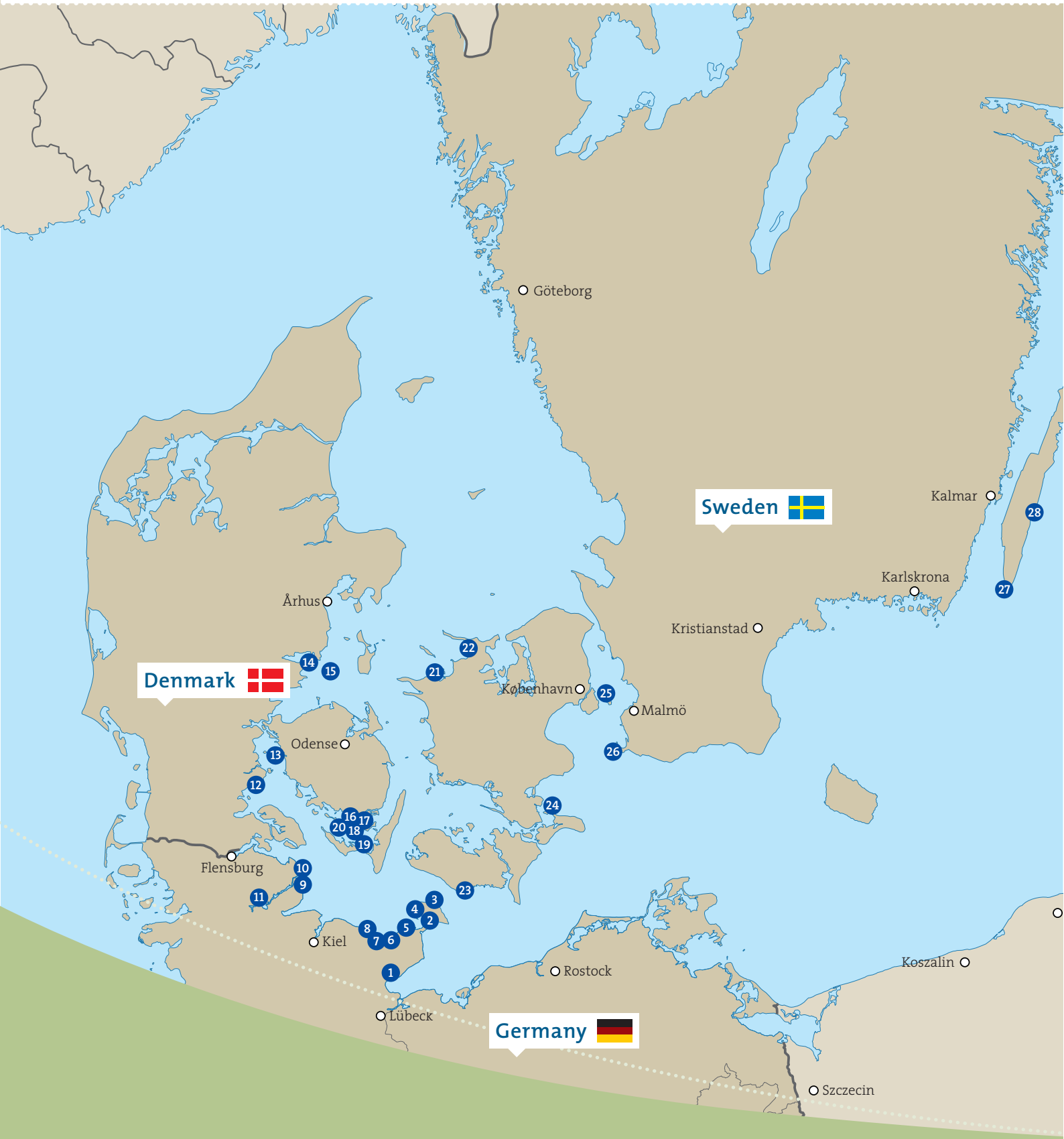
Stiftung Naturschutz
Schleswig-Holstein

LIFE BaltCoast 2005–2012

Rehabilitation of Baltic Coastal Lagoon Habitat Complex

34 LIFE BaltCoast project sites




Estonia
Haapsalu
Pärnu
Riga
Liepāja
Lithuania
Klaipėda
Kaliningrad
Słupsk
Gdańsk
Elbląg
Life
1 Neustädter Binnenwasser
2 Sundwiesen Fehmarn
3 Grüner Birk
4 Südwest Fehmarn
5 Eichenholzniederung
6 Weißenhäuser Brök
7 Sehlendorfer Binnensee
8 Kleiner Binnensee
9 Schwansener See
10 Oehe-Schleimünde
11 Reesholm
12 Halk Nor
13 Bågø
14 Hjarnø
15 Endelave
16 Hjelmshoved
17 Monnet
18 Store Egholm
19 Halmø
20 Urehoved-Dejrø
21 Store Vrøj Krageø
22 Korevlen
23 Saksfjed-Hyllekrog
24 Ulvshale
25 Saltholm
26 Falsterbo-Foteviken
27 Ottenby
28 Sydöstra Ölands
29 Högbyhamn
30 Nemunas delta
31 Linaküla-Sääreküla
32 Sõmeri
33 Teorehe
34 Kõrgesaare-Mudaste

Introduction to coastal habitats of the Baltic Sea region

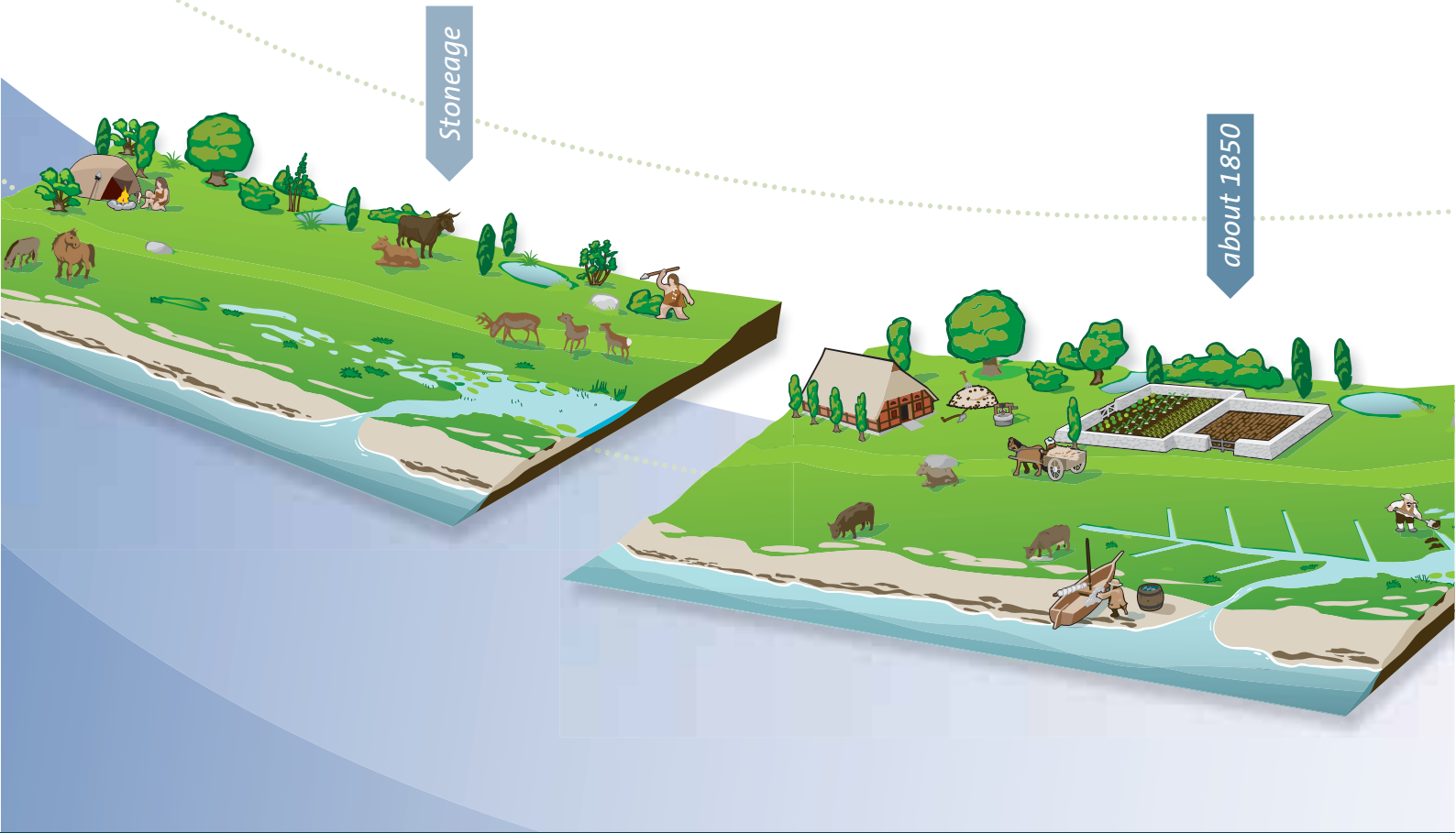
The LIFE-Baltcoast project focuses on conserving the distinct diversity of habitats – the lagoon habitat complex – resulting from coastal development processes on the Baltic Sea after the most recent ice age, which ended about 10,000 to 15,000 years ago.

After the ice sheets melted, the area adjacent to the Baltic Sea was colonised by herds of wild grazers. At first these were mainly reindeer but as it became warmer, wild horses, ox and red deer followed on. The animals were hunted by Stone Age nomadic hunters.

When humans settled down and started farming, wild grazing as a natural process was replaced by human extensive farming practises, and the wild grazers were replaced by domesticated cattle and horses. This style of farmland management remained largely unchanged over many centuries. In southern Sweden grazing of coastal meadows can be traced back to the Bronze Age. Due to their long and gradual development, boreal coastal meadows and Atlantic salt meadows are very rich in wildlife, with species adapted to the very special conditions of the habitats and some occurring only on these types of meadows. Birds such as dunlin, with a mainly northern distribution range, have probably been using the Baltic shores as breeding grounds ever since the ice of the last glaciation disappeared.

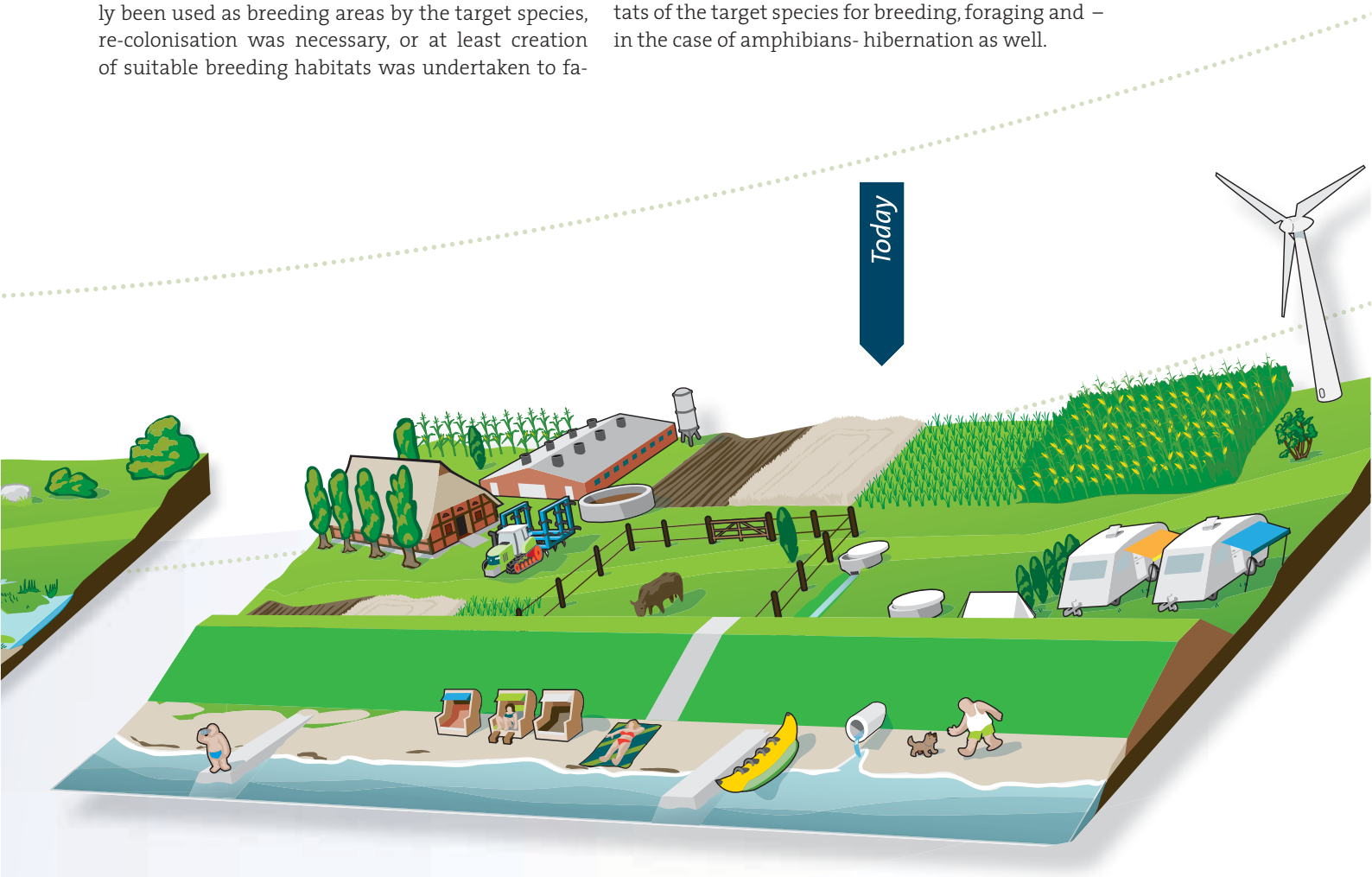
Nature was able to adapt to the gradual changes over thousands of years; species adapted both to coastal dynamics and the impact of agricultural grazing. Today, many species have come to depend on these semi-natural conditions, so the fast changes in land management techniques that have occurred over recent decades have had severe consequences for nature.

On the Western Baltic, farmers became less and less interested in grazing the coastal areas. Much of the land behind the dikes, often pump drained, was ploughed and converted to arable. In Denmark and Germany arable farming and pig production replaced dairy cattle and grassland farming in many places, causing abandonment of wetter coastal meadows.



In Sweden intensification of agriculture did not happen everywhere and traditional grazing regimes on coastal meadows survived, supported by agri-environmental schemes during last 20 years.
As a consequence of the collapse of the former Soviet Union, on the Eastern Baltic, in Estonia and Lithuania, grazing ceased almost entirely. Coastal grasslands were quickly overgrown by reed beds and later by scrub like juniper, willow and elder. As these changes have taken place, grassland species and wader birds have disappeared from many areas.

At this stage, the LIFE-Baltcoast project was started with the aim of improving wildlife conservation conditions within the lagoon habitat complex, particularly to meet the habitat requirements of certain target species – ruff, dunlin, natterjack and green toads. Where the target species were still present, the strategy was to halt decline by re-establishment of a suitable habitat. For some sites which had previously been used as breeding areas by the target species, re-colonisation was necessary, or at least creation of suitable breeding habitats was undertaken to facilitate future re-colonisation. When it came to the birds, it was decided to concentrate first on actions to improve their breeding areas to enable successful reproduction before focusing on transit and winter resting sites.
The 34 project areas in Germany, Denmark, Sweden, Estonia and Lithuania were chosen within the Natura 2000 network, in order to integrate all habitat types relevant to the lagoon habitat complex. Each project area comprised its own set of habitat types of different quality and composition. Most areas were integrated in the coastal landscapes and subject to numerous influences, which, from a nature conservation point of view, have been mostly negative.
The project started with a systematic check of the conditions at each project site by conservation experts for birds, amphibians and vegetation. For each site an individual conservation strategy was discussed. Suggested actions were outlined to improve the hydrology, the vegetation structure and the habitats of the target species for breeding, foraging and – in the case of amphibians- hibernation as well.



Summary

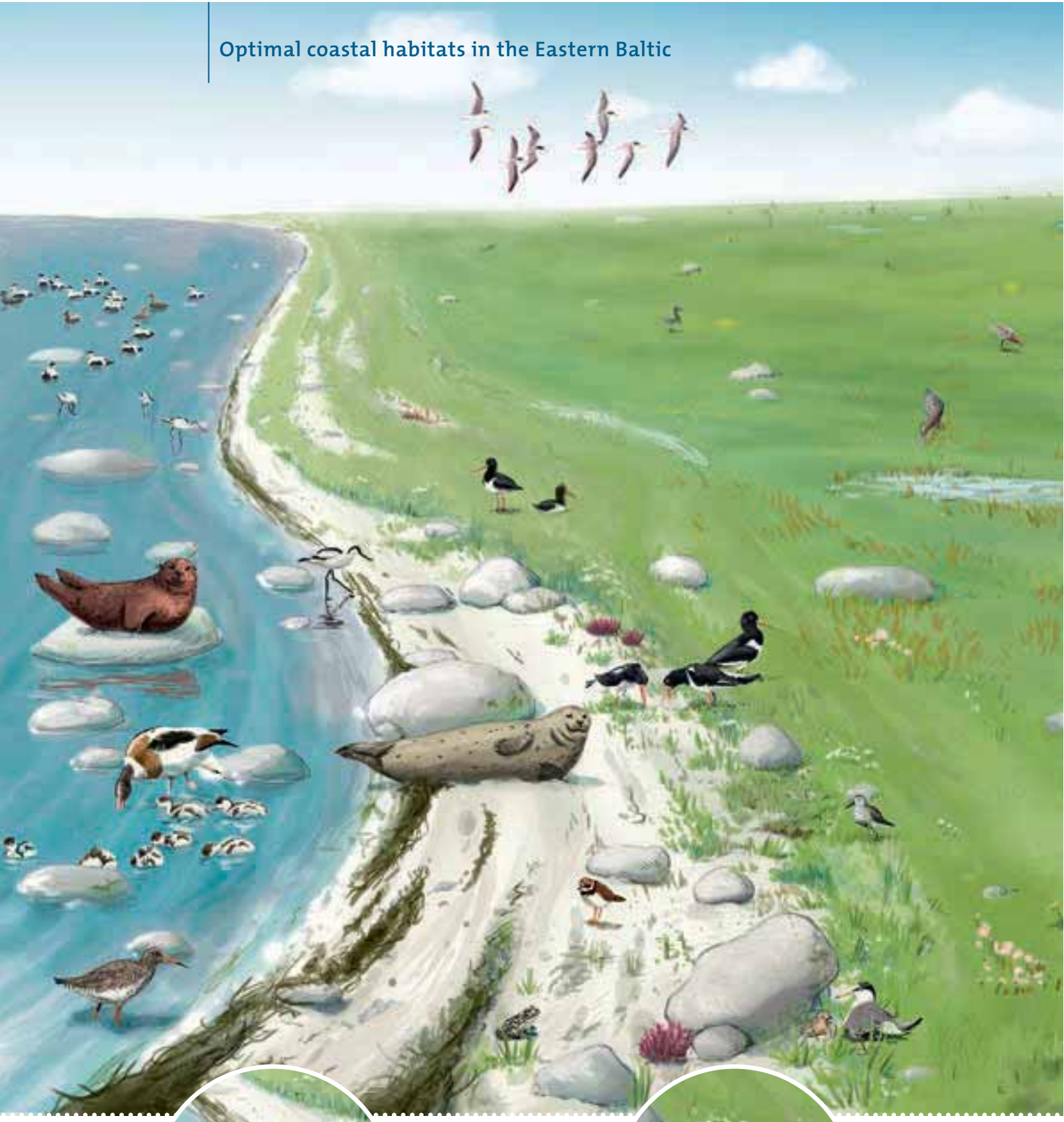
Following main actions were carried out:

- *Restoring natural hydrology of lagoons either by re-opening of natural connections to the sea or by closing pipes draining the lagoons.*
- *Preventing eutrophication (nutrient enrichment) of lagoons by by-passing pipes leading the nutrient rich water around the lagoon or establishing nutrient retention ponds for drainage water.*
- *Restoration of natural depressions and lagoons, which had become overgrown with high vegetation and/or silted up.*
- *Reintroduction of grazing by installing infrastructure such as fences, watering facilities, a barn and shelters.*
- *Removal of unwanted scrub vegetation, including alien invasive species such as Japanese rose.*
- *Blocking ditches and drains to re-create natural shallow flooding on salt meadows.*
- *Protecting birds breeding in colonies against predation by installing 'fox fences'.*
- *Management of small populations of natterjack and green toads by creation of breeding ponds or/and hibernation sites as well as carrying out supportive breeding.*
- *Preservation of creeping marshwort (Apium repens) by establishing back-up populations for one source population in Schleswig-Holstein.*

Thanks to this programme of actions LIFE-Baltcoast was able:

- *To improve the conservations status in boreal coastal meadows, salt meadows and dunes by removing litter and aggressive plant species and enable the development of species rich grasslands again.*
- *To improve the hydrology and plant diversity of several lagoons in Sweden, Denmark and Germany, either by re-establishing the natural exchange of water between the Baltic Sea and the lagoons; or by closing drainage which had artificially lowered the water table of lagoons; or by deepening lagoons that had become silted up and overgrown by scrub plants.*
- *To witness dunlin and ruff return to some of their former breeding sites in Denmark, Estonia and Sweden and to increase the avocet colony during seven years of the project from about 50 pairs to 202 pairs.*
- *To support small populations of natterjack and green toads along the Baltic coast, in particular in Germany, Denmark and Sweden (Öland) by improving and re-creating their breeding and feeding habitats, hibernation places and creating back-up populations.*
- *To establish a reserve population of creeping marshwort (Apium repens), despite the fact that the ecology and reasons for the decline of the plant were unknown at the beginning of the project.*

Optimal coastal habitats in the Eastern Baltic



Avocet *(Recurvirostra avosetta):*
- breeding habitat: bare ground and mud flats at beaches or lagoon shores
- feeding habitat: shallow waters

Dunlin *(Calidris alpina):*
- breeding habitat: low grass sward in open coastal meadow with other meadow birds
- feeding habitat: shallow flooding with very short vegetation or mudflats

Ruff *(Philomachus pugnax)*
male (right) and female:
- breeding habitat: fresh wet meadows with longer grass for hiding, dancing places for the males
- feeding habitat: fresh water pools and flooding

Natterjack toad *(Bufo calamita):*
- breeding habitat: short grazed, temporarily flooded open and freshwater pools,
- feeding habitat: sandy beaches with drift lines of seaweed, grazed salt meadows and open dunes
- hibernation: in the sand of dunes, in old stone walls, etc.

Optimal lagoon habitat complex in the Western Baltic

Natterjack toad

Ruff

Avocet

Green toad *(Bufo viridis):*
breeding habitat: sparsely vegetated, shallow ponds and lagoons
feeding habitat: stony beaches with hiding places and drift lines with tangflies, dry grasslands
hibernation: stonewalls, basement of old houses, villages

Little tern *(Sterna albifrons):*
breeding habitat: sandy beaches or shallow gravel banks preferably on islands without predators
feeding habitat: shallow waters at the coast and lagoons with clear water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Threats to natural coastal habitats:

Human impact and changes in land use over the last 200 years have had a severe impact on coastal landscapes. In the Western Baltic up to 90% of former wildlife habitats had been lost over the last decades.

A diverse range of causes led to dramatic declines in both the Eastern and Western Baltic. The situation was so severe that even nature reserves were affected by developments in recent decades. Therefore an urgent need to improve the conservation condition of coastal habitats around the Baltic lagoons in general existed when the Baltcoast project began in 2005. To illustrate the wide range of influences on lagoon habitat complexes and its species, the threats in the German project "Sehlendorfer Binnensee" are explained below.

nature reserve **Sehlendorfer Binnensee**

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1 2 **Tourist infrastructure**
Especially in the second half of the 20th century, coastal areas became popular as tourist attractions and for leisure activities. In this context, several camping grounds were built like this one on dunes close to Hohwacht. In addition, an area with holiday houses overlooking the beach was constructed on a beach wall. In the process, dune ground was levelled, completely stopping the natural dynamic shifting of dune sand by water and weather. As a result, whole areas of dry sandy dune habitats and dry grasslands were lost.

3 **Overgrown salt meadows**
When agricultural practices changed and cattle ceased to graze salt meadows, those sites were overgrown by reed bed. Overgrown salt meadows are lost as breeding grounds for BaltCoast's target wader birds like Baltic dunlin, ruff, redshank and others. Lack of grazing meant that shallow depressions that were breeding sites for natterjack and green toad became overgrown and shaded and so could not be used for reproduction anymore.

4 **Ditches in lower salt meadow**
Ditches in the lower salt meadows were built to drain the surrounding land to make it useful for agriculture. The result was an unnatural meadow hydrology.

5 **Upper salt meadow put to arable**
In the case of the upper salt meadows, the main reason for the change of the habitat was agriculture and its need for land. Over the decades more and more salt meadows have been drained and put to arable use.

6 **Dike and pump draining**
For flood protection and intensification of land use, upper salt meadows had been diked and pump draining was built. Consequently the natural water level had been lowered down, and native species lost their habitat.

7 **Island lost for breeding birds**
The construction of a system of dikes and pump draining had another bad impact on this habitat complex: the former island and favoured breeding ground – marked with a circle in the picture – was not an island any more. Instead of a safe, predator-free place for breeding coastal birds, this area has been developed as farmland.

8 **Predation pressure**
Bird predators like foxes and martens have found increasingly easy cover in the land surrounding bird breeding grounds, moving them closer to their prey. Bird nests and chicks are thus in much more danger, and breeding success has been impaired. The distance between predator habitats and potential bird breeding sites is now less then 300 m.

9 **Invasive rose**
Since men have explored the world, goods have been exchanged – even centuries ago. Seamen and traders brought products including plants to Germany. Around 1850 Rosa rugosa came to Europe and to Germany. Unfortunately for dune habitats this is an undesirable plant which spread quickly by seeds and roots. The Japanese rose can form a uniform dense coverage. In doing so, Rosa rugosa became a problem as an invasive plant (neophyte) that displaced native species. This has happened over large swathes of the Baltic coast.

10 **Eutrophication**
Especially in Western Europe intensive livestock farming and traffic are sources of massive nitrogen output. This high atmospheric nutrient loads as well as those from adjacent fields and the catchment of the lagoons increases vegetation growth and effects water quality badly. To a certain extent it is possible to counteract this by increased management, but increased management activities are likely to cause negative effects on species e. g. reduce the breeding success for meadow birds. Eutrophication also affects species negatively by causing higher predator density and reduced breeding success for toads by bad quality in breeding waters.

Actions

Among the different actions within the LIFE-Baltcoast programme, one can distinguish between "soft" actions focusing on the increase of knowledge and "hard" actions with construction work on ground.

"Soft" actions

Expert visits

In LIFE-Baltcoast highly qualified experts worked together with their specialist counterparts in other countries, as international teams focusing on their own common specialism. They worked in multidisciplinary teams; for example, ornithologists, botanists and amphibian experts worked hand in hand to run a project that tried to balance the management needs of birds, plants and amphibians. In many sites this was a new approach to nature conservation. At the beginning of the project, a group of experts visited all the sites. Based on discussions with the local managers, the group drew up an individual, site specific conservation strategy with actions to be implemented during the project. The aim was to improve the conservation status of all the habitat types within the lagoon habitat complex to make them suitable for re-colonisation by target species like ruff, dunlin, natterjack and green toads. At sites where target species were still present, the aim was to halt declines by re-establishing effective habitat conservation. Furthermore, it was agreed to prioritise conservation actions, firstly implementing measures to improve bird breeding grounds to enable successful reproduction and then secondly focusing on transit and winter resting sites.

Avocet road crossing

Expert visits

In order to establish these priorities, one of the main tools in the project was a number of expert visits. These took place in each of the project countries and had a theoretical as well as a practical aspect. Additionally, all partners had the opportunity to exchange experiences in annual workshops in each of the participating countries.

Fine-tuning-management

Another key aspect of LIFE-Baltcoast was the so-called "fine-tuning-management". Unlike conventional projects, the members of LIFE-Baltcoast checked continuously to see if project actions were achieving the planned aims. If the outcome was other than expected, the local project managers discussed alternatives with the experts on site to ensure that habitat conditions were geared as closely as possible to the needs of the specific target species. This so called "fine-tuning management" became repeatedly necessary over the lifetime of the project and was one of the main reasons for success with the target species Baltic dunlin, ruff, green and natterjack toad.

International Networking

Prior to LIFE-Baltcoast, limited exchange of information on population sizes and trends of target species and management on target species breeding sites, hindered cross-site and cross-country understanding of the conservation needs. During the project a large amount of data on breeding numbers of target bird species dunlin, ruff, avocet and black-tailed godwit were collected from published and unpublished sources, together with some data about land use practice. The international network of bird experts created within LIFE-Baltcoast facilitated easier, widespread access to data that had hitherto been scattered, fragmented and unpublished. Data were stored in a specially-developed database and can be downloaded from: www.life-baltcoast.eu

On a few occasions, the international Baltic network

of bird experts joined the annual conference of the International Wader Study Group, where knowledge and experiences were exchanged with a wider audience. An international networking group of amphibian experts, formed in the earlier LIFE-Bombina project, was improved and consolidated to benefit the BaltCoast project.

Networking for new rules

The experts of BaltCoast project have contributed significantly to a new set of rules to support meadow management in Estonia. A number of the experts' key recommendations for the species orientated management of meadows are likely to be incorporated into the Rural Development Plan for the period 2014–2020. The subsidies for semi-natural habitat management played a vital role in the success of sustaining BaltCoast results and it is very important that the new subsidy schemes take into account the results of the project.

Conservation camps

Conservation camps took place in all Estonian project sites and at some sites over several years in a row. The camps aimed to improve the conservation status of project sites as well as to involve the wider public in conservation management. Participants learned about the species that inhabit the coastal areas, threats to those species and how they could contribute to species conservation.

"Hard" actions

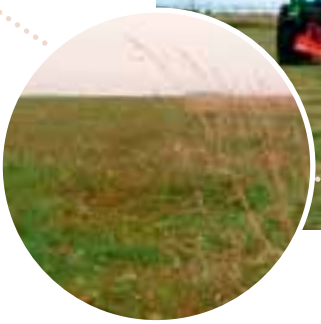
"Hard" actions aimed to change hydrological or other conditions on sites to improve the conservation status of the habitat types. Additionally LIFE-Baltcoast aimed to make sites formerly colonised by one or more of the target species suitable for potential recolonisation. Key work in restoring the lagoon habitat complex for target species centred on the restoration of depressions, cleaning of lagoons, blocking of ditches, creation of hibernation sites and restoration of dunes. The work was monitored daily by amphibian experts from the partner Amphi Consult.

Actions and effects
Return of the Dunlin – "the Saltholm case"

Saltholm, an island in the Baltic Sea next to Copenhagen, is one of the best meadow bird sites in the western Baltic. Between 2000 and 2005, low grazing pressure from summer grazing cattle resulted in salt meadows becoming overgrown, especially in the wet areas.

Baltcoast project experts discussing the "coarse grass problem" with farmer: in the salt meadows an aggressive coarse grass – the tall fescue *(Festuca arundinacea)* – established itself in large areas of grazed meadows. Normal dairy cattle do not like to graze this grass. With consequently low grazing pressure the grass can produce seeds and spread in the meadows.

Through the Baltcoast project a change of the grazing regime was supported: from mainly summer grazing with dairy heifers to primarily year-round grazing by robust and hardy cattle with a little additional summer grazing. During winter robust cattle burn their body fat – up to 100 kilogram – and graze coarse grasses. Meadows at the end of winter should be clear, as visible on this photo from March 2008



Initial mowing in meadow areas dominated by tall fescue.
The birds' view of mown and unmown parts of the meadows at Saltholm: by initial mowing the visibility for ground nesting birds was improved, so making it easier for them to spot stalking predators

The hay was stored in the project-financed barn as "back up fodder" in harsh winters for the year-round grazing cattle. A solar panel generates energy for watering facility.

Galloway cattle at feeding place at the end of harsh winter

Ole Thorup inspecting the Saltholm site during dunlin breeding season in early June 2011. A Danish ornithology magazine stated: "Saltholm: Best conditions for meadow birds for 50 years"

Markus Sørensen talks to project experts about his experience of managing the Holmegården farm over the course of a whole year on a small island in the Baltic Sea. Challenges occur during winter when the island can be flooded by storm tides.

Dunlin *(Calidris alpina)* in typical habitat at the nesting site on Saltholm, June 2011.

Due to increase of geese grazing the grazing density of cattle has to be adjusted to get the right vegetation structures. Especially in dry years, as shown on the photo, a site is easily overgrazed. Managing a site for specific demands of Dunlin requires flexibility in the management. An annual monitoring of vegetation structures during the breeding period enables to adjust the grazing pressure of cattle in the core breeding areas.

Recommendation for dunlin management

Successful dunlin management demands very thorough vegetation monitoring, as there is a delicate balance involved

- Breeding dunlin require large areas of low grass sward with smaller wetlands of clear water or with very short vegetation, which can only be created by relatively intensive grazing. On the other hand, dunlin are very vulnerable to nest destruction by grazing cattle in the incubation period that lasts from late April/early May till late June. Thus, grazing should ideally be postponed till around 1st June and must not involve a high animal density before late June.
- To counteract unwanted high and dense vegetation, additional mowing can compensate for insufficient grazing.
- Dunlin are site faithful and actions carried out at existing breeding sites and in the near vicinity have the highest chance of success.

Results

- The project was successful in creating potential dunlin habitat for future breeding at Endelave (DK), Store Egholm (DK) and Grüner Brink (D) and Högby hamn (S)
- The dunlin returned to the sites Saltholm (DK) and Teorehe (Est)
- At the Estonian site “Kihnu” island the number of dunlin breeding pairs increased due to habitat management from 4 to 8 pairs

Actions and effects
Conservation of colony breeders

Coastal birds such as the pied avocet *(Recurvirostra avosetta)* are ground-nesting, exposing their eggs and chicks to predation. Colony breeding is one strategy to limit this risk. Many birds together can scare away birds of prey, corvids and gulls more effectively during daylight hours. However, a high density of nests on the ground can also work against the species – it draws night-active mammalian predators such as foxes or martens. This predation risk can be reduced by breeding on islands as on Landgrens Holme in Falsterbo (S).

Even when a bird colony is strong and remote, mammalian predators can track it down, even swimming to reach small, isolated islands. Once an individual predator has succeeded in doing this, it will often return in the breeding season and again in the following years. So bird colonies are naturally not safe and stable. Colony birds counter such predation pressure by switching between breeding sites.

Human settlements and tourism in coastal areas, such as in Falsterbo, inhibit a "switching strategy" for colony breeders. Former possible breeding sites are used today as e.g. a golf course. Furthermore, housing areas, woodlands and scrub like Japanese rose provide shelter and prey for predators such as foxes, martens and badgers the whole year round and therefore facilitate a high predator density.

In order to protect the only possible nesting site of pied avocet in Falsterbo an electric anti-predator fence (red line) was built, running to a total length of app. 3600m.

The electric anti-predator fence was integrated into the cattle fence. A ground-level line prevents predators crawling underneath, a top line prevents them jumping over and there are several barbed and electrified strands in between to further deter them. Grass has to be mown twice in the breeding season to avoid short-circuiting the ground-level line.

Great reproduction success in Falsterbo (S) in 2012: over 350 fledged juveniles. In years when the fence has worked to exclude predators, the reproduction of the 110 pairs is 15 times higher than in years with predation.

After a new peninsula appeared at Grüner Brink (D) a new bird colony of little terns *(Sterna albifrons)* and common terns bred successfully in the first year without predation.

In the second year, fox predation occurred and a floating electric anti-fox fence was built immediately at the base of the peninsula. This ensured another successful breeding year. In the following two years the colony had no success due to gull and weasel predation and the number of breeding pairs decreased rapidly. Since then no bird colony has established. The strategy of unpredictability was used and birds switched to other sites in the western Baltic. Power supply to the fence needs checking daily, because predators also check daily and seize the opportunity if the fence is not working properly - as here at Südwest Fehmarn (D).

Volunteers helped to make an artificial bird island suitable for common terns at Sehlendorfer Binnensee.

Common terns regularly breed successfully at Sehlendorfer Binnensee. But in one year out of four all chicks were lost due to predation by an eagle owl.

Recommendation for the management of bird colonies

- Predation prevention can achieve only limited success in improving reproduction rates in areas where there are too few natural breeding sites and birds are forced to breed in the same spot every year.
- Predation prevention by electric fences or artificial islands is only possible on a small scale.
- Technical installations need daily maintenance and are therefore time consuming and costly.
- Excluding one predator means that another one might take over. So if fencing excludes mammalian predators, others such as marsh harriers, peregrine falcons, eagle owls, ravens, gulls, etc., may take over and become specialists at colony predation.
- The best predation control is to enable colony breeders to choose between several breeding sites. Then they can operate their natural predation prevention strategy by being unpredictable for predators.
- Predation prevention might be needed to avoid the extinction of some worldwide threatened species until more breeding sites are established.

Actions and effects

Breaking the trend and retaining the ruff

Ruff *(Philomachus pugnax)* are declining dramatically all over the Baltic as a consequence of a combination of destruction of staging sites and lack of wet meadows and proper meadow management for breeding

Optimal ruff habitat is lacking at most of the species' former coastal sites around the Baltic Sea. Meadows with shallow fresh water flooding – as here the "Salmi meadow" in Matsalu NP in Estonia – have been drained and converted to fertilized meadows or even arable fields.

One of the project actions "Restoration of depressions" created new ruff feeding habitat. The ponds are also calling sites of the green toad at Ottenby, Sweden and are temporarily fenced-off for optimized reproduction.

"Before": Blocking of a shallow ditch at the project site Sydöstra Öland in autumn.

"After:" Flooding re-occured at the end of the winter after ditch blocking at the site Sydöstra Öland in autumn.

Even in the dry summer of 2012 the wet meadow, which was flooded during late winter (photos before and after) attracted breeding ruff. Flower rich meadow provides good food conditions for ruff chicks in mid-June at Sydöstra Öland, Sweden.

Susanne Forslund project manager from Kalmar County looking for ruff at Sydöstra Öland, Sweden.

Recommendation for retaining the ruff

Key features for success with ruff protection were

- creating shallow flooding by retaining winter rain
- reactivation of freshwater depressions, or scrapes, by digging
- creating the right vegetation structures by combined mowing and grazing management
- involve experienced ruff site manager in planning a conservation project for ruff

Results

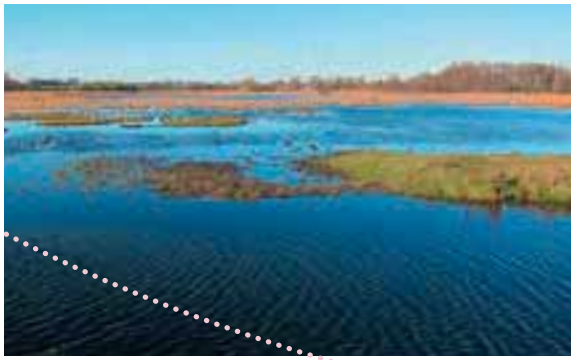
- Ruff actions were successfully implemented at Sydöstra Öland (S), Ottenby (S) and Saltholm (DK)

Actions and effects
Restoration of lagoons

Lagoons in grazed salt meadows are important water bodies in the coastal habitat complex with influx from the Baltic Sea, as here in autumn. Roosting golden plovers occupy lower salt meadows which are colored by the reddish saltwort on the island of Store Egholm (DK).

Due to diking and draining, lagoons were lowered or dried up completely and when grazing ceased because it became uneconomic, coastal landscapes changed: salt meadows and shores became overgrown. During this succession, typical habitats like lower salt meadows and mudflats with saltworth disappeared, resulting in the loss of breeding birds such as dunlin, ruff, avocet and the local extinction of natterjack and green toad at many sites.

The restoration of the natural hydrology was one of the strategies to improve conservation status of lagoons. Here land owners inspect a dam at Högby hamn (S). The former ditch was closed and the natural outflow system was reactivated with a dam to maintain a certain water level in the lagoon.



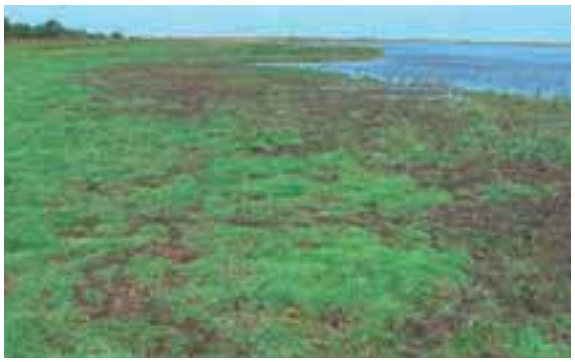
The retention of water in early spring improves breeding habitat for dunlin (foreground) and ruff (background) at Högby hamn (S).

Re-connecting lagoons: pipes in a small road dam between lagoon and Baltic Sea improve hydrology towards more natural condition at Store Vrøj (DK).

Before: Lagoons behind dikes became overgrown and silted-up and one action was dredging to re-activate the lagoon again, as here being carried out at Südwest Fehmarn (D).

After: Cleaned and grazed lagoons – here behind the dike at Südwest-Fehmarn (D) – provide new habitats for waders and natterjack toad, which used the flooded area in the foreground for reproduction three years after cleaning.

Grazing around lagoons made the reed disappear and helps to keep them open, as here at Südwest-Fehmarn (D). Mainly robust cattle were used for grazing but grazing by Konik horses added an extra value: in year-round grazing without supplementary feeding during winter they dig up the roots and graze the fresh re-growth of reed in spring. This gave the best result on reed reduction.



Due to a combination of grazing and saltwater flooding reed disappeared at lagoon edges at Grüner Brink (D). Such places are indicating good foraging habitats for waderbirds, because they are temporary flooded. Only grazing can keep them open.

On the grazed shores an annual plant community on salty mudflats appeared with saltworth (*Salicornia europea*) and the threatened, hairy tangworth (*Bassia hirsuta*).

Recommendations for lagoon restoration:

- conservation should aim to restore a dynamic natural hydrology
- conservation of artificially drained or disconnected lagoons can be improved by stopping drainage or reconnecting the lagoons to the sea by tubes under road dams or re-opening small dikes
- also have in mind that, in a later stage of the lagoon development, naturally "disconnected" freshwater lagoons occur, and subsequent reconnection to saltwater will harm habitats like toad reproduction ponds or ruff breeding habitat or species-rich upper salt meadows

Results

- improved sea water inflow at four sites with total area of 71 hectra
- purification and deepening of lagoons at six sites with total area of 25 hectar

Actions and effects
Improving coastal meadows along the Baltic sea

Typical coastal meadows in the Western Baltic are Atlantic salt meadows. The salty, often flooded parts are the lower salt meadow. Above approx. one meter above mean sea level flood frequency is low and less-salt-tolerant vegetation establishes itself. Such low-salinity meadows around the Baltic Sea require grazing, otherwise they become overgrown by reeds.

On the aerial photo, reed beds show clearly as the brownish vegetation on the island in Eichholzniederung (D). The upper salt meadow will be colonized by scrub and later become woodland, as visible in the lower right foreground.

Coastal meadows are – like many semi-natural habitats – threatened either by intensification or by abandonment. Many boreal coastal meadows in the Eastern Baltic have been abandoned for as long as 15 years, as in Teorehe (Est).

Lower salt meadows were drained by diking and pump draining, and upper salt meadows were converted to arable fields as shown here behind the hedges at Kleiner Binnensee (D). The lagoon water lost salt content and became more fresh.

Upper salt meadows are often characterized by anthills, as here at the Eskkiltorpsängar (S), which is a coastal meadow that has been grazed for centuries. The Baltic field gentian *(Gentianella campestris baltica)* can sometimes be found on the anthills.

Natural creeks and shallow flooding areas of varying sizes and depths occur naturally. In lower salt meadows, floodwaters are more brackish and in upper salt meadows, they are more fresh water dominated. This diverse hydrology is often not that visible, as on Eskiltorpsängar in Vellinge (S). The diversity created by the combination of salt and fresh water, wet and dry spots is the basis for huge biodiversity in coastal grasslands, with more than 450 species occurring in Atlantic coastal meadows.

A coastal meadow was almost destroyed by deep ditches at Neustädter Binnenwasser (D). The ditches also caused problems for grazing pastures, because they created the conditions for reed to start to colonize the salt meadows.

Small ditches can quickly and severely change the abiotic diversity in coastal meadows. Flood pools, as visible in the photo, are often influenced by that. The effects are often underestimated by nature conservationists. In repeated site meetings, farmers, site managers, amphibian and bird experts and botanists discussed strategies for reactivating the natural hydrology while improving conservation values and still being able graze the site in future.

"Before": At Hyllekrog (DK), small ditches can drain depressions and lower parts of salt meadows over decades, even if the ditches are not maintained. This is the situation shown here by Kåre Fog.

"After": After blocking these ditches at Hyllekrog (DK) several small lagoons reappeared. Sosme areas were used by green toad for reproduction. After seeing these positive effects, blockings were also made in very small ditches at other sites, e.g. at Süd-Westfehmarn (D), with similar effect on the toads. Formerly salty small lagoons developed a more "diverse" hydrology and some became so fresh that green toad was able to reproduce. The improved hydrology created new feeding and breeding habitats for meadow birds (see also page 22/23)

"Before": The Estonian coastal meadow working group inspecting Boreal coastal meadows which became overgrown by scrub during abandonment and so lost their conservation value for species such as meadow birds.

Volunteers cleared scrub from coastal meadows and piled it up for further treatment.

"After": Open coastal meadows are valuable breeding sites for meadow birds.

To facilitate the reintroduction of grazing, fences were installed on sites that had been abandoned for some years - as here at Endelave (DK). The fences were extended into the shallow bay so that cattle could graze the long grass and reeds between the coastal meadow and the bay.

Robust cattle were bought by project partners in Denmark, Lithuania and Estonia. These cattle were loaned to farmers to start grazing again, as here on Endelave (DK). Farmers were allowed to keep any offspring the cattle produced while in their stewardship so that, at the end of the contract, they only had to return to the project partner the same number of cattle they had started with. The returned herd was then further utilised to start another farmer grazing N2000 areas

Ornithologists Hannes Pehlak, Ole Thorup and Martin Altemüller (from left to right) found a nest of Baltic dunlin at Teorehe (Est). By mowing reed in lower areas and by resuming grazing, the natural hydrology of the Boreal coastal meadows was restored and Baltic dunlin recolonized the site 3 years after restoration started.

Year round grazing in coastal areas requires shelters for the animals on some sites. In Denmark mobile barns were often used.

On the island of Saltholm (DK) a barn was built to store hay from summer mowing to feed the cattle when the island was flooded (see drift in fence at the left) or when snow covered the grass in winter. For the effect on the meadows see chapter "Ruff" and "Toads"

A good conservation status can be reached by year-round grazing with robust cattle with a density of approx. 0.5 cattle per ha, as here on Südwest Fehmarn (D).

Even grazing-sensitive plants such as Sea lavender (Limonium vulgare) can survive grazing when sites are big enough and grazing intensity is low.

When salt meadows behind dikes become more fresh water influenced, valuable wet meadows can be developed over decades, as here at Schwansener See (D) with e.g. a local natterjack toad population. Orchids started to spread under a year-round grazing regime with hardy cattle. Such sites can easily be destroyed by simply opening a dike to allow saltwater ingress and increased salinity.

Recommendations for coastal meadow management:

- Grazing is needed on coastal grasslands to keep or develop a good conservation status.
- Natural hydrology – as defined by text on page 28 – provides abiotic diversity for a species rich community. Ditches which lower the depth of winter rain water in the meadows by just ten cm can severely change the parameters conditions. So bear in mind the "micro-hydrology" when deciding about ditches.
- For lagoons in salt meadows please see chapter Lagoon restoration
- Involve experienced coastal meadow managers, ornithologist, botanist and herpetologist when planning a site restoration to ensure existing habitat characteristics are not lost and that the best possible conservation strategy for habitats and species is put in place.
- Fresh water dominated coastal grasslands which are live breeding sites for typical "fresh water dependent species" such as natterjack and green toad or meadow birds such as ruff or black-tailed godwit should not be re-flooded with salt water until a similar number of suitable quality fresh water meadows had been developed and the species to be displaced have succeeded in colonizing the new sites.
- Have in mind re-establishment of the complete habitat complex, not only coastal grasslands. Include in restoration concepts habitats with functional connections, such as lagoons, estuaries, dunes and beaches.

Results

Coastal meadows were restored on 2800 ha by

- Reintroduction or improvement of grazing and the investment in 120.000 m of fences, over 80 cattle, 12 shelters, over 40 water facilities in Denmark at nearly all sites in Germany at Oehe-Schleimünde, Eichholzniederung, Neustädter Binnenwasser, Südwest-Fehmarn (D), in Estonia at Teorehe, Sõmeri, Kõrgessaare-Mudaste and in Lithuania at Nemunas delta.
- Blocking ditches in Denmark at Hyllekrog, in Germany at Schwansener See, Kleiner Binnensee, Südwest-Fehmarn and Neustädter Binnenwasse and in Sweden at Sydöstra Öland
- Combined mowing and grazing regime at Saltholm (DK), Neustädter Binnenwasser (D) and Teorehe (Est)

Actions and effects

Improving dune habitats including reduction of the alien invasive species Rosa rugosa

Typical dune habitats at the Western and Northern Baltic coast are not widely distributed and often much smaller then at the North Sea, as here at the spit of Hyllekrog (DK).

Dune development starts when drifting sand is caught by low, annual vegetation and drift on the upper beach.

Tourism and beach management influences dune development: on the upper beach vegetation is inhibited by walkers and removal of drift in summer, as here at Weißenhäuser Brök (D).

As a coastal protection measure, areas of drifting sand were planted with Rosa rugosa in the last century. The Japanese rose is very competitive, so that this species replaces natural vegetation in dunes by an average 10–15% per year, but flooding and other calamities can multiply this rate. Fruits are spread by flood and also by fox, which like to feed on these.

In the western Baltic, dunes classified as "natural nutrient poor" systems today receive as much fertilizer dressing via rain and aerial deposition as farmers put on their most productive arable fields 100 years ago. Today this nutrient input results in fast succession towards grass and later scrub dominated vegetation. Typical species-rich dune vegetation is replaced and dynamics are reduced by fixing the sand, as here on Hyllekrog (DK).

"Before": The driving force in the succession process is the accumulation of old plant material called "litter", as here from bushgrass *(Calamagrostios epigeios),* which forms a dense cover over the dune sand, as here at Weißenhäuser Brök (D). Light-dependent dune plants cannot compete or germinate and become extinct. However, other grasses such as sand sedge *(Carex arenaria)* or tall oat-grass *(Arrhenatherum elatius)* can subsequently colonize the area.

Winter grazing by Highland cattle taking the litter at Weißenhäuser Brök (D).

"After": Dune restoration aims to reduce litter and dominant grass species by grazing with robust cattle mainly – in the first years – during winter grazing from September to end of April without supplementary feeding. During that period the cattle use up to 100 kilogram fat from the previous summer for survival. After three winters of grazing the litter is gone, as here at Weißenhäuser Brök (D).

After five years of grazing typical grey dune plant species such as common thyme *(Thymus vulgaris)* and lady's bedstraw *(Galium verum)* started to spread again because litter coverage has been reduced by 35 % and bare ground increased by 85 %, enabling seeds to germinate during a "summer grazing break" at Weißenhäuser Brök (D), where all rare and typical dune plants were supported by this management.

Cattle help spread plants e.g. by dung, as here for maiden pink *(Dianthus deltoides)* established around cattle dung in a plot formerly dominated by bush-grass *(Calamagrostis epigeios)*.

Winter grazing also reduces the height and coverage of Rosa rugosa. Cattle like to graze plants year-round for fresh shoots, fruits and in winter for branches and sometimes also roots.

Bare ground in between the rose shoots is recolonised by dune vegetation.

"Before" situation in 2007: Japanese rose bushes on the former camping at Sehlendorfer Binnensee (D), when the area was added to the pasture grazed by Scottish highlander cattle.

"After" 5 years of grazing the rose bushes disappeared. Year round grazing cattle can eradicate whole Japanese rose bushes, if grazing pressure is high enough during summer.

Kaare Fog instructs an excavator driver in the process of the restoration of a former campsite in a dune area. All artificial installations, clayish sands from roads and garden plants were removed under the supervision of biologist expert at Sehlendorfer Binnensee (D).

Aerial view to the formerly levelled camping area which was restructured with dune-slack-like depressions and dune-like sand piles. The site is grazed together with adjacent salt meadows.

Public launch of the grazing at the hiking trail, which crosses pasture at Sehlendorfer Binnenseen (D).

Ground view four years after restoration. Typical dune vegetation slowly recolonizes the bare ground, going along with few ruderals. In total 6,4 hectar of dunes were restored at Sehlendorfer Binnensee (D).

Recommendations for dune management:

- Grassy, overgrown dunes can be restored by using robust cattle grazing to remove the litter and break the dominance of grasses.
- Management to eradicate Japanese rose requires year-round robust cattle grazing without supplementary feeding in winter. It also needs experienced cattle, which know that Japanese rose can be grazed, and a farmer who trusts the toughness of his cattle.
- Rosa rugosa eradication by grazing takes time. Time span can be shortened by digging up complete bushes by machines with strainer shovel.

Results

Dune restorations were carried out at following sites:

- By restoration of a former camping site at Sehlendorfer Binnensee (D)
- By re-introduction of grazing at Hyllekrog (DK), Korevlen (DK), Weißenhäuser Brök (D), Schwansener See (D) Oehe-Schleimünde (D) and Grüner Brink (D)

Actions and effects
Targeted management for coastal toad species

The green toad (*Bufo viridis*; round photo below) and the natterjack toad (*Bufo calamita*; round photo left) are typical species in coastal habitats in the southern, western and eastern Baltic up to Estonia.

Stony beaches are preferred foraging habitat for green toad, with good hiding structures in upper beach.

Optimal natterjack toad breeding habitat is a grazed, shallow flooded upper salt meadow with good freshwater quality, as here on island of Saltholm (DK). Green toad uses similar waters, but which are deeper and might also be slightly brackish. Natterjacks can use waterbodies with a salinity up to 5 ‰, green toads up to 8 ‰.

Blocking of small ditches in grazed, unfertilized meadows allowed flooding of short grass to happen again. These are the best breeding waters for natterjack toads (egg-string in foreground), as seen here at Schwansener See (D), where the population increased from twelve calling males to about 100.

"Before": "Restoration of depressions" was one of the core components of reactivating temporary, freshwater ponds in coastal meadow – if necessary by excavator.

"After": This reactivated temporary fresh water pond in coastal meadows is now a calling pond of natterjack toad at Südwest-Fehmarn (D). By reactivating natural depressions by digging and running a suitable grazing regime, breeding habitats were improved. Sometimes just the suitable grazing was enough to restore the breeding habitats in natural depressions..

Drift lines at unmanaged beaches are important feeding habitats for both toad species, providing areas where they can forage on warm August nights on tang flies.

Natterjack toad foraging on drift line at night. These animals are growing fast due to a plentiful food supply.

Dune-slack-like new ponds were created at a former camping site. These are reproduction ponds for reintroduced natterjack and green toad populations. Adjacent grazed, sandy habitats are optimal foraging and hibernation sites for the toads. Monitoring board in foreground.

To provide a supply of toads for re-introduction to pond sites, eggs were collected and reared in stations – as here, in a glasshouse in Kiel. They were brought through to big tadpoles or young toads.

The "outdoor rearing" developed by Amphi Consult allowed the "production" of already big natterjack toads for release. The toads were fed with collembola and later with crustacea from seaweed. Bigger animals are an advantage in coastal areas, where wet sites around breeding ponds can suffer severe bird predation on young toads. Bigger toads can live on dry habitats and can be released there too.

Perfect "nature like" and warm conditions in the outdoor rearing area during metamorphosis of the tadpoles.

Releasing toads was used for PR work on e.g. "NDR" TV with artificial shelters for young toads in foreground. "Mass release campaign" over 3 years at Sehlendorfer Binnensee (D) helped to reintroduce green and natterjack toad.

Children watch Claes Andrèn releasing green toads at Ottenby Fågelstation on the island of Öland (S). The reintroduction toads were reared at the Nordens Ark Zoo from another Swedish population.

Return of the toads' chorus was successful for green toad (above) at Ottenby on the island of Öland (S), and for natterjack toad (left) at Urehoved (DK) and for both species at Sehlendorfer Binnensee (D) thanks to the combined targeted habitat management and reintroduction.

Recommendations for toad management:

- Reactivate the "toad habitat complex" of good breeding ponds, safe terrestrial habitat and hibernation sites.
  - In the first instance, good reproduction ponds – as fresh as possible in egg laying time – with several hundred young ones per pond/year are needed:
  - For Natterjack toad: breeding waters are typically a shallow temporary freshwater flooding in well grazed meadows, which are in optimal case dry most time of the year and filled with water for five to nine weeks after heavy rain in late winter, spring or summer.
  - For Green toad: Breeding ponds are preferably deeper water bodies with no or little vegetation. Ponds should be filled at end of winter then slowly dry up until late August.
- The right grazing in coastal meadows and dunes creates structurally rich grasslands with low, open vegetation and patches of bare ground. Sunlight can warm the ground, with the results that food is reachable and toads hiding in loose sand can warm up for night-time hunting.
- For hibernation, sandy, dry areas such as dunes are preferred by natterjacks for digging themselves in. Green toads use mainly human settlements such as cellars, barns, piles of stones, stone walls or unkempt areas around farms for hibernation.
- Within the "toad habitat complex", night traffic on roads through villages, along the coast (e.g. to camping sites) can cause high loss rates, and should therefore be minimised. Migration over arable fields can lead to similar high losses due to ploughing and to toad contacts with fertilizer, which can cause severe chemical burns on the toad's skin.
- Reintroductions of the toads species should only be carried out after points one to four are achieved and can be guaranteed by future management.

Results

- Natterjack toad populations were secured: in Denmark at Bågø (DK), Halmø, Endelave, Halk Nor, Urehoved and in Germany at Schwansener See, Südwest-Fehmarn
- Green toads were secured: at Saltholm (DK), Hyllekrog (DK), Store Egholm (DK), Monnet (DK) and Hjelmshoved (DK)
- Reintroductions after habitat management were successful:
  - for natterjack toad: in Germany at Schwansener See (D) and Sehlendorfer Binnensee (D), in Denmark at Urehoved (DK)
  - for green toad: Urehoved (DK), Ottenby (S), Sehlendorfer Binnensee (D)

Actions and effects

Establishment of reserve populations for the creeping marshwort (Apium repens)

The creeping marshwort *(Apium repens)* is a tiny plant species from the parsley family and it is threatened across the whole of Europe.

The Apium task force inspects the site at Sundwiesen (D)on the island of Fehmarn. The creeping marshwort occurs in wet grasslands with a short sward. In the western Baltic the most northern site is on the island of Fehmarn in a former coastal meadow which has been grazed by cattle since the plant was found there in the 1980s. In Denmark this plant has been extinct for the last two decades.

Since the ecology of the species, e.g. germination, seed dispersal, seed survival in the soil, salt water tolerance and the soil characteristics were not known, the working group led by Prof. Kai Jensen at the University of Hamburg carried out investigations in the lab and in the field.

Creeping marshwort can grow on different types of wet soils but finds it hard to survive if hit by flooding with salt water. Furthermore, because it is low-growing, it is easily shaded out by taller plants. Therefore *Apium repens* requires hard grazing to create a short sward. Even if grazing stops for only a few weeks during summer and competing grasses grow up, Apium can become extinct on such a site, as an experiment showed.

Sandra Burmeier is pictured planting a reserve population in a reactivated depression at Eichholzniederung in April 2007. Half the plants were fenced against trampling by cattle and half wer unprotected, outside the fence.

Four months later the creeping marshwort had established itself inside and outside the fence. Due to tough grazing and fluctuating water levels the creeping marshwort survived at the site.

Recommendations for establishment of *Apium repens* reserve population:

Creeping marshwort habitats need the following characteristics:

- Neutral to basic soils
- Intermediate to high disturbance frequencies and intensities
- High but fluctuating water table
- A comparatively high nutrient content.
- *Apium repens* is "disturbance dependent", which means the site has to be managed by grazing or mowing in order to prevent the plant becoming overgrown by competing plants.
- Bare ground is needed for germination and therefore trampling by grazers is a positive except perhaps in the first month after planting.
- High and fluctuating water levels are needed:
  - High water table in winter with an inundation (flood) phase which protects the plant against frost damage.
  - Low water levels, but wet soils during summer to encourage possible flowering and seed development.

Results:

- With the increased knowledge based on scientific investigation of the ecology of *Apium repens* the conservation management was improved.
- *Apium reserve* populations were established at three German sites: Eichholzniederung, Sehlendorfer Binnensee and Südwest Fehmarn.
- A conservation guide for Apium repens was written by Kai Jensen, Jan Schwerdtfeger & Sandra Burmeier (download: www.life-baltcaost.eu)

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Natura 2000
Natura2000 is a pan European network of protected sites which represent areas of the highest value for natural habitats and species of plants and animals that are rare, endangered or vulnerable in the European Union (EU). This network includes currently 25.000 sites of all 27 member states of the EU. Collectively they cover a substantial area: almost a fifth of Europe's land and water.

The Natura2000 network includes two types of area:
- Areas were designated as *Special Areas of Conservation* (SAC) according to the Flora-Fauna-Habitat (FFH) directive. They support rare, endangered or vulnerable natural habitats and species of plants or animals.
- Where areas support significant numbers of wild birds and their habitats, they were designated as *Special Protection Areas* (SPA) according to the bird directive.

LIFE
The LIFE Programme is the EU's funding instrument for the environment and climate action. Since its creation in 1992 LIFE has co-financed over 3 950 pilot or demonstration projects, contributing more than EUR 3.1 billion to environmental protection in Europe.

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