 2017). Increased nutrient levels in the water have been an advantageous change for *Vaucheria* spp. communities (C1 & C3: LC), and nutrient levels are not expected to decrease rapidly in the future, either (C2a: LC).

**Reasons for change of category:** New habitat type.

**Trend:** Stable.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *coastal lagoons* (1150), *large shallow inlets and bays* (1160) and *boreal Baltic narrow inlets* (1650). May be included in *coastal lagoons (fladas) and lakes created by land uplift (glo-lakes) with a maximum area of ten hectares protected under the Water Act* (587/2011).

15.02

#### Benthic habitats characterised by *Chorda filum* and/or *Halosiphon tomentosus*

	IUCN Red List Category	Criteria	Trend
Whole of Finland	LC		=
Southern Finland	LC		=
Northern Finland			

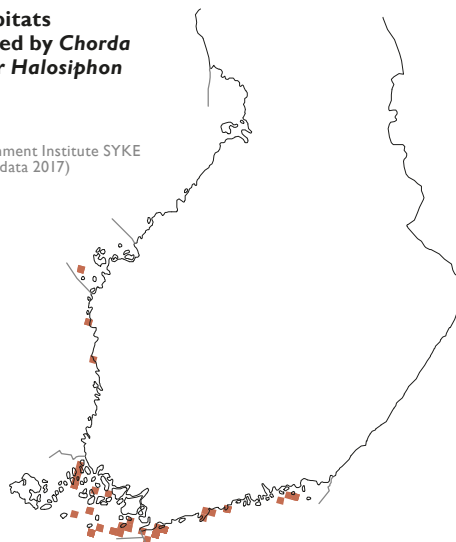
**Description:** The habitat type is characterised by at least 10% coverage of vegetation dominated by *Chorda filum* (known as the dead man's rope or the sea lace) and/or the furry rope weed *Halosiphon tomentosus*. The habitat type typically occurs in relatively sheltered areas with either sandy, coarse or mixed substrates, and the locations of the occurrences demonstrate great interannual variation. Additionally, the prevalence of *C. filum* is linked to the Baltic saline pulses (Hällfors and Heikkonen 1992). Both species usually coexist with several others, forming mixed communities with submerged plants and algae. This description focuses on *C. filum*, which is the more common of the species, but the description also applies to the smaller and rarer *H. tomentosus*.

*C. filum* thrives in the photic section of the littoral zone and can usually be found at depths of less than 10 metres. The annual aggregations grow attached to hard substrates, such as small pebbles and rock as well as on mussels and bay barnacles (*Amphibalanus improvisus*). It is common for strands of *C. filum* to grow in clumps, several individual strings closely attached to the same small surfaces. Under favourable conditions, the fast-growing *C. filum* strings can reach lengths of up to one metre, while it may attain a width of only 3 mm (South and Burrows 1967; Russell 1985; Tolstoy and Österlund 2003; Leinikki et al. 2004; Koistinen 2017d).

Due to the thin and stringy structure of *C. filum*, it is rare for the species to dominate the plant community. *C. filum*, growing attached to the smallest of pebbles and mussels, adds to many kinds of habitat types; they often form mixed habitats with either other algae or submerged plants, depending on the bottom substrate (Hansen et al. 2012). *C. filum* as a species offers no specific shelter or food source to other species but, being adaptable, it

#### Benthic habitats characterised by *Chorda filum* and/or *Halosiphon tomentosus*

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(Source: VELMU data 2017)





Kuuskaajaskari, Bothnian Sea. Photo: Heidi Arponen, Metsähallitus Parks & Wildlife Finland

functions as a part of the polyspecific community and adds to the diversity of the habitat (Hansen and Snickars 2014). When reaching habitat type-forming densities, communities of *C. filum* tend to be small in area and surrounded by other submerged plants.

The habitat type combines the HELCOM HUB classes AA.I1S2, AA.J1S2 and AA.M1S2 (HELCOM 2013a): Baltic photic coarse and sandy sediments and mixed substrate dominated by *Chorda filum* and/or *Halosiphon tomentosus*.

**Geographic variation:** No known geographic variation.

**Relationships to other habitat types:** Patches dominated by *Chorda filum* and *Halosiphon tomentosus* often occur in the vicinity of habitat types dominated by other algae and submerged plants. Even more often, *C. filum* occurs in a mixed habitat. Additionally, there may be considerable yearly variation in both *C. filum* and *H. tomentosus*.

**Distribution:** The distribution of the habitat type is limited by the distribution limit of *Chorda filum*, which correlates with the minimum salinity of 4 psu. The habitat type has been observed from the Quark to the eastern parts of the Gulf of Finland (VELMU data 2017), but the main distribution area is located between the middle and outer parts of the Archipelago Sea. Data for the Åland Islands was not available.

**Threat factors:** Increased turbidity and benthic siltation (WEP 2).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – *Chorda filum* and/or *Halosiphon tomentosus* – being lost or reduced to such an extent that there would no longer be any habitats classified as as this habitat type.

**Justification:** Benthic habitats characterised by *Chorda filum* and/or *Halosiphon tomentosus* was assessed as a Least Concern (LC) habitat type (A1–A3, B1–B3, C1–C3).

*C. filum* and/or *H. tomentosus* communities are tolerant of eutrophication (Hansen and Snickars 2014), and they are not estimated to have declined in quantity at least

over the past 50 years or over the longer historical time frame (A1 & A3: LC). They are not expected to decline significantly over the next 50 years, either (A2a: LC).

The estimated extent of occurrence is around 70,000 km<sup>2</sup> (VELMU data 2017). There are observations of the habitat type in 44 grid cells of 10 km x 10 km, but the total number of grid cells occupied is estimated to be above the threshold of 55 grid cells. The habitat type is Least Concern on the basis of Criterion B (B1–B3: LC).

Eutrophication-related abiotic changes are not regarded as having had significant adverse effects on *C. filum* and/or *H. tomentosus* communities (C1 & C3: LC), and no changes significant for the habitat type are expected over the next 50 years, either (C2a: LC).

**Reasons for change of category:** New habitat type.

**Trend:** Stable.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *large shallow inlets and bays* (1160) and the underwater parts of *boreal Baltic islets and small islands* (1620).

15.03

#### Benthic habitats characterised by annual filamentous algae

	IUCN Red List Category	Criteria	Trend
Whole of Finland	LC		+
Southern Finland	LC		+
Northern Finland			

**Description:** The habitat type is characterised by at least 10% coverage of annual vegetation dominated by annual filamentous algae. The species forming the habitat type include *Cladophora glomerata*, *C. fracta*, *Dictyosiphon foeniculaceus*, *Stictyosiphon tortilis*, *Ectocarpus siliculosus*, *Pylaiella littoralis*, *Bangia atropurpurea*, *Acrosiphonia arcta*, *Spongomorpha aeruginosa*, *Ulothrix* spp. and *Ulva* spp.

Annual filamentous algae grow attached to hard surfaces. Even small rocks may serve as substrates under favourable conditions. Most species included in the habitat type are filamentous green and brown algae, and the habitat type most commonly occurs from the splash zone down to a depth of 3–4 metres. *Ulva* spp. are not strictly filamentous but are included in the habitat type, as they have growth habits, environmental requirements and functional traits similar to the rest of the species. The species in the habitat type are fast-growing, and often form monospecific or polyspecific fur covering rock surfaces ranging from the shoreline to the *Fucus* zone. The maximum depth of occurrence of annual filamentous algae is often dictated either by the decreasing availability of light or by larger perennial algae becoming more common; regional differences are great. Most annual filamentous algae can also grow on perennial algae as epiphytes. Many species of annual filamentous algae are of marine origin, and the number of species found in the less saline Bothnian Bay is significantly lower than elsewhere on the coast.

Eastern Gulf of Finland. Photo: Juho Lappalainen, Metsähallitus Parks & Wildlife Finland ►





As fast-growing colonisers, annual algae benefit from eutrophication and quickly occupy substrates other species have deserted (Wallentinus 1984). *Fucus* spp., especially, lose in the competition against filamentous algae because before *Fucus* spp. has been able to reproduce, *P. littoralis* spreads to the bare substrates that have become uncovered after winter. The latter can additionally grow on top of aggregations of *Fucus* spp., blocking the light and suffocating the *Fucus* stands (Kiirikki and Lehvo 1997).

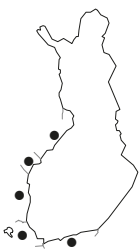
The most common species in the habitat type throughout the entire coast is *C. glomerata* (Kiirikki and Lehvo 1997; VELMU data 2017). Like *P. littoralis*, it can grow both on hard surfaces and as an epiphyte on perennial vegetation. The dominating species within the habitat type can vary from year to year (Kiirikki and Lehvo 1997). Especially after long and cold winters, the usually dominant *C. glomerata* may have to surrender to *D. foeniculaceus*. *P. littoralis* is most commonly found underneath *Fucus* bushes, but under favourable conditions it can form monocultures or multispecies communities with other annual filamentous algae.

Filamentous algal mats are often covered by a thin layer of diatoms (e.g. *Cocconeis pediculus*, *Gomphonema olivaceum*, *Rhoicospenia abbreviata*): a large part of the biomass of filamentous algae can actually consist of diatoms (Snoeijs 1995; Svensson et al. 2014). Many invertebrates, such as *Gammarus* spp., Hydrobiidae, chironomid larvae and ostracods can graze on both diatoms and filamentous algae (Norkko et al. 2000; Snoeijs-Leijonmalm et al. 2017).

The habitat type includes, except for occurrences dominated by red algae, the HELCOM HUB classes AA.A1S and AA.M1S1 (HELCOM 2013a): Baltic photic rock, boulders and mixed substrate dominated by filamentous annual algae. The original HELCOM HUB classes also include habitats dominated by the red alga *Ceramium tenuicorne*, which are in this classification included in I1.02 Benthic habitats characterised by red algae.

**Geographic variation:** In the Bothnian Bay, there are fewer species than elsewhere on the Finnish coast (Bergström and Bergström 1999; VELMU data 2017).

**Relationships to other habitat types:** The zone dominated by annual filamentous algae tends to be limited in deeper waters by habitats dominated by *Fucus* spp., but most of the species also occur as epiphytes in benthic habitats characterised by other organisms.



**Distribution:** The habitat occurs commonly throughout the coast of Finland. The species composition varies depending on the environmental factors and the year.

**Threat factors:** –

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost.

This would result from annual filamentous algae being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by annual

filamentous algae was assessed as a Least Concern (LC) habitat type (A1–A3, B1–B3, C1–C3)

Eutrophication of the Baltic Sea has increased the proportion of communities dominated by filamentous algae (A1 & A3: LC), and the situation is not expected to change significantly over the next 50 years (A2a: LC).

The habitat type is abundant and widespread, so the extent of occurrence and the area of occupancy are above the thresholds set for Criterion B (B1–B2: LC). The habitat type is Least Concern also on the basis of subcriterion B3.

With the nutrient level of water increasing, eutrophication has improved the living conditions of these communities (C1 & C3: LC). Nutrient levels may not increase any further but are unlikely to decrease significantly, either, so no abiotic changes harmful to these communities are anticipated over the next 50 years (C2a: LC). The composition of the species community has changed due to eutrophication, as some species have declined and others benefitted. The relative severity of the biotic changes cannot be assessed (D1–D3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Improving. With eutrophication continuing, annual filamentous algae gain a competitive advantage in relation to other macrophytes.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *reefs* (1170) or the underwater parts of *boreal Baltic islets and small islands* (1620).

16

## Benthic soft substrate habitats characterised by invertebrates

16.01

### Benthic habitats characterised by *Mya arenaria*

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>DD</b>	A1–A3, B1, B2, D1–D3	?
Southern Finland	<b>DD</b>	A1–A3, B1, B2, D1–D3	?
Northern Finland			



Örö, Archipelago Sea. Photo: Noora Hellén

**Description:** The habitat type is characterised by sandy or muddy sandy sediment that is almost or completely unvegetated, and the infaunal community is dominated by the sand gaper clam *Mya arenaria*. *M. arenaria* is one of the largest bivalves found on the Finnish coast. Its characteristic pale, oval shell can reach a length of 5 cm (Filippenko and Naumenko 2014; Väinölä 2017a). *M. arenaria* often co-occurs in multispecies infaunal communities with the lagoon cockle *Cerastoderma glaucum*, *Hydrobia* spp. mud snails and the ragworm *Hediste diversicolor* (Boström and Bonsdorff 1997).

After the pelagic larval stage, *M. arenaria* settle on and burrow into sandy sediments. After reaching a depth of 10–20 cm, they usually remain in the same location for the rest of their life, up to 20 years. *M. arenaria* are relatively common, ranging from shallow waters down to a depth of 15 metres, and relatively tolerant to changes in both salinity and temperature (Englund and Heino 1994; Strasser 1999; Filippenko and Naumenko 2014). The deeply burrowed adults are resilient and safe from almost all predators, as only their siphons are visible on the sea bottom. Larvae and young stages, however, are prey to several other species such as the flounder (*Platichthys flesus*), gobies (Gobiidae) and brown shrimps (*Crangon crangon*) as well as wintering sea ducks (Strasser 1999). Adult *M. arenaria* die where they lived, and their sturdy, empty shells create new microhabitats for other species (Palacios et al. 2000).

Shallow sandy bottoms usually have diverse infaunal communities, and *M. arenaria* seldom dominates the community. The species is often accompanied by large numbers of the Baltic tellin *Macoma balthica*, the snails *Hydrobia* spp., the ragworm *H. diversicolor* and even the brown shrimp *C. crangon* (Boström and Bonsdorff 1997; VELMU data 2017). Similar biotic communities may occur also on sandy bottoms partially covered by vegetation.

The habitat type combines the HELCOM HUB classes AA.J3L4 and AB.J3L4 (HELCOM 2013a): Baltic photic and aphotic sand where infaunal biomass is dominated by the sand gaper (*Mya arenaria*).

**Geographic variation:** No known geographic variation.

**Relationships to other habitat types:** Habitat patches dominated by *Mya arenaria* may occur close to other sandy habitat types such as common eelgrass (*Zostera marina*) meadows and different kinds of vascular plant communities. Rocky or muddy habitat types may also be found close by.



**Distribution:** *Mya arenaria* is of marine origin and requires salinities of at least 4.5 psu. The network for sampling sandy bottoms is fairly sparse, and therefore the distribution of the habitat type is very poorly known. It is unclear to what extent *M. arenaria* dominates the biomass of infaunal communities. The possible distribution area of the habitat type is limited in the north to the Quark. The map is based on the habitat type occurrences that have been estimated based solely on the quantities of bivalves in the POHJE data (2017).

**Threat factors:** Drifting algal mats and seafloor anoxia (WEP 2), marine sand extraction (EXT 1).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – the sand gaper clam (*Mya arenaria*) – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by sand gaper (*Mya arenaria*) was assessed as a Data Deficient (DD) habitat type (A1–A3, B1 & B2, D1–D3).

The habitat type is poorly known and there is no data on its possible quantitative changes (A1–A3: DD). Sandy bottoms have been strongly underrepresented in benthic sampling, which is why there is very little observation data (POHJE 2017). *M. arenaria* is common as a species, but it is unclear to what extent it is the dominant species on sandy bottoms, hence the habitat type is DD as regards its extent of occurrence and area of occupancy (B1–B2: DD; B3: LC).

The biotic changes in bottoms dominated by *M. arenaria* cannot be estimated, although they are likely to have occurred to some extent and may also occur in the future (D1–D3: DD). Drifting algal mats may also cover sandy bottoms and, when remaining in place for a long period, cause anoxia.

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *sandbanks which are slightly covered by sea water all the time* (1110), *large shallow inlets and bays* (1160) and the underwater parts of *Baltic esker islands* (1610). May be included in *coastal lagoons (fladas) with a maximum area of ten hectares* protected under the Water Act (587/2011).

16.02

#### Benthic habitats characterised by *Macoma balthica*

	IUCN Red List Category	Criteria	Trend
Whole of Finland	LC		+
Southern Finland	LC		+
Northern Finland			

**Description:** The habitat type is characterised by sandy or muddy sediment that is almost or completely unvegetated, and the infaunal community is dominated by the Baltic tellin *Macoma balthica*. The habitat type is probably the most common bottom habitat dominated by infaunal communities in the area (Villnäs and Norkko 2011; VELMU data 2017). *M. balthica* is most common at depths of 2–5 metres, where it can have abundances of several hundred individuals per square metre, but it has been found at a depth of 190 metres (Segerstråle 1960; 1962; Laine 2003; Bonsdorff 2006). *M. balthica* thrives on both muddy and sandy bottoms and tolerates salinities as low as 3 psu (Bonsdorff 2006).

*M. balthica* tends to occur in mixed communities with other infaunal species. Typical co-occurring species on muddy bottoms include crustaceans (such as the amphipod *Monoporeia affinis*), chironomid larvae, polychaetes (e.g. *Marenzelleria* spp., *Bylgides sarsi*) and the

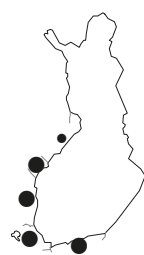
priapulid worm *Halicryptus spinulosus*. Other bivalves (the sand gaper *Mya arenaria* and the lagoon cockle *Cerastoderma glaucum*), oligochaetes and crustaceans (*Corophium volutator* and *Bathyporeia pilosa*) are more common in exposed, sandy sites (Laine 2003; Törnroos et al. 2015). The species composition is also related to depth. The crustaceans *Saduria entomon* and *Pontoporeia femorata* and the nemertean worm *Cyanophthalma obscura* are more common in deeper parts (Laine 2003). Snails such as *Potamopyrgus antipodarum* and *Hydrobia* spp. that graze in partly vegetated shallow areas are common (e.g. Bonsdorff and Blomqvist 1993).

*M. balthica* is considered a keystone species in the Baltic. It is a small (usually under 2 cm) clam that burrows in the sediment. Only its siphons protrude from the sediment. It feeds either on the organic material deposited on the bottom or the phytoplankton it filters from the water column (Fish and Fish 1989). Through bioturbation (sediment mixing and ventilation), the species enhances the oxygenation of the bottom and nutrient fluxes between the sediment and water column (Michaud et al. 2006; Volkenborn et al. 2012). As a common species, *M. balthica* is a significant source of food for many species from invertebrate predators to fishes and birds (Ejdung and Bonsdorff 1992; Aarnio et al. 1996; Lappalainen et al. 2004; Nordström et al. 2010; Borg et al. 2014).

The habitat type combines the HELCOM HUB classes AA.H3L1, AB.H3L1, AA.J3L1 and AB.J3L1 (HELCOM 2013a): Baltic photic and aphotic muddy and sandy sediments where infaunal biomass is dominated by Baltic tellin (*Macoma balthica*).

**Geographic variation:** Geographic variation has not been described, but the composition of accompanying species varies depending on environmental factors such as salinity.

**Relationships to other habitat types:** The habitat type may gradually transform into bottoms dominated by other infauna or vegetation, depending on environmental factors. In several sites, a shift in dominance from *Monoporeia affinis* to *Macoma balthica* has occurred in recent decades, possibly linked to the changes in temperature, nutrient levels and/or oxygen levels (e.g. Kauppi et al. 2015; Weigel et al. 2015).



**Distribution:** The distribution of the habitat type on the Finnish coast follows the distribution of the dominant species, *Macoma balthica*. The habitat type is common on the entire Finnish coast, except in the very lowest salinities.

**Threat factors:** Seafloor anoxia (WEP 2).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – the Baltic tellin (*Macoma balthica*) – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by Baltic tellin (*Macoma balthica*) was assessed as a Least Concern (LC) habitat type (A1 & A2a, B1–B3, C1).

Benthic habitats characterised by *M. balthica* have disappeared from deep sites that have become anoxic. The net change over the past 50 years was, however,



Pitkäviiri, eastern Gulf of Finland. Photo: Petra Pohjola, Metsähallitus Parks & Wildlife Finland

assessed as positive, as over the same period there has been a marked shift in dominance from the amphipod *Monoporeia affinis* (cf. I6.06) to *M. balthica* (Baltic Sea benthic fauna monitoring data 2016; POHJE 2017) (A1: LC). *M. balthica* communities were not assessed to decrease significantly in the future, either (A2a: LC). *M. balthica* is quite tolerant of short-term oxygen depletion. Any possible longer-term historical quantitative changes in benthic habitats characterised by *M. balthica* cannot be assessed (A3: DD).

*M. balthica* communities are abundant and widespread, so the extent of occurrence and the area of occupancy as well as the number of locations are above the thresholds set for Criterion B (B1–B3: LC).

The habitat type's abiotic changes could, in principle, be examined on the basis of factors such as oxygen conditions. Despite the occurrence of anoxia, oxygen conditions on the whole are not regarded as having deteriorated very strongly in the distribution area of this habitat type over the past 50 years (C1: LC). The relative severity of any possible longer-term historical or future abiotic changes cannot be assessed (C2a & C3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Improving. With eutrophication continuing, *Macoma balthica* is likely to continue to benefit from the trend in relation to other benthic fauna.

**Links to administrative classifications:** May be included in the Habitat Types Directive habitat types *sandbanks which are slightly covered by sea water all the time* (1110), *coastal lagoons* (1150), *large shallow inlets and bays* (1160) and *boreal Baltic narrow inlets* (1650).

I6.03

Benthic habitats characterised by <i>Cerastoderma</i> spp.			
	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>DD</b>	A1–A3, B1, B2, D1–D3	?
Southern Finland	<b>DD</b>	A1–A3, B1, B2, D1–D3	?
Northern Finland			

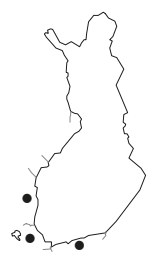
**Description:** The habitat type is characterised by sandy or muddy sediment that is almost or completely unvegetated, and the infaunal community is dominated by the lagoon cockle *Cerastoderma glaucum*. *C. glaucum* is a small (1–3 cm) bivalve that occurs mainly at depths of less than 10 metres, but occasionally the species has been found even at a depth of 30 metres (Leinikki et al. 2004). *C. glaucum* larvae are pelagic, and the young stages often live attached to vegetation. Adult individuals burrow into the sediments with only their short siphon protruding. The shell is deeply grooved, often brownish or slightly pink in colour, and laterally it resembles a heart. The similar-looking and closely related common cockle *C. edule* is frequent on the sandy bottoms of the southern Baltic Sea but does not occur in Finnish waters. Another closely related species is the Copenhagen cockle *Parvicardium hauniense*, which can be found in Finnish waters.

Shallow sandy bottoms usually have diverse infaunal communities, and *C. glaucum* seldom dominates the community. The species is often accompanied by large numbers of the Baltic tellin *Macoma balthica* and the sand gaper *Mya arenaria*, mud snails (*Hydrobia* spp.), insect larvae, the ragworm *Hediste diversicolor*, and the amphipod *Corophium volutator* (VELMU data 2017; POHJE 2017). Similar biotic communities may also occur on sandy bottoms partially covered by vegetation. *C. glaucum* are a source of food for a variety of fish and bird species.

The habitat type includes the HELCOM HUB class AA.J3L2 (HELCOM 2013a): Baltic photic sand where infaunal biomass is dominated by cockles (*Cerastoderma* spp.).

**Geographic variation:** No known geographic variation.

**Relationships to other habitat types:** Habitat patches dominated by *Cerastoderma glaucum* may occur close to other sandy habitat types such as common eelgrass (*Zostera marina*, I2.08) meadows or vascular plant communities of various kinds. Rocky or muddy habitat types may also be found close by.



**Distribution:** *Cerastoderma glaucum* is of marine origin and requires salinities of at least 4 psu. The distribution of the habitat type is very poorly known, and it is unclear to what extent *C. glaucum* dominates the infaunal communities. The habitat type does not in any case occur north of the Quark. The map is based on the habitat type occurrences that have been estimated based solely on the quantities of bivalves in the POHJE data (2017).

**Threat factors:** Seafloor anoxia, decrease in vegetation (WEP 2).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – the lagoon cockle (*Cerastoderma glaucum*) – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by *Cerastoderma* spp. was classified as a Data Deficient (DD) habitat type (A1–A3, B1 & B2, D1–D3).



Pitkäniemi, Bothnian Sea. Photo: Heidi Arponen, Metsähallitus Parks & Wildlife Finland

The habitat type is poorly known and there is no data on its possible quantitative changes (A1–A3: DD). Sandy bottoms have been strongly underrepresented in benthic sampling, which is why there is very little observation data (POHJE 2017). *C. glaucum* is common as a species, but it is unclear to which extent it is the dominant species on sandy bottoms, hence the habitat type is DD as regards the extent of occurrence and the area of occupancy (B1–B2: DD, B3: LC).

Biotic changes in bottoms dominated by *C. glaucum* cannot be assessed, although they are likely to have occurred to some extent and may also occur in the future (D1–D3: DD). Drifting algal mats may also cover bottoms dominated by *C. glaucum* and, when remaining in place for a long period, cause anoxia.

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** May be included in the Habitat Types Directive habitat types *sandbanks which are slightly covered by sea water all the time* (1110), *large shallow inlets and bays* (1160), the underwater parts of *Baltic esker islands* (1610) and *boreal Baltic narrow inlets* (1650).

16.04

Benthic habitats characterised by Unionidae			
	IUCN Red List Category	Criteria	Trend
Whole of Finland	EN (VU–EN)	A3	?
Southern Finland	EN (VU–EN)	A3	?
Northern Finland			

**Description:** The habitat type is characterised by a substrate that is almost or completely unvegetated, and the infaunal community is dominated by bivalves of the family Unionidae. The habitat type occurs in shallow and sheltered locations where salinities are low (e.g. estuaries and sheltered bays). Most of the bottoms dominated by Unionidae occur in the photic zone, but they can also be found in areas with very poor water transparency. The substrate tends to be silt or clay possibly mixed with sand.

The quantity of Unionidae bivalves at the bottom varies from solitary individuals to small groups of around 10 individuals. In the available data, *Anodonta anatina* was the most common Unionidae species. It also has the widest distribution area among the Unionidae that occur in coastal waters, covering the Finnish coast, including the northernmost Bothnian Bay. Other Unionidae species recorded in the coastal waters are *Unio crassus*, *U. pictorum* and *U. tumidus* as well as *A. cygnea* (Oulasvirta and Saari 2008; Valovirta et al. 2011; Leinikki and Leppänen 2014). *U. crassus* only lives in running water, and therefore its occurrence in the habitat type is limited mainly to estuaries with flowing river water.

Unionidae are large oval mussels that settle on the bottom as adults, burrowing into the sediment and moving about on the seabed. They filter nutrients from water (Bergengren et al. 2004). Hermaphroditism occurs in Unionidae and can either be simultaneous (the mussel acts both as the male and female at the same time) or the mussel may change sex in the course of its life. Hermaphroditism occurs especially in small stretches of water, and it is more common in young individuals (Pekkarinen 1993; Hinzmann et al. 2013). The prevalence of hermaphroditism varies also between species. The early stages of these bivalves are dependent on their fish hosts that they attach to until they have matured into small mussels, after which they detach their hold and fall to the bottom (Bergengren et al. 2004). The juvenile stage is probably the most sensitive period in the life cycle of these bivalves, but it is also the most poorly known (Lundberg and Bergengren 2008).

It is usual to find variation among Unionidae beds regarding light, wave action, depth and substrate. Patchy occurrence is also common for the habitat type.

The habitat type corresponds to the HELCOM HUB class AA.H3L6 (HELCOM 2013a): Baltic photic muddy sediment where infaunal biomass is dominated by Unionidae.

**Geographic variation:** There is geographic variation within the habitat type: it is most common in estuaries

and sheltered bays in the inner archipelago, but in the Bothnian Bay the habitat type also occurs in more open areas of the archipelago.

**Relationships to other habitat types:** Habitat patches dominated by Unionidae may occur close to other habitat types characterised by shallow, soft bottoms, such as other infaunal communities or vascular plant communities of different kinds. Rocky or muddy habitat types may also be found close by.



**Distribution:** The habitat type has a patchy distribution along the entire coast of Finland in low-saline estuaries and inner bays.

**Reasons for becoming threatened:** Dredging and port construction (WHC 3), stream and river water acidification and pollutants (CHE 3), benthic siltation (WEP 2).

**Threat factors:** Dredging and port construction (WHC 3), stream and river water acidification and pollutants (CHE 3), benthic siltation (WEP 2).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from bivalves from the family Unionidae being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by Unionidae was assessed as an Endangered (EN) habitat type due to a quantitative decline over the historical time frame (A3).

Over the past 50 years, benthic habitats characterised by Unionidae are estimated to have declined by 30–50% (A1: VU). There is no monitoring data. Instead, the estimate is an expert assessment based on the combination effect of multiple harmful changes. Unionidae communities have been destroyed both by measures related to hydraulic construction, such as port construction, fairway maintenance and flood control, as well as by changes in water and benthic quality, such as increased acidity and solids, heavy metals and siltation. The drainage of sulphate soils, particularly in Ostrobothnia, has increased acidity in coastal estuaries, and forest drainage and intensification of agriculture have increased the quantity of solids in streams and rivers. Land drainage relating to more intensive agriculture has also increased the acidity and heavy metal loading of streams and rivers. Eutrophication-related benthic siltation and blockage of the porous structure of the oxygenated bottom has been a problem for small bivalves in particular, as they also need oxygenated conditions when burrowing into the sediment.

Over the historical time frame, the reduction of Unionidae communities is estimated to be even greater (up to 80%, A3: EN, VU–EN). In addition to factors affecting them over the past 50 years, reasons for this include port construction in estuaries, other shoreline construction and changes in stream and river water having taken place already before the 1960s that have degraded the living conditions of Unionidae in coastal estuaries. The decline of Unionidae communities in



Mussalo, eastern Gulf of Finland. Photo: Juho Lappalainen, Metsähallitus Parks & Wildlife Finland

coastal estuaries is also connected to the decline of bivalve populations in streams and rivers.

The habitat type is not expected to decline significantly further over the next 50 years or it may even begin to increase if stream and river water quality and, consequently, bivalve living conditions in coastal estuaries, start to improve (A2a: LC). The quantitative increase may also be facilitated by any decrease in the salinity of coastal waters.

The geographic distribution of Unionidae communities covers the entire coast of Finland, and the number of 10 km x 10 km grid cells occupied is also estimated to be well above the threshold value of 55 grid cells. The habitat type is Least Concern on the basis of Criterion B (B1–B3: LC).

Abiotic variables that could in principle correlate with the quality of the habitat type include stream and river water acidity and quantity of solids. There are no usable datasets on these, however, so the scale of change cannot be assessed (C1 & C3: DD). The habitat type is not anticipated to decline further in terms of its abiotic characteristics in the future (C2a: LC).

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** May be included in the Habitats Directive habitat type *estuaries* (1130).

16.05

#### Benthic habitats characterised by infaunal polychaetes

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>NE</b>		
Southern Finland	<b>NE</b>		
Northern Finland			

**Description:** The habitat type is characterised by sandy, coarse or muddy sediment or mixed substrate that is almost or completely unvegetated. The substrate must have a mud, silt or clay content of at least 20%. The infaunal community is dominated by polychaetes.

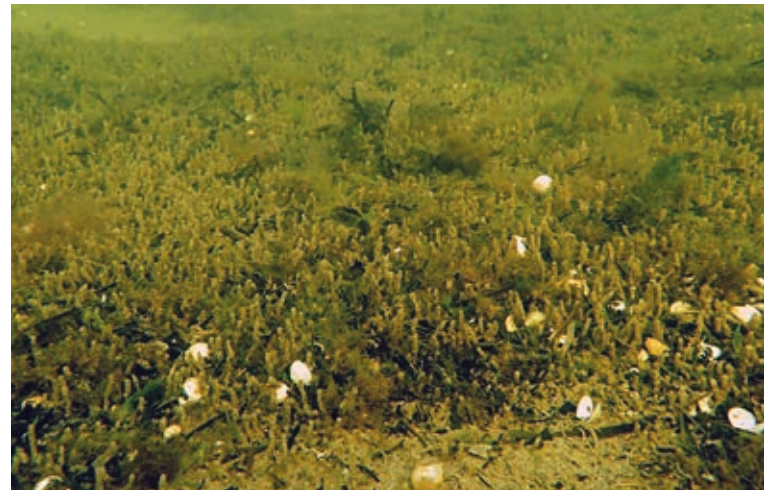
Habitats on the coast of Finland dominated by Polychaeta are poorly known. While polychaetes are common inhabitants of soft bottoms, they are generally small and therefore rarely dominate the benthic fauna. In Finnish waters, only the ragworm *Hediste diversicolor* and the invasive alien polychaetes of *Marenzelleria* spp. are large or abundant enough to potentially dominate the biomass and, consequently, determine a habitat type. *Marenzelleria* spp. are small and slender but they can be highly abundant on bottoms with no other infauna, and they have been highly successful alien species in their new habitat (Zettler et al. 2002; Ezhova et al. 2005; Lännergren et al. 2009; Villnäs and Norkko 2011; Kauppi et al. 2015).

Of the original Baltic polychaetes, *Pygospio elegans* prefers sandy sediments, whereas *H. diversicolor* can be found not only on sand but also on clay and mixed substrates, occasionally even on hard bottoms amongst *Mytilus trossulus* mussel beds (Koivisto 2011).

Most polychaete species on the Finnish coast are small in size, less than 5 mm long. Other polychaetes in the habitat type include *Boccardiella ligerica*, *Fabricia stellaris* and *Manayunkia aestuarina*, which are rarely found in the Bothnian Bay, and *Bylgides sarsi*, which occurs only in the Archipelago Sea and the Gulf of Finland. Only *H. diversicolor* and *Marenzelleria* spp. can grow longer than 4 cm, and only the latter occur across the entire coast of Finland (Kauppi et al. 2015; POHJE 2017; VELMU data 2017).

Most polychaetes burrow in soft sediment. Some species are tube-forming, dwelling in tubes constructed of available particles, while others construct a network of burrows. Some have a tentacle crown that they use to catch food. Others, such as *H. diversicolor*, have multiple structures for catching and shredding prey of different sizes (Barnes 1974; Barnes 1994; Väinölä and Vanhove 2017). The lifespan of even the largest polychaetes rarely exceeds three years (Gudmundsson 1985; Ambrogi 1990; Sarda et al. 1995). All polychaete species coexist with other benthic infauna, and due to their small size they rarely dominate the infaunal community (Villnäs and Norkko 2011; VELMU data 2017; POHJE 2017).

*Marenzelleria* spp. may mitigate the effects of anoxia and eutrophication in sediments by burrowing deeper and wider than other infauna (Zettler 1996; 1997; Kotta et al. 2001; Norkko et al. 2012). Even though most polychaetes, especially *Marenzelleria* spp., are relatively tolerant to eutrophication and anoxic periods, prolonged periods without oxygen will eventually destroy the populations (Gamenick et al. 1996; Kube and Powilleit 1997; Schiedek 1997).



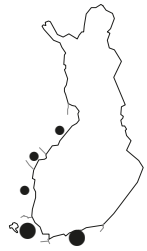
Raippaluoto, Quark. Photo: Jon Ögård, Metsähallitus Parks & Wildlife Finland

The habitat type combines the HELCOM HUB classes AA.H3M3, AA.H3M5, AA.I3M, AA.J3M4, AB.H3M3, AB.H3M5, AB.I3M, AB.J3M4 (HELCOM 2013a): Baltic photic and aphotic muddy, coarse and sandy sediments where infaunal biomass is dominated by *Marenzelleria* spp. or other polychaetes.

**Geographic variation:** The habitat type varies at least by species composition. Of the potential habitat forming polychaeta, only *Marenzelleria* spp. occur across the entire coast of Finland, whereas *Hediste diversicolor*

has not been recorded in the Bothnian Bay (POHJE 2017; VELMU data 2017). *M. arctia* is the dominating *Marenzelleria* species in the deep open areas of the northern Baltic Sea (Kauppi et al. 2015).

**Relationships to other habitat types:** The habitat type may gradually transform into bottoms dominated by other infauna or vegetation, depending on environmental factors. *Marenzelleria* in particular readily invade areas other species have deserted. The other organisms, however, are likely to reappear on bottoms dominated by *Marenzelleria*.



**Distribution:** The habitat type potentially occurs along the entire coast of Finland where suitable bottom substrates can be found. Occurrences are likely to be most abundant in the Gulf of Finland and the Archipelago Sea (Kauppi et al. 2015).

Polychaete communities are often a combination of several species, some of which may be invasive ones. The successful invasion by *Marenzelleria* spp. of the Finnish coast has probably led to an expansion of this habitat type. It is currently not known if this has caused a decrease in the habitats dominated by native polychaetes.

Different species of *Marenzelleria* seem to prefer dissimilar habitats (Blank et al. 2008). *M. viridis* and likely also *M. neglecta* prefer shallow sandy sediments with only low organic content (Kube et al. 1996; Quintana et al. 2007). *M. arctia* thrive on deep and nutrient-rich bottoms and occupy more extensive areas compared to *M. viridis* and *M. neglecta*. Among *Marenzelleria*, *M. arctia* has also best adapted to the low temperatures in the deep waters of the northern Baltic Sea (Maximov et al. 2015).

**Threat factors:** Not evaluated.

**Description of habitat type collapse:** Not evaluated.

**Justification:** The habitat type has not been assessed because it is unclear to what extent benthic habitats characterised by infaunal polychaetes other than those dominated by the current alien species have existed in Finland.

**Reasons for change of category:** New described habitat type, but not evaluated.

**Trend:** Not evaluated.

**Links to administrative classifications:** None.

16.06

#### Benthic habitats characterised by *Monoporeia affinis* and/or *Pontoporeia femorata*

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>EN (EN-CR)</b>	AI	?
Southern Finland	<b>EN (EN-CR)</b>	AI	?
Northern Finland			

**Description:** The habitat type is characterised by sandy or muddy sediment that is almost or completely unvegetated, and the infaunal community is dominated by the amphipods *Monoporeia affinis* and/or *Pontoporeia femorata*. The habitat type occurs most commonly on deep soft bottoms and less frequently on shallow muddy or sandy bottoms.

*M. affinis* is one of the most common species on the deep bottoms of the Baltic Sea but may also occur in shallower waters. The species occurs in both freshwater and marine environments but requires relatively high oxygen concentrations and a good supply of food. Sinking diatoms from the spring phytoplankton blooms especially seem to be crucial for growth and

Benthic habitats characterised by infaunal polychaetes, Bensjär, Archipelago Sea. Photo: Visa Hietalahti





Monoporeia affinis. Photo: Jan-Erik Bruun

reproduction. *P. femorata* has similar habitat preferences but only occurs in higher salinities and in cold waters, usually at depths below 10 metres. Under favourable conditions both *M. affinis* and *P. femorata* can occur in abundances of more than 10,000 individuals per square metre. (Donner et al. 1987; Bonsdorff et al. 2003; Leinikki et al. 2004).

Both species burrow in the sediment during daytime and may swim up towards the surface at night. When feeding and searching for protection, they dig and crawl into the substrate, mixing and oxygenating the sediment. This bioturbation reduces the effects of eutrophication by increasing the retention of phosphorus in the sediment.

The species diversity in the habitat is generally relatively high, but some deep, offshore communities have a considerably lower diversity (HELCOM 2012). In these habitats, especially, *M. affinis* is an important food source for species such as the crustacean *Saduria entomon*, the polychaete *Bylgides sarsi* and the priapulid worm *Halicryptus spinulosus*, and it is also eaten by several fish species, such as the cod (*Gadus morhua*), the Baltic herring (*Clupea harengus membras*), the smelt (*Osmerus eperlanus*) and the fourhorn sculpin (*Myoxocephalus quadricornis*) (Donner et al. 1987; Englund et al. 2008).

The habitat type combines the HELCOM HUB classes AA.H3N1, AB.H3N1 and AB.J3N1 (HELCOM 2013a): Baltic photic and aphotic muddy and aphotic sandy sediments where infaunal biomass is dominated by *Monoporeia affinis* and/or *Pontoporeia femorata*.

**Geographic variation:** The geographic variation of the habitat type is linked to the distributions of the type species. *Pontoporeia femorata* does not tolerate salinities below 6 psu, and it is only rarely encountered in the northern Bothnian Sea and in the eastern Gulf of Finland. However, the more abundant *Monoporeia affinis* occurs along the entire coast of Finland.

**Relationships to other habitat types:** The habitat type may gradually transform into bottoms dominated by other infauna, such as polychaetes or bivalves. The Baltic tellin (*Macoma balthica*) favours slightly warmer and shallower bottoms than *Monoporeia affinis* (Bonsdorff et al. 2003). The low oxygen content in the deeper areas might alter the dominance towards *Marenzelleria* spp.



**Distribution:** The habitat type occurs along the entire coast of Finland. In long-term sample time-series data, both *Monoporeia affinis* and *Pontoporeia femorata* have demonstrated cyclical population fluctuation for reasons that are not currently fully understood (Andersin et al. 1978; HELCOM Red List Benthic Invertebrate Expert Group 2013).

The fluctuation in the quantities of species is reflected in the prevalence of the habitat type if these cycles still occur. In recent decades, *M. affinis* has declined in many areas, often leading to a dominance of the Baltic tellin *Macoma balthica* and *Marenzelleria* spp. (e.g. Eriksson Wiklund and Andersson 2014; Kauppi et al. 2015; Weigel et al. 2015).

**Reasons for becoming threatened:** Competitive advantage possibly gained by the Baltic tellin *Macoma balthica* from seafloor anoxia and eutrophication (WEP 3), dispersal of polychaetes of *Marenzelleria* spp. (IAS 2).

**Threat factors:** Competitive advantage possibly gained by the Baltic tellin *Macoma balthica* from seafloor anoxia and eutrophication (WEP 3), dispersal of polychaetes of *Marenzelleria* spp. (IAS 2).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – the amphipods *Monoporeia affinis* and/or *Pontoporeia femorata* – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** The quantitative decline of communities where infaunal biomass is dominated by *Monoporeia affinis* and/or *Pontoporeia femorata* was assessed to correspond to Endangered at the nationwide level (A1: EN, range of category EN–CR), but the differences between marine areas are large. It should be noted that this reduction can be observed specifically in the benthic classification based on biomass dominance rather than on population trend estimates concerning the amphipod abundance.

The relative decline of the habitat type was estimated to exceed 80% at least in the Gulf of Finland and the Bothnian Sea and possibly also in the Åland Sea-Archipelago Sea area. Benthic fauna monitoring data



Pontoporeia femorata. Photo: Lauri Laitila



was collected for the assessment (Baltic Sea benthic fauna monitoring data 2016; POHJE 2017). In the northern part of the Bothnian Bay, the area covered by the habitat type appears to have remained unchanged (until the early 2010s). The region-specific estimates of change were combined to form a nationwide assessment, taking into account the areas potentially covered by the habitat type, which were calculated for the Gulf of Finland, the Archipelago Sea and the Åland Sea on the basis of proportion of oxygenated bottom areas deeper than 20 metres and, for other marine areas, those deeper than 10 metres.

Zoobenthos data collected from monitoring stations shows that communities where infaunal biomass is dominated by *M. affinis* and/or *P. femorata* have disappeared or declined very strongly on most sites where they had been found at some point in the period studied. In most cases they have been replaced by communities dominated by *Macoma balthica* or infaunal polychaetes. In Southern Finland in particular, these amphipod communities have in places declined strongly or disappeared altogether. Both species are highly sensitive to anoxia (e.g. Johansson 1997; Wiklund and Sundelin 2001), but they have also declined on oxygenated bottoms for reasons that are in part unknown. It has been suggested that, through their food supply, the species suffer from changes in the quantity and species composition of phytoplankton (e.g. Johnson and Wiederholm 1992; Lehtonen and Andersin 1998; Eriksson Wiklund and Andersson 2014). The reduction in *M. affinis* may also be part of natural long-term cyclical fluctuations (Andersin et al. 1978; 1984), but potentially cyclical reductions are also counted as a genuine reduction, unless recovery following a downward phase is certain (cf. IUCN 2012).

On the other hand, in places there have been no major changes in the biomass of these amphipod populations, but increases in other species have altered the dominant species ratios, with a habitat type dominated by *M. affinis* transformed into a habitat type dominated by some other species. If dominance was examined on the basis of numbers of individuals, the changes observed would not be as strong.

In both cases, the habitat type has usually changed into one where infaunal biomass is dominated by *M. balthica* or *Marenzelleria* spp. The alien polychaetes of *Marenzelleria* spp. have dispersed into the Baltic Sea since the 1980s and are currently abundant in benthic sediments in all of Finland's marine areas (Kauppi et al. 2015; Katajisto et al. 2017). The increased abundance of *M. balthica* is probably related to increased access to food through eutrophication and possibly to the improved survival of individuals settling on the bottom following the reduction of *M. affinis* (Elmgren et al. 1986). It is unlikely for *M. affinis* to have been displaced by *M. balthica* or *Marenzelleria* spp. The species may, however, have been able to benefit from the free space created in many areas following the amphipod decline (e.g. Eriksson Wiklund and Andersson 2014).

The possible quantitative changes in the habitat type cannot be assessed over the historical time frame or concerning the future (A2a & A3: DD). The extent of

occurrence and the area of occupancy are above the thresholds set for Criterion B. The habitat type is Least Concern on the basis of Criterion B (B1–B3: LC).

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** None.

16.07

<b>Benthic habitats characterised by <i>Bathyporeia pilosa</i></b>			
	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>DD</b>	A1–A3, B1, B2, C1–C3, D1–D3	?
Southern Finland	<b>DD</b>	A1–A3, B1, B2, C1–C3, D1–D3	?
Northern Finland			



*Bathyporeia pilosa*. Photo: Hans Hillewaert, Wikimedia Commons

**Description:** The habitat type is characterised by sandy or coarse sediment that is almost or completely unvegetated, and the infaunal community is dominated by the sand digger shrimp *Bathyporeia pilosa*. The habitat type occurs most commonly in shallow and relatively exposed bays with sandy bottoms and less frequently on coarse and even slightly muddy bottoms.

*B. pilosa* is a tiny (4–6 mm) but robust amphipod that occurs in marine and brackish environments. It spends most of the day buried in the sediment. *B. pilosa* populations are usually located in relatively shallow waters, but the species has been found as deep as 42 metres (Dahl 1944). *B. pilosa* tolerates both low salinities as well as other environmental stress factors relatively well but requires access to the water column to feed during the night. Drifting filamentous algal mats therefore have a negative impact on populations of *B. pilosa* (Khayrallah and Jones 1980; Norkko et al. 2000; Väinölä 2017b).

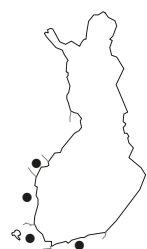
Under favourable conditions, *B. pilosa* can occur in extremely high abundances of up to 10,000 individuals per square metre (Vader 1965). Due to its small body

size and patchy occurrence, *B. pilosa* rarely dominates the infaunal community. It often coexists with many larger species, such as bivalves (the Baltic tellin *Macoma balthica*, the sand gaper *Mya arenaria*) and polychaetes (e.g. *Marenzelleria* spp., *Pygospio elegans*). Large populations of the crustacean *Saduria entomon* are known to limit the population sizes of *B. pilosa* through predation (Sandberg 1996).

The habitat type combines the HELCOM HUB classes AA.I3N3, AB.I3N3 and AA.J3N3 (HELCOM 2013a): Baltic photic and aphotic coarse sediments and photic sand where infaunal biomass is dominated by sand digger shrimp (*Bathyporeia pilosa*).

**Geographic variation:** No known geographic variation.

**Relationships to other habitat types:** The habitat type may gradually transform into bottoms dominated by either other infauna (e.g. bivalves, polychaetes) or vegetation depending on the environmental factors.



**Distribution:** *Bathyporeia pilosa* occurs along the entire Finnish coast, except for the Bothnian Bay and the easternmost Gulf of Finland. The dense populations occur in the substrate as fluctuating patches, which makes sampling difficult (Mettam 1989). The distribution and prevalence of bottoms dominated by *B. pilosa* is poorly known.

**Threat factors:** Drifting algal mats and seafloor anoxia (WEP 3), marine sand extraction (EXT 1).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from the dominant species – the sand digger shrimp (*Bathyporeia pilosa*) – being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by sand digger shrimp (*Bathyporeia pilosa*) was assessed as a Data Deficient (DD) habitat type (A1–A3, B1 & B2, C1–C3, D1–D3).

Communities dominated by *B. pilosa* are likely to occur here and there on sandy bottoms, but *B. pilosa* is not easily caught by sampling equipment and its occurrence and any changes in abundance are therefore very poorly known. In addition, variation in local distribution appears to be strong (Khayrallah and Jones 1980; Mettam 1989). The habitat type may have declined due to eutrophication related sandy bottom siltation and increased anoxia, but the quantitative changes were assessed as Data Deficient as regards the past as well as the next 50 years (A1–A3: DD). In Väinämeri, NE Baltic Sea, Orav-Kotta et al. (2004) found that habitats suitable for *B. pilosa* have decreased over the past 30 years.

The extent of occurrence and the area of occupancy of *B. pilosa* communities are poorly known. Estimated on the basis of marine zoobenthos observations (POHJE 2017), the geographic distribution is less than 50,000 km<sup>2</sup> and the number of 10 km x 10 km grid cells occupied 15, but the habitat type may occur considerably more extensively in the Bothnian Sea and the Gulf of Finland. The habitat type is Data Deficient also on the basis of Criterion B (B1 & B2: DD, B3: LC).

Eutrophication may have had a negative impact on benthic habitats characterised by *B. pilosa* through factors such as increased algal mats or anoxia, but the relative severity of any abiotic and biotic changes that have possibly already taken place in the past or will take place in the future cannot be assessed (C1–C3, D1–D3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *sandbanks which are slightly covered by sea water all the time* (1110), *large shallow inlets and bays* (1160) and the underwater parts of *Baltic esker islands* (1610).

16.08

#### Benthic habitats characterised by midge larvae (Chironomidae)

	IUCN Red List Category	Criteria	Trend
Whole of Finland	LC		+
Southern Finland	LC		+
Northern Finland			

**Description:** The habitat type is characterised by muddy or possibly sandy substrate that is almost or completely unvegetated, and the infaunal community is dominated by midge larvae (Chironomidae).

Midge larvae are common infaunal species on soft bottoms. They occur mainly in shallow coastal areas with low salinities. In the larval stage they feed on the organic material in the substrate or on smaller animals, such as plankton, while they themselves are a source of food for many fish species (Kahanpää 2017).

In the Finnish coastal waters, species belonging to, e.g. the subfamilies Tanypodinae and Chironominae are very common (POHJE 2017). They usually co-occur with other benthic insects, polychaetes or bivalves, but midge larvae can dominate especially on oxygen-depleted bottoms. In the last larval stage, the larvae of the largest species are around 3 cm long. The large larvae, coloured by haemoglobin, inhabit especially the deeper or oxygen-depleted bottoms, while individuals in shallow water tend to be smaller and paler (Kahanpää



Midge larvae.

2017). One of the species tolerant to low oxygen levels is *Chironomus plumosus*, which is red in its larval stage (e.g. Hoback and Stanley 2001) and lives in the bottom sediment in a U-shaped tube.

The habitat type combines the HELCOM HUB classes AA.H3P1, AA.J3P1, AB.H3P1 and AB.J3P1 (HELCOM 2013a): Baltic photic and aphotic muddy and sandy sediments where infaunal biomass is dominated by midge larvae (Chironomidae).

**Geographic variation:** No known geographic variation.

**Relationships to other habitat types:** The habitat type can gradually transform into bottoms dominated by other infauna, such as polychaetes or bivalves. Especially in oxygen-depleted circumstances, areas dominated by midge larvae can co-occur with layers of anaerobic bacteria.



**Distribution:** Midge larvae occur as infauna in shallow coastal waters throughout the Finnish coast, but they dominate the biomass mainly in oxygen-depleted pools in the coastal waters.

**Threat factors:** –

**Description of habitat type collapse:**

A habitat type is regarded as collapsed if all of its occurrences have been lost.

This would result from midge larvae (Chironomidae) being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by midge larvae (Chironomidae) was assessed as a Least Concern (LC) habitat type (A1–A3, B1–B3, C1–C3).

The eutrophication of the Baltic Sea may have increased the quantity of bottoms dominated by midge larvae, as some Chironomidae are more tolerant of temporary anoxia or low-oxygen conditions than other species of benthic fauna (A1 & A3: LC). The situation is not expected to change significantly over the next 50 years (A2a: LC).

The habitat type occurs throughout the Finnish coastal area and is not rare. The extent of occurrence and the area of occupancy are above the thresholds set for Criterion B, and the habitat type is Least Concern also on the basis of subcriterion B3 (B1–B3: LC).

Communities of chironomid larvae are not likely to have suffered much from changes resulting from eutrophication in coastal waters. Instead, they have actually gained and are likely to continue to have a competitive advantage from poor oxygen conditions (C1–C3: LC).

The composition of chironomid midge larvae communities is likely to have changed due to eutrophication, as some species have declined and others benefitted. It is, however, unclear to what extent bottoms where infaunal biomass is dominated by midge larvae have actually existed on oxygenated bottoms. The relative severity of biotic changes cannot be assessed (D1–D3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Improving. With eutrophication continuing, midge larvae (Chironomidae) are likely to continue to benefit from the trend in relation to most other benthic fauna.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *estuaries* (1130), *coastal lagoons* (1150) and *large shallow inlets and bays* (1160). May be included in *coastal lagoons (fladas) and lakes created by land uplift (glo-lakes) with a maximum area of ten hectares* protected under the Water Act (587/2011).

16.09

#### Benthic habitats characterised by meiofauna

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>DD</b>	B2, D1–D3	?
Southern Finland	<b>DD</b>	B2, D1–D3	?
Northern Finland			



An ostracod. Photo: Emmi Hänninen, Metsähallitus Parks & Wildlife Finland

**Description:** The habitat type is characterised by coarse, sandy, silty and/or muddy sediment or a mix of these that is almost or completely unvegetated. The infaunal biomass is dominated by meiofauna. The habitat type occurs at all depths, but it becomes more likely with increasing depth.

The Baltic meiofauna is a varying group of animals living partially within the sediment. The most common are nematodes, oligochaetes, ostracods, copepods, turbellarians and rotifers (Elmgren 1984; Aarnio and Bonsdorff 1992; Coull 1999). Meiofauna is defined to comprise individuals smaller than 1 mm in length (Nascimento 2010), but most of the species are much smaller, even 0.040–0.5 mm in size. Salinity and temperature gradients are decisive factors for the species composition and abundance of both meiofauna and macrofauna (Elmgren 1978; Widbom and Elmgren 1988). Meiofauna, especially nematodes, are highly tolerant of both anoxia and eutrophication and therefore often form habitats in areas where macrofauna can no longer survive (Elmgren 1975; Van Colen et al. 2009). In the Gulf of Bothnia, where macrofaunal communities may have lower biomass, meiofauna may have a greater role than macrofauna (Elmgren 1978; Elmgren 1984; Furman et al. 2014). In addition to soft bottoms and open water, meiofauna are also found within biotic communities on hard-bottom habitats, but due to their small size

they integrate into the surrounding biotic community (VELMU data 2017).

Nematodes are the most abundant group of benthic meiofauna in the Baltic Sea, ranging between 67–91% of the species observed in the sediment (Olafsson and Elmgren 1997). The next most common groups on the Finnish coastline are harpacticoid copepods and ostracods (Elmgren 1984; Coull 1999; Katri Aarnio, pers. comm. 2017). Being a large group, meiofauna have versatile and diverse dietary requirements; harpacticoid copepods and ostracods prefer to eat diatoms, while nematodes also include bacteria in their diet (Giere 2009; Nascimento 2010). Sedimentation of organic matter may increase the proportion of groups grazing on the substrate in meiofaunal communities (Olafsson and Elmgren 1997). According to recent studies, meiofauna may benefit from eutrophication and related sedimentation, gaining competitive advantage over macrofauna. Macrofauna are more vulnerable to the effects of eutrophication due to their larger size, longer and more complicated life cycle, and higher energy requirements (Nascimento 2010). Prolonged eutrophication and sedimentation, however, result in loose algal mats and anoxic bottoms, which are considered the greatest threats to meiofaunal communities.

Baltic meiofaunal communities have been studied far less than macrofaunal ones; most often meiofauna are only briefly mentioned as a part of the whole biotic community. Additionally, meiofauna samples are rarely defined to the species level, and meiofaunal processes are understood only on a very general level.

The habitat type combines the HELCOM HUB classes AA.H4U1; AB.H4U1; AB.I4U1 and AB.J4U1 (HELCOM 2013a): Baltic photic and aphotic sandy, muddy and coarse sediments where infaunal biomass is dominated by meiofauna.

**Geographic variation:** The habitat type is poorly known. The species composition presumably varies in different parts of the Finnish coast, depending on environmental factors. The relative proportion of nematodes is assumed to increase when moving from the basin of the Baltic Sea proper to the Bothnian Bay. Ostracods are more common in the southern parts of the Finnish coast and on harder bottom sediments. Oligochaetes can often be found on muddy bottoms where no other species are found (Arlt et al. 1982; VELMU data 2017).

**Relationships to other habitat types:** Meiofauna can be found on almost all bottoms but, due to their small size and biomass, they rarely form habitats. Seasonal shifts are common in mixed communities with macrofauna, especially in shallow waters (Olafsson and Elmgren 1997; Nascimento 2010).



Zoological Station.

**Distribution:** The habitat type is assumed to occur throughout the Finnish coast both in shallow coastal waters and on the deeper bottoms, but there are no confirmed observations of bottoms dominated by meiofauna. The habitat type has been little researched, and most data is centred at biological research stations such as the Tvärminne

**Threat factors:** Seafloor anoxia (WEP 2).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from meiofauna being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by meiofauna was assessed as a Data Deficient (DD) habitat type (B2, D1–D3).

As the classification of benthic communities is based on biomass, oxygenated bottoms belong to types characterised by macrofauna. Bottoms dominated by meiofauna are likely to be associated mainly with temporary anoxia, which has increased due to the eutrophication of the Baltic Sea. Meiofauna dominated communities are likely to be a succession stage after oxygen depletion, so occasional anoxia may create areas suitable for domination by meiofauna. The quantity of the habitat type is not estimated to have decreased. Instead, it may even have increased over the past 50 years (A1 & A3: LC). The quantity is not expected to decrease significantly over the next 50 years, either (A2a: LC)

The occurrence of bottoms dominated by meiofauna is poorly known, but the extent of occurrence and the number of locations are assumed to be above the thresholds set for subcriteria B1 and B3 (B1 & B3: LC). On the other hand, the number of 10 km x 10 km grid cells occupied cannot be estimated (B2: DD).

Although temporary anoxia may even have increased the quantity of this habitat type, it is unclear how the biotic quality and, for example, the biotic communities of the occurrences have changed. Among groups of organisms belonging to meiofauna, nematodes tolerate anoxia but benthic copepods (Harpacticoida) and ostracods do not. The relative severity of the changes in species composition cannot be determined, so the habitat type is Data Deficient on the basis of biotic changes (D1–D3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** None.

17

## Other benthic habitats

17.01

### Benthic habitats characterised by microphytobenthic organisms and grazing snails

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>DD</b>	A1–A3, B1–B3	?
Southern Finland	<b>DD</b>	A1–A3, B1–B3	?
Northern Finland			

**Description:** The habitat type is characterised by the occurrence of low-growing algae and diatoms (Bacillariophyta) that cover hard rock and boulders. The proportion of macrovegetation in the habitat type is less than 10%. According to Johansson et al. (2012),

the most common algal species present in the habitat type are *Aegagropila linnaei*, *Cladophora glomerata* and *Battersia arctica*. Filamentous green algae *Rhizoclonium* spp., *Spirogyra* spp. and *Batrachospermum* spp. are also often present. It is common for cyanobacteria (e.g. *Rivularia* spp.) and detritus to accumulate on surfaces and on algae. The habitat type covered by low-growing algae occurs most at shallow depths below 5 metres, but unvegetated surfaces covered by diatoms and detritus can be found even at a depth of 20 metres.

Snails graze the organic material growing and accumulating on hard surfaces. The most common of the snails are *Stagnicola palustris*, *Lymnaea stagnalis* and *Radix* spp. *Radix* spp. can be found deeper than the others. The snails *Theodoxus fluviatilis* and *Bithynia tentaculata* co-occur with the above-mentioned snails (Kangas 1971; Nyman et al. 1987). Snails in the habitat type provide an important source of nutrition for fish such as the common whitefish (*Coregonus lavaretus*) (Söderberg 2016).

The habitat type corresponds to the HELCOM HUB class AA.A2W (HELCOM 2013a): Baltic photic rock and boulders characterised by microphytobenthic organisms and grazing snails.

**Geographic variation:** No known geographic variation.

**Relationships to other habitat types:** The habitat type occurs on exposed rock and boulders throughout all archipelagic zones and can change gradually into bottoms characterised by annual or perennial filamentous algae, *Fucus* spp. or red algae.

**Distribution:** The habitat type is common in the Quark and the Bothnian Bay but also occurs in the Gulf of Finland and can also be found in other parts of the Finnish coast.

**Threat factors:** –

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from microphytobenthic organisms and



Hanko, western Gulf of Finland. Photo: Anu Riihimäki, Metsähallitus Parks & Wildlife Finland

grazing snails being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by microphytobenthic organisms and grazing snails was assessed as a Data Deficient (DD) habitat type (A1–A3, B1–B3).

The habitat type's extent of occurrence is poorly known, and there is no data on its possible quantitative changes.

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types reefs (1170) or the underwater parts of boreal Baltic islets and small islands (1620) and the underwater parts of Baltic esker islands (1610).

17.02

#### Benthic habitats characterised by anaerobic organisms

	IUCN Red List Category	Criteria	Trend
Whole of Finland	LC		+
Southern Finland	LC		+
Northern Finland			

**Description:** The habitat type occurs mostly on aphotic soft bottoms with no vegetation. The content of mud or other fine-grained sediments is at least 20% in the substrate. The biotic community is dominated by anaerobic organisms. The species composition is not very well known, but the bacterium *Beggiatoa* is believed to commonly occur in the anoxic patches of shallower waters at least.

The habitat typically occurs at depths of over 50 metres (HELCOM 2013a). In recent decades, anaerobic biotic communities have also been found in shallower coastal areas, especially in the Archipelago Sea and the western Gulf of Finland (Conley et al. 2011; Virtanen et al. 2018). Anoxic patches have been found at depths of 10–40 metres in the Archipelago Sea (Conley et al. 2011). Unlike the relatively stable anoxic patches at greater depths, the shallow and therefore more exposed patches can vary slightly in terms of their location and stability (Stal et al. 1995).

Anaerobic biotic communities also occur beneath dense mats of filamentous algae (Snoeijs 1999), loose algal mats (Norkko and Bonsdorff 1996) and cyanobacteria colonies (Stal et al. 1985; Stal 1995). The dense mats require light in order to grow, but they block the light from entering the lower layers and therefore create an anoxic environment for anaerobic organisms. These narrow-space habitat biotic communities can occur on both soft (*Vaucheria* spp., loose algal mats) and hard substrates (*Spirulina* spp.). They have not been studied much so far, and it is not known how permanent or localised they are.

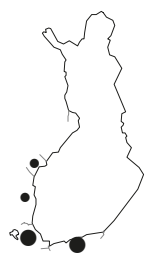
The habitat type includes the HELCOM HUB class AB.H4U2 (HELCOM 2013a): Baltic aphotic muddy sediment dominated by anaerobic organisms.



Pirttilouttu, Bothnian Sea. Photo: Heidi Arponen, Metsähallitus Parks & Wildlife Finland

**Geographic variation:** No known geographic variation.

**Relationships to other habitat types:** At greater depths, the habitat type often occurs alongside soft bottoms dominated by various macrofauna. In shallower areas the habitat type can occur variably in the vicinity of different kinds of soft and hard bottoms and alongside both animal and plant communities.



**Distribution:** Habitats characterised by anaerobic organisms are found throughout the entire coast of Finland, with the exception of the northern Bothnian Bay. They are most common in the Archipelago Sea and the western Gulf of Finland.

**Threat factors:** –

**Description of habitat type collapse:**

A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from anaerobic organisms being reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats characterised by anaerobic organisms was assessed as a Least Concern (LC) habitat type (A1–A3, B1–B3, C1–C3).

The eutrophication of the Baltic Sea has increased the quantity of the habitat type through the degeneration of seafloor oxygen conditions (A1 & A3: LC), and the situation is not expected to change significantly over the next 50 years (A2a: LC).

The habitat type is found in all of Finland's marine areas, and the extent of occurrence and the area of occupancy are above the thresholds set for Criterion B (B1–B2: LC). The habitat type is LC also on the basis of subcriterion B3.

From the perspective of this habitat type the Baltic Sea's abiotic conditions have changed in a way supporting the occurrence of anaerobic communities (C1–C3: LC).

**Reasons for change of category:** New habitat type.

**Trend:** Improving as eutrophication continues further.

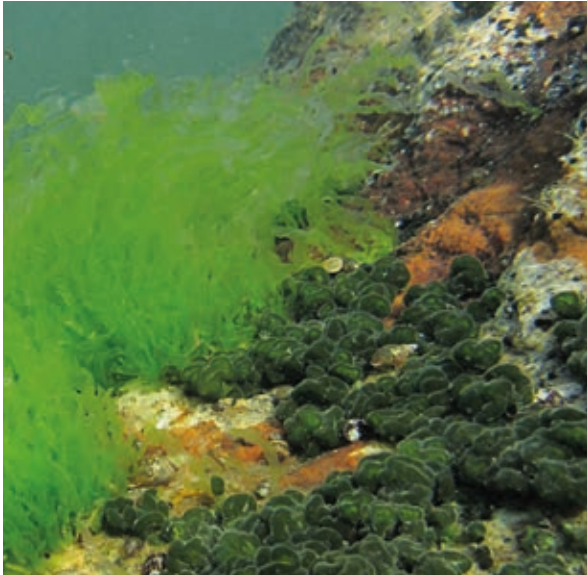
**Links to administrative classifications:** May be included in the Habitats Directive habitat type *boreal Baltic narrow inlets* (1650).

17.03

#### Benthic habitats characterised by globular colonies of cyanobacteria or ciliates

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>NE</b>		
Southern Finland	<b>NE</b>		
Northern Finland			

**Description:** The habitat type candidate is characterised by globular colonies of cyanobacteria (Cyanophyceae) or ciliates (Ciliophora) that dominate bottoms with no permanent vegetation. These taxonomically very



Bokreivit, Bothnian Sea. Photo: Anniina Saarinen, Metsähallitus Parks & Wildlife Finland

distant organisms can form macroscopically similar, gelatinous balls, usually only a few centimetres in diameter (Mollenhauer et al. 1999). In surveys conducted in recent years, such colonies have been observed to cover areas of a few square metres on individual unvegetated bottoms in sheltered and shallow bays (VELMU data 2017). More commonly, these globular colonies grow attached to vegetation; in these cases, other species tend to outweigh their biomass. Overall, very little is known about this possible new habitat type.

The globular colonies usually consist of ciliates from the genus *Ophrydium* or cyanobacteria from the genera *Nostoc* or *Rivularia* (Mollenhauer et al. 1999). *Ophrydium* spheres may be hollow and easy to break down, whereas cyanobacteria tend to form more solid and firm spherical masses. It is not known how stable or temporary the habitat type patches of globular colonies are.

No corresponding HELCOM HUB classes (HELCOM 2013a).

**Geographic variation:** No known geographic variation. All of the known species thrive in both freshwater and brackish environments.

**Relationships to other habitat types:** The habitat type usually occurs in fairly sheltered locations which are otherwise dominated by vascular plant or infaunal communities.



**Distribution:** The habitat type is most likely very rare, but can occur throughout the Finnish coast. The only confirmed occurrences have been found in the eastern Gulf of Finland (VELMU data 2017).

**Threat factors:** Not evaluated.

**Description of habitat type collapse:** Not evaluated.

**Justification:** The habitat type has not been evaluated.

**Reasons for change of category:** No changes (new described habitat type, but not evaluated).

**Trend:** Not evaluated.

**Links to administrative classifications:** May be included in the Habitats Directive habitat types *estuaries* (1130), *coastal lagoons* (1150), *large shallow inlets and bays* (1160) and *boreal Baltic narrow inlets* (1650). May be included in *coastal lagoons (fladas) and lakes created by land uplift (glo-lakes) with a maximum area of ten hectares protected under the Water Act (587/2011)*.

17.04

Benthic shell gravel habitats			
	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>DD</b>	A1–A3, D1–D3	?
Southern Finland	<b>DD</b>	A1–A3, D1–D3	?
Northern Finland			

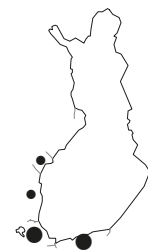
**Description:** The habitat type refers to bottoms with shell gravel coverage of at least 90%. In Finland, the habitat type is poorly known. Shell gravel consists of shells or shell fragments of the blue mussel (*Mytilus trossulus*), the sand gaper (*Mya arenaria*), the Baltic tellin (*Macoma balthica*) and/or the lagoon cockle (*Cerastoderma glaucum*). Shell gravel typically forms small patches on other sediments, occasionally also mixing with sand or gravel. *Mytilus* shell gravel tends to occur in slightly deeper areas than gravel derived from other mussels (10 and 8 metres, respectively, on average) (VELMU data 2017).

Shell gravel tends to be loose and probably offers shelter for many small invertebrates, but there is little research data on the accompanying fauna. In the southern Baltic Sea, shell gravel bottoms are divided into several subtypes according to the dominant shell gravel species, and the subtypes are inhabited by very specialised fauna (HELCOM 2013a).

The habitat type combines the HELCOM HUB classes AA.E and AB.E (HELCOM 2013a): Baltic photic and aphotic shell gravel.

**Geographic variation:** The only known aspect of geographic variation relates to the shell material (see Distribution).

**Relationships to other habitat types:** Shell gravel typically accumulates into a relatively thin layer on top of other substrates. Shell gravel occurs on both soft and hard substrates. Shell gravel bottoms are often found underneath vertical walls or boulders dominated by *Mytilus trossulus*, or between sand and/or gravel ridges in exposed areas.

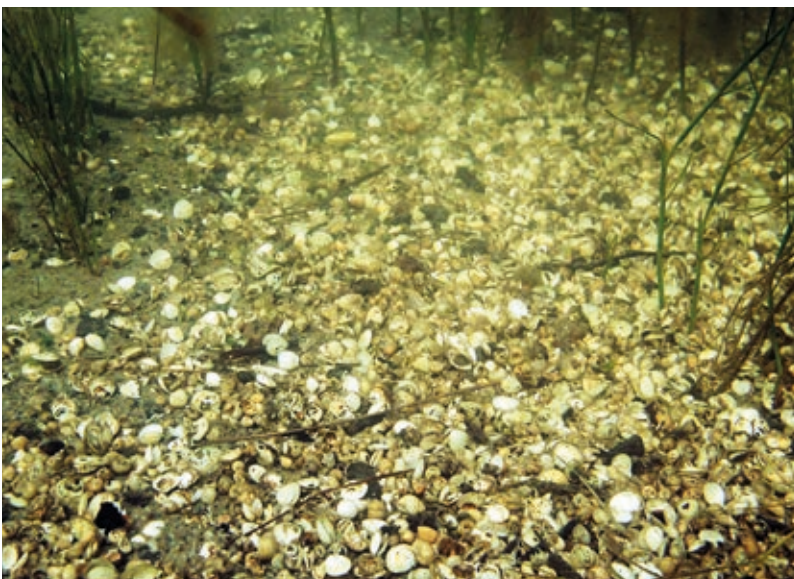


**Distribution:** *Mytilus* shell gravel bottoms are mainly located in the Archipelago Sea and the western Gulf of Finland. Other shell gravel habitats occur throughout the Finnish coast, excluding the Bothnian Bay (VELMU data 2017).

**Threat factors:** Benthic siltation (WEP 2), reduced salinity (CC 1).

**Description of habitat type collapse:**

A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from shell gravel being lost or reduced to such an extent that



Kaffebådan, Quark. Photo: Pekka Lehtonen, Metsähallitus Parks & Wildlife Finland

there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic shell gravel habitats was assessed as a Data Deficient (DD) habitat type (A1–A3, D1–D3).

The habitat type is poorly known, and there is no data on its possible quantitative changes (A1–A3: DD). The aggregate extent of occurrence of shell gravel consisting of shells of various bivalve species extends from the Gulf of Finland to the Quark (EOO > 60,000 km<sup>2</sup>), and the number of 10 km × 10 km grid cells occupied is above the thresholds set for subcriterion B2, hence the habitat type is Least Concern on the basis of Criterion B (B1–B3: LC). Gravel patches consisting mainly of blue mussel (*Mytilus trossulus*) shells have been observed in 61 and other types of shell gravel in 33 grid cells (VELMU data 2017).

The biotic communities of shell gravel or their possible changes are not known (subcriteria D1–D3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** None.

17.05

#### Benthic habitats with ferromanganese concretions

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>DD</b>	A3, C1–C3, D1–D3	?
Southern Finland	<b>DD</b>	A3, C1–C3, D1–D3	?
Northern Finland			

**Description:** Mineral precipitates that form a habitat type are typical of deep waters (e.g. the Pacific Ocean) and shallow seas like the Baltic Sea. The concretions are formed under aerobic conditions on the seabed and in the seabed surface sediments through biogeochemical processes catalysed by micro-organisms (e.g. Zhang et al. 2002; Yli-Hemminki et al. 2014). A habitat patch

should have iron-manganese concretion coverage of at least 90% in order to be classified in this habitat type.

Iron-manganese precipitates, i.e. ferromanganese (FeMn) concretions (or FeMn nodules / polymetallic nodules), are typical mineral deposits of the Baltic seabed, especially its northern parts. As the name suggests, most of the mass in the concretions is iron and manganese but can also include phosphorus, arsenic and rare earth metals. Diverse bacterial species that live on the surface of the concretions and its porous interior either increase the mass or corrode the concretions. The FeMn concretions in the Baltic Sea resemble lake ores and deep-sea manganese nodules. However, there are differences both in the structure and chemical composition of the concretions as well as in the way they are formed.

In the Finnish coastal waters, FeMn concretions occur on the seafloor at water depths of 1–75 metres and even deeper in the open sea. The size and the shape of the concretions vary greatly: the smallest nodules are only a few millimetres in diameter, while the largest cover several square metres. The shape and size of the concretions are determined by the seabed relief and the seabed substrate (Zhamoida et al. 2004). The concretions lying on the seabed are often rugged and porous. They grow gradually in oxic conditions, but their growth rate is relatively slow (0.003 to 0.3 mm per year, e.g. Grigoriev et al. 2013). Under anoxic conditions, the concretions begin to dissolve, releasing metals and nutrients into the marine environment.

Typically, discoidal concretions and crusts occur on gentle slopes in areas with no deposition or with low sedimentation rates. FeMn concretions often cover early Holocene Ancyclus lacustrine clays or glaciolacustrine clays. Extensive concretion fields might form locally. In the eastern Gulf of Finland, the abundance of concretions may reach 50–60 kg/m<sup>2</sup> (Zhamoida et al. 2017). Sometimes, however, concretions occur only intermittently.

Despite their abundance, seabed concretions have been very little studied. The concretions increase both geological and biological heterogeneity (geodiversity) on soft bottoms by forming hard three-dimensional structures that provide shelter and attachment surfaces for benthic organisms. In addition, concretions can protect the soft seafloor from erosion and near-bottom currents.

FeMn concretions bind environmental pollutants as well as phosphorus, which is an important nutrient for living organisms. As the quantity of phosphorus in the concretions is higher than in the surrounding water, the concretions might play an important role in controlling the internal loading in the Baltic Sea.

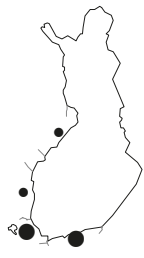
Ferromanganese concretions are often associated with relatively rich benthic fauna dominated by bivalves, such as the lagoon cockle (*Cerastoderma glaucum*), the Baltic tellin (*Macoma balthica*), the blue mussel (*Mytilus trossulus*); snails *Peringia ulvae*, *Ecrobia ventrosa*; oligochaets; polychaetes: *Hediste diversicolor*, *Marenzelleria* spp., *Boccardiella ligerica*; ostracods and chironomid larvae (Kotilainen et al. 2020; Leinikki 2020).



The habitat type combines the HELCOM HUB classes AA.F and AB.F (HELCOM 2013a): Baltic photic and aphotic ferromanganese concretion bottoms.

**Geographic variation:** FeMn concretions occur throughout the Finnish coast, in all sea areas. Based on the VELMU data, however, within the Finnish coastal waters the 90% coverages required by the HELCOM HUB classification (HELCOM 2013a) have so far been found only in the Archipelago Sea and the Gulf of Finland.

**Relationships to other habitat types:** In deeper waters, the habitat type often co-occurs with soft bottoms dominated by benthic fauna. On shallower bottoms the habitat type may occur variably in the vicinity of different kinds of soft and hard bottoms and alongside both animal and plant communities.



**Distribution:** FeMn concretions are widespread in all parts of the Baltic Sea, including the Finnish coastal waters. The richest concretion fields in the Finnish waters are found in the Gulf of Finland and the Archipelago Sea (VELMU data 2017), but the 90% coverages required for the habitat type status have also been found in the Bothnian Sea and the

Bothnian Bay (Winterhalter 1966). Elsewhere in the Baltic, there are abundant occurrences in areas such as the Gulf of Riga (Glasby et al. 1997).

**Threat factors:** Seafloor anoxia (WEP 2), exploitation of concretions (EXP 1).

**Description of habitat type collapse:** A habitat type is regarded as collapsed if all of its occurrences have been lost. This would result from ferromanganese concretions being lost or reduced to such an extent that there would no longer be any habitats classified as this habitat type.

**Justification:** Benthic habitats with ferromanganese concretions was assessed as a Data Deficient (DD) habitat type (A3, C1–C3, D1–D3).

There is no direct monitoring data for the assessment of the habitat type's quantitative changes. Ferromanganese concretions may form on sites with suitable geo-bio-chemical conditions. Under anoxic conditions, concretions begin to dissolve (e.g. Yli-Hemminki et al. 2016), but the precise dissolution rate in natural conditions is not known. Quantitative reduction is assumed to have been and to be rather low over the 50-year time frame (A1 & A2a: LC), but the longer-term historical reduction cannot be estimated (A3: DD). In other marine areas, concretions are exploited due to the economic value of manganese, for example. Trial extractions of ferromanganese concretions have taken place on the Russian side of the Gulf of Finland, too. Their large-scale exploitation is, however, unlikely over the next 50 years, as extraction is not currently economically viable.

Benthic habitats with ferromanganese concretions are not particularly rare in the Baltic Sea (e.g. Winterhalter 1980; Boström et al. 1982; Glasby et al. 1997; Hlawatsch et al. 2002; Zhamoida et al. 2004; 2007; 2017). In Finland, their extent of occurrence extends from the Gulf of Finland to the Bothnian Bay, and the numbers of the 10 km x 10 km grid cells occupied and locations are also above the thresholds set for Criterion B (B1–B3: LC).



Eastern Gulf of Finland. Photo: Anna Downie.

A study was conducted to examine developments in the habitat type's abiotic quality by estimating when anoxia began in coastal basins of different depths. This examination of annually laminated sediments in the Gulf of Finland showed that, towards the present day, anoxia has begun to occur in shallower and shallower basins (Kotilainen et al. 2007). Calculated from increases/expansion of anoxia, the relative severity of the change would be more than 50% over the past 50 years, which might even correspond to classification as Endangered (EN). No direct parallel can be drawn from the anoxia data to the occurrence of ferromanganese concretions, as the precise dissolution rate of concretions is not known. This is why the habitat type was assessed on the basis of abiotic quality factors as Data Deficient as regards the past and the next 50 years (C1–C3: DD). The biotic communities of benthic habitats with ferromanganese concretions and their possible changes are very poorly known (D1–D3: DD).

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** None.

18

## Pelagic habitats and sea ice

The physical environment is the main factor determining the structure of the Baltic Sea pelagic ecosystems. Physical factors affect the species composition and the structure of the food web. Salinity varies both in the north-south direction and in the east-west direction: surface water salinity is highest (15–25 psu) in the southern Baltic due to the direct effect of the North Sea, while the water in the gulfs in the northern and eastern parts of the Baltic (the Bothnian Sea and the Gulf of Finland) is close to freshwater due to river water

input. The pelagic salinity in the Finnish marine area is 3–6.5 psu (Furman et al. 2014).

The Baltic Sea is located between 54°N and 66°N latitude, stretching for 1,300 km. Because of this, the timing of seasons (the amount of light, temperature, ice cover) is very different between the southern and the northern Baltic.

The seabed topography of the Baltic Sea affects the saline water currents in the deep waters. The deep, saline waters form a permanent salinity gradient in the Baltic Proper and the Gulf of Finland, while the thresholds prevent the deep waters from entering the Åland Sea and the Bothnian Sea in greater amounts.

The pelagic zone in the open sea is the medium for many infaunal larvae. The production of the pelagic habitat determines the amount of organic matter falling on the seabed and, consequently, affects the amount of food available for the infauna as well as the oxygen conditions (HELCOM 2017). The pelagic habitat is also the route of dispersal between habitat types for many organisms. A part of the life cycle of migratory fishes is located in the pelagic habitat.

The pelagic habitat types described below refer only to the open sea areas of Finland. The habitat types examine the entire food web. Biotic communities of the coastal areas and the archipelago that are equivalent to those in the open sea also occur in the open water – or pelagic zone – but these areas and communities have not yet been described and assessed in a corresponding manner. Sea ice in the Finnish marine area is discussed below as one of the habitat types.

The subtypes of the pelagic habitats do not correspond to the pelagic habitat types in the HELCOM HUB classification (HELCOM 2013a).

18.01

#### Pelagic habitats in the northern Baltic Proper and the Gulf of Finland

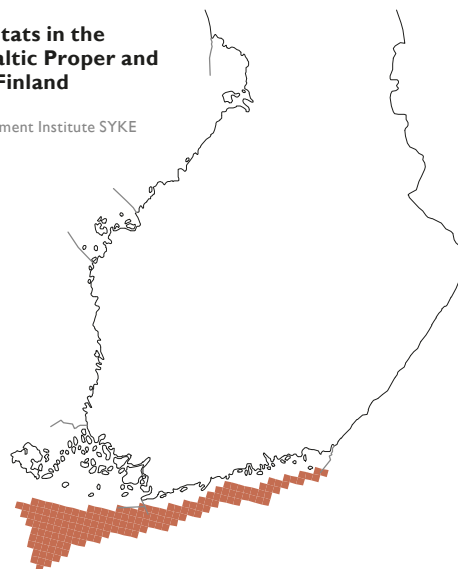
	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>DD</b>	BI, CI, DI	?
Southern Finland	<b>DD</b>	BI, CI, DI	?
Northern Finland			

**Description:** The surface water salinity in the pelagic zone in the northern Baltic Proper and the Gulf of Finland varies between 3–6.5 psu (Furman et al. 2014). The probability of an ice cover forming in the winter is 10–50% in the northern Baltic Proper and 50–90% in the Gulf of Finland. The phytoplankton spring bloom takes place at the turn of April and May. The summer minimum with low production of phytoplankton takes place in June and early July (Hällfors et al. 1981). Mass occurrences of nitrogen-binding diatoms (genera *Aphanizomenon*, *Nodularia* and *Dolichospermum*) occur every summer.

Primary production and peak zooplankton biomass are higher compared to other pelagic habitat types. The marine copepods from the genera *Pseudocalanus* and *Temora* occur more abundantly than in pelagic habitats of other marine areas (Gorokhova et al. 2016). Both

#### Pelagic habitats in the northern Baltic Proper and the Gulf of Finland

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phytoplankton and zooplankton communities have a greater variety of species compared to those in other habitat types. The species composition of fish also includes more marine species. The Gulf of Finland is the southernmost area of occurrence of the Baltic ringed seal (*Pusa hispida botnica*).

**Geographic variation:** Salinity rises pronouncedly in the area from east to west. Because of this, in the Finnish waters marine species are most abundant in the northern Baltic Proper. The ice cover in the winter lasts longest in the eastern part of the area.

**Relationships to other habitat types:** The pelagic habitat type is seamlessly linked to both the coastal habitat types and the benthic habitat types in the deep sea below the open water column. Due to the enhanced eutrophy, pelagic productivity has increased, and the benthic habitats are largely anoxic because of the breakdown of the organic material that has sedimented on the seabed.

**Distribution:** The habitat type occurs in the open sea areas of the northern Baltic Proper and the Gulf of Finland.

**Threat factors:** Eutrophication (WEP 3), increase in water temperature and reduction in salinity (CC 2), invasive alien species (IAS 2).

**Description of habitat type collapse:** A pelagic habitat type may collapse when eutrophication progresses. Eutrophication changes algal communities to a direction that is more disadvantageous for zooplankton, which in turn affects the upper food chain (Lehtinen et al. 2016). The higher temperatures and reduced salinity caused by climate change has an adverse effect on the amount of large marine zooplankton species that are important for larger predators, which further reduces the quality of food supply (Suikkanen et al. 2013). In addition, eutrophication results in lower transparency (HELCOM 2017). Climate change decreases the occurrence of ice and may result in winters without any ice cover, which affects winter production dynamics and has a strong negative effect on the reproduction of the Baltic ringed seal (*Pusa hispida botnica*). Abiotic changes would have considerable impacts also on the pelagic species composition and functioning of communities. The



Gulf of Finland. Photo: Riku Lumiaro

critical threshold values leading into collapse cannot be estimated, however.

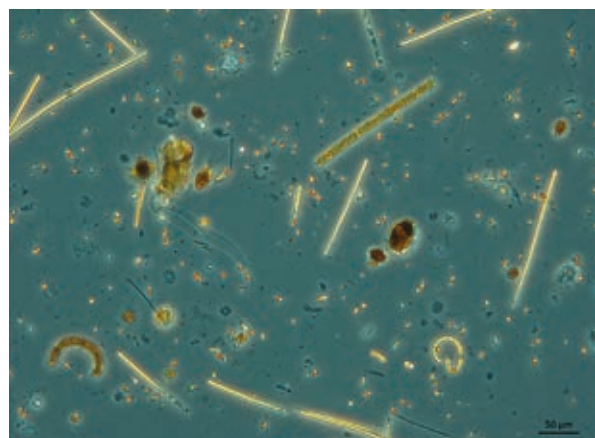
**Justification:** Pelagic habitats in the northern Baltic Proper and the Gulf of Finland was assessed as a Data Deficient (DD) habitat type (B1, C1, D1).

Pelagic habitats in the northern Baltic Proper and the Gulf of Finland occupy more than 160 grid cells of 10 km x 10 km on the Finnish side, and the habitat type's calculated extent of occurrence is around 31,000 km<sup>2</sup> when excluding adjacent marine areas outside Finland. Combined with abiotic and biotic decline, the habitat type would fulfil the criteria for Vulnerable (VU) under subcriterion B1. It is, however, unclear how the adjacent pelagic areas outside Finland should be taken into account in the assessment. Pelagic biotic communities cross national borders a lot more easily than communities of terrestrial habitat types. In species assessments, populations outside Finland are taken into account as a factor lowering the IUCN Red List category if they are regarded as reducing the risk of the species being lost in Finland (Liukko et al. 2017), but there are no corresponding guidelines as regards habitat type assessment. A decision was made for the time being to classify the habitat type as Data Deficient on the basis of subcriterion B1 (DD; B2 & B3: LC).

Physical, chemical and biological variables were examined for the assessment of the pelagic habitat type, with data commonly available on these since 1979. According to the data, surface water temperatures

have risen (in the Gulf of Finland as well as in the Baltic Proper) and salinity has decreased (in the northern part of the Baltic Proper), which is associated with global warming and with increases in winter precipitation and stream and river flow rates. Climate change has also reduced the duration of winter ice cover.

The levels of dissolved inorganic nitrogen and phosphorus as well as chlorophyll a have increased in the Gulf of Finland (HELCOM 2017). The eutrophication level is considerably higher than the natural level. Cyanobacterial biomass has also increased in the



Microscopic organisms in pelagic Gulf of Finland. Photo: Sirpa Lehtinen

Gulf of Finland (Lehtinen et al. 2016). The state of the zooplankton community is poor, as the average size of zooplankton has reduced below the target size (Gorokhova et al. 2016). The reproduction of the Baltic ringed seal (*Pusa hispida botnica*) has been jeopardised due to the shorter period of winter ice cover.

Clear physical and profound chemical and biological changes have taken place in the pelagic habitat type over the past decades (Suikkanen et al. 2013; HELCOM 2017). Assessing the relative severity of abiotic and biotic changes is, however, difficult and uncertain, as the critical values of the variables resulting in habitat type collapse are not known. The habitat type is Data Deficient (DD) on the basis of subcriteria C1 and D1.

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** None.

**Finland's responsibility habitat type:** Included in the responsibility habitat type *pelagic habitats of northern Baltic Sea*.

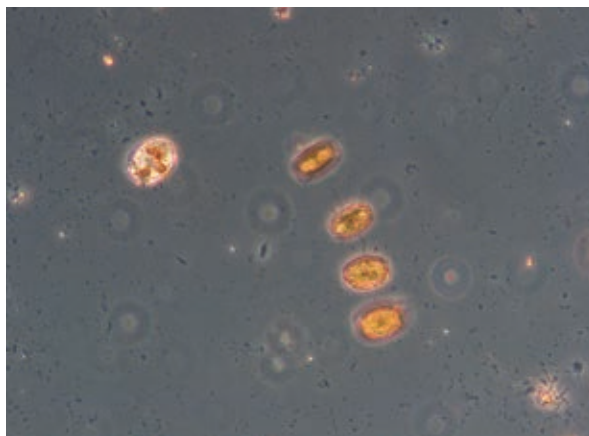
18.02

#### Pelagic habitats in the Bothnian Sea and the Åland Sea

	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>DD</b>	BI, C1, D1	?
Southern Finland	<b>DD</b>	BI, C1, D1	?
Northern Finland			

**Description:** The surface water salinity in the pelagic zone in the Bothnian Sea and the Åland Sea varies between 4.5–6 psu (Furman et al. 2014). The probability of an ice cover forming in the winter is 50–90%.

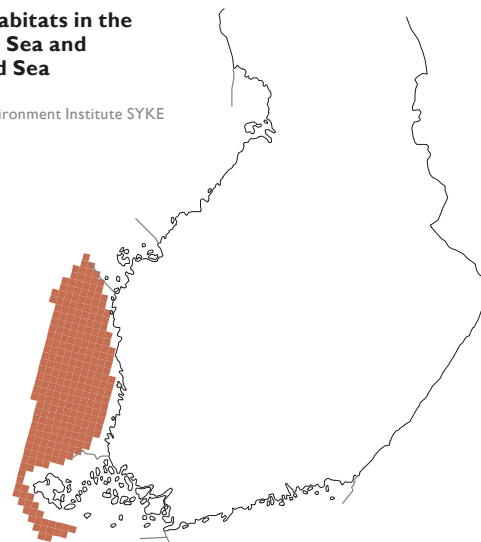
The phytoplankton spring bloom takes place in mid-May, while the summer with low production takes place in June and early July (Hällfors et al. 1981). Mass occurrences of nitrogen-binding diatoms (genera *Aphanizomenon*, *Nodularia* and *Dolichospermum*) are rare. The biomass in the zooplankton community is dominated by the freshwater copepod *Limnocalanus*. Rotifers from the genus *Synchaeta* are abundant in terms of their species numbers (Zooplankton monitoring data



Dinoflagellates and diatoms in the pelagic microscopic community of the Bothnian Sea. Photo: Sirpa Lehtinen

#### Pelagic habitats in the Bothnian Sea and the Åland Sea

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in the pelagic area 2015). The population of the Baltic herring (*Clupea harengus membras*) is especially strong.

**Geographic variation:** The pelagic area is relatively coherent. The eastern and western parts of the area are somewhat different in character due to the currents that bring the less saline water from the Bothnian Bay to the western parts of the area. The differences in salinity do not, however, affect the pelagic species or communities.

**Relationships to other habitat types:** The pelagic habitat type is seamlessly linked to both the coastal habitat types and the benthic habitat types in the deep-sea below the open water column.

**Distribution:** The habitat type occurs in the open sea areas of the Bothnian Sea and the Åland Sea.

**Threat factors:** Eutrophication (WEP 3), increase in water temperature and reduction in salinity (CC 2), invasive alien species (IAS 2).

**Description of habitat type collapse:** A pelagic habitat type may collapse when eutrophication progresses. So far, the area has been spared from the worst consequences of eutrophication, such as massive cyanobacterial blooms or seafloor anoxia (HELCOM 2017). However, the area has become increasingly eutrophic at least in part due to changes in water exchange between the northern parts of the Baltic Proper and the area (Kuosa et al. 2016). For reasons as yet unknown, increasing volumes of nutrient-rich water are penetrating the area from the south (Rolff and Elfving 2015), which is already causing extensive cyanobacterial blooms. The amount of organic matter from terrestrial sources has also increased, leading to increased oxygen consumption on the seafloor (Ahlgren et al. 2017). These may be consequences of climate change. Climate change may also increase inflows of water from streams and rivers and, consequently, reduce salinity levels, which in turn affects species and communities. Rising temperatures also boost the growth of cyanobacteria. Several alien species have spread into the area (incl. the mud crab *Rhithropanopeus harrisi*). The critical threshold values leading to collapse cannot be estimated, however.

**Justification:** Pelagic habitats in the Bothnian Sea and the Åland Sea was assessed as a Data Deficient (DD) habitat type (BI, C1, D1).



Åland Sea. Photo: Riku Lumiaro

The habitat type occupies almost 300 grid cells of 10 km x 10 km, and the calculated extent of occurrence is around 38,000 km<sup>2</sup> when excluding Sweden's corresponding marine areas. Combined with abiotic and biotic decline, the habitat type would fulfil the criteria for Vulnerable (VU) under subcriterion B1. However, it is unclear how Sweden's corresponding pelagic area should be taken into account in the assessment. Pelagic biotic communities cross national borders a lot more easily than communities of terrestrial habitat types. In species assessments, populations outside Finland are taken into account as a factor lowering the IUCN Red List category if they are regarded as reducing the risk of the species being lost in Finland (Liukko et al. 2017), but there are no corresponding guidelines as regards habitat type assessment. A decision was made for the time being to classify the habitat type as Data Deficient on the basis of subcriterion B1 (DD; B2 & B3: LC).

Physical, chemical and biological variables were examined for the assessment of the pelagic habitat type, with data commonly available on these since 1979. According to the data, surface water temperatures have risen and surface salinity decreased, while deep-water salinity has increased. This means more pronounced pelagic stratification, which is likely to be related to climate change, increases in winter precipitation and in stream and river flow rates and the increased saline deep-water influxes from the south. The amounts of

dissolved inorganic phosphorus and nitrogen have increased, and so has the amount of silicate.

The level of eutrophication in the pelagic areas of the Bothnian Sea and the Åland Sea are considerably higher than the natural level (HELCOM 2017). Concentrations of chlorophyll a (an indicator of phytoplankton amount) and the biomass of the nitrogen-fixing *Aphanizomenon* cyanobacterium have increased (Kuosa et al. 2016; HELCOM 2017). The state of the zooplankton community is good, except for the Åland Sea where the average size of zooplankton has decreased below the target size (Gorokhova et al. 2016). Baltic herring (*Clupea harengus membras*) stocks are good in the Bothnian Sea.

Clear physical, chemical and biological changes have taken place in the pelagic habitat type over the past decades (Kautsky and Kautsky 2000; Rolff and Elfving 2015; Kuosa et al. 2016; HELCOM 2017). Assessing the relative severity of abiotic and biotic changes is, however, difficult and uncertain, as the critical values of the variables resulting in habitat type collapse are not known. The habitat type is Data Deficient (DD) on the basis of subcriteria C1 and D1.

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** None.

**Finland's responsibility habitat type:** Included in the responsibility habitat type *pelagic habitats of northern Baltic Sea*.



Bothnian Bay. Photo: Riku Lumiaro

18.03

#### Pelagic habitats in the Bothnian Bay

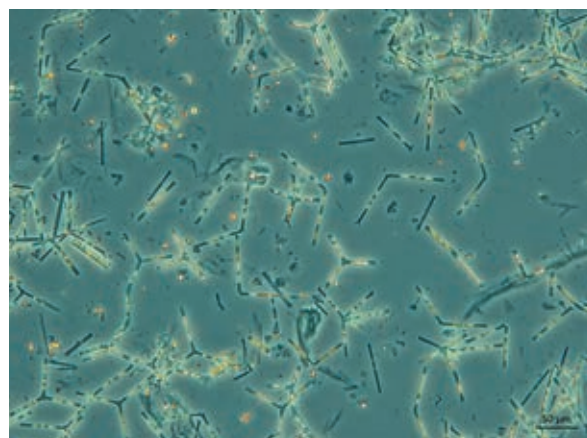
	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>DD</b>	BI, CI, DI	?
Southern Finland	<b>DD</b>	BI, CI, DI	?
Northern Finland			

**Description:** The surface water salinity in the pelagic zone in the Bothnian Bay varies between 3–4.5 psu (Furman et al. 2014). The probability of an ice cover forming in the winter is over 90%.

The Bothnian Bay differs from the other pelagic habitat types in the Baltic Sea in terms of its seasonal rhythm. The species composition demonstrates a strong freshwater effect, and many marine species present in other pelagic habitats are missing from the Bothnian Bay (e.g. the moon jellyfish *Aurelia aurita*). The pelagic phytoplankton has a short growing season and does not peak until June (Hällfors et al. 1981). There is no actual seasonal minimum in the summer. Both in early and late summer, diatoms (Bacillariophyta) are abundant and dominate the species composition more than in the other habitat types. Mass occurrences of nitrogen-binding diatoms (genera *Aphanizomenon*, *Nodularia* and *Dolichospermum*) do not occur in the pelagic habitats of the Bothnian Bay. Primary production is more modest and peak zooplankton biomass lower than in the other marine areas. Especially rotifers from the genus

*Synchaeta* and water fleas (Cladocera) are dominant in the zooplankton community. The population of the vendace (*Coregonus albula*) is strong. The Bothnian Bay is the most important area of occurrence for the Baltic ringed seal (*Pusa hispida botnica*).

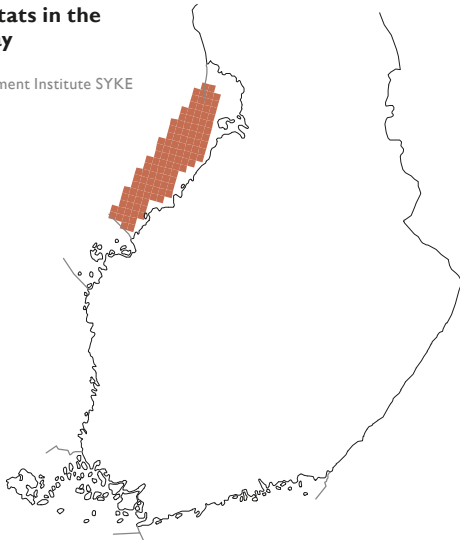
**Geographic variation:** The most important ecological gradient relates to the fluctuation of salinity in the surface water. However, the pelagic zone is a relatively coherent entity, and the brackish water species occurring in the area do not recede before the fresher waters (less than 3‰) in the very north. In the south in the Quark area, the salinity increases considerably,



Diatoms in pelagic Bothnian Bay. Photo: Sirpa Lehtinen

**Pelagic habitats in the Bothnian Bay**

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which provides a natural limit to the Bothnian Bay pelagic area. Except for the northernmost part, the food web in the pelagic zone is rather coherent.

**Relationships to other habitat types:** The pelagic habitat type is seamlessly linked to both the coastal habitat types and the benthic habitat types in the deep sea below the open water column. In the Bothnian Bay primary production is relatively low both in the pelagic zone and the benthic habitats in the deep waters below it, and the bottom sediments are oxidic.

**Distribution:** The habitat type occurs in the open sea area of the Bothnian Bay, and it borders the Quark in the south.

**Threat factors:** Increase in water temperature and reduction in salinity (CC 3), eutrophication (WEP 2), invasive alien species (IAS 1)

**Description of habitat type collapse:** The pelagic habitat type is in part arctic and occurs at its extremes in terms of salinity. Its ecosystem is characterised by a long period of ice cover extending throughout the area. The ecosystem’s production is also naturally low (HELCOM 2017). The pelagic habitat type may collapse as a consequence of climate change either due to changes in temperature conditions or to increased freshwater impact. If the surface water temperature rises considerably, the occurrence of ice decreases significantly and the salinity level drops, the habitat type’s characteristic features will be lost in the whole of the Baltic Sea and also globally. Eutrophication alters the living conditions of species by, for example, reducing transparency. All abiotic changes would have considerable impacts also on pelagic species and the functioning of pelagic communities. The critical threshold values leading to collapse cannot be estimated, however.

**Justification:** Pelagic habitats in the Bothnian Bay was assessed as a Data Deficient (DD) habitat type (B1, C1, D1).

The habitat type occupies around 120 grid cells of 10 km x 10 km on the Finnish side, and the calculated extent of occurrence is around 14,000 km<sup>2</sup> when excluding Sweden’s corresponding marine areas. Combined with abiotic and biotic decline, the habitat type would fulfil

the criteria for Endangered (EN) under subcriterion B1. However, it is unclear how Sweden’s corresponding pelagic area should be taken into account in the assessment. Due to currents in the open sea, pelagic biotic communities cross national borders a lot more easily than communities of terrestrial habitat types. In species assessments, populations outside Finland are taken into account as a factor lowering the IUCN Red List category if they are regarded as reducing the risk of the species being lost in Finland (Liukko et al. 2017), but there are no corresponding guidelines as regards habitat type assessment. A decision was made for the time being to classify the habitat type as Data Deficient on the basis of subcriterion B1 (DD; B2 & B3: LC).

Physical, chemical and biological variables were examined for the assessment of the pelagic habitat type, with data commonly available on these since 1979. The data shows that surface water temperatures have risen, salinity has decreased and silicate concentrations have increased in the pelagic areas of the Bothnian Bay (Kuosa et al. 2016). The change is associated with climate change and with increases in stream and river flow rates, which has increased the amount of silicate and reduced seawater salinity. There have been no changes in transparency in the pelagic areas of the Bothnian Bay, but the eutrophication level is higher than the natural level (HELCOM 2017). Diatom biomass has decreased. The state of the zooplankton community is still good (Gorokhova et al. 2016).

Clear physical and partial chemical and biological changes have taken place in the pelagic habitat type of the Bothnian Bay over the past decades (Kuosa et al. 2016, HELCOM 2017). Assessing the relative severity of abiotic and biotic changes is, however, difficult and uncertain, as the critical values of the variables resulting in habitat type collapse are not known. The habitat type is Data Deficient (DD) on the basis of subcriteria C1 and D1.

**Reasons for change of category:** New habitat type.

**Trend:** Unknown.

**Links to administrative classifications:** None.

**Finland’s responsibility habitat type:** Included in the responsibility habitat type *pelagic habitats of northern Baltic Sea*.

18.04

Baltic Sea seasonal ice			
	IUCN Red List Category	Criteria	Trend
Whole of Finland	VU (NT-VU)	C1, C2a	–
Southern Finland	VU (NT-VU)	C1, C2a	–
Northern Finland			

**Description:** Sea ice covers the Finnish coast for 5–7 months a year, usually from late November to early April (Haapala and Leppäranta 1996). Both the duration and the extent of the ice cover vary significantly from year to year, depending on the regional temperatures and wind conditions, but the Bothnian Bay, the Quark and at least the shallow waters in other coastal areas freeze as a rule. Ice formation usually begins in Novem-



Pack ice in Hailuoto, Bothnian Bay. Photo: Rami Laaksonen

ber on the coasts of the Bothnian Bay and the eastern Gulf of Finland, followed by the Quark and the Bothnian Sea. During average winters, sea ice grows to cover the rest of the Bothnian Sea, the Archipelago Sea, the Gulf of Finland and the northern parts of the Baltic Proper. The ice cover usually reaches its maximum extent between mid-January and late March, and the entire Finnish sea area freezes over once in every two years on average. Following the spring melting period, most of the Gulf of Finland is ice-free by the end of April; by mid-May the ice cover remains only in the northernmost Bothnian Bay, and by early June the entire Finnish coast is free of ice (Finnish Meteorological Institute 2017). In recent decades, the extent of the sea ice has been on the decline (BACC Author Team 2015).

In the Baltic Sea, ice typically occurs as a cover of fast ice, floating drift ice and pack ice, i.e. highly concentrated drift ice. Fast ice forms attached to the coastline or in the archipelagos where water depth does not exceed 20 metres. Fast ice is the first to form in the autumn and the last to melt in the spring. Shallow coastal bays may freeze from top to bottom. Drift ice floats in the open sea and is carried along by the winds and currents. Drift ice can be even or driven together into partially overlapping floes. Drift ice packed into tight layers is called “pack ice”. The drift ice field constantly shifts by wind force or currents, and larger open water areas appear as the ice floes compress on the shores. Pack ice can form a mass several metres

thick, while fast ice thickness is typically less than 120 cm (BACC Author Team 2015).

The physical properties and the composition of the biotic community in sea ice largely depend on the salinity of the parent water (Piiparinen et al. 2010; Kaartokallio et al. 2017). Baltic sea ice typically has low permeability and a low number of pockets filled with brine, constraining the habitability of the ice for many organisms (Meiners et al. 2002; Granskog et al. 2003). The brine salinity can also vary drastically within the ice, further restricting the development of sympagic communities (i.e. communities associated with sea ice) (Lizotte 2003).

Sea ice supports communities of prokaryotic and eukaryotic microbes (diatoms, flagellates, dinoflagellates), ciliates and rotifers that live within or on the surfaces of the ice. Food webs within sea ice are truncated, as the small capacity of the brine pockets restricts the size of the organisms. The most common algae include diatoms (such as *Pauliella taeniata*, *Nitzschia* spp., *Melosira arctica* and *Chaetoceros* spp.), small autotrophic flagellates and dinoflagellates (e.g. *Peridiniella catenata*). Other common organisms include bacteria (typically belonging to the classes Flavobacteria and Gammaproteobacteria), heterotrophic flagellates and ciliates (e.g. *Strombidium* spp.) (Thomas et al. 2017).

Sea ice is an essential element for the reproduction of the Baltic ringed seal (*Pusa hispida botnica*), which requires at least five weeks of continuous ice cover from



February to March for giving birth and nursing (Helle 1980; Laidre et al. 2008). Sea ice is also important for the early life stages of the common whitefish (*Coregonus lavaretus*), as the ice protects the eggs from the effects of the waves and currents (Veneranta et al. 2013).

The habitat type corresponds to the HELCOM HUB class AC (HELCOM 2013a): Baltic Sea seasonal ice.

**Geographic variation:** Decreasing salinity in the parent water weakens the habitability of sea ice and decreases sympagic biomass, production and diversity. The shift from the Gulf of Finland to the low-salinity Bothnian Bay is clear in the gradual decrease in the biota (Kuparinen et al. 2007). Chain-forming diatoms (e.g. *Melosira arctica*) dominate the sympagic biomass in the Bothnian Bay, but their significance to the biotic community decreases towards the south, possibly due to the decrease in the thickness of superimposed snow-ice (Piiparinen et al. 2010, Rintala et al. 2010). In the Bothnian Bay, sympagic biomass and algal blooms are restricted to the bottom layer of the ice, whereas in the southern coast they stretch through the ice in a more varied manner (Thomas et al. 2017).

River-water inflows create local gradients in sea ice salinity, caused by the gradual mixing of freshwater and seawater (Granskog et al. 2005; Steffens et al. 2006; Piiparinen et al. 2010). As the ice season progresses and the ice ages, sympagic communities in fast ice and drift ice develop in different directions; chlorophytes decrease in fast ice, whereas ciliates and rotifers increase. Drift ice and packed ice demonstrate the opposite trend (Meiners et al. 2002; Piiparinen et al. 2010; Rintala et al. 2010).

Light conditions in the ice vary considerably along the over 600-km long north-south gradient between the southern coast and the northern Bothnian Bay. The Gulf of Finland is often already free from ice on the sunny days of spring, while the Bothnian Bay is still under a cover of sea ice. This shortens the developmental cycles of sympagic communities in the south (Thomas et al. 2017). The primary production in the sympagic community is also affected by the variation in the amount of snow (Thomas et al. 2017).

**Relationships to other habitat types:** Sea ice influences the Baltic benthic habitat types in several ways. The ice scours shallow bottoms during the winter, removing vegetation and sessile animals from the substrate. The shading effect of the sea ice also controls the timing and species composition of the spring algal bloom. Without the ice cover, the pelagic plankton bloom would occur later in the spring, and the community would incorporate a larger proportion of flagellated species compared to diatoms (Thomas et al. 2017). Sea ice also changes the effects of water currents and winds in the pelagic environment.

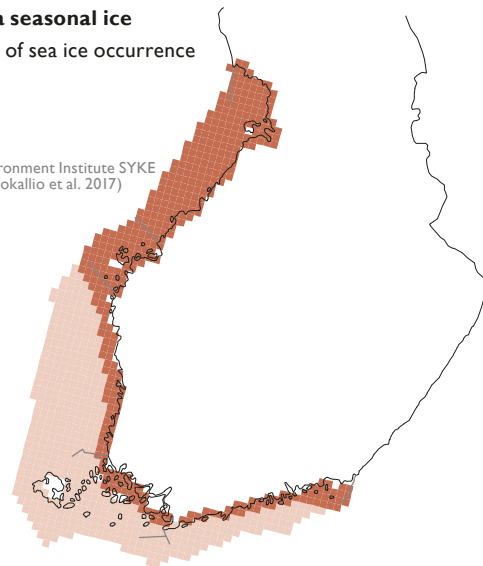
**Distribution:** The distribution of sea ice is highly variable due to its seasonal nature and dynamic dependence on the temperature and wind conditions. The length of the ice season typically ranges from 130–200 days in the Bothnian Bay to 80–100 days in the Gulf of Finland (BACC Author Team 2015, Climate Guide 2017). The Bothnian Bay, the Quark and at least the shallow coastal waters in other areas freeze each

### Baltic Sea seasonal ice

Probability of sea ice occurrence



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(Source: Kaartokallio et al. 2017)



year, while the entire Finnish sea area freezes once in every two years on average (Kaartokallio et al. 2017).

**Reasons for becoming threatened:** Climate change (CC 3), shipping (WT 1).

**Threat factors:** Climate change (CC 3), shipping (WT 1).

**Description of habitat type collapse:** The collapse of the Baltic Sea seasonal ice habitat type was examined from two perspectives. The theoretical extreme was set at zero ice days, that is, a situation where no ice is formed in the winter off the coast of Finland. However, as regards biota dependent on sea ice, the number of critical ice days is considerably higher, and the maximum figure in the range of variability was based on the nursing period of the Baltic ringed seal (*Pusa hispida botnica*). The Baltic ringed seal gives birth on ice and nurses the pup on ice for around five weeks (Helle 1980). Therefore, the maximum limit for the range of variation for collapse used was 35 ice days. It should be noted that this threshold value is also theoretical and imprecise, as factors significant for the successful reproduction of the Baltic ringed seal naturally also include other factors such as the location of areas that freeze over and the permanence of ice cover from birth onwards. Critical threshold values concerning the extent or duration of sea ice cover as regards other organisms dependent on seasonal sea ice are not known at all.

**Justification:** Baltic Sea seasonal ice was assessed as a Vulnerable (VU) habitat type on the basis of abiotic decline over the past and next 50 years (C1, C2a).

Climate change has resulted in reduced seasonal ice cover in the Baltic Sea. On the Baltic-wide scale, the maximum annual sea ice coverage has decreased by 35% since the 1960s (Niskanen et al. 2009). On the other hand, Finland's entire marine area still freezes over on average every other year (Kaartokallio et al. 2017), and the assessment did not aim to estimate any change in maximum coverage (A1–A3: NE).

The extent of occurrence of Baltic Sea seasonal ice and the number of 10 km x 10 km grid cells occupied as well as the number of locations are above the thresholds

set for Criterion B, and the habitat type is therefore classified as Least Concern on the basis of Criterion B (B1–B3: LC).

The changes caused in Baltic Sea seasonal ice by climate change were examined on the basis of ice day data from seven coastal stations (Jouni Vainio, Finnish Meteorological Institute, pers. comm. 2017). The duration of ice winter has shortened variably at all stations from the 1970s to the 2010s, on average by 26%. This figure can also be regarded as an estimate of the relative severity of the change in accordance with subcriterion C1 if collapse is set at zero ice days, which is the theoretical minimum of the duration of ice winter. The maximum for the collapse value range in turn was set at the nursing period of the Baltic ringed seal (*Pusa hispida botnica*; see Description of habitat type collapse). This way, by using 0–35 days as the range for collapse, the relative severity of the change on the basis of subcriterion C1 is 26–40%, which corresponds to IUCN Red List categories NT–VU.

Efforts were also made to assess future changes in Baltic Sea seasonal ice by using the sea ice modellings of Höglund et al. (2017). Calculated applying a variety of scenarios and the above-mentioned range for collapse, the relative severity forecast for the next 50 years (C2a) was assessed to be 10–44%, which corresponds to categories LC–VU. Considering that the lower limits of the C1 and C2a assessments were based on the extreme situation of zero ice days, the most plausible Red List category for past as well as future decline was believed to be Vulnerable (C1 & C2a: VU), with the range of category being NT–VU.

It should be noted that there is very high variability between Finland's marine areas as regards the ice situation. Ice organisms throughout Finland are used to a regular ice cover of a rather long duration. The most advanced ice communities in Finland's marine areas can be found in the Gulf of Finland and the Bothnian Sea, where the salinity is relatively highest. The succession of ice biota from the mid-winter community until the late-winter algal bloom in the ice requires that the ice cover remains in place until the end of March, which is no longer usually the case in the Gulf of Finland. At the same time, the living conditions of the Baltic ringed seal population of the Gulf of Finland have deteriorated, and the disappearance of ice almost entirely, due to climate change, is on the horizon. The ice situation of the Bothnian Sea is still reasonably good. The ice communities of the Bothnian Bay are not as advanced, but the Bothnian Bay's ice ridges appear to be important habitats for algal production. As regards the Baltic ringed seal, the Bothnian Bay population is becoming increasingly important for the species. Shipping volumes are anticipated to increase further, which creates pressure to take the Baltic ringed seal's most important winter habitats into account.

**Reasons for change of category:** New habitat type.

**Trend:** Declining. Climate change is further weakening the ice conditions of the Baltic Sea.

**Links to administrative classifications:** None.

**Finland's responsibility habitat type:** *Baltic Sea seasonal ice* is a responsibility habitat type.

19

## Baltic Sea habitat complexes

19.01

### Fladas (coastal lagoons)

	IUCN Red List Category	Criteria	Trend
Whole of Finland	VU	CD3	–
Southern Finland	VU	CD3	–
Northern Finland			

**Description:** The description of fladas (coastal lagoons) is based on Kekäläinen et al. (2008) in the previous assessment of threatened habitat types. Fladas are shallow bays that are becoming isolated from the sea due to land uplift. A threshold or a similar obstacle at the inlet limits the flow of water between the flada and the sea. As land uplift progresses, the flada will become increasingly separated from the sea, first becoming a glo-lake and eventually a separate pool once the detachment from the sea is complete and sea water cannot even occasionally reach the basin. New fladas are constantly forming from shallow bays by the coast.

Fladas are usually very shallow, but the central part of the pool may also be several metres deep. In the Gulf of Finland, the Archipelago Sea and the Åland Archipelago, fladas are commonly bordered by bedrock, whereas in the Quark and Bothnian Bay regions, fladas mostly form in depressions between moraines (Rogen and De Geer moraines). In the Bothnian Bay, sandy beaches also act as forming grounds for fladas. The fladas in the Quark archipelago may also form in the mazes between islands. In the continental zone, there are fladas that receive fresh water from streams and small rivers.

The flada succession – the process of fladas and glo-lakes splitting from the sea – includes a distinguishable juvenile stage, where the connection to the sea remains relatively broad and the average water depth is greater than in proper fladas. As the succession process continues, the sill between the pool and the sea grows closer to the surface, the connection to the sea weakens, and the effects of saline water in the pool decrease. The common reed (*Phragmites australis*) may colonise and take over the inlet of the basin, blocking the water flow between the flada and the open water. Compared to fladas restricted by geological obstacles, basins separated from the sea by reedbeds are more susceptible to the effects of seawater and rough winds, especially during the winter when the reeds are more sparse and fragile than in the growing season.

Due to abundant vegetation and enhanced organic matter sedimentation, flada bottoms are usually covered in a thick layer of sludge. Near the inlet, the bottom may be less sludgy due to stronger currents. Fladas are essentially dead ends where currents from the sea and the river basin deposit organic matter. Due to the nutrient-binding effect of the abundant vegetation, the water is usually clear, which in turn allows light to reach the bottom. The shallowest fladas can freeze completely



Sjölörsviken, Quark. Photo: Jaakko Haapamäki, Metsähallitus Parks & Wildlife Finland

during winter, which may result in temporary anoxic conditions in the early spring. This consequently promotes the release of nutrients from the bottom and augments the natural eutrophy of fladas. The seasonal and annual variation in the environmental factors also causes fluctuation in the often abundant and species-rich vegetation of fladas.

The vegetation of fladas depends on water depth, exposure, substrate quality and salinity. The species composition reflects the proximity to the sea, the freshwater inflow and the amount of solids and nutrients in the spring meltwater. Additionally, the vegetation is affected by the prevailing stage of succession. Nine botanical developmental stages have been recorded in the Ekenäs archipelago (Munsterhjelm 1987; 1997; 2005): 1) the *Myriophyllum-Ceratophyllum-Chaetomorpha* stage, 2) the *Vaucheria* stage, 3) the *Ceratophyllum-Myriophyllum* stage, 4) the *Stuckenia pectinata-Chara tomentosa* stage, 5) the *Chara tomentosa* stage, 6) the *Chara tomentosa-Najas marina* stage, 7) the *Najas marina* or the *Najas marina-Ruppia maritima* stage, 8) the *Chara aspera* stage and 9) the vegetation-poor stage.

Fladas are typically bordered by reeds, mostly the common reed (*Phragmites australis*) and possibly also reed canary grass (*Phalaroides arundinacea*), as well as club-rushes (*Schoenoplectus* spp.), while the centre of the lagoon and the inlet remain open. Salt-water relict species such as the slender spike-rush (*Eleocharis uniglumis*), the hairgrass *Deschampsia bottnica*, the creeping bentgrass

(*Agrostis stolonifera*), the seaside arrowgrass (*Triglochin maritima*) and the sea aster (*Tripolium pannonicum*) can linger for years by the shoreline and on the occasionally submerged coastal meadows after the connection to the sea has been lost. The exceptional flada habitat also maintains many threatened and near threatened species such as the Baltic water-plantain (*Alisma wahlenbergii*), the fourleaf mare's tail (*Hippuris tetraphylla*), the flat-stalked pondweed (*Potamogeton friesii*) and Braun's stonewort (*Chara braunii*). The characteristic species of fladas, the large *C. tomentosa*, has severely declined in both fladas as well as in shallow bays. Because of increased eutrophication, reedbeds have become increasingly prevalent in fladas, and they may completely overgrow the shallowest fladas if the development continues.

Fladas support abundant and diverse communities of benthic fauna and insects. In addition, their relatively warm waters provide plenty of nourishment and shelter for fish fry, and important spawning sites for many fish species, such as the northern pike (*Esox lucius*) and the European perch (*Perca fluviatilis*), as well as cyprinids and amphibians.

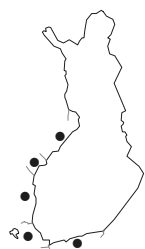
Fladas are also vital nurseries for aquatic birds, especially diving birds and dabbling ducks. Migrating swans (*Cygnus* spp.) use fladas as feeding and resting grounds, stirring the bottom of the lagoon when they feed, bringing food to the surface for other birds. Ospreys (*Pandion haliaetus*), white-tailed eagles (*Haliaeetus albicilla*) and Caspian terns (*Hydroprogne caspia*) regularly feed

in fladas. The surrounding reeds provide a habitat for the western marsh harrier (*Circus aeruginosus*) and the Eurasian bittern (*Botaurus stellaris*).

**Geographic variation:** Fladas in the Bothnian Bay are often small, having a surface area of only a few hundred square metres. Coastal uplift is faster in the Quark and the Bothnian Bay than in the Archipelago Sea and the southern coast, resulting in a faster succession process in these regions.

Due to variations in salinity, there are clear regional differences in the vegetation of fladas, especially in the early phases of the flada succession. Due to the low salinity, the flora in the Bothnian Bay excludes strictly marine species. In the Quark region, the flora nearly lacks some species common elsewhere, such as the rigid hornwort (*Ceratophyllum demersum*) and the filamentous algal species *Chaetomorpha* spp. and *Vaucheria* spp. The star duckweed (*Lemna trisulca*), on the other hand, is commonly dominant in many shallow fladas in the Quark.

**Relationships to other habitat types:** A flada is a stage in the gradual succession process that starts from a shallow bay and ends with a glo-lake completely disconnected from the sea. The diverse habitat complex consists of several habitat types dominated by vegetation, such as *Chara* bottoms. Seasonal and annual variation is common.



**Distribution:** The habitat complex occurs commonly throughout the Finnish coast. Fladas are the most numerous in areas where the coastline is broken, such as the Bothnian Bay and the southwestern archipelago (Munsterhjelm 1985a; 1985b; 1987; 1997).

Flada sizes vary depending on the topography and the regional characteristics, ranging from a few hundred square metres to several dozen hectares. The number of fladas varies as the succession continues as well as depending on shore modification. Fladas have been surveyed in more detail in the Archipelago Sea and the Bothnian Sea, where 68 of the almost 700 possible flada sites were identified as fladas separated from the sea by a threshold (Sydänoja 2008). The total number of fladas is not known.

**Reasons for becoming threatened:** Dredging (WHC 3), eutrophication-related changes in vegetation, incl. increased abundance of filamentous algae or other vegetation (WEP 2), waterborne transport (WT 1), acidic runoff (CHE 1), mowing of reedbeds at inlets (OTF 1).

**Threat factors:** Dredging (WHC 3), eutrophication-related changes in vegetation, incl. increased abundance of filamentous algae or other vegetation (WEP 2), waterborne transport (WT 1), acidic runoff (CHE 1), mowing of reedbeds at inlets (OTF 1).

**Description of habitat type collapse:** The habitat complex would collapse if dredging was to prevent the succession of juvenile fladas into fladas. Multiple approaches were used when examining the quality of fladas, and the relative severity of their overall change was not assessed specifically on the basis of any individual quality variable. Fladas could, however, be regarded as being at least close to collapse if the shores

of all fladas were constructed and/or dredged or species tolerant of eutrophication were dominant in all fladas (cf. the human pressure variable and species tolerant of eutrophication in the assessment justification).

**Justification:** Fladas was assessed as a Vulnerable (VU) habitat complex due to historical abiotic and biotic quality changes (CD3).

The Water Act (587/2011) currently prohibits the alteration of fladas with a maximum area of ten hectares, but human activity will continue in fladas larger than that. Juvenile fladas are not protected, either, and the natural succession is only safeguarded in protected areas. In other areas, human pressure disturbs flada succession in various ways. If fladas are defined as water areas separated from the sea by a threshold, the dredging of the threshold destroys the flada. Flada thresholds have been dredged to maintain or improve sea access (e.g. Sydänoja 2008), so the number of fladas has decreased, but there is no estimate of the magnitude of this decline (A1 & A3: DD). Based on a rough but indicative examination of geospatial data, more than 50% of potential flada occurrences are constructed (buildings and/or landing stages on shores) or have been dredged.

Shallow inlets and bays are occasionally dredged open already in the juvenile flada stage, which means fewer fladas are created through land uplift than would be the case naturally. It can also be expected that efforts will be made to maintain sea access in the future, too, if possible under the Water Act. The surface area of unconstructed fladas represents only around 5% of the potential total area of fladas, so flada succession may be able to progress only in a small proportion of juvenile fladas in the future. On the other hand, efforts are also being made to maintain sea access in fladas undergoing isolation from the sea and becoming glo-lakes, which means they remain fladas for a longer period. All in all, the future quantitative development of fladas is difficult to assess (A2a: DD).

The extent of occurrence as well as the area of occupancy and the number locations of fladas are clearly above the thresholds set for Criterion B. The habitat complex is Least Concern on the basis of Criterion B (B1–B3: LC).

The abiotic and biotic changes in fladas were examined on the basis of many different datasets, but no single quality variable that is quantitative and satisfactorily explains the overall quality variation could be found. Regarded as the best starting point for describing the quality changes in potential fladas was the proportion of areas under human pressure, with the extent of coastal construction and dredging examined in proportion to the size of the flada. The value of the human pressure variable for fladas averaged around 37%, with a 100-metre buffer used for buildings, landing stages and dredging. This variable does not, however, tell the whole truth about quality changes in fladas. It does not contain information about eutrophication, and dredgings taken into account when calculating the variable may have been weighted too low in relation to their impact. As mentioned above, dredgings may also have completely destroyed fladas instead of causing minor quality changes.

Holiday homes by fladas involve a lot of motorboating, which destroys vegetation and causes turbulence that releases fine solids and nutrients from the seafloor and therefore results in increased turbidity.

Shallow and small in area, fladas are sensitive to loading from the sea as well as from the surrounding land areas. Forest felling, drainage and agriculture in the drainage basin result in changes in nutrient economy as well as in hydrology, which may lead to acidification and, consequently, fish deaths. Agriculture plays the biggest role on the southern coast of Finland, whereas on the coast of the Gulf of Bothnia the hydrology and the state of fladas are affected most strongly by forestry. Eutrophication is detrimental to the characteristic vegetation of fladas, and filamentous algae become dominant. Consequences of eutrophication also include more intensive vascular plant production and overgrowing of areas. Species tolerant of eutrophication formed the majority of vegetation cover in 79% of those fladas for which vegetation data was available (VELMU data 2017). This indicates the strong impact of eutrophication. The change that has taken place in overall quality is estimated to reach relative severity exceeding 50%, which corresponds to Vulnerable (VU) under subcriterion CD3.

**Reasons for change of category:** No changes.

**Trend:** Declining. With the eutrophication trend continuing, the state of the habitat type is expected to decline further.

**Links to administrative classifications:** Included in the Habitats Directive habitat type *coastal lagoons* (1150) and may be included in *boreal Baltic narrow inlets* (1650). *Fladas with a maximum area of ten hectares* are protected under the Water Act (587/2011).

**Finland's responsibility habitat type:** Included in the responsibility habitat type *succession series of fladas and glo-lakes (coastal lagoons) on the land uplift coast*.

the flada succession. The pH is usually above 7, which means glo-lakes are alkaline.

The vegetation of glo-lakes depends on water depth, exposure, substrate quality and the distance from the sea. Marine species are markedly scarcer than during the flada stage and continue to decline due to the reduction in salinity as the glo-lake further separates from the sea. Abundant submerged vegetation and the common reed (*Phragmites australis*) bordering the shore are characteristic of glo-lakes. Common species are stoneworts (Charales), the spiny naiad (*Najas marina*), the flat-stalked pondweed (*Potamogeton friesii*), and the star duckweed (*Lemna trisulca*). As some glo-lakes retain an open connection to the sea after the spring floods, they have a significant role as spawning sites for fish. Much like fladas, glo-lakes also provide a favourable habitat for many amphibians and birds.

**Geographic variation:** Due to the variation in salinity, there are regional differences in the plant species present. Glo-lakes often have salinity gradients in Åland, especially, where the basins are deeper. In the Quark and the Bothnian Bay, glo-lakes may become overgrown with vegetation more rapidly than the ones on the southern and southwestern coast of Finland due to the shallowness of the basins and the faster land uplift.

**Relationships to other habitat types:** The glo-lake is the second to last stage in the gradual flada succession process before the pools separated from shallow bays become open mires or freshwater lakes.



**Distribution:** The habitat complex occurs throughout the Finnish coast. Glo-lakes are the most numerous in areas where the coastal line is broken, such as the Bothnian Bay and the southwestern archipelago (Munsterhjelm 1985a; 1985b; 1987; 1997). Glo-lake sizes vary depending on the topography and the regional characteristics, ranging from a few hundred square metres to a several dozen hectares. On average, glo-lakes are slightly smaller than fladas.

**Reasons for becoming threatened:** Dredging (WHC 3), eutrophication-related changes in vegetation, incl. increased abundance of filamentous algae or other vegetation (WEP 2), acidic runoff (CHE 1).

**Threat factors:** Dredging (WHC 3), eutrophication-related changes in vegetation, incl. increased abundance of filamentous algae or other vegetation (WEP 2), acidic runoff (CHE 1).

**Description of habitat type collapse:** The habitat complex would collapse if dredging were to prevent the succession of fladas into glo-lakes. Multiple approaches were used when examining the quality of glo-lakes, and the relative severity of their overall change was not assessed specifically on the basis of any individual quality variable. Glo-lakes could, however, be regarded as being at least close to collapse if the shores of all glo-lakes were constructed and/or dredged or if their vegetation were to consist mainly of species tolerant of eutrophication.

19.02

Glo-lakes (coastal lagoons)			
	IUCN Red List Category	Criteria	Trend
Whole of Finland	VU	CD3	=
Southern Finland	VU	CD3	=
Northern Finland			

**Description:** The description of glo-lakes is based on Kekäläinen et al. (2008) in the previous assessment of threatened habitat types. Glo-lakes are lagoons that are entirely detached from the sea due to land uplift, only receiving sea water during a storm or the high tide. A glo-lake follows the flada and glo-flada stages in the flada succession.

In the Quark, glo-lakes usually form in depressions between moraines (De Geer and Rogen moraines). In the Bothnian Bay, on the other hand, glo-lakes are very shallow. In the Gulf of Finland, the Archipelago Sea and the Åland Archipelago, glo-lakes are commonly bordered by bedrock. Glo-lake bottoms are typically covered in a thick layer of sludge, accumulated during

**Justification:** Glo-lakes was assessed as a Vulnerable (VU) habitat complex due to historical abiotic and biotic quality changes (CD3).

Glo-lakes with a maximum area of ten hectares are protected under the Water Act (587/2011), but glo-lakes larger than that are not protected by law. As mentioned in the context of fladas, the natural succession of fladas and glo-lakes is only safeguarded in protected areas. Outside protected areas, higher numbers of holiday homes and the resulting dredging of boating channels and opening of choked thresholds in the name of fisheries management have in many areas halted the natural succession of fladas into glo-lakes. There is no estimate of the quantitative decline of glo-lakes, however (A1 & A3: DD). Based on a rough but indicative examination of geospatial data, more than 50% of potential glo-lake occurrences are constructed (buildings and/or landing stages on shores) or have been dredged.

It is likely that efforts will be made to maintain sea access from glo-lakes with constructed shores if possible under the Water Act. The surface area of unconstructed glo-lakes represents only around 14% of the potential total area of glo-lakes, so natural glo-lake succession may be able to progress only in a small proportion of

glo-lakes in the future. All in all, the future quantitative development of glo-lakes is difficult to assess (A2a: DD).

The extent of occurrence as well as the area of occupancy of glo-lakes are clearly above the thresholds set for Criterion B. The habitat complex is Least Concern on the basis of Criterion B (B1–B3: LC).

The aim was to examine the abiotic and biotic changes in glo-lakes in the same way as those of assumed fladas. Regarded as the best starting point for describing the quality changes in potential glo-lakes was the proportion of areas under human pressure calculated from geospatial datasets, with the extent of coastal construction and dredging examined in proportion to the size of the glo-lake. The value of the human pressure variable for glo-lakes averaged 22%, with a 100-metre buffer used for buildings, landing stages and dredging. However, this variable only illustrates part of the quality changes in glo-lakes. Glo-lakes are sensitive ecosystems and vulnerable to loading from the drainage basin. Forest felling, drainage and agriculture in the drainage basin have resulted in changes in the nutrient economy and hydrology of glo-lakes. In eutrophic glo-lakes, the characteristic vegetation has suffered and water areas

Sundom, Quark. Photo: Jaakko Haapamäki, Metsähallitus Parks & Wildlife Finland



have become overgrown, with reedbeds gaining space. The change that has taken place in overall quality is estimated to reach relative severity exceeding 50%, which corresponds to Vulnerable (VU) under subcriterion CD3.

**Reasons for change of category:** Change in method.

**Trend:** Stable.

**Links to administrative classifications:** Included in the Habitats Directive habitat type *coastal lagoons* (1150). *Glo-lakes with a maximum area of ten hectares* are protected under the Water Act (587/2011).

**Finland's responsibility habitat type:** Included in the responsibility habitat type *succession series of fladas and glo-lakes (coastal lagoons) on the land uplift coast*.

19.03

Coastal estuaries			
	IUCN Red List Category	Criteria	Trend
Whole of Finland	EN	CD3	?
Southern Finland	EN	CD3	?
Northern Finland			

**Description:** The description of estuaries is based on Kekäläinen et al. (2008) in the previous assessment of threatened habitat types. An estuary comprises a large mosaic of habitats ranging from communities dominated by submerged vegetation to deciduous forests. An estuary is defined as the area within the sphere of influence of river water, and it can be divided into three parts: 1) the delta, i.e. the innermost zone, comprising diverse vegetation, 2) the receiving basin, i.e. the area outside the delta strongly influenced by fresh water inflow, where intense sedimentation makes it difficult for vegetation to gain a foothold and 3) the estuary proper with a noticeable salinity gradient from fresh to saline water.

Estuaries are naturally in a state of continuous transition. Transported sediments accumulate at the mouth of the river as the current slows, causing silting and moving the estuary towards the sea. The phenomenon is similar to the land uplift in the Gulf of Bothnia. Estuaries can move up to dozens of metres towards the sea in a year. The inner parts of the estuary are not saline and are similar in nature throughout the coast. The outer parts in turn are influenced by the regional differences in the salinity of the seawater.

The plant communities in estuaries are mainly formed by various types of emergent and submerged plants. The first to colonise the accumulated sediments are club-rushes (*Schoenoplectus* spp.), followed by the water horsetail (*Equisetum fluviatile*) and the common reed (*Phragmites australis*). Other common species in estuaries are bulrushes (*Typha* spp.), pondweeds (*Potamogeton* spp., *Stuckenia* spp.), watermilfoils (*Myriophyllum* spp.), the yellow water-lily (*Nuphar lutea*) and the European white water-lily (*Nymphaea alba*). Thriving closest to the shoreline, there are sedges (*Carex* spp.) and grasses. In the most eutrophic waters, there may also be lemnid communities. The species composition varies depending on the biogeographical location of the estuary and

the type of the bottom sediment. The muddiest sites develop annual communities of mudworts (*Limosella aquatica*), which are tolerant to the low water levels in dry summers. In rainy years, the banks are often completely under water and the vegetation cannot develop properly. Overall, the species composition of estuaries is characterised by patchiness, increased by ice scouring during the winter and by the muskrat (*Ondatra zibethicus*) burrowing among the roots.

Vast estuaries are important habitats, especially for aquatic birds and shorebirds but also for birds of prey and passerines. The most abundant species include the mallard (*Anas platyrhynchos*), the northern shoveler (*Spatula clypeata*) and the common teal (*A. crecca*). Other common bird species include the Eurasian bittern (*Botaurus stellaris*), the whooper swan (*Cygnus cygnus*), the western marsh harrier (*Circus aeruginosus*), the spotted crane (*Porzana porzana*), the common tern (*Sterna hirundo*), the sedge warbler (*Acrocephalus schoenobaenus*), the bearded reedling (*Panurus biarmicus*) and the reed bunting (*Schoeniclus schoeniclus*).

Many submerged or shoreline plants are threatened or near threatened. These include the greater water-parsnip (*Sium latifolium*), the Baltic water-plantain (*Alisma wahlenbergii*), the pendant grass (*Arctophila fulva*), the fourleaf mare's tail (*Hippuris tetraphylla*), the cut-grass (*Leersia oryzoides*), the buttercup species *Ranunculus reptabundus*, the fine-leaved water dropwort (*Oenanthe aquatica*), the flat-stalked pondweed (*Potamogeton friesii*), the pygmyweed (*Crassula aquatica*), the knotweed species *Persicaria foliosa*, different types of charophytes (Charales) such as Braun's stonewort (*Chara braunii*), the opposite stonewort (*C. contraria*), and the stonewort species *C. strigosa*, *C. intermedia*, *Nitella confervacea* and *N. gracilis*.

Estuaries are also important spawning sites for fish such as the European perch (*Perca fluviatilis*) and the zander (*Sander lucioperca*), and vegetation-rich estuaries also provide a habitat for the northern pike (*Esox lucius*). In the estuary of the river Kokemäenjoki, there is a small population of the zarte (*Vimba vimba*) and, in river habitats, also the asp (*Aspius aspius*).

### Coastal estuaries

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(Source: Metsähallitus  
Parks & Wildlife Finland)



Meadows and forests in flood-prone areas can also be considered part of the estuary. The estuary forests are dominated by deciduous trees. The vegetation remains rich because of the regular floods and resembles vegetation of herb-rich forests and herb-rich heath forests.

**Geographic variation:** There are regional differences in the species compositions of the habitat type. Additionally, the plant communities of the southern coast are mostly noticeably more diverse than in the Bothnian Bay due to the higher salinity in the south.

**Relationships to other habitat types:** The habitat type is a continuum of several different underwater and shoreline habitat types. The estuary complex consists of underwater substrates as well as unvegetated bottoms, such as bottoms characterised by insect larvae, reed and club-rush beds, coastal meadows and coastal forests dominated by deciduous trees.

**Distribution:** The most expansive estuary complexes on the Finnish coast are at the mouths of the Rivers Kemi and Kokemäenjoki. Other sizable complexes include the estuaries of the Rivers Temmesjoki, Tyrnävänjoki and Ängeslevänjoki at Liminganlahti Bay, the estuary of the River Kymijoki, the estuaries of the Rivers Kyrönjoki and Porvoonjoki, the estuary of the River Lapväärtinjoki as well as the estuaries of the Rivers Laihianjoki and

Sulvanjoki that discharge into the Sundominlahti Bay. The surface area of estuaries varies considerably.

This assessment only includes data on rivers with a flow rate greater than 1 m<sup>3</sup>/s. The map presents the 47 coastal estuaries in Finland that meet this definition, but the number of estuaries would increase considerably if rivers with lower flow rates were also taken into account.

**Reasons for becoming threatened:** Stream and river water acidification and pollutants (CHE 3), dredging, port construction and damming of streams and rivers (WHC 3), increased turbidity, benthic siltation and eutrophication-related changes in vegetation (WEP 2), coastal construction (CST 2), drainage in flooded areas (DR 1), forest regeneration and management measures (F 1), waterborne transport (WT 1), water body regulation (WBR 1), overgrowth of coastal meadows following the discontinuation of grazing (OGR 1).

**Threat factors:** Stream and river water acidification and pollutants (CHE 3), dredging, port construction and damming of streams and rivers (WHC 3), increased turbidity, benthic siltation and eutrophication-related changes in vegetation (WEP 2), on-shore construction (CST 2), drainage in flooded areas (DR 1), forest regeneration and management measures (F 1),

Estuary of Kymijoki in Ahvenkoskenhaara, eastern Gulf of Finland. Photo: Petra Pohjola, Metsähallitus Parks & Wildlife Finland





waterborne transport (WT 1), water body regulation (WBR 1), overgrowth of coastal meadows following the discontinuation of grazing (OGR 1).

**Description of habitat type collapse:** Multiple approaches were used when examining the quality of coastal estuaries, and the relative severity of their overall change was not assessed specifically on the basis of any individual quality variable. Coastal estuaries could, however, be regarded as being at least close to collapse if all corresponding coastal water bodies were assessed as poor in terms of their ecological status (cf. ecological status of surface waters in the data on Water bodies according to the Water Framework Directive 2013) or if the shores of estuaries were to be extensively constructed or dredged.

**Justification:** Coastal estuaries was assessed as an Endangered (EN) habitat complex due to historical abiotic and biotic quality changes (CD3).

As extensive habitat complexes, coastal estuaries are relatively permanent in terms of their number, which is not regarded as having changed significantly in the past or to change significantly in the future (A1–A3: LC). Some coastal estuaries have, however, been dammed to create freshwater pools (Bonde and Lax 2003), which is when these coastal estuary occurrences can be regarded as having been destroyed.

Coastal estuaries can be found throughout the Finnish coastal area. In this examination, coastal estuary data was for practical reasons limited to the largest streams and rivers with flow rates exceeding 1 m<sup>3</sup>/s. There are 47 coastal estuaries of this magnitude in Finland, and they occupy more than 100 grid cells of 10 km x 10 km. The extent of occurrence and the area of occupancy are above the thresholds set for Criterion B. The habitat complex is Least Concern on the basis of Criterion B (B1–B3: LC).

The abiotic and biotic decline of coastal estuaries can be seen in many different datasets, but no single quality variable that is quantitative and satisfactorily explains the overall quality variation could be found. Regarded as the best starting point for describing the quality changes were ecological status assessments of coastal water bodies corresponding to coastal estuaries (cf. ecological status of surface waters in the data on Water bodies according to the Water Framework Directive 2013). Only 6% of the surface area of coastal estuaries is found in coastal water bodies whose status is good. In terms of surface area, coastal estuaries whose status is moderate account for 40%, poor for around 50% and bad for a couple of percent. Based on the breakdown of surface area, the status of coastal estuaries is on average right between moderate and poor. If the ecological status classes were to be equated to IUCN Red List categories, the threat status would be between Vulnerable (VU) and Endangered (EN). The data on ecological status includes some heavily modified coastal estuaries classified as poor, although they are regarded as Collapsed (CO) as a habitat complex.

Coastal estuaries have been a hub for waterborne transport for several centuries, and at the same time human settlements have been created in the vicinity of many coastal estuaries. Separate datasets were used to

examine the rate of alteration and human pressure on coastal estuaries. According to Corine Landcover 2012 data, the local area of coastal estuaries (with a 2-km buffer) averaged 16% of artificial areas and 18% fields or other agricultural areas. There is a wastewater treatment plant in one in three and a marina in more than one in three coastal estuaries in Finland. In addition, one in eight coastal estuaries has a shipping port. Reported dredging has taken place in almost 90% of the examined coastal estuaries, with dredging sites averaging three per square kilometre. These activities have modified the bottoms and flow conditions of coastal estuaries, destroyed biotic communities and impaired water quality.

The ecological status of only 11% of streams and rivers connected to estuaries is good. The status of 40% is moderate, of 27% poor and as many as 22% are classified as poor or heavily modified. The status of the stream or river affects the coastal estuary via the quality of the water brought by it and through hydrological changes. Nutrient, humus and pollutant loading from streams and rivers has grown strongly due to human activity. Increases in non-point source pollution were associated with the increased use of artificial fertilisers and forest and mire drainage starting from the 1950s. The strong growth of industrial production and the resulting burden on water bodies dates back to the same period. Although the proportion of organic matter and environmental toxins transported by stream and river water has since decreased, there are still large quantities of pollutants in benthic sediments. The increase in the humus load is visible as benthic siltation, which deteriorates the living conditions of, for example, bivalve communities.

There have not been any significant reductions in nutrient loading from stream and river water recently. Eutrophication and increased turbidity have resulted in increases in the stands of emergent plants in coastal estuaries at the expense of other macrophytes. The increased abundance of reedbeds has also been boosted by the discontinuation of the previously common coastal grazing and mowing. This in turn has affected other species composition, such as bird fauna.

The regulation of streams and rivers for power production began on an extensive scale after World War II. Flood protection work and related regulation of streams and rivers in Ostrobothnia began in the 1960s. Both altered the natural flood cycles of streams and rivers and degraded the natural state of coastal estuaries. Weaker floods have had an adverse effect on coastal estuary habitat types, such as flooded forests and meadows. Of the coastal estuaries examined in greater detail, in more than half (57%) the stream or river or at least half of its distributaries had been dammed. In addition, drainage had been used to transform wet riparian parts of estuaries into dry land, and riparian forests of estuaries had become less diverse in terms of their structure due to forestry.

All in all, human pressures are estimated to have caused a historical quality change the relative severity of which corresponds to Endangered (EN) in the abiotic as well as biotic features of coastal estuaries (CD3). Finland

does not have any coastal estuaries of rivers or large streams remaining in their natural state.

**Reasons for change of category:** No changes.

**Trend:** Unknown.

**Links to administrative classifications:** May be included in the Habitats Directive habitat type *estuaries* (1130).

**Finland's responsibility habitat type:** *Coastal estuaries* is a responsibility habitat type.

19.04

Reefs			
	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>NE</b>		
Southern Finland	<b>NE</b>		
Northern Finland			

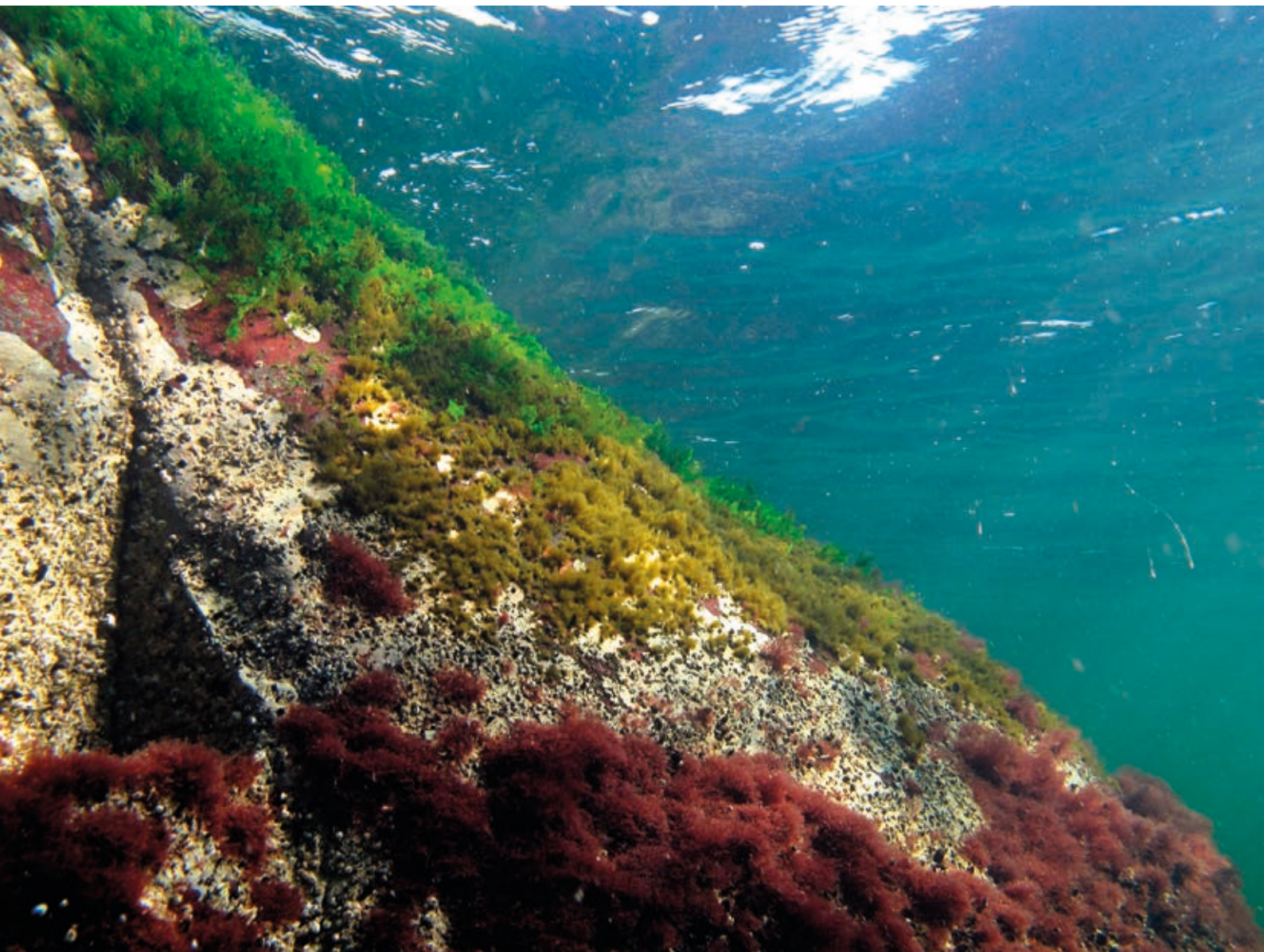
**Description:** The habitat complex is characterised by hard and coarse substrates that are completely or partially submerged and protrude from the flat seabed (HELCOM 1998). The habitat type also includes individual boulders and lumps formed by bivalve colonies. Additionally, the habitat complex encompasses the underwater rocky shores of the middle and inner

archipelago that are not included in the Natura 2000 Directive habitat types 1170 (*reefs*) and 1620 (*boreal Baltic islets and islands in outer archipelago and open sea zones*).

Reefs are characterised by multi-layered communities of algae and invertebrates. Reef communities vary regionally and locally with the water salinity, light penetration and exposure to water motion. Algal communities are usually divided into three zones, primarily based on the availability of light. The filamentous algal zone is the closest to the surface, bladder wrack (*Fucus vesiculosus*) zone lies beneath it, followed by the red algal zone. The filamentous algal zone is dominated mainly by annual green, brown and red algae (Chlorophyta, Phaeophyceae, Rhodophyta). On exposed shores the sea ice and surf may completely scour away the algal aggregations on hard surfaces, which are then colonised by new species in the spring. The warm surface water and the filamentous algae provide shelter and food to many invertebrates such as crustaceans (e.g. *Gammarus* spp.) molluscs (e.g. Hydrobiidae, *Theodoxus fluviatilis*, *Macoma balthica*) and insect larvae (Chironomidae) that graze on the algae and other organic matter that accumulates on the algal filaments (Råberg and Kautsky 2007).

The bladder wrack (*F. vesiculosus*) zone is one of the most diverse habitat types in the Baltic. In addition to

Western Gulf of Finland. Photo: Julia Scheinin, Metsähallitus Parks & Wildlife Finland



other algae, sessile invertebrates also live on the surfaces of and below the large *Fucus* stands. The *Fucus* zone supports an extensive community of invertebrates, the most common of which are *Gammarus* shrimps, isopod crustaceans (e.g. *Idotea balthica*), bivalves (*Cerastoderma glaucum*) and snails (Koivisto and Westerborn 2010).

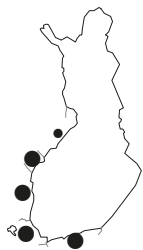
The communities in the red algal zone include both annual and perennial red and brown algae. The most common species in the zone are *Furcellaria lumbricalis*, *Ceramium tenuicorne*, *Coccotylus truncatus* and *Phyllophora pseudoceranoides*. It is characteristic of the species in the zone to be able to thrive in deep waters where the amount of available light is too low for other species. The red algal zones diversify the hard surfaces of the deep and create structures that provide shelter and food for the varied community of invertebrates. The infauna sustained by the red algal communities are important feeding grounds for instance for many aquatic birds (the long-tailed duck *Clangula hyemalis*, the common eider *Somateria mollissima*, the velvet scoter *Melanitta fusca*).

The availability of light under the algal zones is so low that photosynthetic vegetation cannot survive. The surfaces are mainly covered by bivalves such as the blue mussel (*Mytilus trossulus*) and other sessile animals. Bivalve colonies provide food and shelter for many types of invertebrates and birds (Koivisto 2011).

The increasing eutrophication causes decreasing visibility and is narrowing all the algal zones. The increasing sedimentation weakens the ability of both algae and mussels to settle in new sites and can, at worst, even smother bivalve communities (HELCOM 2009).

**Geographic variation:** In the low-salinity waters north of the Quark, the bladder wrack zone, the red algal zone and bivalve beds are missing. On the hard bottoms of the reefs they are replaced by water mosses (*Fontinalis* spp.), which commonly co-occur at depths of 3–5 metres with algae and vascular plants (Koponen et al. 1995, Bergström and Bergström 1999).

**Relationships to other habitat types:** The habitat complex consists, for example, of *Fucus*, red algal and bivalve bottoms. Reefs occur in the vicinity of the islands and islets in the outer archipelago, which have been described as a coastal habitat complex.



**Distribution:** Reefs occur commonly throughout the entire coast of Finland. The most numerous occurrences can be found south of the Quark.

**Threat factors:** Not evaluated.

**Description of habitat type collapse:** Not evaluated.

**Justification:** The habitat complex was not evaluated.

**Reasons for change of category:** No changes (new described habitat complex, but not evaluated).

**Trend:** Not evaluated.

**Links to administrative classifications:** Includes the Habitats Directive habitat types *reefs* (1170) and the underwater parts of *boreal Baltic islets and small islands* (1620).

**Finland's responsibility habitat type:** Included in the responsibility habitat type *rocky bottoms of the Baltic Sea*.

19.05

Sandbanks			
	IUCN Red List Category	Criteria	Trend
Whole of Finland	<b>NE</b>		
Southern Finland	<b>NE</b>		
Northern Finland			

**Description:** The habitat complex consists of sandbanks and gravel banks that are wholly or partially submerged and protrude from the flat seabed (HELCOM 1998). Sandbanks consist mainly of sand and gravel, but the banks and mounds may include small stones or mud. Most sandbanks are found in relatively shallow water (< 20 m) and their shape and location may be altered by currents. (Airaksinen and Karttunen 2001; HELCOM Red List Biotope Expert Group 2013b).

Being a mobile substrate, sandbanks are a difficult habitat for vegetation, especially in open areas (Christianen et al. 2013; Ondiviela et al. 2014). In more sheltered sites, the vegetation on sandbanks can be very diverse, and meadows dominated by the common eelgrass (*Zostera marina*) form one of the most diverse habitat types in the Baltic Sea. Other common species in addition to eelgrass include tasselweeds (*Ruppia* sp.), *Zannichellia* spp., pondweeds (*Potamogeton* spp., *Stuckenia* spp.) and stoneworts (*Chara aspera*, *C. canescens*). By binding the mobile substrate in place with their roots, submerged vegetation supports a wide variety of invertebrates, including polychaetes (*Hediste diversicolor*, *Marenzelleria* spp.), bivalves (*Macoma balthica*, *Mya arenaria*, *Mytilus trossulus*, *Cerastoderma glaucum*) and crustaceans (*Saduria entomon*, *Bathyporeia pilosa*, *Crangon crangon*), which, in turn, provide nutrition for fish such as flounders (*Platichthys flesus*) and gobies (Gobiidae).

Sandbanks are vulnerable to eutrophication, dredging and disposal of dredged material (HELCOM Red List Biotope Expert Group 2013b). The potential exploitation of sandbanks for sand, gravel and mineral aggregate extraction is a smaller threat to the habitat type.

**Geographic variation:** The geographic variation of sandbanks has not been systematically studied, but at least their species composition varies according to aspects such as salinity. The common eelgrass (*Zostera marina*), for instance, is absent from the northern and eastern sandbanks. Additionally, sandbanks in the Bothnian Bay may be larger and flatter than the southern ones.

**Relationships to other habitat types:** Sandbanks often occur in the vicinity of wider sandy substrate areas. In the Archipelago Sea, the habitat complex is concentrated near the coast, in the proximity of moraine bottoms left by the last ice age, and postglacial mud bottoms. Sandbanks occur in the vicinity of esker islands, which have been described as a coastal habitat complex.



Kolaviken, western Gulf of Finland. Photo: Mats Westerborn, Metsähallitus Parks & Wildlife Finland



**Distribution:** Sandbanks occur unevenly on the Finnish coast. The largest sandbank areas are located in the Archipelago Sea. Fairly large numbers of sandbanks have also been found in the Bothnian Bay and the Gulf of Finland. Sandbanks are less prevalent in the Bothnian Sea and in the Quark (Geological Survey of Finland 2016; Kaskela and Rinne 2018).

**Threat factors:** Not evaluated.

**Description of habitat type collapse:** Not evaluated.

**Justification:** The habitat complex was not evaluated.

**Reasons for change of category:** No changes (new described habitat complex, but not evaluated).

**Trend:** Not evaluated.

**Links to administrative classifications:** Includes the Habitats Directive habitat types *sandbanks which are slightly covered by sea water all the time* (1110) and the underwater parts of *Baltic esker islands* (1610).

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## DESCRIPTION SHEET

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<b>Pages</b>	98	Language	English
<b>Keywords</b>	Threatened habitat types, biotopes, Baltic Sea		
<p><b>Abstract</b></p> <p>This report is a partial translation of the final report in Finnish on threatened habitat types (Threatened habitat types in Finland 2018, Part II: Descriptions of habitat types, The Finnish Environment 5/2018) that presents a total of 420 habitat types. This report includes all the evaluated habitat types of the Baltic Sea, as well as six new marine habitat types, which were described but not yet evaluated (NE). Also included are habitat types regarded as of least concern (LC) and those with deficient data (DD).</p> <p>For each habitat type a description, distribution map, photo, and the reasoning behind the assessment result are presented. The descriptions of the habitat types include their characteristics, geographical variation, connectivity to other habitat types, occurrence in Finland, reasons for being threatened and future threats, trend in the state of the habitat type, correspondence of the habitats type with habitat types covered by statutory protection, and whether the habitat type is one for which Finland has an international responsibility.</p> <p>Part I of the final report (in Finnish Suomen luontotyyppien uhanalaisuus 2018, SY 5/2018 and in English Threatened Habitat Types in Finland 2018, FE 2/2019) presents the assessment method for threatened habitat types, results and reasoning of the assessment, and proposals for measures prepared by the experts groups. In the whole country 186 habitats types were assessed as threatened (48% of the number of habitats types). The share of threatened habitat types is much larger in southern Finland (59%) than in northern Finland (32%). The assessment was conducted by broadly-based expert groups in 2016–2018.</p> <p>This was the second assessment of threatened habitat types in Finland. This assessment was conducted using the international IUCN Red List of Ecosystems method. Because of the new assessment method, the results of the first and second assessment of threatened habitat types are not directly comparable with each other. The conclusion that can be made, however, is that the decline and degradation of habitats has not diminished.</p>			
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## KUVAILULEHTI

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<b>Tekijät</b>	Aarno Kotilainen, Suvi Kiviluoto, Lasse Kurvinen, Matti Sahlha, Eva Ehrnsten, Ari Laine, Hans-Göran Lax, Tytti Kontula, Penina Blankett, Jan Ekeboom, Heidi Hällfors, Ville Karvinen, Harri Kuosa, Rami Laaksonen, Meri Lappalainen, Sirpa Lehtinen, Maiju Lehtiniemi, Jouni Leinikki, Elina Leskinen, Anu Riihimäki, Ari Ruuskanen ja Petri Vahteri		
<b>Julkaisun nimi</b>	Suomen luontotyyppien uhanalaisuus 2018: Itämeri Luontotyyppien punainen kirja Osa 2: Luontotyyppien kuvaukset		
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<b>Sivumäärä</b>	98	Kieli	englanti
<b>Asiasanat</b>	Uhanalaiset luontotyypit, biotoopit, Itämeri		
<b>Tiivistelmä</b>			
<p>Julkaisu on Itämeren luontotyyppijä koskeva osakäännös luontotyyppien uhanalaisuusarvioinnin loppuraportin toisesta osasta (Suomen luontotyyppien uhanalaisuus 2018, Osa 2 – luontotyyppien kuvaukset, SY 5/2018), joka esittelee suomeksi yhteensä 420 luontotyyppiä. Tässä julkaisussa ovat mukana kaikki arvioidut Itämeren luontotyypit ja myös kuusi uutena kuvattua, mutta vielä arvioimatta jätettyä (NE) meriluontotyyppiä. Mukana ovat myös säilyviksi (LC) ja puutteellisesti tunnetuiksi (DD) arvioidut luontotyypit.</p> <p>Kustakin luontotyyppistä esitetään kuvaus, esiintymiskartta, valokuva sekä arviointituloksen perustelu. Luontotyyppien kuvauksiin on kirjattu muun muassa luonnehdinta luontotyypin ominaispiirteistä, maantieteellinen vaihtelu, liittyminen muihin luontotyyppihin, esiintyminen Suomessa, uhanalaistumisen syyt ja tulevaisuuden uhkatekijät, luontotyypin tilan kehityssuunta, luontotyypin vastaavuus tärkeimpien säädöksissä turvattavien luontotyyppien kanssa sekä luontotyypin mahdollinen kuuluminen Suomen kansainvälisiin vastuuluontotyyppihin.</p> <p>Loppuraportin ensimmäinen osa (suomeksi Suomen luontotyyppien uhanalaisuus 2018, SY 5/2018 ja englanniksi Threatened Habitat Types in Finland 2018, FE 2/2019) esittelee puolestaan luontotyyppien uhanalaisuuden arviointimenetelmän, arvioinnin tulokset ja perusteet sekä asiantuntijaryhmien laatimat toimenpideehdotukset. Koko maassa uhanalaisiksi arvioitiin 186 luontotyyppiä (48 % luontotyyppien lukumäärästä). Etelä-Suomessa uhanalaisten osuus (59 %) on selvästi suurempi kuin Pohjois-Suomessa (32 %). Arviointi toteutettiin vuosina 2016–2018 laajapohjaisissa asiantuntijaryhmissä.</p> <p>Luontotyyppien uhanalaisuus arvioitiin Suomessa toista kertaa. Arvioinnissa siirryttiin käyttämään kansainvälistä IUCN Red List of Ecosystems -menetelmää. Ensimmäisen ja toisen uhanalaisuusarvioinnin tulokset eivät ole suoraan vertailtavissa arviointimenetelmän muutoksen vuoksi. Tulosten perusteella voidaan kuitenkin tulkita, ettei luontotyyppien häviämishuoka ole vähentynyt.</p>			
<b>Kustantaja</b>	Ympäristöministeriö		
<b>Julkaisun jakaja/myynti</b>	Sähköinen versio: <a href="http://julkaisut.valtioneuvosto.fi">julkaisut.valtioneuvosto.fi</a> Julkaisumyynti: <a href="http://julkaisutilaukset.valtioneuvosto.fi">julkaisutilaukset.valtioneuvosto.fi</a>		

## PRESENTATIONSBLAD

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<b>Författare</b>	Aarno Kotilainen, Suvi Kiviluoto, Lasse Kurvinen, Matti Sahla, Eva Ehrnsten, Ari Laine, Hans-Göran Lax, Tytti Kontula, Penina Blankett, Jan Ekeboom, Heidi Hällfors, Ville Karvinen, Harri Kuosa, Rami Laaksonen, Meri Lappalainen, Sirpa Lehtinen, Maiju Lehtiniemi, Jouni Leinikki, Elina Leskinen, Anu Riihimäki, Ari Ruuskanen och Petri Vahteri		
<b>Publikationens titel</b>	Hotbedömning av Finlands naturtyper 2018: Östersjön Rödlistning Del 2: Beskrivningar av naturtyperna		
<b>Publikationsseriens namn och nummer</b>	Miljön i Finland 23/2020		
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<b>Sidantal</b>	98	Språk	engelska
<b>Nyckelord</b>	Hotade naturtyper, biotoper, Östersjön		
<b>Referat</b>	<p>Denna publikation är en delvis översättning av den andra delen av slutrapporten om bedömningen av hotade naturtyper (Hotbedömning av Finlands naturtyper 2018, Del 2: Beskrivningar av naturtyperna, Miljön i Finland 5/2018) som behandlar sammanlagt 420 naturtyper och som publicerats bara på finska. Denna rapport omfattar alla naturtyper i Östersjön som ingått i bedömningen och dessutom sex marina naturtyper som beskrivs som nya men som ännu inte har bedömts (NE). Bland naturtyperna finns också de naturtyper som bedömts som livskraftiga (LC) och naturtyper i fråga om vilka det råder kunskapsbrist (DD).</p> <p>För varje naturtyp presenteras en beskrivning, en utbredningskarta, ett fotografi och en motivering till bedömningsresultatet. I beskrivningarna av naturtyperna ingår bl.a. en karakterisering av naturtypens särdrag, uppgifter om geografisk variation, koppling till andra naturtyper, förekomst i Finland, orsakerna till att naturtypen är hotad, framtida hotfaktorer, utvecklingsriktningen för naturtypens tillstånd, information om i vilken grad naturtypen motsvarar de viktigaste naturtyperna som bevaras genom lagstiftning och information om huruvida naturtypen hör till de naturtyper som Finland har särskilt ansvar för att bevara.</p> <p>Den första delen av slutrapporten (på finska Suomen luontotyyppien uhanalaisuus 2018, SY 5/2018 och på engelska Threatened Habitat Types in Finland 2018, FE 2/2019) redogör för den metod som tillämpades vid hotbedömningen av naturtyperna, resultatet av och grunderna för bedömningen samt de åtgärdsförslag som expertgrupperna utarbetat. I hela landet bedömdes 186 naturtyper vara hotade (48 % av det totala antalet naturtyper). I Södra Finland är andelen hotade naturtyper (59 %) betydligt högre än i Norra Finland (32 %). Bedömningen utfördes 2016–2018 av expertgrupper med bred sammansättning.</p> <p>Det här är andra gången det görs en hotbedömning av naturtyperna i Finland. Den här gången tillämpades den internationella metoden IUCN Red List of Ecosystems i bedömningen. Resultaten från den första och den andra hotbedömningen är inte direkt jämförbara eftersom bedömningsmetoden inte är den samma. På basis av resultaten kan man dock uttyda att hotet om utrotning inte har minskat.</p>		
<b>Förläggare</b>	Miljöministeriet		
<b>Distribution/ beställningar</b>	Elektronisk version: <a href="http://julkaisut.valtioneuvosto.fi">julkaisut.valtioneuvosto.fi</a> Beställningar: <a href="http://julkaisutilaukset.valtioneuvosto.fi">julkaisutilaukset.valtioneuvosto.fi</a>		

The threat status of Finnish habitat types has now been assessed for the second time. In this report the assessment results are provided for 48 marine habitat types of the Baltic Sea.

For each habitat type a description, distribution map, photo, and the reasoning behind the assessment result are presented. The descriptions of the habitat types include their characteristics, geographical variation, connectivity to other habitat types, occurrence in Finland, reasons for being threatened and future threats, trend in the state of the habitat type, correspondence of the habitats type with habitat types covered by statutory protection, and whether the habitat type is one for which Finland has an international responsibility.

The IUCN Red List of Ecosystems Categories and Criteria was adopted as the method for the second assessment. The primary assessment criteria used were change in habitat type quantity, change in abiotic and biotic quality, and rarity. The current trends for habitat types in terms of their state were also assessed.

The final report in Finnish has two parts. Part I (translated also in English) presents the threat status assessment method, results and basis of assessment as well as a summary of the action proposals drawn up by expert groups for all of the habitat type groups. This report (partial translation of Part II) gives the habitat type descriptions and assessment justifications for the habitat types of the Baltic Sea. The descriptions of other habitat type groups are only available in Finnish in the original Finnish final report (Part II).



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