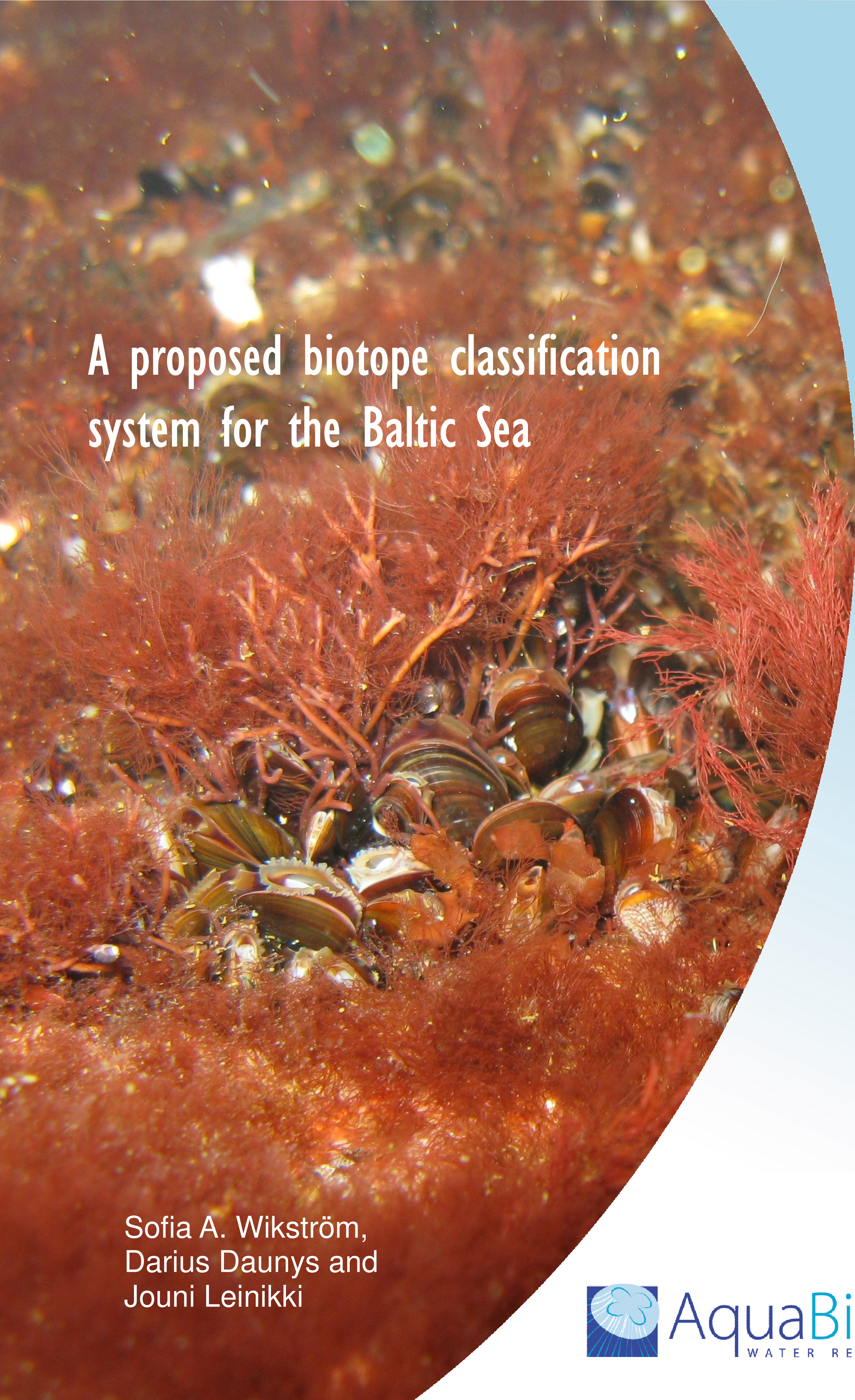

A proposed biotope classification system for the Baltic Sea

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AquaBiota
WATER RESEARCH

S T O C K H O L M, 16 D E C E M B E R 2 0 1 0

Title:
A proposed biotope classification system for the Baltic Sea

Funding:
The preparation of this report was funded by EC (contract no. MARE/2008/07) and Swedish EPA

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Quality control of report:
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Front page photograph:
Red algal community with Mytilus (Karl Florén, AquaBiota)

AquaBiota Report 2010:06

ISBN: 978-91-85975-11-2
ISSN: 1654-7225

CONTENT

1. INTRODUCTION

The Baltic Sea Action Plan (BSAP) proposes that an international biotope classification system should be developed for the Baltic Sea by the year 2011. Such a classification system is needed for marine spatial planning and for the reporting to the EC Directives, including the upcoming Marine Strategy. It is further needed for the identification of valuable and threatened biotopes in the Baltic Sea, presently addressed by the Project for Completing the HELCOM Red List of Species and Habitats/Biotopes.

The only previous attempt to develop a common Baltic biotope classification was done within the HELCOM EC-NATURE Red List Project (HELCOM 1998). This involved a large number of experts from the Baltic Sea area and provided a thorough and well covering description of Baltic Sea biotopes defined mainly by substrate and depth zone, which was used as basis for the HELCOM Red list of marine biotopes. It was presented as preliminary classification based on available knowledge, which should be developed further as soon as more information on Baltic Sea biotopes was available. Since then, it has been acknowledged that a weakness of the HELCOM Red list classification is that it contains very little biology, i.e. biotopes defined by the present or dominating species. In the same time, several recent national and international projects have produced more detailed, biology-defined habitats for local areas of the Baltic Sea (e.g. Olenin 1997, Urbanski & Szymelfenig 2003, Riecken et al. 2006).

This document presents a draft version of a Baltic biotope classification based on the HELCOM Red list of biotopes (1998), and aims to update the classification to lower levels adding biological features. The ambition has been to create a classification that meets the needs of the Baltic region and reflect major features of the Baltic ecosystem. In the same time, the aim has been to enable smooth transfer of the Baltic units to the European habitat classification system EUNIS. The proposed biotope classification therefore represents a compromise classification between an independent Baltic classification and EUNIS, as both should be consistent in terms of structure.

This report has been produced in connection to the EUSeaMap project, a European Commission-funded project that will produce broad-scale habitat maps for the Celtic, North, Baltic and Mediterranean Seas, and the Project for Completing the HELCOM Red List of Species and Habitats/Biotopes. Swedish EPA has contributed with funding for the participation in the HELCOM work. Apart from the authors, experts in the HELCOM working group for Biotopes provided important input to earlier versions of the proposed classification.

It is important to point out that the proposed biotope classification presented here is not fully covering the diversity of biotopes in the Baltic Sea. It provides the first step towards a full biotope classification system, but further work involving experts from all parts of the Baltic Sea are needed to pursue the work. Gaps and needs for complements identified during the work are described in Section 8. It is also important to point out that the work has been focused on describing biotopes inside Öresund and the Danish straits (Baltic Proper, Gulf of Bothnia and Gulf of Finland). Biotopes in Kattegat can be classified using the present marine EUNIS system and have therefore not been included in the present Baltic biotope classification proposal.

2. DESCRIPTION OF WORK

One important part of the work has been to compile existing habitat classification systems and to evaluate how a Baltic biotope classification can build on these previous efforts. The results from this compilation are given in section 3. In parallel, we have analysed field data from the phytobenthic zone of Finland and Sweden in order to identify important habitats (described in section 4).

Based on the outcome from the compilation of existing systems and analyses of field data, we propose which environmental factors that should be used for the upper levels of the classification, the criteria and classes for these factors and the hierarchical organisation of the factors (section 5). Finally, lower-level biotopes defined by biology have been added from existing habitat classifications and from the analyses of Swedish and Finnish samples (section 6).

3. EXISTING HABITAT CLASSIFICATION SYSTEMS

This section gives a short overview of existing national and international classifications of habitats and biotopes for the Baltic Sea. The use of habitat and biotope terms refer to their original meaning in reviewed classifications. Bibliographic details of information sources are given in relevant sections.

The only biotope classification covering the entire Baltic Sea is the HELCOM Red list of biotopes. The biotopes have been incorporated in the European habitat classification system EUNIS without any large changes, allowing classification of Baltic habitats to a varying level of detail.

Three national (German, Polish and Lithuanian) biotope lists and one joint classification of three Baltic States (Lithuania, Latvia and Estonia) are currently known and published for the Baltic region. All of them have been developed independently and for different purposes. German biotope list was derived from the Red List of German biotopes (Riecken et al., 2006) and therefore reflects national conservation aims. Two Polish lists have been developed in the framework of research projects: one based on application of new GIS mapping algorithms (Urbanski, Szymefenig, 2003) and the second originating from the extensive field sampling program carried out in the framework of European and Norwegian Financial Mechanism funding. Lithuanian national classification (Olenin et al., 1996) was developed for the national purposes of seabed zonation, whereas joint effort of three Baltic States was funded by LIFE Nature Program for delineation on NATURA 2000 sites (Martin et al. in prep).

3.1. HELCOM classification of benthic biotopes

Sources: HELCOM 1998, HELCOM 2007.

Currently HELCOM biotope classification is the only Baltic wide classification, developed by a team of national experts representing all Baltic Sea countries. The classification was aimed at development of a common understandable language when describing Baltic biotopes as habitats of communities and species and to provide a basis for a Baltic wide mapping of underwater environment. Biotopes or biotope types have been defined according to Blab et al. (1995) as the spatial components characterized by “specific ecological, unique and more or less constant environmental conditions”. Their plant and animal communities constitute a major part of, and form to a large degree, the characteristic environment and therefore are important indicators for the geographical limits of the biotope types.

The HELCOM biotope types are differentiated according to substrate type (7 major types: rock, stony, hard clay, gravel, shell gravel, sandy and muddy bottoms, in addition to peat and mixed bottoms) and three depth zones (hydrolittoral, sublittoral photic and sublittoral aphotic). Geomorphological features such as reefs, bars and banks have been considered at relevant combinations of substrate types and depth zones. Presence and dominance of macrophyte vegetation are the only biological features, included into classification, whereas mussel beds and bubbling reefs were considered as separate categories alternative to substrate type.

At the later stage (HELCOM, 2007) several biotopes were added to the earlier classification version considering EC Habitat Directive Annex I habitat types and OSPAR Initial List of Threatened and/or Declining Species and Habitats: seagrass beds, macrophyte meadows and beds, gravel bottoms with Ophelia species, maerl beds, sea pens and burrowing megafauna communities.

3.2. Baltic components of existing EUNIS

Source: Davis et al. 2004.

The European habitat classification system EUNIS classify habitats according to the characterising elements of the biotic environment (for instance dominant species) and a set of abiotic factors which are important drivers of community composition. The classes are arranged hierarchically, where the upper levels are mainly identified by abiotic factors (down to level 3) and the lower levels are described by a combination of biotic and abiotic descriptors.

The basis for the marine part of EUNIS is a classification of marine habitats of Britain and Ireland developed by the British JNCC (Connor et al. 2004; Davis et al. 2004). The system has been extended to include also marine habitats of other European marine regions, including the Mediterranean and Baltic Seas. Baltic habitats were included in the EUNIS system by basically incorporating the biotopes defined in the HELCOM Red List (HELCOM 1998). This resulted in a revised EUNIS system that allowed classification of Baltic marine habitats as far as level 3, in some instances to lower levels. However, several problems make the Baltic component of the EUNIS system problematic. The main problems are that habitats defined by biology is missing, with some exceptions, and that the lower hierarchical levels (level 5 and 6) do not correspond to the rest of EUNIS classification units. Furthermore, it has not been tested whether the environmental (non-biological) factors in the present EUNIS version are the most important factors for habitat classification in the Baltic Sea. However, it is important to point out that the marine EUNIS classes works well to classify biotopes in Kattegat.

3.3. Polish classification

Two separate biotope initiatives have described habitats of the Polish marine area.

1) Source: Urbanski & Szymelfenig 2003

In total 13 benthic habitats have been derived using GIS overlay of bathymetry and sediment maps (cross-classification) and fuzzy set theory (deriving combinations of habitats based on probability of their occurrence). Euphotic depth was estimated from satellite maps and using measured Secchi depths. Sediment data (1: 200.000) was based on Shepard classification with GSD extension for sandy sediment. The resulting list of benthic habitats is strictly based on 7 sediment categories (stony bottoms, gravel, sand, mud, clay, peat and mixed bottoms), each except peat bottoms found in both below and within euphotic zone.

2) Source:
(http://www.pom-habitaty.eu/en/index.php?option=com_weblinks&catid=14&Itemid=18)

Results from a project supported by a grant from Iceland, Liechtenstein and Norway through the EEA Financial Mechanism “Ecosystem approach to marine spatial planning – Polish marine areas and the Natura 2000 network”

In total 17 benthic habitats have been described from a large amount of benthic samples taken along the Stilo-Ustka open coast, in the Slupsk bank and Puck Bay, where acoustic mapping of bathymetry and sediment has also been done. Three habitats described for Stilo-Ustka area and Slupsk bank are examples of the most widespread seabed types and include detailed description of biology. Another 14 habitats identified in the Puck Bay are less consistent in scale (e.g. soft bottom with epifauna and infauna *Hydrobia* sp. versus river mouths) and consider a lower number of biological features.

Table 1. Overview table of Polish habitats (+ present in the lists; - absent from the lists)

Substrate/depth	Within photic zone	Below photic zone
Stony bottoms	+ (features not specified) 1. dominated by red algae	+ 1. dominated by Mytilus trossulus, Balanus improvisus and gammarids;
Gravel bottoms	+ (features not specified)	+ (features not specified)
Sandy bottoms	+ (features not specified) 1. Dominated by crustaceans (Bathyporeia, Eurydyce, Crangon) 2. Zostera marina beds	+ (features not specified)
Muddy bottoms	+ (features not specified)	+ (features not specified)
Clay bottoms	+ (features not specified)	+ (features not specified)
Peat bottoms	+ (features not specified)	-
Mixed bottoms	+ (features not specified)	+ (features not specified)

3.4. German classification

Source: Riecken et al. 2006.

The German list of biotopes was derived from the Red List of biotope types and therefore reflects endangered or protected seafloor areas rather than overall seabed diversity. The Classification is using principal division of biotope types into hydrolittoral, coastal and offshore (Table 2). Within these three geographic divisions, substrate/sediment type is the most important for differentiation of biotope types. Several types such as reefs and sandbanks are also distinguished; however biology remains largely not covered by the list. In total 26 biotope types have been identified.

A large majority of the German Red list biotopes correspond to level 4 habitats in the EUNIS classification. Part of them (hydrolittoral biotopes) are identical to HELCOM Red list biotopes and therefore present in EUNIS.

Table 2. Overview table of the German Red Biotope List (+ present in the list; - absent from the list)

Substrate/ depth zone	Hydrolittoral zone	Coastal waters	Offshore waters
Hard substrate	+ (features not specified)	Hard substrate reefs Biogenic reefs (blue mussels)	Hard substrate reefs Biogenic reefs (blue mussels)

Gravel	+ (features not specified)	+(features not specified)	+(features not specified)
Sand	+ (features not specified)	Sanbanks*	Sandbanks* (incl. megaripples) Eelgrass beds**
Fine substrate	-		
Mud	+ (features not specified)	-	-
Peat	Free of or low in macrophytes	+ (features not specified)	+ (features not specified)
Shell debris	-	+ (features not specified)	+ (features not specified)
Mixed	+ (features not specified)	-	-

*Sandbanks – distinguished as individual habitat; **Eelgrass beds – individual habitat, not specified according to substrate

3.5. Lithuanian national classification

Source: Olenin 1997.

In total 10 benthic biotopes have been defined in the Lithuanian coastal waters down to depth of approx. 30 m (Table 3). The classification is based on different substrate types and hydrodynamic division (swash zone, surf zone, breakers zone, and offshore zone) within two depth zones (pseudolittoral and sublittoral). Biology is included considering dominant species or characteristic biological features (e.g. floating algae mats) and is compatible with EUNIS level 5 and 6 units.

Table 3. Overview table of the Lithuanian classification

Substrate/ exposure	Swash zone	Surf zone	Breakers zone	Offshore zone
Boulders	no macroflora or macrofauna	Cladophora spp. Enteromorpha spp.	Balanus	Furcellaria fastigiata Mytilus, Balanus
Pebbles	decomposing algal mats	Floating filamentous green algae, Gammarus	Balanus, Gammarus	Balanus, Mytilus, Macoma
Sand	decomposing algal mats	Floating filamentous green algae, Gammarus, Bathyporeia	Bathyporeia, Mysis, Pygospio	Macoma, Pygospio
Mud	non-existing	non-existing	non-existing	Nereis, Marenzelleria

3.6. Baltic LIFE classification

Source: Martin et al. in prep.

In total 25 habitats have been identified in three Baltic countries based on exposure (three classes: sheltered, moderately exposed, exposed), substrate (hard and soft bottoms) and biology (dominant species or presence of taxonomic group; Table 4). Photic zone is integrated into classification through recording presence of vegetation; therefore habitats of the photic zone can be discriminated from those distributed below photic zone. Each habitat is comprehensively described in terms of species composition, biomass and density.

Table 4. Overview table of the LIFE classification of three Baltic countries (Lithuania, Latvia, Estonia)

Substrate/ exposure	Sheltered	Moderately exposed	Exposed
Hard bottoms	1. *Fucus vesiculosus* 2. Bivalves and B. improvisus 3. No particular species dominance	1. *Fucus vesiculosus* 2. *Furcellaria lumbricalis* 3. Bivalves and *B. improvisus* 4. No particular species dominance (<20 m) 5. No particular species dominance (>20 m)	1. *Furcellaria lumbricalis* 2. *B. improvisus* 3. *M. trossulus* and *B. improvisus* 4. moraine ridges with *Mytilus trossulus* and *Balanus improvisus*
Soft bottoms	1. Higher plants 2. Charophytes 3. Bivalves 4. No particular species dominance	1. *Zostera marina* 2. Higher plants (excl. *Z. marina*) 3. Charophytes 4. *Furcellaria lumbricalis* 5. Bivalves 6. No particular species dominance	1. *Macoma balthica* 2. *Pygospio elegans* and *Marenzelleria neglecta* 3. mobile amphipods

3.7. Summary of existing classifications

In total 91 seabed units have been classified in five national lists of habitats, biotopes and biotope types. The major common feature of reviewed classifications is that all of them are based on substrate types and listed units can be differentiated according to their position in respect to the photic depth limit (Table 5). Different number of substrate categories is used; however the lowest division into hard, soft and mixed bottoms is common or possible to derive from unit descriptions. EUNIS depth categories (hydrolittoral, infralittoral, circalitoral and sublittoral) are used in few lists only and cannot be directly derived for Polish habitats, some Baltic LIFE classification habitats and German Red List biotope types.

The second component of the habitat matrix in different lists (except Polish) is typically associated with shore-open sea gradient (German Red List, Lithuanian classification) or exposure (LIFE classification for three Baltic countries), however, there is no uniform approach between countries.

Biological details (if present) are usually based on dominant or characteristic species, except German Red List biotopes, which comprise features of the Habitat Directive Annex I habitat type (e.g. reefs, beds).

None of habitat and biotope classifications (excluding the conservation-aimed German Red list of biotope types) refer to geomorphologic features such as banks, bars and reefs (Table 5), which are present in the EUNIS classification. Additionally, most of the national classifications refer to habitats and biotopes in the coastal waters, whereas offshore environments and particularly aphotic zones outside banks remains largely not covered.

Table 5. Summary of existing habitat/biotope classifications for Baltic Sea areas

Factor/classification	LIFE habitat classification	German Red List of biotopes types	Lithuanian biotope classification	Polish habitat classification	EUNIS
Exposure	3 classes	-	-	-	Sporadic, 3 classes
Depth zones	- - (depths given)	+ (hydrolitoral zone only)	+ (pseudolittoral, sublittoral, only)	- - (depths given)	hydrolittoral infralittoral circalittoral sublittoral
Photic/aphotic	- (possible to derive)	-	- (possible to derive)	+	+
Substrate	2 classes: soft bottoms hard bottoms	8 classes: hard, gravel, sand, fine substrate, mud, peat, shell debris, mixed	4 classes: boulders, pebble, sand, mud	7 classes: stony, gravel, sandy, muddy, clay peat, mixed	6 major classes + features
Geomorphologic features	-	+	-	-	+ bars, banks etc.
Biology					
Dominant species	+	-	+	+	+
Taxonomic groups	+	-	-	+	+
Vegetated/unvegetated	+	+	-	-	+
Mussel beds, seagrass beds, etc.	- (possible to derive)	+	-	+ (partly)	+
Habitat Directive types	+ (correlation matrix available)	+ (sandbanks and reefs)	-	-	Reefs, inlets, banks

4. ANALYSES OF FIELD DATA

The field data set used to set the threshold values was compiled from a large number of diving surveys from the Swedish and Finnish coasts. The data was collected using a standard method for monitoring of phytobenthic communities in the Baltic Sea (Kautsky 1992; HELCOM 1999). In short, diving transects were placed perpendicular to the shoreline, from the shore to the deepest occurrence of macroalgae or plants and the substrate type and surface cover of all algae, plants and sessile animals were noted within depth sections in a 6-10 m wide corridor along the transect line.

The Finnish phytobenthos data of 3153 records was collected by Alleco Oy during several mapping and monitoring projects along the Finnish coast between 2002 and 2009. The Alleco standard for phytobenthic data includes position (derived from starting point, direction and distance), depth, % coverages of different substrata, % coverage and average height for each species. The observations are made from an area of 4 m^2.

The Swedish phytobenthic data of 2366 records was taken from the Swedish National Database for phytobenthic monitoring, including data collected along the entire Swedish coast of the Baltic Sea between 1980 and 2009. The data was adjusted to fit into the Alleco standard by adding the average heights of the species based on literature.

The data was classified with BalMar analysis (Backer et. al 2004, Alleco 2005), which determines biotope classes at 10 hierarchical levels. The topmost 6 levels are determined by the physical environment (salinity, light, energy and substrate) and the levels 7-10 by the abundance of species. Perennial vegetation and sessile animals are given most weight, while annual algae and infauna are used to determine biotopes only when the coverage of the first of these “Functional groups” is less than 10 %. For this work, we only used the biological data (levels 7-10) to determine the biotope classes. The biotope class was defined by the BalMar level 9, “Dominant species”, where one or several most abundant species (totalling at least 50% of the dominating Functional group’s abundance) give the name to a biotope class. Abundance of vegetation and sessile animals was determined by multiplying the % coverage with average height of each species.

The BalMar analyses resulted in a large number of BalMar biotopes (defined by dominant species). The list was condensed to a lower number of biotopes by combining biotopes with very similar species composition and some very rare biotopes.

5. ENVIRONMENTAL FACTORS – UPPER LEVELS

The collation of existing habitat classification systems shows that substrate is always and depth zone almost always included as environmental factors, although the exact classes differ between systems. Energy occurs in EUNIS (only on hard substrate habitats) and in the Baltic states LIFE habitats, and implicitly in the coastal water-offshore division in the German Red list. The HELCOM (as well as the German) Red list further contain geomorphologic features such as reefs, banks and bars and separate biotopes dominated by macrophytes.

Analyses of biological samples from Sweden show that depth, substrate and (to a smaller degree) wave exposure are the most important factors determining the distribution of species and communities at smaller scales, while salinity is also important at a Baltic-wide scale (Nyström Sandman et al. in prep., Wallin et al. in prep.). This is also in accordance with many other studies pointing out these factors as important for species distributions in the Baltic Sea (e.g. Kautsky & van der Maarel 1990, Eriksson & Bergström 2005).

Jointly, this points out substrate, depth, wave exposure (energy) and salinity as factors to consider for the proposed Baltic biotope classification. The four factors are discussed in detail below.

5.1. Substrate

In the EUNIS system, habitats are coarsely divided according to substrate (hard/sediment) at level 2 and the sediment habitats are further subdivided according to sediment type at level 3. The sediment classes used at these levels are shown in Table 6 (finer subdivisions occur at lower EUNIS levels where appropriate). The sediment classes correspond well to the classes in the HELCOM habitat Red list, but the Red list also divides the hard substrate into finer units (Table 6).

The proposed Baltic EUNIS keeps the basic structure from EUNIS, with division according to hard/sediment at level 2 and a finer division at level 3, but adds a finer division also of hard substrate (Table 6). The finer classes are chosen in order to reflect major differences in biological communities. Hard substrate is thus divided into three categories; rock, till and hard clay.

Till is used here to describe residual material from glacial or glacifluvial deposits. This class is geologically defined as a heterogeneous hard substrate with boulders, cobbles and pebbles, sometimes with patches of sand and coarse sediment. The presence of sediment patches means that higher plants and charophytes may be present, but the patches do not have similar faunal communities to larger sediment areas. It has been suggested that well sorted boulders and cobbles should be separated from biotopes that include also sediment patches. In the present version, this distinction is made at a lower level (in names of biologically defined biotopes), but it is also possible to do this division at level 3. Other terms that have been suggested for this substrate type are "mixed hard substrata" or "mixed consolidated sediment".

Hard clay is a very specific habitat type, which typically has very little epibiota but also no infauna, which justify that it is separated from the other hard substrata at level 3.

If mixes of rock and till are common, it might be necessary to introduce another class at level 3 to include these mixes. The alternative is to map such mix biotopes as mosaics (as is done in EUNIS).

Table 6. Substrate classes occurring in the Atlantic and Mediterranean EUNIS, the HELCOM habitat Red list and the proposed Baltic EUNIS

EUNIS 2	EUNIS 3	HELCOM Red list	Baltic EUNIS 3
Rock and other hard substrate	-	Soft rock	Rock
	-	Hard rock	
	-	Stony bottoms	Till
	-	Hard clay	Hard clay
Sediment	Coarse	Gravel	Coarse
		Shell gravel	
	Sand	Sand	Sand
	Mud	Mud	Mud
	Mixed sediment	Mixed sediment	Mixed sediment

5.2. Depth zone

At level 3, the EUNIS system defines three depth zones on rock and two zones on sediment on the continental shelf (Table 7). The littoral zone represents the intertidal, while the division of the subtidal (sublittoral zone) into infra- and circalittoral is based on light – the infralittoral is defined as the zone with vegetation-dominated communities. A finer division of the sublittoral occur at lower levels in the system, such as division of the sublittoral in infra- and circalittoral on sediment and separation of the deep circalittoral.

The HELCOM habitat Red list separates three depth zones (Table 7). The hydrolittoral is defined as the zone between the mean water level and the annual maximum low water (MLW). This zone is not equivalent to the intertidal (or littoral) of tidal costs but defines a zone that is above air under irregular but extended periods, forming a harsh environment for aquatic species. The zone is often clearly discernable from deeper communities due to the dominance of annual species that recolonise the zone after long periods above the water. The sublittoral zone is divided into the photic and aphotic zone. The HELCOM Red list does not provide a definition of the limit between the photic and aphotic zone, but following the general definition of the photic zone (sufficient sunlight for photosynthesis to occur) it would include the entire depth zone where macroalgae are found (including deep areas with only crust-forming species).

For the Baltic EUNIS, it is proposed that three depth zones are introduced at level 3, symmetrical over both rock and sediment habitats (Table 7). The hydrolittoral is defined as in the HELCOM Red list. The deeper limit of the infralittoral is suggested to be defined as in EUNIS, i.e. by presence of biotopes characterised by (or dominated by) macrovegetation. However, it is acknowledged that “dominance” has to be defined properly so that there is a common understanding of where to set the limit between the infra- and circalittoral zones. Apart from the three depth zone introduced at level 3, the circalittoral in the Baltic proper is divided into habitats above and below the deep (about 40-80 m) halocline at level 4. This reflects that zoobenthic communities below the halocline often have a distinct composition, irrespective of depth.

Analyses of field data from Sweden and Finland showed that vegetation-dominated habitats extended down to a depth/Secchi depth ratio of 1.8-3.2 in the Baltic proper and Bothnian Sea, and down to 1.2-2.0 in the Bothnian Bay (EUSeaMap Project Partners 2010). However, it should be noted that the results are based on a rather weak map of Secchi depth. The depth limit of the infralittoral should therefore be tested also for other areas and using better Secchi depth data.

Table 7. Depth zones occurring in the Atlantic and Mediterranean EUNIS, the HELCOM habitat Red list and the proposed Baltic EUNIS

EUNIS level 3	EUNIS lower levels	HELCOM Red list	Baltic EUNIS level 3
Littoral		Hydrolittoral	Hydrolittoral
Infralittoral (on rock) /Sublittoral	Infralittoral (on sediment)	Photic zone	Infralittoral
Circalittoral (on rock) /Sublittoral	Circalittoral (on sediment)	Aphotic zone	Circalittoral
	Deep circalittoral		

5.3. Energy

In the present EUNIS system, energy from waves and currents is introduced at level 4, but only in the rock habitats (infralittoral and circalittoral depth zones). The HELCOM habitat Red list does not consider energy. However, energy is regarded to be an important structuring factor for Baltic Sea communities, both on rock and on sediment. For the Baltic EUNIS system, three energy classes (high, moderate and low) are therefore proposed at level 4 for both hydro- and infralittoral rock and sediment.

Further discussion is needed to achieve a common understanding of the three energy classes across the Baltic Sea. In the present EUNIS proposal, the low energy class is applied to sites protected from the open sea in small bays or inner parts of archipelagos, which typically have a large fraction of sediment substrate and diverse phanerogam communities. Moderate energy sites represent more open areas that are sheltered from the open Baltic Sea, such as larger bays (e.g. Gulf of Riga) and areas sheltered by islands. These sites typically have rich seaweed communities on hard substrate, including dense *Fucus* beds close to the surface, and communities of *Zostera* and other hardy phanerogams and charophytes on sediment. High energy sites are exposed to the open Baltic Sea and are characterised by mobility also of stones and the lack of fine sediment in shallow areas. Phanerogams and charophytes are absent and shallow *Fucus* communities are missing or sparse.

Based on analyses of field data from Sweden and Finland, using wave exposure values calculated using SWM (Isaeus 2004), the following thresholds were used for broad-scale mapping in the EUSeaMap project: 60 000 between low and moderate energy and 600 000 between moderate and high energy (EUSeaMap Project Partners 2010). However, this is based on data from a limited part of the Baltic Sea and should be tested also for other areas.

5.4. Salinity

Salinity is an important structuring factor at the Baltic-wide scale, setting the limit for the distribution of both marine and freshwater species. It has therefore occurred in discussions of a Baltic biotope classification system and is used as one of the factors in the BALANCE marine landscapes (Al-Hamdani & Reker 2007). Within the EUSeaMap project we have concluded (based on field data and literature) that it is highly relevant to separate areas with salinity less than approximately 4.5 psu ("oligohaline") from areas with higher salinity, since this is the tolerance limit for a number of marine species (EUSeaMap Project Partners 2010). Also around 18 psu is an important threshold, representing the tolerance limit for kelps, echinoderms and a number of other marine species. This is also often used as the threshold between polyhaline (>18 psu) and mesohaline (<18 psu) salinity zones in the literature. Also within these salinity classes there is a slow transition of communities, driven by different tolerance of the different species.

Despite that salinity is clearly an important factor; it is not included at a high level in the proposed Baltic EUNIS system. This is partly to keep the system as simple as possible, but also since salinity is perceived as a difficult factor to include properly. Low-saline (olighaline) areas occur both in the Bothnian Bay and in bays and lagoons in other parts of the Baltic Sea and it not necessarily relevant to group these biotope types together. It is therefore proposed that salinity is introduced at lower levels when relevant, possibly separating lagoon biotopes from Bothnian Bay biotopes. So far salinity classes are indicated in the title of biotopes at level 5 or 6. There are also alternative ways to specify salinity range (e.g. in the description of biotopes) when updating the classification.

5.5. Hierarchy structure

The hierarchy of the proposed Baltic habitat classification combines three major vertical zones (hydrolittoral, infralittoral and circalittoral) and two principal seabed types (hard bottoms being rock and other hard substrata and soft bottoms being sediment) at level 2 (Table 8).

Level 3 considers substrate and sediment categories in more details: hard substrate is divided into rock, till and hard clay, whereas sediment are grouped into coarse sediment, sands, mud and mixed.

At level 4 energy is introduced for hydrolittoral and infralittoral rocks and sediment, but the circalittoral zone is further divided into two vertical zones (above and below halocline) combining complex salinity and depth effects, which act differently in various Baltic regions.

Level 5 specifies types of biological communities either addressing large grouping (vegetation or fauna dominated communities) for sediment and less frequently occuring substrate types (mixed or hard clay) or provide more detailed division of community types (annual algae, red algae, Fucus communities, sparse benthic communities) in case of highly diverse and widespread infralittoral rock and other hard substrate environments (Appendix 1). For circalittoral rock and sediment, level 5 classifies communities specified by dominant species.

Level 6 defines communities characterised by dominant species similarly to circalittoral rocks and sediment at level 5 and is used for diverse infralittoral habitats, where types of biological communities were specified at upper level.

The presented version of the hierarchy structure includes a number of biotopes that are not supported by the data that was accessible for the project. Uncertain biotopes are indicated by [?] in Table 8. They are included for completeness at this stage, but their inclusion in the final classification should be properly evaluated.

Table 8. Hierarchy structure and factors used for description of the Baltic EUNIS classification units. Uncertain biotopes are indicated by [?] and should be documented or excluded in the further development of the classification.

Level 2		Level 3	Level 4
Vertical zones	Substrate type	Substrate type	Energy/halocline
Hydrolittoral	Rock and other hard substrate	Rock	High energy
			Moderate energy
			Low energy
		Till	High energy
			Moderate energy
			Low energy
		Hard clay	
	Sediment	Coarse sediment	High energy
			Moderate energy
			Low energy
		Sand	High energy
			Moderate energy
			Low energy
		Mud	
		Mixed sediment	High energy
			Moderate energy
			Low energy
Infralittoral	Rock and other hard substrate	Rock	High energy
			Moderate energy
			Low energy
		Till	High energy
			Moderate energy
			Low energy
		Hard clay	High energy
			Moderate energy [?]
			Low energy [?]
	Sediment	Coarse sediment	High energy
			Moderate energy
			Low energy
		Sand	High energy
			Moderate energy
			Low energy
		Mud	High energy [?]
			Moderate energy
			Low energy
		Mixed sediment	High energy
			Moderate energy
			Low energy

Level 2		Level 3	Level 4
Vertical zones	Substrate type	Substrate type	Energy/halocline
Circalittoral	Rock and other hard substrate	Rock	Above halocline
			Below halocline
		Till	Above halocline
			Below halocline
		Hard clay	Above halocline
			Below halocline
	Sediment	Coarse sediment	Above halocline
			Below halocline
		Sand	Above halocline
			Below halocline
		Mud	Above halocline
			Below halocline
		Mixed sediment	Above halocline
			Below halocline

6. FINER LEVEL BIOTOPES

Lower level biotopes (level 5 and 6) have been included from following sources:

- BalMar analyses (phytobenthic communities in Sweden and Finland). The biotopes compiled from the BalMar-generated biotopes (see Section 4) were added at level 5-6, following the divisions for substrate, depth zone and wave exposure developed within the EUSeaMap project (EUSeaMap Project Partners 2010).

- Lithuanian biotopes. Lithuanian biotopes described in Olenin (1997) have been directly introduced into the proposed system at level 5 following three major parameters: substrate, depth zone and biological community. Being located at the exposed central Baltic coast (eastern Gotland Basin) all units were assigned to high energy mesohaline environment.

- Life Baltic MPA classification (Martin et al., in prep.). Habitats from classification of coastal habitats mapped in Estonia, Latvia and Lithuania have been directly introduced at level 5 and 6 following habitat descriptions.

- Helcom Red list habitats based on substrate and vertical zones have been included into upper levels of classification.

- Central Baltic (eastern Gotland Basin) circalittoral habitats have been specified from Lithuanian national monitoring zoobenthos database covering period from 1980 to 2005 for depths down 120 m. Only regularly occurring communities have been derived from database and described by supplementary depth and sediment parameters. These communities were added to the level 5 of proposed classification, however better spatial coverage is needed in order to have overall variability of substrate types represented in the system.

The biotopes included in the present version do not show the full range of habitats present in the Baltic Sea and should be complemented. Most notably, we lack habitats from the south-western and the easternmost parts of Baltic Sea, but also in the rest of the Baltic Sea some biotope types are poorly covered (c.f. Section 8).

7. PRELIMINARY HABITAT DESCRIPTIONS FOR BALTIC EUNIS

One important step to produce a Baltic biotope classification is to prepare descriptions of the defined biotopes to give a common understanding of the different biotopes and how they are delimited. Here, we show examples of habitat descriptions for five of the proposed habitat classes. The format follows the EUNIS style for habitat descriptions. Note that the two *Fucus* examples present two different levels in the hierarchy (levels 5 and 6).

AC.122 Baltic moderate energy infralittoral rock dominated by [Fucus] communities
Dense or sparse stands of [Fucus] species on rock. [Fucus vesiculosus] is the predominating species in a large part of the Baltic proper, while mixed stands of [F. vesiculosus] and [F. radicans] are common in the Bothnian Sea and [F. serratus] occurs in deeper areas in the southern Baltic proper. The biotope is present from the water line to 14 m depth in the mesohaline zone (4.5-18 psu).

AC.1222 [Fucus vesiculosus] on moderate energy infralittoral rock
Dense vegetation (at least 25 % cover) of [Fucus vesiculosus] on rock. The rock below the [Fucus] canopy is often occupied by other seaweeds, such as [Cladophora rupestris], [Rhordochorton purpureum] and [Ceramium] species. The contribution of red algal species generally increases with depth. [Balanus improvisus], [Mytilus edulis/trossilus], and [Electra crustulenta] are sometimes common. The biotope occurs from the water line to 8 m depth (occasionally deeper) in the mesohaline zone (4.5-18 psu).

AD.2214 [Zostera marina] on moderate energy sand
Vegetation dominated by [Zostera marina]. Other phanerogams may be present in low densities, e.g. [Potamogeton pectinatus], [Ruppia] species and [Zannichellia palustris]. The biotope is present on low to moderate energy shores with sandy sediments, typically from 2 to 7 m depth and in a salinity of at least 5 psu.

AF.211 [Macoma balthica] in mesohaline circalittoral fine sand above halocline
Very fine to medium sand devoid of vegetation and dominated by infaunal bivalve [Macoma balthica]. Other bivalves [Mya areanaria], [Hydrobia spp.], ostracods, oligochaets and spionid polychaetes [Pygospio elegans] and [Marenzelleria neglecta] can be abundant, though never dominant in terms of biomass. The biotope is widespread in the central Baltic and typically found in depths from 10 m down to lower halocline boundary in depth of approx. 80 m. Contribution of shallow species and species diversity in the community decreases with depth.

AF.325 [Scoloplos armiger] in the mesohaline circalittoral mud below halocline affected by temporary anoxia
Mud below halocline, typically affected by temporary anoxia and dominated by polychaete [Scoloplos armiger]. Polychaete [Bylgides sarsi] is common, while other species such ostracods, mobile crustaceans [Diastylis rathkey] and [Pontoporea affinis] occur irregularly. Community temporarily occurs in central Baltic in depths below 100 m. Species diversity rarely exceeds 3-4 species.

8. FURTHER STEPS TOWARDS A COMPLETE BALTIC BIOTOPE CLASSIFICATION

The present version of the Baltic biotope classification includes a number of biotopes at levels 5 and 6, but these levels have to be complemented with more biotopes in order to provide a complete classification system for the Baltic Sea. Below, the most apparent gaps in the present system are listed:

- The south-western part of the Baltic Sea is not covered. This region represents the transition zone towards the more saline Kattegat and the region can be predicted to house a number of biotopes unique for the Baltic Sea.
- The inner part of Gulf of Finland is not covered.
- The hydrolittoral zone is poorly covered, especially for sediment.
- Specific lagoon biotopes are not fully covered.
- The phytobenthic data analysed from Sweden and Finland included little data from protected land-uplift bays, so biotopes specific for these bays are missing to a large degree (including apparent biotopes such as reed beds)
- The Swedish-Finnish data did not include sediment samples, so biotopes characterized by infaunal communities need to be defined for these areas.

Apart from these gaps, national experts will probably be able to identify further gaps that need to be be filled. We propose the following procedure to complement the existing classification:

1) Compilation of datasets from regions and biotope types that are not covered at present
2) Analyses of this data to define new biotopes and incorporation of the biotopes into the hierarchical system
3) Analyses and decision on relevant threshold values between classes of salinity, wave exposure, depth zones and substrate categories
4) Evaluation of the biotope classification by relevant experts
5) When necessary, agreement on a common understanding of biotopes across regions
6) Writing descriptions of all described biotopes, including how they are differentiated from similar biotopes and reference to the dataset(s) from which they were derived

It is very important that benthic experts (both phyto- and zoobenthos) representing all geographic regions of the Baltic Sea participate in this process. During the process, both higher and lower levels, and particularly 4 and 5 most likely will get more complicated, since more classification factors (both environmental and biological) are likely to be introduced.

So far Habitat Directive Annex I habitat types have not been addressed by the classification due to different interpretations used in various countries for the same types. There will be a need to decide upon a framework to be used for grouping of biotopes into the Habitat Directive Annex I habitat types as soon as Baltic wide agreement on habitat sub-types will be reached. Habitat types can be introduced at levels 4-5 and this would need further modification of classification structure, but there are also alternative ways for assigning classification units at levels 5 and 6 to a particular Annex I habitat type.

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APPENDIX

Appendix 1

Preliminary Baltic biotope classification, using EUNIS coding and terminology. Codes and names are preliminary. Source for biotope is given when relevant.

CODE	HABITAT NAME (PROVISIONAL)	SOURCE
AA	**Baltic hydrolittoral rock and other hard substrate**	
AA.1	Baltic hydrolittoral rock	
AA.11	Baltic high energy hydrolittoral rock	
AA.111	Baltic high energy hydrolittoral rock dominated by annual algae	[SW/FI] Jouni Leinikki
AA.112	Baltic high energy hydrolittoral rock dominated by epifaunal communities	
AA.1121	[Balanus improvisus] on high energy hydrolittoral rock	[SW/FI] Jouni Leinikki
AA.113	Baltic high energy hydrolittoral rock with sparse benthic communities	[SW/FI] Jouni Leinikki
AA.12	Baltic moderate energy hydrolittoral rock	
AA.121	Baltic moderate energy hydrolittoral rock dominated by annual algae	[SW/FI] Jouni Leinikki
AA.122	Baltic moderate energy hydrolittoral rock dominated by epifaunal communities	
AA.1221	[Balanus improvisus] on moderate energy hydrolittoral rock	[SW/FI] Jouni Leinikki
AA.123	Baltic moderate energy hydrolittoral rock with sparse benthic communities	[SW/FI] Jouni Leinikki
AA.13	Baltic low energy hydrolittoral rock	
AA.131	Baltic low energy hydrolittoral rock dominated by annual algae	[SW/FI] Jouni Leinikki
AA.132	Baltic low energy hydrolittoral rock dominated by epifaunal communities	
AA.133	Baltic low energy hydrolittoral rock with sparse benthic communities	[SW/FI] Jouni Leinikki
AA.2	Baltic hydrolittoral till	
AA.21	Baltic high energy hydrolittoral till	
AA.211	Baltic high energy hydrolittoral till dominated by annual algae	[SW/FI] Jouni Leinikki
AA.212	Baltic high energy hydrolittoral till dominated by epifaunal communities	
AA.213	Baltic high energy hydrolittoral till with sparse benthic communities	[SW/FI] Jouni Leinikki
AA.22	Baltic moderate energy hydrolittoral till	
AA.221	Baltic moderate energy hydrolittoral till dominated by annual algae	[SW/FI] Jouni Leinikki
AA.222	Baltic moderate energy hydrolittoral till dominated by epifaunal communities	
AA.223	Baltic moderate energy hydrolittoral till with sparse benthic communities	[SW/FI] Jouni Leinikki
AA.23	Baltic low energy hydrolittoral till	
AA.231	Baltic low energy hydrolittoral till dominated by annual algae	[SW/FI] Jouni Leinikki
AA.232	Baltic low energy hydrolittoral till dominated by epifaunal communities	
AA.233	Baltic low energy hydrolittoral till with sparse benthic communities	[SW/FI] Jouni Leinikki
AA.3[?]	Baltic hydrolittoral hard clay	
AB	**Baltic hydrolittoral sediment**	
AB.1	Baltic hydrolittoral coarse sediment	
AB.11	Baltic high energy hydrolittoral coarse sediment	
AB.12	Baltic moderate energy hydrolittoral coarse sediment	
AB.13	Baltic low energy hydrolittoral coarse sediment	
AB.2	Baltic hydrolittoral sand	
AB.21	Baltic high energy hydrolittoral sand	

AB.22	Baltic moderate energy hydrolittoral sand	
AB.23	Baltic low energy hydrolittoral sand	
AB.231	Baltic low energy hydrolittoral sand dominated by macrovegetation	
AB.2311	[Enteromorpha spp.] community om low energy hydrolittoral sand	LT [Darius Daunys]
AB.2312	[Chara spp.] community on low energy hydrolittoral sand	LT [Darius Daunys]
AB.3	Baltic hydrolittoral mud	
AB.4	Baltic hydrolittoral mixed sediment	
AB.41	Baltic high energy hydrolittoral mixed sediment	
AB.42	Baltic moderate energy hydrolittoral mixed sediment	
AB.43	Baltic low energy hydrolittoral mixed sediment	
AC	**Baltic infralittoral rock and other hard substrata**	
AC.1	Baltic infralittoral rock	
AC.11	Baltic high energy infralittoral rock	
AC.111	Baltic high energy infralittoral rock dominated by annual algae	[SW/FI] Jouni Leinikki
AC.112	Baltic high energy infralittoral rock dominated by [Fucus] communities	
AC.1121	Sparse [Fucus] communities on high energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.113	Baltic high energy infralittoral rock dominated by red algae, [Sphacellaria arctica] or [Cladophora aegagrophila]	
AC.1131	[Furcellaria lumbricalis] on high energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.1132	[Polysiphonia sp.] on high energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.1133	Mesohaline [Sphacellaria arctica] on high energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.1134	Mixed red algal communities on high energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.114	Baltic high energy infralittoral rock dominated by epifaunal communities	
AC.1141	[Balanus improvisus] and/or [Electra crustulenta] on shallow high energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.1142	[Mytilus edulis] and other sessile animals on steep high energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.12	Baltic moderate energy infralittoral rock	
AC.121	Baltic moderate energy infralittoral rock dominated by annual algae	[SW/FI] Jouni Leinikki
AC.122	Baltic moderate energy infralittoral rock dominated by [Fucus] communities	
AC.1221	[Fucus radicans] on moderate energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.1222	[Fucus vesiculosus] on moderate energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.1223	[Fucus serratus] on moderate energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.1224	Mixed [Fucus] communities on moderate energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.123	Baltic moderate energy infralittoral rock dominated by red algae, [Sphacellaria arctica] or [Cladophora aegagrophila]	
AC.1231	[Furcellaria lumbricalis] on moderate energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.1232	[Polysiphonia fucoides] on moderate energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.1233	Mesohaline [Sphacellaria] on moderate energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.1234	Mixed red algal communities on moderate energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.124	Baltic moderate energy infralittoral rock dominated by epifaunal communities	
AC.1241	[Mytilus edulis] and [Dreissena polymorpha] on moderate energy infralittoral rock	LIFE Baltic MPA classification [EST]
AC.1242	[Mytilus edulis] on moderate energy infralittoral rock	[SW/FI] Jouni Leinikki

AC.1243	[Balanus improvisus] and/or [Electra crustulenta] on shallow moderate energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.125	Baltic moderate energy infralittoral rock with sparse benthic communities	
AC.1251	Mesohaline moss communities on moderate energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.13	Baltic low energy infralittoral rock	
AC.131	Baltic low energy infralittoral rock dominated by annual algae	[SW/FI] Jouni Leinikki
AC.132	Baltic low energy infralittoral rock dominated by [Fucus] communities	
AC.1321	[Fucus vesiculosus] on low energy infralittoral rock	[SW/FI] Jouni Leinniki, LIFE Baltic MPA classification [EST]
AC.1322	[Fucus radicans] on low energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.133	Baltic low energy infralittoral rock dominated by red algae, [Sphacellaria arctica] or [Cladophora aegagrophila]	
AC.1331	[Furcellaria lumbricalis] on low energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.1332	[Polysiphonia fucoides] on low energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.1333	Mesohaline [Sphacellaria] on low energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.1334	Mixed red algal communities on low energy infralittoral rock	[SW/FI] Jouni Leinikki
AC.134	Baltic low energy infralittoral rock dominated by epifaunal communities	
AC.1341	Oligohaline [Balanus improvisus] and bivalves on low energy infralittoral rock	LIFE Baltic MPA classification [EST]
AC.135	Baltic low energy infralittoral rock with sparse benthic communities	
AC.1351	Oligohaline low energy infralittoral rock with no particular species dominance	LIFE Baltic MPA classification [EST]
AC.2	Baltic infralittoral till	
AC.21	Baltic high energy infralittoral till	
AC.211	Baltic high energy infralittoral till dominated by annual algae	[SW/FI] Jouni Leinikki
AC.2111	Mesohaline [Cladophora glomerata] and [Enteromorpha intestinalis] on high energy boulders and cobbles	LT [Darius Daunys]
AC.212	Baltic high energy infralittoral till dominated by [Fucus] communities	
AC.2121	Sparse [Fucus] communities on high energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.213	Baltic high energy infralittoral till dominated by red algae, [Sphacellaria arctica] or [Cladophora aegagrophila]	
AC.2131	[Furcellaria lumbricalis] on high energy infralittoral boulders and cobbles	LIFE Baltic MPA classification [LT]
AC.2132	[Polysiphonia sp.] on high energy infralittoral boulders and cobbles	LT [Darius Daunys]
AC.2133	Mesohaline [Sphacellaria arctica] on high energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.2134	Mixed red algal communities on high energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.214	Baltic high energy infralittoral till dominated by epifaunal communities	
AC.2141	Mesohaline [Mytilus edulis] and [Balanus improvisus] on high energy boulders and cobbles	LIFE Baltic MPA classification [LT]
AC.2142	Sparse mesohaline [Balanus improvisus] on high energy boulders and cobbles	LIFE Baltic MPA classification [LT]
AC.22	Baltic moderate energy infralittoral till	
AC.221	Baltic moderate energy infralittoral till dominated by annual algae	[SW/FI] Jouni Leinikki
AC.222	Baltic moderate energy infralittoral till dominated by [Fucus] communities	
AC.2221	[Fucus radicans] on moderate energy infralitoral boulders and cobbles	[SW/FI] Jouni Leinikki

AC.2222	[Fucus vesiculosus] on moderate energy infralitoral boulders and cobbles	LIFE Baltic MPA classification [EST]; [SW/FI] Jouni Leinikki
AC.2223	[Fucus vesiculosus] on moderate energy infralittoral mixed bottoms	[SW/FI] Jouni Leinikki
AC.2224	[Fucus seratus] on moderate energy infralitoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.2225	Mixed [Fucus] communities on moderate energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.223	Baltic moderate energy infralittoral till dominated by red algae, [Sphacellaria arctica] or [Cladophora aegagrophila]	
AC.2231	[Furcellaria lumbricalis] on moderate energy infralittoral boulders and cobbles	LIFE Baltic MPA classification [EST]
AC.2232	[Polysiphonia fucoides] on moderate energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.2233	Mesohaline [Sphacellaria] on moderate energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.2234	Mixed red algal communities on moderate energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.2235	Oligohaline [Cladophora aegagrophila] on moderate energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.2236	Oligohaline [Sphacellaria arctica] on moderate energy infralitotral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.224	Baltic moderate energy infralittoral till dominated by epifaunal communities	
AC.2241	[Mytilus edulis] and [Dreissena polymorpha] on moderate energy infralitoral boulders and cobbles	LIFE Baltic MPA classification [EST]
AC.2242	[Mytilus edulis] on moderate energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.225	Baltic moderate energy infralittoral till with sparse benthic communities	
AC.2251	Oligohaline moss communities on moderate energy infralitoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.2252	Mesohaline moss communities on moderate energy infralitoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.23	Baltic low energy infralittoral till	
AC.231	Baltic low energy infralittoral till dominated by annual algae	[SW/FI] Jouni Leinikki
AC.232	Baltic low energy infralittoral till dominated by [Fucus] communities	
AC.2321	[Fucus vesiculosus] on low energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinniki, LIFE Baltic MPA classification [EST]
AC.2322	[Fucus radicans] on low energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.233	Baltic low energy infralittoral till dominated by red algae, [Sphacellaria arctica] or [Cladophora aegagrophila]	
AC.2331	[Furcellaria lumbricalis] on low energy infralittoral boulders and cobbles	LIFE Baltic MPA classification [EST]
AC.2332	[Polysiphonia fucoides] on low energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.2333	Mesohaline [Sphacellaria] on low energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.2334	Mixed red algal communities on low energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.2335	Oligohaline [Cladophora aegagrophila] on low energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.2336	Oligohaline [Sphacellaria arctica] on low energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.234	Baltic low energy infralittoral till dominated by epifaunal communities	
AC.2341	[Mytilus edulis] on low energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki

AC.235	Baltic low energy infralittoral till with sparse benthic communities	
AC.2351	Oligohaline moss communities on low energy infralittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AC.3	Baltic infralittoral hard clay	
AC.31	Baltic high energy infralittoral hard clay	
AC.311[?]	Baltic high energy infralittoral hard clay dominated by macrovegetation	
AC.312	Baltic high energyinfralittoral hard clay dominated by epifauna communities	
AC.3121	Mesohaline [Mytilus edulis] and [Balanus improvisus] on high energy hard clay ridges	LIFE Baltic MPA classification [LT]
AC.32[?]	Baltic moderate energy infralittoral hard clay	
AC.33[?]	Baltic low energy infralittoral hard clay	
AD	**Baltic infralittoral sediment**	
AD.1	Baltic infralittoral coarse sediment	
AD.11	Baltic high energy infralittoralcoarse sediment	
AD.111	Baltic high energy infralittoral coarse sediment dominated by macrovegetation	
AD.112	Baltic high energy infralittoral coarse sediment dominated by faunal communities	
AD.12	Baltic moderate energy infralittoral coarse sediment	
AD.121	Baltic moderate energy infralittoral coarse sediment dominated by macrovegetation	
AD.122	Baltic moderate energy infralittoral coarse sediment dominated by faunal communities	
AD.13	Baltic low energy infralittoral coarse sediment	
AD.131	Baltic low energy infralittoral coarse sediment dominated by macrovegetation	
AD.132	Baltic low energy infralittoral coarse sediment dominated by faunal communities	
AD.2	Baltic infralittoral sand	
AD.21	Baltic high energy infralittoral sand	
AD.211[?]	Baltic high energy infralittoral sand dominated by macrovegetation	
AD.212	Baltic high energy infralittoral sand dominated by faunal communities	
AD.2121	[Macoma balthica] in high energy mesohaline fine to very fine sand bottoms	LIFE Baltic MPA classification [LT]
AD.2122	[Marenzellereia neglecta] and [Pygospio elegans] in high energy shallow mesohaline sand bottoms	LIFE Baltic MPA classification [LT]
AD.2123	[Bathyporeia pilosa] in high energy shallow mesohaline medium to fine sand bottoms	[LT] Darius Daunys
AD.22	Baltic moderate energy infralittoral sand	
AD.221	Baltic moderate energy infralittoral sand dominated by macrovegetation	
AD.2211	Loose [F. lumbricalis] on mesohaline moderately energy sand bottoms	LIFE Baltic MPA classification [EST]
AD.2212	Charophytes on mesohaline moderate energy sand bottoms	LIFE Baltic MPA classification [EST], [SW/FI] Jouni Leinikki
AD.2213	Higher plants [Potamogeton spp.], [Zannichellia palustris] and [Ruppia maritima] in moderate energy mesohaline sandy bottoms	LIFE Baltic MPA classification [EST], [SW/FI] Jouni Leinikki

AD.2214	[Zostera marina] on moderate energy sand	LIFE Baltic MPA classification [EST]; [SW/FI] Jouni Leinikki
AD.2215	Charophytes on oligohaline moderate energy sand	[SW/FI] Jouni Leinikki
AD.222	Baltic moderate energy infralittoral sand dominated by faunal communities	
AD.2221	Bivalves [Macoma balthica], [Mya arenaria] and [Cerastoderma glaucum] on moderate energy sand	LIFE Baltic MPA classification [EST]
AD.2222	Mesohaline moderate energy infralittoral sand with no particular species dominance	LIFE Baltic MPA classification [LV, EST]
AD.23	Baltic low energy infralittoral sand	
AD.231	Baltic low energy infralittoral sand dominated by macrovegetation	
AD.2311	[Potamogeton sp.] on low energy oligo-mesohaline fine sand (Baltic lagoons)	[LT] Darius Daunys
AD.2312	Charophytes on low energy oligo-mesohaline sand	LIFE Baltic MPA classification [EST]; [SW/FI] Jouni Leinikki
AD.2313	Higher plants on low energy mesohaline sand	LIFE Baltic MPA classification [EST]; [SW/FI] Jouni Leinikki
AD.2314	Higher plants on low energy oligohaline sand	[SW/FI] Jouni Leinikki
AD.232	Baltic low energy infralittoral sand dominated by faunal communities	
AD.2321	Bivalves on low energy mesohaline sand	LIFE Baltic MPA classification [EST]
AD.2322	Low energy oligo-mesohaline sand with no particular species dominance	LIFE Baltic MPA classification [EST]
AD.3	Baltic infralittoral mud	
AD.31[?]	Baltic high energy infralittoral mud	
AD.32	Baltic moderate energy infralittoral mud	
AD.33	Baltic low energy infralittoral mud	
AD.331	Baltic low energy infralittoral mud dominated by macrovegetation	
AD.3311	Charophytes on low energy mesohaline mud	[SW/FI] Jouni Leinikki
AD.3312	Higher plants on low energy mesohaline mud	[SW/FI] Jouni Leinikki
AD.3313	Charophytes on low energy oligohaline mud	[SW/FI] Jouni Leinikki
AD.3314	Higher plants on low energy oligohaline mud	[SW/FI] Jouni Leinikki
AD.4	Baltic infralittoral mixed sediment	
AD.41	Baltic high energy infralittoral mixed sediment	
AD.411	Baltic high energy infralittoral mixed sediment dominated by macrovegetation	
AD.412	Baltic high energy infralittoral mixed sediment dominated by faunal communities	
AD.4121	Mixed community of epi- and infaunal species in mesohaline exposed gravel and coarse sand	[LT] Darius Daunys
AD.4122	[Theodoxus fluviatilis] in mesohaline exposed gravel and coarse sand	[LT] Darius Daunys
AD.42	Baltic moderate energy infralittoral mixed sediment	
AD.43	Baltic low energy infralittoral mixed sediment	
AE	**Baltic circalittoral rock and other hard substrata**	
AE.1	Baltic circalittoral rock	
AE.11	Baltic circalittoral rock above halocline	

AE.111	Dense [Mytilus edulis/trossilus] on circalittoral rock	[LT] Darius Daunys
AE.12	Baltic circalittoral rock below halocline	
AE.2	Baltic circalittoral till	
AE.21	Baltic circalittoral till above halocline	
AE.211	Dense [Mytilus edulis/trossilus] on circalittoral boulders and cobbles	[LT] Darius Daunys
AE.212	Communities of hydoids, [Electra crustulenta] and/or [Mytilus edulis/trossilus] on circalittoral boulders and cobbles	[LT] Darius Daunys
AE.213	Oligohaline [Ephydatia fluviatilis] and [Cordylophora caspia] on circalittoral boulders and cobbles	[SW/FI] Jouni Leinikki
AE.22[?]	Baltic circalittoral till below halocline	
AE.3	Baltic circalittoral hard clay	
AE.31	Baltic circalittoral hard clay above halocline	
AE.32	Baltic circalittoral hard clay below halocline	
AF	**Baltic circalittoral sediment**	
AF.1	Baltic circalittoral coarse sediment	
AF.11	Baltic circalittoral coarse sediment above halocline	
AF.111	Sparse [Mytilus edulis] and [Balanus improvisus] in mesohaline circalittoral gravel bottoms	LIFE Baltic MPA classification [EST]
AF.12[?]	Baltic circalittoral coarse sediment below halocline	
AF.2	Baltic circalittoral sand	
AF.21	Baltic circalittoral sand above halocline	
AF.211	[Macoma balthica] in mesohaline fine sand above or within halocline	[LT] Darius Daunys
AF.212	[Pontoporea affinis] in mesohaline mudy sand above halocline	[LT] Darius Daunys
AF.22	Baltic circalittoral sand above halocline	
AF.3	Baltic circalittoral mud	
AF.31	Baltic circalittoral mud above halocline	
AF.32	Baltic circalittoral mud below halocline	
AF.321	Mesohaline [Pontoporea femorata] on sandy mud and mud below halocline	[LT] Darius Daunys
AF.322	Mesohaline [Bilgydes sarsi] on circalittoral mud below halocline	[LT] Darius Daunys
AF.323	Mesohaline [Ostracoda] on circalittoral sandy mud below halocline	[LT] Darius Daunys
AF.324	Mesohaline [Diastylis rathkey] on circalittoral mud below halocline	[LT] Darius Daunys
AF.325	Mesohaline [Scoloplos armiger] on circalittoral mud below halocline affected by temporary anoxia	[LT] Darius Daunys
AF.326	Mesohaline anoxic mud without benthic macrofauna	[LT] Darius Daunys
AF.4	Baltic circalittoral mixed sediment	
AF.41	Baltic circalittoral mixed sediment above halocline	
AF.42	Baltic circalittoral mixed sediment below halocline	

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