Pearls of the Baltic Sea

Networking for life: Special nature in a special sea

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A string of Baltic pearls to protect

Around 15,000 years ago, the Baltic Sea region was a very quiet and cold place. Time seemed to have stopped. The stillness was absolute.
What would eventually become the Baltic Sea, and the land surrounding it, lay dormant underneath a huge ice sheet which, in places, was up to three kilometres thick.

When the ice finally started to melt, a new world emerged. Well, not completely new. It was more as if a new world was born on the surface of the solid foundation of a very old world – a newborn tucked up in an ancient cradle.

The re-birth of the Baltic Sea region was not peaceful and smooth. The reluctant retreat of the mighty ice sheet, flooding by enormous water masses when the world ocean rushed in and out of the area, and the invincible force of land rising after having been pressed down many hundreds of metres for thousands and thousands of years, marked the event.

← Marine landscape in the Great Belt area, Denmark

Icy archipelago, Finland.

Veczemju Cliff, North Vidzeme, Latvia

The Baltic Sea and the land around it were shaped in an interaction between colossal forces of nature. All the stages in this dramatic process played a part in creating the features and characteristics we can see today: the nature, habitats and ecosystems that are unique to the Baltic Sea region.

Without the many changes and transformations that took place over thousands, millions, indeed billions of years, we would not have this highly varied pattern of special, in some cases globally unique, formations and living environments to enjoy, cherish and protect.

When you know what to look for, you can read the fascinating history everywhere, on land and under water. Many chapters of this story have already been written, but new ones are continuously added. Remaining forces from the dramatic past will again reshape the coastal zone and seabed of the young Baltic Sea region.

Nature conservation – not only about nature

Alarmingly, the natural values on the Baltic Sea coast and in the sea itself are at risk. This is not due to uncontrollable natural forces of the past, but to controllable current activities of man.

Coastal and marine and landscapes of the Baltic Sea region – areas in nature that are a delight to the eye and the soul, and at the same time constitute essential living environments for marine plants and animals and for birds – form the string of pearls that is the network of Baltic Sea Protected Areas (BSPAs). However, if just taken for granted, these natural pearls will gradually lose their lustre. Little can be done then to make them shine again and they will become lifeless and dull.

A journey to some of the magnificent and precious sceneries and ecosystems of the Baltic Sea region of today makes you realise just how much is at stake.

Preserving and taking good care of a generously extended and complete network of areas – coastal and marine landscapes – is not just a matter of maintaining the grandness and beauty of the highly special environments in the Baltic Sea region. Nature conservation is only partly about protecting nature for the sake of nature itself.

There is a general consensus in the world that we need to protect oceans and seas because we need the resources and services they provide. And there is an equally strong international consensus that we need protection of areas and ecosystems along our coasts, including shallow-water areas and seabeds, as well as offshore shallow areas that constitute biodiversity pools and refuges.

Marine landscape, Fehmarn Belt, Germany.

Opposite page: Lighthouse, Vorpommersche Boddenlandschaft, Germany, and rough sea at Lahemaa, Estonia.

Baltic nature at risk

Many human activities in the sea and within the drainage area threaten the values of the currently nearly 100 Baltic Sea Protected Areas.

The risk of oil spills is the most frequently highlighted threat and is perceived as existing or potential in 64 of the areas, a majority of them in the southern parts of the Baltic. Eutrophication and human disturbances, respectively, are classified as almost as threatening (indicated for 57 of the areas), followed by tourism and recreation (54), pollution from shipping other than oil (50), pollution from agriculture (40) and the construction of wind farms (39).

On a species level, the sturgeon (*Acipenser sturio*) is so far the only species to become extinct in the Baltic Sea in recent history. However, other species are becoming less abundant, or have to fight harder for their existence when external factors cause their range and distribution to be reduced.

At the moment, 61 species, one third of them fish, have been placed on the HELCOM list of threatened or declining species. The need to protect 30 of these species, (13 bird species, 9 fish species, 4 species of seals or porpoises, 2 algal and 2 vascular plant species), is referred to as a reason for including an area in the BSPA network. Or put differently, some kind of active protection in BSPAs is granted for only half of the species that are threatened or declining in the Baltic Sea area.

But why should many and large areas along the coast of the Baltic Sea, as well as offshore shallow grounds and banks, be included in a network and covered by particular management and rules?

The World Conservation Union (IUCN) has defined a protected area as "an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means". And a network of marine protected areas is "an organised collection of individual sites, designed to link individual areas, and to comprehensively represent a region's spectrum of marine life characteristics".

"Marine values" to be protected is about conservation values as such (including the protection of endangered species), but also about commercial values (e.g. sustained fisheries and aquaculture), scientific values, recreational values ("human" values as well as a commercial), cultural values and aesthetic values.

The reasons to protect marine and coastal areas in any part of the world, including the Baltic Sea region, can thus be summarised in some key concepts: protection, restoration, wise use, understanding, enjoyment, representativeness and heritage.

The Quark, Finland.

Bladderwrack, Svenska Högarna Archipelago, Sweden.

Good reasons for protection

The World Conservation Union (IUCN) has defined some key concepts as overall reasons for protection of marine areas in the world.

Protection means protection of natural or cultural diversity, e.g. protecting ecosystems and the species they contain, critical habitats for endangered or economically important species, and/or genetic diversity and particular species.

Restoration means to restore something that has been damaged or degraded but can still be rescued and brought back to either a natural or at least a considerably better state, e.g. restoring threatened species or degraded ecosystems especially for the benefit of fisheries.

Wise use very much includes people. People need to be able to benefit, on an ecologically sustainable basis, from the creation of a network of marine protected areas. Management of protected areas is much about making it possible to protect without putting up walls or fences. Human activities should be compatible with the primary goals of protection and conservation.

Understanding means having the opportunity to learn more about environments and ecosystems in order to be able to manage them properly. Monitoring and research will be required.

Enjoyment is about people appreciating and being allowed access to the places of natural beauty and richness along the coast and in the sea. Unless we can see and enjoy these areas, we will not support the management and rules that apply for their long-term protection.

Representativeness stands for maintenance of significant ecosystems or other particular features typical of a region or a country.

Heritage comprises a number of things. By protecting an area on the coast or in the sea, we make a real effort to safeguard what has been given to us and what should be passed on to future generations. It could be about biodiversity (including abundance and diversity of marine organisms), productivity (the ability of the system to produce organisms that can be harvested) or cultural and historical elements (in the case of the Baltic Sea, very much the traces of the dramatic process of creation).

Baltic pioneers

The 1992 Helsinki Convention was the first ever regional sea agreement to include a policy and a set of instruments for nature conservation of coastal and marine areas.

The first step to establish a network of such protected areas was taken in 1990. The countries around the Baltic Sea made a common political statement with the intention to set up a network of "protected areas representing the various Baltic ecosystems and their flora and fauna".

Two years later this commitment was included as a separate part (Article 15) of the new and revised 1992 Helsinki Convention. The Baltic Sea countries agreed that they would "individually and jointly take all appropriate measures with respect to the Baltic Sea Area and its coastal ecosystems influenced by the Baltic Sea to conserve natural habitats and biological diversity and to protect ecological processes. Such measures shall also be taken in order to ensure the sustainable use of natural resources within the Baltic Sea Area".

The commitment to protect Baltic Sea ecosystems, species and biological diversity through a network of protected areas has eventually also become a regional way of implementing the 1992 Convention on

Biological Diversity, and its special agreement in 1995 on the protection of marine biodiversity, the Jakarta Mandate. Moreover, at a global conference held the same year, countries around the world were urged to establish marine protected areas, particularly systems of large marine protected areas with complete marine ecosystems.

Offshore, marine, coastal or terrestrial?

To have an area designated as a BSPA does not in itself guarantee any specific level of protection. For an area in the Baltic Sea to be legally protected – be it an area located far out in the open sea, in the coastal waters of an individual country or on the shores of that country – protection must be ensured by means of national legislation. This also includes EU legislation, or commitments made in international conventions and nationally implemented in national legislation.

Countries can designate areas to be included in the BSPA network for many reasons but an agreed set of criteria (p. 16) must be met.

So far the most commonly used criterion has been that an area has "regionally important biological values". "Terrestrial and marine values" is the second most common ground for designating an area as a BSPA, followed by criteria connected to the importance for birds (as a breeding or feeding area).

The presence of "marine values" in an area is often highlighted. Nevertheless, protection of marine species, habitats and biotopes – including important marine "mini worlds" like bladderwrack belts, eelgrass or stonewort meadows or mussel beds – has been less commonly referred to as a motive for designating an area as a BSPA.

Marine landscape, Archipelago Sea, Finland.

Opposite page: Grey seal pup, Falsterbo peninsula with Måkläppen, Sweden.

The legal basis

The effort to establish the network of protected areas is based on Article 15 in the 1992 Helsinki Convention. Two HELCOM Recommendations that were both adopted in 1994 deal with the more concrete aspect of the work:

- 15/5: *System of coastal and marine Baltic Sea Protected Areas* (BSPA), which included the first list of 62 proposed areas; and
- 15/1: *Protection of the coastal strip*

Three additional HELCOM Recommendations have subsequently supplemented these basic documents:

- 16/3: *Preservation of natural coastal dynamics* (adopted in 1995)
- 19/1: *Marine sediment extraction in the Baltic Sea* (adopted in 1998)
- 21/4: *Protection of heavily endangered or immediately threatened marine and coastal biotopes in the Baltic Sea Area* (adopted in 2000)

Recommendation 15/5 is accompanied by separate documents, also approved (and updated) by HELCOM, on guidelines for designation and management of BPSAs:

- *Guidelines for designating marine and coastal Baltic Sea Protected Areas (BSPAs) and proposed protection categories* (latest version adopted in 2003)
- *Guidelines for Management of Baltic Sea Protected Areas (BSPAs)* (latest version adopted in 2005)

Mussel bed, Archipelago Sea, Finland.

Checklist for Baltic protected areas

A coastal or marine area of the Baltic Sea Region can be designated as a BSPA if it meets a set of criteria agreed within HELCOM.

- Particular protection should be given in a designated BSPA to the species, natural habitats and nature types of the marine and coastal ecosystems of the Baltic Sea Area, to conserve biological and genetic diversity and to protect ecological processes.
- The reasons for protecting the area should be high biodiversity; habitats of endemic, rare or threatened species and communities of fauna and flora; habitats of migratory species; nursery and spawning areas; and/or rare, unique or representative geological and geomorphologic structures or processes.
- A designated BSPA should cover at least 1,000 hectares for terrestrial parts and/or 3,000 hectares for marine/lagoon parts.
- The landscape of a designated BSPA should have a high level of "naturalness", i.e. be as undisturbed as possible by human activities. Economic activities within an area should follow the principle of sustainable use.
- The coastal and marine environment of a BSPA should be as free as possible from pollution. If it is found that an area is polluted, actions should be taken as soon as possible to significantly improve the state of the environment.
- A designated BSPA should have a high level of representativeness, i.e. be a representative ecological functional entity for a Baltic Sea Region as a whole, for one of its sub-regions or for one Baltic Sea State.

The proposed protection status of the designated BSPA should also correspond to internationally accepted protection categories IUCN; UNESCO; European Union, etc).

A database for BSPAs

The HELCOM Baltic Sea Protected Areas Database is available in an open information web version for visitors – **http://bspa.helcom.fi** – as well as in a restricted work version for government agencies.

The database will shortly also be linked to the Baltic GIS system available on the HELCOM web site. This will make it possible for visitors to connect directly to the overall map of the BSPAs and maps displaying the extension and location of individual areas.

The open web version is there for anyone interested in the BSPAs to learn more about the areas and about threatened or declining biotopes and species. One can also search for information on types of Baltic biotopes and biotope complexes, as well as for Natura 2000 habitats.

The database allows for search for various kinds of information, geographically (country or subregion of the Baltic Sea) and/or by topic.

Sites
Information can be searched, inter alia, by name or BSPA id number, by country or subregion, or by protection or location. The information on each BSPA is divided into nine categories:

- General information
- Selection criteria
- Management
- Protection status
- Problems and threats
- Important habitats
- Important species
- Important biotopes

Species
Species can be searched by code, type, scientific name, English common name or by HELCOM, OSPAR or Natura 2000 listing.

The restricted version of the database is a tool for the Contracting parties to the Helsinki Convention to update existing data, put in new data and nominate new sites. The structure of the BSPA database is compatible with the structure of the EU Natura 2000 database, allowing also uploading from the national Natura 2000 MS-Access databases. Lists on species and habitats in the EU Bird Directive and Habitats Directive have been included.

More on offshore, marine, coastal or terrestrial: page 176.

Most of the BSPAs cover both terrestrial (coastal on land) and marine (offshore or in coastal waters) parts. When BSPAs comprise large archipelago areas, large coastal lagoons and large areas of fjord-like bays, vast water areas are included also if protection of the marine environment is not the primary reason for making the area a BSPA.

So far, only a few BSPAs are situated entirely or partly in water areas outside the countries' territorial waters, or in waters that belong to the exclusive economic zone of a single country. It would be valuable to include more of the important offshore grounds and banks as BSPAs in the future, as these are essential links in the chain of interdependent ecosystems in the Baltic Sea.

Quite a lot, but still not enough

Roughly 7 per cent of the Baltic Sea is currently included in Baltic Sea Protected Areas. Compared to the corresponding figure for the world as a whole, this is quite a lot.

However, compared to global ambitions and needs, much still remains to be done also in the Baltic Sea region to achieve sufficient

protection of marine areas in the strictest sense of the word. The creation of a representative global network of marine protected areas by 2012 was agreed by the world's nations at the 2002 World Summit on Sustainable Development (WSSD). In 2003, the World Parks Congress called on the international community to "greatly increase the marine and coastal area managed in marine protected areas by 2012" and stated that "these networks should be extensive and include strictly protected areas that amount to at least 20–30 per cent of each habitat, and contribute to a global target for healthy and productive oceans".

A vast majority of the world's nations are also contracting parties to the Convention on Biological Diversity (CBD). In 2004, they set

Opposite page:
Stonewort marine landscape, Archipelago Sea, Finland.

Nemunas Delta, Lithuania.

the target to have at least 10 per cent of each of the world's ecological regions effectively conserved. They further agreed that the goal should be "the establishment and maintenance of marine and coastal protected areas that are effectively managed, ecologically based and contribute to a global network of marine and coastal protected areas".

The importance of establishing a coherent and representative network of marine protected areas is recognised also in the European Marine Strategy.

The idea to create an interconnected system rather than protecting single areas here and there, has good scientific backing. The scientific terms are "connectivity" and "ecological coherence". In layman's terms it is simply a question of insurance – to be on the safe side you make an investment covering several objects (not all the eggs in one basket) and establish a management system for taking good care of your assets.

Over the years, it has become evident that the environment and biodiversity is not a system of isolated building-blocks that can be combined at random, but a giant and logical jigsaw puzzle with a system of connecting vessels. If pieces are missing, the picture will be incomplete. If one vessel is gone or blocked, the essential flow will be destroyed.

Lahemaa, Estonia.

Bubbling reef, Fladen, Sweden.

An unprotected world ocean

In 2003, the UN Environment Programme and the IUCN estimated that on a global basis 4,116 marine areas were in some way protected. To be defined as "marine", the area should incorporate shoreline and marine habitats. That also included, but was not restricted to, areas that were specifically dedicated to marine conservation.

The marine areas in the UN list containing marine and coastal elements covered 4.3 million km^2, including the land (shoreline) areas. The single largest marine protected area in the world was then, and still is, the Great Barrier Reef Marine Park in Australia, which alone covers 345,400 km^2.

According to the best estimate at the time for actual protected sea area (largely or entirely marine) the coverage would correspond to 1.64 million km^2, or 8.7 per cent of the global total of natural areas placed under some kind of protection in 2003.

Calculated in relation only to the total surface area of the world's oceans and seas, however, the marine protected areas of the world in 2003 only covered around 0.5 per cent of the sea. Thus, far less than even one single per cent of the seas and oceans – which cover over 70 per cent of the total surface of the globe – has been set aside as protected areas. In many cases the areas placed under protection are, however, not sufficiently managed. According to evaluations made, the management goals and objectives are properly met in less than one tenth of the areas.

In 2005, the number of designated marine areas had risen to around 4,600, covering some 2.2 million km^2. That increased the percentage to 0.6 of the surface of the world's oceans and seas. In comparison, almost 13 per cent of the total land area of the globe has been included in protected areas.

Whichever way coverage and percentages are compared, the conclusion will be the same: all over the world the protection of marine areas lags behind.

A system of core areas, buffer zones and corridors that enable species to move between areas will ensure the most robust protection possible. One nature type or ecosystem should not be represented by only one single area; if (worst case scenario) one area cannot be maintained, a backup area should be provided.

In this way, the string of pearls can be kept intact with each pearl maintaining its lustre. That, in essence, is what the network of Baltic Sea Protected Areas is all about.

All-European, North European or Baltic?

Much has happened since 1992. Today, the Helsinki Convention Area is largely part of the European Union. EU legislation and policy, including that of nature conservation and protection of habitats and species, applies to most of the Contracting Parties to the Helsinki Convention. All Baltic Sea countries are parties to the pan-European Bern Convention and have thus agreed to co-operate for the conservation of European wildlife and natural habitats. Furthermore, the Baltic Sea countries are parties to the global Convention on Biological Diversity.

Luoto Archipelago, Finland.

From individual areas to ecological coherence

Ecological coherence – a concept which is frequently used but not clearly defined – reflects a new understanding in nature conservation.

The protection of individual areas here and there is not sufficient. When it became evident that we must protect areas that are interconnected and form a larger whole, concepts such as connectivity and coherence came into use.

According to the IUCN "an ecological network is regarded as a coherent system of natural and/or semi-natural landscape elements that is configured and managed with the objective of maintaining or restoring ecological functions as a means to conserve biodiversity while also providing appropriate opportunities for the sustainable use of natural resources."

According to the ongoing discussion within HELCOM, an ecologically coherent network of protected areas should "provide protection of areas of ecological significance".

This could, for example, include areas with a high proportion of habitats for migratory species; areas of importance for feeding, breeding, moulting, wintering or resting species; important nursery, juvenile or spawning areas; and areas with high natural biological productivity.

Based on the HELCOM guidelines for the selection of BSPAs, criteria should be set up for an ecologically coherent network of BSPAs to make it possible:

- to protect species, natural habitats and nature types in order to conserve biological and genetic diversity;
- to protect ecological processes and to ensure ecological functions;
- to maintain or restore natural habitat types at a favourable conservation status in the natural range of the species of that habitat;
- to protect areas with threatened and/or declining species and habitats, and important species and habitats;
- to protect areas of ecological significance;
- to protect areas with high natural biodiversity;
- to protect unique or representative geological or geomorphological structures or processes;
- to protect sensitive areas;
- to protect representative areas;
- to replicate features (having sufficiently many different areas where the same features occur, so that they are not lost altogether if something happens in the other area).

An ecologically coherent network of protected areas should also, via a system of core areas, buffer zones and corridors, ensure ecological connectivity. It should be possible for species to move between protected areas that are located near each other.

The map shows 12.5 km wide buffer zones around the BSPAs (light green) and Proposed BSPAs (dark green), respectively.

© HELCOM. Map: Hanna Paulomäki

Nesting sand martins, Ostseeküste am Brodtener Ufer, Germany.

The overall goal for the protection of coastal and marine areas in the Baltic Sea region is to have an ecologically coherent and well-managed network of coastal and offshore BSPAs, Natura 2000 areas and Emerald sites in place.

The objectives of the three networks are basically the same, and one protected area can meet the criteria set up in all three networks. Natura 2000 and Emerald sites can be recognised also as BSPAs.

In addition to being partners in the two European networks of protected areas, the Baltic Sea countries and the North Sea countries (Denmark, Germany and Sweden being both) co-operate to ensure a sub-regional level of protection in the two neighbouring North European seas that are already by nature closely connected and inter-dependent. Again, there are no conflicting goals, just an additional way of looking at the greater whole for the benefit of all parts included in the system.

Found only in the Baltic

One difference, however, and a very important one, between the Baltic network and the two European ones, is the clear regional emphasis in the BSPA network.

Natura 2000 sites and Emerald sites are established for the purpose of ensuring conservation from an overall European point of view. Less attention may be paid to special regional features. The protection of habitats and species that are of special conservation concern on a regional level may be slightly less prioritised.

For the BSPA network, however, the explicit aim is to protect natural values – habitats, biotopes, ecosystems and species – of the Baltic Sea area.

One only needs to take another quick glance at the dramatic history of this region to realise that there are plenty of nature types and ecosystems that are highly special, very typical and even unique to the Baltic Sea region.

Natura 2000, Emerald or MPA?

Natura 2000 network

The objective of the Natura 2000 network is to protect the most seriously threatened habitats and species across Europe. In order to do this, EU members compile lists of their finest wildlife areas that contain the habitats and species listed in the Birds Directive (Special Protection Areas, SPAs, for birds) and the Habitats Directive (Special Areas of Conservation, SACs, for other species than birds, and for habitats).

The eight of the nine countries around the Baltic Sea that are EU members have selected national Natura 2000 sites. A Natura 2000 site can also be recognised as a BSPA. Currently, close to 99 per cent of all designated BSPAs are also Natura 2000 sites (boreal or continental region). Several marine areas that have already been selected as Natura 2000 sites have, however, not yet been designated as BSPAs.

So far, relatively few offshore marine areas have been included in the Natura 2000 network. According to the EU Commission this represents the most significant gap in the network, as the establishment of a "marine network of conservation areas under Natura 2000 will significantly contribute, not only to the target of halting the loss of biodiversity in the EU, but also to broader marine conservation and sustainable use objectives".

Emerald network

The Council of Europe has established the Emerald network of Areas of Special Conservation Interest as part of the work under the Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats). The network of Emerald sites is based on the same principles as Natura 2000. One could say that the Emerald network is the extension of the Natura 2000 principles to countries that are not EU members.

Also Emerald sites can be recognised as BSPAs if countries in the Baltic Sea region report them to HELCOM. Natura 2000 sites are automatically also Emerald sites, which ensures the coherence of the Emerald network for the whole of Europe. The existence of the Natura 2000 network means that building the Emerald network can be concentrated to non-EU states.

Marine Protected Areas

There is also a joint HELCOM-OSPAR Work Programme on Marine Protected Areas between the Baltic Sea countries and the North Sea countries (co-operating under the OSPAR Convention). The objective of the Work Programme is to ensure consistent protection of marine areas in both seas. The overall goal is to have a joint network in place by 2010 of well-managed marine protected areas that, together with the Natura 2000 network and the Emerald network, is ecologically coherent.

Curonian Spit, Lithuania.

Where else in Europe will you find vast archipelagos with thousands and thousands of islands, islets and skerries? Where else will you find areas where land continuously rises almost one metre from the sea every century, making the concept of "shore" virtually a floating one? And where else in Europe can you see huge sand dunes wander like enormous waves, similar only to the endless sandy landscapes in a desert? And where else do marine and freshwater species live side-by-side in the sea?

Baltic areas of global importance

In several cases, measures taken within the Baltic Sea area framework to protect coastal and marine areas are not just of mere Baltic or even European importance.

Around 40 Baltic areas, several of which are BSPAs, with shallow offshore or coastal waters and coastal wetlands, are essential and even internationally outstanding for wintering birds. Without the option for migrating birds to make Baltic stops on their extensive flyways, the

populations of these birds, coming from a very large area, extending from the tundra in the northeast to the Atlantic Ocean in the west and Africa in the south, would suffer.

Four areas (three of which are mainly offshore) – Northern Kattegat and adjacent banks , Vorpommersche Boddenlandschaft and Oder-Szczecin Lagoon, Pomeranian Bay, Gulf of Riga – are counted among the globally important areas for migratory birds, on a level with the wetlands of the Danube Delta, the Wadden Sea and the Camarque.

Two of the BSPAs – the High Coast and the Quark area – have been inscribed on UNESCO's World Heritage List of World Natural Heritage Sites as a joint globally outstanding example of "the important processes that formed the glaciated and land uplift areas of the Earth's surface". The Curonian Spit is one of the World Cultural Heritage Sites, which has been threatened by the natural forces of wind and waves, but "its survival to the present day has been made possible only as a result of ceaseless human efforts to combat the erosion of the Spit".

Wintering birds, Vorpommersche Boddenlandschaft, Germany.

Opposite page: White-tailed eagle and grey seal pup, Svenska Högarna Archipelago, Sweden.

Four BSPAs – Slowinski National Park, North Vidzeme, the West Estonian Archipelago, and the Archipelago Sea Area – are included in the World Network of Biosphere Reserves recognised under UNESCO's Man and the Biosphere Programme as representatives of "innovative and demonstrative approaches to conservation and sustainable development".

Making it work

There is little point in first defining a coastal or marine landscape as valuable and worth protecting, defining the threats to its natural values, declaring it officially protected, and then leaving it without clear targets and instruments for management. That is much like standing on the captain's bridge, spotting another ship and realising that you are likely to collide, and still not using all your navigation and steering equipment to stay clear of the danger.

On the coast of North Vidzeme, Latvia.

Arctic tern at Falsterbo peninsula with Måkläppen, Sweden.

Management of protected areas is by no means always easy to accomplish. Even the most excellent management plans can be hard to implement. There are series of conflicting interests involved and nature conservation is still considered by many stakeholders as a "soft" demand compared to "hard" economic ones. It can be very difficult to get the message across that nature conservation is really about hard economics too, in a short-term as well as a long-term perspective.

However, in order to meet the requirement of "sustainable use of natural resources as an important contribution to ensure ample provident protection of environment and biodiversity", clear and effective management of BSPAs is the second step to take to keep the string of pearls intact.

Shaped for the future by a dramatic past

A journey to the pearls of the Baltic Sea, to the mosaic of coastal landscapes and underwater worlds, is also a journey through the fascinating history of what we now call the Baltic Sea region. Visiting the Baltic Sea Protected Areas is really a beautifully illustrated field lesson in geology, geomorphology, glaciology, plate tectonics, brackish-water ecology and much more.

From one extreme to another

It is a story in several dimensions of time and space – from inside the globe and moving all over it; from great depths to huge heights; during periods of stillness and periods of violent collisions; from tropical heat to icy cold. It is the story of warm seas and lagoons, systems of rivers and lakes, dry land and almost desert, and of ice.

As living proof of everything that has happened, the Baltic Sea region exhibits a rich spectrum of coastal and marine landscapes. They all tell their part of the story of what took place – and still does – after the retreat of the massive ice sheet, the periods of sea level rise and flooding, the ongoing process of gradual land uplift, and the erosive forces along low-lying shores where land uplift has stopped but other forces are at work.

← Marine landscape, Svenska Högarna Archipelago, Sweden.

Below: Darßer Ort, Vorpommersche Boddenlandschaft, Germany.

Opposite page: Kreideküste, Jasmund, Germany.

Coral reefs, chalky critters and amber

The Baltic Sea region has been on the move across Planet Earth for hundreds and hundreds of millions of years, on a never-ending journey, and has changed guise time and time again. Continental plates have collided, oceans have opened and closed, and on the Baltic seabed and along the coasts there are remains of these long expeditions in varying climates and conditions. Today we can read these stories of warm seas and lagoons; of systems of rivers and lakes; of dry land and almost desert; and of ice.

During one period, when the Baltic basin-to-be was practically arid, layers of sandy sediments hundreds of metres thick were deposited – this is the sandstone we can find everywhere on the Baltic seabed today.

The tropical period, when the Baltic region was on the move south of the Equator, has left the most remarkable remains. Fossils of coral reefs that are believed to have been the largest in the history of Earth can be found on former seabed and coastal reefs that are now exposed above sea level, especially on the islands of Gotland, Saaremaa and Hiiumaa. To this day one can find intact fossils of tropical-sea mussels, brachiopods (ancient organisms resembling mussels), sea lilies, starfish, sea urchins, sea anemones, sea cucumbers, bony-fish, corals and much more.

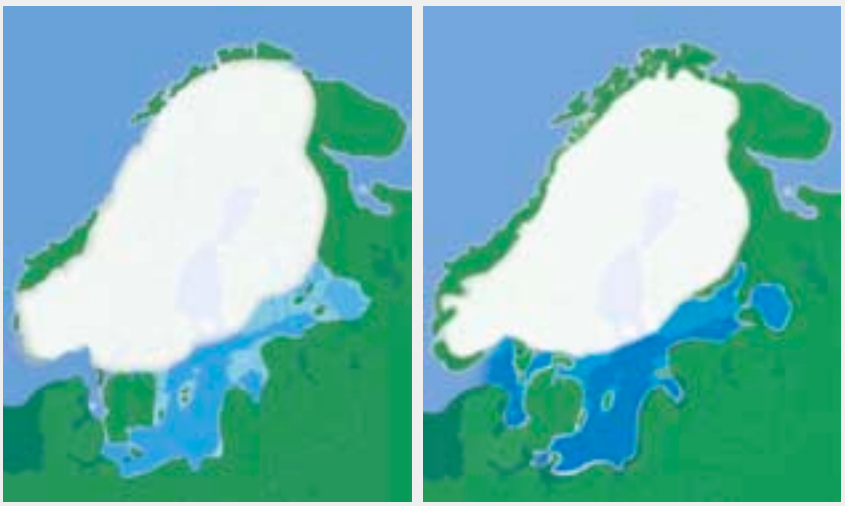
Ice, water and uplift

Around one million years ago, vast land areas in both the Northern and the Southern Hemisphere were covered with huge sheets of ice up to three kilometres thick. Also North America and Northern Russia were pressed down by heavy ice. In this part of the world, new ice was continuously formed in the centre of the Scandinavian Mountains, creating inland ice that covered large parts of Northern and Central Europe, and Russia as far as to the Urals.

Several ice sheets have for long periods of time affected the entire Baltic Sea area. The ice sheet of the last glaciation quite efficiently removed traces and remains of earlier ones. Therefore, not very much is known about the initial glaciation history and development of the Baltic Sea area.

The last 50,000 years in the Baltic Sea region have been characterised by a complex course of events where ice sheets have advanced and retreated. When we refer to the "Ice Age", we usually mean the last (Weichsel III) of three major advances. In all essentials, the Baltic Sea area is characterised by the events during that age and the current times of warm climate (Holocene-present). The major development phases, when the Baltic Sea was turned into alternately a freshwater or marine body of water, are well-known: The Baltic Ice Lake, the Yoldia Sea, the Ancylus Lake and the Littorina Sea.

Around 15,000 years ago, the large sheet of thick inland ice still covered much of Northern Europe, but it had melted enough for its southern margin to be located almost along the present southern coast of the Baltic Sea. Some 3,000 years later, the south-



The major post-glacial development phases in the Baltic Sea area – the Baltic Ice Lake, the Yoldia Sea, the Ancylus Lake and the Littorina Sea – and the area in its present state of development.

Millions and millions of years later, the journey continued further north, towards a harsher climate. At the same time, there was a general sea level rise and the amount of small chalk-forming organisms, like foraminifers and coccoliths, multiplied significantly. Evidence of this can be seen on the German island of Rügen, with the famous chalk cliffs (soft rock) as a special landmark, as well as on the Danish island of Møn and at Stevns Klint on the island of Zeeland.

When continental plates collided again, the violent creation of the Alps much further to the south also caused a rise in the land to the north. Most probably, the so-called Tornquist zone emerged at this time. Today we find the bubbling reefs (see more on page 61) in the Kattegat along that zone.

Parts of the Baltic Sea region later became dry land again, with extensive coniferous forests. Eventually, the ocean flooded the area again and the forests were buried on the seabed – but not forgotten. Every time we find a piece of amber we find a reminder of the soft resin once trickling down the tree-trunks, and of the buzzing and creeping insects that were trapped in the sticky drops.

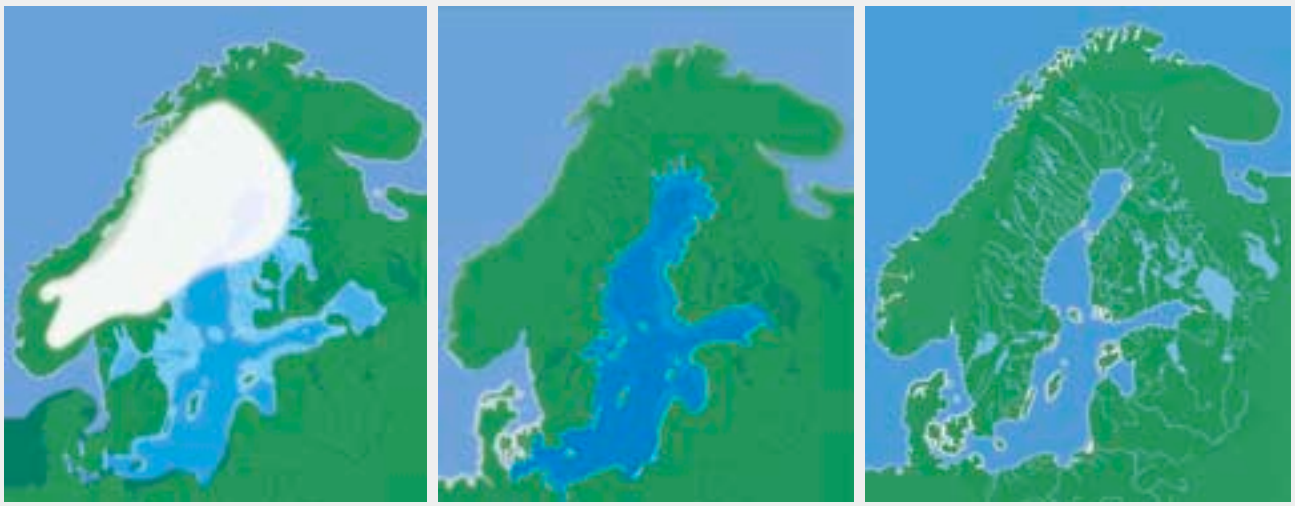
ern margin of the ice sheet could be found at the level of Gotland, the northern coast of Estonia, and further east in the Gulf of Finland.

Another well over 1,000 years later, the ice sheet had retreated to central Sweden and southern Finland and lingered there for an additional thousand years or so. The ice did not disappear altogether from the Baltic Sea area, all the way up to the northernmost part of the Bothnian Sea, until approximately 8,000 years after that.

During all this time, three forces of nature interacted in the (re)creation of land and sea. The ice sheet melted and the once depressed land was lifted, and from time to time the level of the world ocean outside the area rose.

When the ice sheet over Europe started melting, first over Central Europe (some 18,000 years ago) and then over Northern Europe, the sea level was about 120 metres lower than it is today. Water from melting ice sheets gradually increased the volume of water in the world ocean, and when the climate became warmer the process continued even faster. Large quantities of water from melting ice entered the world ocean, which raised the sea level by 15–20 metres per century.

Although glaciation as such is a past stage in history, the dynamic post-glacial process of land uplift and shore displacement has formed all parts of the Baltic region. Depending on several factors, the large, heavy, thick ice sheet had exerted different pressure on the land in different areas and this has affected the development “after the ice”. In the Gulf of Bothnia it is very much an ongoing process.



Solid rock beneath our feet

The Baltic Sea is a comparatively young creation, only some 14,000–15,000 years old. It rests in a shallow depression of crystalline bedrock that is around two billion years old. The basin was formed gradually, but its current shape was chiselled out around 100,000 years ago.

In the wider perspective of time and evolution, the Baltic Sea is like a shallow pool of water on top of an ancient mountain. With its mean depths of around 60 metres, it rests like a rockpool (with a small outlet) in a dent of solid rock, almost 35 kilometres high.

A small fringe of the oldest (at least 2.6 billion years old) bedrock in all of Northern Europe protrudes on the northernmost coast of the Bothnian Bay. Most of the primary bedrock beneath the Baltic Sea area is, however, a bit younger, meaning "only" 1.9– 1.75 billion years old.

In places – particularly in the Baltic world of vast archipelagos – one can still see exposed bedrock with the naked eye. In large areas the old bedrock is, however, completely concealed below thick layers of younger sedimentary (stratified) rock.

For millions and millions of years, rocks have eroded and withered into pebbles, gravel, sand, limestone and clay. Rain and snow have washed these tiny bits of rock into watercourses for further transport to shallow coastal seas. Once in the water, the material has sunk to the bottom. The pressure of the water, in combination with various chemical processes, has gradually compressed and transformed the pebbles and grains into different kinds of more or less hard sedimentary rock.

Already on the northern coast of Estonia and the coast of the island of Öland, the crystalline bedrock is hidden under layers of sedimentary rock 150–200 metres thick. South of the island of Gotland the thickness of the layer increases to 800 m, in the Gulf of Riga 1 km, and off the Lithuanian coast 2 km. On parts of the Polish coast, one would have to drill 3–3.8 km to find primary bedrock, and in other areas all the way down to a depth of well over 8 km.

Much of the seabed of the Gulf of Bothnia is also covered by sedimentary rock, mainly very old sandstone. This, however, is largely the result of continents colliding some 1.3 billion years ago in another and warmer climate. Big quantities of sand were then flushed into fractures in the bedrock, compressed and transformed into sandstone. This reddish sandstone can be found all over the Baltic basin, both immediately visible and covered by younger sandstone, limestone, shale and other kinds of sedimentary rock.

Living on the edge

The Baltic Sea is also a sea living on the edge, with natural constraints and an inherent vulnerability.

Compared with other sea areas in the world, where ecosystems and species have had millions of years to form and mature under conditions that have not altered drastically, the Baltic Sea has only had these few thousand years during which the sea has swayed from one condition to another. The climate has changed, the water area has expanded and shrunk, the salinity and temperature of the water has shifted over and over again.

More on the characteristics of the Baltic Sea: page 172.

No wonder the Baltic Sea is considered an ecologically very young and dynamic sea area.

In fact, at its present state of development, life of the Baltic Sea is less than about 4,000 years old. In this perspective, not a lot of time.

Moraines – sign of an icy past

There are many formations and materials on the seabed and in the coastal zone that reveal the region's glacial past.

The Baltic Sea region is moraine terrain. When the thick ice sheet finally disappeared, around 10,000 years ago, evidence of the grinding ice, abraded surfaces, rocky material shuffled and reshuffled, remain everywhere.

When you see moraine (till) of different kinds (an unsorted mixture of rock, boulders, stone, pebbles, gravel, sand and clay, as if a giant steamroller has forced its way through the landscape) you see signs of the retreat of the ice sheet. Moraines were formed when the stepwise shrinking ice took old and new layers of loose-lying soil with it, transported it for a while and then left it behind somewhere else.

Kokkola Archipelago, Finland.

De Geer morains, the Quark, Finland.

Imagine a giant who carries a bag of stones of all sizes, from very large blocks to very fine sand and clay, opens the bag somewhere and just throws away the contents without caring about where and how they land on the ground – then you will know what ground moraine looks like, a blanket of glacier till deposited on all of the surface over which a glacier has moved. And, naturally, the same is true for moraine formations on the seabed.

If unsorted material was moved underneath or along the ice, or pushed along its margin, various formations were eventually left behind as so-called end moraines and large systems of end moraines. These ridges can be very high, very wide and very long.

Melting ice produced cold glacial rivers that flowed in "tunnels" within and underneath the ice sheet or flooded at the ice margin. Glacial rivers moved finer components of the rocky material in a more tidy way and left behind ridges such as eskers and boulder ridges, as well as sediments of clay, silt and sand. Where the material is neatly sorted, you will know that it was once transported in water and deposited.

Eskers are long, winding ridges of stratified sand and gravel, often several kilometres long. You find them on land, but also in the sea as islands and systems of islands.

Gain some, lose some

A retreating sea and advancing shoreline in the north, an advancing sea and retreating shoreline in the south. The Baltic Sea region is, indeed, a world of contrasts, all caused by the ice.

For example, 60-70 per cent of the Baltic coastal zone in Poland is subject to erosion, accompanied by the permanent recession of the shoreline. The recent average shoreline retreat in Poland amounts to 50–100 centimetres per year, which results in an annual loss of up to 340,000 m^2 of land. In Germany, one third of the cliffs along the coast of Schleswig-Holstein and almost half of the cliffs in Mecklenburg-Vorpommern are eroding, and in places as much as 2–4 metres of shoreline are lost every year.

Abrasion coast, Ostseeküste am Brodtener Ufer, Germany, and Wolinski National Park, Poland

Quite the opposite is happening in the Gulf of Bothnia, where land-giving processes take place to such an extent that they can even be difficult to manage. Land uplift will continue for another 10,000 years or so – possibly supplemented by additional sea level rise caused by the ongoing climate change. In all areas where the annual rate of land uplift is anything from 4 to almost 10 millimetres per year, the shores are literally moving towards the receding sea.

At most, land was depressed to a level of 800–1,000 metres below normal. About 500 metres or more have been regained, but the process will continue to include another 50–125 metres. The land area of the archipelago increases by one km^2 per year in the narrow and shallow Quark. In around 2,000 years, sufficient land will have risen from the sea to form a land bridge between Finland and Sweden and transform the Bothnian Bay into a freshwater lake.

Land uplift in the Quark, Finland.

High cliffs and long spits

Steep cliff coasts along the southern shores of the Baltic tell stories of end moraine formations that have been eroded for a long time by sea and winds. Fine material has been transported along the coast and accumulated in sheltered areas, where sand bars, spits and ridges have been formed. Coarser material is found as unsorted rocks, boulders, pebbles and gravel at the feet of the cliffs. This can be seen particularly along the German and Polish coasts, as well as in some places along the Danish coast and the coast from Lithuania to Estonia.

Large accumulations of sand along the coast are the result mainly of abrasion of moraine cliffs, but also of other processes. The large dune complexes, including the fascinating landscapes of moving (shifting) dunes, are formed as a result of several forces working together. Winds blow up the dunes, and waves and ice form beach ridges. Shifting dunes build up and move when new sand is being fed to the shore from the sea, together with the impact of strong winds that transport sand on land, thereby forming and displacing dunes.

The famous sandy spits that embrace large Baltic lagoons also have (a still ongoing) history of accumulation of sand from eroded cliffs.

Moving dunes, Curonian Spit, Lithuania.

Moving shorelines in land that rises

Shores that move away is not just a theoretical concept in the Baltic, it is something you can see with your own eyes. Harbours that used to be located by the sea suddenly have a considerable strip of dry land blocking the way to the water. Old shipping lanes are no longer usable, grounds can emerge where passage was once safe. Buildings, and even whole communities, have to be moved. Ownership of the new land that used to be water-covered seabed becomes a matter of legal dispute.

Rocky bottoms, resting under the surface of the sea, suddenly pop up as boulders and skerries in vast archipelagos up north. Fine material has been washed away, leaving bare rocks above water. Given time they develop into islets, islands and peninsulas. Closer to the coast, once open sea inlets are being cut off from the sea and transformed first into seawater-fed fladas, then into freshwater glo lakes, eventually into mires and finally into forestland.

A majority of the Baltic archipelagos are located in the northern Baltic Proper, the Gulf of Finland, the Archipelago Sea and the Gulf of Bothnia. Almost without exception, they all seem to be scattered into hundreds or thousands or even tens of thousands of islands, islets and skerries over usually (but not always) large water areas.

Archipelagos are jigsaw puzzles of different worlds, above and under water, comprising a multitude of biotopes and biotope complexes: offshore deep waters; coastal shallow waters; cliffs; sloping rocky shores; spits and bars; beaches; beach ridges; dunes; wetlands and meadows; coastal lakes (glo lakes); and pools. They have rocky, sandy and moraine coasts; flat coasts subject to intensive land uplift; fjord-like bays; fladas; estuaries and river mouth areas; and esker islands. And under water, different worlds of hard bottoms, mixed sediment bottoms and soft bottoms open up at small and larger depths.

Opposite page: Moraine landscape rising from the sea, the Quark, Finland.

Stora Nassa Archipelago, Sweden.

Fjords, Förden, Bodden and lagoons

All along the Baltic Sea coast one finds wide, shallow expanses of water, or narrow sea inlets, that were created due to general land uplift and in some cases resulted in the formation of some kind of barrier towards the open sea.

In the Kattegat and the Belt Sea, one finds the typical Danish and Swedish fjord landscapes: shallow water, large water areas, islets, indented coastline and complex mixtures of landscape types. In intermediate and outer archipelagos, open areas of water between islands are another kind of fjord-like bays or inlets. Along the coast of Schleswig-Holstein, long, narrow, tube-like bays are known as Förden.

Further to the east, large and shallow lagoons have formed when bays have been more or less separated from the sea by surrounding land but still have permanent (although in some cases only just) connection and water exchange with the sea. The German coastal landscape of lagoon-like Bodden, separated from the sea by spits or sills, is very characteristic. It continues also into the Polish Szczecin Lagoon area. The Vistula and Curonian Lagoon are both locked behind rigid sandy arms of high and growing sandbars of the Vistula Spit and Curonian Spit, respectively.

Resting birds. Vorpommersche Boddenlandschaft, Germany.

Opposite page: Skælskør Fjord, Smålandsfarvandet, Denmark, and a view over the Curonian Lagoon, Lithuania.

What the floodwater left behind

There is also historic evidence in the Baltic Sea region of times when the world ocean came rushing in and caused much of what is now land to be flooded.

Geologists talk of the Littorina transgression in several stages. This relates to a period over thousands of years, beginning some 8,500 years ago, when the world ocean flooded the Baltic region. The water stayed at the same level for a long time, because the effects of flooding were compensated by ongoing land uplift, and left its distinct marks in the landscape as fossil raised beaches. When you see them, high above the present sea level, you know that you are standing on the former seabed of the Littoria Sea looking up towards an ancient shoreline. Remains of the highest coastline recorded anywhere in the world can be found in the Baltic Sea region, at an altitude of almost 286 metres on the Skule Mountain off the High Coast (Bothnian Sea). However, raised beaches of different kinds and levels occur in many places in the Baltic Sea region.

Shingle (cobblestone/rubble) stone fields are another type of old beaches found in areas where land has risen from the sea. Wave-washed stones and boulders, once lifted from the seabed onto a shore, well

grinded by the mechanical wear of the waves into being smooth and round, are found high up in the landscape, far away from any shore.

One can go on forever describing the wide spectrum of signs of "after-the-ice" and "after-the-floods" events, formations and phenomena in the post-glacial Baltic Sea region. However, nature itself is a superior textbook and always extends an invitation to a journey in the footsteps of an icy and wet dramatic past.

The pearls of the Baltic Sea are worlds of worlds, each of them unfolding not just one nature type, but a pattern of several formations, zones of interaction between land and sea, and living environments.

For the purpose of building the network of Baltic Sea Protected Areas, the open waters, the seabed, and the coastal landscape of the Baltic Sea area have been divided into a number of biotopes and biotope complexes – from the deepest bottom areas to the highest coastal cliffs.

For non-experts the details of each and every biotope or biotope complex can be slightly confusing, especially since one biotope complex can comprise a series of biotopes, and biotopes can comprise a number of features.

More on Baltic biotopes and biotope complexes: page 178.

Opposite page: A raised beach, Rahja Archipelago, Finland (top). Shingle stone field, Bothnian Sea National Park, Finland.

Baltic ringed seals, the Quark, Finland.

Biotopes at risk

Obviously, a BSPA should first and foremost be viewed and appreciated as a whole, as a beautiful and functional piece of the Baltic Sea region. Then it will be seen as one of the pearls in the string that should be kept intact or, preferably, even have more pearls added.

Marine landscape, Östliche Kieler Bucht, Germany. Wetland, Greifswalder Bodden, Germany.

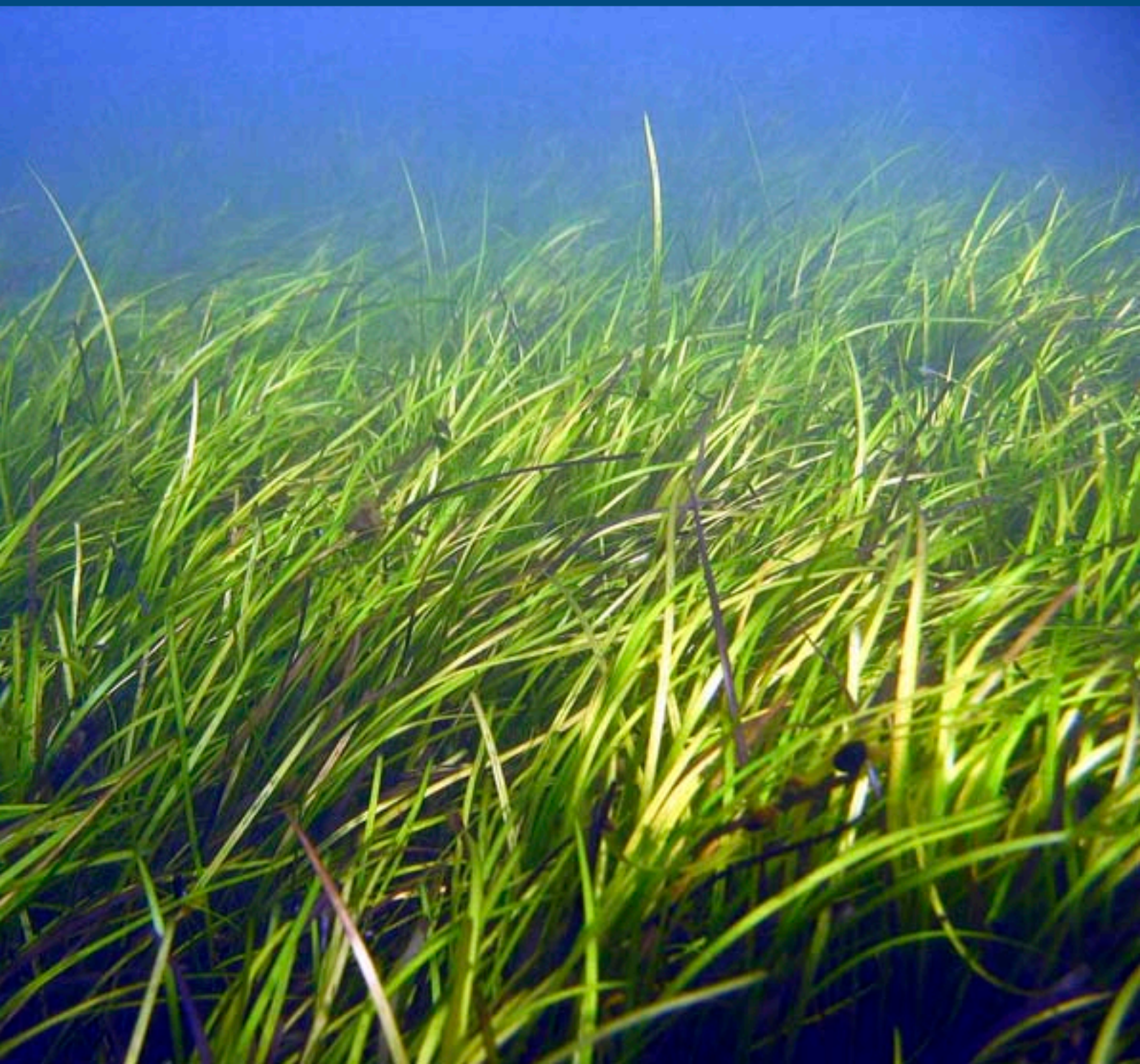
However, an overall assessment of threats to biotope complexes and biotopes in the Baltic Sea area gives cause for concern. Experts have rated over 80 per cent of all biotopes as endangered. Of the Baltic coastal and marine biotopes, 15 per cent are rated as heavily endangered, for example, offshore deep waters, sandy bottoms, various dune

formations, and coastal meadows and wetlands. Lagoons, including Bodden areas and fladas, are examples of heavily endangered Baltic biotope complexes.

The risks of losing parts of or entire biotopes and areas must be recognised and efforts made to manage them. Otherwise the magnificence of the great variety of worlds, shapes and life forms along the Baltic Sea coast and in the sea itself could be reduced to a memory of what future generations will refer to as another post-glacial, though mainly man-made, dramatic past of the Baltic Sea region.

Waters at Kępa Redłowska, Poland.

A Grand Tour of the Baltic Sea Protected Areas



Nearly 100 areas of varying size, representing a large variety of nature types, ecosystems and historical events in the Baltic Sea region, currently make up the network of BSPAs.

Welcome aboard this special ship that will take you around the Baltic Sea on a Grand Tour of the Baltic Sea Protected Areas! This time we can only make brief stops in each area, but a world of Baltic nature awaits your visit. Hopefully our Grand Tour will help you discover new pearls and re-discover the ones you are already familiar with.

Like all major sailing trips this one has also been divided into shorter legs. The first one takes you exclusively to the offshore underwater world, starting in the Kattegat and ending in the Baltic Proper.Legs 2–8 will gradually take you along the coast, also starting in the northern parts of the Kattegat but ending this time in the northern parts of the Bothnian Bay. The division into legs is mainly geographical, but you will also find that you move between stretches more or less dominated by certain features and forces – low-lying fjord-like bays, cliffs, and sandy beaches and dunes in regions of erosion and flooding, as well as archipelagos in regions of distinct land uplift.

So, feel the sea air in your face, look out over the open water, listen to the sound of the waves, and be prepared for plenty of dives under water and visits ashore along the way – the Grand Tour of the Baltic Sea Protected Areas can commence.

Leg 1
From Herthas Flak to Salvorev
The world of shallow-water offshore banks and grounds, raised areas of seabed that are surrounded by deeper water. People and human activities (except for fisheries) are generally far away in these areas that are some of the least known worlds of the Baltic Sea.

Leg 2
From Rønner to Stavns
Moraine coast with extensive shore meadows, dunes, marshes and grazing lands. Large, shallow, bays and fjord-like expanses. Long, sandy beaches but also places where you can see bare crystalline bedrock. An area of shallow waters and generous space of low-lying land, side-by-side with rough rocks and a harsh sea.

Leg 3
From Lundåkrabukten to Greifswald
Fjords, Förden and Bodden. Low-lying islands and peninsulas. Mudflats, sandflats, dunes and meadows. Reefs and sandy bottoms. But also rocky moraine cliffs, steep coasts, and bedrock horsts. Grinding erosion of cliffs, moving sand, and the transition between marine and brackish.

← Eelgrass meadow, Denmark.

Leg 4
From Wolinski to Palanga
Sand, sand, sand. The long coast of sandy dunes, dramatically high, wide and moving dunes, and sandy beaches. And the coast of long, sandy spits and large lagoons. Strong forces of erosion and accumulation, high cliffs and coastal lakes, and a very special river delta.

Leg 5
From Pape to Lahemaa
Long sandy coasts with dunes. Open waters, low-lying islands with alvars, shallow bays and inlets, a large estuary, klints and moraine coasts. Highly productive shallow waters. Some of the most important bird areas in the Baltic. Core areas for grey seals and ringed seals. Two large Biosphere Reserves.

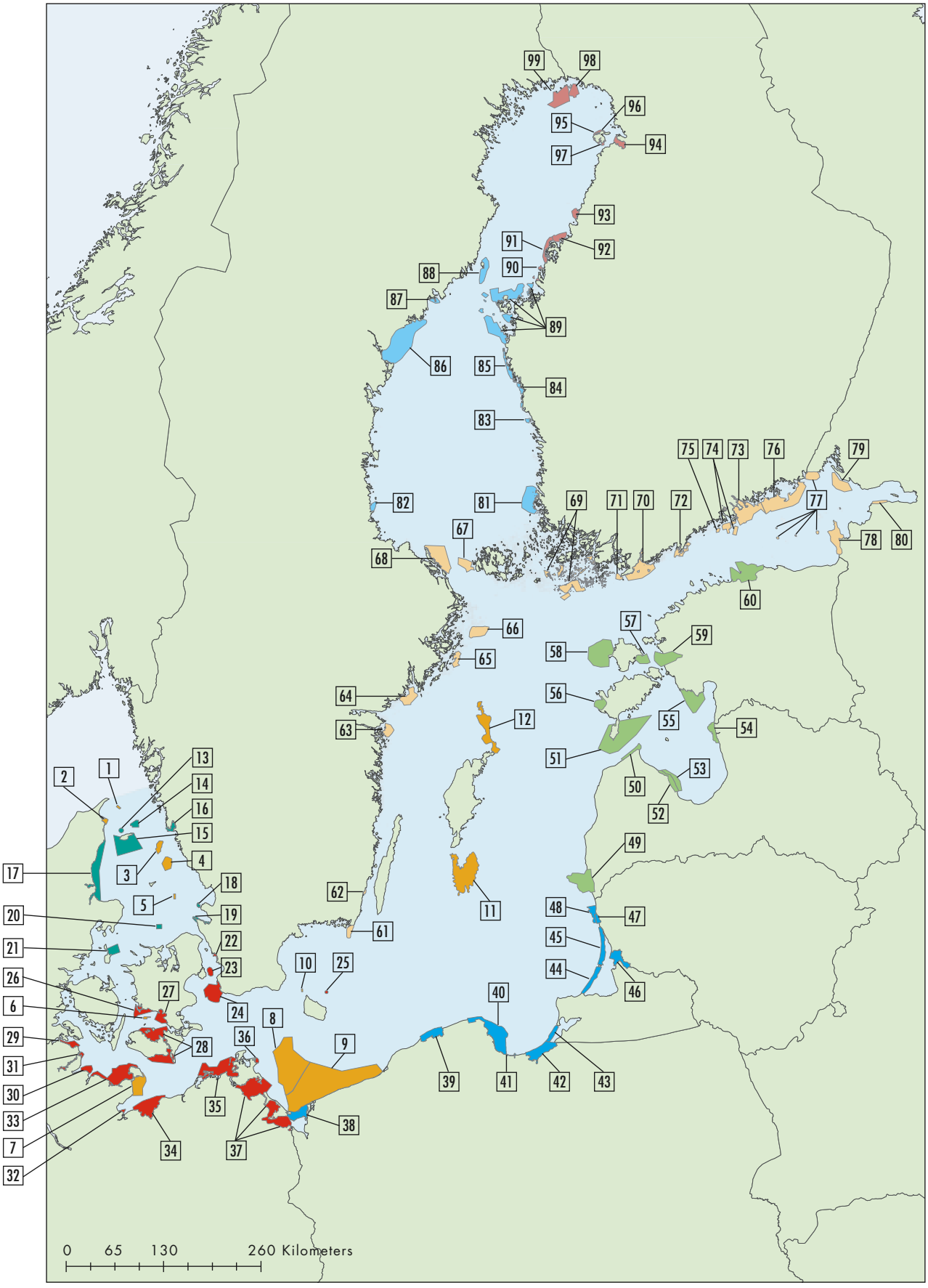
Leg 6
From Torhamn to Lebyazhye
A broad spectrum of archipelagos along a wide arch, from south to north and from west to east, exhibiting the variety of these complex environments. From lush green inner archipelagos, sheltered bays, narrow straits, through wide open bays, to barren, polished islets and exposed skerries in the outer archipelagos.

Leg 7
From Uusikaupunki to The Quark
Archipelagos from south to north where land uplift really makes all the difference and continuously shapes and reshapes coastal and marine landscapes. Moraine coasts. Forested mountains and hills facing the sea. Two World Heritage sites. Shores increasingly influenced by the forces of the winter ice. Many species at their northern distribution range.

Leg 8
From Uusikaarlepyy to Haparanda
Archipelagos, but also wide sandy beaches. Almost Arctic conditions. The largest bay in the Gulf of Bothnia. Transition from brackish to almost freshwater conditions. One transboundary archipelago covered with ice during a large part of the year. Shallow waters of rocks, boulders and sandbanks.

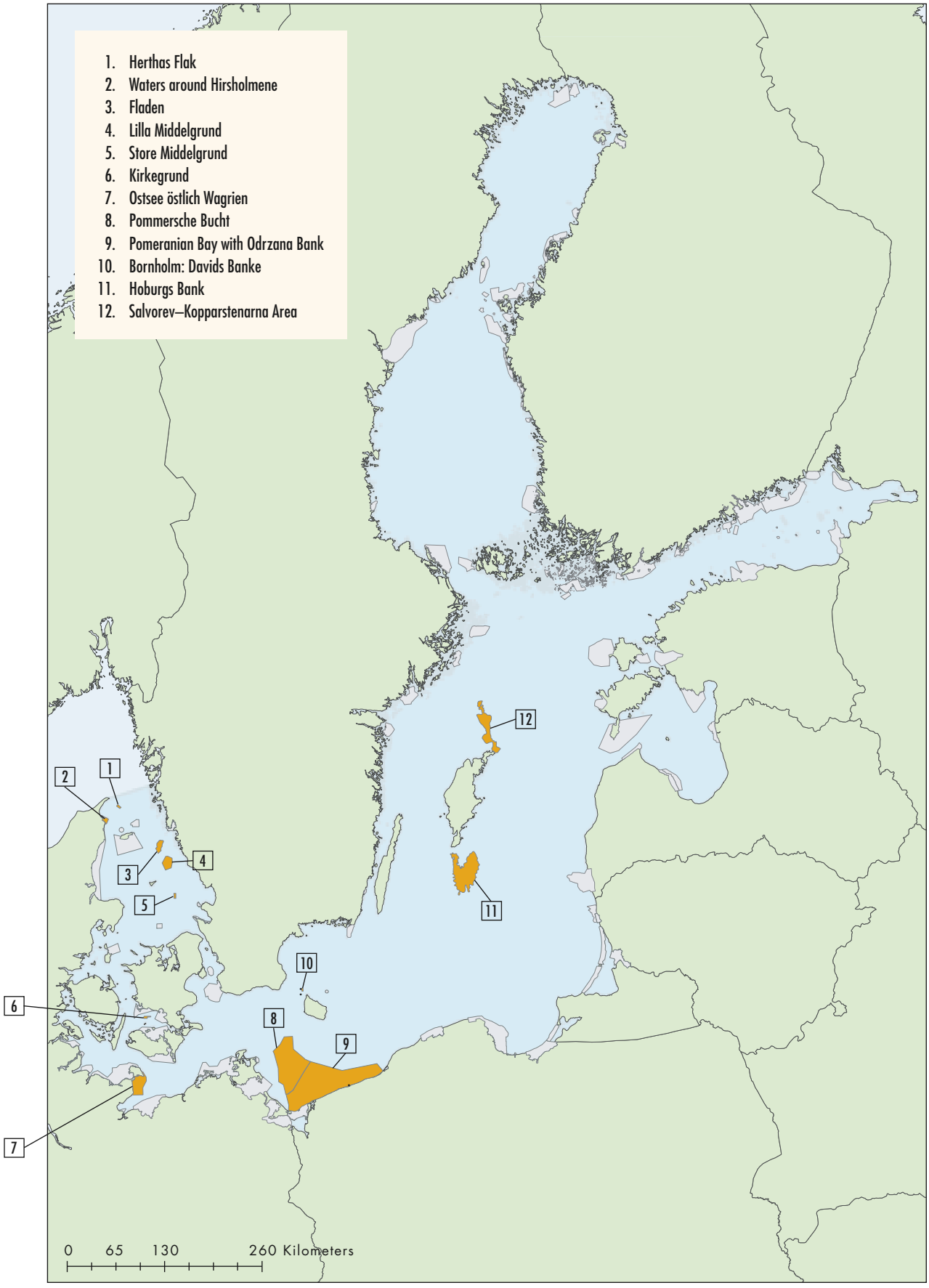
Scientific names of all species mentioned in Legs 1–8: page 186.

	Area	BSPA id	Country
1.	Herthas Flak	BSPA 137	Denmark
2.	Waters around Hirsholmene	BSPA 135	Denmark
3.	Fladen	BSPA 118	Sweden
4.	Lilla Middelgrund	BSPA 119	Sweden
5.	Store Middelgrund	BSPA 132	Denmark
6.	Smålandsfarvandet: Kirkegrund	BSPA 185	Denmark
7.	Ostsee östlich Wagrien	BSPA 177	Germany
8.	Pommersche Bucht	BSPA 172	Germany
9.	Pomeranian Bay with Odrzana Bank	Proposed BSPA 170	Poland
10.	Bornholm: Davids Banke	BSPA 126	Denmark
11.	Hoburgs Bank	BSPA 115	Sweden
12.	Salvorev–Kopparstenarna Area	BSPA 109	Sweden
13.	Waters around Rønner	BSPA 188	Denmark
14.	Læsø Trindel–Tønneberg Bank	BSPA 136	Denmark
15.	Waters around Læsø	BSPA 134	Denmark
16.	Kungsbackafjorden	BSPA 113	Sweden
17.	Aalborg Bay, Randers Fjord and Mariager Fjord	BSPA 133	Denmark
18.	Hallands Väderö	BSPA 194	Sweden
19.	Kullaberg	BSPA 112	Sweden
20.	Waters around Hesselø	BSPA 131	Denmark
21.	Stavns Fjord and adjacent waters	BSPA 130	Denmark
22.	Lundåkrabukten	BSPA 193	Sweden
23.	Waters around Saltholm	BSPA 129	Denmark
24.	Falsterbo Peninsula with Måkläppen	BSPA 111	Sweden
25.	Bornholm: Ertholmene	BSPA 184	Denmark
26.	Smålandsfarvandet: Skælskør Fjord and the sea and coast between Agersø and Glænø	BSPA 128	Denmark
27.	Smålandsfarvandet: The sea and coast between Karrebæk Fjord and Knudshoved Odde	BSPA 186	Denmark
28.	Smålandsfarvandet: North of Lolland, Guldborg Sund, Bøtø Nor and Hyllekrog-Rødsand	BSPA 187	Denmark
29.	Flensburger Förde	BSPA 173	Germany
30.	Eckernförder Bucht mit Flachgründen	BSPA 175	Germany
31.	Schlei	BSPA 174	Germany
32.	Ostseeküste am Brodtener Ufer	BSPA 178	Germany
33.	Östliche Kieler Bucht	BSPA 176	Germany
34.	Wismarer Bucht–Salzhaff	Proposed BSPA 4	Germany
35.	Vorpommersche Boddenlandshaft National Park	Managed BSPA 3	Germany
36.	Jasmund National Park	Managed BSPA 2	Germany
37.	Strelasund/Greifswald Lagoon/Isle Greifwalder Oie/Odra Mouth Area	Proposed BSPA 1	Germany
38.	Wolinski National Park with surrounding water areas	BSPA 86	Poland
39.	Slowinski National Park with surrounding water areas	BSPA 85	Poland
40.	Nadmorski Landscape Park with surrounding water areas	BSPA 84	Poland
41.	Kepa Redlowska Reserve with surrounding water areas	Proposed BSPA 182	Poland
42.	Vistula Spit Landscape Park	BSPA 83	Poland
43.	Vistula Spit Reserve	BSPA 164	Russia
44.	Curonian Spit National Park	BSPA 163	Russia
45.	Curonian Spit National Park	BSPA 122	Lithuania
46.	Nemunas Delta Regional Park	BSPA 124	Lithuania
47.	Pajuris Regional Park	BSPA 123	Lithuania
48.	Palanga	Proposed BSPA 125	Lithuania



Area	BSPA id	Country
49.	Pape–Pērkone Area	BSPA 99	Latvia
50.	Lielirbe–Kolka Area	BSPA 98	Latvia
51.	Irbe Strait	Proposed BSPA 95	Estonia
52.	Kaltene–Engure Area	BSPA 97	Latvia
53.	Offshore section Kaltene-Engure	Proposed BSPA 100	Latvia
54.	North Vidzeme Biosphere Reserve: Coastal section Dzeni-Ainazi	BSPA 96	Latvia
55.	Kihnu Strait	Proposed BSPA 94	Estonia
56.	Vilsandi National Park	BSPA 91	Estonia
57.	Hiiumaa Islets	BSPA 92	Estonia
58.	Kõpu Peninsula on Hiiumaa	BSPA 90	Estonia
59.	Matsalu National Park	BSPA 89	Estonia
60.	Lahemaa National Park	BSPA 88	Estonia
61.	Torhamn Archipelago	BSPA 110	Sweden
62.	Värnanäs Archipelago	BSPA 192	Sweden
63.	St. Anna–Missjö Archipelago	BSPA 108	Sweden
64.	Hartsö–Askö Archipelago	BSPA 107	Sweden
65.	Bullerö–Bytta Archipelago	BSPA 191	Sweden
66.	Stora Nassa–Svenska Högarna Archipelago	BSPA 106	Sweden
67.	Signilskär–Märket	Proposed BSPA 146	Finland
68.	Gräsö–Singö Archipelago	BSPA 105	Sweden
69.	Archipelago Sea	BSPA 143	Finland
70.	Tammisaari and Hanko Archipelago and Pojo Bay marine protection area	BSPA 144	Finland
71.	Tulliniemi bird protection area	BSPA 157	Finland
72.	Kirkkonummi Archipelago	BSPA 58	Finland
73.	Pernaja Bay and Pernaja Archipelago marine protection areas	BSPA 161	Finland
74.	Söderskär and Långören Archipelago	BSPA 159	Finland
75.	Porvoonjoki estuary–Stensböle	BSPA 160	Finland
76.	Eastern Gulf of Finland Archipelago and waters	BSPA 145	Finland
77.	Ingermanlandskiy	Soon to be proposed as BSPA 162	Russia
78.	Kurgalskiy Peninsula	Soon to be proposed as BSPA 166	Russia
79.	Berezovye Islands	Soon to be proposed as BSPA 196	Russia
80.	Lebyazhye	Soon to be proposed as BSPA 197	Russia
81.	Uusikaupunki Archipelago	BSPA 142	Finland
82.	Axmar Archipelago	BSPA 190	Sweden
83.	Oura Archipelago	BSPA 141	Finland
84.	Kristiinankaupunki Archipelago	BSPA 156	Finland
85.	Närpiö Archipelago	BSPA 155	Finland
86.	High Coast	BSPA 104	Sweden
87.	Kronören	BSPA 189	Sweden
88.	Holmö Islands	BSPA 103	Sweden
89.	Outer Bothnian Threshold Archipelago (The Quark)	BSPA 140	Finland
90.	Uusikaarlepyy Archipelago	BSPA 154	Finland
91.	Luoto Archipelago	BSPA 153	Finland
92.	Kokkola Archipelago	BSPA 152	Finland
93.	Rahja Archipelago	BSPA 151	Finland
94.	Liminka Bay	BSPA 150	Finland
95.	Hailuoto, north shore	BSPA 147	Finland
96.	Isomatala–Maasyvänlahti	BSPA 149	Finland
97.	Kirkkosalmi	BSPA 148	Finland
98.	Bothnian Bay National Park	BSPA 139	Finland
99.	Haparanda Archipelago	BSPA 101	Sweden

Marine landscape, Svenska Högarna, Sweden.



From Herthas Flak to Salvorev

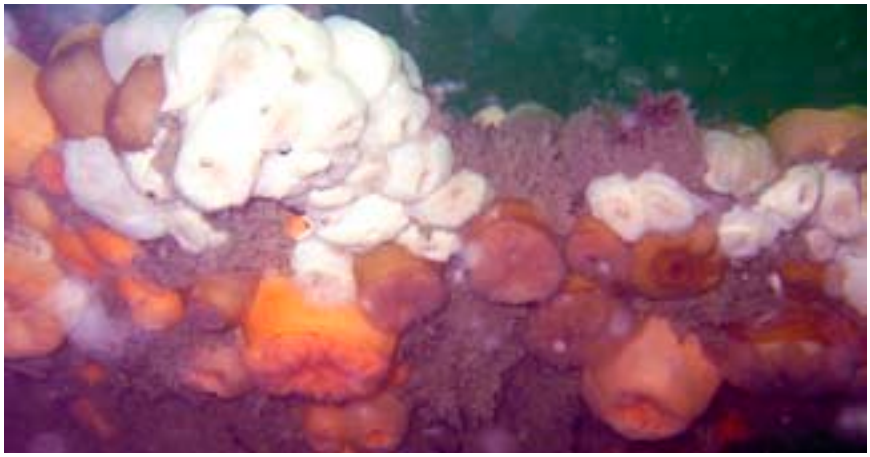
Land meets the sea in the coastal zone and this area of transition is a virtual cascade of life. Under the surface of the shallow coastal waters, where the sun shoots beams into the water for underwater forests to absorb, the sea creates places for fish and bottom-living animals to live, rest, hide, feed and reproduce. Deeper down, below the level where sunlight matters, there is yet another world with other life forms that know how to make the most of what happens in the water above.

The wet world of seabeds cannot be separated from the dry world of beaches and shores. The largely out-of-sight world of seabeds continues in a constant interaction and interdependence with the visible world of shores and hinterlands.

But let us go even further out to sea, much further from land. This is the world of the shallow-water offshore banks and grounds, raised areas of seabed that are surrounded by deeper water. People and human activities are far away, at a comfortable distance, the water is clearer for algae to grow, fish to spawn and feed, and birds to find delicious seafood. In general, there is less that disturbs life out here. It is not uncommon to find rare species, organisms that can no longer survive in areas closer to the coast but find safe refuge on the banks and grounds. An underwater tour of offshore areas is a journey to some of the least known worlds of the Baltic Sea.

The Herthas Flak reef rises from the surrounding sandy bottom at a depth of 20 metres. Large stones and boulders dominate here, which is otherwise uncommon on reefs in these parts. Stones occur densely from the foot of the reef to its highest peak at a depth of around 10 metres below the sea surface. In its deeper areas it harbours algae and animals that are rare in these waters, and it is likely to function as an important depot of Kattegat deep-water reef species. A bubbling reef area extends close to the stone reef, with pillars rising up to some 1.5 metres from the seabed.

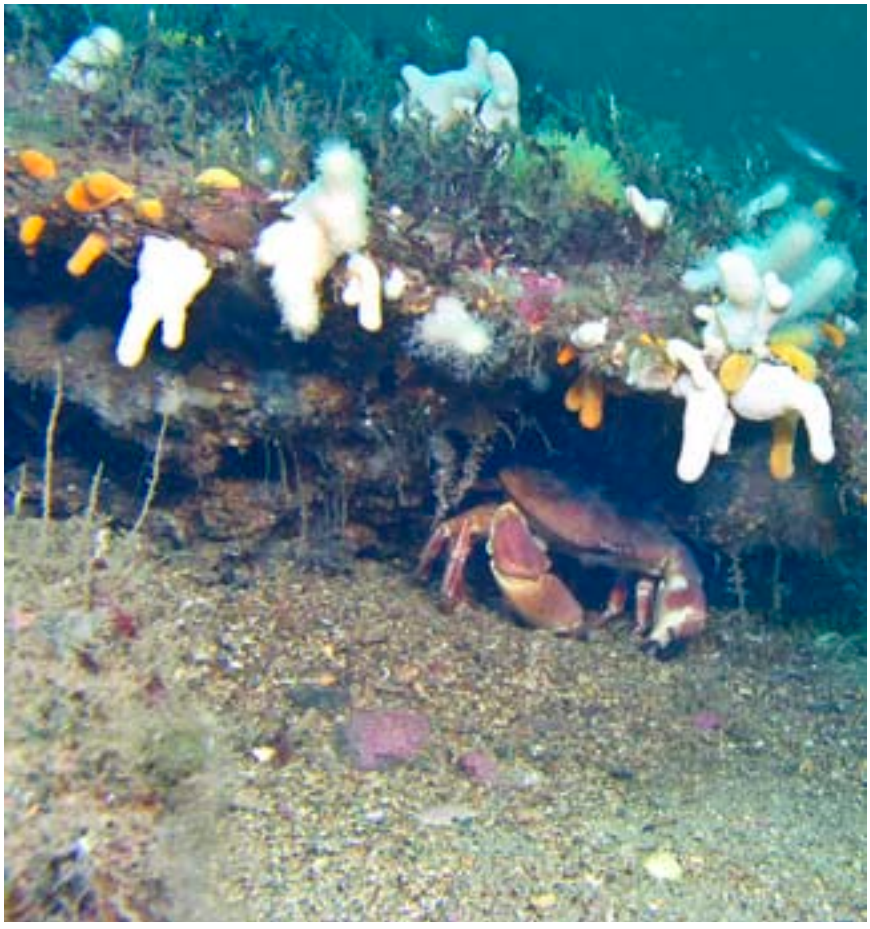
Bubbling reef, Herthas Flak, Denmark.



The islets of Hirsholmene, with a uniquely rich bird life, constitute the upper part of the largest reef in Danish waters. There are submerged stony reefs and bubbling reefs in the area Waters around Hirsholmene. The reefs hold a rich diversity of abundant macroalgae. Geological history literally pops out of the seabed in the shape of bubbling reefs. These intriguing formations are found in particularly large concentrations in the waters around the islets.

The Fladen bank rises around 65 metres from the seabed and in the shallowest parts it is only around five metres below sea level. Extensive forests of large brown algae (Laminaria) grow on the boulders, stones, gravel, sand and shell gravel that reach down to about 30 metres. Maerl (loose-lying calcified red algae that afford a three-dimensional reef structure to the seabed) can be found on Fladen. The bank is rich in species, many of them rare. The bank is a refuge for at least ten red-listed animal species. Many fish species spawn and nurse here – including leopard-spotted goby, cod and common ling. The largest Baltic Sea population of common seals is found in the area, together with many grey seals. A variety of birds that are rarely observed close to the coast (among them razorbill, guillemot, black guillemot and fulmar) come to Fladen to feed and rest. Furthermore, the first ever observations of bubbling reefs in Swedish waters have been made here.

The bubbling reef structures were originally formed as a result of different chemical reactions in wells of seeping methane gas in sediments. The gas most probably formed when plant material was decomposed 125,000– 100,000 years ago. The gradual land uplift in the Kattegat area caused the surrounding soft sediment to start eroding. Thereby the hard sandstone structures, once created and hidden in the sediments, were openly exposed in the water. The hard sandstone structures rise like big columns 2–3 metres tall from the seabed. They can also look like mushrooms popping up from the sediments or occur as individual slabs or more widely distributed lithified pavements over large areas. This could appear to be a hostile environment, but algae and bottom-living animals of many colours and shapes thrive on the sandstone formations. Over 100 species of bottom-living animals have been found on bubbling reefs, which display a most diverse ecosystem, including animals that normally do not live on stone reefs. Many animals live within the hard structures, in holes bored by sponges, bristle worms and mussels. However, only a few species occur in the sediments surrounding the gas seeps.

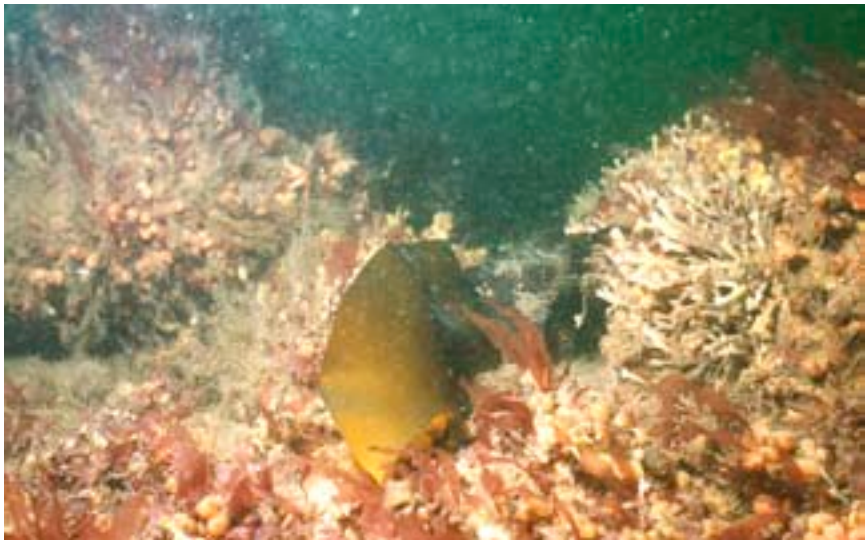


Bubbling reefs in the waters around Hirsholmene, Denmark and (opposite page) at the Fladen bank, Sweden.

Underwater reef, Store Middelgrund, Denmark (above) and jellyfish, on Kirkegrund, Dennmark.

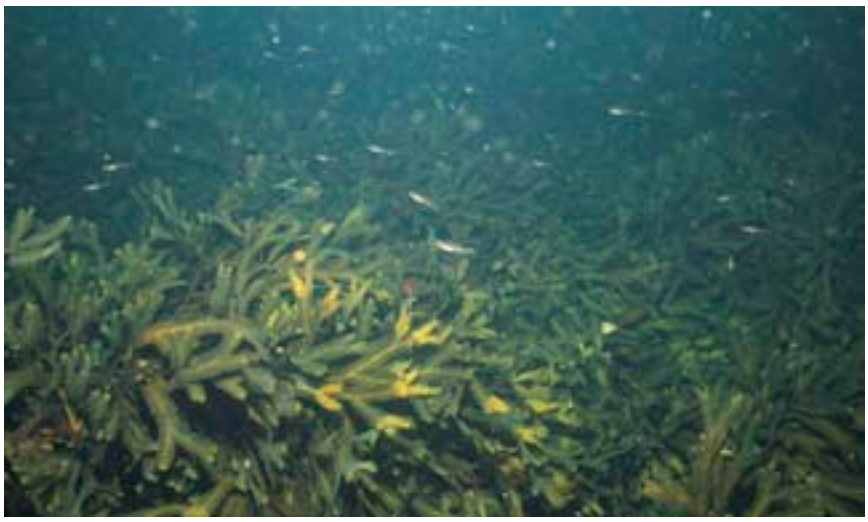
The Lille Middelgrund and Store Middelgrund banks, both consisting of sand, shell gravel, stones and boulders (more common on Lilla Middelgrund), are not very far apart. Harbour porpoises live and have their calves in the waters of both grounds. Rare bottom-living species like the horse mussel (a long-lived species, no longer common in coastal waters) inhabits Store Middelgrund. Great scallop is one of the species of bottom-living animals frequently observed on Lille Middelgrund. More than 130 species of macroalgae (around 20 of them rare ones), including dense stands of Laminaria species with rich animal life, grow on Lilla Middelgrund. This makes the area richer in macroalgae than near-coast areas in the Kattegat. Maerl can be found on both Lilla and Store Middelgrund. Both areas are important for birds; Lilla Middelgrund has been estimated to be the fourth most important wintering area for birds in the Baltic Sea region. Several species, including offshore-living species like in the Fladen area, come there.

Before leaving the offshore Danish waters – a quick look at the Kirkegrund reef, in the central part of the extensive Danish Smålandsfarvandet. It is a stony reef surrounded by sandy areas. In these very shallow waters (less than a metre deep in the shallowest parts) red and green algae and blue mussels cover the stony bottoms and eelgrass sways gently on the sandy bottoms.



Marine landscapes, Ostsee östlich Wagrien, Germany (above) and Kirkegrund, Denmark.

Sagas Bank and the Staberhuk Grund are both located within the water area Ostsee östlich Wagrien off the island of Fehmarn. Rich stands of algae and as many as 115 species of bottom-living animals have their home on the bottoms of stones, gravel and sand at water depths up to 15 metres on Sagas Bank. Mussel-eating birds find plenty of food on the beds of regionally rare, long-lived mussels in the muddier outskirts of the bank. The ground area Staberhuk, also with a mixture of sand, gravel and stones, is rich in red algae. Closer to the shore, meadows of eelgrass provide an excellent living environment for a variety of animals.



Marine landscapes, Great Belt, Denmark (opposite page), and Pommersche Bucht and Oder Bank (German part).

The German part of the Pommersche Bucht includes the ground area Adler Grund to the north, and the western part of the large sandy Oder Bank to the south, whereas the Polish part of the area, the Pomeranian Bay (Zatoka Pomorska) with Odrzana Bank, consists of the eastern parts of the bank and the bay. With ten species of wintering bird occurring in concentrations of international importance, the area is unique on a global scale. Furthermore, the small (600 animals at the most) Baltic population of harbour porpoise depends on the bay.

Adler Grund, with stone fields as well as sandy bottoms, is the largest and shallowest area in the southern part of the Baltic. It harbours over 90 species of bottom-living animals and, together with the Oder Bank, is the starting point for animals ready to spread over bottom areas that have recovered after periods of oxygen deficiency. Dense stands of algae, including the rare brown alga smooth cord weed, grow in the shallowest parts. Beds of blue mussel, and Baltic telling, dominate at greater depths. The area is important for fish.

The Oder/Odrzana Bank, largely sandy but also with gravel and boulders, rises conspicuously from the bottom at the depth of 7–12 metres. Young fish feed here and species like plaice and turbot depend on the bank for spawning. “Only” around 50 species of bottom-living animals occur here, clearly dominated by blue mussels in thick beds.

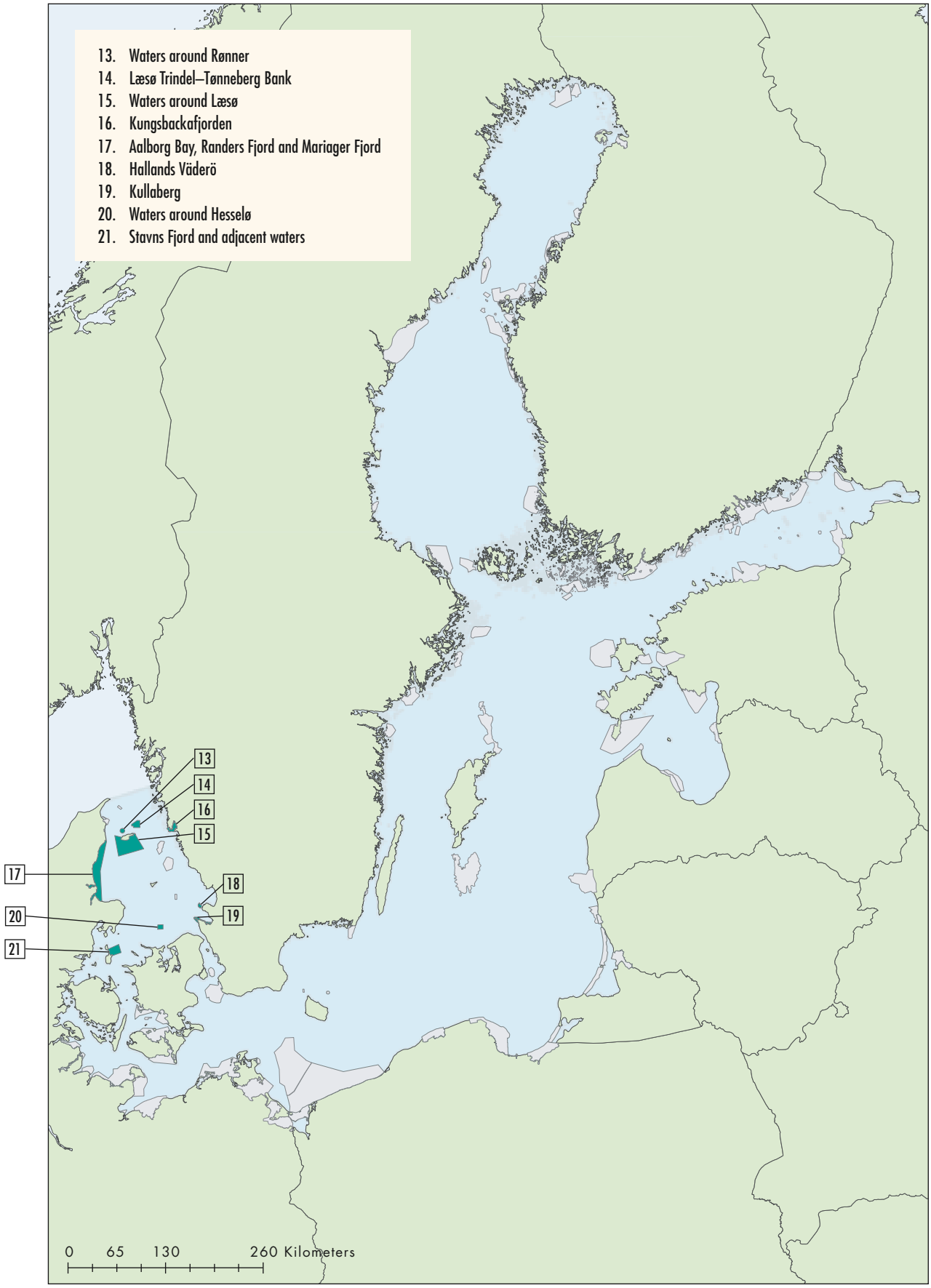
The area Davids Banke, off the island of Bornholm, is an elongated reef area rising at the most to 12 metres below the water surface. Stones and boulders dominate down to around 33 metres, accompanied by plenty of blue mussels (further up, at around 19 metres, mussel beds even cover around 60 per cent of the bottoms). Baltic herring and species of flatfish are common; harbour porpoises and common seals occur occasionally. Both mussel-eating and other birds are frequent visitors.

Large parts of the Hoburgs Bank sink to a depth of around 35 metres with notable impact of waves still at 25 metres. The vegetation is lush, and algae grow down to a depth of 27–33 metres. Some species very rare to this part of the Baltic Sea can also be found. Blue mussels dominate at all depths, but have a hard time with hundreds of thousands, possibly as many as one million, hungry birds. About 25 per cent of the entire Northern Hemisphere population of long-tailed duck winter here and consume over 100,000 tonnes of mussels annually. Other species of wintering or breeding birds also feed on small fish and crustaceans. Baltic telling, aquatic sowbug, sea mats and other animals live on the bottoms. Turbot, Baltic cod, flounder and salmon come here, as do grey seals of the small population found in the Central and Southern Baltic.

The impact of waves on the offshore ridge (reef and ground area; average depth 20, maximum depth 40, and minimum depth 2–3 metres) Salvorev–Kopparstenarna is so strong down to a depth of four metres that organisms are literally swept away. Plants and animals exist more sparsely in shallower parts, but below around 13 metres, and especially on sandy bottoms with boulders around 25 metres down, algae can thrive. The dominating community of blue mussels is, however, affected by the general instability of the bottom and by large numbers of mussel-eating birds. This is the second most important bird area in the western part of the Baltic Sea. Flounder and Baltic herring are common and cod and eelpout also occur. Turbot, herring and Baltic sprat spawn here, and grey seals come to feed.

Marine landscape, Davids Banke, Denmark, and (opposite page) Hoburgs Bank and Salvorev-Kopparstenarna, respectively, Sweden.

Strong water movements have sorted moraine material on a core of bedrock on the bottoms of the offshore areas in Swedish waters around the island of Gotland. Finer material has been flushed away, leaving ridges of boulders and stones, surrounded by patches of sand (where the waves make riffles). It is an exposed living environment for algae and bottom-dwelling animals, especially in the shallowest areas where the impact of the waves is strongly felt. This bottom structure is unique in a global perspective.



From Rønner to Stavns

A large area in the Northern Kattegat includes Waters around Rønner, Læsø Trindel-Tønneberg bank, and Waters around Læsø. Here, reefs appear both above and under the water surface, and north of the Danish island of Læsø they contain a unique richness of algae. Out of a total of 280 species found in the Kattegatt, these reefs harbour 238 of them, including many species rarely found elsewhere in this part of the Baltic region. Common seals come here in large numbers.

On shallow sandbanks permanently covered by water, boulders provide a good environment for algae such as spiral wrack, bladderwrack and serrated wrack. Eelgrass meadows grow over large areas of sandy bottoms in the southern parts of the area. Some sandy and muddy areas are above water during low water periods. All of these shallow "wet" areas, together with coastal meadows and dunes, make ideal places for waders and other birds.

Northeast of Læsø the water is salt and the currents are strong. A "hilly" landscape of highly diverse sandy and silty-muddy bottoms, at water depths that vary from 9 to 50 metres, opens up with stone reefs, bubbling reefs and a rich vegetation of algae. This is home for breeding harbour porpoises – during the summer over 1,000 animals may gather here, more than anywhere else in the Baltic. It is also a place for herring and wintering birds.

The bay of Aalborg Bugt, with the Randers Fjord and Mariager Fjord, extends along the eastern coast of Northern Jutland, over large areas of shallow water, coastal meadows, dunes (klitter), wetlands and semi-natural grazing land.

As the Randers Fjord and its surrounding landscape is a text-book example of the development of this kind of fjord-like landscape after the retreat of the ice sheet, research and education takes place here. The

Marine landscape, Læsø Trindel-Tønneberg Bank, Denmark.

Marine landscape, Læsø
Trindel-Tønneberg Bank, Denmark.

landscape along the fjord is characterised by large areas of old seabed and old high-river banks. The outer mouth area constitutes a transition zone where freshwater from the inner parts of the fjord meets the marine water of the Kattegat. It is a flat and shallow area, surrounded by reed beds, dikes, low-lying meadows and cultivated land. Sandy islands appear during periods of low water. Birds rest here in large numbers, and the waters harbour large stocks of salmon, sea trout, twaite shad and sea lamprey.

Mud flat, and overview of Mariager Fjord, Denmark.

The shallow outer part of the long Mariager Fjord resembles the Wadden Sea, with extensive shallow coastal stretches. Many of the shore meadows have well-developed coastal lakes and saltmarshes. There are also various types of dunes. The marine and coastal biotopes, as well as the outer parts of the fjord, provide invaluable breeding, resting and feeding areas for a variety of birds, and it is also a favourite place for common seals and fish, like the rare herring species twaite shad.

The area to the south comprises a large shallow water area, the outermost parts of Mariager Fjord and Randers Fjord respectively, and a narrow strip of land adjacent to the water. On land one finds beach ridges and shifting dunes. Water-covered sandbanks make up more than half of the marine area; coastal lagoons and coastal lakes, sandflats, estuaries, and large shallow bays and inlets make up the rest.

Kungsbackafjorden is a large fjord-like bay (an estuary) with some 70 islets and skerries scattered over a vast water area. The solitary island of Nidingen and exposed outer islets have rocky shores with sea cliffs and rocky bottoms with algae and animals typical for hard bottoms in the part of the northern Kattegat. The area houses a large population of common seals. Various flatfish, garpike, European eel, mackerel, Atlantic salmon, sea trout, and sea lamprey, find spawning, nursing and feeding areas in the shallow waters. Bottom-living fish feed on mussels, crustaceans and other animals found on soft bottoms at greater depths. The shallow waters, in combination with saltmarshes and pastures on the mainland coast, offer excellent habitats for a large diversity of birds, especially during migration periods. Large number of swans, ducks and gees can be seen here, as well as kittiwake (the largest colony in Swedish waters).

Kungsbackafjorden, Sweden.

For the most part, the 2.3 km long and 650 metres wide Hallands Väderö is an island of exposed rock, with some vegetation on heath land. A rich plant and animal life thrives in the surrounding waters and on the bottoms. Hard bottoms of exposed rock are covered in algae. Lobster and other truly marine species may appear here and an abundance of blue/common mussel form beds. This is also an important spawning and nursing area for herring and various species of flatfish. During periods of low water, clay and sand bottoms are feeding grounds for birds, and about 70 bird species breed in the area (the sole breeding site in the Kattegat for razorbill and guillemot). Common seals rest in colonies of 300–400 animals in the seal sanctuary and on surrounding small islands and skerries.

Hallands Väderö, Sweden.

Horsts like Kullaberg are cores of bedrock that have remained standing when surrounding land has receded on either side. Steep cliffs rise from the sea here, with rocky outcrops on the ridge above. A heavily indented shoreline exhibits over 100 metres high, steep precipices, as well as numerous caves, rocky pillars, bays and small rocky skerries off the coast. Shingle shores dominate and extend on the bottoms down to a depth of 20–25 metres. Then rocks and boulders take over, and finally level out in a sandy bottom. A great variety of species, including ones that normally occur only in truly marine environments, for example lobster, live in this transition zone (a southern boundary area for many species). Algae grow on underwater rocky slopes down to around 22 metres, and the waters harbour numerous fish species, blue mussels, sea urchins, star fish, sea anemones, soft corals (dead man's fingers), sea cucumbers, sea squirts and scallops. Some 275 bird species can be observed in the area and around 90 species of bird breed here. Atlantic bird species like kittiwake, gannet, fulmar, storm petrel, and shearwater, appearing after northwesterly or westerly storms, are a very special feature.

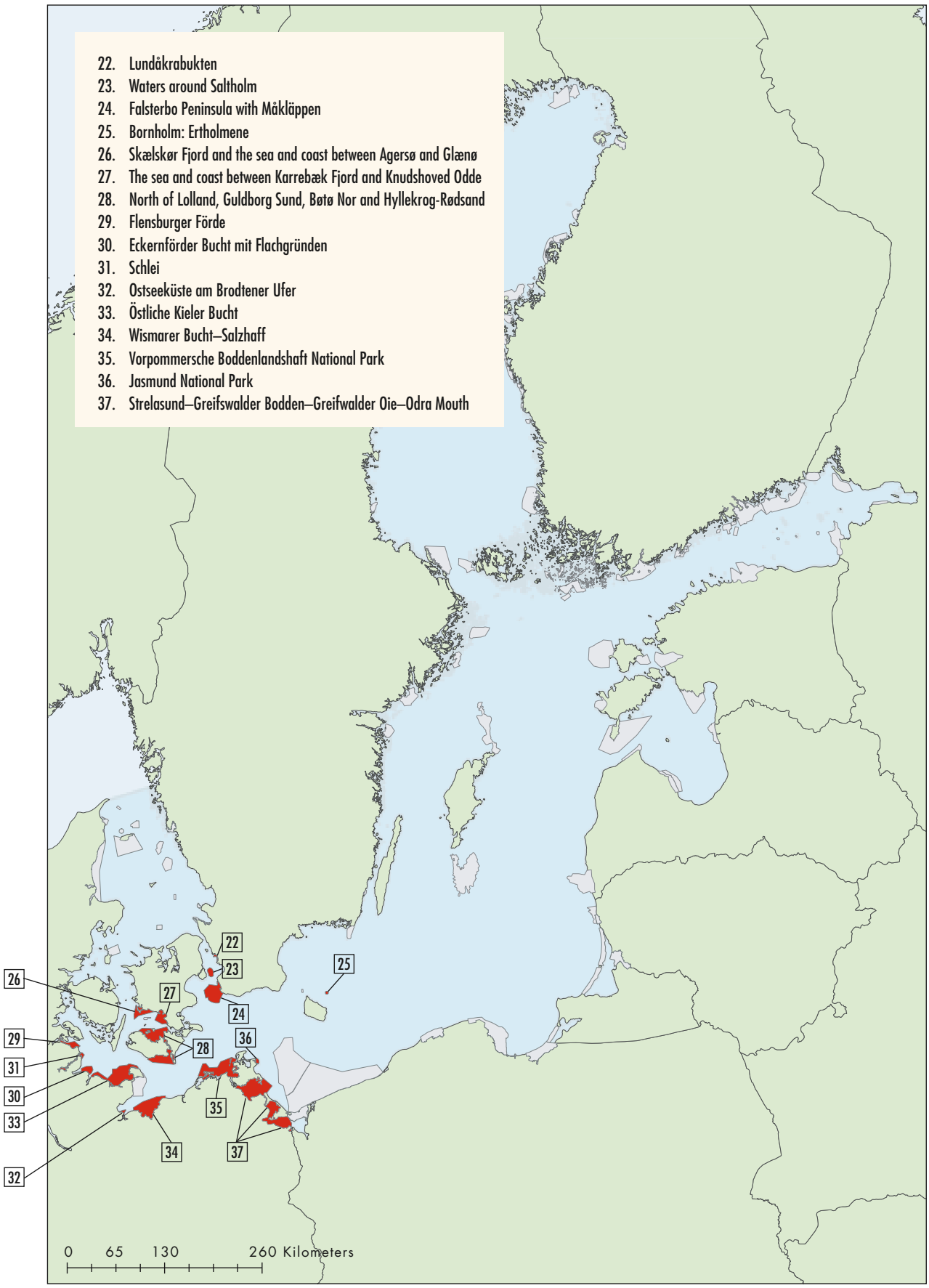
Kullaberg, Sweden (steep cliff, aerial view, and marine landscape).

Marine landscape, Waters around Hesselø, Denmark.

On the shores of the small single island of Hesselø there are salt meadows, stony beaches and moraine cliffs. In the Waters around Hesselø the bottoms consist of reefs, sandbanks and some muddy parts. Extensive mussel beds are found here at larger depths, as well as a rich variety of algae typical of southern Kattegat waters. Hesselø and the surrounding waters, together with the island of Anholt, is the home of what is probably the largest colony of common seal in Europe. Grey seals can also be found here, and this is also an important wintering area for black guillemot.

Stavns Fjord is a unique fjord-like landscape with small islands and undisturbed coastal stretches. This shallow area (average depth 1.8, max. depth 8.6 metres) is situated between two end moraines that make up the northern and southern parts of the island of Samsø. The inner part of the fjord has developed into a wadden area and marshes with a water depth of less than 20 centimetres. The fjord is sheltered by the long Besser reef, which is only covered by seawater during periods of high water. The interesting geological diversity and development makes the area a living archive for education and research. The many small uninhabited islands and the abundance of fish in the shallow waters attract common seals. Shore meadows, salt meadows, moraine cliffs and sandy beaches occur on land. Reefs, lagoons, sandbanks and large shallow inlets and bays are found in the sea. Eelgrass grows on the soft bottoms outside the reef, exposed to the open sea, and a variety of algae grow on stones and boulders on hard bottoms. Baltic telling and white abra dominate among bottom-living animals. This is a spawning area for herring and a nursery for several species of flatfish. It is a resting, nesting/breeding and wintering area for large populations of birds, including the second largest colony of common eiders in Danish waters.

Stavns Fjord, Denmark.



Leg 3

From Lundåkrabukten to Greifswald

A generally shallow bay and its adjacent and often flooded low-lying shores and meadows make up Lundåkrabukten with sandy-muddy bottoms and a dynamic landscape of sandbanks. Eelgrass grows at depths from just over one metre. Freshwater animal species that can tolerate large fluctuations in salinity and temperature live on shallow depths, and Baltic telling, sand gaper and other mussels live further out. During winter, small fish and bottom-living animals migrate to deeper waters where they are consumed by cod and flounder. The bay is a rich nursing and feeding area for most fish species in the Sound (eel, plaice, turbot, brill, flounder and sole), and a spawning ground for garpike, cod and mackerel. Fish also move into the area during the night to feed. The area attracts migrating, breeding (over 120 species) and wintering birds in large numbers. It is a resting and wintering area of international importance for the whooper swan.

Lundåkrabukten, Sweden.

Waters around Saltholm, Denmark (marine landscape and aerial view).

The extensive areas of water only a few metres deep, the grazed shore meadows and the virtual lack of predators (foxes, minks or rats) make the Waters around Saltholm an essential breeding, moulting and resting area for birds. Algae and large eelgrass meadows grow on mostly sandy, muddy bottoms with stones and boulders. Ducks, swans, waders and terns eat heartily of a smorgasbord of fish, snails, mussels and other animals. Wintering and moulting mute swans depend on the area, as do about 15,000 breeding common eiders (the largest colony in Europe). White-tailed eagle, peregrine falcon and marsh harrier also come here. Common seals and grey seals frequently use the small islands to the south.

Falsterbo peninsula with Måkläppen, Sweden.

The large Falsterbo peninsula with Måkläppen (once an island) is an area consisting mainly of sandy beaches, dune areas, shore meadows and heaths. Moraine deposits have gradually been overlaid with sandy sediments. A large area of constantly submerged sandbanks (max. depth: 20 metres) surrounds the peninsula. The seabed also includes lagoons and muddy, exposed sandy bottoms. New sandy reefs and lagoons are continuously created: the area is strongly influenced by the movements of water and winds. It is the only place along the Swedish coast where shifting dunes form; the beach has increased in width by over 50 metres in one century. There is also a unique landscape of open dune slacks. The Måkläppen sandbar extends far into the sea and undergoes continuous change. Sandbanks on the bottoms are devoid of vegetation or covered with eelgrass meadows. Lagoons with water exchange with the Baltic Sea have vegetation of similar plants, fringed by stands of reed and sea club-rush. The rich supply of fish which spawn and grow in the shallow waters attracts grey seals and common seals, especially to Måkläppen. Sometimes harbour porpoises turn up. This is one of the best known places in north-western Europe for migrating birds, especially birds of prey, and important also for various species of waders. Rare amphibians also find refuge here.

Crystalline bedrock is clearly visible on the rocky island of Bornholm (a veritable example of geological variation) and on the rocky cliffs and steep coasts of the group of islands called Ertholmene: the islands of Christiansø (a bedrock horst), Frederiksø, Græsholmene (uninhabited bird reserve), and a number of small skerries like Tat and Østerskær. Here, the coast sinks down to water depths of 40 metres only a few hundred metres off land. Rocky bottoms and partly exposed reefs surround the islands. Algae, typical for depth-dependant zones, grow here. Beds of blue mussels dominate among bottom-living animals at all depths. Erholmene is an important bird area and the only known Danish site with breeding razorbills and guillemots. Baltic herring come here to spawn.

Ertholmene (Bornholm), Denmark.

The coastal area of the Skælskør Fjord – sea and coast between Agersø and Glænø, the Sea and coast between Karrebæk Fjord and Knudshoved Odde, and the area North of Lolland, Guldborg Sund, Bøtø Nor and Hyllekrog-Rødsand, are all part of the vast Smålandsfarvandet.

The Skælskør– Agersø–Glænø area has a distinctive character, with lagoons, bays and narrow inlets separated from the sea by islands and sandbanks, plus a considerable marine area between the mainland and the island of Agersø. A brackish fjord and freshwater bay at Skælskør

Marine landscape, Dybsø Fjord, Karrebæk Fjord and Knudshoved Odde, Denmark.

and a diked-in lagoon (Borreby bog) are also part of the area. Seabirds that feed on bottom-living animals favour the shallow sea areas. The area is of international importance for wintering common eider and velvet scoter, and extensive shore meadows serve as nesting and resting areas for a variety of birds, e.g. avocet. Rare plants include the salt-tolerant species hairy smotherweed. Salt meadows and ordinary meadows meet in the Borreby bog, with its mosaic of open water and grazed meadows and areas covered by small flowered willow-herb. The bog is a unique bird area, with, e.g. bittern and several pairs of breeding marsh harriers. Agersø is a habitat for the very rare and endangered European fire-bellied toad and for Northern crested newt.

The Karrebæk–Knudshoved area consists of the ”double coastline” along the south-western coast of the island of Zeeland. Erosion coasts are common towards Smålandsfarvandet, and in sheltered areas with sandbanks, wadden areas and shore meadows. The shallow Avnø fjord and several coastal lagoons characterise the area. Knudshoved Odde, a long peripheral moraine ridge, separates the fjord from the outer part of Smålandsfarvandet. Islands with associated banks enclose the largest lagoons. This double coastline is a shallow marine area with a dynamic coastal development. Meadows of stonewort cover the bottoms of Dybsø fjord, a fjord-like bay with good water quality owing to a small surrounding drainage area.

Knudshoved Odde, and North Lolland, Smålandsfarvandet, Denmark.

Biotopes of international importance can be found almost everywhere. Large stretches of shore meadows are interspersed with beach ridges with complex biotopes and a rich biodiversity. The shallow sandbanks and low-lying islands are of international importance as feeding, breeding or nesting areas for birds, and many birds winter here. Common seals, with a population of a few hundred animals, breed in the area.

To the south, the North of Lolland area is a group of sparsely distributed islands surrounded by shallow water, including the islands and the accessible coastal areas of Lolland and Falster. The coastline changes from flat beaches to low cliffs. There are large, shallow inlets and bays, coastal lagoons, reefs, sandflats, saltmarshes and dunes. The bottoms are generally sandy, with some scattered stones. Eelgrass grows over large areas. The seal sanctuary around Rødsand is the only place in Danish waters where grey seals have their pups, and the area is generally of importance for both grey seals and common seals. It has also been ranked one of the ten most important areas in the Baltic Sea for wintering birds.

On the German coast, three fjord-like bays open up. Flensburger Förde faces the Kiel Bay and the Baltic. It has sandy bottoms, sandbanks and stony/gravel bottoms with mussel beds. The outer and wider part of the area has a diverse composition of species in shallow bottom sediments. There are also wind-generated wadden areas. The shallow, lime-rich – Kalkgrund – bottoms of Geltinger Birk, a nature reserve located on a peninsula (a raised beach landscape) in the mouth of the fjord, harbour over 170 species of bottom-living animals, including endangered species such as the mussels narrow-hinge astarte, peppery furrow shell and *Macoma calcarea* (a relict species), and species of bristleworms. Eelgrass meadows flourish on the seabed. With its shallow waters, coastal and wet meadows, sandy and gravel beaches and dunes, the Geltinger Birk area is of international importance for wintering, resting and feeding birds; over one year up to 200 species of birds can be observed here.

Flensburger Förde, Germany.

Eckernförder Bucht mit Flachgründen comprises the long, deep sea inlet (fjord), and the shallow bottom areas off the wide mouth of the fjord. The shallow ground areas – Flachgründen – in the mouth area harbour important mussel beds with a rich diversity of bottom-living animals. This area is important for large numbers of wintering and feeding birds.

Eckernförder Bucht (mit Flachgründen), and Schlei, Germany (below).

The narrow and relatively shallow Schlei area has reduced water exchange with the Baltic Sea and is the most eutrophicated of the three areas, especially in its inner parts. Beds of blue mussels are found on the bottoms (with reefs and sandbanks in the outer part of the area), as well as pondweed, eelgrass and algae. Migrating birds come to the wind-formed wadden area, which offers a rich menu of bottom-living animals.

Due to eutrophication, the inner bottom areas are poorer in plants and animals. Nevertheless, fish in the Schlei include such rarities as two species of lamprey. Harbour porpoises are recorded regularly in this area.

The Ostseeküste am Brodtener Ufer is a long coastal stretch with steep and up to 20 metre high active cliffs. Waves and winds erode them by 80–100 cm every year and the resulting sand is transported to the Lübeck Bay where it forms sandy beaches. Below the steep cliffs, the beaches are covered with boulders and eroded material. This dynamic and largely unexploited coastal landscape, where the forces of the sea and the winds never rest, together with the features of the immediate Hinterland that is characterised by agriculture, offers a variation of habitats for a number of plant and animal species. The wide shallow water area with sandbanks is a resting and wintering site of international importance for birds. The steep cliffs are of particular importance as breeding sites (over 2,600 nests bored as small, deep tunnels into the cliffs) for sand martins making up one of the largest colonies in all of Europe.

Ostseeküste am Brodtener Ufer, Germany.

In the transition area between the Kiel Bay (Kieler Bucht) and the Baltic Proper, at an average depth of 15–25 metres, the Östliche Kieler Bucht includes sandbanks and reefs. The fields of mega ripples (ripple marks) – elevations that can rise up to several metres on the seabed – are a special feature. These structures, with sand layers at least 40 cm thick, could be compared to a submerged dune landscape and they are very rare in the Baltic. The area comprises typical sandy bottoms and hard bottom biotopes that exhibit the highest biodiversity of all offshore areas in the German Baltic waters. On hard bottoms lush stands of algae can be found. Close to 280 species of bottom-living animals live here, including many marine species (37 of them red-listed) that are not found anywhere else in the Baltic. Harbour porpoises and common seals with their young, are regularly observed in the area.

The Wismarer Bucht consists of several small bays, one of which is the shallow Bodden water area Salzhaff. The southern coast of the inner bay is a long, low-lying sandy stretch with dunes and stony bottoms. Steep cliffs rise along the coastline but are constantly being reshaped by the eroding forces of sea and winds. The outer parts are characterised by sandy and muddy bottoms, covered with eelgrass, at shallow depths.

This is an area of sandbars, raised beaches, salt meadows and flooded wetlands. It harbours brackish-water and saltwater plants (an uncommon feature), and the boulder bottoms off the steep coast are sought-after reproduction sites for bottom-living animals that need brackish or saline conditions.

Marine landscape, Östliche Kieler Bucht, Germany.

Wismarer Bucht, Germany (also below).

The Salzhaff is a 1–4 metre deep lagoon with more saline water than is otherwise found in the Bodden landscape. Although almost completely enclosed by the Wustrow peninsula and the island of Kieler Ort, it has an uninterrupted water exchange with the Baltic Sea. During periods of low water, the shallowest parts are temporarily laid dry. Typical wind-formed wadden areas occur to the west. The shallow waters, with lush vegetation and a rich supply of bottom-living animals, and the sheltered bays with adjacent salt meadows, offer excellent habitats for a large number of species of resting, breeding, feeding and/or wintering birds.

The Vorpommersche Boddenlandschaft National Park consists of the Darß–Zingst peninsula, the western coast of the island of Rügen, the islands of Hiddensee and Ummanz, and several small islets in between. An abundance of alternating cliff and flat shoreline, spits, lakes, shallow sea inlets (Bodden), raised beaches, windy flats, sand dunes and beaches characterise the landscape, which was created when previously dry land was flooded, leaving hill ridges as islands. Erosion by the sea has continued ever since, and the material from the eroded formations has been transported and deposited elsewhere as sandbanks, spits of land and peninsulas. The peninsula and the islands of Hiddensee and Rügen have gradually continued to grow closer together over time.

There are three types of steep coast with cliffs. Eroded end moraines form steep cliffs of clay or marl (rich in chalk), e.g. at Dornbusch. Cliffs formed on stretches of sandy beach, like Darßer Weststrand and Zingster Nordstrand. Eroded peat cliffs, which are a very special feature in the park. The many nests of sand martins, bored into

the sides of moraine cliffs at depths as great as two metres, are a well-known feature. There are over 1,500 breeding pairs of sand martins at Dornbusch and surrounding areas.

Around half of the total area (805 km² of the park) is open sea or Bodden area. The muddy-bottom Darß-Zingster Boddenkette (Darß–Zingst Bodden chain) has a clear salinity gradient and is separated from the Baltic by the peninsula. The sandy-bottom Westrügenschen Bodden is separated from the sea by the island of Hiddensee. Sandy bottoms harbour eelgrass meadows down to a depth of 8 metres. Along the length of the Bodden coast, reeds grow like fences on wide flats and provide a safe environment for shy species of birds. A large wadden area is found around the sandy spits of Hiddensee. The shallow waters house a unique coastal fauna. Overall, the park is an important bird area; more than 100 bird species come to the area to rest, feed and winter here, and the park is famous for harbouring tens of thousands of migrating cranes, geese and many other species.

Vorpommersche Boddenlandschaft National Park, Germany (pp. 90-91).

Jasmund is a peninsula on the island of Rügen. The white chalk cliffs that rise majestically up to 161 metres above the sea are a famous landmark and a special feature in the Jasmund National Park. The cliffs face constant erosion and with every storm, parts of the cliffs fall to the ground, including rocks and fossils of sponges, oysters and sea urchins. In 2005, due to a landslide caused by spring-thaw weather conditions, 20 metre high pieces of Wissower Klinken, one of the most scenic and best known of the outcrops, were broken off and fell into the Baltic Sea.

In general, the topography of the land area of the park is dominated by moraine hills covered with beech-pine-oak forests. Other typical biotopes include coastal grey dunes, sandy beaches, boulder beaches, coastal meadows, coniferous forests on dunes, natural reed, rush and sedge stands, bogs with low vegetation, and riverine areas under backwater influence by the sea.

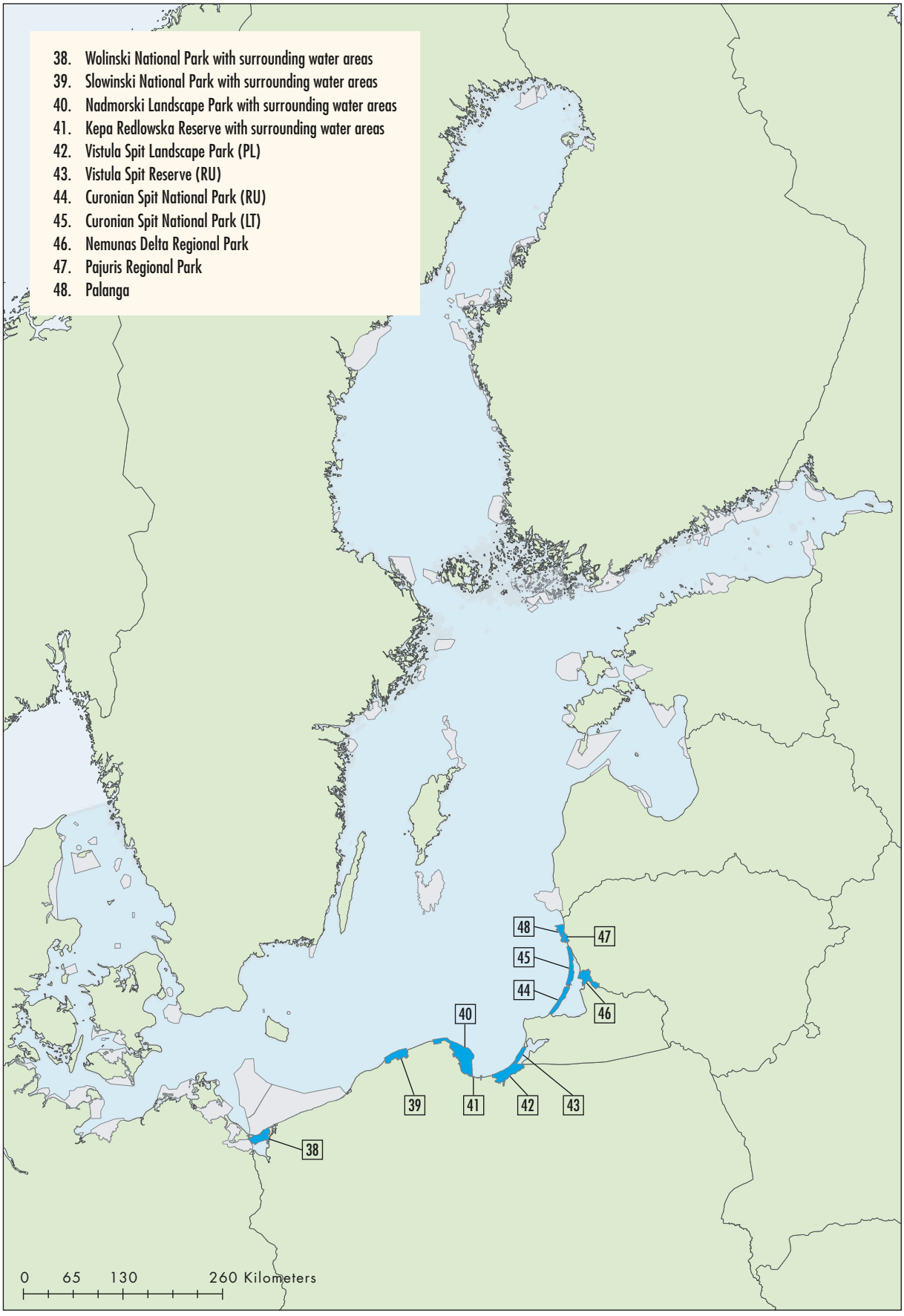
An almost 500 metre wide strip of the sea, out to a water depth of about 10 metres, is included in the park area. The seabed consists of chalk ridges and sandbanks, boulder bottoms with growth of algae, mussel beds and also areas of silty bottom. In very cold winters, packed ice can exert such a pressure that bottom material is reshuffled, thereby also changing the conditions for bottom-living organisms. Marine and freshwater species live side-by-side in the shallow brackish waters. Some salt-tolerant plants grow in the poor, thin soil between the stones on the boulder beaches below the steep cliffs. The undisturbed beech woods in the area behind the steep cliffs have swamp-like ponds and springs of groundwater that harbour a variety of plants.

The main flyway for migratory birds along the southern/south-eastern Baltic coast passes the island and over 230 bird species have been recorded. The shallow lagoon waters offer important wintering areas for many birds.

Jasmund National Park, Germany.

Greifswalder Bodden, Germany.

The Strelasund–Greifswalder Bodden–Greifswalder Oie–Oder mouth area consists of the narrow sound between the mainland and the island of Rügen, the lagoon off Greifswald, the small island of Oie, and the mouth of River Oder on the Oder lagoon (Oderhaff/Zalew Szczecinski). Here one finds coastal lagoons and estuaries with coastal wetlands and meadows, muddy bottoms, stony bottoms, large sandbars and sandy beaches. The brackish-water lagoon and bay area – Greifswalder Bodden – is shallow (average depth: 5–6 m; max. depth: 13.5 m). One feature in its southern part is a large wind-formed wadden area, with silty exposed sandflats that attract large numbers of breeding and resting waders. The island of Oie, with surrounding waters, is an important resting site for migratory species.



From Wolinski to Palanga

The island of Wolin, with the Wolinski National Park with surrounding water areas, is located at the mouth of the River Oder. Around one fourth of the park area consists of water out to a maximum depth of 10–11 metres. The Pomeranian and Oder Bay water area also includes the delta of the River Swina, a complex of water and muddy islands that are periodically flooded. Almost one third of the park area comprises the shallowest part (mean depth: 1.5 metres) of the generally shallow (mean depth: 3.8 m) Szczecin Lagoon/Oder Lagoon on the inside of the island. The 15 km long and up to 95 metre high, active moraine cliffs constitute the most characteristic feature of the Wolinski National Park. As sea and winds continuously erode the cliffs, they recede by approximately 80 cm per year.

The marine biotopes of the park include coastal lagoons, estuaries, large shallow inlets and bays and submerged sandbanks. In near-shore waters the seabed consists of stony and partly muddy bottoms with numerous mussel beds. On the hard bottoms one finds a variety of green, red and brown algae, including bladderwack. The area holds several fish species, including Baltic herring, three lamprey species, salmon, aspen, sabre fish, mud loach and short-horn sculpin. Harbour porpoises and grey seals occur in the area.

Wolinski National Park (Wolinski Park Narodowy), Poland.

The Slowinski National Park borders the Baltic Sea along 32 kilometres of coastline on the outside of the long, sandy Łeba spit (a sandbar). The sea, out to a water depth of 10 metres, constitutes about one third of the total area of the park. The area is an example of the dominating kind of coast in Poland – the around 400 kilometres of flat coast with a belt of dunes and sandy beaches. This area is one of the few sections of the Polish coast where the process of accumulation (of sand in dunes) is still markedly stronger than the process of erosion and abrasion (of cliffs and sandy shores). Shifting dunes of different heights, large coastal lakes, sandy beaches, and peat bogs, are distinct features. In 1977, the park was added to the UNESCO Man and Biosphere Programme.

The shifting dunes move at a rate of 3–10 metres per year and some reach a height of up to 40 metres or more. Due to the intensity and scope of the process, they are of interest in a European perspective – these are very large sand dunes and the park exhibits the different stages of dune succession (from embryonic to grey dunes). On the spit there is a unique complex of mobile dunes and dune slacks.

Below: Wolinski National Park, Poland

Opposite page: Slowinski National Park (Slowinski Park Narodowy), Poland

Lake Łebsko (mean depth: 6.3 metres) and Lake Gardno (mean depth: 2.6 metres) are the two main bodies of water. At one time sea bays, they were more or less cut off from the sea when the sand bars of Łeba and Gardno were formed. As both lakes have a narrow connection to the Baltic the water is brackish (up to 3 psu; Lake Łebsko slightly saltier than Lake Gardno). Due to sedimentation from rivers, the lakes are slowly becoming shallower. Surrounding reeds and sedges provide good shelter for birds.

The marine biotopes of the park include coastal lagoons, estuaries (several rivers flow into the area), large shallow bays and inlets, and submerged sandbanks. The bottoms of the coastal waters are mainly sandy with little vegetation. Mussels and crustaceans, including brown shrimp, dominate among bottom-living animals. The waters off the spits offer important nursing ground for young bottom-living fish. Baltic herring, river lamprey, brook lamprey, twaite shad and salmon are found in these waters. Grey seals and harbour porpoises occur in the area.

Well over 250 species of birds come to the area, which is an essential breeding and wintering site. In spring and autumn thousands of mallards, mergansers and swans can be observed, and during migration periods several rare species of birds appear.

Slowinski National Park, Poland.

The BSPA Nadmorski Landscape Park with surrounding water areas extends along the Polish coast from Bialogóra Nature Reserve to the Hel Peninsula. The park includes the Puck Bay, which is sheltered by the peninsula. The Kepa Redlowska with surrounding water areas is also located on the coast along the bay.

The Nadmorski Landscape Park exhibits sandy beaches, a moraine coast with cliffs, large spits of sand separating the bay and the lagoon from the sea, as well as estuaries and river mouth areas. The cliffs consist of moraine clay. Active cliffs, where abrasion is intense, are covered only by herbal vegetation, whereas cliffs with slow or no abrasion carry shrubs and forests. A narrow strip (10–15 metres wide) of sandy beach dominates, but pebbles can occasionally be found below cliffs after storms with onshore winds.

Dynamic, natural processes occur in the park area, between sea and land. This can be observed particularly on the Hel Peninsula and at the 33 metre high clay-silt sand cliff in Jastrzebia Gora (on Cape Rozewie). The retreat due to erosion from the sea, and groundwater erosion on land, is 1.6 metres per year, which is one of the most spectacular examples of cliff erosion along the Baltic coast. The beach below the cliff is very narrow and does not offer much protection from eroding waves.

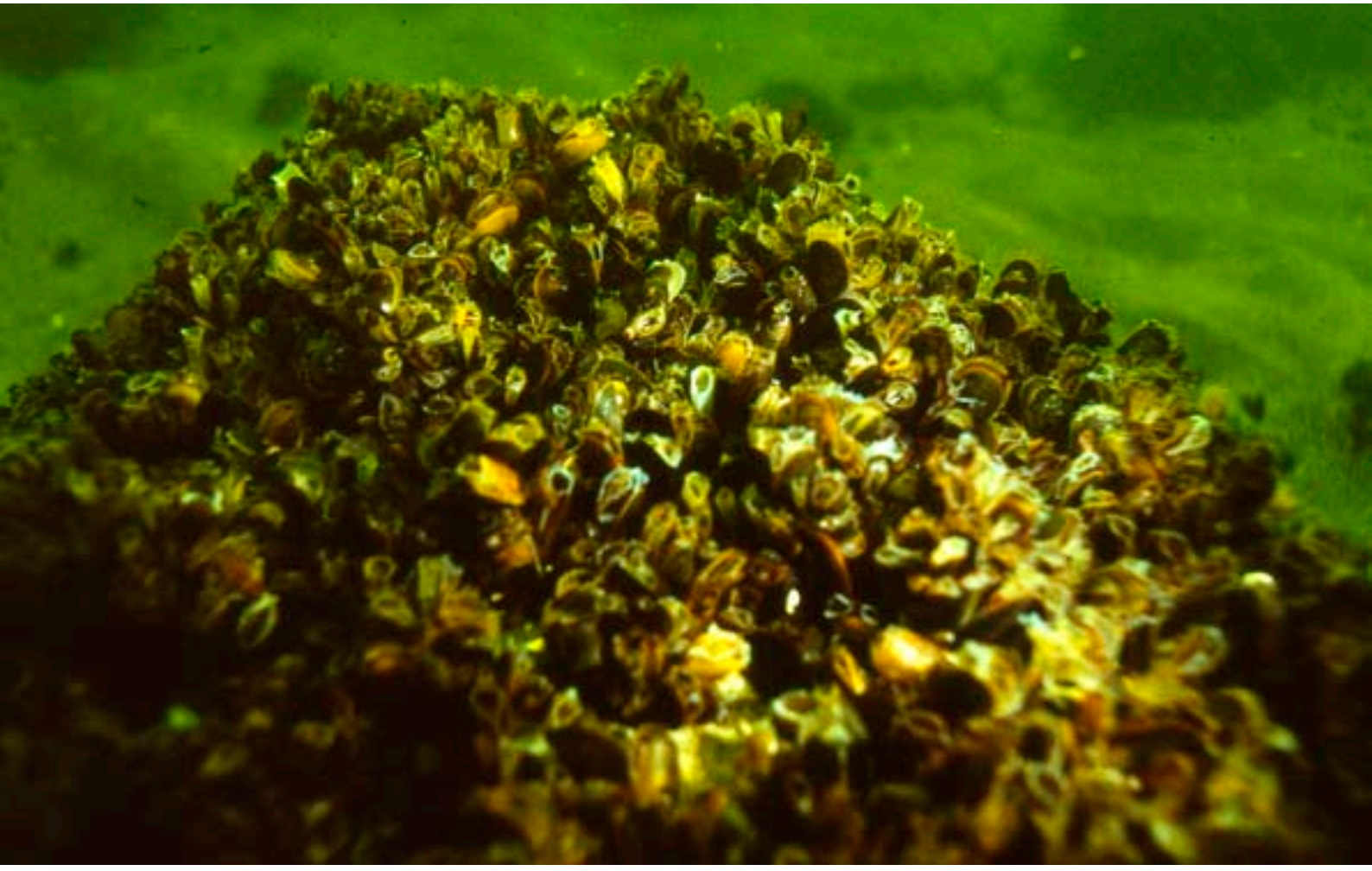
The Hel Peninsula is a 36 km long, narrow, relatively flat sandy spit

Hel Peninsula (Mierzeja Helska), Nadmorski Landscape Park (Nadmorsky Park Krajobrazowy), Poland.

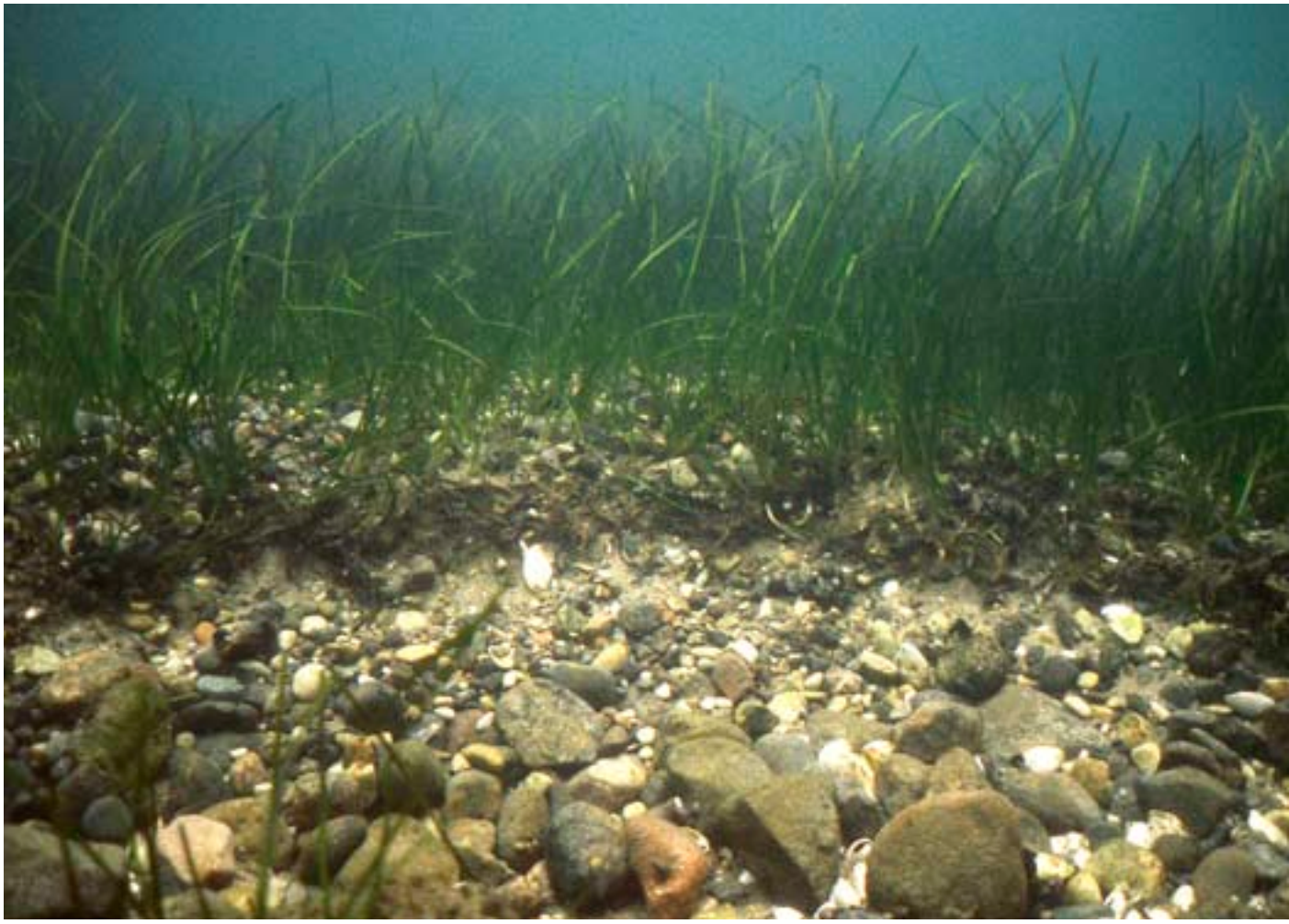
with a landscape that is unique for Europe and has even been referred to as ”the longest pier in Europe”. It is characterised by 2–10 metre high dunes, vegetation of pine forest with birch and rowan, and dry heath land. Originally a submerged sandbank that rose from the sea, the forces of coastal erosion now threaten to make the peninsula disappear again. Until the 17th century it was still a chain of small islands that formed a strip of land only during the summer. In the early 1800's, the peninsula was about 900 metres wide in places. In the last 30–40 years, erosion has eaten away 43–64 metres of the width. Today the tip of the peninsula is three kilometres wide, but in general the spit is only 100–300 metres wide.

The sandy bottoms on the Baltic side of the Nadmorski Landscape Park have not been thoroughly investigated, but the plant and animal life is very likely to be similar to that on the bottoms off the Slowinski National Park. Fish species include salmon, Baltic herring, sabre fish, allis shad, twaite shad and asp. The large number of wintering birds includes a colony of plovers that constitutes 10 per cent of the total Baltic population. Harbour porpoises and grey seals occur regularly in the area.

Marine landscapes, Puck Bay (Zatoka Pucka), and Redlowo, Poland.



In its natural state, the Puck Bay with extensive underwater eelgrass meadows and algae like bladderwrack and black carrageen growing abundantly on stones and boulders sticking up from the sandy bottom, probably represented the richest and most diverse marine/brackish-water area on the southern coast of the Baltic Sea. All the major groups of Baltic bottom-living animals in shallow waters were present. However, due to eutrophication the ecosystem has changed and has became completely dominated by filamentous brown algae, which now make up 80 per cent of the biomass. The once abundant eelgrass, bladderwrack and black carrageen have declined drastically. As a consequence, bottom-living animals like mussels and bristleworms have increased and crustaceans, snails and insect larvae have decreased. Catches of fish such as European eel, roach, pike and pike-perch have gone down drastically, and the disappearance of pike has resulted in an increase in the number of three-spined stickleback, which is now the dominating fish species in the area. The alien (originally Ponto-Caspian) fish species round goby was first introduced in the Puck Bay in 1990 by means of ballast water discharge and has since then become a dominating species in the bay, where it competes with flatfish, e.g. flounder, for food.



The transboundary Vistula Spit (Mierzeja Wiślana, Vislinskaya kosa, Вислинская коса), here in Poland.

The active moraine cliff and highly differentiated geological structure of the coastal zone makes the Kepa Redlowska special. In addition to the cliff, the area is characterised by natural beech forests, remnant coastal meadows, and sandy beaches with some shingle and stones. The seabed off the Kepa Redlowska area is sandy or muddy with stones and boulders. Some sandy bottom areas covered by eelgrass still remain, despite the impact of eutrophication in the Puck Bay. Bladderwrack, black carrageen and other algae can be found on boulders. The waters, being part of the Puck Bay and ultimately the Gulf of Gdañsk, are important for a variety of birds.

The Polish Vistula Spit Landscape Park and Russian Vistula (Baltic) Spit Reserve include the Vistula Spit and parts of the Vistula Lagoon. About one third of the 65 km long, narrow sandbar is on the Russian side. Around two thirds of the Russian reserve is water (Vistula Lagoon), whereas the Polish park comprises only land.

The Vistula Spit was formed when land started to rise after the withdrawal of the ice sheet; sand brought by the Vistula was discharged into the lagoon. Wind, weather, water – and later – man have since shaped this special landscape.

The beaches along the Baltic side of the spit are not wider than 10–50 metres. They are sandy with extensive dune formations of typical succession from embryonic to grey dunes, as well as dune slacks, and sandy beach ridges. From peaks of the giant dune embankment, such as the so-called ”camel hump”, 49 metres above sea level, one has an impressive view. Behind the dunes there are also heaths and dry meadows, where some rare and endangered species can be found. The spit also exhibits, behind the dunes, coastal bogs, fens, swamps with wet forests, deciduous and coniferous forests on dunes, as well as natural reed, rush and sedge stands.

The biotopes on the seacoast include coastal lagoons, estuaries, large shallow bays and inlets and, in waters as deep as 18–29 metres, submerged old dune complexes and relict cliffs. The seabed consists of sandy bottoms, with the same plants and animals as in the Nadmorski and Slowinski areas. In the few places where pebbles or gravel occur on the bottom, blue mussels and bay barnacles can be found.

The Vistula Spit and Lagoon are important stops for migratory birds on the East Atlantic flyway and serve as an essential resting and feeding area for tens of thousands of birds. This is also an important nesting area for many species.

The continuous expansion of the Vistula Spit has almost cut off the 90 km long, 7–13 km wide and shallow (mean depth: less than 3 metres) Vistula Lagoon from the open Baltic. Water exchange takes place only through the narrow straight at Baltiysk in the north, giving a salinity of 1–4 psu. Freshwater species dominate, with only very few brackish-water species living side-by-side. The sandy or muddy bottoms support reeds, rushes, sedges and pondweeds. Worms and midges dominate among the bottom-living animals, with bristleworms preferring the northwestern, more saline parts. Important fish species in the lagoon are Baltic herring (spawning area), pike-perch, European eel, perch, roach and river lamprey.

The Russian Curonian Spit National Park and Lithuanian Curonian Spit National Park both include parts of the Curonian Spit and the Curonian Lagoon. Around one third of the area of the Lithuanian park is land, almost half is sea up to 2 km offshore, and the Curonian Lagoon covers some 15 per cent of the area. The Nemunas Delta Regional Park is located in the Lithuanian part of the delta of the shared River Nemunas.

The transboundary Curonian Spit (Kuršių Nerija, Kurshskaya kosa, Куршская коса), here in Lithuania.

Curonian Spit, Lithuania.

The Curonian Spit is a 99 km long, thin (400 m-3.8 km wide) curved sand dune peninsula that separates the Curonian Lagoon from the Baltic Sea. The northern 52 km long stretch of the peninsula belongs to Lithuania, while the rest is part of the Kaliningrad Oblast, Russia.

The Curonian Spit consists of vast areas of sand, dunes and dunal vegetation. It is a mosaic of sandy ridges, and includes all stages of succession typical for dunes. The highest moving sand dunes in Europe are found here.

On the western coast, the sandy beaches meet the sea. The up to 15 metre high and 120–130 metre wide fore-dune ridge, consisting mainly of sand and only some gravel, borders the beach. Behind the ridge, a sand plain opens with a layer of sand (blown from the sea) more than six metres thick. The blown-out tops of former dunes can be seen on the eastern edge of the plain. Further to the east, the Great Dune Ridge rises at heights varying from 10 to 67 metres.

Strong winds, drifting sand, soils that heat up quickly but are dry and infertile, salty water and sudden and frequent weather changes are factors that make the coastal plains similar to the steppe conditions in the south-eastern part of Europe. Salt-tolerant species, with thick water-retaining leaves can live above the high-water mark, where they make up the first barrier towards the sand. Fore-dunes are often planted with marram and lyme grass, with long roots to stabilise the sand. Behind the fore-dunes, the vegetation is richer and more diverse. There are also some magnificent 100–150 year old pines, spruces and oaks.

The natural forests were cut in previous centuries, and in order to protect the local villages from drifting sands the spit has been reforested with mountain pine and other coniferous trees. At present, nearly

89 per cent of the area is covered by semi-natural forests or plantations and the rest of the area comprises different types of dunes and reed stands on the Curonian Lagoon shore. On older dune complexes, pine forests have been planted and wet dune slacks or alder stands also occur.

The East Atlantic flyway for migratory birds runs along the spit and millions of birds of more than 300 species pass here. The Nemunas Delta Regional Park is of equal importance for birds.

The seabed in the coastal waters off the Curonian Spit are mainly sandy, with none or little vegetation of algae, and with Baltic telling as the dominating species of bottom-living animals.

The Curonian Lagoon is the largest of the lagoons along the south-eastern coast of the Baltic. It is an enclosed, shallow, almost freshwater body with a mean depth of 3.8 metres, connected to the Baltic only through the 400–600 metre wide strait at Klaipėda. The northern part has a salinity that fluctuates between freshwater and 8 psu. The bottoms are sandy and/or muddy, with different zones where freshwater species dominate or live side-by-side with brackish-water species (e.g. the zebra mussel dominating in the central parts). The lagoon is one of the most productive waters in Northern and Eastern Europe, with 50 species of fish including carp, salmon, sea trout, pike, pike-perch and perch.

Nemunas Delta Regional Park (Nemuno Deltos Regioninis Parkas), Lithuania.

Nemunas Delta Regional Park, Lithuania.

The Nemunas Delta Regional Park is a cobweb of watercourses, islands, meadows, marshes and woods. The delta is flooded every spring and sometimes in midwinter. The scenery of the delta, with its two main arms Atmata and Skirvytė, and with the Rusnė Island in the middle, is very special. Water is present everywhere and dominates the landscape: river arms branching out, a big lagoon lake and other small lakes, all connected. More than 430 plant species have been identified in the delta, 15 of them red-listed, and about 40 fish species, many of which spawn here (capelin, smelt, catfish, bream, pike-perch, asp, silvery bream, roach and Crucian carp). During spring flooding many plant-eating fish enter the riverbeds, inlets, bays, lakes and polder ditches to spawn. A number of fish migrate here from the Curonian Lagoon.

The Lithuanian coastal stretch along the Baltic Sea, from the Pajuris Regional Park via Palanga to the Latvian border consists mainly of sandy beaches (at some places as wide as 300 metres) with dunes and dune slacks. One exception is the Olando cap, a 25-metre high moraine cliff formed by the ice and covered by a forested dune. The cliff is constantly eroded by wind and waves and the sand is transported to the beaches in, e.g. Palanga.

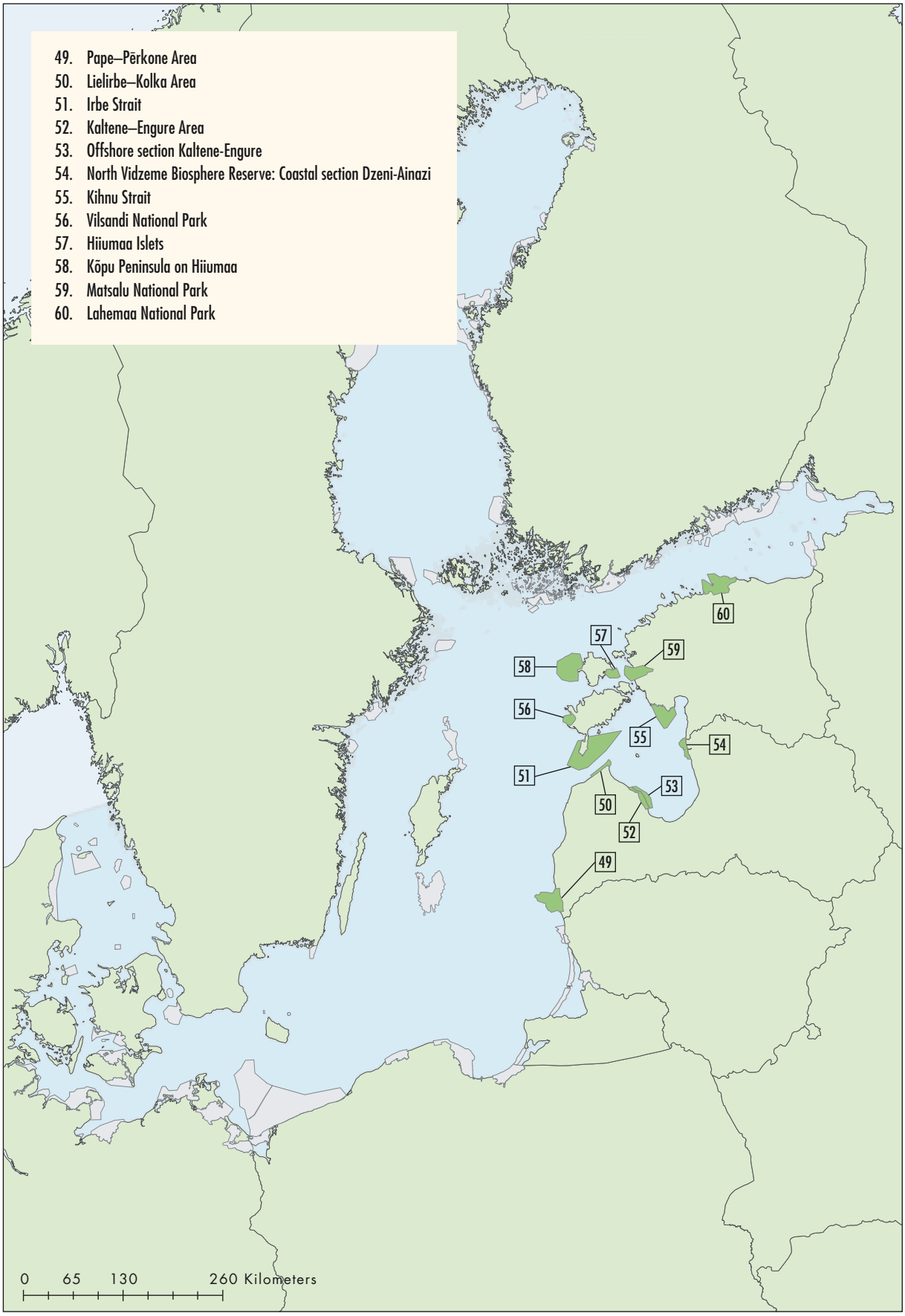
The Nemirseta dunes located within the Pajuris park, and coastal meadows highly influenced by sand, have a unique flora including a number of species that are endemic to the eastern coast of the Baltic.

The most characteristic feature of the bottom areas along the Pajuris–Palanga coast is an underwater ridge/reef with a mixture of stones, gravel and sandy bottoms. It is 2–3 km wide in its southern part and 10–15 km wide in its northern part. In its shallowest parts (close to the shore from which it is separated by some hundred metres of sandy bottoms) the water depth is 4-5 metres, and further towards the open Baltic Sea around 25–30 metres.

Ten species of algae grow on the stony parts, with bladderwrack and black carrageen being the most important ones, particularly as spawning areas for Baltic herring and other fish species. Blue mussels dominate (90 per cent) among bottom-living animals forming the basis for a special diversified bottom community. With about 40 different species, this community is dominated by blue mussels has the highest biodiversity in the south-eastern Baltic Sea. The large numbers of blue mussel shells create new micro-biotopes for a variety of smaller animals such as small crustaceans and worms. A mixture of marine and freshwater species of fish live in the area, including Baltic herring, Baltic sprat, common goby, perch, bream and three-spined stickleback. Grey seals occur occasionally along the coast.

Besides being very important for a number of bird species, the Pajuris–Palanga coastal area is the second-largest wintering site in the Baltic Sea for the globally threatened Steller's eider. The population that comes here represents five per cent of the total wintering population in the Barents Sea, White Sea and Baltic Sea.

Pajuris Regional Park, (Pajūrio regioninis parkas), Lithuania.



From Pape to Lahemaa

The Pape–Pērkone area consists of a marine area in the open Baltic Sea, the narrow Pērkone coastal stretch of land that separates the coastal Lake Pape and a former lake (Lake Nida), which is nowadays a bog, from the sea. The land areas around Lake Pape are also included.

The two originally inshore lakes were both formed after the retreat of the ice. As Lake Nida had no connection to the adjacent sea, and consequently no free flow of water, it eventually became a high bog. Lake Pape, on the other hand, was continuously fed new water by two small rivers. As a result, the water level rose until a connection was established between the now brackish-water lake and the sea.

There are sandy beaches with shifting dunes along the coast. Long stretches of the Latvian Baltic coast have high moraine cliffs and many of them are subjected to erosion. Where this process decreases or comes to a stop, the cliffs are overgrown with plants typical of beach and foredunes. Around 5 metre high white dunes extend for a few kilometres. In some areas, two or three white dunes, 120 km long, run parallel to the coast. A unique coastal ecosystem has developed close to the Nida bog. Where the bog, the beach and the foredune are connected, an interesting community is found on peat and sand where typical species of tall herbs grow together with dune species.

Pērkone sea coast, Latvia.

The seabed in the marine part of the area consists mostly of stones and gravel with black carragen as the dominating species of macroalgae. It is a northern extension of the underwater ridge that has its southern boundary just north of Klaipeda in Lithuania. As such, the area is an important spawning ground for Baltic herring, turbot and flounder. In all, the area holds 31 species of fish, including the rare twaite shad.

The Pape–Pērkone area is an internationally significant breeding, migrating and wintering site for birds, with the narrow strip of land between Lake Pape and the sea as a major "bottleneck" for migratory birds that seek land but need to avoid open water surfaces. The lake itself is an important resting area for migratory birds on the flyway that connects the tundra and taiga belts of Russia with north-western Europe. In total, 271 bird species have been recorded around Lake Pape, 15 of which are red-listed.

The Kolka–Lielirbe area comprises a 34 kilometre long coastal stretch around the Kurzeme (Courland) peninsula, and the sea areas off this coast, facing the Irbe Strait and the Gulf of Riga. The coastal stretch Kaltene–Engure and the offshore section Kaltene–Engure extend along the eastern side of the Kurzeme Peninsula.

Sandy coasts with sandy beaches, dunes in various stages, and dune slacks dominate the Kolka–Lielirbe area. On the landside of the dune areas one finds natural or almost natural deciduous and coniferous forests on the dunes, as well as swamp woods, transition mires and quaking bogs. There are also dry meadows, including Nordic alvars. The area exhibits a large variety of biotopes, and more than 800 plant species have been registered.

The seabed off the peninsula consists of sand, gravel and stones. In shallow areas there are also submerged sandbanks. Baltic tellin is found in large numbers on the bottoms, and the underwater area is also an

Kolka–Lielirbe area, Latvia (also above).

Sörve peninsula, Irbe Strait (Kura kurk, Irbes jūras šaurums), Estonia.

important nursery ground for flatfish and spawning ground for Baltic herring. Other important fish species are salmon, common whitefish, river lamprey and brook lamprey. Grey seals and Baltic ringed seals occur regularly in the coastal waters.

Irbe Strait forms the main passage (max. depth: 25 metres) between the Gulf of Riga and the Baltic Sea, and runs between the Sõrve Peninsula on the Estonian island of Saaremaa and the Kurzeme Peninsula. The BSPA comprises the Estonian part of the strait; a diverse area around the peninsula that includes islets and small islands, coastal lagoons, large shallow inlets and bays, submerged sandbanks, periodically exposed mudflats and sandflats, as well as mixed sediment bottoms and reefs.

The Irbe Strait area is representative of the highly diverse upper offshore slope of the Gulf of Riga. Algae grow as deep as 15 metres, and vascular plants are found in sheltered locations along the northern part of the peninsula. Shallow bottoms are characterised by pebbles, gravel and sand. Stones and boulders are covered by an abundant and diverse vegetation of algae, including bladderwrack and black carrageen. At greater depth the bottoms become more sandy/silty. Blue mussels and bay barnacles dominate in stony areas, and Baltic tellin on sandy bottoms.

The strait is the migratory route for Baltic herring and Baltic sprat between the Gulf of Riga and the open Baltic Sea and supports the highest catches of fish in the Gulf of Riga region, with herring and sprat being the main species. Furthermore, herring spawn in the waters of the strait, and its western part is also an important feeding ground for sprat, herring and young flounder. Grey seals occur regularly in the area; around 50 seals are normally found at one time on and around the small islets of the Sörve Peninsula.

In the offshore section Kaltene–Engure, the seabed consists of mixed sediments (sand, gravel and stones), with growth of bladderwrack mixed with green, brown and red algae. At depths below 10 metres the bottoms are more silty-sandy, with pebbles and small stones. At this depth and below, high densities of mussels such as Baltic tellin dominate. The area is an important spawning ground for Baltic herring and other fish species. The waters off Kaltene are home to grey seals and Baltic ringed seals.

The coastal stretch of Kaltene–Engure is mainly sandy with some beach ridges consisting of gravel, pebbles and boulders. Boulder beaches occur, although only rarely, along the coast between Mersrags and Engure. The Kaltene–Engure stretch is a dune landscape in different stages, including dune slacks. Alder forests, bog woodland, coastal meadows, deciduous swamp forests, mires and quaking bogs are other types of biotopes found along the coast or around Lake Engure.

Kaltene–Engure area, Latvia.

The large coastal Lake Engure is one of Latvia's most important nature protection sites. Originally an open coastal lagoon, the lake is now connected to the Baltic Sea only through a narrow channel. The vegetation of the lake is dominated by extensive stands of reed, rush and sedges. Stoneworts also occur in some places. The lake is an important spawning ground for ide.

The Gulf of Riga, including the Irbe Strait, supports close to 1.5 million wintering seabirds. In this respect it is one of the four outstanding areas in the Baltic Sea. Internationally important concentrations of nine species are found here. In north-western Europe as a whole, it is the second most important wintering area for red-necked grebe, affording the area global importance. Furthermore, the area is beyond comparison the single most important wintering area for long-tailed duck, and the second most important area for velvet scoter. White-tailed eagles also nest in the area.

Around 180 species of birds, of which at least 30 red-listed in Europe (including white-tailed eagle, corncrake, Eurasian bittern and little bittern), nest on islets in Lake Engure, and on land areas around the lake.

The North Vidzeme Biosphere Reserve is a huge complex landscape in Northern Latvia, on the border to Estonia. This lake region, with more than 60 large lakes, also features gently sloping hills and rolling plains formed by the ice. Raised bogs are another distinct feature. The Coastal section Dzeni–Ainazi extends along 53 km of the Latvian coast

Kaltene–Engure area, Latvia.

North Vidzeme Biosphere Reserve: Coastal section Dzeni–Ainazi (Ziemeļvidzemes biosfēras rezervāts: Dzeni-Ainazi), Latvia (above).

Kihnu Strait, Estonia.

in the eastern Gulf of Riga. It is a mixture of sandy and moraine coasts with grey and white dunes, together with some gravel and shingle beaches. Complexes of coastal meadows can be found in the northern part of the area, and sandstone cliffs are found in the central part.

The seabed comprises mixed sediment bottoms with mussel beds, similar to that of the waters off Kaltene-Engure. River Salaca, which discharges on the coast of Vidzeme, is the most important salmon reproduction site in the eastern Baltic region and the fourth most important site in the entire Baltic region. Baltic herring spawn in the coastal waters, which also hold river lamprey, brook lamprey and eelpout. Ringed seals occur in the area.

The shallow waters of the Dzeni–Ainazi coastal stretch are internationally important for wintering birds, as is the entire Gulf of Riga. The Vidzeme area is also home to white and black stork, osprey, corncrake, honey buzzard, little crake, black tern and common tern. The Kihnu Strait is equally strategically placed for migrating birds of many species.

The Kihnu Strait, between the island of Kihnu and the Tôstamaa Peninsula (and the islands within its boundary), is a stony and largely

shallow (mean depth: less than five metres) sea area influenced by the Gulf of Riga and the River Pärnu. Marine biotopes include coastal lagoons, submerged sandbanks, mixed sediment bottoms and reefs. An extensive, lush vegetation of algae, including bladderwrack and black carrageen, is found on groups of large stones in the shallow water. There is an abundance of bottom-living animals.

Several freshwater and marine fish species spawn and nurse their offspring in the area, including Baltic herring, ide, perch and common whitefish. Herring, pike, perch, pike-perch and vimba also feed here. Grey seals and Baltic ringed seals occur regularly, and for ringed seal the area just northeast of the island of Kihnu is the main breeding and feeding area in the Gulf of Riga.

The Matsalu National Park is a large coastal wetland consisting of the Kasari delta, the Matsalu Bay, coastal and flooded meadows, reed beds, forests and the shallow Moonsund waters with islets.

Here one finds estuaries, shallow coastal lagoons, large shallow inlets and bays, periodically exposed mudflats and sandflats, submerged sandbanks, sandy bottoms, reefs, and stony banks with growth of algae.

Kihnu Strait, Estonia.

The bottom areas in the "marine" areas consist of mixed bottoms of sand and silt with stones. The shallow waters in the Matsalu Bay, as well as the rivers and deltas, are very productive. A total of 49 species of fish have been identified in the area, including pike, roach, ide and bream.

Grey seals and Baltic ringed seals are regular visitors to the outer parts of the Matsalu Bay. Otter, a mammal that has become rare in many other areas around the Baltic Sea, also finds a safe place here.

Not surprisingly, the Matsalu area – a large bay with coastal meadows, reed-beds and islets – offers favourable conditions for migrating and breeding birds. In total, 275 bird species have been registered. During the spring migration more than two million birds pass the area, a vast majority being long-tailed ducks and other diving ducks. Tens of thousands of Bewick's swans – a very large proportion of the entire population – and barnacle geese pass here. Cranes, gray-lag goose, bittern and several species of birds of prey, including white-tailed eagle, also find their way to Matsalu.

The West Estonian Archipelago Biosphere Reserve comprises the islands of Saaremaa, Hiiumaa, Vormsi and Muhu, as well as numerous islets and marine areas. Hiiumaa Islets, Kõpu Peninsula–Hiiumaa National Park, and Vilsandi National Park are all parts of the Biosphere Reserve.

Baltic ringed seal and grey seal depend on the coastal areas of the Biosphere Reserve. Vilsandi is the largest area in the Baltic Sea for grey seals to have their pups, and several hundred pups are born here every year.

Matsalu National Park, Estonia.

Matsalu National Park, Estonia.

Coastal lagoons, large shallow bays and inlets, exposed mudflats and sandflats, submerged sandbanks and reefs are typical coastal biotopes in the area. The seabed of the Hiiumaa area (between the Hiiumaa islets at a depth of 2–4 metres) is mainly sandy and muddy, with some stones. Pondweed and eelgrass dominate the bottoms, with bladderwrack and black carrageen growing on stones and boulders.

More than 600 species of higher plants, many of them rare, are found on the Hiiumaa islets, representing almost half of the total species in all of Estonia. Some plant species on the islets have their westernmost distribution range here. There are also several species that are characteristic of the islands, for example, crested cow-wheat, cow-wheat, wild pansy and small-flowered willow herb. On the island of Hiiumaa, more than 1,000 plants have been found, and over 80 rare species within the BSPA.

The shallow coastal waters off the west coast of the islands of Hiiumaa and Saaremaa constitute one of the five most important areas in the Baltic Sea for wintering birds, including thousands of common goldeneye, mute swan and goosander. It is of international importance for four species, and the most important area of all for the north-east European population of Steller's eider. Altogether 187 species have been recorded on the Hiiumaa islets, 110 of them breeding (including white-tailed eagle). Vilsandi welcomes some 250 species, 112 of which are known to breed on the limestone shores and cliffs adjacent to the sea.

Saarnaki, Hanikatsi, Vareslaid, Kõverlaid, Ahelaid and Kõrgelaid are the largest of the Hiiumaa Islets. Most of the young islets consist of moraine; only one of them (Langekare) is based on limestone. The Saarnaki islet is about 2,000 years old, others rose from the sea later, some only a few hundred years ago, and the land is still rising slightly (around 20–30 cm per century). These young islets are flat and low (0.5–2.0 metres high). Saarnaki is the highest.

Kõpu peninsula–Hiiumaa National Park, Estonia.

The islets house coastal and wooded meadows, Nordic alvar, deciduous woods and sandy beaches. The sandflats and mudflats are colonised by glasswort and other annual salt-tolerant plants. The bays offer favourable spawning grounds for perch, ide, common whitefish and garpike.

The Kõpu Peninsula with the Hiiumaa National Park is located on the westernmost part of the island of Hiiumaa. The peninsula reaches a maximum height of 67 metres and the beaches are mainly sandy. Wooded dunes and shifting white dunes are found along the shoreline. Fixed coastal grey dunes also occur.

Vilsandi is a large complex of shallow bays on the western coast of the island of Saaremaa, with many small offshore and inner islets and some lakes. Coastal dunes can also be found. The vegetation includes reed beds, coastal meadows and forests. The Vilsandi National Park in-

Vilsandi National Park, Estonia (above) and Sarnaki, Hiiumaa Islets, Estonia.

cludes a narrow strip of land on the island of Saaremaa and 161 islands and islets (about one tenth of all islands in Estonia). The seabed consists mainly of hard bottoms, with algae typical for this part of the Baltic Sea growing down to depths of around 20 metres in clear water areas.

The Lahemaa National Park comprises an area of 725 km² (almost one third of which is water) on the northern coast of Estonia, bordering on the Gulf of Finland.

The coast is indented by four large, pointed peninsulas undercut by wide bays. Off the coast there are also some small islands. The fact that peninsulas and bays, as well as the offshore islands, are orientated from northwest to southeast vividly reflects the direction of the movement of the retreating ice sheet.

Lahemaa can be divided into the wide coastal plain (rich in peninsulas and bays), a limestone plateau, and a slope (klint). To the south, the plain borders with the North-Estonian Klint – a relatively gentle slope. The cliffs of Tsitre and Muuksi in the western part of Lahemaa, and the bedrock outcrops in the valleys of Rivers Valgejõgi and Loobu (where these rivers fall over the cliff) are the only exceptions. The Klint rises 67 metres at its highest point. At the foot of the Klint there are large gravel and sand terraces, deposited by glacial rivers. Thus, the Klint provides a well-defined boundary between the plain and the plateau. The many waterfalls of the rivers flowing through the national park and into the Gulf of Finland (Nõmmeveski on River Valgejõgi, Joaveski on River Loobu, and Vasaristi on the Vasaristi stream) represent a special feature of the Klint area. The edge of the Klint is characterised by limestone plateaus – Nordic alvars.

Biotopes on the coast and coastal plain include coastal meadows, wooded meadows, some sandy beaches, various types of dunes with dune slacks and flat chalk rocks. Many beaches are characterised by

Lahemaa National Park, Estonia.

large numbers of big boulders, brought there by glacial rivers. The southern part of the park extends into a plain with large forests and mires (around 70 per cent of the land area is forested). This plain was formed in a large ice-dammed lake.

Several of the rivers harbour spawning stocks of salmon and other salmonid fish species. The rare and endangered freshwater pearl mussel and the thick-shelled river mussel can be found in some of the rivers – a sign of high water quality. The freshwater riverbanks also provide homes for vulnerable and endangered species such as otter.

Large shallow inlets and bays, coastal lagoons, sandy beaches, mixed sediment bottoms, reefs, periodically exposed mudflats and sandflats, and submerged sandbanks, characterise the coastal area. Two coastal lakes located on the coastal plain were cut off from the Gulf of Finland around 2,000–3,000 years ago. On one of the peninsulas, two fladas are still connected to the sea during periods of high water.

The bottom structure in the waters off the coast of Lahemaa is very diverse, and the seabed reaches down to a depth of 90 metres. Algae can be found down to depths of around 15 metres. Fish species in the area include Baltic herring, common whitefish, twaite shad, lamprey and salmon. Herring spawns in the waters off the coast.

The coastal waters are important resting areas for species of migratory birds: well over 220 bird species have been registered here.

Lahemaa National Park, Estonia.

From Torhamn to Lebyazhye

Where the southernmost area of continuous crystalline bedrock on the seabed off the Swedish coast appears, you find the Torhamn Archipelago, with reefs (including bubbling reefs), submerged sandbanks and soft rock bottoms. There are also large shallow inlets and bays, and coastal lagoons. The shallow areas offer spawning grounds for Baltic herring. Other fish species in the area include pike, perch, flounder, turbot and cod. European eels use these waters during their migration towards the Sargasso Sea. The islands and Torhamns udde (a flat cape with coastal meadows and juniper heaths) is one of the foremost sites in Sweden for migrating, resting and breeding birds. White-tailed eagle and osprey occur, as well as graylag goose, black guillemot and several species of tern. In the spring up to 100,000 eiders can pass the area in one day. The area is also home to three rare (red-listed) amphibians.

The Värnanäs Archipelago is a moraine archipelago with shallow, open water, scattered with grounds and sedimentary, low-lying islets and skerries. There are submerged sandbanks, estuaries and reefs. Pondweeds, water milfoil, rigid hornwort, white water-buttercup and sea lace algae dominate on the soft bottoms in shallow waters. The area is considered to be one of the most important breeding grounds for the small Baltic population of common seal. As many as 140 common seals have been observed on the main island of Värnanäs at one time, probably accounting for about half of the reproduction of these seals in Kalmar Sound. The shallow waters are also spawning areas for several fish species, and the archipelago is an important area for breeding, resting and wintering birds.

Torhamn Archipelago, Sweden.

Sankt Anna–Missjö Archipelago, Sweden.

The very wide, finely chiselled Sankt Anna–Missjö Archipelago has a character of its own, in many respects unique to the Baltic Sea, due to the bedrock of granite and gneiss (bare or covered with a thin layer of soil) and the existence of closely spaced bedrock cracks. Only a quarter of the area consists of land in this mainly outer archipelago area with a substantial number of islets and skerries, and only a few larger islands. As the waters are shallow and difficult to navigate, the area has remained comparatively undisturbed. On exposed rocky bedrock bottoms bladderwrack grows down to a depth of 6 metres, and species of red algae can be found in depths down to 15 metres. On soft bottoms in sheltered locations, one finds eelgrass meadows and stands of Baltic stonewort. In areas with mixed bottoms (reefs/sandbanks), eelgrass, pondweeds and bladderwrack grow closely together. Birds come to the archipelago in large numbers; in areas with large amounts of bird droppings a particular and species-rich flora has developed. White-tailed eagle feeds here, and grey seals are a common feature.

Hartsö–Askö–Fifång Archipelago, Sweden.

The intermediate Hartsö–Askö–Fifång Archipelago has three large islands to the north and a number of islets and skerries to the south. There are both narrow and large shallow inlets, coastal lagoons and reefs. The shores consist of rocky or sandy beaches and low, coastal meadows characterised by pasture. Marine research and education have been carried out at the Askö Laboratory since the early 1960's. Filamentous green and brown algae, bladderwrack (decreasing) and red algae occur on the highly productive hard bottoms. In the outer parts, red algae grow down to a depth of 20–25 metres, followed by blue mussels. Eelgrass grows on sandy, shallow soft bottoms, together with pondweeds. Mudsnails and Baltic tellins are the most common bottom-living animals. The shallow waters are spawning grounds for Baltic herring and Baltic sprat, occurring in large numbers. Other important fish species are European eel, pike, perch, pike-perch and flounder. Grey seals and otters are found in the area, which is also important for birds.

Well over 1,400 islands and islets make up the large intermediate and outer crystalline bedrock and moraine Bullerö–Bytta Archipelago. There are numerous small, nearly isolated bays and fladas in the area, as well as one large, fairly sheltered, shallow area surrounded by islands and islets. Small, almost enclosed, shallow bays and lagoons are common. Three species of red-listed stoneworts have been found in one of the shallow soft bottom areas. The outer parts of the archipelago have rocky bottoms, including many reefs, with a rich vegetation of algae growing in the zones (green, brown, red algae) that are typical of the Baltic Proper. It is an important bird area with over one hundred breeding and wintering bird species.

Bare crystalline bedrock is the dominating surface of the numerous islands and islets in the large outer Stora Nassa–Svenska Högarna Archipelago. Glacial striae, giant's kettles and rockpools tell the story of the once grinding ice sheet. Stora Nassa consists of more than 400 closely spaced rocky islands and islets, separated by fladas and narrow sounds. Svenska Högarna, the outermost archipelago in this region, comprises some 50 islands and islets. There are numerous reefs, but also many small, nearly isolated bays. The area is one of the northernmost localities for eelgrass in the Baltic. Twelve fish species, dominated by Baltic

Bullerö–Bytta Archipelago, Sweden.

herring and perch thrive here, and grey seals are regularly observed on the islands. Altogether 130 bird species visit the area. Around 50 species, particularly velvet scoter, breed here.

The Signilskär–Märket Archipelago and the Gräsö–Singö Archipelago are located not far from each other in the western part of the Åland Sea, in the northern part of the transition zone (Southern Quark–Åland Sea) between the Baltic Proper and the Bothnian Sea. A mixture of marine, brackish-water and freshwater species of plants and animals

Stora Nassa–Svenska Högarna Archipelago, Sweden.

live here. For many of them, it is their inner northern distribution range.

Signilskär–Märket consists of two largely offshore areas with an archipelago of islets. Signilskär is a group of around 50 small and mainly bare, rocky islands. The main island of Signilskär is an important breeding area for several species of birds, and an important feeding and wintering area for white-tailed eagles. A bird-ringing station is located on the island. Märket is a flat rock, around 300 metres long, 100 metres wide and less than four metres high. Although the skerry is readily flooded at high water levels, including stormy weather, it is an important site for seals and around a hundred grey seals can be gathered here.

The outer Singö Archipelago constitutes the southern part of a larger area, which includes also the Gräsö Archipelago. In all, the area comprises close to 1,000 low-lying, largely bare islands and islets. Land uplift continues with about 60 cm per century, and there is a distinct zoning of vegetation in the area, with extreme pioneer species like sea buckthorn. Shallow, narrow inlets and bays, including fladas, are typical features. As the shallow water becomes warm early in the spring or summer, these areas and their vegetation are of key impor-

Märket, Signilskär–Märket Archipelago, Finland.

Gräsö–Singö Archipelago, Sweden.

tance as spawning and nursing grounds for fish like perch, pike, Baltic herring, common whitefish and roach. In total 35 species of fish have been registered in the area. Grey seals occur regularly. The diversity of breeding and feeding birds includes Arctic skua, white-tailed eagle and osprey. The area has been ranked as one of the 30 most important in the Baltic Sea for a large number of species of wintering birds.

The bottom topography in the northern part of the area (shallow, with numerous grounds) differs from that in the southern part (greater depth). The bottoms in the inner, sheltered parts consist of finer sediments, but no such bottoms exist in the more exposed outer parts. Bladderwrack grows as individual plants down to a depth of around 10 metres, followed by other algae. In shallow, protected bays, stoneworts are the most common plants. The variety of bottom-living animals is limited, with Baltic tellin dominating together with the crustacean *Monoporeia affinis.* Other crustaceans, insect larvae and freshwater snails are also common.

The Archipelago Sea with around 1,000 islands and islets in the outer archipelago extends for almost 100 km from east to west, and 40 km from north to south. It is a complex, wide belt of islands reaching from south-west of the city of Åbo to the most remote islands at Utö. Clusters of small islands separated by large expanses of open water are a typical feature. All three major types of archipelagos are represented – from the inner, lush green islands separated by narrow sounds, across wide bays, to the barren, rocky islands in the outskirts, openly exposed to winds and waves. Grey seals and Baltic ringed seals find excellent places to live here.

The average water depth in the area is 23 metres, and the ongoing land uplift, which adds 40–50 cm of land each century, is an important characteristic. Vivid evidence of the retreating ice sheet can also be found in the third Salpausselkä lateral moraine, which now forms islands of sand and pebbles with long reefs. Esker islands with coniferous forests, sandbanks and dunes in all stages are also found.

The larger islands are generally forested, and the area is very important for the preservation of natural hardwood forests, and habitats such as Nordic alvar and calcareous flat rocks. Here one finds natural forests of primary succession stages, typical of land uplift coastal areas. Within one tiny islet, small patches of freshwater bogs, freshwater and brackish-water ponds, bushes, meadows, barren rocks, wind-beaten shores and sheltered coves can be found, side-by-side.

The typical Baltic zonation of green algae, bladderwrack and other brown algae, followed by red algae, occurs on hard bottoms. In sheltered shallow bays with soft sediments, eelgrass extends in meadows with freshwater plants like pondweeds.

Archipelago Sea, Finland.

The area is a haven for birds such as mute swan, black guillemot, great crested grebe and numerous species of sea gulls. White-tailed eagles breed in the area, as do Arctic terns on small islets. The endangered species Caspian tern and dunlin are found here. The great cormorant has recently spread to the archipelago, and their increasing numbers are cause for concern.

Hundreds of islands dominate the marine landscape of the large Tammisaari and Hanko Archipelago and Pohjanpitäjänlahti Bay Marine Protection Area. The area comprises the bay area, the marine parts of the Tammisaari Archipelago, and the marine areas of the southern bays of the Hanko Penisula.

All coastal zones typical of this part of the Gulf of Finland are represented: outer, intermediate and inner archipelago, and mainland. The seabed and marine habitats are protected. There is also a need, however, for protection of the fjord-like bay as a biotope complex, as well as of fladas, shallow bays, rockpools, and birdlife in the area. Biological research and education, focused on brackish-water environment and archipelagos, have been carried out for more than a century at the Tvärminne Zoological Research Station, located on the Hanko Peninsula.

Several islands in the archipelago are large and forested, although the majority are small and rocky with sparse vegetation. The archipelago is formed by a plain that gradually declines towards the sea and is ruptured both parallel to and across the shoreline. The Pohjanpitäjänlahti Bay is a ruptured valley delimited by a threshold and resembles a shallow fjord.

Archipelago Sea, Finland.

Tammisaari and Hanko Archipelago, Finland.

Tidal rivers, estuaries, mud flats, sand flats, lagoons (including saltwork basins), coastal sand dunes, sand beaches, machair, shingle, sea cliffs, islets, and coniferous woodlands constitute five per cent of the area, whereas the rest are marine areas and sea inlets. Extensive sub-marine sandbanks and dunes in all stages can also be found. Especially the shallow sandy bays on the southern fringe of the Hanko Peninsula are important for birds. A diversity of algae occurs, including some rare species. In sheltered bays and coves, a variety of vascular plants can be found. Eelgrass, however, occurs sparsely.

The Hanko Peninsula is part of a large end moraine – the First Salpausselkä – that contains mainly sand and gravel deposited by glacial rivers. The Tulliniemi bird protection area constitutes the tip of this esker ridge and peninsula; it is the westernmost part of the ridge above sea level. Tulliniemi and Uddskatan further out are rocky, with rather exposed shores. Because of its geographic location, Tulliniemi is one of the most important routes for migratory birds. It is also extremely important for nesting birds, such as common eider, long-tailed duck,

greylag goose, common tern and Arctic tern. Osprey and white-tailed eagle have also been recorded.

The winds affecting the shores of the peninsula cause erosion, but also cause sand to accumulate and form beach ridges and tombolos (narrow ridges of sand that link steep and often vertical columns of rock in the sea to the mainland). Dunes border the small, sandy bays opening to the south. The dunes on the distal slopes of the end moraine are usually small, although there is much well-sorted fine sand on these slopes. Higher, stabilised dunes can be found on the top. A more than one kilometre long, sandy beach faces south-east. The extensive and representative bottom areas, linked to the esker, are mainly sandy and carry plants such as stoneworts. There are also clearly distinguishable rocky shores with algae.

Tulliniemi bird protection area, Finland.

Söderskär, Söderskär–Långören Archipelago, Finland (above). Kirkkonummi Archipelago, Finland.

A large area of inner, intermediate and outer archipelago, the Kirkkonummi Archipelago includes islands and islets, skerries and other rocks (including Obbnäs granite, a unique rock type, resembling rapakivi granite). Some sandy shores also exist in the Sommarn (a fairly large area with sandy bottom; an important feeding ground for birds) and in the Upinniemi archipelago. Most of the islands are small, barren and rocky, but a few are larger and forested. Some islands have small areas of low vegetated coastal meadows and shallow lagoons. Compared to other Finnish archipelago areas, the waters here are deep and lack the most representative banks. However, typical rocky reefs and sandbanks do occur. The area is important for birds, both in terms of numbers and diversity.

Pernaja Bay, Little Pernaja Bay, and Pernaja Archipelago marine protection area, Söderskär and Långören Archipelago, and Porvoonjoki estuary–Stensböle are located in very close vicinity of each other off the Finish coast in the Central Gulf of Finland.

Pernaja Bay and the archipelago marine protection area comprise a large inner, intermediate and outer archipelago area that harbours many valuable biotopes and habitats and their species. The mainly small and rocky islands and islets are separated by large expanses of open sea. Esker islands occur, with sandy, rocky and shingle beaches, as well as stony banks. The narrow, brackish-water sea inlets Pernaja Bay and Little Pernaja Bay are both areas of importance for birds; the Pernaja Bay even of international importance. A large number of bird species find breeding or resting (during migration) sites here.

Pernaja Bay (above), and Porvoonjoki estuary–Stensböle, Finland.

Söderskär and Långören Archipelago represent a large outer archipelago area consisting of small islands and islets. The area includes Långören, a fairly large esker island, and surrounding waters; Söderskär, an island reserved as a bird sanctuary; and the Sandkallan-Stora Kölhällen seal sanctuary with surrounding waters. Tunnholmen, a large forested island with different shore types (shingle, sand, cliffs and meadows) is also part of the area. The biggest population of grey seal in the Gulf of Finland is found in the Sandkallan area. Surrounded by shallow banks it is an

important nesting and resting area also for birds and a staging ground for migratory birds.

The northernmost section of the Porvoonjoki area consists of the Linnanmäki esker mound and the lush bay of Maari. The larger southern section is located in the water area and banks of the River Porvoonjoki estuary (delta), comprising inter alia Stensbölefjärden. The shallow estuary supports an abundant and rich variety of plants, dominated by reeds and rushes. Muddy and sandy bottoms occur, and sandflats. The estuary is an important resting site for over 40 bird species. Stensbölefjärden, a large, very shallow area of open water bordered by belts of reed, holds the most valuable bird community among the bays of southern Finland.

Only one per cent of the area of the very large outer Eastern Gulf of Finland Archipelago and waters comprises shingle beaches, sea cliffs, and islands. The extensive area covers the entire northeastern part of the Gulf of Finland: open sea (some 60 km wide) scattered with several large and forested islands, and hundreds of small, rocky islets and skerries.

Two faces of the Eastern Gulf of Finland Archipelago and waters, Finland.

The area is dominated by groups of islands, which also include quite large forested islands. Most of the islands have steep shores, and bare rocky islets surrounded by deep waters and exposed to surging waves. The typical reddish-brown rapakivi granite is found here. The shores are mostly sandy beaches with rocks or cliffs, but there are also some shoreline meadows with low vegetation. In some places, the ice and waves have created pebble and gravel embankments. One finds raised beaches of boulders and shingle (also popular breeding places for colonies of Arctic terns).

Islands and submarine ridges separate the sea basins. Underwater sandbanks surround the islands. Underwater esker formations and the two-kilometre long esker island of Långviran (now with sandy beaches and shallow shores), bear evidence of the ice sheet.

The Eastern Gulf of Finland in general represents a transition zone, shifting from a marine to a less marine environment, and this is reflected in the mixture of brackish-water/marine species and freshwater species, as well as in the distribution of plants and animals. For example, this is the eastern limit for the distribution of blue mussel (indicated by the absence of eider in the area), as well as for bladderwrack. The archipelago area is an extensive spawning area for Baltic herring, and home to both grey seals and ringed seals. In the winter, the ice on the Eastern Gulf of Finland is a prerequisite for the reproduction of the Baltic ringed seal.

The Gulf of Finland forms a key link in the migratory flyways of many Arctic birds and is well known for its diversity of birds. In the spring, hundreds of thousands Arctic water birds and waders pass through the area on their way to their nesting places in the north. The Arctic tern and gulls are typical birds in the area.

Four areas are soon to be proposed as BSPAs in the Russian part of the Eastern Gulf of Finland. They will cover a very large expanse of water, with islands and framed by mainland areas.

The proposed Ingermanlandskiy area consists of a number of islands in the central and northern parts of the inner Gulf of Finland.

Ingermanlandskiy (Ингерманландский) Russia.

The northern islands of the Ingermanlandskiy area have rocky shores, whereas sandy beaches and dunes dominate on the islands further to the south. The shallow waters around the islands are home to a rich variety of species. Stands of reed, sedge, horsetail and other typical coastal plants can be found. Fish species in the area include Baltic herring, Baltic sprat, common whitefish, pike-perch, smelt, salmon and sea trout. Commercially important species such as Baltic herring, pike-perch and perch spawn here. The combination of shallow waters, and beaches constitutes a haven for thousands of birds of different species – a total of 120 have been noted.

The Kurgalskiy Peninsula area (a regional nature reserve) comprises the peninsula and large parts of the surrounding waters.

Ingermanlandskiy, Russia.

Kurgalskiy Peninsula (Кургальский полуостров), Russia.

The coastal part of the area is mostly forested with species typical to the south taiga zone (e.g. oak, linden, ash, maple and elms). On the coast there are numerous black alder marshes, bogs with aspens and birches. Of the two large lakes on the peninsula, one has brackish water and a remaining connection with the Gulf of Finland. The peninsula has a rich biodiversity, including such rare species as the freshwater pearl mussel (and mammals like bears). More than 200 bird species have been recorded, more than 30 of them being listed as rare, including white-tailed eagle and osprey.

The Kurgalskiy reef archipelago comprises numerous islands and reefs made up of stone ridges interspersed with spits of sand and shingle. The shallow coastal waters are important as resting and feed-

Berezovye Islands (Березовые острова), Russia.

ing grounds for migratory birds. The shallow waters and reefs, particularly to the west and northwest of the peninsula, are essential feeding and breeding areas for Baltic ringed seals and grey seals.

The Berezovye Islands (a regional nature reserve), an archipelago area consisting of numerous larger and smaller islands and water areas, is located in the eastern part of the Gulf just west of the major port of Primorsk. The islands are mostly covered with pine and birch forests. On the Severnyi Berezovyi island spruce and pine-spruce forests dominate. Black alder forests are common along the coasts. Raised, transitional and lowland bogs can be found on larger islands. The most interesting floristic and geobotanical aspects of the islands are associated with maritime vegetation. There are characteristic maritime meadows, marshes and moors, as well as sandy beaches and dunes with typical plant communities. Important commercial fish species in these waters are Baltic sprat, smelt, bream, pike-perch and perch. The Baltic ringed seals give birth to their pups on the ice fields west and south of the islands. The shallow waters, bays and straits around and between the islands serve as important resting and feeding places for many bird species during their spring migration, with swans, geese, diving ducks,

Berezovye Islands, Russia.

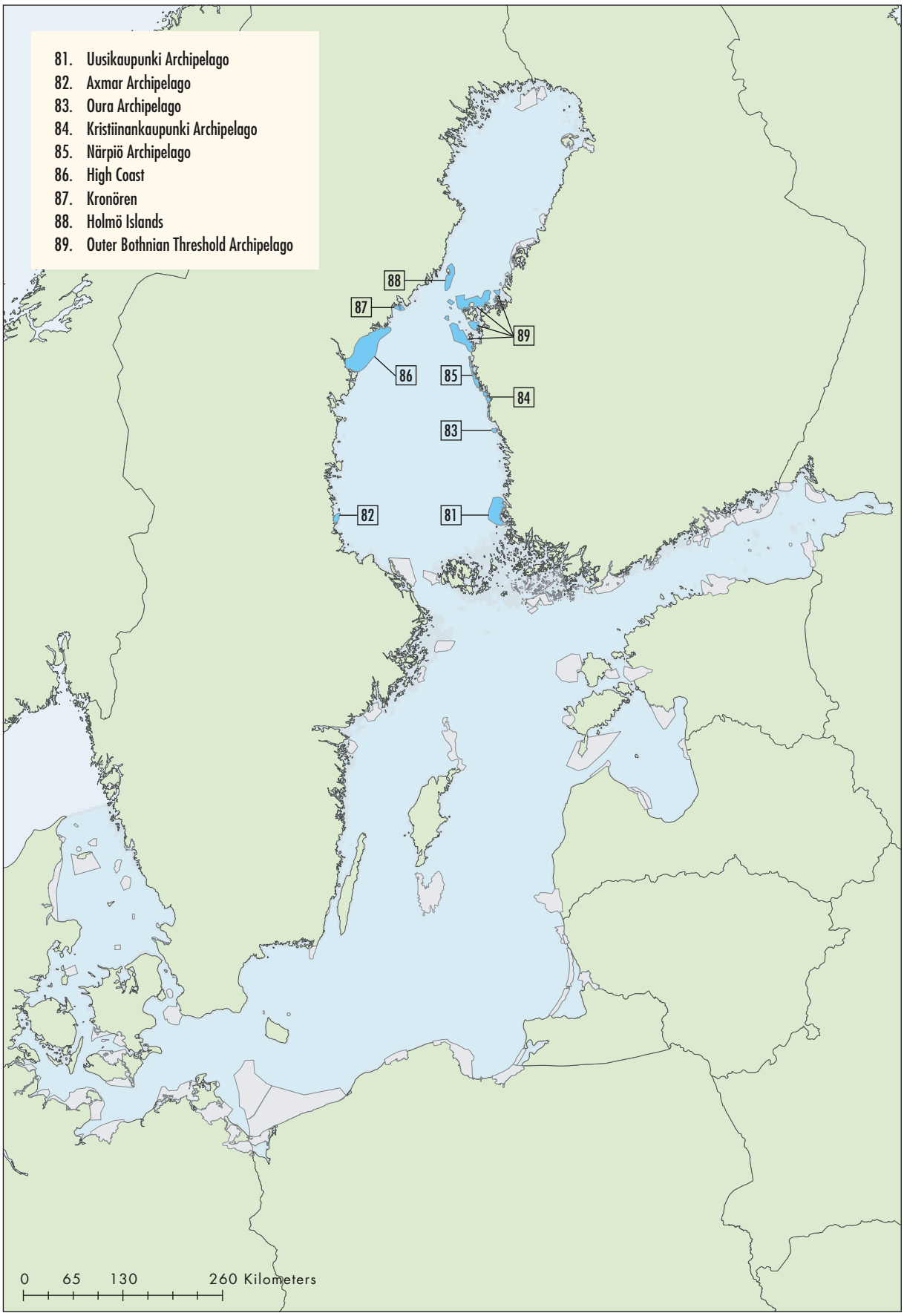
mergansers and dabbling ducks being the most common. Nesting and breeding birds in the area are various species of gulls, terns and ducks.

The Lebyazhye area (a regional nature reserve) is a coastal stretch along the southern coast of the Gulf, between Sosnovyi Bor to the west and Bolshaya lzhora to the east, with adjacent shallow coastal waters with a depth from 1 to 3 metres.

The coastline forms capes, bays and creeks. Along the coast there are sand ridges alternating with lower areas. Pine forests mostly cover the ridges, while bogs dominate the lower areas. Black alder forests still exist in the zone between the ridges and lower parts. The coastal zone is of botanical significance with many rare species.

During the spring migration, various species of birds depend on the coastal areas as resting places. In all, 120 species of migratory birds have been documented here. The area is of particular importance to whopper swan and Bewick's swan, which can be counted in tens of thousands. It is also an important breeding and nesting area for many species of ducks, as well as for some rare species such as corncrake and water rail.

Lebyazhye (Лебяжье), Russia.



From Uusikaupunki to the Quark

Small rocky islands and skerries make up the large outer Uusikaupunki Archipelago, with rocky shores, cliffs with vegetation (including pioneer vegetation), coastal lagoons and reefs. The archipelago, where the annual ice cover varies from one year to the next, is representative of the Bothnian Sea area, as is the flora and fauna including some rare species. It is an important nesting area for birds, as well as a resting place during migrations. The inland lake on the island of Vekera, in the southern part of the area, harbours an exceptional bird population. Here you will also find remarkable vegetation, with rocky meadows, juniper meadows and a rare type of sphagnum moss. Pine and spruce forests grow beyond the normal marine forest border. On the island of Putsaari, different vegetation types appear in succession, from open lakeshore vegetation over damp birch forest and stands of common alder to maple groves and bare rock.

The Axmar Archipelago comprises the coast, one large and several smaller islands, and almost a hundred islets. The area harbours grey seals. Moraine with many large boulders is a typical feature for the entire archipelago and the mainland coast. Moraine ridges and material left behind by glacial rivers can be found everywhere. The shallow waters are difficult to navigate due to boulders, and the effects of land uplift are obvious. On land, it is almost impossible to find a spot not covered by pebbles and boulders. Several islets have shingle stone fields on top of flat rock, with typical low coastal spruce. Pioneer vegetation

Axmar Archipelago, Sweden.

Kristiinankaupunki Archipelago, Finland.

along the shores is common. The coastal zone is not very wide and the mighty coniferous forest grows almost on the waterfront. However, in places there are also rocky beaches, sandy beaches and beach ridges extending out into the sea.

Marine biotopes include lagoons, large shallow bays and inlets, submerged sandbanks, and sometimes exposed silty and sandy bottoms. In sheltered shallow areas, including a river estuary, high stands of reed, pondweed and species of stoneworts offer sheltered environments for spawning fish and for resting and breeding birds. Sea trout spawns in the river falling into the estuary. Fish species in coastal waters include perch, roach, Eurasian minnow, bleak, white bream, three-spined stickleback and Baltic herring. Mixed sea bottoms typically support a fringe of algae (including small stands of bladderwrack) on boulders down to 3–4 metres, succeeded by other brown algae down to a depth of 12 metres. In the gravel between boulders one can also find individual stands of green algae and various vascular plants growing side-by-side.

The representative and varied Oura Archipelago is a prime example of land uplift. The Oura and Enskeri Archipelagos are parts of a large archipelago area with a total of some 1,200 small low rocky islets, skerries and grounds, including underwater eskers (about one fourth of which are in the Oura area). Some skerries are actually large boulders shaped from rocks. There are reefs and stony banks, as well as rocky cliffs with vegetation. The landscape is dominated by large open-sea areas with some large, mainly forested islands and groups of hundreds of scattered small islets and skerries on the fringe of the sea. Most of these are rocky and more or less bare, sometimes only with a thin layer of boulder soil, occasionally with some trees.

Some rocky islets and skerries have shingle stone fields and some are covered with heath. Sea-buckthorn is a typical and common representa-

tive of pioneer vegetation. The islands of Iso-Enskeri and Vähä-Enskeri hold a remarkable number of more than 200-year-old pine trees. The relatively open northern part of the archipelago supports a diversity of brackish-water plants, including bladderwrack, abundant in places, accompanied by willow moss. Otters and grey seals are found in the area. Common fish species include perch, pike, salmon, sea trout, pike-perch and ide. This is also an important bird area.

The Kristiinankaupunki Archipelago is a narrow zone of intermediate and outer archipelago with many small islands and islets. Grey seals and ringed seals are found here. Most islands and islets are small, treeless and rocky, whilst the large islands have forests, heaths, meadows and sand dunes. The bedrock is characterised by shale formations (schists) running from north to south, and fissure valleys extending in the same direction. Bare cliffs are common on the islands, which have fairly steep shores. Rocky shores and boulders occur frequently,

Närpiö Archipelago, Finland.

The High Coast, Sweden.

in some places with narrow beaches of pebbles and sand. Submerged sandy and stony beach ridges and banks extend from the shore. The islet Domarkobban is the top of such a ridge, and here one finds comparatively wide sand dunes. Many islands have representative coastal meadows with a diversity of nesting birds. Several of these bird species, as well as many plant species found in the area, are classified as threatened. Beach ridges of bladderwrack that has drifted ashore attract birds. In places, drift lines tens of metres wide and hundreds of metres long have formed.

In the Närpiö Archipelago the moraine-covered islands of the Quark gradually replace the rocky islands found further to the south. This is a transition area, similar to Kronören on the Swedish side and characterised by shallow bays, fladas and glo lakes. It comprises a narrow intermediate archipelago, an area in the outer archipelago, and the Pjelax Fjard - a small part of the mainland dominated by coastal meadows, adding a large estuarine ecosystem with changing salinity, muddy bottoms, salt marshes and reed stands. Södra Björkön is a flat island levelled by a thick layer of moraine, with stony shores, meadow shores and algal beach ridges. Svartön, off the bay, is one of the few well-preserved forested islands that has remained in its natural state. Grey seals and Baltic ringed seals are found in the area. The estuary, shallow waters and marshes make the area highly important for birds. Kaldonskär constitutes a group of rocky and treeless islands and skerries, where over 90 bird species are found in summer. Furthermore, the seabed covered with stones and silts, harbour abundant colonies of mussels (lagoon cockle and Baltic tellin). Waders stop at the silt-covered shores to feed and rest during their migration.

The High Coast area consists of around 70 islands – including the Ulvö Islands and Trysunda – and islets scattered over a water area comprising almost half the size of the entire area. There are areas of exposed reddish Nordingrå granite (around 1.5 billions years old) and dolerite in steep cliff formations, as well as sandy beaches. The High Coast is characterised by hilly mainland, elevated islands, deep bays and straits. A highly diversified forested landscape continues all the way out to the hilly coast. The area becomes increasingly shallow; new islands emerge and islands are transformed into peninsulas. Shallow inlets, open bays and great depths can all be found within a limited area owing to the particular topography. In a global perspective, the combination of the special features of the Baltic Sea (and more particularly the Gulf of Bothnia) and those of the High Coast, constitute a unique set of conditions for marine life.

Marine landscape, High Coast, Sweden.

The Kronören Archipelago, the Holmö Islands Archipelago and the Bothnian Threshold Archipelago, are all included in the shallow threshold area of the Northern Quark – generally referred to only as the Quark. This is the narrow region that separates the Bothnian Bay from the Bothnian Sea (as opposed to the Southern Quark forming the border area between the Bothnian Sea and the Åland Sea).

The (Northern) Quark is the narrowest and shallowest area in the Gulf of Bothnia, approximately 80 km across, and only around 25 km between the easternmost Swedish and the westernmost Finnish islands. The area as a whole is characterised by land uplift at a rate of 80–90 cm per century, with new land surface constantly rising. In around 2,000 years, sufficient land will have risen from the sea to form a land bridge between Finland and Sweden and transform the Bothnian Bay into a freshwater lake.

Salinity varies between 2 and 5 psu in the Quark area, and the composition of species in the sea is a unique mix of freshwater and marine species. The Quark is the northern distribution limit for many marine/brackish-water species. In addition, the area harbours many glacial and post-glacial relict species. And of the 24 endemic plants restricted to Baltic Sea shores, 16 are found here (reflecting the evolutionary process in land uplift areas).

Holmö Islands, the Quark, Sweden (left). Kronören Archipelago, the Quark, Sweden (below).

Almost all fish species found in the Quark live along the coast and depend on its world of islets and estuaries for reproduction. The Baltic herring is the most common marine fish species. Other freshwater or marine species include perch, roach, ruffe, common whitefish, sea trout, smelt (important also as food for other fish) and grayling.

The Quark area is characterised by the shapes created by crystalline bedrock and moraine soil. The eastern side of the area is quite appropriately referred to as Stenriket ("the realm of stones"). The eastern part of the Quark, with several separate groups of islands (mainly in the intermediate and outer archipelago), is larger, flatter and thus more expansive. The Holmöarna islands constitute the single largest western part of the area, with the archipelagos at Kronören and around Snöan to the south.

The seabed consists of shallow sunlit areas, as well as deep dark areas devoid of vegetation. There are both hard rocky bottoms and soft bottoms.

The Kronören Archipelago includes a peninsula with surrounding waters and a handful of islands. In this exposed coastal and drumlin landscape one can see flat, bare rocks with low-lying black diabase dykes that have penetrated the bedrock of gneiss. Shingle stone fields

The Quark, Finland.

Marine landscape, the Quark, Finland.

and bare wave-washed rock shelves can be found, as well as water-filled rockpools and raised beaches at different levels. There is primary vegetation, as well as old forest. Old sea inlets have been transformed into glo lakes. Fish spawn in several shallow and nutrient-rich fladas. In the wintertime, grown common whitefish, perch, grayling and pike migrate here and can be caught through holes in the ice.

The coastal and marine parts of the area include submerged sandbanks, reefs, lagoons, large shallow bays and inlets, and coastal cliffs covered with vegetation. Filamentous green algae dominate in the upper zone of hard bottoms, with brown algae below. Bladderwrack is found in patches only, since this area represents the northern limit for the species on the Swedish coast of the Bothnian Sea. Soft bottoms in the bays are rich in vegetation, including four-leaf mare's-tail. Baltic tellin, aquatic sowbug and the crustacean *Monoporeia affinis* are common bottom-living animals, together with other crustaceans, snails and insect larvae.

Although 150 km apart, the High Coast and the Quark Archipelago form a transboundary World Natural Heritage Site. The steep High Coast and the flat Quark Archipelago (the "Low Coast") are topographical opposites, but together they serve as a unique example of ongoing geological and biological processes, and ecosystem development in time and space. On the High Coast, post-glacial geological history on land covering approximately 9,600 years can be observed, whereas the corresponding period of time in the Quark is about 2,000 years. Remains of the highest coastline recorded anywhere in the world can be found at an altitude of almost 286 metres on the Skule Mountain off the High Coast.

Grey seals occur in the area. The tip of the peninsula is famous for its diversity of migrating and stationary birds, e.g. white-tailed eagle, osprey, graylag goose, velvet scoter, Arctic scua, red-throated diver and Arctic tern. Birds also look for prey in the fladas. A more peculiar feature is the presence on the peninsula of moose, deer, reindeer, red deer and fallow deer in the flat rock forests close to the sea.

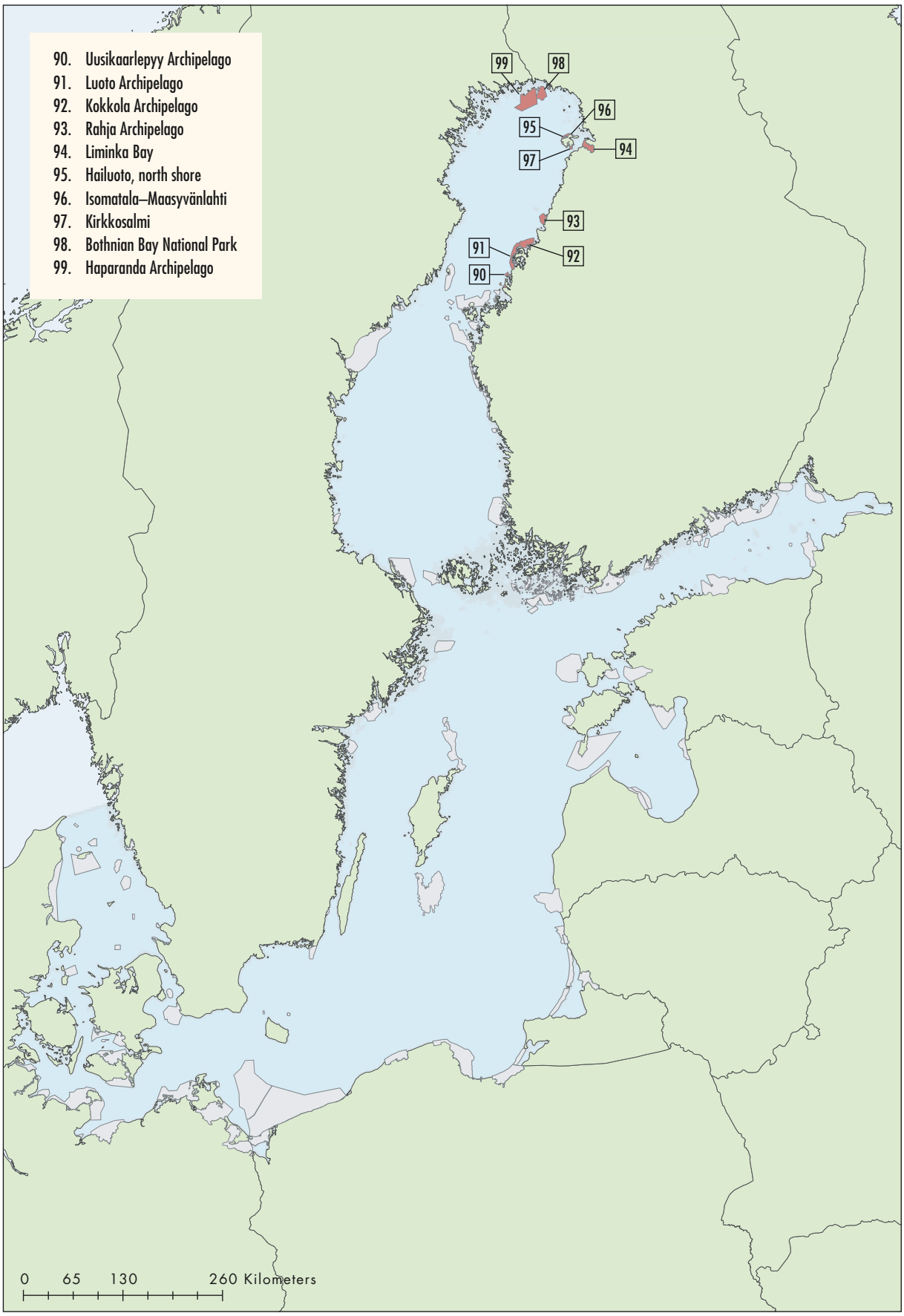
The large Holmö Islands Archipelago comprises four main islands and a number of islets and skerries in the western part. This archipelago is the only large group of islands in an otherwise island-sparse area, but it is typical of land uplift in this coastal area. The cluster of islands is made up of drumlins and de Geer moraines. There are shingle stone fields and few high points. Two of the main islands are separated by a narrow sound, still navigable by small craft. However, hundreds of previously sheltered bays in the area have already been cut off from the sea. There are submerged sandbanks, silty and sandy sometimes exposed bottoms, mudflats, sandflats and reefs. The islands demonstrate the typical succession of vegetation of coastal and offshore land uplift areas. Spruce forests on level ground and wetland areas affected by land uplift largely dominate the main islands. One of the islands, however, features coastal birch forests. Colonies of Baltic ringed seals can be found here, as well as a number of birds. The shallow waters offer important spawning and breeding areas for Baltic herring and common whitefish.

The Quark, Finland (also opposite page).

Several separate groups of islands make up the large Outer Bothnian Threshold Archipelago (also the Kvarken Archipelago World Heritage site). The Björkö archipelago, extending from the inner to the outer archipelago, is particularly representative and fine-featured when it comes to geomorphology and biotopes, characteristic of land uplift areas.

There are altogether some 6,000 islands, islets and skerries in the area, most of which are located in the outer or intermediate archipelago. There are also forested islands in the inner archipelago, as well as natural coastline areas. The bedrock mainly consists of granite and gneiss; stones and boulders are the predominant feature on beaches, whereas bare cliffs and sandy beaches are rare. Even the highest points are only 20–25 metres above sea level. The mean water depth is less than 10 metres. The islands are composed of various moraine formations, e.g. De Geer moraines. Moraine ridges (drumlins) can be 2–4 metres high, around 100 meters wide and sometimes several kilometres long. In many places, the entire process of land uplift in the coastal zone can be observed. The rising land, human activities and the bedrock and soil form prerequisites for vegetation on land. In the southern part of the sea, algae (including bladderwrack) can grow down to a depth of 10 metres, whereas in the north filamentous algae covered with diatoms (microalgae) dominate.

The area is important for several species of birds and seals. Many bird species have their northernmost population in this region, e.g. eider, due to the lack of blue mussels in the Bothnian Bay. The grey seal and Baltic ringed seal are both found, and a seal sanctuary has been established in the south-western part of the area.



From Uusikaarlepyy to Haparanda

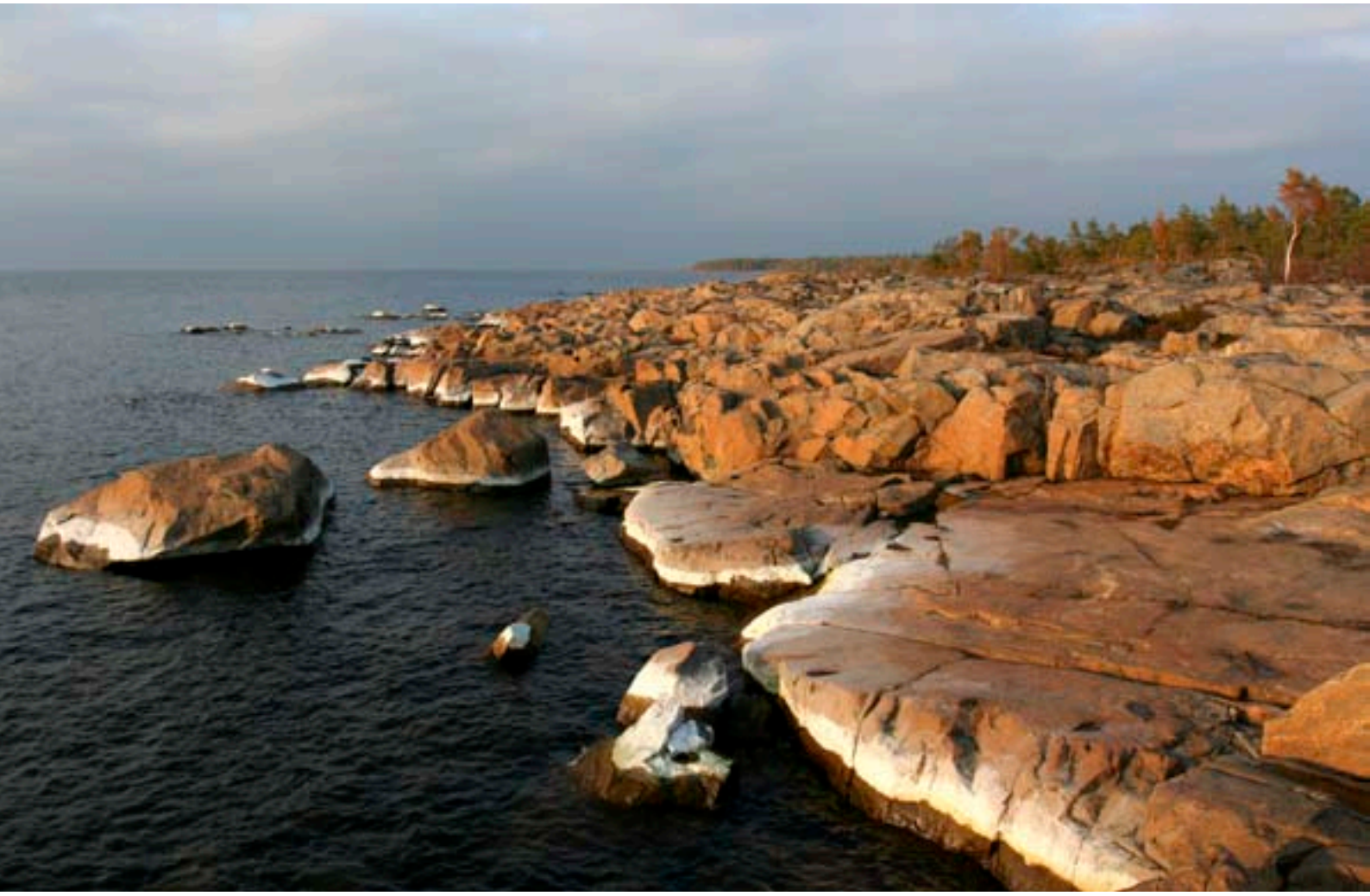
The Uusikaarlepyy Archipelago, located immediately north of the Quark area, includes important biotopes typical of the land uplift area on the coast (characterised by Vaasa granite). The preservation of the dune areas is a priority. Shores with sea cliffs dominate the intermediate and outer archipelago areas. The islands of Sandören, Torsö and Trutören have rocky, stony and sandy shores. On the mainland coast, the Storsand area is a long, sandy beach, where coastal forces have levelled an esker thereby forming layers on the shore. Here history can be read in the development from a bare beach to the present series of various sand dune formations and dune slacks. Stubben, the outermost group of islands in the archipelago, consists of three larger moraine islands with stony shores.

With numerous high and rocky islands, separated by large expanses of open water, the Kokkola Archipelago constitutes a large archipelago area representative of all the stages of strong land uplift processes. One finds beaches of shingle and sand, mud flats, lagoons (saltwork basins), shallow inlets, herb-rich meadows, aapa mires, forested islands and less sheltered rocky islands. Several regionally threatened and endemic plant species can be found on the shores. The archipelago is a valuable breeding area for a large number of bird species, and migrating birds depend on the area for resting and feeding. Fish like Baltic herring and common whitefish spawn in shallow bays and inlets, and the area is important for fishing of Baltic herring, common whitefish, perch, and smelt.

Kokkola Archipelago, Finland.

Some 360 islands, islets and skerries, surrounded by a vast water area, constitute the intermediate and outer Luoto Archipelago in the land uplift area and transition zone between the Quark and the Bothnian Bay. Research and studies on land uplift, including the succession of coastal vegetation, have been carried out here for decades. West of the main islands of Luoto and Eugmo, the outer archipelago opens up with hundreds of islets separated by sounds and small fjards. To the east, one finds Larsmo-Öjasjön, the largest dammed freshwater basin in Finland. There are rocky, sandy (e.g the 2.5 kilometre long Ådösand) and moraine shores, but the moraine cover is thinner than in the Quark area. Also here, a levelled esker line continues into the sea. There are forested islands and less sheltered rocky islands. A large number of breeding or migrating bird species depend on the outer archipelago.

The abundance of extensive shore areas in an almost natural state is the most valuable feature of the land uplift coastal and marine landscape of the outer and inner Rahja Archipelago. It is regarded as the most natural of all archipelagos along the Finnish coast, mainly due to the low density of summer houses and other human activities



Luoto Archipelago, Finland.

Rahja Archipelago, Finland.

in the area, and to the comparatively low level of eutrophication. The Rahja archipelago is one of the largest and most diverse of the northern archipelagos. The wide outer part is characterised by vast, open sea areas and a handful of rocky-shore islands, with valuable sites for birds. The inner, slightly more closed archipelago consists of sea areas, inlets and a great number of fairly small and flat islands and islets with rocky shores. As the islets are heavily influenced by the action of waves, vegetation is scarce. In the mainland coastal zone one finds vast stretches of characteristic low-lying shore meadows, but also some steep and rocky shores. The area also contains the estuary of River Siipojoki, as well as fladas and glo lakes at different stages of development.

Liminka Bay, north shore of Hailuoto, Isomatala–Maasyvänlahti, and Kirkkosalmi – form a large area in the eastern Bothnian Bay. Due to the ongoing, and in this region very strong, land uplift, the area between Liminka Bay and the island of Hailuoto will in the coming 150–300 years be transformed first into a shallow inlet and then into an inland lake.

Together, the largest bay in the Gulf of Bothnia, and the largest island in the northern part of the Gulf, constitute one of the internationally most important sites in Europe for migratory birds. The Liminka Bay, a wetland and bird area of international importance, and the northern shore of the island of Hailuoto, form a unique combination of vast stretches of peat bog with taiga forest on land and a rising island in the sea with wide shore meadows. A total of 170 bird species are known to rest in this area.

Land uplift very much characterises the Liminka Bay area; the shoreline can move several meters in a year. Large low-growing meadows, reed beds, rushes, glo lakes, bush thickets and small islets form a rich variety of habitats. This shallow bay (max. depth: 7 metres) and big estuary of two rivers has almost freshwater conditions. The area is representative of land uplift in the Bothnian Bay, as well as of the environment of a northern Baltic estuary with an exceptionally high biodiversity.

Around ten kilometres off the mainland, the island of Hailuto was originally called ”the herring islet” (Baltic herring is ”haili” in Finnish, thus ”Hailuoto”) by fishermen who settled there in the early 11th century. The island was formed from the merge of many smaller islands, separated by the Kirkkosalmi strait, only about 200 years ago. Eventually, the entire island area will be part of the mainland.

Geomorphologically the northern part of the island is the end point of a large esker formation. A dune was the first part to appear when the island rose from the sea, and the island has dune formations around

Liminka Bay, Finland.

Hailuto, north shore, Finland (above) and Kirkkosalmi, Finland.

eleven kilometres wide. Dune slacks are common. The island has long sandy beaches, coastal meadows, lichen heaths (evidence of extensive reindeer farming in older days), marshes, glo lakes, forest ponds and forests in different stages of natural succession. Submerged sandbanks cover wide, shallow-water areas around the island. Ringed seals and grey seals rest on sheltered rocks.

The southern region of Hailuto, the Maasyvänlahti–Isomatala area, is a typical land uplift coast area and an internationally important wetland and bird area. Isomatala is a separate small island (Iso matala = "large ground") immediately to the south of the main island, with some open islets around. On its shores there are vast silt sediment formations, which are sometimes exposed. The island has semi-natural coastal meadows, reed beds, small marshes (transition mires), glo lakes, and natural forests. Maasyvänlahti is a glo lake on the main island.

Today, the former sound of Kirkkosalmi area is a long sea inlet that is gradually developing into inland lakes. It is an open seashore area with a series of large glo lakes with sandy beaches, low-growing coastal meadows, reed beds, rushes, bush thickets and primary succession forests. It is an important bird area.

Bothnian Bay National Park, Finland.

A merger of the Bothnian Bay National Park to the east of the border island of Kataja, and the Haparanda Archipelago national park only 15 km to the west, into one huge Bothnian Bay national park has been discussed. For the time being, however, the areas remain separate in terms of administration, but from the points of view of nature, biotopes, habitats and connectivity, they could be viewed as one.

The vast and unique archipelago area Bothnian Bay National Park covers a total of almost 159 km², practically all of which is protected. Land areas constitute a mere 2.5 km² of this extensive area, which is characterised by groups of low-lying, open moraine islands and islets with rocky shores shaped by waves and ice. They are separated by shallow (max. depth: 10 metres) open water areas full of rocks and boulders with shallow sandbanks extending into the sea (and some sandy shores on land). The area is covered by ice for around six months every year. The largest islands – Selkäsarvi, Pensaskari and Iso-Huituri – have traditionally been used as base camps for fishing and hunting.

The strong land uplift still shapes the area, which exhibits pioneer plants, natural forests of primary succession stages, sandy and rocky dry heaths, dry meadows and coastal meadows, as well as glo lakes. The area supports a high diversity of species, including endemic and threatened plants like the Siberian primrose, in a highly seasonal environment. The large sea area, with salinity of 2 psu or less, exhibits an interesting mix of a few marine species and a number of brackish-water and freshwater species. On exposed rocky shores microalgae such as diatoms dominate on depths of 2–5 metres. Below that and down to a depth of 8 metres the vegetation consists mainly of the green alga marimo. In more sheltered localities on sandy bottoms the vegetation is characterised by vascular plants such as various species of stonewort and pondweed.

Haparanda Archipelago, Sweden.

Seven islets and parts of three bigger islands have been set aside as bird protection areas, where entry is totally or partly prohibited during the nesting season. The area constitutes a breeding or resting site for about 60 bird species, including Arctic tern, velvet scoter and greater scaup duck. Baltic ringed seals and grey seals live in the area; a seal sanctuary has been established around one of the skerries (Möyly), on the southern border of the park.

About 1,500 years ago, it was an uninterrupted water surface. Today the Haparanda Archipelago comprises the two main islands of Sandskär and Seskarö-Furö and several smaller islets and skerries, surrounded by about 60 km² of shallow water. The strong forces of land uplift have caused the seabed to rise and reveal a landscape: young, low-lying moraine islands and islets, with long stretches of sand and a number of striking sand formations, with some dunes reaching heights of 20 metres. A three kilometre long sandbar facing the north distinctively shapes the island of Sandskär. However, along the present and previous shorelines, beach ridges, shingle stone fields and even exposed primary bedrock also occur. Primary successions of pine forest occur, with heather and various berries. Dunes and shores harbour plants like the endemic field sagewort and Siberian primrose. The area is important for resting, migrating birds, and well over 200 species of birds have been observed.

Everyday concern helps protect the Baltic pearls

The sum of people's everyday concern and careful behaviour is an act of collective management of nature and a way to take care of, and maintain natural values in the long run. Behaving in the right way when visiting land or water really matters.

Keep in mind that you are a temporary guest in environments where animals and plants live permanently. Do not destroy their homes and values that cannot be replaced. Leave the area in the condition that you yourself would like to find it when arriving. Only leave your footprints behind!

Everyday concern when boating

- Follow the speed limits – they have been set for a reason. In many cases, speed limits are needed for the protection of wildlife during periods when animals are particularly sensitive to disturbance. Speed limits have also been set to protect shores from erosion by intense waves. Information on maximum speeds is available on maps, sea charts and along sea-lanes.

- Large speedboats cause noise that is disturbing and frightening to wildlife. Respect the animals in the coastal zone and do your utmost to refrain from using powerful engines for your personal pleasure at the expense – in some cases survival – of other living beings.

- The very best way to remove fouling organisms, such as bay barnacles on leisure craft, is to regularly brush the surface clean, manually or at a fully equipped cleaning station. If you have to use antifouling paints, use only approved products. Note that in some parts of the Baltic (especially in parts of the Gulf of Bothnia) antifouling paints are not permitted at all for use on leisure craft.

- For outboard engines, use fuels that are as environmentally compatible as possible. In order to reduce emissions of hydrocarbons, alkylate gasoline is a far better choice than traditional fuels. The common two-stroke outboard engines have low thermal efficiency and are extremely fuel-consuming. Combustion is incomplete and around 50 per cent of the exhaust gases, with their contents of hazardous polycyclic aromatic hydrocarbons, remain as small, buoyant liquid drops in the water stirred up by the propeller. This polluting activity takes place mainly during the 2-3 months of spring and summer when the marine environment is at its peak with regard to biological productivity. Since most leisure craft with outboard engines are used in vulnerable coastal shallow waters, the marine spawning areas and nurseries are severely affected.

- Don't throw any kind of solid or liquid waste over board. Keep all kinds of waste – from household waste to waste oil and toilet waste – on board until you can leave it ashore in a proper refuse container

← Bubbling reef, Fladen, Sweden.

or reception facility provided by a marina or guest harbour. The Baltic Sea is a Special Area according to the global MARPOL Convention (about the prevention of pollution from shipping, including leisure craft) and discarding rubbish and other types of solid and liquid waste is prohibited in Special Areas.

- If you have a chemical toilet on board, use biologically degradable fluids only. Water toilets with holding tanks should be emptied in marinas or guest harbours with reception facilities. Sewage must not be pumped overboard.

- Use chemicals that are as environmentally compatible as possible on board - for the operation of the boat and household purposes (e.g. cleaning chemicals).

- The increasing use of personal watercraft and water skis causes noise pollution. In shallow waters, personal watercraft also cause damage to animals and plants, above and under water. In some parts of the Baltic Sea, the operation of personal watercraft is altogether prohibited.

- Remember that even a quiet and peaceful activity like canoeing can cause disturbances to nesting birds. When canoeing you can come very close to birds before they discover you – or you discover them. That will give birds less time to escape, which is a stress factor for them.

- When you go ashore, follow the same general rules that apply to everyone who visits the coastal zone (see below). Respect the fact that you are virtually landing in the home of other living beings. As a rule, regard nature in the coastal zone – the mainland coastal strip as well as islands and islets – as a place where you should move around with caution and great respect for animals and plants.

- Pay special respect to seals and birds during the breeding seasons in spring and summer – seal sanctuaries and bird sanctuaries (protection areas) have been established for a reason. Be aware of and follow the rules about right to access in different areas. Information on which periods the areas are closed (when no approach whatsoever by human beings is allowed) is found in information brochures, maps and sea charts and on signs posted along the shores of the sanctuary or protection area.

- If birds fly up when you approach, it is a sign that you have come to close. Don't go even closer – keep away instead. If you come across a fledgling or a seal pup that appears to be abandoned, leave immediately. By no means touch the animal or try to move it. The mother is very likely to be somewhere nearby, just waiting for you (and the danger you represent) to disappear.

- Dogs should be kept under control at all times. When wildlife is particularly vulnerable – during the most sensitive time of year, when the young are being born and raised – even gentle dogs can be dangerous. During this period dogs should always be kept on a lead. Also at other times of the year, dogs must be kept under supervision to prevent them from harassing wildlife.

Everyday concern when visiting the shore

- Don't make camp fires directly on bare rocks. The heat causes the rocks to crack and the damage is irreparable.

- Only light fires in specially designated places or, if no such special place is available or prepared, only in places where sufficient protection can be provided, preferably in areas with gravel or sand. Always be aware of the risk of causing a large-scale fire in nature; an ill-managed fire can easily spread or damage ground and vegetation. Never light fires in very dry or windy areas.

- If you light a fire on the ground, never leave the fire or its remains unattended. Make absolutely sure that you have put out the fire completely (including embers); an outdoor fire, if not put out completely, may smoulder unnoticed for a long time before flaring up. Before you leave the place, collect the ashes and take them with you for safe disposal in a waste reception facility. That way you will help avoid the risk of fires, and the risk of heavy metals leaking from the ashes.

- Don't use disposable grills. They remain very hot for a long time and fires are regularly caused when people either leave used grills unattended, or discard hot grills in litter bins. If for any reason you have to use a disposable grill, take it with you when you leave and make sure it is properly disposed of.

- Don't leave any kind of solid or liquid waste ashore. If regular litter bins are available in the area you can dispose of ordinary dry household waste (packaging etc.) there, but nothing else.

- Never leave cigarette or cigar butts on the ground or in the water. Besides being a fire risk on shore, butts dissolved by rain or seawater will leak a large amount of hazardous substances.

Everyday concern when angling

- Never fish more than required for your personal use (eating on the spot or taking home for consumption later).
- Put small fish back in the sea. If very young, the fish has not yet had the option to spawn. In effect, taking young fish is a way of reducing the stock. For some species, e.g. plaice and cod, there are rules of minimum length for fish that may be landed.
- Be sure not to fish in privately owned water areas or in areas where fishing is otherwise explicitly prohibited. Signs will be posted in areas where you are not allowed access for fishing.
- In many areas fishing requires a special licence or other authorisation. Fishing licences and information on regulations can be obtained at tourist bureaus, nature centres, guest harbours or other visitor centres.
- Usually, free fishing (when no licence is required) is only permitted with hand-gear such as rod, jig and similar equipment with hook and line. The use of a boat is not usually permitted in these cases, nor the use of nets, trolling (with or without motor), tip-up or the like.

Everyday concern in nature conservation

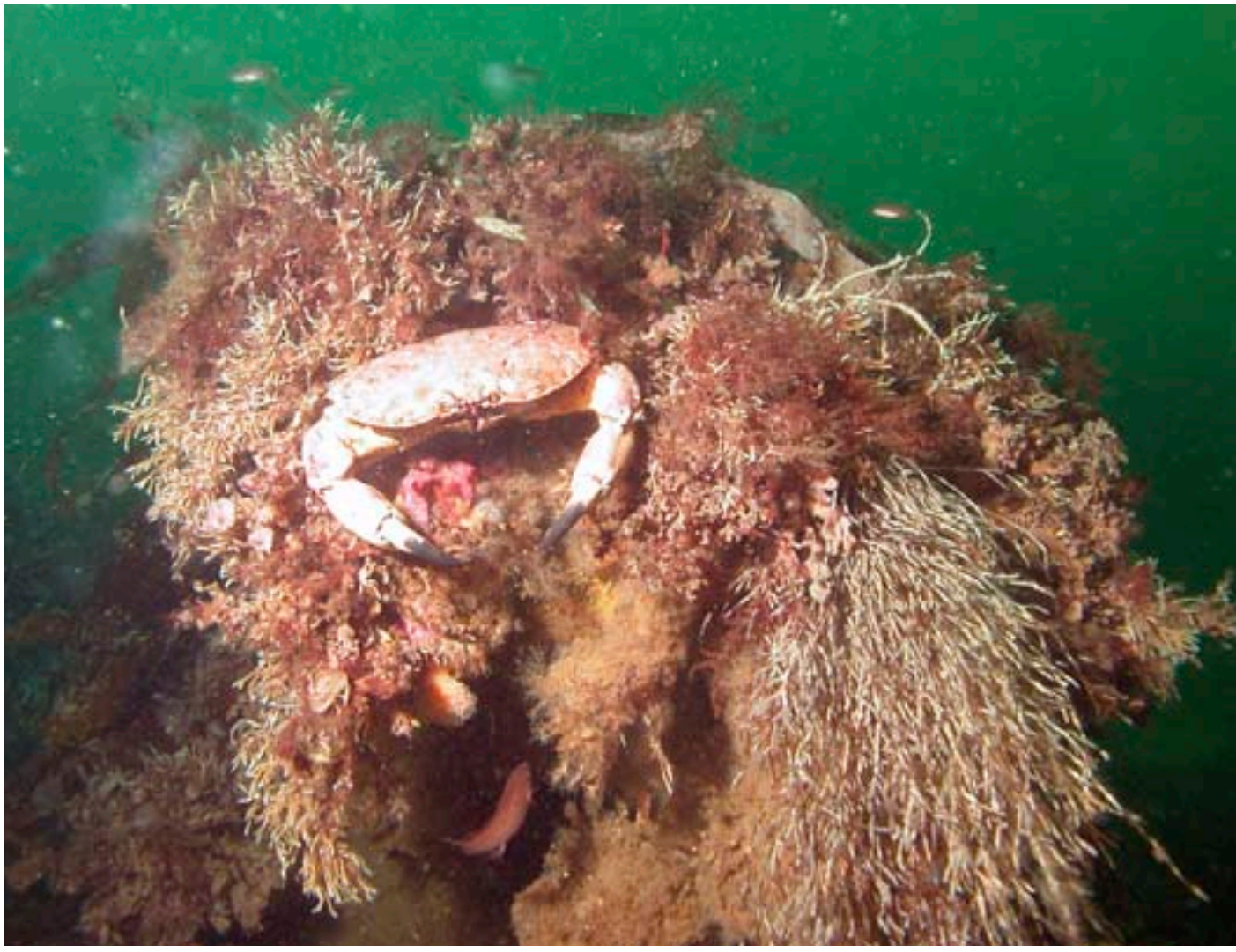
- Ensure that the network of Baltic Sea Protected Areas is completed into a truly coherent and interconnected system of protected areas to ensure protection of the wide range of biotopes, biotope complexes and species of animals and plants of the Baltic Sea area.
- Speed up the efforts to protect offshore areas. No areas situated below the sunlit zone of the Baltic Sea have yet been included among the designated BSPAs.
- Ensure that every BSPA is provided with a comprehensive and effective management plan that is efficiently implemented and enforced.
- Make all efforts to have major shipping lanes located as far as possible away from sensitive BSPAs
- Don’t allow extraction of sand or gravel within the limits of BSPAs.

- Ensure that discharges of nutrients and hazardous substances from landbased sources directly into the waters of a BSPA are not allowed.

- If fishing is still allowed within a BSPA, destructive fishing methods and gear (such as bottom trawls) must not be allowed. By-catches of seabirds and marine mammals must be brought to an absolute minimum. By-catches of non-target species must be drastically reduced and the practice of discards banned.

- The establishment of wind farms should be carefully considered within BSPAs and not allowed if these installations seriously compromise the purpose of designating the area as a BSPA. The same applies when granting permission for the placement of pipelines, power cables and other technical installations on the seabed that could cause damage to areas of importance for marine life.

Waters around Laesø, Denmark.



More facts and figures about Baltic Sea nature

Natural constraints – a fact of life

The Baltic Sea is special and precious in its own right; there is no other sea in the world quite like it. Here you find natural environments, habitats and ecosystems that are unique to this region because of the many changes and transformations it has undergone.

But it is also a sea living on the edge, with natural constraints and an inherent vulnerability.

Compared with other sea areas in the world, where ecosystems and species have had millions of years to form and mature under conditions that have not altered drastically, the Baltic Sea has only had a few thousand years during which the sea has swayed from one condition to another. The climate has changed, the water area has expanded and shrunk, the salinity and temperature of the water has shifted over and over again.

No wonder the Baltic Sea is considered an ecologically very young and unstable sea area.

In fact, at its present state of development, life of the Baltic Sea is less than around 4,000 years old. In this perspective, not much time.

← Meadow of stonewort species, Åland Sea, Finland.

Temporarily brackish

At the moment – and in the very long historical perspective it really is just a brief moment – the Baltic Sea is a large brackish-water area. There is a constant and substantial input of freshwater from precipitation and from many and often large rivers within the huge (1.7 million km^2, four times the size of the area of the entire sea) drainage area. Without the random, but occasionally substantial, influx of high-salinity water from the outside world of oceans, the Baltic would, however, have been transformed into a gigantic freshwater lake long ago.

In the Baltic Sea the concept of "salinity" means different things, like gradually going from dark shades of a colour to very light shades of the same colour. The gradual transition from salt to brackish to almost freshwater in both surface and bottom water is called a salinity gradient. It means going from next to oceanic conditions in the northern Kattegat (surface water salinity, 20 psu) to almost lake conditions in the northernmost Bothnian Bay and easternmost Gulf of Finland (1–2 psu).

To mix or not to mix

Water layers in the Baltic Sea, from surface to bottom, differ in terms of both salinity and temperature. As a consequence, barriers are formed in the water, between more saline bottom water and less saline surface water (formation of a so-called halocline), and between colder bottom water and warmer surface water (formation of a so-called thermocline).

Salinity barriers prevent surface water from mixing downwards in the water mass. This causes problems, as the surface water contains oxygen that would otherwise be mixed down into the bottom water. When this does not happen, the bottom water gradually becomes more oxygen-poor and seabeds can become temporarily lifeless. Thermoclines form during the months of summer and early autumn, but disappear in the winter when the surface water also cools down.

When the water cannot mix, particulate and dissolved substances in the deep-water layers do not readily leave the system via the surface layers. Instead, such substances are likely to re-circulate back to the bottom again. Consequently, the Baltic Sea is an efficient trap and sink for nutrients and pollutants.

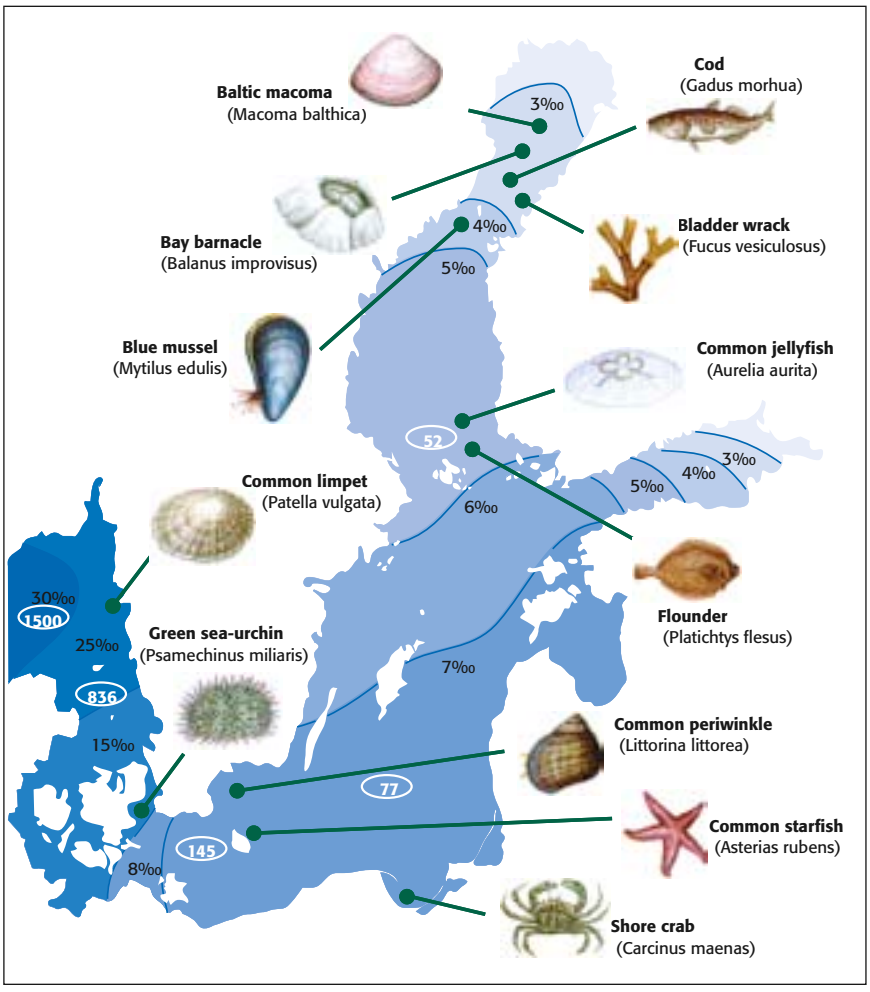
There is also a climatic gradient in the Baltic Sea, from sub-arctic to temperate conditions. In the northern parts, ice covers the sea for up to six months every year. Life in the sea does not stop. There is even life in the ice, but the long period of coldness and darkness, and the mechanical wear of the ice, is clearly a hampering factor. Compared to what is offered in the southern parts of the sea, where ice covers are very rare and the productive season could be up to nine months every year, life in the north is demanding.

Stressful life in border zones

Given the harsh living conditions in both the open sea and in coastal waters, no wonder that only a limited number of species have so far succeeded in colonising the Baltic Sea. It is not the home of very rich marine biodiversity in terms of variation. The number of plant and animal species is comparatively small, although often with many individuals of each species.

But quite tough and adaptive species live here! The Baltic Sea has a unique mix of marine and freshwater species adapted to the brackish conditions, as well as possibly also a few true brackish-water species. And they literally live side by side.

The variations in salinity and the stratification of the water profoundly influence the distribution of plant and animal species throughout the area. Going



north, the numbers and the diversity of plant and animal species gradually decrease.

Many Baltic species live in border zones. More marine species must endure conditions that provide too low salinity, and freshwater species must tackle conditions of too high salinity. Thus, for quite natural reasons, the Baltic Sea is really an almost impossible environment for most species since they have to adapt to a basically stressful life without any hope for breaks. You cannot blame them for not growing as big as their relatives do in other seas.

Life in the coastal zone in the northern Baltic Proper and the Gulf of Bothnia is possible for species with short lifecycles only, because plants and bottom-living animals are, literally, scraped off every year by the ice. Long-lived species cannot survive such hard mechanical wear.

Mountains, valleys, rocks and muds

The Baltic Sea is a generally shallow sea (50–55 metres) but the figure conceals quite dramatic variations in the underwater landscape. There are also deep basins, with depths sinking down to between 250 and 459 metres, and sills (thresholds) lying no deeper than 18–25 metres.

Looking down on the seabed, one will see different things in different parts of the sea. Depending on history, currents, and other factors, various types of hard, mixed and soft bottoms provide the basis for all kinds of life on the bottom of the sea.

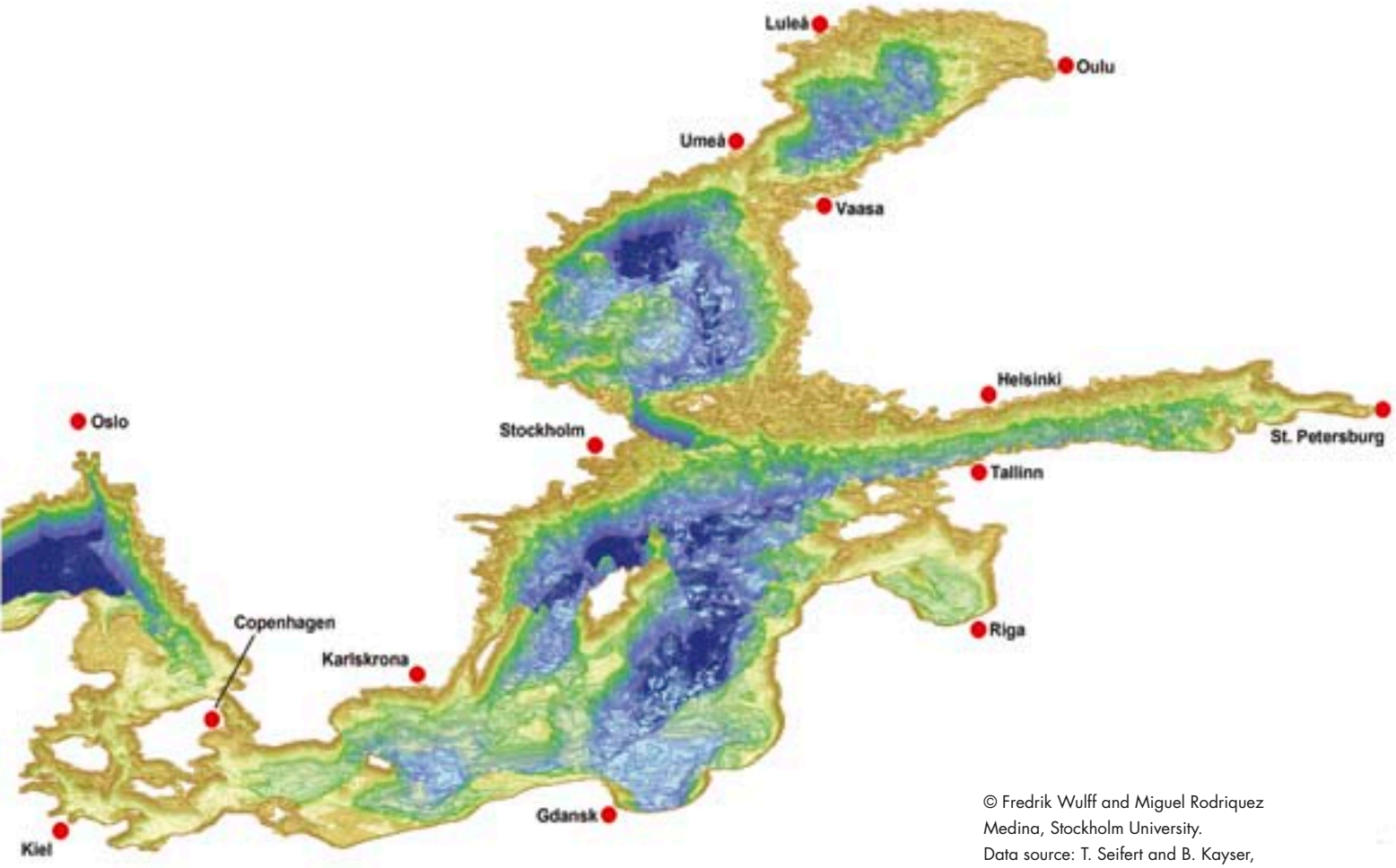
The fact that the Baltic Sea is rather shallow also gives the seabed a special role. In a deep sea, the seabed lies comparatively "quiet" at a large depth. In the generally shallow Baltic Sea the seabed is actively involved in the overall circulation of nutrients and pollutants that enter the sea. This way the Baltic Sea resembles an ordinary lake more than a sea.

The bottom sediments in the Baltic Sea have a more unpredictable function as sinks and traps. Substances might or might not re-circulate into the water sometime in the future. They could be permanently stored, and stay fixed, or be much more temporarily stored until oxygen conditions change and the substances are re-circulated again.

Pillars of the community

Like the capacity of a living organism to resist disease, biodiversity is one important component of the ability of an ecosystem to adapt to changing circumstances. Given the inevitable fact that new changes will occur in the dynamic Baltic Sea system and transform it again, resilience is about securing robust coastal and marine landscapes and intact biodiversity.

As there is not a multitude of species to choose from, some of them function as keystone species. If one species disappears, it causes an irreparable tear in the net because no other species can replace it. In a young, immature



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Data source: T. Seifert and B. Kayser, Institut für Ostseeforschung.

system like that of the Baltic Sea, each species has developed in relation to the special conditions in that system and obtained an unusually big role in terms of maintaining the structure and dynamics of the systems. In the Baltic Sea, belts and "forests" of bladder wrack, eelgrass and stoneworts, as well as beds of blue mussel, are particularly important as habitat formers. They are, literally, pillars of entire communities, as nurseries, shelters and food stores for a myriad of other species.

Unwanted additions

In the young Baltic Sea system all species are, by definition, introduced species, and new ones are still being added by natural means. However, the introduction of new (alien) species from other sea areas is a reason for concern. So far, more than 105 invasive, introduced species have been recorded. A majority of them have been introduced during the last 100 years, mainly through shipping. Some 60–70 species have established reproducing populations in the Baltic, or at least in some parts of the sea. Some of the introduced and known invasive species have already caused substantial damage.

Offshore? Marine? Coastal? Terrestrial?

In HELCOM Recommendation 15/5, areas to be protected in the system of Baltic Sea Protected Areas are classified as "coastal" or "marine".

Is there a difference between a marine area and an offshore area? Where do territorial waters and economic zones fit in? Are coastal areas terrestrial? Is the seabed close to the shore, coastal or marine?

Zones between sea and land

The littoral zone is the transitional area between land and sea. It includes the seabed, the shore, and the part of the coast (land areas) that is influenced by waves, flooding and sea spray.

Biotopes situated in the "wettest" parts of the littoral zone (the sublittoral or the hydrolittoral) are marine biotopes. The hydrolittoral is a bit higher up than the sublittoral, but still below the mean water level. The sublittoral, however, is always covered by seawater. The sublittoral zone is generally defined as the area lying between the low tide line and the edge of the continental shelf, or ranging in depth to about 200 meters. As there are hardly any places in the Baltic Sea with a water depth of more than 200 metres, the sublittoral should be defined here as more or less the entire Baltic Sea, going from the end of the hydrolittora and outwards into the open water.

Biotopes in the drier parts of the area where sea meets land (the geolittoral or the epilittoral) are terrestrial biotopes, i.e. land areas. The sea from time to time floods the geolittoral. The epilittoral is above the highest water level and extends further up on land as the "coastal zone". Although it is furthest from the sea, it can sporadically be influenced by sea spray and other marine processes.

Marine areas

Marine biotopes in the Baltic Sea are thus located in the open sea, at various distances from land, or within the hydrolittoral.

Marine areas in the open sea, like banks or grounds far from land, are offshore marine areas. Offshore strictly means "at a distance away from the shore", but in practical terms "outside territorial waters" is a relevant definition.

Bays, lagoons and other areas within territorial waters, but still extending enough far out to be considered ”open water”, are also defined as marine areas (and biotopes). This type of water area could also be referred to as ”coastal waters”, but their main parts are not necessarily close to the shore.

By definition the seabed is situated at the largest depth of the littoral, always covered by seawater or at least below the mean water level. Thus, the seabed is a marine area.

Territorial water or EEZ?

As there are no international waters in the Baltic Sea, marine areas are either included in a country's territorial water or in a country's exclusive economic zone (EEZ).

Territorial waters, within which a state has absolute sovereign rights, extend from the so-called baseline out to a maximum of 12 nautical miles.

The EEZ outside a country's territorial waters extends from the baseline out to a maximum of 200 nautical miles. Riparian states do not have absolute sovereign rights within the EEZ. This is why conflicts can occur between, for example, the wish of a riparian state to conserve and manage natural resources within that zone, and the rights of other states of shipping, application of underwater cables etc. However, a riparian state has rather far-reaching rights to promulgate legislation for the purpose of preventing, limiting or in other ways controlling pollution, disturbance and other threats to natural values.

Coastal areas

What then is the ”coast”? The Baltic Sea countries, in HELCOM Recommendation 15/1, have agreed that the Baltic coast extends 3 km landwards from the mean water line. In other words, the Baltic coast starts with the epilittoral and continues upwards. According to another HELCOM definition, however, the ”coastal strip” extends ”at least 100 to 300 meters from the mean water line landwards and seawards”.

Coastal landscapes on land are defined as terrestrial biotopes – these are coastal areas, located in the geolittoral or epilittoral. They are also referred to as ”coastal terrestrial areas”.

Coastal areas or landscapes could include, for example, islands, peninsulas, beaches, cliffs, spits and bars, coastal lakes, beach ridges, marshes and estuaries. They are all located on land or surrounded by land, although usually in close vicinity of the sea.

Waters at Kępa Redłowska, Poland.

Baltic biotopes at sea

Offshore, deep waters

Offshore grounds and banks are examples of biotopes found in the open Baltic Sea, at depths exceeding 15–25 metres, and largely without interaction between wave orbits and the seabed. These offshore areas in deep waters can be located above or below the salinity barrier in the water (the halocline).

Coastal, shallow waters

Biotopes located in the more shallow water body of the Baltic Sea, at depths no greater than 15–25 metres, and usually with an interaction between wave orbits and the sea bottom, can be divided into outer coastal or inner coastal waters.

The outermost part of archipelago areas is one example of outer coastal waters. These waters may extend to some nautical miles from the coast, sometimes beyond coastal channels and basins and above offshore banks and bars.

More or less sheltered or enclosed brackish or estuarine water bodies like lagoons, fjards, fjord-like bays and river mouths, are examples of inner coastal waters in the Baltic Sea.

Baltic biotopes on the seabed

Hard bottoms are divided into rocky bottoms, reefs, stony bottoms, gravel bottoms, hard clay bottoms, shell gravel bottoms, and mussel beds.

- Rocky bottoms consist of hard rock or soft rock, or materials that resemble rock. A hard-rock bottom consists of crystalline bedrock (solid rock), like granite and gneiss, or of sedimentary rock like sandstone and limestone. A soft-rock bottom consists of sedimentary rock-like chalk or boulder-clay or marl.

- Reefs are ridges of solid rock or accumulations of coarse mineral material. A reef rises above a flat bottom and lies either entirely below the water surface or extends only partly above water.

- Stony bottoms are predominantly covered by big stones or boulders. In areas where there are no rocky bottoms, stony bottoms have the same function and harbour more or less the same species as rocky bottoms.

- Gravel bottoms consist entirely of gravel and small stones like pebbles. They emerge when currents sweep away finer material or when gullies cut through old sediments.

- Hard clay bottoms consist of compact clay sediments. Clay is, by definition, a soft bottom material, but a hard clay bottom has the character of a hard bottom.

- Shell gravel bottoms consist of gravel mixed with shells or small shell fragments of mussels and other molluscs, often in large patches of soft sediment. When abundant, they can form shell gravel banks.

- Mussel beds become a seabed type of their own when dense colonies of mussels occur, often in multi-layered beds, on hard or soft materials on bottoms below the sunlit zone. The beds can consist of colonies of blue mussel

throughout most of the Baltic Sea Area, horse mussel in the Kattegat and zebra mussel in coastal lagoons.

Mixed sediment bottoms consist of a mixture of stones, gravel, sand, mud and/or clay. They can be found, for example, in moraine areas. The mixture of hard and soft bottom creates a good living environment for a comparatively high diversity of species.

Soft bottoms are divided into sandy bottoms, sandbanks, muddy bottoms, peat bottoms and bubbling reefs. At greater depths in the Baltic, soft accumulation bottoms are the most common. In these locations, bottom sediments are, typically, moved and formed by currents.

- Sandy bottoms consist largely of sand.
- Sandbanks are submerged banks of sand, mainly in areas where the water depth does not exceed a couple of metres but not immediately on the coast. Sandbanks are usually large and can take various shapes. They are either devoid of vegetation or covered by eelgrass. For fish, sandbanks are important spawning grounds. Sandbars are submerged ridges built up by currents and/or waves in coastal waters. Sometimes systems of sandbars develop parallel to the coast.
- Muddy bottoms consist of silt, mud or soft clay.
- Peat bottoms consist of subfossil material that has been laid bare by currents or protrudes in gullies.
- Bubbling reefs are very rare. They are found on sandy bottom areas in the Kattegat and consist of large petrified sandstone structures, carved out by erosion, with gas seeping wells in the surrounding and almost barren sediments around.

Baltic biotopes on beaches and shores

Cliffs and caves

Coastal cliffs and caves can be made of crystalline bedrock, moraine, limestone, sandstone or chalk, and can be with or without vegetation.

Coastal cliffs are steep slopes or vertical rock walls marked by unbroken steepness. They are the result of friction between the rock and moving particles in water or wind (abrasion). The surface of the rock of an active cliff is literally scraped off. Near the shoreline, cliffs are at times in the process of retreating due to, for example, the impact of waves, currents, ice, wind or groundwater and weather. A non-active cliff is resistant to abrasion, whereas an active cliff is subjected to erosion. If there is a change from abrasion processes to accumulation processes, active parts of cliffs can become inactive and vice versa. The slopes of inactive cliffs are often covered with shrubs and trees.

Moraine cliffs consist mostly of a mixture of marl, clay, sand and stones (boulder clay). Sometimes these cliffs are of pure sand, marl or hard clay.

Coastal caves are excavations in cliffs, usually larger than 1 m^3 caused by waves or ice pressure. These caves are often deep enough not to have any, or very low, daylight.

Sloping rocky shores

Gently sloping rocky shores are made of crystalline bedrock, sandstone, or limestone, with or without vegetation. These shores of compact solid rocks are long coastal stretches (plains) that slope gently into the water.

Spits and bars

Spits and bars are strips of sand, gravel, pebbles and/or shingle. One finds them along the shore or across the entrance of small bays, and they can be connected with the mainland. Unlike sandbars, which are submerged ridges in coastal waters, spits and bars are found above water in the epilittoral or geolittoral. Spits and bars are formed by waves and winds. As spits and bars in most cases are practically devoid of vegetation, they constitute important sites for birds (breeding sites for waders and terns; roosting sites for other coastal birds and waterfowl).

Beaches

Beaches in the Baltic Sea area are made of sand, gravel and pebbles (shingle), or boulders.

Sandy beaches are influenced by wave and wind action, as well as by salt and sand drift. There is usually no vegetation in the lower parts of sandy beaches, but one frequently finds drift lines or accumulations of dead algae along the shore. In the upper parts there can be primary dunes with characteristic grass vegetation.

Lahemaa, Estonia.

Mixed sediment shores are made up of boulders and boulder clay or marl, usually on moraine coasts with stone blocks larger than 20 centimetres.

Beach ridges

Beach ridges – which are not to be confused with dunes – consist of various mixtures of sand, gravel, pebbles or boulders, and can be with or without vegetation. These ridges are formed by the forces of waves or ice.

In addition, there are beach ridges consisting of accumulated algae or other plants. On erosive coasts where fossil peat layers are worn off, one can find beach ridges of peat.

- Beach ridges of rocky material can be formed by waves, ice pressure and fluctuating water levels during storms. On coastal plains there can be systems of ridges running parallel to the coast. Older beach ridges can become covered with shrubs and trees.

- Beach ridges made of plants – algae (like bladder wrack) or other plants (like eelgrass) – can be moved from one place to another by waves.

Dunes

Coastal dunes are hills or ridges of sand piled up by the wind. They can be of various height and shape, but are always formed by windblown sand along sandy beaches. Dunes are determined by winds, humidity of the sand, and vegetation.

Depending on the degree of exposure and succession, dunes can be anything from completely without vegetation to being more or less covered with marram grass or blue lyme grass; heather/ling or crowberry, or dwarf shrubs, bushes or forests.

- Foredunes are the beginning of dune succession. They are low sand formations on the upper beach, strongly influenced by wind and seawater. Foredunes are normally colonised by fragments of typical primary dune vegetation.

- White dunes are higher dunes, where freshwater lentils start developing. Windblown sand is permanently accumulated on white dunes. They are gradually colonised by marram grass, blue grass or sand sedge.

- Green dunes represent an intermediate stage between the white and grey dune stage. Only small amounts of new, windblown sand are accumulated, and conditions are favourable for species of grass to grow in the sand.

- Grey dunes are quite high but do not increase in size; the accumulation of sand has ceased. Some grey dunes are enriched with humus where lichens, mosses and grass (poor grasslands) grow.

- Grey dunes can be divided into brown dunes with different kinds of vegetation. Brown dunes with dwarf shrubs are sheltered and have a shallow fragile soil layer. Here one finds, for example, heather and crowberry. Brown dunes with dune shrubbery are also sheltered and characterised by sand consolidation, enrichment of humus and vegetation of typical shrubs, for example, common juniper or burnet rose. Brown dunes with trees can be covered with natural or almost natural coniferous forest like pine, or natural or almost natural deciduous forest (beech, birch, oak).

- Wet dune slacks are moist or water-filled (groundwater) depressions formed in sand dunes. Owing to local hydrology (groundwater table, activities that can cause draining, etc.) these dune wetlands can be waterlogged or have standing water but also dry out considerably. Depending on the degree of water contact, salinity and lime content in the soil, wet dune slacks can constitute wet meadows, fens or swamps, with anything from low vegetation to shrubs or trees.

- Migrating dunes are dunes or large dunes – generally without any stabilising vegetation – that literally move (shift), like huge sand waves. This motion is caused by strong sand drift in the prevailing wind direction.

Wetlands and meadows

Coastal wetlands (reed, rush and sedge stands; swamps, bogs or fens) and meadows constitute different biotopes found on flat or gently sloping sedimentary shorelines or on already developed soil layers of different types of rock. These wetlands and meadows are always covered with vegetation.

Wetlands are geologically young, swampy or marshy (can be temporarily influenced by brackish water), or peated. In sheltered bays or inlets of shallow coastal waters in the Baltic, even areas in the geolittoral can be covered with trees.

- Coastal stands of reed, rush and sedge can be natural (not in use or modified by man) or harvested (at specific intervals).

- Coastal swamps include different biotopes on coastal wetland sites with vegetation (herbs, shrubs or trees, including willow, ash and alder) on inorganic soils flooded by fresh or brackish water throughout most of the vegetation.

- Coastal bogs consist of different biotope sites on coastal floodplains, forming a part of a biotope mosaic of coastal wetlands in humid-climate areas. These areas are nutrient-poor (oligotrophic), with rain-fed vegetation on thick layers of peat; mostly peat moss like Sphagnum spp.

- Coastal fens are biotopes on coastal wetland sites with vegetation on peat layers (formed mainly from sedges and brown moss species) developing under the impact of groundwater and floodwater. So-called ”rich fens” develop where groundwater rich in calcium carbonate is available. ”Poor fens” are found in areas where conditions are neutral or acid.

Meadows and pastures include several coastal biotopes.

- Salt pioneer swards are the lowest part of salt marshes. On episodically flooded mudflats annual pioneer formations can occur, for example, common glasswort, annual sea-bite or pedunculate sea-purslan.

- Lower meadows typically occur on more or less wet and episodically flooded coastal areas with meadows of, for example, reflexed saltmarsh-grass, creeping bent and saltmarsh rush.

- Upper meadows are elevated marsh areas that are flooded only during extreme weather conditions. The grass species red fescue dominates.

- Dry meadows, including alvars, are mostly semi-natural meadows as part of a complex of dry coastal meadows.

- An alvar (also referred to as pavement barren or limestone pavement) is a horizontal exposure of nearly barren limestone plain, covered only by a thin soil layer. Alvars can be found on the coast and also reach further inland. In the Baltic Sea coastal areas, alvars are found on the islands of Öland and Gotland, and distributed along the whole northern coast of Estonia wherever limestone comes to the surface near the seashore.

- Tall herb stands can be found situated landward of the occasionally flooded zone of the Baltic coast.

Riverbeds, river banks and oxbow lakes

These biotopes of riverine and river mouth areas represent the lowest part of rivers and riverside areas influenced by backwater effects of the sea. They harbour freshwater communities, and also some marine elements.

A river bed, in the bottom zone of a river, is always covered with water. A river bank is the riverside, from the river bed to the river shore. An oxbow lake is a lake or pond cut off from the main parts of a river.

Coastal lakes

Coastal lakes, including glo lakes, are separated from the sea by beach ridges, large spits or rocks with varying amount of vegetation. When these natural barriers grow bigger, coastal lakes can become completely separated from seawater inflow and develop into brackish and eventually into freshwater lakes. In these brackish and freshwater coastal lakes one usually finds submerged plants and reed stands.

Glo lakes are typical for areas with extensive land uplift. A glo lake is a small, shallow brackish-water body that has been cut off from the sea following a typical succession in three main stages; shallow sea inlet or bays, flada and glo lake. Gradually, when the land rises, the inlet or bay becomes a flada. The flada is still connected to the sea through a narrow sound, but eventually that connection is broken. When that happens, the former flada has become a glo lake. The lake is virtually cut off from the sea, but during periods of high water levels or storms, the lake can temporarily be fed some new salt/brackish water.

Pools

Permanent (including rock pools) or temporary freshwater or brackish-water pools are small usually sheltered or very sheltered water bodies. They infrequently or never receive input of water from the adjacent sea. Temporary pools occasionally dry out.

Baltic biotope complexes

A biotope complex is a larger unit of coastal landscape. It is a typical, ecologically coherent complex of different specific biotopes. Biotopes in a biotope complex can be distributed in a characteristic composition. A complex can also contain habitats that reflect typical regional features. Due to specific ecological qualities like, for example, water salinity, sand supply or geological origin, biotope complexes are generally very clearly delimited.

Rocky coasts are long coastal stretches, where crystalline bedrock, such as granite, or sedimentary rock, for example, limestone or chalk, is the dominant

feature. A rocky coast consists of a complex of different biotopes, and can include cliffs as well as gently sloping rocky shores. Cliffs constitute a subtype of rocky coasts.

Sandy coasts are long coastal stretches, where sand is the dominant feature. A complex of different sandy biotopes, such as dunes and sandy beach ridges, forms the landscape. Sandy coasts are mainly formed where coastal sediment is being accumulated, but they may also occur where outwash plains meet the coast.

Moraine coasts can occur as cliffs, and as gently sloping and low-lying shores. Moraine can consist of anything from big stones to clay, usually homogenous, sometimes well sorted, sometimes not sorted at all. In sheltered parts of shores with (salt) marsh vegetation and fine sediment, moraine can be found alongside inactive cliffs. In exposed areas below the active cliffs, beaches of fine material (fine sediment, sand, gravel etc.) are often missing since any accumulation of debris is swept away by waves and currents and only coarse components make up the beach. Near-shore sea bottoms along moraine coasts are usually a mixture of stone, gravel, sand, clay, etc.

Flat coasts subject to intensive land uplift are areas where the annual primary land uplift exceeds 7 mm (actual total land uplift) and where the succession of biotopes along the land uplift gradient from marine to terrestrial environments can be seen. On flat shores these successions often result in a distinct zoning of various biotopes under continuous change. The past, present and future of these different stages of succession is reflected in the neighbouring biotopes.

Fjords are long, often narrow sea inlets, which are usually separated from the open sea by a submerged sill. No minimum depth is defined, but a fjord area can be anything from very shallow to more than 1,000 metres deep. Sedimentation is the most intense at the head of a fjord associated with a major river.

Fjards • fjord-like bays (”fjärdar”, and “Förden”) are shallow, structurally complex and often narrow sea inlets typical of post-glacial lowland coasts with an open and irregular coastline. Fjards usually lack a main channel and the characteristic sill of most fjords. The shape of a fjard often reflects the morphology of the area. Fjards are relatively shallow, often with numerous islands. ”Förden”, which are a very common landscape feature in Denmark and Schleswig-Holstein (Germany) are often tube-like elongated bays consisting of remains after glacial rivers. They can also be terminal basins of glacial erosion.

Lagoons, including Bodden, barrier lagoons and fladas/flads, are different kinds of bays that are more or less separated from the sea by surrounding land, but still with permanent connection and water exchange with the sea. Lagoons are commonly shallow, often with a varying salinity. Large coastal lagoons may have a surface area of several km² whereas small lagoons can be only a few hectares in size. Bodden are lagoon-like internal coastal waters. They are more or less separated from the adjacent Baltic Sea by moraines, spits and/or sills (submerged moraines). They are usually shallow with sandy or muddy bottoms, often with stones and occasionally with deeper areas (holes). Depending on the degree of separation from the sea, these shallow waters often have large salinity fluctuations. “Boddenlandschaft” is a typical coastal landscape of the easternmost German coast and the Polish coast. Barrier lagoons represent a succession

stage of a barrier coast where coastal bars evolve into spits and finally enclose coastal lakes. These lagoons are generally no more than one metre deep. Fladas (flads) are small, shallow, clearly delimited brackish-water bodies, which are still connected to the sea. The bottom of fladas is usually covered with submerged vegetation. Fladas are common in land uplift areas, as part of a succession process.

Large spits of sand and/or gravel separating a lagoon from the sea originate from sand and gravel that has been transported along the shore, before it is deposited (when the transport energy becomes weaker). If the supply of sand is sufficient, dunes can form. A spit is attached to land at one end and separated from the mainland by a strait/sound/narrow/sill at the other end. A lagoon or bay separates the spit from the mainland while the spit separates the bay from the open sea.

Riverine areas under backwater influence by the sea are found above the river estuary (mouth, outlet), where seawater periodically or occasionally penetrates the land along a flat, swampy river valley. Depending on local conditions, species of freshwater or salty habitats may occur.

Estuaries and river mouth areas in the Baltic Sea area can be, for example, lagoons, bay-like river mouth areas, deltas, or parts of archipelago areas. The common feature is that freshwater meets the brackish water of the sea. The vegetation in estuaries (river mouth areas) can be very rich/diverse, consisting of reeds, sedges and submerged plants.

Archipelagos are groups of numerous islands, islets and skerries of various sizes and substratum types, usually close to a mainland and usually zoned on grounds of land mass, exposure to winds and waves, and types of vegetation. A succession of biotopes from marine to terrestrial environments is visible on almost every island, and a succession from exposed marine or terrestrial biotopes to more sheltered biotopes, often closer to the mainland, is visible on a larger scale. Archipelagos usually extend over a large area and may comprise many types of biotope complexes.

Solitary islands are not included in archipelagos. Plant and animal species on solitary islands are not or extremely rarely found on the mainland.

Esker islands consist mainly of sand, gravel and boulder clay with scattered stones of variable size. Eskers are sinuous ridges formed from drift deposited in tunnels running through a glacier. Esker islands host a unique mosaic of different kinds of vegetation communities.

WHICH SPECIES?

Amphibians

Fire-bellied toad *(Bombina bombina)*
Northern crested newt • Great crested newt • Warty newt *(Triturus cristatus cristatus)*

Bottom-living animals

Aquatic sowbug • Skorv (*Saduria entomon*)
Baltic tellin *(Macoma baltica)*
Blue mussel *(Mytilus edulis • Mytilus trossulus)*
Bay barnacle • Acorn barnacle *(Balanus improvisus)*
Brown shrimp *(Crangon crangon)*
Dead man's fingers *(Alcyonium digitatum)*
European lobster *(Homarus gammarus)*
Freshwater pearl mussel *(Margaritifera margaritifera)*
Great scallop (*Pecten maximus*)
Horse mussel *(Modiolus modiolus)*
Lagoon cockle *(Cerastoderma glaucum)*
Macoma calcarea
Marenzelleria neglecta
Monoporeia affinis
Mudsnail *(Potamopyrgus antipodarum)*
Narrow-hinge astarte (*Astarte montagui*)
Ocean quahog • Black clam • Iceland cyprina *(Arctica islandica)*
Peppery furrow shell *(Scrobicularia plana)*
Sand gaper *(Mya arenaria)*
Sea mat *(Electra crustulenta)*
Thick-shelled river mussel *(Unio crassus)*
Zebra mussel *(Dreissena polymorpha)*

Birds

Arctic skua *(Stercorarius parasiticus)*
Arctic tern *(Sterna paradisaea)*
Avocet *(Recurvirostra avosetta)*
Barnacle goose *(Branta leucopsis)*
Bewick's swan • Whistling swan *(Cygnus columbianus)*
Black guillemot *(Cepprus grylle)*
Black stork (*Ciconia niger*)
Black tern (*Chlidonias niger*)
Caspian tern *(Sterna caspia)*
Common eider *(Somateria mollissima)*
Common goldeneye *(Bucephala clangula)*
Common tern (*Sterna hirundo*)
Corncrake (*Crex crex*)
Crane (*Grus grus*)
Dunlin *(Calidris alpina schinzii)*
Fulmar *(Fulmarus glacialis)*
(Northern) gannet (*Morus bassanus*)
Golden plover *(Pluvialis apricaria)*
Goosander • Common merganser *(Mergus merganser)*
Graylag goose *(Anser anser)*
Great bittern *(Botaurus stellaris)*
Great cormorant *(Phalacrocorax carbo sinensis)*
Great crested grebe (*Podiceps cristatus*)
Greater scaup duck *(Aytha marila)*

Guillemot *(Uria alge)*
Honey buzzard *(Pernis apivorous*)
Kittiwake *(Larus tridactylus)*
Little bittern (*Ixobrychus minutus*)
Little crake (*Porzana parva*)
Long-tailed duck *(Clangula hyemalis)*
Mallard *(Anas platyrhynchos)*
Marsh harrier *(Circus aeruginosus)*
Mute swan *(Cygnus olor)*
Osprey *(Pandion haliaeetus)*
Peregrine falcon *(Falco peregrinus)*
Razorbill *(Alca torda)*
Red-necked grebe *(Podiceps grisegena)*
Red-throated diver *(Gavia stellata)*
Sand martin *(Riparia riparia)*
Steller's eider *(Polysticta stelleri)*
Storm petrel *(Hydrobates pelagicus)*
Velvet scoter *(Melanitta fusca)*
Water rail *(Rallus aquaticus)*
White stork (*Ciconia ciconia*)
White-tailed eagle *(Haliaeetus albicilla)*
Whooper swan *(Cygnus cygnus)*

Fish

Allis shad *(Allosa allosa)*
Asp *(Aspius aspius)*
Atlantic cod *(Gadus morhua morhua)*
Atlantic herring (*Clupea harengus harengus)*
Atlantic mackerel *(Scomber scombrus)*
Atlantic salmon *(Salmo salar)*
Atlantic sturgeon *(Acipenser sturio)*
Ballan wrasse (*Labrus berggylta*)
Baltic [Bornholm] cod *(Gadus morhua callaris)*
Baltic herring *(Clupea harengus membras)*
Baltic sprat *(Sprattus sprattus)*
Baltic sturgeon *(Acipenser oxyrinchus)*
Bleak (*Alburnus alburnus*)
Brill (*Scophthalmus rhombus*)
Brook lamprey (*Lampetra planeri*)
Capelin *(Mallotus villosus)*
Cockos wrasse (*Labrus mixtus*)
Cod (see Atlantic cod or Baltic cod)
Common bream • Carp bream *(Abramis brama)*
Common ling (*Molva molva*)
Common whitefish (*Coregonus lavaretus)*
Crucian carp *(Carassius carassius)*
Eelpout • Viviparous blenny *(Zoarces viviparus)*
Eurasian minnow (*Phoxinus phoxinus*)
European brook lamprey *(Lampreta planeri)*
European eel *(Anguilla anguilla)*
European river lamprey *(Lampetra fluviatilis)*
European perch (*Perca fluviatilis*)
European smelt *(Osmerus eperlanus)*
Flounder *(Platichthys flesus)*

Garfish (*Belone belone*)
Grayling (*Thymallus thymallus*)
Ide *(Leuciscus idus)*
Herring (see Atlantic herring, or Baltic herring)
Leopard-spotted goby (*Thorogobius ephippiatus*)
Mud loach • Weather loach • European weatherfish (*Misgurnus fossilis*)
Northern pike *(Esox lucius)*
Pike-perch *(Sander lucioperca)*
Plaice *(Pleuronectes platessa)*
Pollack (*Pollachius pollachius*)
Roach *(Rutilus rutilus)*
Round goby (*Neogobius melanostomus*)
Ruffe *(Gymnocephalus cernuus)*
Sabre fish *(Trichiurus lepturus)*
Sand goby *(Pomatoschistus minutus)*
Sea lamprey *(Petromyzon marinus)*
Sea trout *(Salmo trutta)*
Sole *(Solea solea)*
Shorthorn sculpin *(Myoxocephalus scorpius)*
Silver bream • White bream *(Blicca bjoerkna)*
Sturgeon (see Atlantic sturgeon, or Baltic sturgeon)
Three-spined stickleback *(Gasterosteus aculeatus)*
Turbot *(Psetta maxima)*
Vimba bream *(Vimba vimba)*
Wels catfish (*Siluris glanis*)

Plants

Algae

Black carrageen • Agar-agar • Baltic agar *(Furcellaria lumbricalis)*
Bladderwrack *(Fucus vesiculosus)*
Marimo *(Cladophora aegagrophila)*
Oarweed *(Laminaria digitata)*
Sea lace • Dead man's rope *(Chorda filum)*
Serrated wrack *(Fucus serratus)*
Smooth cord weed *(Chorda tomentosa)*
Spiral wrack *(Fucus spiralis)*
Sugar kelp *(Laminaria saccharina)*

Stoneworts (Charophyta)

Baltic stonewort *(Chara baltica)*
Braun´s stonewort *(Chara braunii)*
Bearded stonewort *(Chara canescens)*
Covergent stonewort *(Chara connivens)*
Chara horrida
Coral stonewort *(Chara tomentosa)*
Rough stonewort *(Chara aspera)*

Mosses (Bryophyta)

Willow moss *(Fontinalis antipyretica)*

Vascular plants

Ash (*Fraxinus excelsior*)
Beech (*Fagus silvatica*)
Birch (*Betula sp.*)

Common hornwort *(Ceratophyllum demersum)*
Cow-wheat *(Melampyrum lineare)*
Crested cow-wheat *(Melampyrum cristatum)*
Eelgrass *(Zostera marina)*
Elm (*Ulmus scabra*)
European black alder (*Alnus glutinosa*)
Fennel pondweed • Sago pondweed *(Potamogeton pectinatus)*
Field sagewort *(Artemisia campestris)*
Fireweed • Rosebay willowherb *(Epilobium angustifolium)*
Fourleaf mare's-tail *(Hippuris tetraphylla)*
Glasswort (*Salicornia virginica*)
Gray alder (Alnus incana)
Hairy smotherweed *(Bassia hirsuta)*
Horned pondweed *(Zannichellia palustris)*
Juniper (*Juniperus communis*)
Linden (*Tilia cordata*)
Lyme grass *(Leymus giganteus)*
Maple (*Acer platanoides*)
Marram grass (*Ammophila arenaria*)
Oak (*Quercus robur*)
Pine (*Pinus silvestris*)
Reed *(Phragmites australis)*
Rowan (*Sorbus aucuparia*)
Rush (Juncus sp.)
Sea buckthorn *(Hippophae rhamnoides)*
Sea club-rush *(Bolboschoenus maritimus)*
Sedge (Carex sp.)
Siberian primrose *(Primula sibirica)*
Small-flowerd willowherb (*Epilobium parviflorum*)
Spiked water milfoil (*Myriophyllum spicatum*)
Spruce (*Picea excelsa*)
White water-buttercup • Water crowfoot *(Ranunculus aquatilis)*
Wild pansy *(Viola tricolor)*

Mammals
American mink *(Mustela vison)*
Baltic ringed seal *(Phoca hispida botnica)*
Brown bear *(Ursus arctos)*
Common seal • Harbour seal *(Phoca vitulina)*
Grey seal *(Halichoerus grypus)*
Harbour porpoise *(Phocena phocena)*
Otter *(Lutra lutra)*

HELCOM – WORKING FOR THE BALTIC SEA

The Baltic Marine Environment Protection Commission – the Helsinki Commission (HELCOM) – is the governing body of the Convention on the Protection of the Marine Environment of the Baltic Sea Area (the Helsinki Convention).

The Convention was first signed in 1974 and revised in 1992. All nine riparian states – Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden – are Contracting Parties to the 1992 Convention, as is the European Community.

The main tasks of HELCOM are to provide timely information about environmental trends and the state of the marine ecosystem. Based on this, common objectives and actions are developed, which the governments of the Baltic Sea States are expected to implement through national environmental programmes and legislation.

HELCOM works through intergovernmental cooperation, and efforts are concentrated on four main environmental priorities:

- Curbing eutrophication (caused by excessive input of nutrients to the sea);
- Preventing pollution by hazardous substances;
- Improving maritime safety and accident response capacity;
- Halting habitat destruction and the decline in biodiversity.

The overall goal is to restore and safeguard the ecological balance of the Baltic Sea, recreating a healthy marine environment with balanced ecosystems for the benefit of present and future generations.

The Convention covers the Baltic Sea and the seabed, as well as the inland waters of the riparian states. Measures are taken in the entire 1.7 million km^2 large drainage area of the sea to reduce landbased pollution. This area includes major parts of the riparian states and also small parts of the territory of Belarus, Czech Republic, Norway, Slovakia and the Ukraine.

As Contracting Parties to the Convention, the countries around the Baltic Sea – individually or jointly – take legislative, administrative or other measures to prevent and eliminate pollution and overexploitation of resources.

HELCOM works as

- a policy-maker for the Baltic Sea area (develops common environmental objectives and actions);
- an environmental focal point (provides information on the state of and trends in the marine environment; on the effects of measures taken; and on common initiatives and positions to form the basis for decision-making in other international fora);
- a body for developing recommendations and guidelines (so far about 200 of them) on issues relevant to the environmental work in the Baltic Sea region);
- a supervisory body (to ensure that HELCOM environmental standards are fully implemented by all parties involved);
- a coordinating body (to ensure swift national and joint international response to accidents and incidents at sea).

The major aspects of the marine environmental work in the Baltic Sea can thus be summarised:

- Take measures to combat pollution from all kinds of landbased sources (all activities within the drainage area), and seabased sources (operational pollution from shipping and offshore activities; seabed mining);
- Take measures to prevent pollution from shipping and offshore accidents, promote maritime safety, and build response capacity to reduce damage from accidents and discharges;
- Promote nature conservation and protection, and protection of biodiversity (halt habitat destruction, establish protected areas; take measures to protect species); and
- Co-ordinate monitoring and produce assessments of the state of threats and the marine environment (trends, impacts and results of measures).

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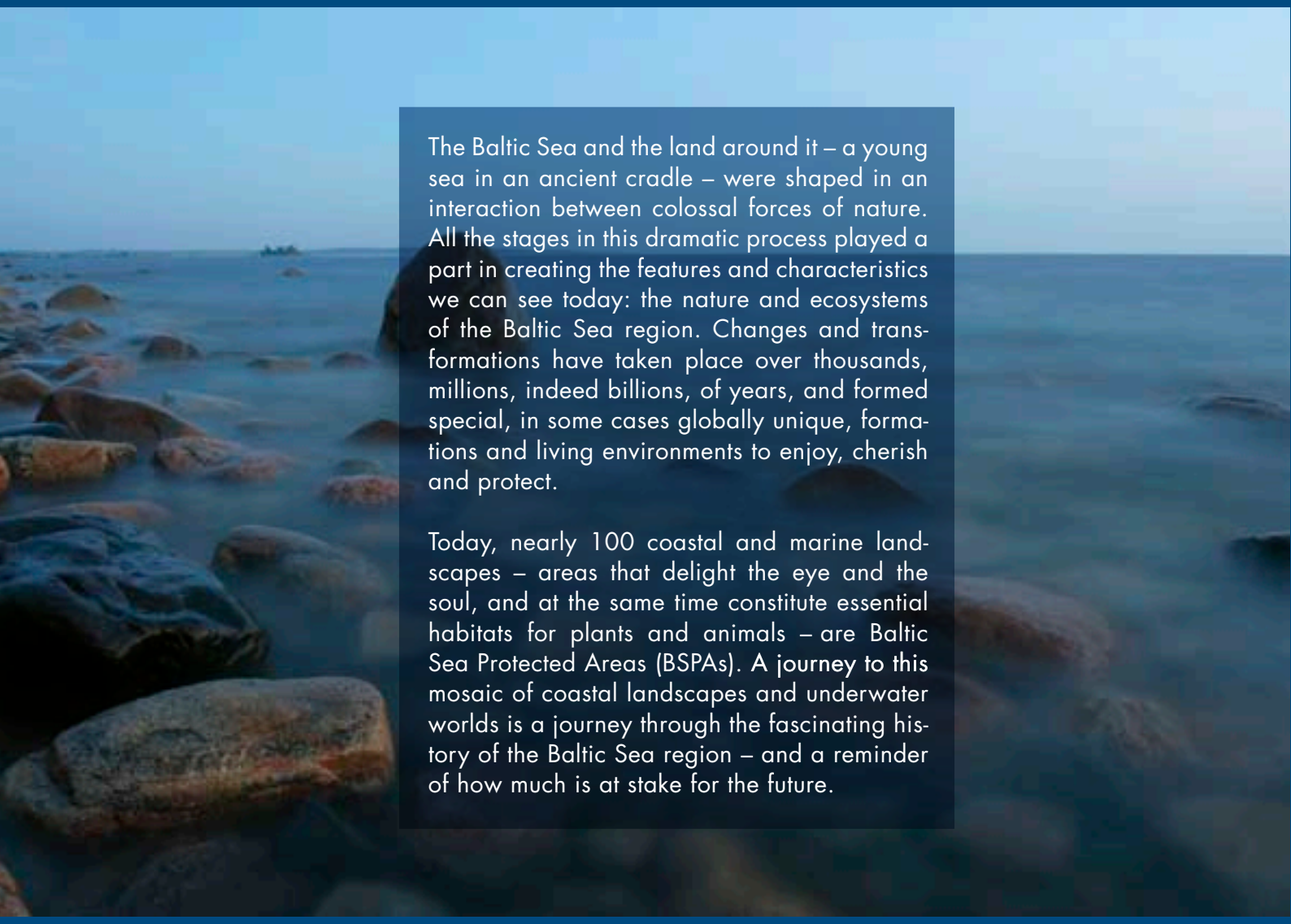

The Baltic Sea and the land around it – a young sea in an ancient cradle – were shaped in an interaction between colossal forces of nature. All the stages in this dramatic process played a part in creating the features and characteristics we can see today: the nature and ecosystems of the Baltic Sea region. Changes and transformations have taken place over thousands, millions, indeed billions, of years, and formed special, in some cases globally unique, formations and living environments to enjoy, cherish and protect.

Today, nearly 100 coastal and marine landscapes – areas that delight the eye and the soul, and at the same time constitute essential habitats for plants and animals – are Baltic Sea Protected Areas (BSPAs). A journey to this mosaic of coastal landscapes and underwater worlds is a journey through the fascinating history of the Baltic Sea region – and a reminder of how much is at stake for the future.