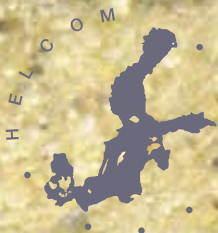


# *The Baltic Sea*

*Discovering the sea of life*

Helena Telkänranta



HELSINKI COMMISSION  
Baltic Marine Environment  
Protection Commission







*The Baltic Sea – Discovering the sea of life*



*The* ***Baltic Sea***  
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Published by the Baltic Marine Environment Protection Commission –  
Helsinki Commission (HELCOM)

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Language revision: Fran Weaver

Editorial board: Anne Christine Brusendorff, Nikolay Vlasov, Juha-Markku Leppänen

Layout: Bitdesign / Leena Närhi

Printed by Erweko Painotuote Oy 2006

ISBN 952-91-9962-7 (sid.)

ISBN 952-91-9963-5 (pdf)

All the photographs in this book have been taken in natural environments.

Some photographs are used in contexts other than the exact geographical location where they were taken, but in all such cases the depicted species also live in the locations described.

The only fictitious element in this book is the story of a family of mute swans on migration, where every detail is nevertheless representative of the authentic behaviour of the species in the wild.



The making of this book has been partially funded by the European Community.



# Contents

Foreword	8
Acknowledgements	9
<b>1. Swans, porpoises, and living filters</b>	<b>10</b>
The meeting point with the oceanic world	12
A haven for migrating birds	13
A porpoise is born	14
Play and display	14
Living filters at work	16
How to make your plumage waterproof	18
Salty water	20
Shoals of 500 million herrings	22
<b>Information boxes:</b>	
Flatfish: eyes on either cheek	13
The harbour porpoise – Europe’s smallest whale	15
The past and future of porpoises	15
Protection based on science	15
Blue mussels – the largest biomass in the Baltic	16
Cockles hidden beneath the seabed	17
Waterfowls’ thermal underwear	19
The six sub-basins of the Baltic Sea	21
Salty inflows from the North Sea	21
Salty waters run deep	21
Herrings’ varying schedules	23
Salty water vital for cod eggs	23
<b>2. Marine gardens</b>	<b>24</b>
On to the Baltic Proper	26
A German haven for bird migrants	28
Guillemot fortresses	32
The epic journey of the eel	34
Eelgrass – the largest individual in the Baltic	36
Fishermen’s unintentional catches	38
<b>Information boxes:</b>	
White-tailed eagles on the rise again	27
HELCOM’s successes in reducing toxic chemicals	27
The arctic tern – a bird of light	29
Plants of sandy and rocky shores	33
The deepest of the deeps	33



The mysterious life of the eel . . . . .	35
Orchids and ancient coral reefs . . . . .	35
Butterflies of Gotland . . . . .	35
Forests of bladderwrack . . . . .	37
Good times for birds . . . . .	39

<b>3. Eye to eye with the underwater world . . . . .</b>	<b>40</b>
Summer in the northern Baltic . . . . .	42
At home in the archipelago . . . . .	46
Unintended havoc . . . . .	47
Attentive fishy fathers . . . . .	48
Animal or vegetable? . . . . .	50
Algae assorted by colour . . . . .	52
Tiny denizens of the underwater world . . . . .	54

**Information boxes:**

Three seal species . . . . .	43
The downs and ups of seal populations . . . . .	43
International co-operation saves endangered animals . . . . .	43
Sensitive nesting islets . . . . .	47
Pipefish – northern seahorses . . . . .	49
Gobies’ nurseries . . . . .	49
Sticklebacks – armed and dangerous . . . . .	49
Polyps – animated twigs . . . . .	51
Sea mats – microscopic animals with their own calcium shelters . . . . .	51
Light and depth . . . . .	53
Sexual and asexual algae . . . . .	53
Successful snail strategies . . . . .	55
Gender-bending shrimps . . . . .	55
Copepods and water fleas – vital links in the food chain . . . . .	55

<b>4. Perches, burbot, and a million jellyfish . . . . .</b>	<b>56</b>
Signs of autumn . . . . .	58
Millions of jellyfish . . . . .	60
Colours of autumn . . . . .	62
Time to migrate . . . . .	63
A black day . . . . .	66
Arrival in Estonia . . . . .	68
Inside the world of fish . . . . .	70

**Information boxes:**

Blue-green algae – ancient life forms . . . . .	59
Why algal blooms occur . . . . .	59
HELCOM’s work reducing nutrient emissions . . . . .	59
Jellyfish – eight eyes and eight noses . . . . .	61
Polyps as parents, jellyfish as grandparents . . . . .	61
More oil on the move . . . . .	67
Curbing oil spills and accidents . . . . .	67
Landscapes created by ice . . . . .	69
Saaremaa – a botanical paradise . . . . .	69
Solitary burbot and sociable perches . . . . .	71
The secret life of fish . . . . .	71



<b>5. Bird paradises of the eastern Baltic</b> .....	72
A haven for millions of birds .....	74
By the salmon rivers of Latvia and Lithuania .....	76
Greetings from faraway seas .....	78
The variety of life .....	80
Eager foster mothers .....	84
The grey heron – a master of patience .....	86
Cormorants hung out to dry .....	86
Underwater soundscapes .....	88
Fast boats – a danger to ducklings .....	88
The beginning of the future .....	90

**Information boxes:**

Visitors from the Arctic .....	75
Salmon in search of home .....	77
Invasive species – from the age of the Vikings to today .....	79
Exotic and problematic invaders .....	79
HELCOM and invasive species .....	79
Why the Baltic is so vulnerable to alien attack .....	81
Diversity and habitats .....	81
Coots' winter gatherings .....	85
Goosanders – fishing as a team .....	85
Cormorants make a comeback .....	87
The perils of plastic .....	89
How does a boat sound underwater? .....	89

<b>What the Baltic Sea could be</b> .....	92
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<b>How can I help to make the sea healthier?</b> .....	94
Get informed and involved .....	94
Pollution prevention begins at home .....	94
Keep rubbish out of the sea .....	95
Prevent pollution when boating .....	96
Protect marine wildlife .....	96

<b>HELCOM – protecting the Baltic Sea</b> .....	97
Information and guidelines based on research .....	98

<b>Index</b> .....	102
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**Maps and diagrams**

- An exceptionally shallow sea
- Salinity variations
- Catchment areas
- Shallows and deeps
- Network of marine protected areas in the Baltic Sea





# Foreword

Porpoises chatter and whistle messages to each other. Colourful orchids bloom on remote islands. Newborn seal pups gaze over fields of ice as white as their own fur coats. Many more beautiful animals and plants like these can be found surprisingly near us, in and around our own sea – the Baltic.

No other sea in the world is quite like the Baltic. It is a body of brackish water, virtually an inland sea, and many parts of the sea freeze over each winter. Although the Baltic is also one of the world's largest bodies of brackish water, its average depths are exceptionally shallow.

These conditions have given rise to unique ecosystems where marine and freshwater species live side by side, together with some arctic relict species trapped here after the last Ice Age.

Today, the Baltic Sea faces more threats than any other sea in the world, in the shape of various forms of pollution and other ecological problems. Toxic chemicals, excessive blooms of blue-green algae and oxygen-depletion on the sea floor are just some of the problems facing the wildlife of the Baltic Sea. The good news is that the sea still is full of many fascinating and even exotic creatures, which it is up to us to cherish and conserve.

People around the Baltic Sea are already working to protect the sea in various ways. A lot of this work is carried out or coordinated by the Baltic Sea Environment Protection Commission (also known as the Helsinki Commission, or HELCOM) – the intergovernmental body that represents all of the nine countries around the Baltic and the European Union.

This book aims to take readers on an armchair tour of the sea, to discover life forms that live so near us, but yet are still so unfamiliar to most of us. This journey starts in the air, where we soar over the sea in the company of birds, and ultimately dive into the water to meet creatures that few of us ever have the chance to see eye to eye. Welcome to this colourful journey around our own unique sea!

# Acknowledgements

Many people have contributed to this book in various ways, and I owe my gratitude to all of them. Anne Christine Brusendorff, Nikolay Vlasov, and Juha-Markku Leppänen of HELCOM constituted an intelligent and supportive team with whom it was a pleasure to produce this book. Their comments and suggestions have been instrumental in determining the final form of the book. Minna Pyhälä, Kaj Granholm, Hanna Paulomäki and Leena Heikkilä of HELCOM have also made many helpful comments and suggestions.

Special thanks are particularly due to all the photographers who made their impressive portfolios available to us, as well as to the many photographers' associations and other people who helped us to find suitable photographs. A complete list of all the photographers whose images are reproduced in this book is given on page 2.

I would also like to thank the graphic designer Leena Närhi for her close cooperation, insight and flexibility throughout the making of the book.

Thanks are also due to Fran Weaver for language checking and editing and to Janet Pawlak for scientific comments.

When compiling material for a book like this, reliable sources of information are invaluable. Such treasure troves worthy of mention in addition to various reference books and reports include the websites of HELCOM, the Finnish Institute of Marine Research, and Alleco.

Special thanks are also due to my daughter and son, Taina and Raimo Tengvall, whose constant support and patience helped to make the writing of this book a pleasurable experience.

*Helena Telkänranta*





1 *Swans, porpoises,*



*and living filters*

# The meeting point



The mute swan, *Cygnus olor*, is the largest bird found in the Baltic Sea. To get their heavy bodies airborne, swans need to build up speed like aircraft on a runway before they can take off.

The brightness of the sunlight left no doubt. Spring was on its way. Reflected rays of light danced on a glittering sea. One sunbeam illuminated a large white form on the shore, making it shine like a small iceberg.

But this white shape did not seem to reflect any enthusiasm about the impending arrival of spring. It moved slightly, unfolding a long and slender neck from beneath a huge wing. Feeling oddly tired, the swan turned his head to make sure his mate was still there.

The two swans had been “engaged” since the previous summer. This is common in the world of swans. Even before they reach sexual maturity at the age of three or four, many males and females form partnerships that last for life.



# with the oceanic world

## A haven for migrating birds

All around the two swans, millions of wintering seabirds were getting more and more excited. The daylight hours were growing a little longer every day. The call of distant shores, far away beyond the sea to the north-west, was becoming more and more tempting.

These shores of the Danish Straits are among the favourite wintering sites of birds in the Baltic, rivalled only by the Gulf of Riga, and the most popular wintering grounds of all – the delta of the River Oder, shared by Poland and Germany.

But by now, the flocks of divers, long-tailed ducks, scoters and many other birds had started to thin out. Some birds had already migrated to the northern parts of Baltic for the summer. Others had headed off to inland lakes, or continued even further north right up to the Arctic Ocean.

Swans of different species also migrate. Our pair of swans are of the species known as mute swans, due to their very limited vocalisations.

The female swan waddled to the edge of the water in order to find a snack of underwater plants. She twisted her long, flexible neck towards the water, plunged her head right into it, looked around – and saw a pair of eyes in the sandy bottom, staring steadily back at her.

The owner of the eyes remained motionless, waiting patiently for the swan to go away. The flatfish wanted to continue what it had been doing: waiting for prey, hiding on the bottom, with only its keen protruding eyes betraying its presence.

### **Flatfish: Eyes on either cheek**

The turbot, *Psetta maxima*, is a master of camouflage. This fish digs itself into a sandy bottom, and waits for smaller fish or other prey to pass by. The fact that turbot has both eyes on the same side of their head gives them an outlandish appearance.

Most turbot has their eyes on their left side. But other species of flatfish, such as the flounder, *Platichthys flesus* (below), usually have their eyes on the right. All turbot, flounders, and other flatfish are born as perfectly normal-looking fish. But soon their face starts to become distorted, and one of their eyes starts to move slowly across to the other side of their head. When the youngsters are a few centimetres long, they already look like miniature adults.

The flounder is also a master of concealment, able to camouflage itself by covering its body with sand – and also by changing its colour to blend in with the surroundings.



## A porpoise is born

As the female swan went on looking for juicy shoots of aquatic plants, a shadow was suddenly cast on the sea bottom – with another shadow following close behind.

Glancing around, the swan saw a harbour porpoise gliding near the surface. The porpoise was carefully attending to another, much smaller creature, which seemed to be moving uncertainly.

A newborn porpoise is easy to recognize by its birth lines, which look like large pale folds in its skin. These lines only remain visible for the first few hours after birth. Otherwise, the calf did not look like a newborn, since it was already almost half as long as its mother.

## Play and display

A boat was slowly passing near the shore, but the passengers did not notice the mother and baby. People travelling by boat are often unaware of the presence of porpoises, who normally prefer to keep a low profile.

Having lifted her head up from the water, the swan heard an odd noise, like a sneeze. This puffing sound was caused by another porpoise surfacing and exhaling, after which it quickly inhaled and disappeared. Porpoises are good at holding their breath, and can stay submerged for six minutes before they need to surface for another lungful.

After diving, this porpoise hurried to join a group of its companions resting further away by the surface. Soon the whole group was in action, flashing their white bellies as they rolled in play. One of them was displaying by swimming upside down – a common trick used by porpoises searching for a mate.

Like whales and other dolphins, porpoises breathe through their blowholes, which are in fact modified nostrils located on top of their heads.





Porpoises are more difficult to spot than their better-known relatives, the dolphins. Whereas dolphins often leap high up into the air, porpoises only visit the surface briefly.

### **The harbour porpoise – Europe’s smallest whale**

The harbour porpoise, *Phocoena phocoena*, is about the size of an adult person. The normal body length is 1.5–1.8 metres, and most weighs less than 80 kilograms, making them the smallest whale species in Europe.

Porpoises are highly intelligent. They communicate using a complex language of clicks and whistles. Most of the sounds they make are so high-pitched that they are beyond our hearing range. Thus a human diver may not hear anything while swimming near a group of porpoises, even though an underwater microphone capable of detecting ultrasound could pick up quite a chatter.

### **The past and future of porpoises**

Most of the Baltic Sea’s porpoises now live in Danish waters, although they are sometimes seen off the German, Polish and Swedish coasts – and occasionally even further north. There are thought to be about 600 porpoises in the Baltic today.

A hundred years ago porpoises were a lot more common. Until the 1930s, their range covered the whole of Baltic Proper, the Gulf of Riga and part of the Gulf of Finland.

But then during the cold winters experienced at the time of World War II the whole of the Baltic Sea was covered with ice. The porpoise population collapsed and never fully recovered. A major reason for this failure to recover has been the toll taken by fishing nets, where porpoises get entangled and die by drowning.

Another problem for porpoises is the accumulation of toxic chemicals in their prey, especially in herrings that comprise a major part of their diet. If these problems can be solved, this intelligent and playful marine mammal could again become a much more frequent sight around the Baltic.

### **Protection based on science**

In order to protect the whole of the natural Baltic marine environment, HELCOM has been cooperating closely for three decades with the scientific community through its own scientific network and through the work of several scientific organisations acting as official observers.

HELCOM uses wide-ranging scientific advice as the basis for decision-making by regularly producing comprehensive assessments on the pressures affecting the marine environment, and their effects on the whole marine food web. For more than 30 years HELCOM has also been helping to build up a common scientific understanding of the marine environment.

## Living filters at work

The female swan stood up to flap her wings for exercise, revealing a mighty wingspan of more than two metres. She had hatched a few years ago as just a little “ugly duckling”, a tiny bundle covered with grey down, but she was now a full-grown member of the largest bird species found around the Baltic Sea. Mute swans have a body length almost equal to that of a human, measuring one and a half metres from their beaks to the tip of their tails.

The male, however, was still lying motionlessly on the sand, simply resting. Regaining his strength and getting over this strange fatigue was his top priority now. Much more was at stake than he could have realised. The coming summer would be the first when the couple would be mature enough to have their own offspring – if the male could survive until then.

The female continued feeding on the smorgasbord of underwater plants, aquatic snails, and other delicacies available in the shallow water. One item on this submarine menu was of no interest to the swan, however, in spite of its abundance. The female purposefully ignored the multitude of blue mussels laid out on the sea floor in groups large and small.

Coastal waters are where marine life is most abundant. Mussels are no exception. The blue mussel lives in shallow waters, normally at depths of just a few metres, where plentiful mussel colonies also serve as shelters for a myriad of small animals.

Blue mussels serve as a hiding place for many other animals, for example the long-spined bullhead, *Taurulus bubalis*, seen in this photograph. Can you find it?





Some cockle species, like *Parvicardium hauniense*, are agile climbers. The cockle uses its single foot for climbing around on aquatic plants.

### **Blue mussels – the largest biomass in the Baltic**

As a blue mussel, *Mytilus trossulus*, gets older, it grows in size at the broad end of its shell. The narrow end is thus the oldest part of the mussel. In the Baltic Sea, blue mussels normally grow to a length of about four centimetres, at which point they may be up to 15 years old.

Blue mussels hold a regional record. They have the largest biomass – the sum of the masses of each individual in the species – in the whole Baltic Sea. Their abundance gives them a very important role in the marine ecosystem. Mussels feed by filtering the water and extracting various micro-organisms. It has been estimated that within a single year, a volume of water corresponding to the whole of the Baltic Sea passes through this army of living filters.

However, even all these miniature labourers are not enough to meet today's needs. Their filtering capacity is not sufficient to negate the effect of excessive nutrients that flow into the Baltic in rivers. These days toxic chemicals – especially persistent organic pollutants – can accumulate in mussels' bodies and get into the food chain via the birds and other animals that eat them.

### **Cockles hidden beneath the seabed**

Mussels are not as sedentary as they first seem. They can glide slowly along the seabed, and some species can even hide themselves in sand. One such shellfish is the lagoon cockle, *Cerastoderma glaucum*. This species has a long, hook-like foot, which it uses to dig itself into the sand until only the ends of its siphons are visible. These siphons are two elongated tubes, one of which is for incoming water and food, while the other is an anal siphon. The end of each siphon is lined with sensory tentacles equipped with a multitude of tiny eyes.

Another agile digger is the Baltic clam, *Macoma baltica*. This species is most common at depths of two to five metres, where one square metre of seabed may house several hundred Baltic clams. Clams can also be found in more modest numbers right up by the shoreline, or at depths down to 70 metres.



A male eider grooming his feathers.

## How to make your plumage waterproof

A sudden movement alerted a colony of blue mussels, prompting them to slam their shells shut. This was not enough to defend them against the intruder, however.

An eider was swimming towards the mussels. Holding his breath and treading the water with his webbed feet, he reached the colony and snatched a mussel with his beak. He then stopped paddling, and immediately bobbed back up to the surface like a cork.

Blue mussels are the most important item in eiders' diet. These large ducks can dive down to depths of twenty metres or more in search of delicacies, although most mussels are found in shallower waters – which usually makes things easier for the eiders.

After eating, the eider joined a group of his companions enjoying a bath in the water, a routine that all ducks frequently engage in. Meanwhile, some other eiders were sitting on the shore taking care of their plumage – gymnastically bending their heads back to reach glands near their tails, from which they extracted drops of a greasy secretion, before rubbing their heads systematically all over their feathers to spread the grease everywhere. They repeated this process over and over, with fresh doses of grease retrieved from their glands.

The swan sat down and started following the same procedure. This operation is very important for all swimming birds, as it keeps their plumage waterproof.

Eiders paddle constantly with their webbed feet while they are diving. As soon as they stop paddling, they will pop straight up to the surface like a cork.



### **Waterfowls' thermal underwear**

Eiders, *Somateria mollissima*, share a special ability with all ducks, geese, and many other water birds. All birds have glands near their tails, which produce a secretion that the bird frequently rubs onto its plumage; but in water birds this secretion is waterproof enough to cause any drops of water to roll away off their feathers like pearls. This waterproof coating also boosts the birds' buoyancy, bringing them back to surface as soon as they stop swimming downwards. A layer of air trapped all around their skin makes the bird much lighter than water.

For birds, keeping their plumage in a good condition is a matter of life and death. Since the outer layer of a well-maintained plumage is waterproof, birds in effect have thermal underwear, since the air trapped in a layer of soft down covering their skin stays perfectly dry while they swim. Because of this life-supporting layer, water birds can comfortably stand in pouring rain or swim in ice-cold water without ever getting wet through.



A female eider rubbing her head onto a gland that produces an oily secretion, which she will then spread over her plumage to form a waterproof layer by rubbing her head all over her body.

The pike, *Esox lucius*, is one of the many freshwater fish that can also thrive in the Baltic Sea thanks to its low salinity.

## Salty water

Water from the Danish Straits tastes very salty. In the waters much further north, where the female swan and her partner had hatched, the water had been far less salty.

The saltiness of the water varies greatly between the different parts of the Baltic visited by migratory birds. In the northernmost parts of the sea, salt concentrations are only a tenth of those in the Danish Straits.





### **The six sub-basins of the Baltic Sea**

Although the water and its inhabitants may look similar throughout the Baltic Sea, at least on the surface, the underwater world of the Baltic is in fact divided into six sub-basins, or “seas within the sea”.

The Danish Straits are characterised by very shallow water, sandy beaches, and rich underwater life. The vicinity of the salty Atlantic Ocean means that their offshore banks are populated with many marine animal and plant species absent from the rest of the Baltic, such as starfish and sea urchins.

The Baltic Proper is largest of the six sub-basins, and also the deepest. It also has some of the Baltic’s largest islands: Gotland, Öland and Møn in the west; and Saaremaa and Hiiumaa in the east.

The Gulf of Riga washes the low, sandy coasts of Estonia and Latvia. The gulf is the most enclosed of all the six sub-basins, being virtually cut off from the Baltic Proper by the islands of Saaremaa and Hiiumaa.

The three northernmost sub-basins are the Gulf of Finland, the Bothnian Sea, and the Bothnian Bay. Ice and snow are an essential fact of life during the winter in all three of these waters, so all their resident animals and plants have had to find ways to cope with such conditions.

### **Salty inflows from the North Sea**

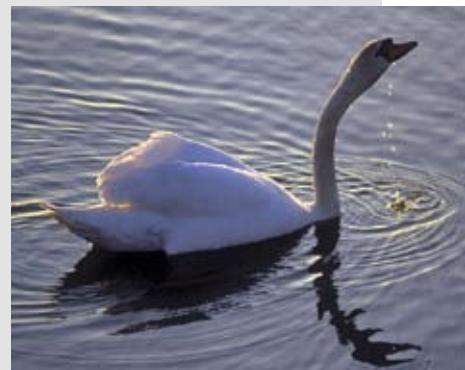
The Baltic Sea is a brackish water body, containing a mixture of true sea water originating from the Atlantic Ocean, and fresh water from the more than 200 rivers that flow into the Baltic.

The reason why the water in the Baltic stays brackish, instead of becoming swamped by saltier sea water, is the narrowness and shallowness of the Danish Straits. These straits are the only connection between the Baltic Sea and the North Sea – and the Atlantic beyond. The average depth of the Straits is less than 20 metres. This makes it an effective barrier preventing the ocean water from freely flowing into the Baltic Sea.

Occasionally, when westerly winds are strong enough, the North Sea feeds the Baltic with a large inflow of salty water. This only happens every few years, but this refreshing replenishment is very welcome. Whenever a major pulse of salty water enters the Baltic, it flows along the sea bottom and replaces some of the old stagnant bottom water, bringing a vital new supply of oxygen for all the creatures of the seabed.

### **Salty waters run deep**

The salinity of surface water in the Baltic decreases slowly towards the north and the east, but a much more abrupt change is experienced when diving directly down into deeper waters. At a depth of somewhere between 50 and 80 metres, there is a sudden change of salinity – an invisible boundary known as the halocline. The layer of fresher water above the halocline always stays on top, because it contains less salt, and is therefore lighter. Beneath the halocline lies a heavier layer of salty bottom water, which has slowly edged through the depths, all the way from the North Sea and the Atlantic.



The salt content of surface water in the Danish Straits is about two per cent. Heading north and east through the Baltic the taste of the seawater changes considerably as its salt content decreases.



Despite its unobtrusive appearance, the sand goby *Pomatoschistus minutus* is one of the most numerous fish in the Baltic Sea, rivalling even the herring in numbers.

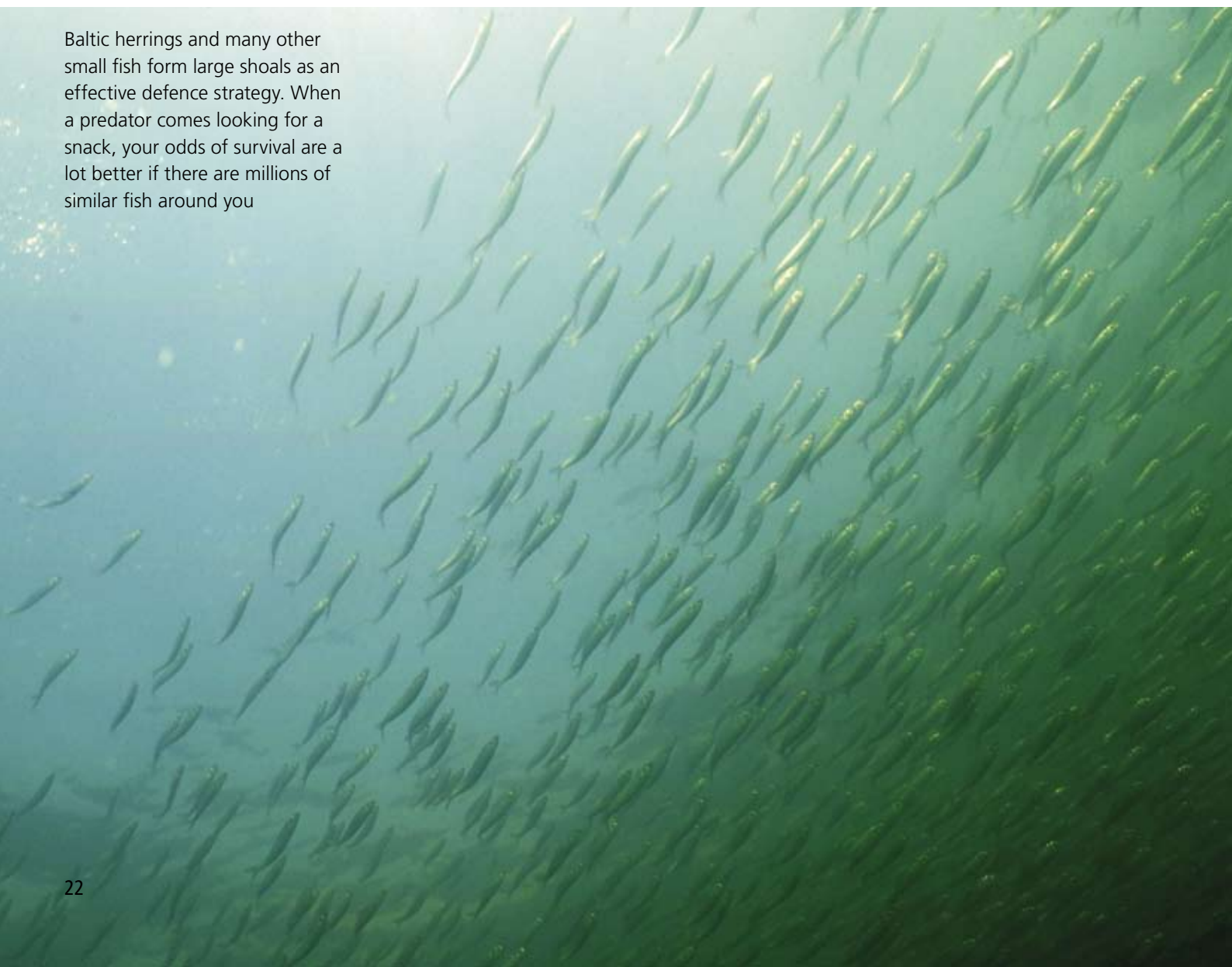
## Shoals of 500 million herrings

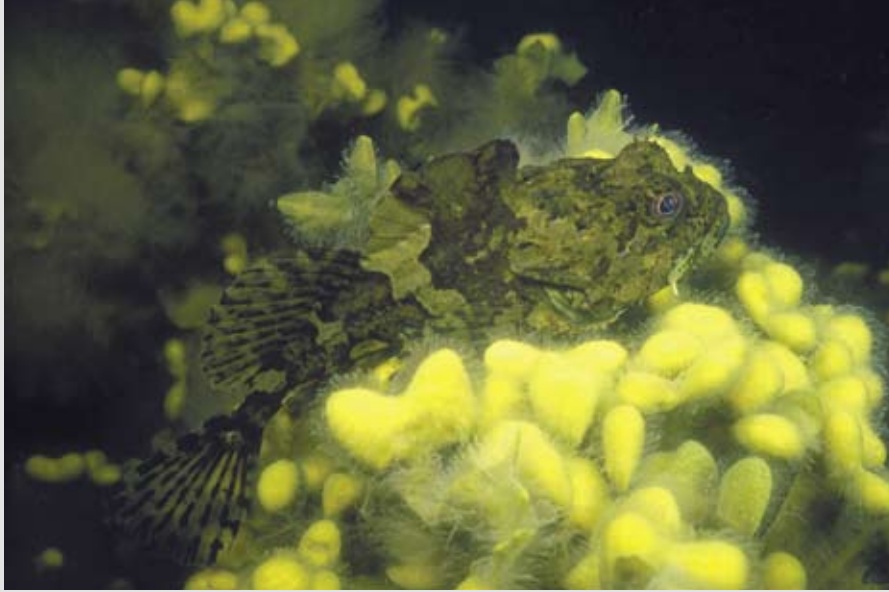
The sun continued to caress the shores and penetrate into the water. Suddenly, countless tiny underwater mirrors seemed to reflect the sunlight. A huge shoal of Baltic herring was passing by. These little fish with their silvery bodies can make an impressive sight: sometimes a single shoal can contain as many as 500 million herrings.

The female swan lifted her head from the water. She had enjoyed her share of the natural gifts of the marine ecosystem – in this case a few fresh buds of underwater vegetation. The urge to head northeast was growing ever more intense.

The male also seemed to be feeling a bit better now. As she took a few restless steps and glanced at him, the matter was settled. Together, they waddled into the water, where they started a long run-up along the surface to build up enough speed to allow their heavy bodies to become airborne. Finally, they took to their wings.

Baltic herrings and many other small fish form large shoals as an effective defence strategy. When a predator comes looking for a snack, your odds of survival are a lot better if there are millions of similar fish around you





Camouflage is a common strategy for avoiding predators. The long-spined bullhead, *Taurulus bubalis*, blends in well with bladderwrack, *Fucus vesiculosus*.

### Herrings' varying schedules

The Baltic herring, *Clupea harengus membras*, is very closely related to the Atlantic herring. Baltic herrings can be found in all parts of the Baltic Sea, but the local herring populations from different waters are not the same. In addition to this regional variation, most herrings spawn in spring, but a minority start to breed in autumn. This effectively divides Baltic herrings into two more separate populations, as a herring that spawns in spring can never breed with an autumn-spawner.

Herrings are highly social fish, which remain in shoals all year long, including the spawning season. Herrings prefer to spawn in the same coastal waters where they were born. Once the spawning is over, they migrate back to the open sea, where they spend the rest of the year.

### Salty water vital for cod eggs

One unique characteristic of the Baltic is that it contains freshwater species and marine species living side by side. But brackish water is an extreme environment for both marine and freshwater fish. The freshwater fish of the Baltic find its waters quite salty, but can just about manage; whereas for the marine fish, the problem is how to cope with a lack of salt.

Salinity levels are mainly a challenge in terms of the physiology of the fish, but for some species they are also crucial for the survival of their eggs. One such species is the cod, *Gadus morhua*. Cod eggs can only survive if they float in the water, and do not sink to the bottom. As long as salinity remains above one per cent, the water is dense enough to keep the eggs suspended in the water. This is why cod can only reproduce in the southerly parts of the Baltic, up to the deep waters near Gotland and Bornholm, as well as in the Gulf of Gdansk.

These days, the cod in the Baltic are having a hard time. Cod like to live near the bottom, but they also need a lot of oxygen. This means that today they are struggling to survive in the oxygen-depleted bottoms caused by the modern phenomenon of eutrophication, which is the result of the excessive amounts of nutrients in the sea today. These problems have caused a drastic decline in the numbers of cod. Another problem is overfishing, which has also taken a heavy toll on the cod population.



# 2 *Marine gardens*





The white-tailed eagle has the largest wingspan of any Baltic bird.

## On to the Baltic Proper

Beneath the migrating swans, a new more expansive seascape was opening up. The two birds had left the narrow, shallow Danish Straits far behind, and a vast, seemingly almost endless sea stretched around them from horizon to horizon.

The swans landed on a shore. While settling their wings, they caught a glimpse of another of the Baltic's largest birds. Above them soared a white-tailed eagle. With its wingspan of almost two and a half meters, the eagle looked like a flying carpet spread across the sky.

### White-tailed eagles on the rise again

The recovery of the white-tailed eagle, *Haliaeetus albicilla*, is one of the big success stories concerning the protection of the Baltic Sea.

By the 1950s and 1960s, the number of white-tailed eagles living around the Baltic had plummeted. Their demise was partly due to people intentionally killing eagles, but other reasons for their disappearance still remained a mystery.

But in the late 1960s, scientists discovered that high concentrations of toxic chemicals such as DDT and PCB had been accumulating in the bodies of the eagles, and of peregrine falcons and many other vanishing birds of prey. These chemicals were making the birds' eggshells exceptionally thin, causing many breakages.

It was realised that the eagles were getting most of these chemicals from the fish they ate, so conservationists started to leave carcasses out for the eagles as safer food. This turned out to be an efficient way to reduce the birds' DDT and PCB intake. Meanwhile, governments started to negotiate limits and bans on the use of the most harmful chemicals.

The Baltic's white-tailed eagles are faring a lot better now. During the last decade, their population has doubled. Breeding pairs have recently been seen in countries like Lithuania and Denmark, where eagles have not bred for decades.

### HELCOM's successes in reducing toxic chemicals

HELCOM has been committed to counteracting hazardous substances ever since the 1974 Convention, which prohibited inputs of substances such as DDT, PCB, heavy metals and some pesticides into the Baltic Sea and waters in its catchment area. The 1992 Convention listed 29 banned or restricted hazardous substances. HELCOM's scientific and technical assessments have greatly increased our knowledge about the Baltic environment and the effects of national policies and economic activities.

As a result of HELCOM's activities, the loads of some hazardous substances to the Baltic Sea have been reduced considerably over the last three decades. Discharges of heavy metals have particularly decreased.

But the Baltic's problems with toxic chemicals are not over yet. One persistent problem concerns dioxins, a group of chemicals originating in emissions from traffic, industry, and waste incineration. These chemicals especially accumulate in older individuals of fish varieties whose bodies are rich in oily fats, such as salmon or larger herrings. By global standards, the dioxin concentrations in fish from the Baltic Sea are exceptionally high.

These problems matter to people, too. The persistent organic pollutants we allow to leak into the environment can easily accumulate in fish, and eventually end up on our dinner tables.

The increasing concentrations of flame retardant agents being found in fish and people are also worrying. These chemicals affect hormone production, and are suspected to be one of the reasons why Baltic salmon, cod and turbot have been suffering from reproductive problems.

A trout, *Salmo trutta*, heading determinedly upstream to spawn in its home river. Trout and other salmonids in the Baltic Sea often have high concentrations of dioxins in their bodies.





Sandstone and limestone cliffs, like these in Rügen in Germany, are a familiar sight around the southern and central parts of the Baltic.



Frogs do not thrive in seawater as a rule, but near the mouths of large rivers the water may be fresh enough for them to spawn.

## A German haven for bird migrants

The German coast was bathed in sunshine as the swans flew over. Among the numerous birds wading in the shallow water, the swans saw some familiar large white shapes with long slender necks. They started to descend for a rest.

More mute swans approached them. The first indication of the arrival of mute swans is a whistling sound made by their wings. This sound helps swans to stay in contact with one another as they fly. As the weather was calm, the swans could hear the the wing-beats of other swans from a distance of more than a kilometre.

At the same time, some other swans were already taking off, eager to get on with their migration. But before our couple could continue their journey, they had a problem. The male's illness had got worse, and he was now very tired and listless.

Though neither of the swans knew it, the reason for his suffering was some small and innocent-looking round objects he had swallowed earlier, believing them to be pebbles. Swans and other birds regularly swallow small stones to help them digest their food.

Many swans and ducks accidentally swallow lead shots left behind by hunters. Thanks to the efforts of conservationists, the use of lead shot has now been prohibited in several countries, but many pieces of shot still remain in the hunting grounds.

The female made a few attempts to get them started on their journey again. But as the male did not react, she gave up. Swans are loyal to their partners, and the natural thing for the female to do now was to stay close to the lethargic male.

Days passed, and so did many other migrating birds. Greylag geese were heading north in noisy flocks. Then, one day, a true sign of spring appeared. An arctic tern, a small, slender, white bird, approached from the south. It hovered for a second above the sea and plunged in with a splash. A moment later, it emerged again, with sunlight glittering both in the water droplets it splashed into the air, and on the little wriggling fish the tern held in its beak.



### The arctic tern – a bird of light

The arctic tern, *Sterna paradisaea*, is a bird of light. It spends more of its life in daylight than any other bird – or any mammal, reptile, or fish, for that matter.

As the first signs of autumn appear in northern Europe, arctic terns migrate to the opposite side of the globe, to feed on fish through the long though not particularly warm summer days around Antarctica. Months later, when the daylight hours start growing shorter in the southern hemisphere, the terns sense that it is time to fly half way round the world again, to ensure they arrive just in time to greet the beginning of the northern summer. The arctic tern is habitually one of the last migrants to arrive in the Baltic in the spring.



The Arctic tern is an agile flyer, which can often be seen hovering in mid-air for a moment before plunging into the water to catch a fish.



Most birds do not fight physically for territories, but male greylag geese, *Anser anser*, will actively fend off any rivals competing for the best nesting sites.





The steep slopes of these guillemots' home cliffs on the island of Stora Karlsö make them as safe as fortresses. Few predators can snatch eggs or young birds from these precipitous ledges.



A young guillemot takes off for the very first time, and glides from its high cliff down to the sea.

The shallow waters around the Baltic's shores are home to countless blue mussels as well as numerous fish, such as this butterflyfish, *Pholis gunnellus*.

## Guillemot fortresses

Beneath two pairs of white wings – one pair eager and strong, and the other at last recovered enough to continue the journey – the vast expanse of the Baltic Proper stretched as far as the eye could see. The views encompassed some of the Baltic's largest islands, including the biggest of them all: Gotland.

Gotland contains rich habitats for many kinds of plants and animals. The same is true of the smaller islands around Gotland, with their steep rock formations. The islands of Stora Karlsö and Lilla Karlsö, for example, are home to many birds, including the Baltic Sea's largest breeding colony of guillemots. These penguin-like brown and white birds busily fly back and forth between their fishing grounds and their rocky cities, where they lay their eggs and later tend their young perched on narrow ledges, safe from most predators.



### Plants of sandy and rocky shores

Gotland is renowned for its abundance of flowers. However, not all of its ground is easy for plants to take root in. At the water's edge, the fine-grained sand is in perpetual motion because of the waves. Only strong-rooted plants such as sand ryegrass, *Leymus arenarius*, can establish a foothold in such shifting sands.

Plants may face another more unexpected problem on the seashore – a lack of water. Although the 21,000 cubic kilometres of the Baltic Sea may be just a few metres away, sandy and rocky shores can be very dry habitats for plants. Plants in such sites depend on rain just as much as if they were hundreds of kilometres inland.



Ryegrass grows to a height of about one metre, and is of great importance to many other plant species, since once ryegrass has bound the ever-shifting sands with its strong roots, other plants can also gain a foothold.

### The deepest of the deeps

The deepest waters of the Baltic Sea are located north of Gotland. Steep underwater cliffs drop down to 459 metres below the surface. Long before this depth is reached, the waters become pitch dark.

Here in the mysterious deeps lives a fish that very few people have ever seen. The snake blenny, *Lumpenus lampetraeformis*, thrives in depths of more than 100 metres. To cope with the perpetual darkness, the snake blenny is equipped with light-generating organs on the sides of its head.

Another creature of deeper waters is the Baltic isopod *Saduria entomon*, whose closest relatives today live in the Arctic Ocean. This species is only present here as a relict species from prehistoric times, when the Baltic Sea was once a gulf of the Arctic Ocean. *Saduria entomon* is quite large for an isopod, growing to a length of eight centimetres. In keeping with its origins, it loves cold water and darkness. It leads an unobtrusive life as a nocturnal scavenger in deep waters, being itself a favourite food of cod and flatfish.



The Baltic isopod, a relict species from the last Ice Age, prefers soft sea bottoms where it is easy to burrow.

## The epic journey of the eel

The night settled over the sea. There was a new moon, and only the dim light from the stars twinkled in the velvet of the night sky. Wrapped in darkness, the two swans slept tightly on the shore. Invisible in the underwater blackness of the calm water beside them, a shoal of silvery snake-like shapes was swimming determinedly past the shore.

These odd creatures were eels – peculiar fish that had an even longer journey ahead of them than our two swans. All the eels in the world migrate once in their lives to the Sargasso Sea in the western Atlantic, to spawn. Unlike most other animals, eels only have offspring once during their whole lives. In spite of this, eels can have very long lives. The oldest eels on record reached the grand old age of 85.

The cowslip, *Primula veris*, is one of the first flowers to add colour to the seaside landscape in the spring.



### The mysterious life of the eel

Eels, *Anguilla anguilla*, originally evolved in the Sargasso Sea in the western Atlantic. Most animal species adapt to reproducing in new geographical locations as they spread into new areas, but eels have somehow retained in their genes the idea that the Sargasso Sea is the only place to spawn.

After their tiny larvae have been born in the Sargasso Sea, they drift unwittingly in various directions with the ocean currents. Some of them end up in northern Europe, and eventually in the Baltic. As the young elvers grow, they start to seek out water with less salt in it. Finally they find a mouth of a river, swim up it, and spend the following years as freshwater fish in rivers and lakes. Eels also have an unusual ability for fish: they can wriggle out of the water and travel for several hours over land.

### Orchids and ancient coral reefs

In addition to hundreds of other flowers, about 40 species of orchids grow on Gotland. Orchids deserve their reputation as rare and rather demanding plants. The secret behind their abundance on Gotland is the nature of the local soils, which are rich in calcium.

The origins of this calcium date back to prehistoric times. The tectonic plates of the Earth's crust have slowly drifted around the globe over the eons, and the rocks that now make up north-western Europe were once located near the equator, about four hundred million years ago.

While the landmasses lay basking under the tropical sun, the shallow seas of the continental shelf were a favourable habitat for coral reefs. The drifting tectonic plates have subsequently carried the remains of these reefs as far north as the islands of Gotland and Saaremaa, where the calcium from the ancient corals continues to enrich local soils.

### Butterflies of Gotland

Gotland and the other flowery islands of the Baltic provide favourable habitats for a wealth of butterflies. For some threatened species these islands represent vital strongholds. One such butterfly is the large blue, *Maculinea arion*, which lives around the southern shores of the Baltic Sea, although in Denmark it has already vanished everywhere except for the island of Møn. In Sweden, large blues can only be found on Gotland and Öland. Another beautiful but endangered species that favours shores and islands is the apollo, *Parnassius apollo*, a large white butterfly decorated with striking red and black markings.



The large blue is one of many threatened butterfly species that still survive by the shores of the Baltic Sea.

The yellow lady's slipper, *Cypripedium calceolus*, exhibits the characteristic shapes and bright colours of orchids.



## Eelgrass – the largest individual in the Baltic

Whenever the swans felt like a snack such as a snail or another small sea creature, they were able to reach down into a submarine garden with a menu as abundant as any top restaurant: a lush growth of bladderwrack.

Bladderwrack “bushes” provide shelter for a myriad of small animals. Just one square metre of the fronds of a healthy bush may harbour 20–30 visible species, and many more microscopic creatures. The visible species alone may have as many as 15,000 individuals on one square metre.

In terms of its impressive offerings, the bladderwrack was rivalled by another marine plant growing nearby. Eelgrass forms large underwater meadows on the sandy sea floor at depths between one and five metres. Eelgrass reproduces through new sprouts that grow out of the mother plant, which are therefore genetically identical to the mother.

It is amazing to think that the largest individual living thing in the Baltic Sea is not a large animal like an old male grey seal, but one of the many individual eelgrasses that have spread out to cover hectares of the sea bed.

Bladderwrack is a key species in the Baltic Sea, as it provides shelter for a multitude of young fish and other sea creatures.







Eelgrass, *Zostera marina*, has an important ecological role especially in the southern parts of the Baltic Sea, where it is more abundant. Many different animals shelter in eelgrass meadows, and unlike bladderwrack, eelgrass is also edible for many species.

### Forests of bladderwrack

In any ecosystem, there are a small number of key species with a special ecological importance, supporting a multitude of other species. In the Baltic Sea, one such species is the bladderwrack, *Fucus vesiculosus*. Bladderwrack is a brown seaweed that can grow to heights ranging from twenty centimetres to one metre, forming “bushes” that live for several years. The plants’ bush-like appearance is due to air-filled vesicles that keep the branch-like fronds suspended, helping them get more sunlight.

Some fish like to spawn in bladderwrack bushes, which then serve as nurseries for their young. Many other fish regularly use bladderwrack for shelter throughout their lives.

Other animals that thrive in these forests of bladderwrack include shrimps and other crustaceans, as well as a wider range of invertebrates from isopods to sea snails.

Some species even live permanently attached to the bladderwrack branches. One of them is the sea mat, *Electra crustulenta*, which builds up ornate colonies resembling honeycombs or net-like lace draped over the bladderwrack. Polyps, *Hydra sp.* and *Laomedea loveni*, and barnacles, *Balanus improvisus*, may also spend all their lives sitting on a bladderwrack.

But bladderwrack has been undergoing a drastic decline in recent decades. This is due to eutrophication, which is caused by the excess nutrients that now burden the ecosystems of the Baltic. Eutrophication promotes the excessive growth of epiphytic and filamentous algae, which can smother bladderwrack and eelgrass, preventing them from receiving sufficient sunlight.

In earlier decades, when the water in the Baltic still was clear, bladderwrack forests could be found down to depths of ten metres. Now these forests have sadly shrunk, and their remnants are today only found at depths of less than five metres.

The fifteen-spined stickleback, *Spinachia spinachia*, spends its summer spawning season in forests of bladderwrack.





A male arctic tern, *Sterna paradisaea*, greets a female with a gift of fish as part of this species' typical courtship ritual.

Cormorants have fared well around the Baltic Sea in recent decades and spread back into many areas where they had previously disappeared.

## Fishermen's unintentional catches

As the spring progressed on Gotland and its neighbouring islands, the flow of migrating birds slowed, and was replaced with enthusiastic displays of courtship and busy nest-building.

A tern approached his partner with a gift of a fish, which she readily accepted. Guillemots were busy on their steep rocky castles. Only one creature on this busy coastline lay motionless: a dead bird caught in a forgotten fishing net.

Carelessly stored fishing gear frequently causes deaths among birds. Fishing lines can also get tightly tangled around a bird's leg, causing necrosis, and leading to the slow and painful death of a crippled bird.

As the dead bird's carcass slowly decayed on the shore, new life was teeming all around. The swans felt a growing urge to continue their journey. The illness of the male had caused them to lag behind their schedule, but resting on this bountiful island had restored some of his strength.

They glanced at each other, extended their necks, spread their wings, and started their accelerating run on the surface of the sea, soon building up enough speed to take flight.





The mute swan is another bird species that has increased its numbers considerably in the Baltic over the past few decades.

### Good times for birds

The last century has been a good time for many bird species around the Baltic Sea. Some have experienced a significant growth in populations, especially the eider, *Somateria mollissima*, the cormorant, *Phalacrocorax carbo*, and many gulls. Some new species have moved into the Baltic, like the sandwich tern, *Sterna sandvicensis*, and the avocet, *Recurvirostra avocetta* – a bird with an exceptional appearance, since its curved beak points upwards at the tip, not downwards as in many species. Meanwhile, some species that only used to inhabit the southern parts of the sea have spread their territories northwards, such as the guillemot, *Uria aalge*, and the large and colourful shelduck, *Tadorna tadorna*.

One reason for the spread of these birds is a change in our attitudes towards wildlife. Hunting and egg collecting have become less popular, allowing more birds to live and breed successfully. More recently, many of the species that suffered from DDT, PCB and other toxic chemicals a few decades ago, have now recovered, thanks to effective measures to ban or limit the use of these chemicals.

Moreover, the increase in bird populations is one of the very few positive side effects of eutrophication, the process caused by excess nutrients flowing into the Baltic because of human activities. Species that feed on fish, mussels or cockles have benefited from the proliferation of these creatures in nutrient-enriched ecosystems.

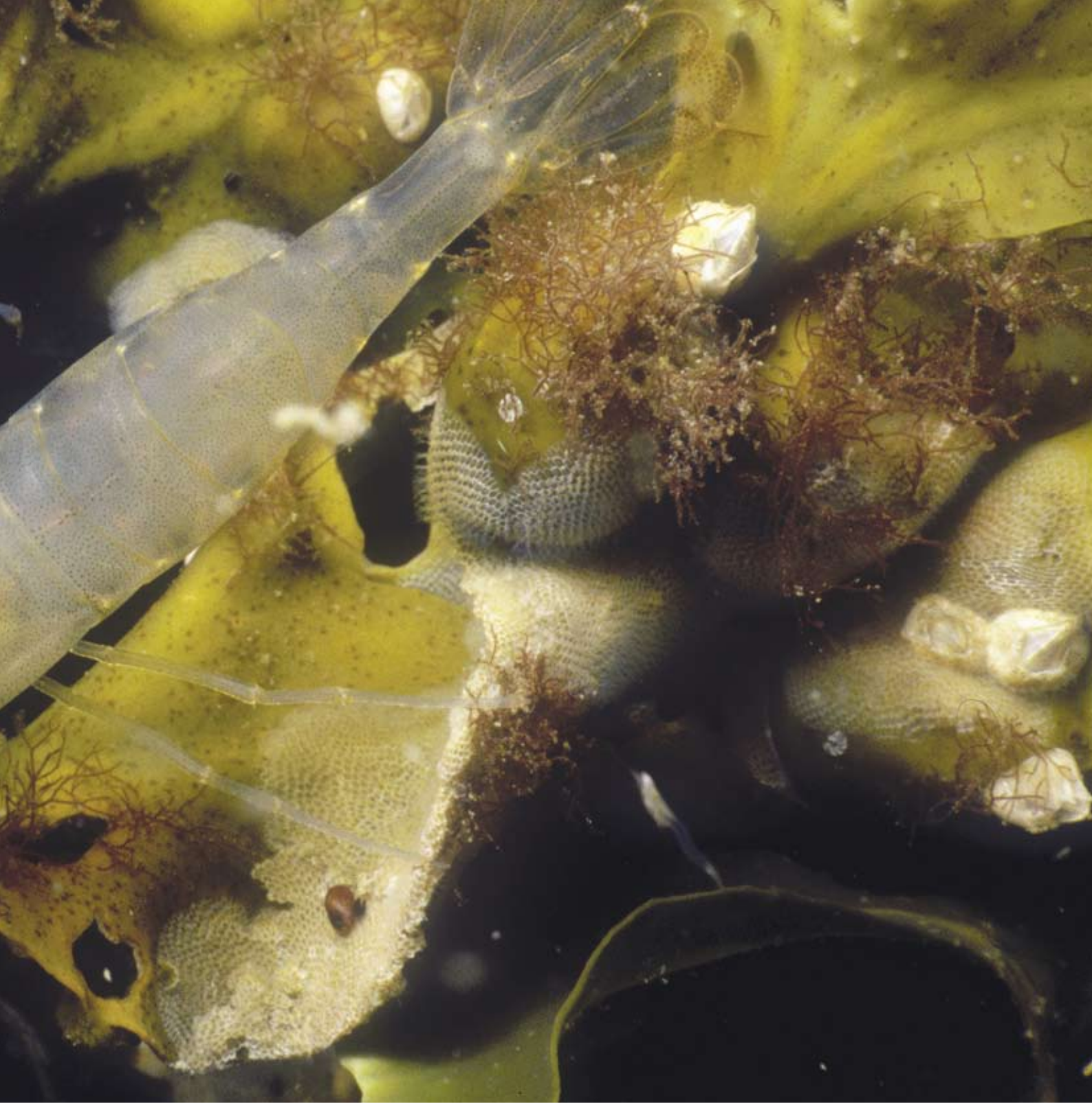
On the other hand, in the last couple of decades the steady rise in many bird populations has come to a halt. Some species' numbers are now even decreasing. One of the main reasons for this is the disappearance of suitable coastal breeding habitats, especially coastal meadows, which have widely been taken over by people for recreational areas. Another factor in these birds' decline is increased disturbance by boats, which can be fatal for small chicks separated from their parents. Eutrophication also plays a role here, as it makes the water murkier, inhibiting the growth of vegetation in shallow water, and leaving less food for plant-eating birds.

Fishing nets and other fishing gear are also often all too effective on dry land. If not stored safely away from wild animals and birds, they can cause slow and painful deaths.





# 3 *Eye to eye with the*



*underwater world*



Even though they look a little overweight, grey seals can also be very agile when necessary.

Seals' true home is the underwater world, where they move around at ease.

# Summer in the northern Baltic

A chorus of loud bellowing calls could be heard on the wind, although it must have been coming from somewhere still out of sight, many kilometres away. As the swans flew closer, the mysterious sound grew stronger and stronger, and its source finally became visible: dozens of grey seals on a rocky islet.

Grey seals are the largest of all the animals found in the Baltic Sea. An adult male can weigh more than 300 kilograms, and be more than three metres in length. Grey seals use barren rocky islets for resting, but also for socialising, which involves communicating with each other using sometimes surprisingly tuneful barking calls. Seals can be seen on islets all year round, but especially in late spring, when they shed their furry winter coat.



### Three seal species

The Baltic Sea is home to three species of seals: the grey seal, the ringed seal, and the harbour seal.

The grey seal, *Halichoerus grypus*, lives in groups. Mother seals prefer to give birth on sea ice, but can also raise their offspring on small islets. Grey seals can nowadays be seen anywhere in the Baltic, but they are most common in more northerly waters, where their most important breeding areas lie off the coasts of Estonia and Finland.

The harbour seal, *Phoca vitulina*, lives in the Danish Straits and around the coasts of southern Sweden. Harbour seals may be solitary or live in small groups. In the summer, females crawl onto islets or sandy beaches to give birth.

The ringed seal, *Phoca hispida*, is also mainly solitary. The ringed seals of the Baltic Sea, *Phoca hispida botnica* form a sub-species of their own, found nowhere else in the world. The two largest populations of the Baltic ringed seal live in the Bothnian Bay and in the Gulf of Riga. In early spring, the females give birth on ice, seeking shelter among large blocks of snow or ice.

Like all other seal pups, young grey seals are born with white fur coats. The pups grow fast, as the fat content of seal milk is exceptionally high.



### The downs and ups of seal populations

The recovery of seal populations is one of the conservation success stories around the Baltic Sea. For a long time, seals were hunted for their fur coats and their fat. They were also widely persecuted because they were thought to compete with fishermen, as they mainly eat fish. In addition to this deliberate toll, however, some other mysterious factor seemed to lie behind seal populations' dramatic collapse in the second half of the 20<sup>th</sup> century.

This riddle was solved in the 1970s, when scientists found that high concentrations of toxic chemicals like PCB were causing deformities in the uteruses of female seals, making them unable to reproduce. Thanks to new regulations controlling the use of these chemicals, these deformities have now become much less common, and seal populations have started to grow again.

There are now about 20,000 grey seals in the Baltic – but this is still only about a tenth of their population a century ago. The Baltic's other two seals species numbering just a few thousand each, which also only represents a fraction of their former populations.



The Baltic ringed seal subspecies is found in no other sea. A hundred years ago, it used to be the most numerous seal in the Baltic Sea, with a population between 100,000 and 200,000, but today there are fewer than 6,000 Baltic ringed seals left.

### International co-operation saves endangered animals

Part of HELCOM's role is to be an environmental policy-maker for the whole of the Baltic Sea area, ensuring that all of the countries around the Baltic develop common environmental objectives and actions. HELCOM also coordinates international conservation activities and co-operates with other international organisations who have been working to help seal populations recover.







During the spring, grey seals gather in large numbers on small islets.



This apollo, *Parnassius apollo*, one of the rarer butterflies found on the Baltic's shores, is searching for nectar in the flowers of a sea aster, *Aster tripolium*.

Summer on the Åland Islands in Finland. The secret behind the abundance of flowers along the shore is their fertilisation with seabirds' droppings.

## At home in the archipelago

The Archipelago Sea was the sight that finally aroused a sense of familiarity in the minds of our homing couple. Like many other birds, swans tend to return every summer to approximately the same area where they were born and where they have spent their previous summers.

Before long, the pair of swans had located a little bay on a remote island where there seemed to be no other swans around to compete for territory. The male, excited by these surroundings, was feeling much better, and he soon busied himself carrying scraps of vegetation to a spot near the water's edge, where the female was arranging them into a large nest mound.

The summer was already quite well advanced, and the small island was blooming like a rock garden. The rich proliferation of plants on remote islands may look out of place, but the secret behind their lushness is not far away: such rocks are in effect "gardened" by seabirds. Whenever they leave their droppings on their home island, they are transferring a steady flow of nutrients from the fish they catch in depths of the sea onto the thin soil of the island, enabling flowers to thrive.

One by one, huge eggs started appearing in the swans' nest. The couple took turns sitting on them. One sunny afternoon, it happened to





### Sensitive nesting islets

Seabirds' nests, like that of this ringed plover, *Charadrius hiaticula*, are a particularly vulnerable element of the marine environment. Their nests are typically right on the ground, and the densities of birds' nests on a Baltic island are higher than in just about any other habitat in northern Europe. Moreover, the effective camouflage colouring and patterns of eggs and chicks mean that intruders can easily step on them quite accidentally. As parent birds flee from their nests, herring gulls and other predators are also given an easy opportunity to feast on the abandoned eggs and chicks. Just a single landing on a nesting islet in the summertime can lead to the destruction of most of its nests.

be the male's turn to warm the eggs. He looked serenely around at the surroundings that had grown more and more familiar to him throughout his long sessions brooding on the nest. Although it is hard for us to imagine what goes on in birds' minds, his feelings could quite possibly be similar to those of an old fisherman in a familiar setting. The surroundings you learn to know, you also learn to love.

## Unintended havoc

As the alarm cries of gulls filled the air, the tranquillity of the island was suddenly gone. A boat approached the island and moored by the shore, regardless of the protesting swarm of noisy gulls and terns overhead. One after another, four people of various sizes clambered onto the shore, followed by a dog. Within just fifteen minutes, they had already unintentionally scared many parent birds away from their nests and trampled on many tiny eggs.

As they approached the swans' nest, the male stretched his neck to its full length, spread his wings and came charging at them hissing loudly. Most birds flee when approached by people or dogs, but an adult male mute swan will not hesitate to defend his nest. After fending off a few more charges and hearing a lot of hissing, the family finally decided to pack up their picnic and hurry back to their boat.

## Attentive fishy fathers

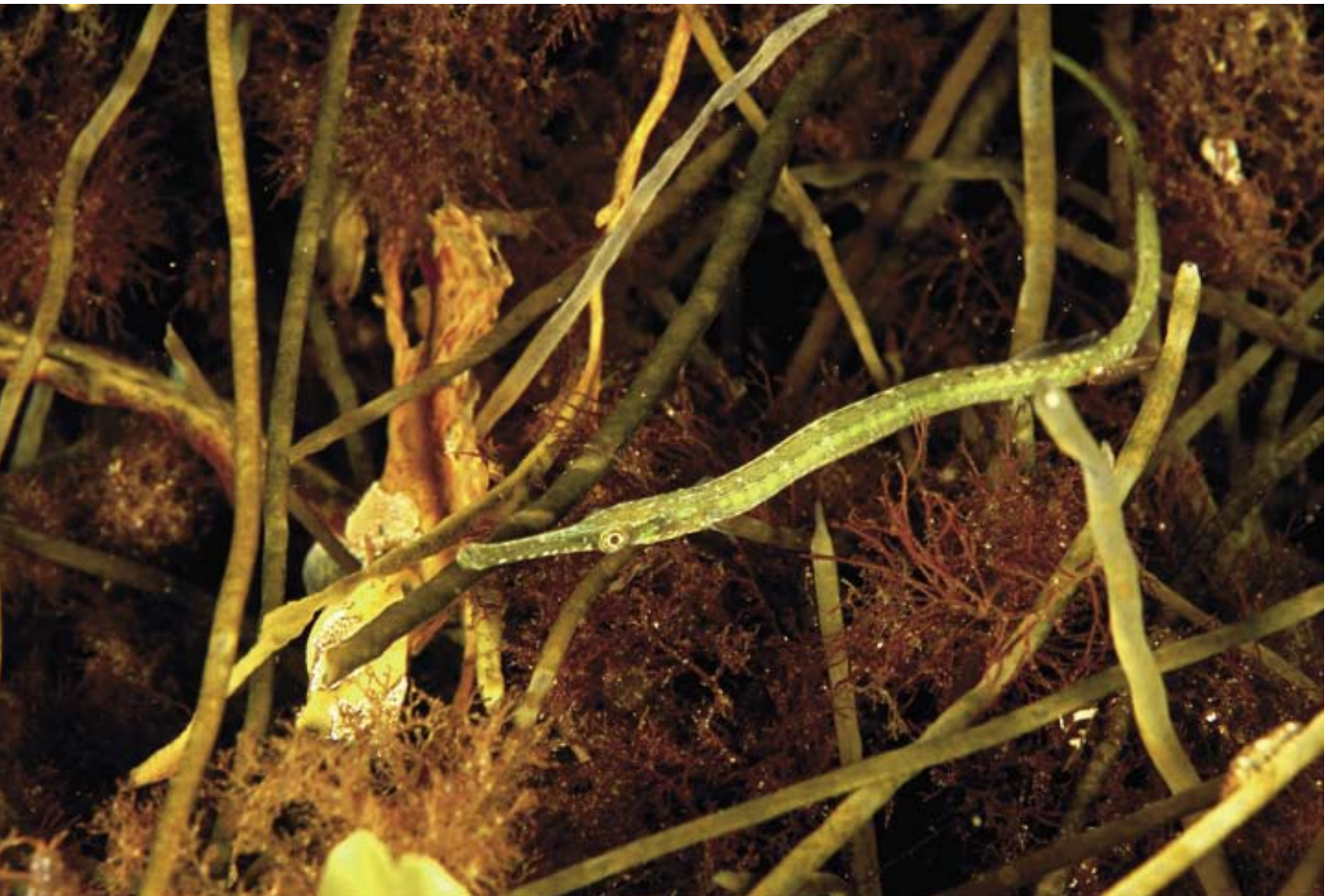
As the female swan waded in the shallow water to feed, she suddenly found she had company: a small fish who seemed to be following her. Sand gobies are curious fish, and they often swim along behind larger creatures that they realise are harmless.

The unobtrusive sand goby is in fact one of the most common fish in the Baltic. Although their numbers have not been accurately surveyed, they may even rival the herring's position as the sea's most numerous fish species.

The sand goby soon went off back about its own business. Being a male, he had to find a nesting site and attract a female to lay here eggs there for him to look after.

In some fish species, protecting the young is the job of the male. Perhaps the most exotic such species in the Baltic is the pipefish – a tiny elongated fish closely related to seahorses. During courtship, the female pipefish places her eggs into a pouch on the male's belly. Only after this does the male release his sperm to fertilize the eggs. The eggs then remain in the safety of his pouch for three to four weeks, until the frail little fry hatch and start to swim freely.

The broad-nosed pipefish, *Sygnathus typhle*, disguises itself from predators by looking like a strand of seaweed.



### Pipefish – northern seahorses

There are two species of pipefish in the Baltic. The broad-nosed pipefish, *Syngnathus typhle*, can change its colour to match its surroundings. This pipefish spends its summers among vegetation and algae in shallow waters, and migrates to deeper waters for the winter. One of its favourite ways of getting around involves standing up vertically in the water and swimming by wiggling its dorsal fin, just like a seahorse.

The straight-nosed pipefish, *Nerophis ophidion*, favours eelgrass meadows. By anchoring itself to a blade of eelgrass with its tail, it becomes effectively hidden, looking like nothing more than an extension of one of the plants. During spawning in the summer, females acquire decorative patches of electric light blue.

The snout of a pipefish not only looks like a pipette, but also serves as one. Pipefish suck up tiny animals for food with their snouts.

A male sand goby guards fertilised eggs that have been laid in an empty mussel shell.



### Gobies' nurseries

Gobies, like the black goby, *Gobius niger*, and the sand goby, *Pomatoschistus minutus*, are small fish with a somewhat frog-like appearance. Their large, bulging eyes help them to survey their surroundings without moving. They also have a habit of sitting like a frog on the sea bottom, using their abdominal fins like legs.

At the start of the reproductive ritual, a male goby chooses a nesting site where the female will lay her eggs. This can be a small piece of rock, or the open shell of a dead mussel. The female then attaches her eggs to the nest, and leaves the male to fertilize and guard them.



### Sticklebacks – armed and dangerous

Three-spined sticklebacks, *Gasterosteus aculeatus*, have quite a different breeding strategy. These fish also eat plankton, and are only a few centimetres long. The male stickleback builds a nest for the offspring to come: it collects pieces of vegetation and secretes a glue-like substance to make them stick together.

Normally three-spined sticklebacks are metallic in colouring, but during spawning the males acquire a bright red underside and an equally fiery temperament. They are prepared to ferociously attack any competitor with a similar bright red belly. The male then protects the eggs and later the newly hatched young with equal bravery, showing that the three spines on his back are not just there for decoration, but can also be used as weapons.

The undersides of male three-spined sticklebacks turn bright red during the mating season.

## Animal or vegetable?

The big day had come. The swans' eggs had started to crack open. For the first time in their lives, the pair were faced with the responsibility of looking after tiny grey youngsters of their own. Sticking up their little downy heads, the hatchlings peered around curiously at the big wide world.

These cygnets each looked just like the ugly duckling so often portrayed in children's fairy stories. But to their doting parents, they were of course the most precious and beautiful young creatures on earth.

Following their parents, the cygnets soon started investigating their surroundings. Their trips out onto shallow waters opened up a whole new world to their young eyes: the world beneath the waves.

Sticking their heads below the surface, the cygnets soon spotted edible plants and small creatures they could feed on. Their curious beaks also encountered several inedible objects that looked like plants – although they were actually animals.

Polyps look like tiny, colourless twigs, but their softness reveals that they are part of the animal world. The sea mats that lie spread out in decorative patterns on various surfaces on the seabed are also animals, in spite of their even more plant-like appearance.

Young mute swans follow their parents constantly. They may occasionally even hitch a free ride on the back of a swimming parent.



### **Polyps – animated twigs**

Polyps are transparent twig-like creatures that belong to a group of animals called cnidarians. There are several species of polyps in the Baltic, but they all live in the same way.

Polyps bodies are just a couple of centimetres long, but their tentacle-like flagellae may extend for up to twenty or thirty centimetres. These flagellae are equipped with poisonous cells, used to catch passing microscopic animals, who are then transported to the polyp's mouth, at the end of its narrow body.

Polyps live attached to the sea bottom. Some species may also anchor themselves to mussel shells or underwater plants. However, they can also move freely if necessary, either by gliding along the bottom or by somersaulting acrobatically through the water.



The isopod on the right is easy to recognise as an animal, but the polyps in the middle – the transparent branched object that looks like a Christmas decoration – also belong to the animal kingdom.

Colonies of sea mat cover underwater plants and other surfaces with their lace-like calcium carbonate formations.

### **Sea mats – microscopic animals with their own calcium shelters**

The sea mat, *Electra crustulenta*, lives in colonies. Each colony builds shelters of calcium carbonate, just like the corals of the oceans. Sea mat colonies spread out in hexagonal patterns reminiscent of honeycombs, but due to their diminutive proportions, they look more like lace. These pattern may be woven over rocks, bladderwrack, blue mussels or just about anything that stays still long enough.

Each of these tiny hexagons is the home of a single animal. Each animal has one flagellum with which it catches microscopic algae to eat. Any individual can function either as a male or a female, but not as both at the same time. Those individuals whose turn it is to be male release their sperm in the spring, while those acting as females keep their eggs in their own safe little hexagons. Once the eggs have been fertilized and hatched, the sea mat larvae start swimming freely and looking for suitable places to set up new colonies.





In the underwater landscape, green algae occur near the surface, whereas red algae prefer to grow a bit deeper down.

## Algae assorted by colour

While foraging in shallow waters with rocky bottoms, the cygnets were able to explore another type of underwater world: verdant gardens of algae.

Such gardens contain various species of algae growing attached to underwater rocky outcrops and loose rocks. One peculiar feature of these gardens is the way the algae are neatly assorted by colour. Green algae flourish closest to the surface. Below this green layer lies a zone of brown bladderwrack, and the deepest vegetation zone is dominated by red algae. This algal assortment by colour is common around the Baltic Sea, where the various types of algae tend to predominate at depths best suited to their requirements regarding the availability of sunlight.



### Light and depth

Algae grow in distinctive zones, because different species of algae use different kinds of pigments in their photosynthesis – the process of capturing energy from sunlight.

The deeper you dive, the less light there is. The colour of the light changes, too, as light of certain wavelengths can penetrate deeper into the water. The blue and green fractions of sunlight reach deeper than the others, and it is precisely these wavelengths that red algae can best exploit. Red and yellow wavelengths are most vital for the green algae that grow closest to the surface, whereas light from these parts of the spectrum is actually harmful to red algae.

### Sexual and asexual algae

The most common green algae in the Baltic include *Cladophora glomerata*, which looks like green strands of hair, and various species in the genus *Ulva*, which resemble flat grass-like blades less than twenty centimetres long, complete with gas-filled vesicles to lift them closer to sunlight.

Individual *Cladophora* are neither male nor female. Instead these algae reproduce by cloning themselves. In late spring, they release huge numbers of spores, which during the next year will grow to form new algae identical to the parent. The *Ulva* algae, in turn, are divided into males and females. They reproduce by releasing large quantities of the algal equivalents of eggs and sperm. To avoid wasting these precious reproductive materials, the whole process is orchestrated by the temperature of water, and possibly also by the phase of moon.

The bladderwrack, *Fucus vesiculosus*, also reproduces sexually. At the tips of their “branches” individuals have vesicles that produce either sperm or eggs, which are then released into the water. In order to do this at about the same time, bladderwracks synchronise their releases with the full moon and the new moon.

Red algae are small, often less than ten centimetres long. One important species in the Baltic is *Furcellaria lumbricalis*. Red algae can thrive at depths down to twenty metres, where very little light penetrates, but they more usually grow at depths of two to four metres, and as the autumn proceeds and light gets scarcer, they spread into shallower waters. As the winter sets in, most individuals die off, but small fragments nevertheless survive until the spring, when they start growing again.

Marine organisms can often be found together in mixed groups of highly diverse species, like this colourful scene containing blue mussels and various algae.



## Tiny denizens of the underwater world

Fish are not the only sea creatures to swim in shoals. Shrimps may also emerge from bladderwrack bushes in large numbers.

The cygnets were particularly interested in the many small but tasty underwater animals, each evidently living in its own preferred location among the zones of different-coloured algae. Isopods and gammarid shrimps favour the green zone, close to the surface. Some isopods also frequent the bladderwrack zone a little deeper beneath the waves. Isopods are among the very few animals that actually can eat bladderwrack, whereas a myriad others use bladderwrack as shelter.



### Successful snail strategies

Water snails are abundant in the shallower waters of the Baltic. Pulmonate snails (which comprise various genera such as *Physa*, *Lymnea*, *Radix*, *Batypomphalus*, *Anisus*, and *Planorbarius*) need air, so they usually have to surface every once in a while to breathe. Only when the water is cold enough, less than eight degrees Centigrade, does the oxygen content of the water rise to a level where the pulmonates can extract all the oxygen they need directly from the water through their skins.

One of the most numerous animals in the whole of the Baltic Sea is another snail, the freshwater nerite *Theodoxus fluviatilis*. Despite its freshwater origins, this species has adapted well to the Baltic's brackish water conditions. Each nerite is a hermaphrodite, being both male and female at the same time. But unlike most hermaphrodites, which need to find a mate to reproduce with, nerites can fertilize themselves. Their young have an unusual way of obtaining food: the parent snail lays its eggs in clusters of a couple dozen, and the first snail to hatch feeds on the rest of the eggs.

Pulmonate snails, *Lymnea*, breathe air, so they must surface every once in a while.

### Gender-bending shrimps

Very many different reproductive strategies can be found among small marine animals. The brown shrimp, *Crangon crangon*, can go so far as to change sex completely. Some of these shrimps start their lives as males and later turn into females.

This species does not spread its eggs and sperm widely through the water in the hope that some of them will meet, as many other species do. Instead, a male presents a female with a neat package of sperm, which the female places on her eggs to fertilize them. After this, the female carries the fertilized eggs carefully with her for a couple of months, until the fry hatch and start swimming freely.



### Copepods and water fleas – vital links in the food chain

Copepods of the group *Copepoda*, and water fleas, *Cladocera*, are distant relatives of shrimps. To the human eye, copepods and water fleas can easily go unnoticed, as their body length is less than two millimetres. However, they have an extremely important role in the aquatic ecosystems of the Baltic. Copepods and water fleas feed on phytoplankton, the microscopic algae that drift everywhere in shallow water and convert sunlight into energy. Small fish and other animals then eat the copepods and water fleas. Copepods are the most important single item on herrings' menu, which makes them the most important link between the phytoplankton that capture energy from the sun, and the herrings, which in turn provide abundant food for numerous other fish, birds, seals, porpoises and people.



Mysid shrimps, of the family *Mysidacea*, are fragile-looking but numerous inhabitants of the Baltic Sea.



4 *Perches, burbots,*



*and a million jellyfish*

# Signs of autumn

The summer was drawing to a close. The cygnets were growing fast and exploring the surroundings ever further away from their nest on the little island, but they were still always accompanied by their watchful parents. Adventuring had recently become a dirtier business, as the water was becoming clogged up with thickening masses of green slime.

The slime was made of blue-green algae, which was blooming profusely in the waters around the swans' home.

Blue-green algae occur naturally in the marine ecosystems of the Baltic, and are normally harmless. But during recent decades, blooms of blue-green algae have become much more intense and widespread. Blooms of some species look like green paint spilled on the water. A more serious problem is that some blooms contain high concentrations of toxic algae – and this means that children and pets should be kept out of the water wherever blue-green algae are visible.

Fields near shorelines or rivers are especially liable to leak nutrients into the water, feeding excessive algal growth. This problem can be mitigated by avoiding over-fertilisation, and by leaving buffer zones of vegetation along the water's edge.





Blooms of blue-green algae sometimes look like patches of paint floating on the water. Some species are toxic, so it is not advisable to swim in such water, or let children or dogs play in the water.

### **Blue-green algae – ancient life forms**

Blue-green algae are misnamed, as they are not in fact algae, but a type of bacteria known to scientists as cyanobacteria. Although they resemble other bacteria structurally, they are unique in that they can capture energy from the sun by photosynthesis, in the same way that algae do.

Blue-green algae are one of the oldest life forms on Earth, having evolved about three billion years ago. They are also to thank for the fact that we have oxygen in the atmosphere. Blue-green algae were the first photosynthetic organisms to emerge on our planet, and started the long process of converting sunlight, water, and carbon dioxide into energy and oxygen.

### **Why algal blooms occur**

Blue-green algae are the best known of the microscopic life forms that occasionally multiply rapidly to form “blooms”, but they are not the only ones. Many species of algae also occur in exceptional quantities in spring. Even though these algae are not toxic, they, too, are a problem for the sea, as their decomposition consumes a lot of oxygen from the water.

The reason why algae and blue-green algae nowadays occur in such quantities is that they are over-fed by the excessive amounts of nutrients that are flowing into the Baltic because of human activities. These excess nutrients largely run directly into the sea from the land, mainly via rivers, although some are airborne pollutants that enter the sea in rain or snow. The main sources of excess nutrients are over-fertilized farmland, sewage, and emissions from industry and traffic.

The only way to make the sea healthy again is to reduce the amounts of nutrients entering the sea from the land. Some positive steps have already been taken towards this end, including changes in agricultural practices and the building of new sewage treatment plants. But a lot more still needs to be done.

### **HELCOM’s work reducing nutrient emissions**

HELCOM has been working since the 1980s to reduce the inputs of nutrients into the Baltic Sea from the countries around its shores. The implementation of the Helsinki Convention and HELCOM’s official recommendations around the Baltic Sea region has resulted in significant reductions in nutrient loads. Without these actions, problems with blue-green algae and the other consequences of excess nutrient loads would be far worse than they are today.

The two problematic nutrients are nitrogen and phosphorus. Thanks to HELCOM’s work, total nitrogen emissions from the countries surrounding the Baltic Sea have been slashed by about 40% since 1980, while phosphorus emissions have been halved.

The four rings on the underside of a moon jellyfish are its reproductive organs. Their orange colouring reveals that this jellyfish is a female. The yellowish tentacles direct food towards the mouth, which is in the middle of the jellyfish's underside. The hair-like organs around the edges of the skirt are used to entrap smaller prey.

## Millions of jellyfish

By early autumn, the blooms of blue-green algae were thankfully just about over for this year.

Meanwhile, a healthier form of marine life had been building up in the water, watched curiously by the young cygnets during their underwater foraging. The strange, pale forms that had been drifting around in the sea during the summer had gradually become bigger and more numerous; and now the sea was literally swimming with fully grown jellyfish.





### **Jellyfish – eight eyes and eight noses**

The moon jellyfish, *Aurelia aurita*, is the only abundant species of jellyfish in the Baltic, although a few other species can be seen occasionally.

Moon jellyfish start swimming around in early summer. Although at this stage they are less than a millimetre in diameter, they are already almost perfect miniatures of their adult form. By July, they have grown to a diameter of about a centimetre. When they reach full size, in August and September, they become impossible to miss – especially if it happens to be a year of a mass occurrence.

Jellyfish move about by creating a pumping movement with their whole body. The fringes of their “skirts” have eight little notches, each sporting a tiny eye, a smell-detecting organ, and a balancing organ.

Jellyfish eat crustaceans, young fish and other small animals. The fine hair-like flagella at the fringes of their skirts are used for directing their prey towards their mouth, which is in the middle of the underside of the jellyfish. The mouth is surrounded by larger tentacles that also help to steer in their food. Jellyfish tentacles and flagella produce poisons used to stun their prey. Unlike some of their oceanic relatives, the moon jellyfish’s poison is so mild that it has no effect on people or other larger animals.

### **Polyps as parents, jellyfish as grandparents**

In spite of their simple appearance, these lumps of transparent jelly are in fact well-developed animals with complex reproduction systems. The four peculiar ring-shaped features in the middle of their bodies serve a vital function. They are the jellyfish’s reproductive organs. In males, they have a purplish colour, whereas a female’s organs are a yellowish orange.

Males release their sperm while swarming near the surface. Females lucky enough to catch the sperm can fertilize their eggs, which they keep lodged inside the armpits of their oral tentacles throughout incubation. Only after hatching will the jellyfish larvae have to face the world on their own.

After reproducing, the jellyfish die. Their bodies then drift around with the current, often piling up in crevasses or other depressions on the seabed in “jellyfish graveyards”.

Yet another peculiar feature of jellyfish is their radically different appearance at different stages of their life cycle. The tiny larvae that hatch from the eggs held in the armpits of the mother jellyfish start their independent life by swimming freely for some time, after which they find a rock, a shell, or some other hard surface to attach themselves to. Here they start growing into polyps that resemble tiny pale-coloured plants. During the following summer, these polyps start reproducing. As these polyps are neither male nor female, they reproduce asexually, by budding. A succession of tiny jellyfish are formed on the surface of the polyp and gradually released into the water. These tiny creatures eventually grow into the familiar UFO-like adult jellyfish, which may be males or females. The adults then reinitiate this strange life cycle during their reproductive swarms in late summer. The polyp stage may live for several years and bud new jellyfish every summer, whereas the adult jellyfish only have a brief existence of a few months.



All these tiny polyp stages of a moon jellyfish are attached to a single blue mussel which is itself just a few centimetres long.

During strong winds, birds prefer to face the wind, instead of letting it blow from beside or behind them, in which case it would penetrate deeper through the plumage and cool their skin. These black guillemots, *Cephus grylle*, are patiently waiting for the storm to end.



## Colours of autumn

The autumn comes early to the northern Baltic. Soon the sea would start to freeze over for the winter.

Buckthorn berries had started to ripen, and flocks of the most eager bird migrants were already heading south. The swan family, too, had left its home island and was now wandering along the neighbouring shores, feeding in shallow waters. The cygnets were now almost as large as their parents, but they still had the characteristic dark grey colouring of juveniles.

They were also still unable to fly. Mute swans learn to fly quite late in their youth, at the age of four months, but these youngsters were not yet at that stage, since their father's illness had delayed the couple's journey back north, and the cygnets had been born later in summer than usual.

## Time to migrate

As the winter drew nearer and nearer, strong winds and storms started buffeting the islands. Most shorebirds had already left, flying southwards in tight flocks. Now it was the turn of ducks, geese, and mergansers to flock together to feed before starting their long journey.

Like the swans, the migrating geese also still had this year's offspring with them. These birds are not guided by instinct along their migration routes, but have to learn them individually from their parents.

The swan family had seen more and more of their kind gathering around them, heading in from the north, and pausing to feed in the shallow bays. The other swan families were now gradually taking off again and continuing their migration.

As snow covered the ground, and ice started forming on the calmer water of the bays where the swans fed, our couple felt an ever stronger urge to head south. If only their offspring could fly.



Sea buckthorn berries, *Hippophae rhamnoides*, in Rauma, Finland. The berries are highly sought after because of their exquisite taste and their exceptionally high vitamin C content.





The prehistory of the Baltic Sea is woven into rocks like these at Lemland in the Åland Archipelago. The primary bedrock is only exposed in the northernmost parts of the Baltic region, where successive ice ages have eroded all the younger sedimentary rocks.

## A black day

One of the young swans stood on the shore preening himself, as a normal part of his daily routine. Only this time there was something wrong. The usual dark grey of the young swan's plumage was smudged with black streaks. Similar black stains were floating in ominous slicks in the water.

The black substance seemed to have appeared from nowhere. But large sections of the shore were now soiled by it – and several ducks were lying dead by the water.

The young swan had been feeling worryingly cold for some time. The black stuff staining his feathers had interfered with his own greasy secretion, which could no longer serve to make his plumage stay waterproof. The ice-cold water had already penetrated through his feathers and down, right down to his skin.

The swan also had a terrible stomach-ache, as he had accidentally swallowed some of the black stuff while trying to clean himself. The outlines of nearby islands started to blur in his eyes. He made one more attempt to clean his feathers, before collapsing onto the shore. For the first time in his life, he truly looked like an ugly duckling.

The rest of the swan family stood for a long time by his motionless body. Only after a day of rain had soaked it beyond recognition did the family reluctantly move on.

Oil is toxic to many life forms, but its indirect effects such as the way it destroys the insulating capacity of birds' plumage can prove to be even more fatal.





The Baltic Sea has some of the busiest shipping lanes anywhere in the world. Ships must also take great care to avoid accidents because the Baltic is so shallow and has such labyrinthine coastlines and archipelagos.

### **More oil on the move**

Oil spills are a frequent problem in the Baltic. Some of these spills originate from accidents, as the Baltic Sea has some of the most frequently used shipping routes for crude oil anywhere in the world. However, a lot of the oil floating around in the Baltic has been deliberately released from ships.

It has been estimated that the Baltic's crowded shipping lanes are used to transport as much as one seventh of all the world's maritime cargo.

So far, the sea has been lucky enough: there have been no truly disastrous oil spills. But the risk still remains. Over the last ten years, the amounts of oil transported across the Baltic have grown six-fold, to more than 160 million tonnes a year – and the numbers and sizes of oil tankers are still on the increase.

Oil spills harm marine life in various ways. Oiled birds can die of cold when the insulating capacity of their plumage is reduced. Oil also makes birds' plumage less waterproof and aerodynamic, and birds that become unable to swim or fly will slowly starve to death. Seals can also be affected. If their fur coats become stained with oil, the animals will no longer be insulated effectively, and they can also be poisoned when trying to clean themselves.

What's more, any oil released into the water will start breaking down into hydrocarbons that are toxic to many forms of marine life, including the microscopic algae which many other animals in turn depend on for food.

### **Curbing oil spills and accidents**

Ever since the first Helsinki Convention was signed in 1974, HELCOM has worked to curb deliberate emissions of oily water and other wastes into the sea. HELCOM co-ordinates the monitoring of illegal oil discharges from ships around the Baltic. Such deliberate pollution has thankfully begun to decline in recent years, at least in areas where legislation is strictly enforced. Another priority around the Baltic has been improvements in readiness to respond to emergencies.

HELCOM has also worked to ensure the safety of navigation in the Baltic Sea. Various safety measures have consequently been adopted by the International Maritime Organisation, including routing measures for certain parts of the sea, and the wider use of pilots. The Baltic's busiest shipping routes are today covered by electronic navigational charts, allowing ships' positions to be automatically updated. HELCOM has also actively promoted new regulations designed to increase the safety of oil transportation.

## Arrival in Estonia

On the verge of winter, the young swans finally acquired enough strength in their wings to enable them to fly. But since the westerly winds were now strengthening again, the swans did not head directly to the southwest, from where the parents had come in the spring. Instead, they chose an easier route via the eastern coasts of the Baltic.

Arriving at the large Estonian island of Saaremaa was like travelling back in time to an earlier stage of the autumn. The weather was much milder on the southern side of the Gulf of Finland.

The short flight from Finland to Estonia also led the swans into a completely new landscape. The Finnish coast had consisted of smoothly eroded rocky shores, and, further out at sea, a rocky archipelago with countless islands and islets. Now, in Estonia, the shores were lined by soft sand overlooked by steep limestone cliffs with peculiar shelf-like formations. Out at the sea, there was no archipelago – just the empty horizon to the north where the swans had come from.

The sedimentary rocks of the Estonian coast bear witness to past eons. Deposits of silt and clay have slowly hardened into layer after layer of rock, with some strata encapsulating the fossil remains of ancient animals and plants.





### Landscapes created by ice

The difference between the Finnish and Estonian coasts is especially striking from the air. The Finnish archipelago looks like someone has scattered a giant jigsaw puzzle into the sea. The Finnish coasts of the Baltic are lined with a total of 81,000 islands of more than 100 square metres – as well as countless smaller granite rocks and skerries.

But just 80 kilometres to the south, the Estonian coast has no archipelago. Swans and other birds can feel soft, fine-grained sand under their webbed feet, instead of the hard, smooth rock of the Finnish coastline.

This difference is because more northerly areas of the Baltic Sea were more radically reshaped during the last Ice Age. The thick continental ice sheet that spread over the region weighed down heavily on the land beneath. The ice was thicker and lasted longer in Finland and Sweden, where its erosive action widely exposed the bedrock. This bedrock is billions of years old, and forms part of some of the oldest geological structures on Earth. Over most of the Baltic region this deep bedrock is covered by limestone and other types of sedimentary rock, “only” a few hundred million years old; but in Finland and northern Sweden such younger rocks have all been eroded long ago.

Other features formed during the ice age include sandy beaches and sand dunes. The innumerable fine grains of sand carved from the bedrock by the ice sheet eventually settled on the sea bottom. Even today, some ten thousand years after the end of the Ice Age, the land around the Baltic is slowly rising, still recovering from being weighed down by the ice sheet. This uplift exposes the shallow, sandy sea floors as beaches. As these new shores are washed by the waves, the sand is effectively sorted, producing distinct zones along the beach where sand particle sizes are as uniform as if someone had neatly arranged finer or coarser grains into separate piles.



Shorebirds like these dunlins, *Calidris alpina*; ringed plovers, *Charadrius hiaticula*; and little ringed plover *Charadrius dubius* frequently gather on shallow shores in the autumn to feed before their long southward migration.

### Saaremaa – a botanical paradise

Saaremaa is home to a grand total of 1,200 plant species. This is largely due to the soil being rich in calcium, as it is on Gotland and some other Swedish islands. The rocks of Saaremaa have likewise formed from the remains of ancient coral reefs that once thrived in shallow tropical seas before the continental plate started its long drift northwards.

Estonia's shores are home to many plants that are known to farmers as weeds, like the sow-thistle, *Sonchus arvensis*, and the hemp-nettle, *Galeopsis bifida*. But these plants have not spread to the shores from farmers' fields; rather seashores are the original natural habitat of many well-known weed species – as well as other plants grown today as crops.



A sunset scene in Lahemaa National Park, Estonia.

## Inside the world of fish

Deep in the sea, the changing seasons are felt far less dramatically than on land. The main differences are a reduction in light, and the cooling of the water. Neither of these changes bother burbot, as these fish feel perfectly at home in cold, dark water.

Down in the murk, chilly depths, a hungry burbot was seeking out smaller fish as prey. This time, however, the burbot failed to notice a lone perch taking a nap among the bladderwrack.

### Solitary burbot and sociable perches

The burbot, *Lota lota*, prefers to live on the sea bottom, and leads a mostly solitary life. Burbot prey on other fish, insects and small sea creatures during the night, relying on their acute sense of smell. They also feel around on the sea floor with the barbels under their lower jaws.

The perch, *Perca fluviatilis*, in contrast, is a social species, active during the daylight hours. Though perches usually swim around in small shoals, they prefer to sleep alone.

Perches also prey on other fish – and will sometimes attack prey almost as large as themselves. Perches that successfully avoiding all their predators can reach an age of more than 30 years. The oldest perches are hump-backed in appearance, and can be half a metre in length.

This perch is actually asleep among the bladderwrack. Fish sleep just like other animals, but as they have no eyelids their eyes remain wide open.



### The secret life of fish

The ability of fish to learn and remember has only been examined very recently by scientists. Many fish evidently have far more developed learning abilities than was previously thought. Many details of their feeding strategies and migratory routes are not guided by instinct, but learned by each individual fish.

Another surprise is that the capability of fish to feel pain has also turned out to be considerably greater than is usually thought. As such research continues, we can expect to learn a lot more over the coming years about previously mysterious aspects of the secret life of fish.

A burbot in its preferred habitat on the sea floor. The barbel extending from under its lower jaw helps it to investigate the sea bed even in total darkness.



5

*Bird paradises of*



*the eastern Baltic*

# A haven for millions of birds

The swan pair and their grey offspring glided down, leaning backwards and spreading their wings as they touched the surface of the sea. Though they were in a large gulf, it took a while to pick a suitable landing spot, as they were far from the first birds to have arrived. Thousands of ducks, geese, mergansers, cormorants, and other swan families were already floating on the calm waters. And still thousands more were sitting on shores preening, grazing or just dozing. It was easy to see that the Gulf of Riga is one of the most important seabird wintering areas in the whole of the Baltic.

Barnacle geese, *Branta bernicla*, stop to rest and feed on the shores of the Baltic Sea before continuing their migration to the British Isles.





### Visitors from the Arctic

Wintering areas in the Baltic, like the Gulf of Riga, are important not only for birds coming from northern parts of the Baltic, but also for those migrating all the way from the Arctic Ocean. Long-tailed ducks, *Clangula hyemalis*, and velvet scoters, *Melanitta fusca*, are among the birds that come pouring in from all over northern Europe, including large areas of Russia. During mild winters, over ninety per cent of the north European populations of these two birds gather in the Baltic.

Black-throated divers, *Gavia arctica*, and goosanders, *Mergus merganser*, are also among the numerous winter visitors. Half of all the northern European birds of these two species can likewise be found around the shores of the Baltic each winter.

The total number of seabirds wintering in the Baltic Sea has been estimated to be about nine million. Half of these are of just one species – the long-tailed duck. Three species' Baltic wintering populations number about one million: velvet scoters, their close relatives common scoters, *Melanitta nigra*, and eiders, *Somateria mollissima*.

The red-breasted merganser, *Mergus serrator*, is common in most parts of the Baltic Sea.

## By the salmon rivers of Latvia and Lithuania

Arriving over the Lithuanian coast is like looking down over a seaside Sahara. Sand dunes form a world of their own. Although they are bone dry, and always on the move, they can still support several pioneering plants and insects.

The swan family parachuted down once more in and settled down for a rest on the shore. Winter was drawing closer. The sandy beaches were still bathed in sunlight by day, but the daylight hours were becoming shorter.

Resting at a mouth of a river, the swans drifted in the slow-moving water that was just about to change from river water into seawater. The estuary was now calm, but unknown to the swans, a completely different scene had been played out at this spot in the spring. Then these waters had been teeming with salmon, swimming determinedly upriver on their quest to return to their spawning grounds.

A tranquil moment on a Latvian beach.







Sand dune ecosystems are always evolving. After the hardiest pioneering plants have established themselves, the sand-hills will gradually become covered by vegetation.

### **Salmon in search of home**

There are still almost forty rivers around the Baltic Sea where salmon, *Salmo salar*, reproduce naturally – including ten in Latvia, seven in Estonia, and two in Lithuania. Salmon return from the sea every spring to these rivers to spawn.

Salmon can swim for hundreds of kilometres looking for the river where they were born. They do this by literally sniffing out water-borne materials that carry the familiar scent of home. Fish have such an acute sense of smell that they can successfully distinguish the waters from the river where they were born from those of other rivers by smell.

Young salmon spend their first few years in their native river. When they are about twenty centimetres long, they migrate downstream to the sea. Only after living at sea for a few more years, so they return to their home river to spawn.

But the salmon of the Baltic face many problems today. Many of their old spawning rivers have become unsuitable, because they have become polluted, overfished, or dammed. Salmon populations have also declined recently due to the excessive amounts of nutrients in the sea.

HELCOM's environmental programmes and nature conservation measures have, however, made the outlook for the Baltic salmon a bit brighter. The productivity of the Baltic's wild salmon stock rose by an average of one million young fish each year over the period 1995–2001.

The bay barnacle is well known for its ability to attach itself firmly to any surface, including the hulls of ships – which probably explains how it originally arrived in the Baltic. This crustacean species originates from North America, and had not been seen in the Baltic Sea before the 19th century.

## Greetings from faraway seas

Dipping its head under the water, a swan can never be quite sure as to what kind of creatures it will encounter. The Baltic Sea today has many new species inadvertently introduced into its waters by man – usually in the ballast waters of ships coming from faraway seas. Often these unintentional hitchhikers die very soon after their arrival. But some species manage to thrive and spread. Many of these surviving invaders originate from the Caspian Sea and Black Sea, whose waters are also brackish.

Such invaders can cause serious problems in delicately balanced natural ecosystems, where native species may not always be able to compete with the newcomers. In the worst cases, some native species may even die out completely.



### **Invasive species – from the age of the Vikings to today**

The oldest invasive species in the Baltic Sea is the sand gaper, *Mya arenaria*. These shellfish are thought to have arrived in the 13<sup>th</sup> century along with Vikings, who used them either as food, or as fishing bait. The sand gaper lives mainly in burrows in sandy bottoms, with only its feeding siphons sticking out, catching any minuscule particles of food that drift by.

The next species to enter the Baltic as a result of human activity was the bay barnacle, *Balanus improvisus*, which arrived in the 19<sup>th</sup> century from America, having probably hitched a lift on sailing vessels. Barnacles attach themselves to hard surfaces such as rocks, mussels, or the bottoms of boats, where they secrete calcium carbonate to form a shield consisting of six hard shell sections.

The bay barnacle itself is a tiny animal that lives inside the safety of this shelly home, keeping a low profile except for its six slender limbs, which it extends out of its shell to catch passing plankton. It also uses these limbs to extract oxygen from the water. Only the barnacle larvae swim freely in the water, searching for new sites to colonise.

During the 19<sup>th</sup> century, about a dozen more alien species appeared in the Baltic. More recently the invasion has only intensified. So far, a total of more than a hundred invasive species have been spotted in the Baltic Sea – and about 60–70 of them have succeeded in establishing viable populations.

### **Exotic and problematic invaders**

The fishhook water flea, *Cercopagis pengoi*, is one of the Baltic's most problematic newcomers. Originating from the Caspian Sea, it appeared in the Gulf of Finland and the Gulf of Riga during the 1990s, and has now spread throughout the Baltic Sea. These water fleas compete for the same food as the fry of herrings, *Clupea harengus*, and sprats, *Sprattus sprattus*, affecting the numbers of these important fish.

There are not many invasive fish in the Baltic, but one notable alien is the round goby, *Neogobius melanostomus*, whose natural range includes the Caspian Sea and the Black Sea. This species first appeared in Polish waters in 1990 and is now spreading, competing for food with flounders and other bottom-dwelling fish.

A less problematic curiosity is the Chinese mitten crab, *Eriocheir sinensis*. This exotic crustacean probably cannot reproduce in the Baltic, as its offspring only thrive in saltier water. If this is the case, every mitten crab seen in the Baltic has travelled here all the way from China, probably in ships' ballast water.

### **HELCOM and invasive species**

HELCOM has overseen several activities related to the problem of non-native species in the Baltic. HELCOM is also currently preparing an Action Plan to prevent the introduction of such alien species in ships' ballast water. Since 1997, all recorded marine invasions have been registered in an on-line database accessible through the HELCOM website, and scientists from the coastal countries all around the Baltic are actively working on projects dealing with this problematic issue.



This mysid shrimp, *Hemimysis anomala*, is one of the most recent hitch-hiking invaders to have been accidentally introduced by man into the Baltic Sea.



The Chinese mitten crab has occasionally been found in Baltic fishermen's nets in recent years.



The dunes in this sandy scene viewed from Nida, Lithuania, stretch into Russia's Kaliningrad Enclave.

## The variety of life

The migrating swan family enjoyed a midday nap on the coast of the Kaliningrad Enclave, which is part of Russia. Again they were not alone. Thousands of seabirds were bobbing up and down like corks, cradled by the waves of the Gulf of Gdansk.

There were birds of many shapes and colours, including ten species of duck, two kinds of merganser, four types of gull, and many more...

In the summertime, the variety of birdlife is at its greatest, with many shorebirds tending their young, and grebes and terns busily fishing for their own hungry offspring. The shores and the underwater world also support a great diversity of other life forms, from which the birds find their food, including plants, fish, and numerous kinds of small animals.

The term biodiversity is used to describe the variety of life – often in terms of the numbers of species present in an ecosystem. Biodiversity is important for two main reasons.

Firstly, the existence of each species has an inherent value as such. If a species goes extinct, it can never be recreated again. The same is true for the differing local populations of any species. Populations far apart from each other can acquire quite different biological characteristics. The Baltic populations of many species are genetically very different from populations of the same species elsewhere. If one of these regional populations is wiped out, nothing exactly like it can ever exist again.

Secondly, having viable populations of every species is an effective insurance to help maintain well-functioning ecosystems. Each ecosystem is a complex web of interacting species, each of them dependent on several others. The disappearance of a single species will therefore also significantly affect many others.

### Why the Baltic is so vulnerable to alien attack

The Baltic Sea is a typical example of an ecosystem especially vulnerable to disturbances, so its ecological balance needs to be handled with care. The reason for this fragility is the low number of species in the sea. Even though the variety of life in the Baltic is still breathtaking, it is much more limited than in tropical seas, for example. This increases the importance of each Baltic species in terms of keeping the ecosystem functioning.

If something drastic happens to bladderwrack, or to herrings, or to the numerous little copepods and water fleas that form vital links in the food chain between microscopic algae and small fish, the whole ecosystem of the Baltic Sea will become distorted – and some of its vital elements, such as its large populations of commercially valuable fish, could ultimately disappear. The numbers of some key species have already been dwindling alarmingly. It is vital that we start to act now – while there is still hope of restoring such declining populations.

### Diversity and habitats

The survival of biodiversity depends on the preservation of the existing range of natural habitats – each of which supports its own characteristic array of species. In the Baltic Sea, more than 130 different marine and coastal habitat types have been identified. These include aquatic habitats such as sandy seafloors dominated by eel-grass and other large plants, rocky seafloors with bladderwrack, or sea-beds covered with dense colonies of mussels; as well as terrestrial habitats like sandy beach ridges dominated by shrubs and trees, coastal dunes, or coastal cliffs and caves.

Invasive species are a major threat to biodiversity, as they can out-compete native species. One recent newcomer in the Baltic Sea is the mysid shrimp *Hemimysis anomala*, which originates from the Caspian Sea.







Several species of gulls are abundant around the Baltic. One of the secrets of their success is their adaptability, since in addition to feeding in pristine marine habitats, many gulls have also learnt how to make a living foraging around towns and cities.



Female goosanders are famous for their maternal instincts, sometimes adopting young from other broods.

## Eager foster mothers

After a taxing flight in the cold morning mist, the Polish coast beneath the migrating family looked very tempting. The swan family dropped down onto the calm waters, and found a nice spot with only a few birds around where they could settle for a welcome rest.

Further out at sea, the scene was more crowded. Coots were gathering in large wintering flocks. These small, squat black water-birds with their characteristic white foreheads seem to be always on the move. A flotilla of goosanders floated by.

In contrast to the fairly small swan family, each young goosander in this single family group had dozens of siblings. Goosanders are notorious for their large broods. A mother may lay more than ten eggs, but if another mother dies or is separated from her brood, the keen mother may adopt the whole bunch of orphaned youngsters. It is not unusual to see a female goosander with twenty little followers, and sometimes even more. Goosander mothers are so fond of foster parenting that they have even been seen kidnapping ducklings from other females.



### Coots' winter gatherings

Like all birds, coots, *Fulica atra*, normally prefer to avoid actual physical combat where someone could get hurt. Coots instead threaten intruders on their territories by raising their wings and extending their neck towards the uninvited guest, and staring aggressively at their rival. Only if this does not help, will a coot launch an attack against another coot.

In their wintering waters, coots become more sociable. They often gather to form compact flocks numbering several hundred birds. Individual birds frequently disappear for a moment from the surface, only to pop up again somewhere else. During their dives, coots scan the seafloor for delicious underwater plants or tiny creatures such as isopods or slugs to feast on.

### Goosanders – fishing as a team

Goosanders, *Mergus merganser*, are closely related to ducks. But like other mergansers, goosanders mainly feed on fish, which are ignored as potential food by most ducks. In the autumn, goosander broods sometimes go fishing as a team. The birds form a chain, and once they have located a shoal of fish, they start splashing water with their wings, still remaining in the chain formation, and drive the shoal towards the shore. Once in shallow water, each of the birds dives down into the trapped shoal to catch their fill.

Oystercatchers, *Haematopus ostralegus*, leave the Baltic Sea in the autumn to head for western Europe and northern Africa.



## The grey heron – a master of patience

The mother and father swan felt quite at home on the Polish coast, surrounded by thousands of other wintering birds just as in the years before. But the youngsters were peering curiously at their wintering neighbours. Some of these birds belonged to species they had never seen before, and others formed vast flocks bigger than any they had ever seen.

Some of their unfamiliar wintering neighbours were strange-looking long-legged stalkers, standing silently in the water. Grey herons are masters of the art of patience. Whereas the young swans fed by simply dipping their heads into the water and retrieving a shoot of plant or an occasional snail within a matter of seconds, the heron that shared this shore with them stood absolutely still for minute after minute, like a statue.

Finally, whenever an unwary fish happened to approach the two perfectly still legs, a sharp beak suddenly stabbed into the water and caught the unlucky fish, who was then quickly gulped down.



Even though grey herons, *Ardea cinerea*, are quite large birds, they often go unnoticed as they stand motionless among the waterside vegetation.

## Cormorants hung out to dry

On a fallen tree on the shore sat a row of equally immobile but quite different-looking bird sculptures. These cormorants were waiting for their feathers to dry out, with their wings spread out like wet washing on a clothes line.

The cormorant is an exceptional seabird in that its plumage is not completely waterproof. Unlike swans, ducks and most other water birds, cormorants get truly wet through when they submerge themselves, and this is why they have to dry out their plumage every once in a while.

Cormorants share some characteristics with herons, even though they are not closely related. Both species build their nests in trees, using branches, and they use the same nests year after year. Both species also mainly feed on fish, although they catch them in different ways. Cormorants fish by diving. They are strong underwater swimmers, and have been observed diving as deep as fifty metres below the surface.

### **Cormorants make a comeback**

The cormorant, *Phalacrocorax carbo*, has recently made an impressive comeback in the northern parts of the Baltic. Centuries ago, the species was common in many parts of the Baltic Sea. However, cormorants were hunted so excessively that by the early 20th century the species had almost completely disappeared from the Baltic. But since the species has been protected, its numbers have started to increase again. Especially during the 1990s, cormorants reappeared in many areas where they had been absent for almost a century.

Cormorants are still spreading northwards and eastwards, rapidly colonising suitable outer islets in the Gulf of Finland and the Bothnian Sea. Other birds have not suffered from their rapid expansion. On the contrary, some birds sharing the same nesting islets have been able to breed more successfully than before. A colony of cormorants is an effective guard against many predators. Research has also shown that cormorants actually help to combat the problems caused by excess nutrients to some extent, since when they eat fish from the sea and defecate on islets, they effectively remove nutrients from the water.

Cormorants are highly sociable birds, as can be seen from this view of a breeding colony on the Polish coast.



## Underwater soundscapes

As the swans gazed at the sea, there were far fewer small boats out there compared to the busy summertime scene. And even when they stuck their heads into the water to search for breakfast, their surroundings were also more peaceful than in the summer, as the high-pitched ringing sound caused by the engines of small boats was not as loud anymore.

Large cargo ships were still sailing the sea, however. Their silhouettes of several ships could be seen moving slowly across the horizon at any time. Ducking their heads underwater, the swans could also hear the low-pitched throbbing noise of their powerful engines, as always.

## Fast boats – a danger to ducklings

The cygnets glanced at one of the last small motorboats still out at sea despite the cold. The full-sized but still greyish youngsters would for the rest of their lives be protected from many dangers by the size of their species. Small but fast boats unintentionally kill many young water-birds of smaller species every year.

Speeding motorboats can easily run over ducklings or other young seabirds without noticing them. And where boats are driven at high speed or alongside islands, young birds can also get scattered by the frightening disturbance. This can make them easy prey for predators until their mother manages to get the youngsters back together again.

Resting at the Gulf of Gdansk.



### The perils of plastic

One surprisingly serious threat to marine life is plastic rubbish. Plastic bags and other scraps of plastic often look like pieces of dead fish when seen from a distance. When a seal or a bird has already grabbed and swallowed the tasty-looking morsel, and only then realises its mistake, it is already too late. Seals and seabirds all too often die of intestinal obstruction, a painful condition caused when their guts become blocked up by pieces of plastic.



### How does a boat sound underwater?

All sounds travel much further underwater than in the air. A boat too far away to be heard is above water can often be clearly audible underwater. The various sounds of different kinds of boat engines today form a permanent part of the soundtrack of the underwater world. Fish have an acute sense of hearing, and many fish make sounds of their own to communicate: mating calls to attract the opposite sex, and short, sharp warning signals to alert other fish to the presence of a predator. Loud engine noises are therefore a serious problem for fish. Research has indicated that reduced reproduction rates among some fish species near harbours are partly caused by the excessive underwater noise.

Some boats are much more silent, however. Sailboats, kayaks, rowing boats and other craft without engines cause no more noise underwater than they do above water. In addition to being able to enjoy all the natural sounds of the sea, people using such boats can also feel happy that they are not adding any noise pollution to the underwater world.

Many underwater sounds result from natural phenomena such as the waves and the sounds made by certain fish species for communication. But increasing amounts of underwater noise are nowadays created by human activities, especially by boat engines. Small pleasure boats produce high-pitched noises beneath the waves, whereas large ships create a deep roaring sound.

# The beginning of the future

The winter had arrived on the Polish coast. Together with a flock of other mute swans, our family had found a comfortable place to settle for the coldest months.

Among the other swans, there were many youngsters as grey as the couple's own offspring. Swans differ from most other birds in that families often stay together for some time even after the offspring have learned to make their living independently. Often whole swan families can be seen sticking together until the next spring.

The male swan could still feel the strain of the long migration in his muscles. He had not yet fully recovered from the poisoning of his digestive system by the lead pellets. But, most importantly, he had managed to survive to the end of the year – as had his partner, and all but one of their first offspring.

If the youngsters could continue to avoid all hazards, they would have a good chance of living to an age of ten years. In the modern world, this is long enough for many changes to take place around them.

Ten years from now, the Baltic will certainly not be the same as it is today. Whether it will change for better or for worse depends on the decisions and actions of the governments and people around this sensitive sea. If enough people from all parts of our society do their bit to help the sea, the Baltic ten years from now could have fewer blooms of toxic blue-green algae, less oil on its waves, and healthier bushes of bladderwrack to support more viable fish populations.

By this time of the year, the cygnets born during the summer have already reached their adult size, but they are still easily recognised by their grey juvenile plumage.





Will the concentrations of nutrients and toxins in these waters be lower ten years from now?

# What the Baltic Sea could be

A hundred years ago the Baltic Sea was a sea of clear water. Algal blooms were rare. The water only contained a fraction of the complex cocktail of toxic chemicals it holds today.

The Baltic is in a sorry state. But it is possible to make the sea healthy again. HELCOM's work aims to ensure that in future II the diverse biological components of the sea, from plankton to fish and seals, will function in balance. This sea of the future will also have a capacity to support a

wide range of human activities carried out in sustainable ways.

This future Baltic Sea will be free of eutrophication, so its waters will become clear once again. Oxygen concentrations in deeper waters will be at natural levels again, supporting marine plants and animals in their natural ranges and numbers. People on their summer holidays will no longer have to worry about toxic blooms of blue-green algae.

Life in the sea will be undisturbed by hazardous substances. This will lead to healthier wildlife, with seal mothers having pups normally, and white-tailed eagles continuing to

spread their majestic wings in the skies. People around the Baltic also have a constant supply of fish that are safe to eat, with minimal concentrations of toxic chemicals.

Maritime traffic will be safe and well controlled, ensuring that the sea is not contaminated by pollution from accidents or deliberate but illegal releases of wastes.



A great crested grebe, *Podiceps cristatus*, feeds a small fish to its young. Grebes often carry their young on their backs, which is just about the safest possible place for them.





With proper management, coastal areas like this part of the Danish coast can provide both a home for wildlife and a recreational setting for people to enjoy.



If you happen to come across a deserted fledgling or a seal pup on the shore, do not touch it, but leave it well alone and walk away. Even if the youngster may look abandoned, its mother is very likely somewhere nearby, anxiously waiting for you to leave.

# How can I help to make

There are many things that everyone, as individuals, can do to help protect the Baltic marine environment and improve its ecological conditions. Examine your everyday activities and think about how you might be contributing to pollution problems. Considerable amounts of problematic pollutants are generated by ordinary people in the form of litter, sewage, traffic emissions, and the chemicals in boat maintenance, cleaning, and even gardening.

Below are some suggestions for ways everyone can make a difference.

## Get informed and involved

Learn all you can about the fragility of the Baltic marine environment. Learn how everyday activities in your community can affect water quality, particularly with regard to sewage treatment. Many nature conservation organisations work to protect the Baltic Sea. Find out about such organisations in your country or region, and support them. Some associations organise voluntary activities where everyone is welcome to participate, such as shore clean-ups or habitat restoration projects.

Report any pollution you notice at sea or along shores.

## Pollution prevention begins at home

Many of the chemicals that we use in our homes and workplaces on the land in the countries around the Baltic eventually end up in the sea. Cutting down on their use in the first place is thus an effective way to protect the sea.

Make sure you do not over-use garden fertilizers. Also cut down on the use of pesticides, herbicides and cleaning chemicals. Whenever you have to dispose of used motor oil, paints, or any other potentially hazardous household chemicals, take them to the appropriate collection points. Never dump any such wastes into sewers or storm water drains.

If living in a house that is not connected to mains sewers, keep your own septic system in good working condition.

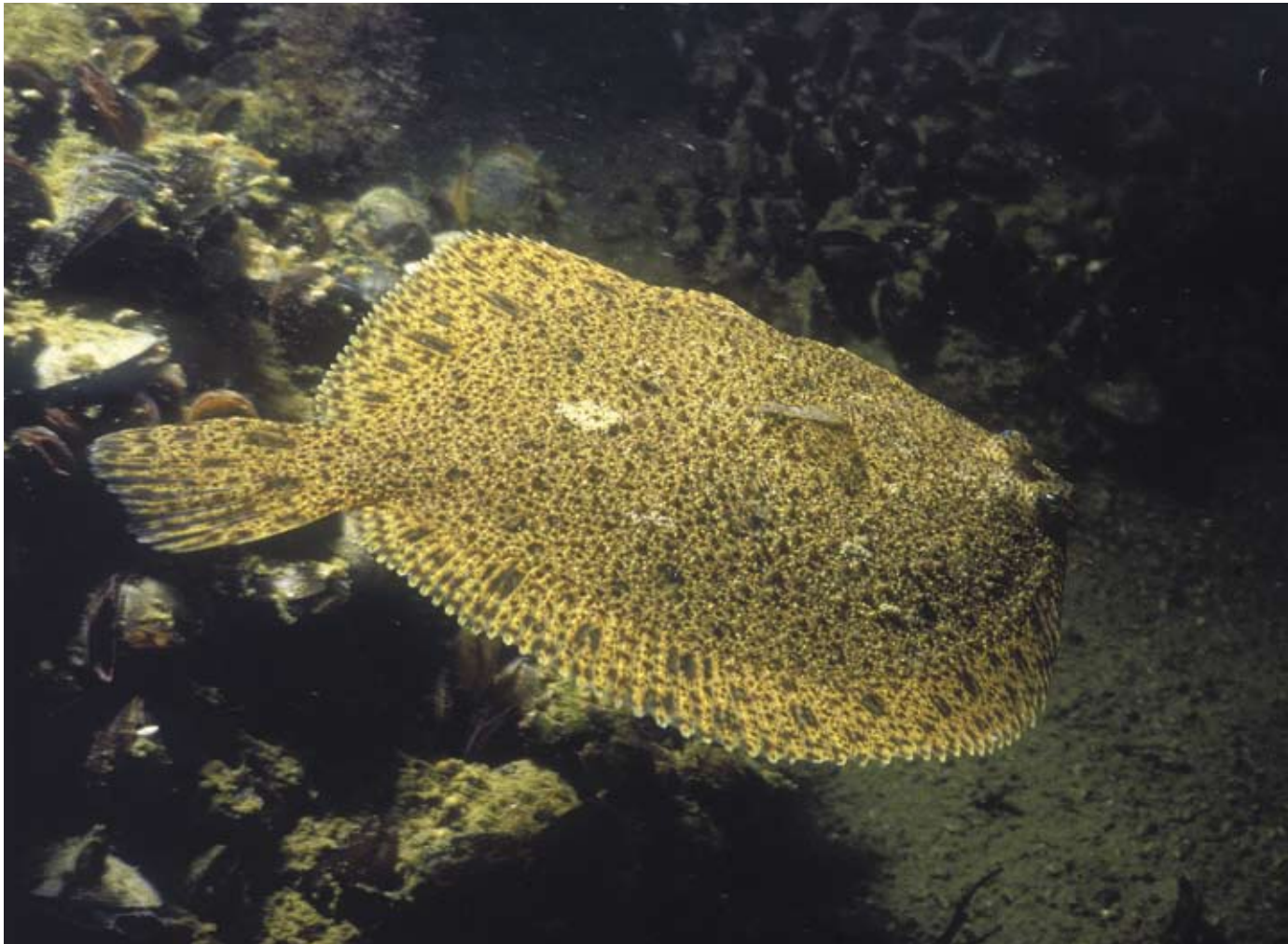
# the sea healthier?

## Keep rubbish out of the sea

Whenever boating or picnicking, put your waste in litter bins or take it back home for safe disposal. Where possible, recycle and compost wastes.

It is especially important to stop any potentially lethal plastic waste ending up in sewers, rivers and ultimately the sea. Once plastic ends up in the sea, it can remain there for very long periods. Many birds, seals and porpoises have died a painful death due to the blockage of their intestines by accidentally swallowed pieces of plastic.

The Baltic Sea is home to about a hundred fish species. Some of them, like the turbot, *Psetta maxima*, have been declining, partly due to toxic chemicals. A healthy sea will be able to support more viable populations of all of these fish species.



Everyone living around the Baltic can help to make the sea cleaner in the future.



## Prevent pollution when boating

Maintain your boat engine to prevent fuel leaks, and use sanitation equipment properly. The chemicals in the products used in boats, such as motor oils, batteries and toxic paints, can be poisonous to fish and other marine life. When they find their way into the food chain they can represent a serious health risk to humans as well. Properly dispose of or recycle such materials and equipment, and choose the most environmentally friendly paints and cleaning chemicals for your boat.

## Protect marine wildlife

When boating at sea, stay away from sensitive habitats. In spring and summer, be especially careful not to go too close to islands and islets where birds are nesting. If you see birds flying into the air as you approach, this is a sure sign that you are already too close. By keeping well away, and never going ashore on such islands you can save the lives of many vulnerable nestlings.

If you happen to come across a deserted fledgling or a seal pup on the shore, do not touch it, but leave it well alone and walk away. Even if the youngster may look abandoned, its mother is very likely somewhere nearby, anxiously waiting for you to leave.

# HELCOM– protecting the Baltic Sea

Since the coasts of the Baltic Sea are shared by nine nations, international cooperation is essential to help this troubled sea.

The Helsinki Commission (HELCOM) is an international organisation that works for the protection of the Baltic Sea marine environment through intergovernmental co-operation between Denmark, Estonia, the European Community, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden.

HELCOM is the governing body of the *Convention on the Protection of the Marine Environment of the Baltic Sea Area*. This Convention, usually known as the Helsinki Convention, was signed by all the Baltic Sea countries in 1974. In the light of political changes, and developments in international environmental and maritime law, a new updated Convention was signed in 1992 by all of the states bordering the Baltic Sea, and also by the European Community.

The Helsinki Convention is the first international agreement ever to take into account all aspects of marine environmental protection. It aims

If the nutrient loads entering the Baltic Sea can be reduced successfully, holiday-makers will no longer need to worry about toxic blooms of blue-green algae.





Chalk cliffs in Rügen, Germany.

to prevent pollution from ships, pollution from land-based sources, and pollution resulting from the exploitation of the seabed. The Convention covers not only the Baltic Sea, but also the whole of its drainage basin within the coastal countries – an area totalling more than 1.7 million square kilometres.

## Information and guidelines based on research

HELCOM's main task is to provide timely information about environmental trends and the state of fragile marine ecosystems. HELCOM also defines important environmental objectives and actions for the governments of the coastal countries to implement through their national environmental programmes and legislation. Nowadays HELCOM also serves as the main environmental policy maker for issues affecting the Baltic Sea.

The backbone of HELCOM's work is made up of joint monitoring and scientific assessment of biodiversity, the state of the sea, and the need for further actions.

There are four main areas of concern in the Baltic Sea.

- Eutrophication, caused by excess nutrients, needs to be reduced significantly.
- Concentrations of hazardous substances in marine ecosystems also need to be brought down to safe levels.
- Navigational practices and maritime safety have to be improved to prevent oil spills and other accidents.
- Biodiversity – the variety of life in the sea – must be carefully protected and cherished.

HELCOM has produced about 200 official Recommendations as practical guidelines for governments, based on scientific research and expert advice. For example, HELCOM recommends that member countries jointly establish a network of coastal and marine Baltic Sea protected areas to conserve biodiversity and protect entire ecosystems. More than 90 marine protected areas have already been established around the Baltic Sea. In order to improve the protection of endangered habitats and species in these sites, HELCOM has recently published a set of guidelines to help member countries to manage their protected areas.

Scientific research provides vital information to help us protect the Baltic Sea successfully.







Pack ice in the Bothnian Sea.



# Index

- Åland 46, 64–65  
algae 37, 52–53, 55, 58–59  
*Anguilla anguilla* 35  
*Anisus* 55  
*Anser anser* 29  
apollo 35, 46  
arctic tern 28–29, 38  
*Ardea cinerea* 86  
*Aster tripolium* 46  
*Aurelia aurita* 60–61  
avocet 39
- Balanus improvisus* 37, 78–79  
Baltic clam 17  
Baltic isopod 33  
Baltic Proper 15, 21  
Baltic ringed seal 43  
barnacle 37, 78–79  
barnacle goose 74  
*Batyropahlus* 55  
biodiversity 80–81, 99  
black goby 49  
black guillemot 62  
black-throated diver 75  
bladderwrack 23, 36–37,  
52–53, 54, 71, 80  
blue-green algae 58–59  
blue mussel 16–17  
Bornholm 23  
Bothnian Bay 21, 43, 100–101  
Bothnian Sea 21, 87  
*Branta bernicla* 74  
broad-nosed pipefish 48–49  
brown shrimp 55  
buckthorn 62–63  
burbot 71  
butterfish 32  
butterflies 35
- Cepphus grylle* 62  
*Cerastoderma glaucum* 17  
*Cercophagus pengoi* 79  
*Charadrius hiaticula* 47  
Chinese mitten crab 79  
*Cladocera* 55  
*Cladophora glomerata* 53  
*Clangula hyemalis* 75  
*Clupea harengus membras* 23, 79  
cockles 17, 39  
cod 23, 27  
common scoter 75  
coot 84–85  
copepods 55, 80  
cormorant 38–39, 86–87  
cowslip 34  
*Crangon crangon* 55  
cyanobacteria 59  
*Cygnus olor* 12  
*Cypripedium calceolus* 35
- Danish Straits 13, 20, 21, 43  
DDT 27, 39  
Denmark 13, 15, 27, 35  
dioxins 27
- eel 34–35  
eelgrass 36–37, 49  
eider 18–19, 39, 75

*Electra crustulenta* 37, 51  
*Eriochair sinensis* 79  
*Esox lucius* 20  
 Estonia 21, 43, 68–70, 77  
 eutrophication 37, 39, 99  
  
 fifteen-spined stickleback 37  
 Finland 43, 46, 63, 68–69  
 fishhook water flea 79  
 flame retardants 27  
 flatfish 13  
 flounder 13  
 freshwater nerite 55  
 frogs 28  
*Fucus vesiculosus* 23, 37, 53  
*Fulica atra* 84–85  
*Furcellaria lumbricalis* 53  
  
*Gadus morhua* 23  
*Galeopsis bifida* 69  
 gammarid shrimps 54  
*Gasterosteus aculeatus* 49  
*Gavia arctica* 75  
 Germany 13, 15, 28, 98  
*Gobius niger* 49  
 goosander 75, 84–85  
 Gotland 21, 23, 32–33, 35  
 great crested grebe 92  
 green algae 52–53  
 grey heron 86  
 greylag goose 28–29  
 grey seal 42–45  
 guillemot 30–32, 39  
 Gulf of Finland 15, 21, 68, 87  
 Gulf of Gdansk 23, 80, 88  
 Gulf of Riga 13, 15, 21, 43, 74–75  
  
*Haematopus ostralegus* 85  
*Haliaeetus albicilla* 27  
*Halichoerus grypus* 43  
 halocline 21  
 harbour porpoise 14–15  
 harbour seal 43  
 heavy metals 27  
 HELCOM 15, 27, 43, 59,  
     67, 77, 79, 92, 97–99  
*Hemimysis anomala* 79, 81  
 hemp-nettle 69  
 herring 15, 22–23, 27, 55, 79, 80  
 Hiiumaa 21  
*Hippophae rhamnoides* 63  
*Hydra* 37  
  
 invasive species 78–79, 81  
 isopods 33, 37, 51, 54  
 jellyfish 60–61  
  
 Kaliningrad 80  
  
 lagoon cockle 17  
 Lahemaa 70  
*Laomedea loveni* 37  
 large blue 35  
 Latvia 21, 76–77  
 Lemland 64–65  
*Leymus arenaria* 33  
 Lilla Karlsö 32  
 Lithuania 27, 76–77, 80

long-spined bullhead 16, 23  
 long-tailed duck 75  
*Lota lota* 71  
*Lumpenus lampetraeformis* 33  
*Lymnea* 55  
  
*Macoma baltica* 17  
*Maculinea arion* 35  
*Melanitta fusca* 75  
*Melanitta nigra* 75  
*Mergus merganser* 75, 84–85  
*Mergus serrator* 75  
 Møn 21, 35  
 moon jellyfish 60–61  
 mussels 16–17, 39  
 mute swan 12–13, 16, 39, 50,  
     62, 90  
*Mya arenaria* 79  
 Mysidacea 55  
 mysis shrimps 55, 79, 81  
*Mytilus trossulus* 16  
  
*Neogobius melanostomus* 79  
*Nerophis ophidion* 49  
 Nida 80  
 nitrogen 59  
 Northern shoveler 85  
 nutrients 16, 37, 39, 58–59, 77, 87  
  
 Oder 13  
 oil spills 66–67, 99  
 Öland 21, 35  
 orchids 35  
 overfishing 23, 77  
 oxygen-depleted bottom 23, 59  
 oystercatcher 85  
  
*Parnassius apollo* 35, 46  
*Parvicardium hauniense* 17  
 PCB 27, 39, 43  
*Perca fluviatilis* 71  
 perch 71  
  
*Phalacrocorax carbo* 38–39, 87  
*Phoca hispida botnica* 43  
*Phoca vitulina* 43  
*Phocoena phocoena* 14  
*Pholis gunnellus* 32  
 phosphorus 59  
*Physa* 55  
 pike 20  
 plankton 55  
*Planorbarius* 55  
*Platichthys flesus* 13  
*Podiceps cristatus* 92  
 Poland 13, 15, 79, 87  
 polyps, 37, 50–51  
*Pomatochistus minutus* 22, 49  
 porpoise 14–15  
*Primula veris* 34  
*Psetta maxima* 13, 95  
  
*Radix* 55  
*Recurvirostra avocetta* 39  
 Rauma 63  
 red algae 52–53  
 red-breasted merganser 75  
 ringed plover 47  
 ringed seal 43  
 round goby 79  
 Rügen 28, 98  
 Russia 75, 80  
 ryegrass 33  
  
 Saaremaa 21, 35, 68–69  
*Saduria entomon* 33  
 salinity 20–21  
 salmon 27, 76–77  
*Salmo salar* 77  
 sand gaper 79  
 sand goby 22, 48–49  
 sandwich tern 39  
 sea aster 46  
 sea mat 37, 51  
 sea urchins 21

seals 42–45, 94  
shelduck 39  
shrimps 37, 54–55  
snails 37, 55  
snake blenny 33  
*Somateria mollissima* 19, 39, 75  
*Sonchus arvensis* 69  
sow-thistle 69  
*Spinachia spinachia* 37  
sprat 79  
*Sprattus sprattus* 79  
starfish 21  
*Sterna paradisaea* 38  
*Sterna sandvicensis* 39  
Stora Karlsö 31, 32  
*Sterna paradisaea* 29  
straight-nosed pipefish 49  
Sweden 15, 35, 43  
*Sygnathus typhle* 48–49

*Tadorna tadorna* 39  
*Taurulus bubalis* 16, 23  
*Theodoxus fluviatilis* 55  
three-spined stickleback 49  
toxic chemicals 15, 16,  
27, 39, 43, 95, 99  
turbot 13, 27, 95

*Ulva* 53  
*Uria aalge* 39

velvet scoter 75

water fleas 55, 79, 80  
white-tailed eagle 26–27

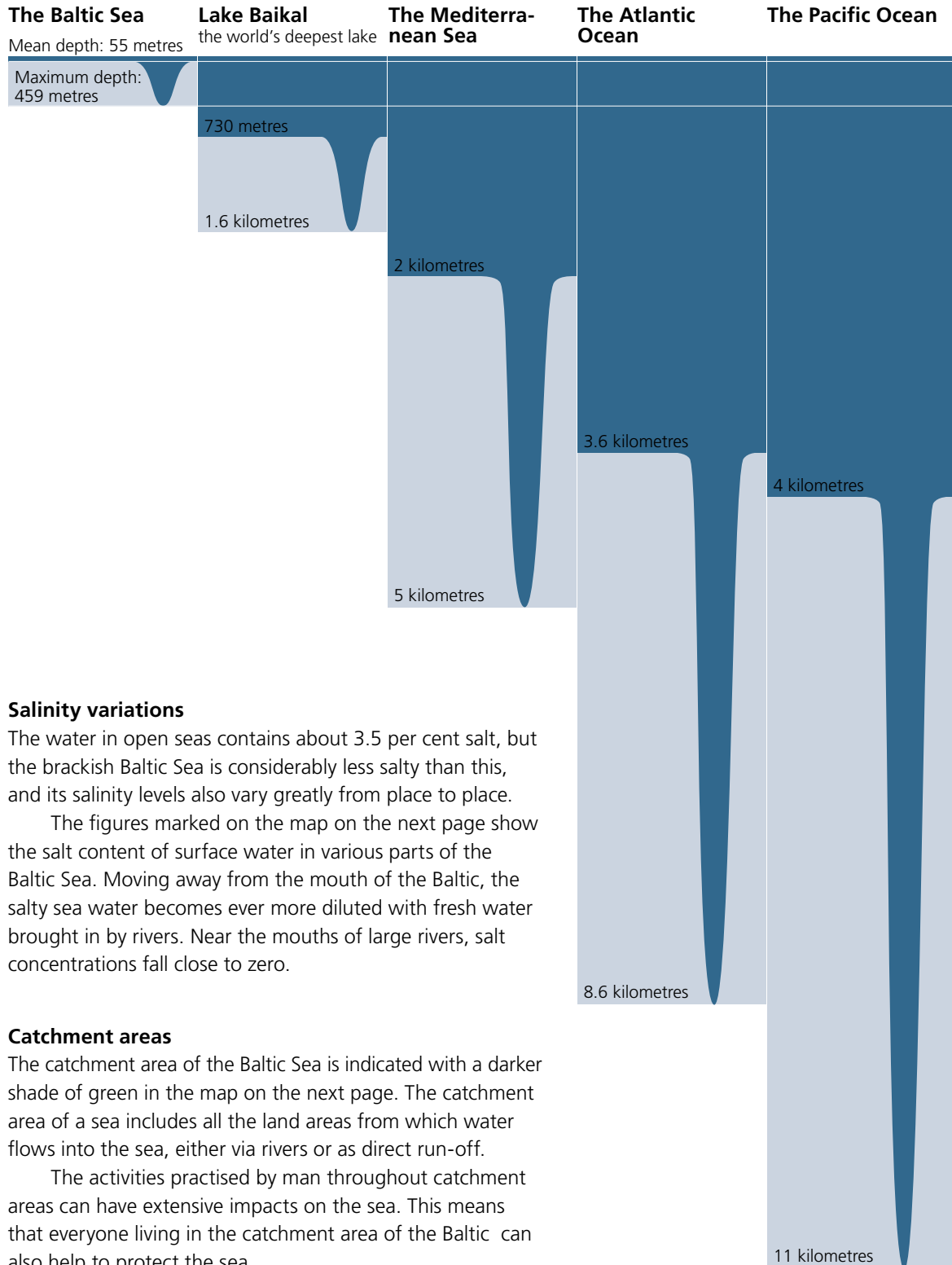
yellow lady's slipper 35

*Zostera marina* 37

# Maps and diagrams

## An exceptionally shallow sea

In comparison to the world's oceans, other seas, and even many large lakes, the Baltic is an exceptionally shallow body of water.



## Salinity variations

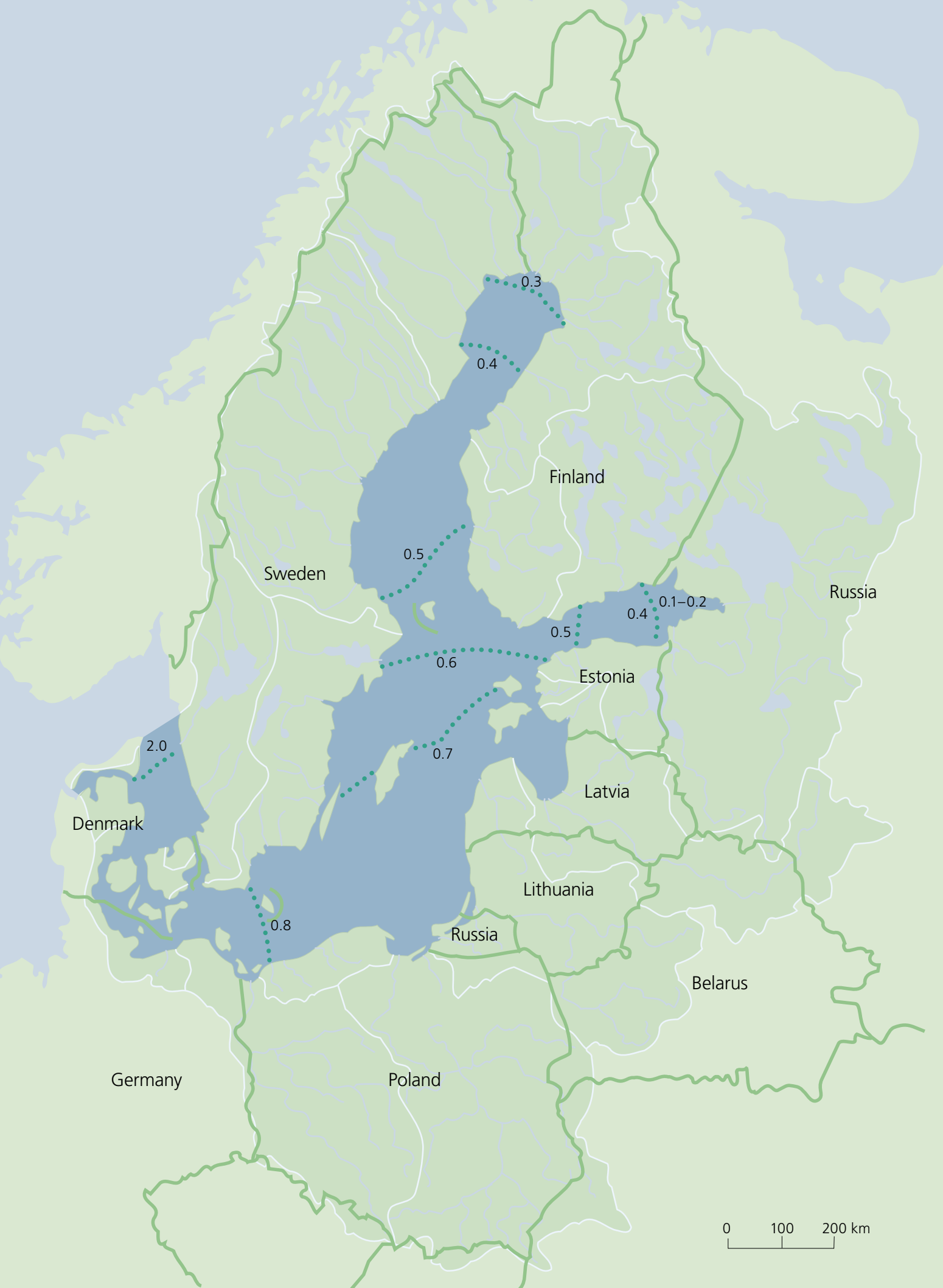
The water in open seas contains about 3.5 per cent salt, but the brackish Baltic Sea is considerably less salty than this, and its salinity levels also vary greatly from place to place.

The figures marked on the map on the next page show the salt content of surface water in various parts of the Baltic Sea. Moving away from the mouth of the Baltic, the salty sea water becomes ever more diluted with fresh water brought in by rivers. Near the mouths of large rivers, salt concentrations fall close to zero.

## Catchment areas

The catchment area of the Baltic Sea is indicated with a darker shade of green in the map on the next page. The catchment area of a sea includes all the land areas from which water flows into the sea, either via rivers or as direct run-off.

The activities practised by man throughout catchment areas can have extensive impacts on the sea. This means that everyone living in the catchment area of the Baltic can also help to protect the sea.



**Shallows and deeps**

The seafloor has a varying profile. The Danish Straits, the Baltic's only link to the Atlantic Ocean, are very shallow, as well as narrow – serving to isolate the Baltic even more from its ocean neighbour. The water then gets deeper towards the northwest, with the Baltic's deepest point being north of Gotland.

**The arrows indicate the route we have travelled with the swans in this book.**





### Network of marine protected areas in the Baltic Sea

As of 2005, a total of 97 marine protected areas were established around the Baltic Sea. These are part of a network of coastal and marine Baltic Sea protected areas which has been jointly set up under HELCOM to conserve biodiversity and protect ecosystems in the region.







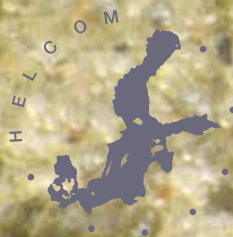




# *The Baltic Sea*

*— more than meets the eye*

The Baltic Sea is home to a great variety of wildlife. In addition to seals, porpoises, and seabirds, the sea is also inhabited by many underwater creatures that few of us ever have the chance to see. This book takes readers into the marine world: soaring over the shores of the Baltic and plunging deep into its fascinating waters. The scientifically accurate but entertaining narrative is accompanied by enlightening information boxes and a beautiful selection of high-quality photographs, including rare underwater images.



HELSINKI COMMISSION  
Baltic Marine Environment  
Protection Commission