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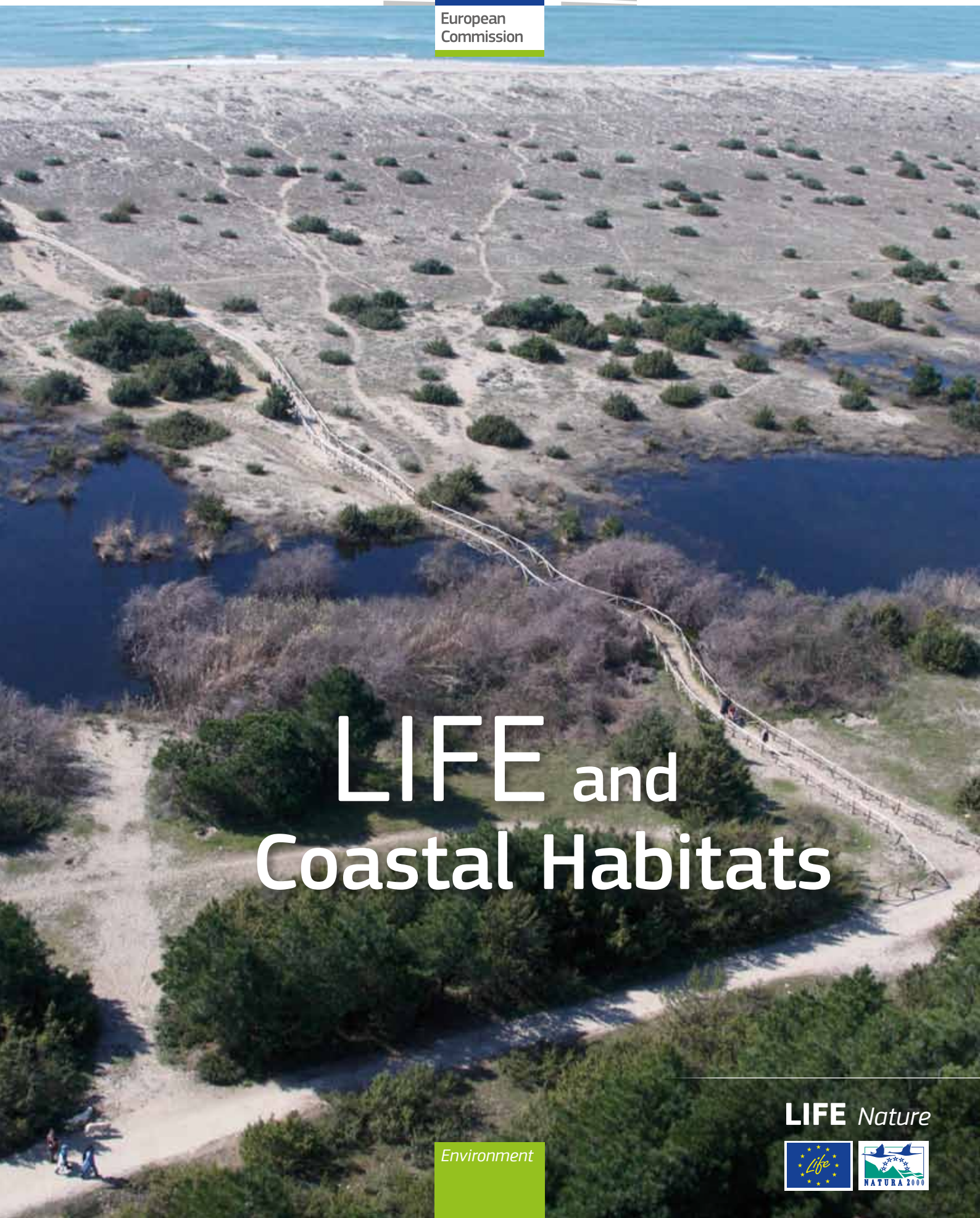

LIFE and Coastal Habitats

LIFE *Nature*

Environment

EUROPEAN COMMISSION
ENVIRONMENT DIRECTORATE-GENERAL

LIFE (*"The Financial Instrument for the Environment and Climate Action"*) is a programme launched by the European Commission and coordinated by the Environment and Climate Action Directorates-General. The Commission has delegated the implementation of many components of the LIFE programme to the Executive Agency for Small and Medium-sized Enterprises (EASME).

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Foreword

Photo: European Commission

Humberto Delgado Rosa
Director for Natural Capital DG Environment, European Commission

The need to balance economic development with environmental protection is nowhere more evident than in Europe's coastal areas. Some 40% of the EU's population lives within 50 km of the sea and the economic importance of coastal regions is clear: they generate 40% of our GDP, while three-quarters of the Union's foreign trade by volume is conducted by sea.

Activities such as shipping, resource extraction, renewable energy and fishing are vital, yet they also put pressure on nature and the environment. This has resulted in habitat loss, pollution and accelerated coastal erosion across Europe.

The quality of coastal waters is still poor in many areas, particularly in the Baltic Sea, Black Sea and North Sea. EU Member States report that only 13% of coastal species are in a 'favourable' conservation status, while 73% of coastal habitats are assessed as being 'bad' or 'inadequate'. Climate change is likely to increase pressures on coastal ecosystems and communities.

Safeguarding the health of such ecosystems has both environmental and economic benefits. It boosts biodiversity, increases resilience to climate change and ensures the continuation of ecosystem services that are crucial to our prosperity and wellbeing, such as maintaining fish breeding areas in estuaries and enabling tourism.

Ecosystems-based approaches are an important part of the EU's integrated policy response to the challenges facing coastal areas. This response spans water, nature protection, pollution, fisheries, climate change and spatial planning and is centred on several policy instruments, including the Marine Strategy Framework Directive (MSFD), Water Framework Directive (WFD), Birds Directive, Habitats Directive and EU Biodiversity Strategy to 2020.

The MSFD sets the objective of achieving a 'good environmental status' for many specific environmental aspects across the entire marine ecosystem; the WFD regulates ecological status in coastal and transitional waters by considering nutrient, chemical and hydromorphological pressures; and the nature directives and Biodiversity Strategy set conservation objectives for improving coastal habitats and species.

As the principal source of European-level funding for nature conservation, the LIFE programme has a crucial role to play in ensuring the effective management and restoration of the Natura 2000 network in coastal areas and in meeting conservation objectives for coastal habitats and species. As this brochure illustrates, LIFE has been a catalyst for actions to improve the conservation status and resilience of coastal habitats across the EU. These range from coastal lagoons, estuaries and salt marshes, to dunes, coastal grasslands and meadows and near-shore marine habitats such as reefs and seagrass meadows. LIFE has also helped address a number of cross-cutting conservation management issues, including the threats posed by invasive alien species and climate change and the challenge of reconciling business with biodiversity. Indeed, the projects featured in this publication show that conserving our natural capital also improves the supply and quality of ecosystem services provided by coastal areas and ultimately supports economic growth and jobs.

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INTRODUCTION

Coastal habitats of the Natura 2000 network

EU policy has helped to address threats to Europe's coastal habitats and to protect the ecosystem services they provide. Innovative approaches to funding nature conservation should enhance the impact of coastal management and restoration work.

Photo: LIFE07 NAT/F/000193/CEN L+R/Thomas Gendre

Coastal Natura 2000 sites provide a range of ecosystem services, and support several economic activities and jobs

The EU's coastline[1] is estimated to stretch almost 68 000 km. The terrestrial part of its coastal zones totals some half a million square kilometres spread across 23 Member States. Almost half of the EU's population lives less than 50 km from the sea, with the majority concentrated in urban areas along the coast. One in seven EU citizens lives within 500 metres of the coast.

1 For the purpose of this publication the ICZM definition of coastline was used, along with coastal habitat types from Annex I of the EU Habitats Directive. 'Coastal area' is defined as a strip of land and sea of varying width depending on the nature of the environment and management needs. (In the majority of the cases this represents a 10 km buffer inland from coastline and 1 km seawards).

Europe's coasts are highly dynamic, shaped by the constant movement of the tides and currents, by sediment deposition and erosion, by weather and by human activity. Our coasts support economic activities, jobs and the well-being of a significant part of the population. They provide a range of ecosystem services, from habitable locations, to harbours and ports, sites for industry and business, holiday destinations, and areas for recreation and enjoyment.

The seaside remains the most popular holiday destination for most of us, favoured by 63% of European holidaymakers. Their rich biodiversity, particularly fish and shellfish, is a major source of Europe's food

Table 1: **Habitats Directive coastal habitat types (* = priority for conservation)**

Coastal and halophytic habitats	
CODE	NAME
1110	Sandbanks which are slightly covered by sea water all the time
*1120	Posidonia beds (*Posidonion oceanicae*)
1130	Estuaries
1140	Mudflats and sandflats not covered by seawater at low tide
*1150	Coastal lagoons
1160	Large shallow inlets and bays
1170	Reefs
1210	Annual vegetation of drift lines
1220	Perennial vegetation of stony banks
1230	Vegetated sea cliffs of the Atlantic and Baltic coasts
1240	Vegetated sea cliffs of the Mediterranean coasts with endemic Limonium spp.
1250	Vegetated sea cliffs with endemic flora of the Macaronesian coasts
1310	Salicornia and other annuals colonising mud and sand
1320	Spartina swards (*Spartinion maritimae*)
1330	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
1410	Mediterranean salt meadows (*Juncetalia maritimi*)
1420	Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)
1430	Halo-nitrophilous scrubs (*Pegano-Salsoletea*)
*1510	Mediterranean salt steppes (*Limonietalia*)
1610	Baltic esker islands with sandy, rocky and shingle beach vegetation and sublittoral vegetation
*1630	Boreal Baltic coastal meadows
1640	Boreal Baltic sandy beaches with perennial vegetation
1650	Boreal Baltic narrow inlets

Coastal sand dunes and inland dunes	
CODE	NAME
2110	Embryonic shifting dunes
2120	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)
*2130	Fixed coastal dunes with herbaceous vegetation (grey dunes)
*2140	Decalcified fixed dunes with *Empetrum nigrum*
*2150	Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)
2160	Dunes with *Hippophae rhamnoides*
2170	Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*)
2180	Wooded dunes of the Atlantic, Continental and Boreal region
2190	Humid dune slacks
21A0	Machairs
2210	*Crucianellion maritimae* fixed beach dunes
2220	Dunes with Euphorbia terracina
2230	*Malcolmietalia* dune grasslands
2240	*Brachypodietalia* dune grasslands with annuals
*2250	Coastal dunes with *Juniperus* spp.
2260	*Cisto-Lavenduletalia* dune sclerophyllous scrubs
*2270	Wooded dunes with *Pinus pinea* and/or *Pinus pinaster*

and economic prosperity. For example, an estimated 8 million to 10 million anglers fish for sport or pleasure and the fishing industry is valued at between €8 billion and €10 billion per year.

The diversity of coastal habitat, including salt-adapted scrub and grasslands, sheer cliffs and rocky shores, sandy beaches and tidal areas, estuaries and lagoons, provide breeding grounds and habitats for marine organisms, as well as for shorebirds, sea turtles and other wildlife.

The annexes of the EU Habitats Directive (92/43/EEC) list eight groups of coastal habitat types for which Natura 2000 sites need to be designated to ensure a 'favourable' conservation status, ranging from tidal areas, salt marshes and meadows to sand dunes. The full list of 40 protected coastal habitats, including 15 that are priority for conservation, is shown in Table 1.

The annexes also list some 150 species that prefer coastal ecosystems and while many of them are strictly protected, some also enjoy additional protection within Natura 2000 sites. In addition, the fact that bird species breed in coastal habitats means that they and the coastal habitats they depend upon are protected under the EU Birds Directive (2009/147/EC).

Some 15% of the EU's coastal zone (landwards and seawards) is included in the Natura 2000 network of protected areas (see Figure 1). As well as protecting habitats and species of European primary importance, the Natura 2000 network contains much of Europe's natural and semi-natural ecosystems, which provide a wide variety of ecosystem services. As Figure 2 illustrates, tidal and dunes habitat types account for the vast majority of those habitats. Indeed, tidal habitats make up more than 80% of the total area covered by coastal habitats.

Threats to coastal habitats

The degradation of coastal ecosystems is observed in almost all areas of the EU. Human activities linked to high coastal population densities are the main driver of this degradation, sometimes with an irreversible impact on species and habitats. According to the EEA (2009) the main causes of changes to coastal ecosystems are coastal erosion; 'urban sprawl' and infrastructure linked to urbanisation and tourism; agriculture; erosion is directly affecting Natura 2000

Seagrass ecosystem services

Seagrass meadows act as biodiversity hotspots and offer coastal protection. They provide a range of both 'regulating' and 'provisioning' ecosystem services. The former includes storm protection, erosion control, carbon sequestration and support; and the latter include spawning or feeding grounds for invertebrates and commercial high value fish species. It has been estimated that Mediterranean Neptune grass (*Posidonia oceanica*) meadows bury some 2 megatonnes of carbon each year, host more than 400 plant species and thousands of animal species and deliver substantial amounts of sand to coastal dune systems through material deposited on beaches after heavy storms.

Photo: LIFE09 NAT/ES/000534/Agustin Barrajon

coastal sites. The latest EU State of nature report (The greatest pressures/threats to marine and costal ecosystems are the 'use of living resources such as fishing (that particularly affects species), followed by 'modification of natural conditions' (that particularly affects habitats) and 'pollution.'

Land-based activities that alter the flow and sediment load of rivers (e.g. inland dam construction) can also have profound effects on the dynamics of coastal ecosystems, in particular coastal wetlands and intertidal habitats situated in estuaries and deltas within Natura 2000 sites. It is anticipated that this situation will be aggravated by climate change and that considerable areas of coastal dunes and wetlands might disappear.

Sea level rise linked to climate change is expected to cause half of Europe's coastal wetlands to disappear, an area of some 4 500 km^2. Climate change is also expected to affect river flows and species in coastal wetlands and estuaries. Higher coastal water temperatures may also shift the balance in favour of invasive alien species.

The conservation status of coastal habitats

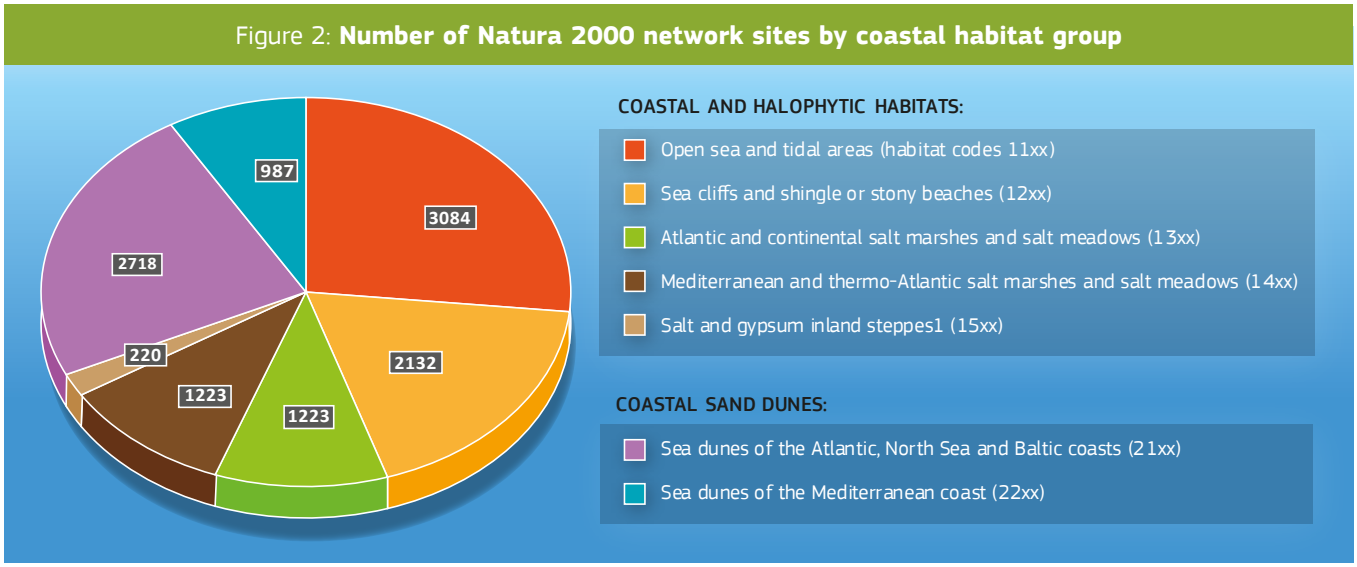
The EU State of Nature[2] report collates the results of Member States' obligatory reporting of the status of protected species and habitats, as required under article 17 of the Habitats Directive and article 12 of the Birds Directive. In the most recent report (for 2007–2012), some 70% of coastal habitats were reported as being in an 'unfavourable' conservation status (see Figure 4). At biogeographic region level, in four of the nine regions - Atlantic, Marine Atlantic, Marine Baltic and Marine Mediterranean - no coastal habitats are in a 'fa-

Fig. 1: **Percentage of coastal zones within 10 km landwards and seawards in the EU 27 protected by Natura 2000 sites***

*By NUTS3 region (Source: EEA 2012)

2 ec.europa.eu/environment/nature/pdf/state_of_nature_en.pdf

Figure 2: **Number of Natura 2000 network sites by coastal habitat group**



Source: Natura 2000 database (EEA, 2016 update) xx – represents Annex I Habitats directive code
*N.B. 15xx only includes the habitat *1510 - Mediterranean salt steppes (Limonietalia)*

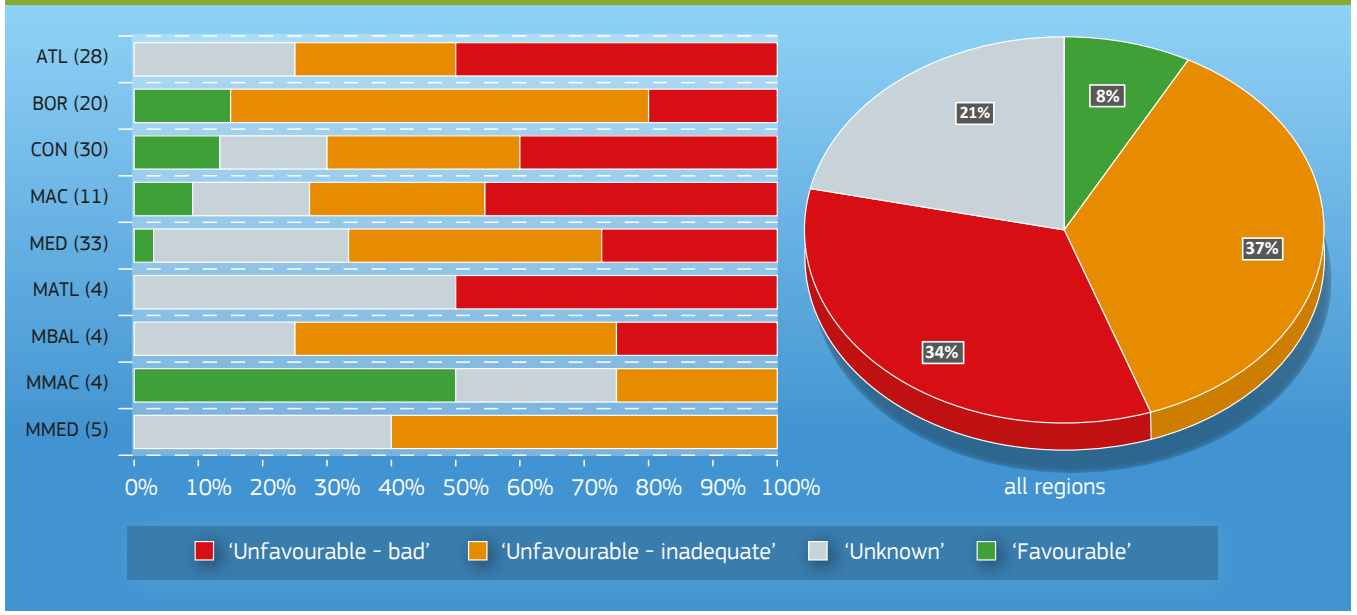
vourable' conservation status. On a more positive note, around 50% of assessments in the Marine Macaronesian region were 'favourable'. The same trend is observed for coastal species included in the annexes of both nature directives.

Integrated solutions for coastal habitats

To solve the environmental problems of Europe's coasts, it is necessary to integrate policy across the traditionally separate domains of water, nature, pollution, fisheries, climate change and spatial planning. This approach, known as Integrated Coastal Zone Management (ICZM), aims to coordinate policies related to nature protection, aquaculture, fisheries, agriculture, industry, offshore wind energy, shipping, tourism, infrastructure and mitigation and adaptation to climate change. It will contribute to sustainable development of coastal zones by the application of an approach that respects the limits of natural resources and ecosystems, the so-called 'ecosystem-based approach' (see box).

The EU adopted a Marine Strategy Framework Directive (MSFD) in 2008. This complements ICZM

Figure 4: **Conservation status of habitat types of EU coastal habitats**



Biogeographic regions - Atlantic (ATL), Boreal (BOR), Continental (CON), Macaronesian (MAC), Mediterranean (MED), Marine Atlantic (MATL), Marine Baltic (MBAL), Marine Macaronesian (MMAC) and Marine Mediterranean (MMED) Source: EEA 2015

Ecosystem-based approach

Ecosystem-based management is an integrated approach to management that considers the entire ecosystem, including humans. The goal is to maintain ecosystems in a healthy, clean, productive and resilient condition, so that they can provide people with the services and benefits on which they depend. This spatial approach builds around acknowledging connections, cumulative impacts and multiple objectives. In this way, it differs from traditional approaches that address single concerns e.g. species, habitats, sectors or activities.

Photo: LIFE05 NAT/LV/000100/M.Vetemaa

and sets quality standards in line with the objectives of the EU Water Framework Directive (WFD), which has applied to freshwater ecosystems since 2000. The WFD requires surface water bodies (e.g. lakes, streams, rivers, estuaries and coastal waters) to be in a 'good' status. Both directives can have a significant influence on the conservation of coastal ecosystems in the EU. The MSFD is the first EU legislative instrument related to the protection of marine biodiversity, as it contains the explicit regulatory objective that "biodiversity is maintained by 2020", as the cornerstone for achieving 'good' environmental status. It aims to ensure that marine ecosystems achieve this goal by mandating the application of an ecosystem-based approach centred on the sustainable use of marine goods and services.

The full implementation of the Natura 2000 network is vital for the conservation of Europe's coastal habitats. The Natura 2000 network already protects much of the coastline of the EU (see Figure 1), and, together with offshore areas, the network currently covers around 6% of all EU seas. However, in order to improve the conservation status of coastal habitats and species it is necessary to achieve full implementation and integration with other coastal EU policies (the ecosystem-based approach). Working at Natura 2000 network biogeographic level can enhance effective implementation and management of coastal Natura 2000 habitats. This is a way to promote among Member States, the sharing of experience, good practice and cross-border collaboration on the management of the coastal Natura

Coastal habitats and species conservation rely on the full implementation of the Natura 2000 network

Photo: LIFE07 NAT/FIN/000151/Heidi Arponen

The Natura 2000 biogeographical process

Launched by the European Commission in 2012, the Natura 2000 biogeographical process is a multi-stakeholders' cooperation process at biogeographic regional level, including seminars, workshops and cooperation activities to enhance effective management of the Natura 2000 network. Key objectives of the process are:

- Collecting up-to-date information on threats and conservation needs for species and habitats;
- Exchanging experiences, case studies and best practices;
- Identifying common objectives, priorities and management actions;
- Developing new management insights, (cross-border) stakeholder cooperation frameworks, networks of specialists and site managers; and
- Promoting Natura 2000 site management that integrates socio-economic objectives.

The marine Natura 2000 process started with a kick-off meeting in 2015, since when a range of follow-up activities have been organised. The achievements and experiences of LIFE projects are highly relevant to the biogeographical process (see page 10).

2000 network (see box, The Natura 2000 biogeographical process).

Truly sustainable coastal management can only be achieved using an integrated and ecosystem approach, with coordinated action at global, regional and local levels, taking into account the pressures and socio-economic realities both on land and at sea. In addition to the full implementation of relevant EU policy this integrated approach also means taking into consideration a number of regional agreements and conventions relating to Europe's seas, including: The Barcelona Convention, EU Strategy for the Adriatic and Ionian Region, OSPAR Convention, the North Sea Conference Declarations, Helsinki Convention, the Trilateral Cooperation on the Protection of the Wadden Sea, the UNEP Mediterranean Action Plan, and the Black Sea Environmental Programme.

LIFE is the only EU programme dedicated to the support of actions addressing biodiversity and the Natura 2000 network

Photo: LIFE05 NAT/IT/000050/NEEMO EEIG/Michele Lischi

Financing coastal management and restoration

For the current financing period (2014-2020), the EU has integrated biodiversity goals into existing funds and instruments - the European structural and investment funds (ESIFs), which include the European Agricultural Fund for Rural Development (EAFRD), the European Regional Development Fund (ERDF), the European Social Fund (ESF), the Cohesion Fund (CF) and the European Maritime and Fisheries Fund (EMFF), as well as the research fund, Horizon 2020. These can complement actions funded through the LIFE programme, the only dedicated means of support for actions addressing biodiversity and the Natura 2000 network. To strengthen coordination and integration of financing for biodiversity and Natura 2000, there was an agreement to adopt Prioritised Action Frameworks (PAFs) for the 2014-2020 period.

PAFs set out a national or regional strategy for protection and management of Natura 2000 within the context of the relevant EU financial instruments, including LIFE, identifying required Natura 2000 conservation priorities. Several LIFE projects supported the drawing up of national and regional PAFs to meet the objectives of the Habitats Directive.

The LIFE programme introduced Integrated Projects for the 2014-2020 programming period in order to be able to implement environmental legislation and goals on a wider scale and to increase the impact of the already-successful programme. Integrated Projects work on a large territorial scale, often over a longer timeframe than 'traditional' LIFE projects, and crucially they allow beneficiaries to access additional significant sums from EU, national and private sector funding.

To date 15 Integrated Projects have been approved, including six addressing Natura 2000 network

Photo: LIFE09 NAT/IT/000110/Annalisa Losacco

Several LIFE Integrated Projects are already targeting large Natura 2000 coastal areas

PAFs, which will leverage total investment of more than €500 million from different sources. Three of these projects are targeting coastal Natura 2000 sites in an integrated way - BNIP - Belgian Nature Integrated Project (**LIFE14 IPE/BE/000002**), LIFE-IP INTEMARES in Spain (**LIFE15 IPE/ES/000012**) and Deltanatuur (**LIFE15 IPE/NL/000016**), which is focusing on PAF implementation of the Netherlands' coastal tidal and transitional wetland habitats (see box).

Dutch Delta Nature: a LIFE Integrated Project

The main problems that hamper improvement of the conservation status of protected features in the Natura 2000 network in the Netherlands are fragmentation, groundwater depletion, eutrophication and shortage of suitable habitat. In particular, Dutch coastal tidal and transitional Natura 2000 network sites are facing specific threats: disappearance of tidal dynamics, disappearance of ecosystem connectivity and pressure from activities such as agriculture, fishery, tourism or flood protection.

In line with the Dutch Prioritised Action Framework (PAF), the Deltanatuur project aims to develop and implement an integrated governance approach for optimal coordination of interests in wet Natura 2000 sites in the Netherlands. By building internal and external capacity, optimising coordination between governmental bodies and involving stakeholders throughout, Deltanatuur expects to deliver a well-structured integrated governance approach for spatial interventions including better linkage to nature objectives in the Dutch delta, broadly supported by relevant stakeholders. This integrated approach will be demonstrated through pilot projects in areas where tensions between nature, flood protection and economic interests have earlier led to a fragmented approach. "We are 24 partners, we've got €75 million, 41 actions and one goal: we want better conditions for delta nature," explains project manager, Wendy Olivier. "The Netherlands is very densely populated, little space, so we have to think in terms of function combination," she says. In addition to the LIFE IP budget, the project will facilitate the coordinated use of €144.85 million of complementary funding from Interreg, (sub)national and private funds.

Photo: LIFE04 NAT/NL/000202

INTRODUCTION

LIFE helps improve the coastal Natura 2000 network

The LIFE programme has invested more than €700 million in projects that have helped to restore and manage coastal habitats within the Natura 2000 network of protected areas.

LIFE has made a major contribution to the success of the EU's Natura 2000 network. The programme has funded more than 1 650 nature and biodiversity conservation projects since it was created at the same time as the Habitats Directive came into force in 1992. These projects represent an investment of more than €3.4 billion, including EU co-funding of over €1.9 billion. In total, LIFE has targeted some 7 000 of the 28 000 sites in the Natura 2000 network.

More than 200 LIFE projects have targeted conservation actions for coastal habitats within the network. The EU has directly contributed some €380 million of a total investment of more than €715 million by LIFE. At site level, this has helped to improve the conservation status of specific coastal habitats in line with the targets of the EU Biodiversity Strategy to 2020. LIFE has also played an important role in the designation and completion of the marine Natura 2000 network, through projects such as INDEMARES (**LIFE07 NAT/E/000732**) in Spain and FINMARINET (**LIFE07 NAT/FIN/000151**) in Finland.

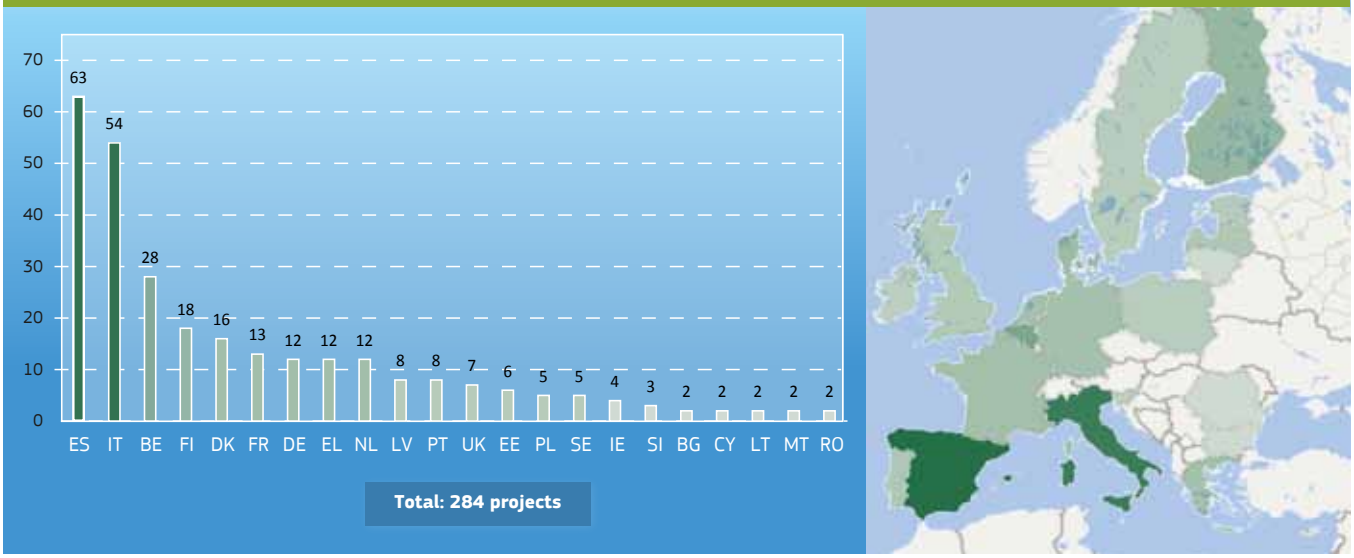
As Figure 1 shows, projects have been widely distributed, covering 20 Member States in total. The greatest concentration of projects has been in Italy and Spain, with Belgium, Finland and Denmark also well represented, particularly in comparison with the number of LIFE Nature projects inland (e.g. in forest or wetland habitats).

The case of Belgium is a good example of how LIFE funding can be used to first define an integrated approach to the management of highly degraded coastal areas and then to apply concrete actions to improve coastal habitats ranging from dunes to salt meadows to coastal grasslands (see pp. 42-45).

Coastal habitats, such as these salt marshes and coastal lagoons in Italy, have been a focus of LIFE conservation actions in EU Natura 2000 sites

Photo: LIFE12 NAT/IT/001122/Vittorio Busatto

Figure 1: **– Number of LIFE coastal projects by Member State since 1992**



Source: LIFE projects database

Coastal habitats targeted by LIFE

LIFE projects have targeted more than 40 coastal habitat types, almost all of those included in Annex I of the Habitats Directive. Figure 2 shows how many projects have targeted different habitat types. Notably, the following habitats have each been targeted by more than 30 LIFE projects: coastal lagoons, fixed and shifting dunes and dunes slacks, wooded/scrub dunes and Mediterranean and Atlantic salt meadows.

Rare and endangered habitats are identified as priority for conservation within the annexes of the Habitats Directive. Among the coastal habitats with this designation are 'Coastal dunes with *Juniperus* spp.' and the unique machair coastal grasslands of Scotland and Ireland. The former has been targeted by 39 LIFE projects (see pp. 42-45) and the latter by four projects (see pp. 58-59).

Best practices and the demonstration effect

LIFE projects implementing pilot actions have had a clear demonstration effect, with new approaches to improving the conservation status of coastal habitats taken up by other projects and site managers as best practices. The main conservation actions featured in this publication are as follows:

- Habitat restoration and management:
  - Restoration of natural dynamics of ecosystems (e.g. dune dynamics in Netherlands and Belgium and tidal dynamics);
  - Ex-situ plant nurseries for coastal habitat restoration;
  - Control of invasive alien plant species in coastal habitats: e.g. Japanese rose (*Rosa rugosa*) in Denmark, and sea myrtle (*Baccharis halimifolia*) in Spain;
  - development of guidelines for integrated coastal habitat management and restoration;
- Communication and awareness-raising among users of coastal areas (e.g. tourists);
- Involvement and collaboration with stakeholders (e.g. salt producers);
- Development and implementation of integrated coastal Natura 2000 network site management plans in an ecosystem-based approach; and
- Cross-border actions (e.g. coastal dunes projects in Belgium and France).

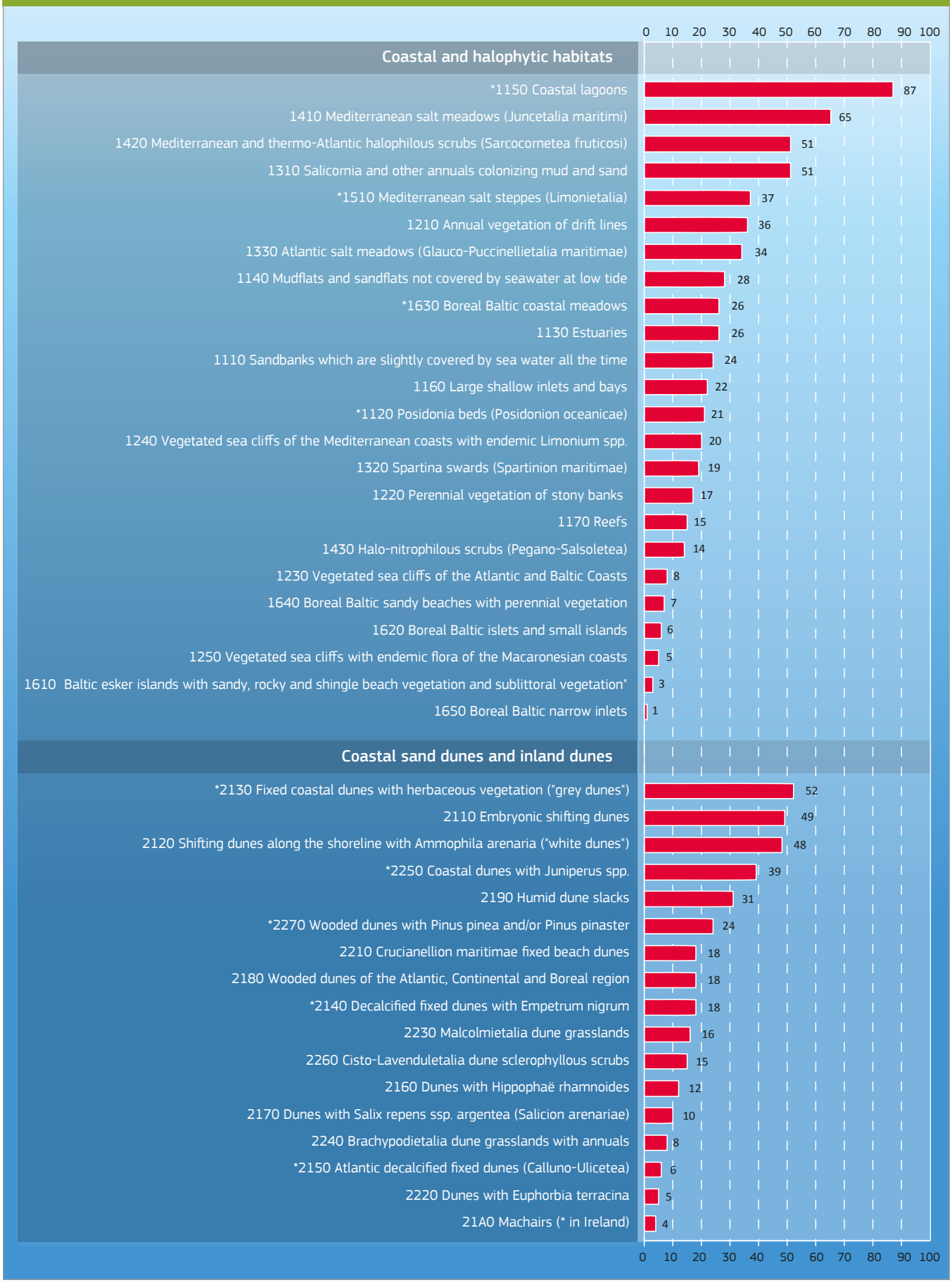
Recovery of endangered species

LIFE project actions to restore and manage coastal habitats have had a direct impact on the conservation status of endangered species that depend upon those habitats (see box – Conserving dune plants in Sicily). By targeting species in an integrated way, taking into account EU coastal and marine policy and the needs of different stakeholders, LIFE has, among other achievements, benefitted seabirds that feed and nest in coastal lagoons and estuaries, monk seals that breed in coastal caves, and loggerhead turtles that nest on sandy beaches and dunes (see pp. 74-75).

Ongoing support for coastal habitats

The current LIFE programme (2014-2020) continues to support, via 'traditional' projects, actions to

Figure 2: **Coastal habitats targeted by LIFE projects (1992-2015)**



LIFE and the Natura 2000 biogeographical process

The Natura 2000 biogeographical process is a multi-stakeholders' cooperation process at biogeographic regional level, including seminars, workshops and cooperation activities to enhance effective implementation, management, monitoring, financing and reporting of the Natura 2000 network. The achievements and experiences of LIFE projects are highly relevant to this process. The second round of biogeographical seminars is in progress and LIFE is providing input in a number of different ways. For instance, a thematic meeting on dunes jointly organised by the Natura 2000 biogeographical process and the LIFE programme took place in the Netherlands in 2016 (see pp. 56-57). The meeting was a milestone event for LIFE projects concerned with dune habitat restoration and its outputs support the Natura 2000 biogeographical process.

Several Member States rely on the LIFE programme to implement Prioritised Action Frameworks (PAFs) for the Natura 2000 network. These conservation programmes are being implemented through traditional LIFE projects and the new LIFE Integrated Projects and include actions targeting coastal areas, such as Dutch Integrated Project, Deltanatuur (see box p.9)

As well as developing best practices, LIFE projects have been active in disseminating the results of their actions. This is particularly important when coastal restoration projects need the active support of different stakeholders. Such communications work also has the benefit of raising awareness of the importance of integrated management of coastal habitats in the Natura 2000 network.

Photo: LIFE06 NAT/B/000087/Misjel Decleer

improve the conservation status of coastal habitats listed in the Habitats Directive. In addition, actions in coastal Natura 2000 network sites can be included in scaled-up Integrated Projects that address measures for nature conservation linked to the PAFs, for instance, actions to restore dunes and coastal marshes.

Projects that address climate change adaptation responses and mitigation actions linked to coastal habitats can be submitted under the LIFE sub-programme for Climate Action (see pp. 81-84). The Natural Capital Financing Facility (NCFF), which is administered by the European Investment Bank on behalf of LIFE, provides tailored loans for projects that deliver on biodiversity and climate adaptation. This is a way of leveraging small investments, open to the private sector, so that they have a large impact. Finally, potential project applicants could also address the need for coastal ecosystem research, green and blue infrastructure and ecosystem services, taking into consideration synergies with Horizon 2020.

Conserving dune plants in Sicily

Muscari gussonei (or *Leopoldia gussonei*) is a plant species endemic to the coast of Sicily. It is confined to dune habitats in Mocconi di Gela, Cava Randello and the Natura 2000 site "Vallata del fiume Ippari". This highly endangered plant is a priority for conservation in the annexes of the Habitats Directive. A recently-completed LIFE project, Leopoldia (**LIFE11 NAT/IT/000232**) worked to re-establish and protect the five sand dune habitats most favoured by *Muscari gussonei* in order to increase the population of this rare plant. By improving knowledge of dune ecosystem morphology and dynamics, the project has been able to develop a masterplan for managing a large stretch of dune and back-dune coastline in the Gela area. It also discovered a new population of *M. gussonei* and for the first time grew the species in plant nurseries for relocation to dune habitats.

COASTAL LAGOONS, ESTUARIES AND SALT MARSHES

Tackling threats to Mediterranean coastal lagoons

The conservation status of Europe's Mediterranean coastal lagoons is 'unfavourable-bad'. LIFE projects are working to counter the pressures that threaten these important habitats and their protected species.

Coastal lagoons are shallow water bodies separated from the sea (or ocean) by a barrier, such as a sandbar, shingle or embankment, but connected to the much larger saltwater body by at least one inlet, though this might be temporary or restricted in some way. Water salinity in coastal lagoons can be very different from seawater, ranging from mildly brackish to hypersaline, depending on precipitation, evaporation, geomorphology, the amount of freshwater coming from rivers and other factors. Coastal lagoons occur in all biogeographic regions, though regional conditions influence their character.

Coastal lagoons are encoded as habitat *1150 in Annex I of the EU Habitats Directive. According to Habitats Directive Article 17 reporting (2007-2012), coastal lagoons are in an 'unfavourable' status in all biogeographic regions and severely threatened across the EU, with the situation worst in the Mediterranean, Continental and Macaronesian regions ('unfavourable-bad') – see chart, p.9.

The situation at Member State level is more variable, with some grounds for optimism. For instance, in Italy, where both conservation status and future prospects are assessed as 'favourable'. Malta and

Mediterranean coastal lagoons are facing pressures and threats linked to coastal development, endangering several bird species, such as flamingos

Photo: LIFE07 NAT/F/000193/Xavier Rufray

Spain report the status and future prospects of Mediterranean coastal lagoons as 'unfavourable-inadequate'. In Portugal, France and Greece, the situation is 'unfavourable-bad'.

The two most widely reported pressures and threats to coastal lagoons are changes in the condition of water bodies and pollution to surface waters. Almost all the pressures and threats are human impacts linked to coastal development.

There have been 88 LIFE projects that have carried out actions in the EU to directly and indirectly benefit coastal lagoons, including 57 in the Mediterranean. This article highlights some of the most notable recent projects in the Mediterranean biogeographic region, the following chapters look at coastal lagoons in the Continental, Black Sea and Atlantic regions.

Projects targeting coastal lagoons have been showing via the implementation of best practices that it is possible to improve the conservation status of this important habitat. The main threats addressed are water quality and water levels, as well as tourist pressures. Actions focus on reconnecting lagoons with the sea, green filtering, controlling tourist access and working with diverse stakeholders, in particular farmers, in order to reduce nutrients input.

The lagoons of Languedoc-Roussillon

There are more than 40 000 ha of coastal wetlands along the coast of Languedoc-Roussillon in south-west France. These include lagoons, peri-lagoons (coastal wetlands) and dunes of Community interest and their associated species, such as waterfowl. In total, 45% of French coastal lagoons are found in this region.

LAG Nature (**LIFE07 NAT/F/000193**) was a five-year LIFE Nature project that set out to create an experimental and demonstrative network of coastal lagoon and dune Natura 2000 network sites along this stretch of the Mediterranean coastline. Led by the Conservatoire des Espaces Naturels du Languedoc-Roussillon (CEN L-R), this ambitious project drew on the support of partners from academia and local authorities.

Project actions focused on a total of five Natura 2000 network sites. This included reconnecting 1 000 ha of peripheral wetlands to 380 ha of coastal lagoons in the Pavlasian ponds Natura 2000 network site, improving the ecological state of the lagoons. Although these habitats remain seriously threatened by deficient hydraulic management and nutrient pollution, project results are encouraging.

Photo: LIFE07 NAT/F/000193/Marjolaine Barosso

LIFE has reconnected more than 1 000 ha of wetlands bordering 380 ha of coastal lagoons in Languedoc-Roussillon, France

The restoration works consisted primarily of cleaning, removing undergrowth, clearing out any small channels, canals and streams, and restoring or replacing small structures such as vertical sluice gates, anti-salt dams and culverts. Restoration of the hydraulic connections between the peripheral coastal wetlands and lagoons has allowed better circulation and a reduction in lagoon eutrophication and enabled the water level to be managed and adapted to the needs of target habitats and species. These actions benefitted macro-invertebrates and the European eel (*Anguilla anguilla*), thereby contributing to improving ecosystem services through improved fishing conditions. New tourist infrastructure at the Salines de Villeneuve, Sicarex and Pointe de la Salaison sites has reduced the impact of public disturbance on protected wading birds. The project also developed cost-effective preventive actions against invasive plant species across 530 ha of coastal wetland habitats. By demonstrating that the spread of these invasive species was linked to hydraulic problems, the project has helped define future priorities for site management.

An important indirect impact of the project was to improve the coordination of environmental governance of the project areas and to raise awareness among decision-makers, tourism professionals, farmers, school children and the general public on the ecological value of the coastal natural areas. The LAG Nature team produced a guide to carrying out restoration activities on lagoon and dune habitats, which other natural area managers may find useful. The project also carried out a study on the impact of leaching treated wastewater on reedbeds surrounding the Or lagoon. This may lead in future to concrete integrated conservation actions to address the threat of nutrient pollution.

According to Jacques Lepart, president of CEN L-R, the LAG Nature project has had "the special quality of uniting ecological experts, involved in knowledge gathering and in lagoon management, with social science researchers to take into account a wide, systemic and global analysis of these natural areas and the threats they are facing."

One of the key achievements of the project was to show that is possible to manage coastal lagoon habitats in an integrated way that takes the objectives of a range of different EU policies into account, including the Marine Strategy Framework Directive, Water Framework Directive and the Recommendation on Integrated Coastal Zone Management, as well as the Birds and Habitats Directives.

Several Mediterranean LIFE projects have taken actions to reconnect coastal lagoons with the sea in order to improve water levels, quality and dynamics

Photo: LIFE09 NAT/ES/000520

Spain's Mediterranean coastal lagoons

LIFE has co-funded two notable projects addressing the conservation and restoration of lagoon habitats on Spain's Mediterranean coast. The first of these is the 2009 LIFE project, Delta Lagoon (**LIFE09 NAT/ES/000520**), which has restored habitats and introduced management measures for Alfcada and Tancada, two coastal lagoons of the Ebro Delta in Catalonia, one of the most important areas for bird conservation in Europe.

The overall goal of the project was to improve the ecological status of the Alfacada and Tancada lagoons through habitat restoration (350 ha) and management measures, such as improvement of hydrological function, elimination of infrastructure that interferes with connectivity, and creation of new lagoon habitats in existing rice fields and abandoned aquaculture facilities.

The Alfacada lagoon is a protected area but until recently it was a private estate used for hunting. It is also vulnerable to the effects of climate change on the water and sediment flux of the Ebro river, which has accelerated the rise in sea level and coastal erosion processes. To counteract these threats, the LIFE project carried out measures designed to mitigate the effects of coastal retreat and climate change, and to improve the status of priority habitats and species, including 10 coastal and migratory wading bird species listed in the annexes of the Birds Directive. As well as restoring the natural hydrological functioning of the lagoon, the project converted some 50 ha of rice fields back to coastal lagoon habitat.

Intensive fish-farming has had a negative impact on the southern part of the Tancada lagoon. The closure of an aquaculture facility in this area gave the Delta Lagoon project the opportunity to restore16 ha of coastal ponds and salt marshes to their natural state. The creation of artificial islets on this lagoon has allowed a number of endangered bird species to breed. 2012 and 2013 saw the establishment of colonies of the slender-billed gull (*Larus genei*), little tern (*Sterna albifrons*) and gull-billed tern (*Gelochelidon nilotica*). In the case of the slender-billed gull, these were the first breeding pairs observed for a decade.

In both coastal lagoons targeted, project actions have had a very positive impact on hibernating and

resident bird species, including the purple swamphen (*Porphyrio porphyrio*). Other species to benefit include the Spanish toothcarp (*Aphanius iberus*) and the European pond turtle (*Emys orbicularis*). The Delta Lagoon team created a new population of some 100 European pond turtles. Monitoring indicates that these turtles are acclimatising to their new surroundings and will be able to establish a reproductive population in 8-10 years.

A second Spanish project, LIFE-PLETERA (**LIFE13 NAT/ES/001001**) is working to recover the ecological functions of the coastal systems of La Pletera, a salt marsh in the Ter estuary, also in Catalonia. La Pletera is threatened by encroaching urban development, and the presence of physical barriers such as a public walkway and levees that hinder the proper ecological functioning of a lagoon system that includes both brackish and hyperhaline coastal lagoons.

Photo: LIFE13 NAT/ES/001001/INGLOBA GROUP

Creating new coastal flooded depressions

The ongoing LIFE project will help ensure that the ecological system can respond appropriately to predicted climate change impacts such as rising sea levels and greater frequency of extreme weather conditions. To do this it will demonstrate best practice in restoring altered or partially built-up natural space in an area heavily affected by development pressure. This includes reconfiguring visitor access points in order to safeguard the habitats from dangers caused by human activity. One of the most important conservation actions will see the creation of a mosaic of four or five permanently flooded depressions linked during flooding. These shallow depressions will support populations of the endangered Spanish toothcarp (*Aphanius iberus*), living in submerged meadows of the aquatic plant, *Ruppia cirrhosa*.

Greek experiences

The recently-completed Greek project ACCOLAGOONS (**LIFE09 NAT/GR/000343**) also addressed the impacts of urbanisation on Mediterranean coastal lagoons as part of efforts to enhance system biodiversity and stability in a coastal area of Thessaloniki province that includes both the Epanomi and Aggelochori lagoons. These habitats have been negatively impacted by drainage and canalisation, with a knock-on effect on important bird species. The Epanomi Lagoon has lost hydrological functions through drainage and canalisation, with subsequent negative impacts on wetland habitat structure and composition. Uncontrolled tourism, leisure and commercial activities, as well as a lack of public awareness, further threaten the ecological integrity of the coastal zone.

The project's restoration works, such as the creation of new canals, ponds and artificial islands and the addition of a sluice gate have improved habitat heterogeneity and benefitted avifauna and are expected to improve water quality in the Epanomi Lagoon. The project also worked to restore water quality and regulate salt production activities in the Aggelochori Lagoon. The creation of a management plan should help safeguard the breeding and resting habitats of important bird species at both lagoons. The document also includes proposals for sustainable year-round eco-tourism activities.

Coastal lagoons in Italy

In Italy, the ZONE UMIDE SIPONTINE project (**LIFE09 NAT/IT/000150**) is also working to manage the impact of tourism by erecting fences and creating new paths away from priority habitats in the wetlands of Capitanata (Puglia region). This project will open small canals to restore the natural hydrology of 40 ha of coastal lagoon habitats.

Three recent coastal lagoon projects have taken place in the part of Italy classified as part of the Continental biogeographic region, including Natura 2000 in the Po Delta (**LIFE09 NAT/IT/000110**), which is featured on the following pages (see pp. 18-20).

COASTAL LAGOONS, ESTUARIES AND SALT MARSHES

Natura 2000 in the Po Delta

A LIFE project in Italy's Po Delta has helped improve coastal lagoon habitats with benefits for water quality, wetland birds and amphibians. Conservation actions have involved multiple public and private sector partners.

The Po Delta is a protected wetlands area of 53 653 ha at the mouth of the River Po, straddling the regions of Veneto and Emilia-Romagna. It is the most complex system of wetlands in Italy, containing coastal lagoons, wet forest, dunes and salt pans. More than 1 000 species of plants and more than 350 vertebrate species are found in the delta, which is an important breeding site for wetland birds, amphibians and reptiles. In recognition of this rich biodiversity, in 2015, the Po Delta Park became a UNESCO Biosphere Reserve.

Despite UNESCO and Natura 2000 protected status, the park is fragmented and the wetlands of the Po Delta face a number of threats linked to human activities, including tourist pressures (there are a number of popular beaches in the vicinity), aquaculture and intensive farming. Stronger sea storms linked to climate change and soil erosion are growing concerns. An increasing threat is water eutrophication, mainly caused by poor water circulation and salinity.

In 2009, the Po Delta Park Consortium, which includes representatives of the park authorities in Emilia-Romagna and Veneto, secured LIFE funding for a four-year project that focused in particular on tackling conservation issues linked to coastal lagoon management.

A key objective of the Natura 2000 in the Po Delta project (**LIFE09 NAT/IT/000110**) was to improve water circulation and nesting conditions for protected bird species in the Valli di Comacchio and Sacca degli Scardovari coastal lagoons.

"For this kind of lagoon it is very important to have an exchange of water with the sea. Eutrophication can occur if sea water cannot enter," explains project manager, Dr Cristina Barbieri, from the Delta

Po Delta Natura 2000 network site (Valli di Comacchio)

Institute of Applied Ecology in Ferrara. "The salinity should be between 25 and 40. It varies by season, depending on evaporation of water. During the summer it is necessary to pump in more fresh water to prevent the lagoons becoming too saline."

One of the tasks of the LIFE project was therefore to restore and modernise sluice gates and pumping stations at the lagoons.

Twin benefits

In a clever piece of project management, material dredged from channels within the lagoons and canals that link the lagoons to the sea was re-used to build artificial islets for nesting birds.

The project team built around 20 islets, with a total surface area of 8.7 ha. These were designed for nesting by eight target bird species, the Kentish plover (*Charadrius alexandrinus*), pied avocet (*Recurvirostra avosetta*), little tern (*Sternula albifrons*), gull-billed tern (*Gelochelidon nilotica*), common tern (*Sterna hirundo*), Sandwich tern (*Sterna sandvicensis*), slender-billed gill (*Larus genei*) and Mediterranean gull (*Larus melanocephalus*).

One challenge was to ensure that the islets met the differing needs of the different species. For instance, according to Dr Barbieri, the Mediterranean gull needs the islets to be submerged, while for other species (breeding one month later), the islets should be above the water level. This meant there was a limit to how high they could be built.

The islets have been colonised by the target species, but also by the yellow-legged gull (*Larus michahellis*), a competitor of 'least concern' in terms of conservation status. This has presented a management challenge. A second challenge has been flooding of the islets linked to heavy rain in 2013 and anomalous water levels in 2014.

Management plan

The project developed a management plan for the Valli di Comacchio Natura 2000 network site that addresses these issues. Thanks to the project, the plan has been approved by the authorities in Emilia-Romagna. A management plan for the parts of the Po Delta Park in Veneto region was due to be approved by the end of 2016. "The plan is to continue with the activities started by the LIFE project," observes Dr Barbieri.

Photo: Eugenio Manghi

Improvements to the lagoons of the Po Delta have benefited several bird species, such as the slender-billed gill (Larus genei)

She notes that this LIFE project has had a positive impact on the coastal lagoons: "The quality of the water has improved. There is a lot of phosphorous and nitrogen from farming. The seawater has improved the quality of the entire lagoon. This is fundamental: it's very, very important," she says, switching from Italian to English to emphasise the point.

The impact of water quality improvements has been seen in the monitoring of biodiversity indicators: "The benthic community has been enlarged," explains Dr Barbieri. "The benthos is also food for fish and for our target bird species."

The project has been broadly welcomed by the local fishing and fish-farming communities. "Everyone benefits from better water quality," says Dr Barbieri. In the protected areas of the Valli di Comacchio and Sacca degli Scardovari coastal lagoons it is only possible to carry out extensive, rather than intensive, aquaculture.

The LIFE project manager notes that, "this is an environment that depends on human activities. In the Comacchio Lagoons, there is one open body of water because of traditional fishing of eels. In the Veneto region, it was the traditional activities of the delta culture - like salt panning and certain ways of fishing - that kept the lagoons alive and in the same condition as in the past. We have to maintain these activities to keep these habitats alive."

Additional impact

In addition to its work on coastal lagoons, the project carried out actions to stabilise the condition of other protected habitats, including Mediterranean salt meadows, Salicornia and Spartina swards. At the Bosco Nordio site, ponds were dug to boost numbers of the European pond turtle (*Emys orbicularis*) and common spadefoot toad (*Pelobates fuscus insubricus*). "This intervention has been very successful, because the two species immediately began to reproduce again," says Dr Barbieri.

Other actions focused on creating habitat suitable for the kingfisher (*Alcedo atthis*) and European bee-eater (*Merops apiaster*), as well as renovating and developing eco-tourism infrastructure.

In this context, an important aspect of the project was the confirmation of a conservation partnership with two fish farms operating in the privately-owned coastal lagoons, Valli Bagliona and Valli Cà Pisani. The owners of these lagoons, which are part of the Natura 2000 network, have signed a five-year public-private management agreement with Ente Parco Delta del Po Veneto, the authority responsible for managing the Po Delta Park in Veneto region. This partnership has seen work carried out by the park to maintain the lagoons and install information boards. In return, the lagoons have been opened up to visitors, such as school groups. "With the project we began a dialogue between the owners and the public," says Dr Barbieri.

Continental lagoons in the Mediterranean

Natura 2000 in the Po Delta is one of three recent LIFE Nature projects that have targeted actions to conserve coastal lagoons in the part of Italy's coast that falls within the boundaries of the Continental biogeographic region. These include a project to restore the Sentina coastal wetlands in the Marche region (Re.S.C.We. - **LIFE09 NAT/IT/000608**), an area of vital importance for migratory birds along a shoreline crowded with tourist settlements and facing the threat of sea-level rise and coastal erosion. Thanks to this LIFE project, which ran from 2010-2013, many rare migratory and nesting bird species have re-colonised the project area, including the crane (*Grus grus*), greater white-fronted goose (*Anser albifrons*), common shelduck (Tadorna tadorna), kingfisher (*Alcedo atthis*), sand martin (*Riparia riparia*), black tern (*Chlidonias niger*) and pygmy cormorant (*Phalacrocorax pygmeus*).

In Ferrara province, the ongoing project LIFE AGREE (**LIFE13 NAT/IT/000115**) is currently working to implement long-term management of coastal lagoons in the 'Sacca di Goro', a site under threat of eutrophication. The project will use proven methods such as dredging of channels and construction of artificial islets for breeding birds as part of an integrated, long-term approach to coastal lagoon management. This functional, ecosystem approach will involve both public authorities and private stakeholders.

Integrating EU policies

LIFE AGREE is being developed according to the principles of ICZM (Integrated Coastal Zone Management), which involves taking an ecosystem approach to the functioning of the lagoon, including both biotic and abiotic components. This holistic point of view considers the effects of coastal dynamics on biodiversity conservation, the economy and hydraulic safety within a vision of long-term management and sustainable development. Project actions will restore and improve the ecosystem services provided by the target coastal lagoons, in particular services that support the local economy and local employment. To this end, cooperatives from the aquaculture and fishing sectors in the area of Sacca di Goro are supporting the work of the project because they see the benefits healthy lagoons have for their industry.

Another Italian project, LIFE-SeResto (**LIFE12 NAT/IT/000331**) is taking a new strategic approach to meeting the objectives of the Habitats Directive and EU water policy. This involves actions to consolidate and restore coastal lagoon habitat by transplanting submerged seagrasses (see p. 66).

Project number: LIFE09 NAT/IT/000110

Title: Natura 2000 in the Po Delta - Conservation of habitats and species in the Natura 2000 sites in the Po Delta

Beneficiary: Ente di Gestione per i Parchi e la Biodiversità - Delta del Po

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Period: 01-Sept-2010 to 30-Nov-2014

Total budget: €4 345 000

LIFE contribution: €2 172 000

COASTAL LAGOONS, ESTUARIES AND SALT MARSHES

Coastal lagoons of the Black Sea

LIFE projects have restored coastal lagoons in Bulgaria to protect habitats from flooding and pollution, and repaired salt pan infrastructure to safeguard breeding sites for bird species of Community importance.

The coastal lakes around the Bulgarian city of Bourgas in the Black Sea region comprise several priority habitat types of the Habitats Directive. Numerous pressures threaten the conservation status of these habitats, with their relative importance differing for each water body. "The main pressures are changes in hydrological regime, pollution, eutrophication, fragmentation, fire and urbanisation," says Diyana Kostovska of the Bulgarian Biodiversity Foundation (BBF).

Bourgas is a major Black Sea port while nearby coastal areas are highly-developed tourist destinations. Human activities have changed the characteristics of the Bourgas Lakes. For instance, Vaya is becoming less saline due to blockage of its sea channel; the dam that created the Mandra reservoir separated it from the protected Poda lagoon, with the loss of wetlands, oaks forests and other habitats; while hypersaline Atanasovsko and Pomoriysko have been converted to salt pans.

LIFE and the Bourgas Lakes

Habitat degradation threatens the area's unique flora and fauna, including species listed in the Birds and Habitats Directives. The Bourgas Lakes are located on the Via Pontica, a key stopover for migrating birds from large parts of northern, eastern and central Europe.

"Bourgas is a bottleneck place for migration, where routes join together, so here the sky turns black when all the storks and pelicans start to arrive," says Vladimir Mladenov of the Bulgarian Society for the Protection of Birds (BSPB). It is on the main migration route for numerous birds of prey and water birds. "Atanasovsko Lake is a very important place for waders, because of its shallow waters," says Mr Mladenov, "Mandra and Vaya are deeper and important feeding sites for fish-eating birds. It is also one of the most important places in Europe for wintering geese."

Photo: LIFE08 NAT/BG/000277

Deepening channels to improve water circulation and water levels benefits coastal lagoon habitats

LIFE for the Bourgas Lakes (**LIFE08 NAT/BG/000277**), coordinated by the BSPB in partnership with BBF, Black Sea Salinas Ltd. and the Municipality of Bourgas, addressed threats facing endangered bird species at three Natura 2000 sites. It restored 14.5 km of dykes and barriers, as resting, roosting and feeding sites for birds. At Mandra-Poda and Atanasovsko Lake, 25 ha of habitats were improved by deepening lakes, while 18 ha were enhanced by reed management. The project constructed eight

Black Sea biogeographic region

The Black Sea biogeographic region extends from Romania and Bulgaria, through northern Turkey and Georgia. It covers just 0.3% of the EU's territory, but the extensive Danube Delta wetlands and a series of coastal marshes and lagoons, coupled with the second largest bird migration route in Europe, make it one of the EU's top biodiversity hotspots.

artificial islands and 10 roosts; insulated 8.8 km of powerlines to prevent bird mortality through collisions and electrocution; initiated a multi-stakeholder agreement to tackle poaching; established an innovative model for cooperation to enforce nature conservation legislation; and developed barriers to prevent predators from accessing key roosting sites. The project also produced the National Action Plan for Conservation of Wetlands of High Significance in Bulgaria, and National Action Plans for five priority bird species.

Atanasovsko Lake

Once a swamp, Atanasovsko Lake became a salt pan in 1906, thus creating a salt industry in Bourgas. As the lake lies below sea level, a 23 km-long freshwater encircling channel is important for gathering rainwater and preventing freshwater and pollution flooding the salt pans. The Burgas-Varna road divides the lake: the northern part and surrounding land is the Atanasovsko Lake Natura 2000 site (see box).

Black Sea Salinas still produce salt by the traditional Fokenski method in this Natura 2000 site. Every spring, seawater is bought into the lagoon via a gated channel. This circulates through a series of evaporation basins having increasing salinity, until arriving in crystallisation basins where salt forms in around 60 days ready for manual harvesting in August.

LIFE project actions helped maintain the salinity of Atanasovsko Lake and reduce the risk of eutrophication

Photo: LIFE08 NAT/BG/000277/Evgeni Dinev

Atanasovsko Lake habitats

Habitats of Atanasovsko Lake Natura 2000 site, with extent and conservation status under the Habitats Directive (MoEW, 2013) [1]

- *1150 Coastal lagoons (20.6% of site area; 1 534.17 ha), 'unfavourable' status;
- *1530 Pannonic salt steppes and salt marshes (250.87 ha), 'unfavourable' status;
- 1310 Salicornia and other annuals colonising mud and sand (110.57 ha), 'favourable' status; and
- 1410 Mediterranean salt meadows (0.56 ha), 'favourable' status.

1 "Mapping and determination of the conservation status of nature habitats and species – Phase I" (2013), MoEW; when 100% of the habitats were mapped.

Salt of Life

"One of the main reasons for establishing the Salt of Life project was the flood in 2010, when many of the dykes and barriers characteristic of traditional salt production were destroyed, the lake was inundated with freshwater and the salinity was reduced almost to zero," says Ms Kostovska, the project manager. "This happened because the channel was blocked with mud and undesired vegetation."

The invertebrates and macro-invertebrates that are food for birds in Atanasovsko Lake are adapted to saline conditions, so changes in hydrochemical conditions affect several trophic levels. The lake has the highest number of birds recorded in one place in Bulgaria: 333 species (of 420 recorded in Bulgaria), including 14 globally-threatened species. "The lake is the biggest salt production place in Bulgaria, but it is also the most popular place for birds," says Ms Kostovska.

The project has cleared over 11 km of freshwater channel and protection dyke by cutting vegetation, and removing mud and silt using a specially-developed dragline machine. This secures the lagoon from flooding and pollution, improves access to the channel and reduces response time in emergency situations, ensures sustainable water levels and good water quality, and prevents harmful reductions in salinity and the risk of eutrophication. The larger area of open freshwater provides feeding sites for birds, especially ducks, and fish have returned.

Instead of natural islands, salt pan infrastructure offers abundant breeding and roosting sites. Around 10% of the world population of Dalmatian pelican (*Pelecanus crispus*), for example, roosts here during the autumn migration. Therefore, the Salt of Life project continued the work of restoring dykes and barriers started in the previous LIFE project, and also created new sites. "During the project, we created four artificial islands with total area 160 m^2 and restored two wooden platforms," says Ms Kostovska.

"All these artificial structures are very useful for birds," says Mr Mladenov. "The dykes and barriers fragment the lake, and every basin has its own unique water depth, salinity and other physical and chemical parameters, which is why there are so many different types of habitat and food resources, and why there is a very big variety of birds using this lake."

Heavy rainfall in 2014 and 2015 again caused local flooding. "The effect of the channel cleaning and dyke renovation could be demonstrated, in comparison to the flood damage in 2010. In December 2014, rainfall was higher than in 2010, water level increased by 40 cm, salinity went down 20-25%, but no serious damage to dykes and barriers occurred," explains Ms Kostovska. Efforts to secure Atanasovsko Lake against flooding will continue. "The channel was constructed with the idea that high rainfall would occur every eight years, but we have seen two years with the highest quantity of annual rainfalls in the past five years, probably an effect of climate change. We have increased the resilience of the hydrological scheme, and in this way we have adapted the lake to climate change."

Benefits for biodiversity and salt production

"Here, business and nature go hand-in-hand," says Ms Kostovska. On evaporation basins, where salt is loaded by long-handled shovels onto a conveyer belt taking it to characteristic storage mounds ('bohars'),

Photo: LIFE08 NAT/BG/000277/Bogdan Boev

Dalmatian pelican (Pelecanus crispus)

Deyan Tomov, Technical Restoration Officer for Black Sea Salinas, explains further: "The *salinas* are separated into different basins, each having a defined water level and salinity gradient. If dykes and barriers are not in good condition, we will not be able to manage the process of water circulation," he says. "The restoration of the channel protects the *salinas* from flooding and supports salt production, because after every flood it takes three years for the *salinas* to recover," he adds.

The project is using innovative approaches to raise public awareness, including an annual salt festival on the shore of the lagoon. Atanasovsko Lake has Bulgaria's largest deposits of medicinal mud and lye, by-products of salt production. In a location where up to 3 200 people a day visit the lagoon by the sea, many to coat themselves in black curative mud or float in hypersaline ponds, a series of information boards explain about nature conservation. The project team consider a high level of public engagement essential for the long-term preservation of coastal lagoons: "When you have people on your side, it is easier to convince institutions to do things in a different way," concludes Radostina Tzenova, the project's Communication Officer.

Project number: LIFE11 NAT/BG/000362

Title: Salt of Life - Urgent Measures to Restore and Secure Long-term Preservation of the Atanasovsko Lake Coastal Lagoon

Beneficiary: Bulgarian Biodiversity Foundation

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Period: 01-Jul-2012 to 31-Aug-2018

Total budget: €2 013 000

LIFE contribution: €1 451 000

COASTAL LAGOONS, ESTUARIES AND SALT MARSHES

Atlantic, Baltic and Continental **coastal lagoons**

The LIFE projects in this chapter highlight the threats facing saline lagoons in the Atlantic, Baltic and Continental biogeographic regions, and the measures implemented to protect habitats and species in the annexes of the Habitats and Bird Directives.

The Atlantic biogeographic region ranges from northern Portugal to northernmost Norway. The coastlines of three EU countries (Ireland, UK and the Netherlands) lie entirely in the region, with another seven countries having coasts partly in the region. It is a region of many coastal lakes and lagoons, which contribute greatly to biodiversity - particularly in terms of water birds and fish.

The Alde-Ore project (**LIFE08 NAT/UK/000199**) addressed some typical threats facing coastal lagoons in the Atlantic region, namely the drying out of wetland areas, increasing water salinity levels (with negative impacts on the aquatic organisms that provide food for birds and other wildlife), encroaching vegetation (including alien non-native species), and the increased long-term threat of flooding due to climate change. Orford Ness, the best-preserved vegetated shingle site in the UK, separates the North Sea from an extensive coastal lagoon.

Coastal lagoon on the Baltic coast of Store Egholm, Denmark

Photo: LIFE05 NAT/D/000152/Hauke Drews

LIFE project beneficiary The National Trust has extended and enhanced several habitat types here, to safeguard feeding and breeding sites for bird species listed in annexes of the Habitats and Birds Directives. The project, for instance, removed grass in the marshes to provide a mosaic of feeding and breeding sites for birds.

The Alde-Ore team established an infrastructure for sustainable water management, by creating an improved system of pools, new ditches (2.4 km) and linear scrapes (4 km), sluices and pumps. Three new inlet sluices enable the controlled abstraction of water from a tidal creek into 3 ha of new saline lagoons, where water can be stored until it is directed to replenish key areas of the lagoon as required. Improved water flows have enabled salinity to be kept below a target level (40) and have prevented the development of pockets of stagnation. The improved pumping system evacuates excessive rainwater and also excessive saltwater after tidal surges. All these project measures ensure the maintenance of water levels in the coastal lagoon, and wetter conditions in the marshes. This helps preserve ecosystem functions, including resilience to climate change.

The Baltic and Continental biogeographic regions

The numerous low-lying coastal lagoons of the Baltic biogeographic region provide large areas for both migrating and breeding water birds. However, in the western Baltic region, many coastal lagoons

and wetlands have been drained and the land used for arable farming, while existing coastal lagoons are at risk of eutrophication due to nutrient runoff from farms. Although coastal areas only comprise a small percentage of the Continental biogeographic region, significant coastal lagoons occur with characteristics similar to those in the Baltic.

The Tryggelev Nor project (**LIFE02 NAT/DK/008588**) reduced nutrient levels and restored hydrological conditions in the Tryggelev Nor coastal lagoon, adjacent to the Baltic Sea. This created the necessary conditions for improving its conservation status, and that of a number of bird species listed in Annex I of the Birds Directive. The project reduced nitrogen loads over the entire wetland area by around 60%. This was achieved by constructing a salt water inlet into the lagoon to flush out nutrient accumulations and establish a more dynamic exchange of water between lagoon and sea, and by raising water levels in the lagoon and establishing a stable water table in the surrounding reedbeds. A key project action was extending the wetland area by converting farmland near the lagoon into 15 ha of reedbeds and 69 ha of open freshwater areas, to create new habitat for target bird species and to act as a buffer zone between intensive agricultural activities and the coastal lagoon.

In the Baltic, the conservation status of many coastal lagoons is being compromised by hydrological change, eutrophication and vegetation overgrowth. The BALTCOAST project (**LIFE05 NAT/D/000152**) tested and demonstrated management measures addressing these threats on 34 Baltic coastal lagoon habitat complexes, each with distinctive set of habitats, located in Denmark, Germany, Sweden, Lithuania and Estonia. The project actions included blocking drainage ditches, reconnecting saline lagoons to the sea (e.g. with tunnels under road dams), using pipes to divert nutrient-rich water around lagoons and establishing nutrient retention ponds, deepening lagoons, and removing eutrophic mud and dense vegetation (including alien non-native species such as Japanese rose – *Rosa rugosa*).

These measures helped retain water in the early spring, enabling water levels to be maintained throughout the year, to the benefit of target breeding birds, amphibians and plants – see box. The project team noted that small naturally-disconnected near-freshwater lagoon areas occur, which provide reproduction ponds for toads and habitat for other species, so reconnecting these with saltwater should be avoided.

The main recommendation of BALTCOAST, and several other LIFE projects, is that restoring dynamic natural hydrological conditions is crucial for providing the conditions that ensure a 'favourable' conservation status for habitats in coastal lagoons.

Denmark: Improving two habitats at once

Bøjden Nor is a protected area in south-west Funen that consists of a shallow coastal lagoon surrounded by salt marshes. The lagoon's catchment was made up of intensively-farmed land and a narrow strip of dry, semi-natural grasslands. Nutrients from farming activities were putting both the dry grasslands and coastal lagoon under pressure. The Danish LIFE project CONNECT HABITATS (**LIFE09 NAT/DK/000371**) set out to conserve both habitats by extending and connecting the dry grasslands and salt meadows. In so doing, the goal was to reduce the input of nutrients to the lagoon from the surrounding catchment area.

The project expanded the area of semi-natural grasslands from 1 ha to 25 ha. It also purchased 5 ha of land that was converted to salt meadow habitat. Monitoring after the land use conversion shows that there has been a 30% reduction in nitrogen entering the lagoon. There are already signs of recovery in the lagoon's condition as it is able to support more wading birds. The buffer zone created by the new salt meadow habitat area surrounding the lagoon will also combat the impacts of future rises in sea level due to climate change.

Photo: Helle Hjorth/Claus Paludan

Some species benefitting from BALTCOAST

Birds: Ruff (*Philomachus pugnax*), dunlin (*Calidris alpina*)
Amphibians: European green toad (*Bufo viridis*) and natterjack toad (*Bufo calamita*)
Plants: Creeping marshwort (*Apium repens*)

COASTAL LAGOONS, ESTUARIES AND SALT MARSHES

LIFE actions for estuaries

LIFE projects have implemented a range of actions to improve the conservation status of estuary habitats which are in an 'unfavourable-bad' condition across the EU.

An estuary is the downstream part of a river valley, subject to the tide, and extending from the upper limit of brackish waters to the sea (or ocean). Estuaries are transition zones with changing gradients of freshwater and saltwater; where reduced water current flows and tidal regime cause deposition of fine sediments, often forming extensive sandflats or mudflats. These contrasting influences are the reason why estuaries are among the most productive, dynamic and complex ecosystems.

Estuaries are of prime importance for wildlife and of major value in terms of their rich natural resources (e.g. as nursery grounds for commercially important fish and shellfish). In addition, they offer a wide variety of economically-valuable ecosystem services such as shoreline stabilisation, nutrient regulation, carbon sequestration, detoxification of polluted waters and energy supply. Estuaries are utilised by a wide range of stakeholders, including municipalities, agricultural and industrial businesses, tourism and leisure operators, hunters and fishers, birdwatchers and nature conservation organisations. Reconciling the demands of these interest groups is therefore essential for protecting estuaries.

Estuaries are widespread throughout the Atlantic biogeographic region in Europe. In the Baltic, river mouths are considered as an estuary subtype, characterised by brackish water and no tides. In the other two European marine biogeographic regions, the Mediterranean and Black Sea, the lack of tides also excludes estuaries in the strictest sense.

An estuary forms a complex ecological unit with a mosaic of surrounding coastal and terrestrial habitat types, which in terms of nature conservation cannot be separated. Therefore, estuaries are effectively habitat complexes, comprising a mosaic of subtidal, intertidal and adjacent terrestrial habitats.

Estuarine LIFE projects have helped implement EU policy in an integrated way

Photo: LIFE14 NAT/FR/000669

Many of these are listed as Annex I habitat types in the Habitats Directive, including estuaries (1130), mudflats and sandflats not covered by sea water at low tide (1140), sandbanks which are slightly covered by sea water all the time (1110), salt marshes and coastal meadows.

According to Habitats Directive Article 17 reporting (2007-2012), estuaries are in an 'unfavourable-bad' status in all biogeographic regions of the EU except for the Marine Black Sea ('unfavourable-inadequate'). The condition of estuaries seems to be worst in the north of the Marine Atlantic region – see chart, p.9.

LIFE addresses threats to estuary habitats

Threats and pressures identified by Member States that compromise the conservation status of estuaries in the EU include dams and other hydromorphological modifications, water pollution (from land and marine sources), eutrophication, invasive alien species and vegetation overgrowth, unsustainable fishing, shipping and port activities, the spread of urban and industrial areas, coastal erosion, sedimentation and climate change.

LIFE projects have helped implement EU policy by addressing all these threats and pressures to the mosaic of habitat types found in estuaries. The representative projects in this chapter have focused their actions on farmland in estuaries, mudflats and sandflats, saltmarshes, a "fossil estuary", and an estuarine island (see box).

The Wadden Sea project (**LIFE99 NAT/DK/006456**) addressed the consequences of intensive farming practices on estuary (1130) and Atlantic salt meadow (1330) habitats and species. To produce grass pellets for livestock over 1 700 ditches were dug to drain grassland areas. After the collapse of the market for grass pellets, this Danish project raised water levels and promoted more extensive forms of agriculture (e.g. without using pesticides and fertilisers). The project restored 2 488 ha of land to its natural hydrological condition, by blocking drains and using sluice gates and other 'low-tech' solutions, and ensured these conditions continued through management agreements with over 200 farmers. Monitoring activities show some indications of recovery of wetland bird populations, including corncrake and lapwing (*Vanellus vanellus*).

Bringing more saltwater into estuaries

The ZTAR (**LIFE09 NAT/BE/000413**) project restored habitats in the Zwin tidal area. The trans-border Zwin estuary site (180 ha in Belgium and 27 ha in the Netherlands) and two other Natura 2000 sites had suffered biodiversity loses due to degradation of mudflat and sandflat habitats, and deposits of sand filling in coastal lagoons and connecting islands to the mainland, thereby exposing ground-breeding birds to predators. Species such as the natterjack toad (*Bufo calamita*) had also disappeared due to the overgrowth of vegetation. The project excavated

An estuary island

10GEMETEN (**LIFE04 NAT/NL/000202**) was the first LIFE Nature project to target estuaries in the Netherlands. A dam constructed in 1970 practically stopped tidal ebb and flow in the Haringvliet estuary Natura 2000 site, at the mouths of the rivers Rhine and Meuse. This considerably reduced the intertidal area on the island of Tiengemeten, with its characteristic mudflats and salt marshes.

The project transformed 700 ha of pastureland on the island into 40 ha of traditional farmland, in which historical buildings are preserved, and 660 ha of tidal habitats. This was achieved by creating an opening for water to breach the island, lowering dykes and digging a creek across the island. The actions raised water levels and, in winter, created a large interior body of freshwater that provides a stopping-over place for migrating birds.

By creating or extending seven habitat types (1130, 3150, 3270, 6430, 6510, 91E0 and 91F0), the project ensured favourable conditions for many species in the annexes of the Habitats and Birds Directives, including birds such as the great bittern (*Botaurus stellaris*) and corncrake (*Crex crex*), the root vole (*Microtus oeconomus*), fish and amphibians. The project beneficiary, the Government Service for Sustainable Rural development (DLG), drew up a management plan for habitats on the island (2007-2024), in collaboration with the environmental NGO Natuurmonumenten and public authorities.

freshwater ponds for amphibians; restored nesting islands for birds; introduced grazing to reduce overgrowth; and deepened and broadened the main gully of the Zwin to enable more seawater to flow into the estuary, so reducing silting and helping to naturally restore estuarine habitats.

In Spain, the ongoing project CONVIVE-LIFE (**LIFE14 NAT/ES/001213**) is addressing the main threats to the conservation status of habitats and species of Community interest in Atlantic estuaries in Cantabria. Again, a key project objective is enabling more saltwater to flow into four target areas, namely, the Tino Menor, Joyel and Oyambre estuaries, and the Victoria Lagoon. This is helping to restore 11 target habitat types in total (1130, 91E0, 9340, 1140, 1110, 1310, 1320, 1330, 1420, 2110 and 4090).

To reinstate more favourable hydrodynamic conditions, the CONVIVE-LIFE project increased tidal water flows by opening dams or gates at the Oyambre, Tinas Menor and Joyel estuary sites. The invasive species sea-myrtle (*Baccharis halmifolia*) was removed from all four sites to enable native vegetation to recover. The project identified eutrophication as the most significant threat at the three estuary sites, where it is characterised by the proliferation of phytoplankton and/or green algae, caused by excessive nutrient loads and insufficient rates of water renewal. In addition to increasing tidal water flows, the project reduced pollution from a fish farm using a pilot artificial wetland system to treat wastewater, and suppressed green algae proliferation at a key location.

In Aiguillon Bay, France, LIFE project actions are following the principles of integrated coastal zone management (ICZM) for estuaries

Photo: LIFE14 NAT/FR/000669

Another ongoing estuary project is restoring habitats in France that have been degraded by mass tourism. LIFE BARGE (**LIFE14 NAT/FR/000669**) is following the principles of integrated coastal zone management (ICZM), which involves understanding the interactions between the wetland of the Marais Poitevin and Aiguillon Bay in order to inform its management strategies. The project is restoring several coastal habitats (including dunes) to create a buffer passive protection zone as a means of protecting areas against sea floods and the rising sea level. Actions include the restoration of 40.5 ha of mudflat habitat and a prospective analysis of the geomorphological evolution of Aiguillon Bay, creating additional saltmarsh for nesting birds, and restoring dune habitats. As with previous LIFE projects involving estuaries, effective cooperation between stakeholders is seen as vital, in this case especially to reconcile nature conservation with visitor access to the dunes.

A fossil estuary

Estuary habitats can exist after the original estuary has gone. The LIFE-FEYDRA project (**LIFE02 NAT/B/008591**) focused on dune restoration in the Yser "fossil estuary" in Flanders (Belgium), the site where a branch of the Yser estuary flowed in the Middle Ages, with the aim of enhancing the conservation status of eight dune habitat types of the Habitats Directive. The project demolished an abandoned wastewater treatment plant and cleared scrub vegetation, to restore the habitats, which included calcareous marshlands, dune pools, moss dunes and open dune grasslands. It also implemented a management plan for woodland, which involved deforestation using specially-adapted equipment (e.g. low-pressure tyres) to avoid damaging the underlying soil and vegetation. The project established hay pasture management practices, including the introduction of Shetland ponies for grazing, to enhance the conservation status of the wet and dune grasslands. In addition, the project installed two adjustable weirs for long-term management of water levels.

The new habitats have created favourable conditions for many species listed in the annexes of the Habitats and Birds Directives, in particular the target plant species creeping marshwort (*Apium repens*) and fen orchid (*Liparis loeselii*), and the amphibians natterjack toad (*Bufo calamita*) and great crested newt (*Triturus cristatus*).

COASTAL LAGOONS, ESTUARIES AND SALT MARSHES

Promoting priority salt marshes

Salt marshes are coastal habitats that are regularly flooded by tidal waters. Attempts to control the impact of tides, along with the silting of estuaries and coastal development, however, have diminished the size and the quality of these habitats.

Photo: LIFE12 NAT/IT/001122/Emiliano Ramieri

LIFE has been improving the tidal dynamics and water levels of the mosaic of salt marshes habitats

Salt marshes are defined as natural or semi-natural terrestrial halophytic ecosystems. Halophytes are plants that grow in highly saline waters. Salt marshes largely occur in the intertidal zone between land and the sea, and are covered by salty or brackish water for at least some of the time. Salt marshes are highly productive coastal wetlands that provide important ecosystem services such as storm protection for coastal cities, nutrient removal and carbon sequestration. Nevertheless, their status across the EU has been deteriorating. The main cause of deterioration of these habitats is enclosure by the erection of tidal barriers or sea walls that keep the sea out and break the connection to the tidal waters. The lack of water destroys the salt marsh and in many cases the land is then converted to intensive agricultural use.

According to the latest Article 17 report (2007-2012), for the vast majority of Member States, salt marsh habitats listed in the Habitats Directive are in an 'unfavourable' conservation status in all biogeographic regions (see Table 1).

Since 1992, more than 250 LIFE projects have targeted protected salt marsh habitats across most of Europe's biogeographic regions. The majority of these have taken place in the Mediterranean and Atlantic regions. Project actions have in the main focused on improving the water quality and restoring

Table 1 – **Conservation status of salt marsh habitats in the EU**

Salt Marsh Habitats (Annex I Habitats Directive)	ATL	BLS	BOR	CON	MAC	MED	STE
1310 - Salicornia and other annuals colonizing mud and sand	U2	U1	U1	U1		U1	FV
1320 - Spartina swards (*Spartinion maritimae*)	U2			U2	U1	XX	
1330 - Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	U2		U2	U2		U1	
1410 - Mediterranean salt meadows (*Juncetalia maritimi*)	U1	U1		U2	U2	U2	
1420 - Mediterranean and thermo-Atlantic halophilous scrubs	U1			U1	XX	U2	
1430 - Halo-nitrophilous scrubs (*Pegano-Salsoletea*)						XX	
*1510 - Mediterranean salt steppes (*Limonietalia*)						U2	

FV 'Favourable' U1 'Unfavourable-Inadequate' U2 'Unfavourable-Bad' XX 'Unknown'

coastal Natura 2000 sites and, in particular, the mosaic of habitats that make up a coastal tidal habitat (see Figure 1).

The importance of the concrete conservation actions carried out by these projects has been recognised in the Natura 2000 biogeographical seminars for the Mediterranean and Atlantic regions.

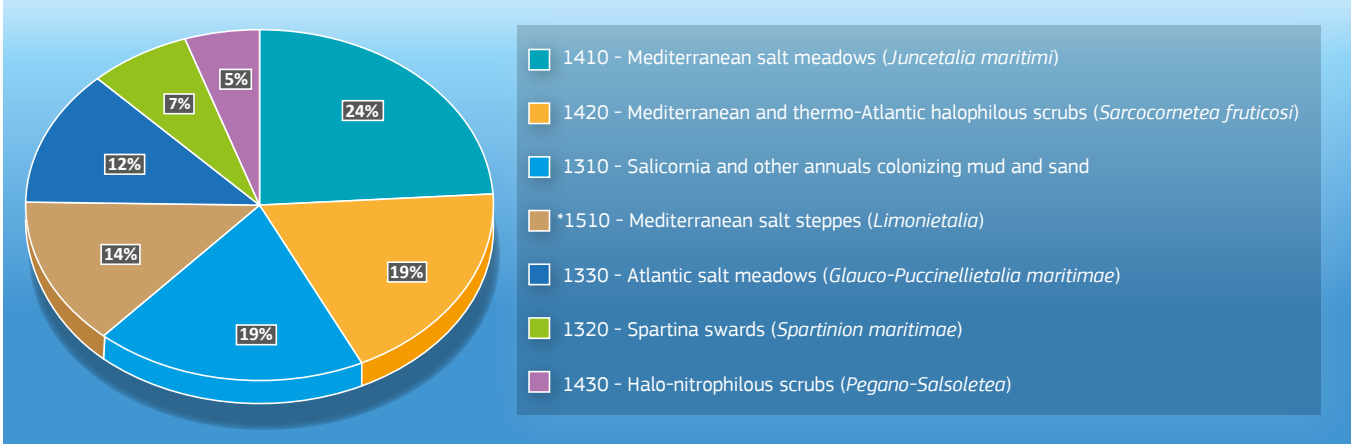
Belgium rewets salt marshes

The Zwin tidal flood plain is located in the most seaward part of the Scheldt estuary. The Belgian part of the Zwin plain is the largest tidal salt marsh site in the country covering 125 ha of tidal saltwater lagoon, gullies, mud flats and salt meadows and it is included in the Natura 2000 network. The dune area, known as the Zwin dunes and polders, adjacent to the tidal site has also undergone many changes in land use (see pp. 42-45).

The Flemish Nature Agency, Natuur en Bos, took over the management of the heavily silted Zwin tidal flood plain in 2006 with the aim of opening it out and restoring affected coastal habitats. In partnership with the Province of Zeeland (The Netherlands), Natuur en Bos subsequently launched the LIFE project ZTAR Zwin Tidal Area Restoration (**LIFE09 NAT/BE/000413**) to restore the rich biodiversity of this internationally-important Natura 2000 network site.

The project, which finished at the end of 2016, carried out large-scale restoration of the ecological dynamics in the Zwin area, including salt marshes. The largest and most expensive part of the project was the deepening and broadening of the main gully of the Zwin. This measure stemmed from the conclusions of the international Zwin commission and aims to increase the area of tidal habitats in the Scheldt Estuary while slowing down the silting up of the Zwin. For these impressive works the project

Figure 1: **LIFE salt marsh projects by habitat**



depended on the tides, because the Zwin gully is constantly influenced by the sea. Dredging of the gully allows much larger volumes of seawater to enter the Zwin flood plain at high tide, thus restoring the tidal dynamics and leading to the natural recovery of the saltmarshes and mudflats. "With a lot more water coming in, the landscape will change a lot. There will be more mudflats," says Piet Lozie of Natuur en Bos. Mudflats are essential in the estuarine ecosystem as they provide foraging opportunities for many wading birds.

At the start of the LIFE project, the salt marsh habitats in the north-eastern part of the Zwin were suffering from high siltation as they were rarely touched by the tide. Vegetation became dense and dominated by a single species. To complement its actions to restore the influence of the tides on the salt marshes, the project removed 8 ha of top soil in order to restart vegetation dynamics. In 2012, canals around the salt marshes were deepened and enlarged. By 2016, habitat types 1310 and 1330 were recovering spontaneously on the area where the top soil was removed. At the same time a new system of gullies started to develop spontaneously under tidal influence, enhancing the diversity of habitats at the site.

Other project actions focusing on improving nesting conditions for coastal bird species such as the little tern (*Sterna albifrons*), common tern (*Sterna hirundo*), Mediterranean gull (*Larus melanocephalus*) and pied avocet (*Recurvirostra avosetta*), all of which have already returned to the site in large numbers. The project also created new pools that can be used by the natterjack toad (*Bufo calamita*), among other species.

LIFE ZTAR's deepening and broadening of the Zwin's main gully will make it possible to enlarge the area influenced by tides, restoring to tidal flooding some 120 ha of the adjacent Willem-Leopoldpolder. The new cross-border tidal area will be enlarged from 150 ha to almost 270 ha, resulting in a durable natural area of gullies, mud flats and salt marshes that currently is covered with farmland.

Relocating sea defences

An important aspect of the project involved removing the dyke that straddles the Belgian-Dutch border and building a new dyke further inland using the sand excavated from the mouth of the main gully of the Zwin. The new 3.8 km long dyke is 6-7 m above sea level. An ingenious system of drainage ditches

Photo: LIFE09 NAT/BE/000413

LIFE restored mudflats in the Zwin estuary, Belgium, and signs of salt marsh vegetation are starting to show

ensures that the saltwater that seeps out from the tidal plain to the surrounding polders flows back to the tidal plain of the Zwin, reassuring arable farmers whose land borders this new dyke that their activities won't be affected by an increase in salinity of the groundwater and the soil in their fields.

Sheep and cattle are now grazing the Zwin plain and the new dyke, in order to "break up the monotony of the sea couch vegetation and allow a larger number of rarer species, both plants and invertebrates to reappear," according to Stijn Loose of Natuur en Bos. It remains to be seen just how the area will develop once the last parts of the old dyke are removed but experts are convinced that more sediment will be deposited in the area. In the near future, more areas will come under marine influences, allowing such priority habitats as salt marshes to develop naturally over time.

Some areas of salt marshes are also found in the Yser estuary on the Belgian coast. These have benefited from the restoration activities that were carried out between 1997 and 2001 by LIFE's Integrated Coastal Conservation Initiative project (see pp. 42-45).

Integrated estuary and lagoon restoration

Salt marshes have also benefitted from estuary restoration measures carried out in the Netherlands. The estuary area of the Eastern Scheldt in Zeeland was once known for its shallow tidal creeks, sand flats, salt marshes and inland brackish marshes. The construction of a series of dams to

protect the Netherlands from flooding had the unfortunate consequence of stopping the tidal regime of the estuary. Without a regular flow of sea water, all these estuary habitats were greatly reduced in size in the Eastern Scheldt.

In response, the Dutch government and local organisations initiated a restoration programme in the 1990s - Plan Tureluur - with a focus on the restoration of estuarine gradients between estuarine, river and inland habitats, the protection of tidal salt marshes including sand flats against erosion, and the restoration of inland brackish marshes.

In total, the plan involves restoring 1 200 ha of extensive brackish marsh along the south coast of Schouwen-Duiveland. The LIFE project Brackish Marsh (**LIFE06 NAT/NL/000071**) has made a significant contribution to the delivery of the plan in the Eastern Scheldt.

The project aimed to turn arable land back to salt marshes and lagoons. The wet and saline soil (the land behind the dyke is 1.5 m below sea level) had hindered its use for agriculture in any case.

The Brackish Marsh team arranged a land swap so that farmers could carry on their business on more suitable fields away from the 178 ha project site.

Derelict infrastructure was cleaned and soil removed by the project in order to restore former creeks and topography. The team also built dams, sluices, culverts and other infrastructure to manage site hydrology.

The original creeks, salt marsh habitats and sandbars are now visible again. Of particular note is the expansion of two protected habitats: Salicornia (1310) and Atlantic salt meadows (1330). In addition, the connections with adjoining habitats are expected to play an important role in the preservation of populations of the project's target bird species.

The project area has become a suitable breeding ground for a number of important European bird species, including the avocet (*Recurvirostra avosetta*), Arctic tern (*Sterna paradisaea*) and common tern (*Sterna hirundo*), as well as a resting and feeding ground for the barnacle goose (*Branta leucopsis*), golden plover (*Pluvialis apricaria*), little egret (*Egretta garzetta*), Eurasian spoonbill (*Platalea leucorodia*) and bar-tailed godwit (*Limosa lapponica*).

The restored area is now visited by many tourists. The LIFE Brackish Marsh project transformed an old church tower ("Plompe Toren") into a tourist and conservation information centre. Adjacent areas covering 230 ha were scheduled to be restored under the Plan Tureluur following the project.

Venice salt marshes in peril

The intertidal salt marshes in the Venice Lagoon are also benefitting from LIFE-supported conservation actions. The entire Venice Lagoon is suffering from natural and anthropogenic erosion, leading to a marked reduction in areas of salt marshes in recent decades. Even inland salt marshes have deteriorated, but conservation of these areas is not straightforward since it is not feasible to reverse the excavations that have occurred or hugely curtail recreational and industrial activity.

The approach being taken by LIFE VIMINE (**LIFE12 NAT/IT/001122**), however, is to carry out continuous

The removal of soil on farmland and the restoration of tidal creeks and topography (left) brought back the tidal saltmarsh habitat (right)

Photos: LIFE06 NAT/NL/000071/Foto Natural/Jan Vink

Photo: LIFE12 NAT/IT/001122

Rough bundles of brushwood, known as Fascines, are stopping erosion in the Venetian lagoon and promoting the recovery of salt marsh boundaries

monitoring and maintenance, rather than one-off actions, in order to prevent erosion. It is regularly repairing small but numerous eroded patches on salt marsh boundaries in order to stop erosion before it becomes irreversible. It is achieving this goal by carrying out low-impact soil bioengineering works, such as strengthening with fascines (rough bundles of brushwood or other material), and manual labour. It is moreover involving stakeholders to increase environmental awareness and promote sustainable local economic activities based on salt marsh services. Demonstrating the socio-economic advantages of conservation is expected to drive demand for the continuation of this work.

An earlier LIFE project also addressed the conservation challenge of the Venetian lagoon. This project – Barene (**LIFE99 NAT/IT/006246**) – tried different techniques, such as the use of sacks, fences and gabions, to restore sandbanks – and thus protect the salt marshes. It established a nursery of plants that could also help stabilise the sandbanks. Around 2 000 seeds of various halophytes were collected in order to cover an area of 800 m^2 with useful plants. This project represented a first step in engaging with stakeholders that was continued in the more recent project.

Other EU salt marsh conservation actions

A management and monitoring plan for the former salt pan habitats in Cadiz Bay was the main outcome of the Spanish LIFE project, Costas Cádiz (**LIFE03 NAT/E/000054**), which addressed the conservation of the range of coastal habitats found in the province. The disused salt pans had been transformed into commercial fish farms, but the plan proposed to restore the regulation system for controlling sea water levels. To his end, the project purchased the rights to use the salt pans on Trocadero Island. Once again LIFE was shown to be a great way to bring local actors together to ensure the continuity of its goals.

Further north on Spain's Cantabria coast, CONVIVE-LIFE (**LIFE14 NAT/ES/001213**) is working to improve the conservation status of several salt marsh habitats, primarily through the removal of invasive alien plant species and restoration of the tidal regime.

Another ongoing project LIFE BARGE (**LIFE14 NAT/FR/000669**) is taking an integrated approach to the restoration of coastal habitats in Aiguillon Bay on the Atlantic Coast of France, including 100 ha of mudflats and 10 ha of Atlantic salt meadows. Deposits of the non-native Pacific oyster (*Crassostrea gigas*) have formed a sediment trap in the bay and will be removed to restore the natural mudflat habitat. Atlantic salt meadows will be created by the reconversion of agricultural polders and restoration of tidal water dynamics. The project's integrated approach extends to actions to reduce the impact of tourism and improve resilience to storms and sea floods, based on the theory of passive resistance.

DUNES

Restoring and managing coastal dune habitats

Threatened by urban sprawl, rising sea levels, increasing tourism, invasive species, sand extraction and pollution, dunes are an endangered habitat that needs protecting. LIFE projects have shown how long-term conservation can happen in an integrated way.

Coastal dunes are characterised by a gradient of a mosaic of habitats, stretching inland from the beach. These habitats are shaped by the wind, sand and their distance from the sea.

Since 1992, there have been more than 172 projects funded through the LIFE programme on coastal dune habitats[1]. These projects have been delivered across six biogeographic regions, 21 Member States and over 250 Natura 2000 sites. The total investment in these projects is over €220 million with €110 million in EU match funding.

As Figure 1 shows, Spain, Italy and Belgium have had the most LIFE projects targeting dune habitats. Per kilometre of coast, Belgium has had the most projects, using LIFE funding over the past quarter century to implement integrated coastal management and habitat restoration in almost all of its coastal Natura 2000 coastal sites.

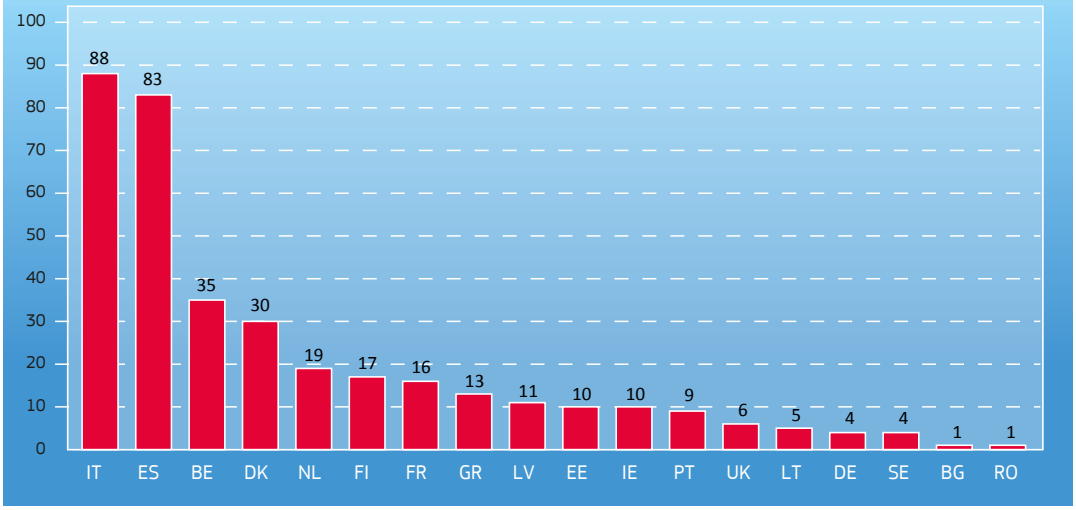
The most commonly-targeted dune habitats have been grey dunes, embryonic shifting dunes, white

1 Inland dunes habitats projects were not considered for this publication

LIFE projects are restoring coastal dune systems in an integrated way, such as by rebuilding the dune system in Valencia, Spain

Photo: LIFE04 NAT/E/000044/NEEMO EEIG/Ainhoa Darquistade

Figure 1: **LIFE dune habitat projects by Member State (1992-2015)**



dunes and humid dune slacks. A large number of mainly Mediterranean projects have also targeted coastal dunes with Juniper species. For inland dunes the most common habitat types are dunes with open *Corynephorus* and *Agrostis grasslands*, and dry sand heaths with *Calluna* and *Genista* (see Figure 2).

When analysed by biogeographic region, coastal dune projects can be seen to have mainly occurred in the Atlantic and Mediterranean regions (see Figure 3). These LIFE projects have been feeding their experiences on good practice for managing and restoring dune habitats into the Natura 2000 biogeographical process, for instance through a LIFE platform meeting in the Netherlands in 2016 (see pp. 56-57).

LIFE projects target coastal dune systems in an integrated way in order to benefit several habitats within a dune ecosystem at once and usually do not only focus on a specific coastal dune habitat and design

Figure 2: **Dune habitats targeted by LIFE projects (1992-2015)**

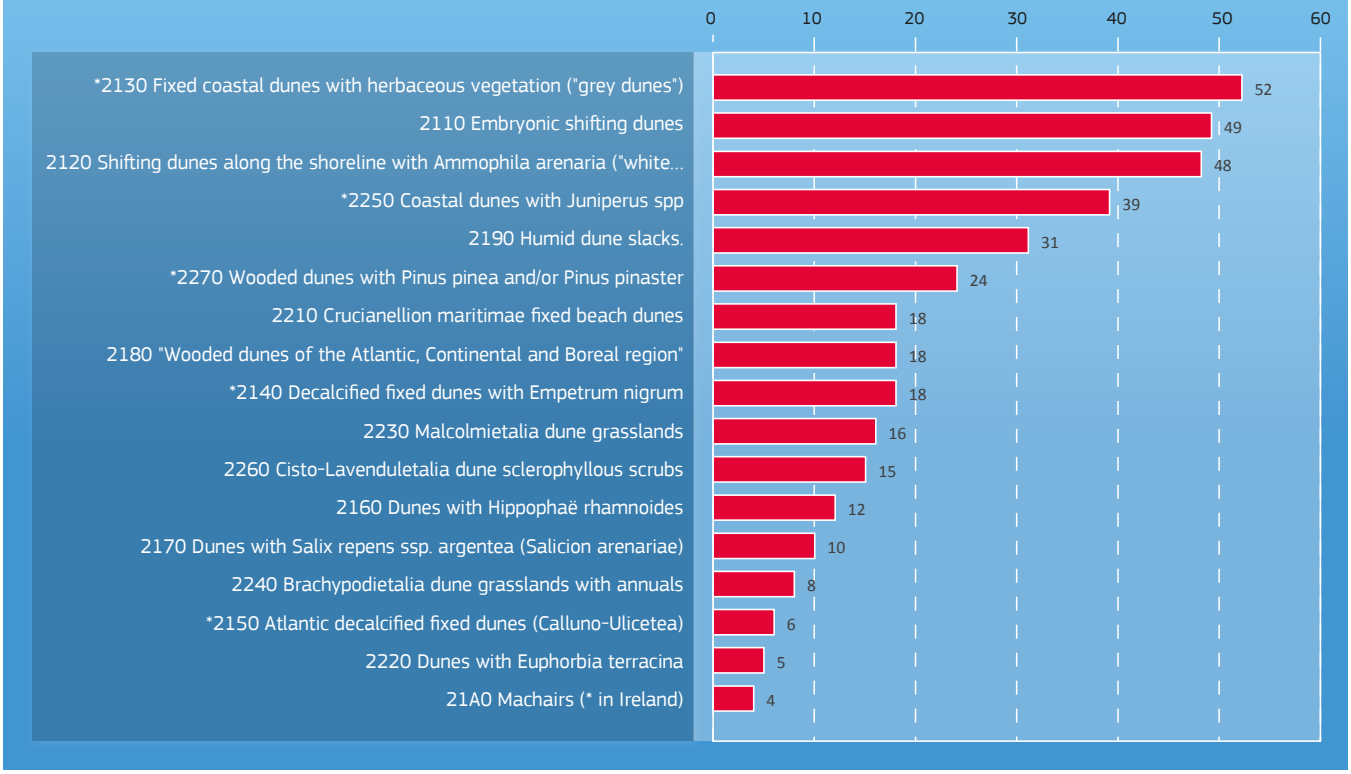
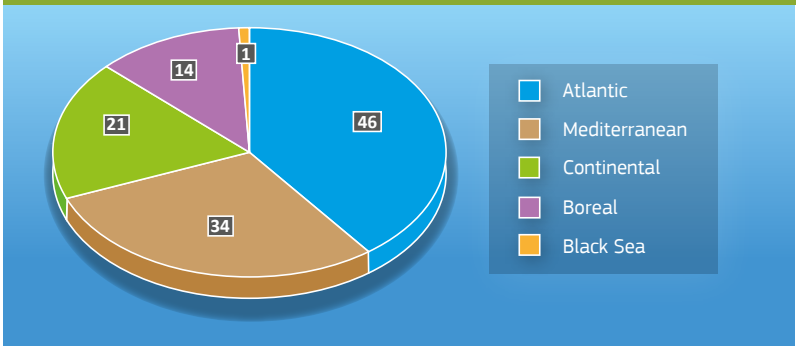


Figure 3: **Coastal dune LIFE projects by biogeographic region**



their actions with the aim of benefiting several habitats at the same time. Figure 4 shows the dune habitat gradient with the number of LIFE projects targeting habitats at each stage of the gradient.

Dune conservation actions

LIFE projects have implemented various best practice and demonstration actions in order to improve the conservation status of coastal dune habitats and manage coastal Natura 2000 sites. These projects are detailed in the following pages. Coastal dune actions can be summarised as the following:

- The restoration of dune areas following the removal of development infrastructure;
- Stabilisation of sand-drift using several different techniques, including less-intensive techniques where time and space allow (the dynamic approach);
- Innovative large-scale dune rejuvenation (reactivation of sand drift): e.g. coastal projects in The Netherlands;
- Re-building of damaged shifting dunes and fixed dunes;
- Land purchase of dune habitats at risk for restoration or management;
- Reducing the impact of recreation pressure through the introduction of visitor management and access control to dunes;
- Control of invasive alien plant species: e.g. Japanese rose (*Rosa rugosa*) and creeping pine (*Pinus mugo*);
- Raising awareness and changing attitudes among well-established stakeholders, such as forestry, agriculture, the armed forces and tourism operators;
- Ex-situ plant nurseries for dune habitat restoration (e.g. in northern Spain),
- Establishment of management and monitoring systems at Natura 2000 site level; and
- Working with local communities to raise awareness of the need for sustainable use of dunes.

Mediterranean dune habitats

Mediterranean dunes are less dynamic than Atlantic dunes, but in general they are more biodiverse. They form a complex mosaic of habitats endemic to the Mediterranean region, and are listed in Annex I of the Habitats Directive, for example dune *Juniperus* species, dunes with hard leaf evergreen scrubs and umbrella pine dunes.

Mediterranean dunes are under threat from several directions. Most damaging is their direct destruction by urban sprawl, accompanied by sand extraction and disturbance, all of which are linked to the explosion of mass tourism in Mediterranean countries. There are also other, more recent threats, such as the spread of invasive plant species (used

Figure 4: **Number of LIFE projects across the dune habitat gradient**

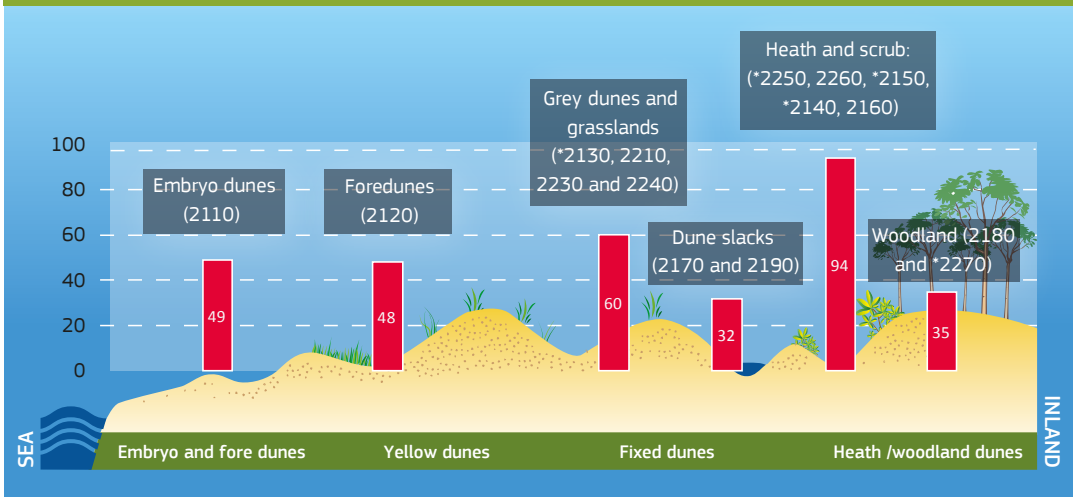


Photo: LIFE13 NAT/DK/001357/Karsten Frisk

Dune habitat actions include the controlled burning of overgrown vegetation (the result of nitrogen deposition) in Denmark

for stabilising shifting sands), and rising sea levels because of global warming. Consequently, Mediterranean dunes have been assessed in the latest Article 17 report as having 'unfavourable', 'bad' or 'inadequate' status.

More than 30 LIFE projects have targeted Mediterranean dunes habitats. In all cases, the main aim was the restoration and management of habitats that had been under pressure from human activities. Actions undertaken by the various projects have included restoration and re-vegetation of the dune chains. Work has been done to restore dune geomorphology and dynamics, and to stabilise dunes using a variety of means, such as planting native species that have been specially adapted to sand – for example, the Italian stone pine (*Pinus pinea*) – or installing artificial barriers. In other cases, dunes have been rehabilitated by controlling access to them, or by eradicating invasive alien plant species. Examples of Mediterranean dune projects can be seen below and on pages 34-37.

Recovering Italian dunes

The project LITORALE VENETO (**LIFE03 NAT/IT/000141**) greatly contributed to the knowledge and management of coastal habitats, producing sound and updated guidelines for dune intervention. It put into practice tools for minimising marine erosion and increased awareness among relevant authorities of this problem. In particular, the project had a positive impact on more than 200 ha of land and increased the size of the grey dune habitat in the project area within the Veneto region of Italy.

An ongoing project at Molise, on the Adriatic coast, is aiming to improve the conservation status of two dune habitats – coastal dunes with junipers, and wooded dunes with Italian stone pine (*Pinus pinea*) and/or maritime pine (*Pinus pinaster*). The MAESTRALE project (**LIFE10 NAT/IT/000262**) has also taken steps to control the spread of invasive alien species and to plant native species supplied by nurseries. Initial results from this off-site cultivation and replanting programme are promising.

Photo: LIFE03 NAT/IT/000141

DUNES

Juniper dune **recovery in the Mediterranean**

LIFE projects have combined established best practice with innovative approaches to help restore a priority for conservation habitat, coastal dunes with junipers.

The ecology of Mediterranean coastal dunes is influenced by extremes of weather. They are subject to higher temperature and humidity differences between seasons than Atlantic coastal dunes, with warmer, wet winters and hot, drier summers. Juniper species are highly adapted to this extreme environment and represent the late successional stage of Mediterranean dunes. Although widespread across the Mediterranean biogeographic region, this special habitat is not common.

Different juniper species make up the habitat in different locations across the bioregion, from Spain and Portugal to Cyprus (see box).

Juniper stands usually cover small areas and are closely associated with other dune habitat types, including dune grasslands and coastal heaths. As well as discrete stands, scattered individual plants can also be found within the fixed dune habitat type. Coastal dunes with *Juniperus* species are listed as a priority for conservation (code *2250) in Annex I of the Habitats Directive.

In general terms, such dunes are threatened across the EU by logging, urban sprawl, tourism development, fires, invasive species, erosion, grazing, fragmentation and pollution. A contributing factor to the habitat's plight is the restricted and slow natural regeneration of junipers. In the latest Article 17 report, the conservation status of coastal dunes with junipers was assessed as 'unfavourable-bad' across all three regions where it is found, with the condition deteriorating in the Mediterranean, largely as a result of urbanisation and tourism. Cyprus was the only country where it was found to be in a 'favourable' status.

Coastal dunes with junipers were assessed as having an 'unfavourable-bad' status

Photo: LIFE07 NAT/GR/000296/Remountou Ilektra

LIFE's contribution

Since 1992, 24 LIFE projects have directly or indirectly targeted coastal dunes with junipers, mostly in Spain or Italy (see Table 1).

These projects have largely focused on implementing concrete conservation actions designed to manage or restore the priority habitats. Management actions include the following: eradication or control of invasive plants; fire prevention; shrub clearance and controlled grazing; and control of tourism pressures and dune access, as well as long-term planning. Where projects have carried out habitat restoration, it has been by means of ex-situ (off-site) germplasm and germination; and planting of junipers and other native plant species.

In most cases, the LIFE projects that have targeted coastal dunes with junipers have not done so exclusively. Instead, actions have been part of an integrated approach that encompasses different habitat types in the dune systems. Thus, projects have carried out actions throughout the mosaic of dune habitats across different succession stages from the sea inland: from primary dune to dune slacks, grey dune and fixed dune. Projects have also set up actions to limit coastal erosion. The destruction of embryonic dunes or shifting dunes located close to the sea can have negative effects on the juniper habitat.

Under pressure in Greece

Coastal dunes with junipers are among the most attractive Mediterranean landscapes. But their aesthetic value has a price. Without adequate controls, pressures caused by tourism – wild camping, littering, forest fires – threatens their very existence. An effect compounded by the naturally-slow regeneration of juniper habitats.

Some 8.6% of coastal dunes with junipers in the Mediterranean biogeographic region are found in Greece. "Raising awareness of the uniqueness and fragility of these habitats is crucial to their survival," says George Kazakis of the Mediterranean Agronomic Institute of Chania (MAICh). Mr Kazakis was project manager of JUNICOAST (**LIFE07 NAT/GR/000296**), a LIFE project that focused on the conservation of coastal dunes with juniper species at four sites in Crete: Chryssi, Elafonissi, Falassarna and Gavdos.

Juniper species on coastal dunes

The following characteristic juniper species may be found on coastal dunes in the Mediterranean:

- *Juniperus oxycedrus* ssp. *macrocarpa* and *Juniperus phoenicea* in Portugal, Spain, France, Italy, Cyprus and Greece.
- *Juniperus phoenicea* ssp. *turbinata* (=*J. lycia, J. phoenicea* ssp. *lycia*) and J. navicularis (=*J. transtagana, J.oxycedrus* ssp. *transtagana*) in Portugal and Spain.

Photo: LIFE13 NAT/ES/000586/J. García de Lomas (CC-BY-NC-ND)

Table 1 – **LIFE projects targeting Mediterranean coastal dunes with junipers**

MS	Conservation status	Conservation status trend	% in region	LIFE projects targeting *2250 (1992-2015)	% of Member State bio-region habitat targeted by LIFE
CY	FV		0.7	0	0.0
ES	U1	Unknown	18.4	10	9.5
FR	U2	-	12,5	1	2
GR	U1	N/A	8.6	1	40
IT	U2	-	47.3	14	25
PT	U1	=	12.5	1	1

The first step was to gather data in order to assess abiotic and biotic factors that influence the habitat. This included information on the geomorphology of coastal dunes in Crete, the composition and structure of dune system plant communities and juniper populations, and the effects of human pressures on the ecological conditions of the habitat. "The knowledge base has been significantly increased thanks to the project," says Mr Kazakis.

This information enabled the project to design and implement appropriate actions to tackle the main natural and anthropogenic threats and to produce habitat protection and restoration guidelines and monitoring protocols to ensure a long-term impact. "As this habitat is next to the beach people use the area during tourist season: they cut branches, light barbecues, drop litter, walk across the dunes, etc." explains Dany Ghosn, science project officer at MAICh.

To address the negative impacts of tourism, the project fenced off the priority habitat, adding noticeboards to explain the reasons why, removed litter, and launched an information campaign to raise awareness. This included a code of conduct with simple but memorable messages for anyone spending time in or near coastal dunes with junipers: "Don't cut juniper tree branches... collect your rubbish... walk on established paths... avoid lighting fires ..."

The project directly addressed the conflict between wild campers and nature conservation. The methodology of multi-stakeholder consultation and participation was an innovative way to engage the users of the habitat, to raise awareness, and ultimately to change attitudes with respect to the conservation and sustainable management of coastal dunes.

This was particularly important for the island of Gavdos and to some extent also to Ierapetra and Elafonisi. These communities benefit financially from the beach-based and outdoor recreational activities of swimming and camping. The project's communication strategy highlighted the fact that the economic well-being of the local communities depends to a large extent on the conservation and sustainable management of the coastal dunes with junipers.

"We also implemented ex-situ conservation actions targeting the habitat," says Mr. Kazakis. This involved collecting seeds and cuttings of keystone plant species to provide live plant material for conservation and demonstration purposes (at the Botanical Garden of MAICh) as well as for the on-site enrichment and enhancement of natural populations.

The JUNICOAST team drafted protocols for seed collection, handling and storage, in line with international standards for preservation, with material being stored at MAICh's seed bank. It also produced protocols for germination, and seedling growth and outplanting. Some 200 saplings are kept at the agronomic institute's plant nursery for future habitat interventions.

According to Mr Ghosn, the ex-situ conservation work has had a noticeable impact at three sites: "There was a 35-40% increase in the number of junipers regenerated at Kedrodasos, a 25-30% increase at Agios Ioannis and an 8-10% increase at Sarakiniko." The project erected 70 small fences in the field to protect replanted and naturally-emerging young junipers.

Large-fruited juniper has been successfully planted in rebuilt dunes in Albufera, Valencia

Photo: LIFE04 NAT/ES/000044

Dune recovery across the Mediterranean

Two LIFE projects in Spain - (**LIFE00 NAT/E/007339**) and its follow-up Enebro Valencia (**LIFE04 NAT/ES/000044**) - carried out a range of habitat restoration actions across a wide area close to the city of Valencia where the dune system had been almost totally destroyed. Actions included the removal of unwanted paths, roads, car parks and sewage works, and the reconstruction of dune hills

and abrasion platforms as part of a programme of semi-fixed dune restoration.

Both projects sowed seeds of keystone species to help fix and repopulate the dunes. Junipers were planted to reinforce the local population. This was a success, with significant improvements in germination rates (rising from 7% to 50%). The action has had a positive impact on the juniper population in the dunes, and thus the habitat's ability to repopulate the area in the future. Data from the germination work helped the beneficiary to develop a predictive model, which is being used by habitat managers to identify the best vegetation for different target areas. This model helps to improve the survival chances of regenerating vegetation, and thus accelerates the recovery of habitat features.

LIFE Conhabit (**LIFE13 NAT/ES/000586**) is implementing actions to control the prickly pear (*Opuntia dillenii*) in juniper dune habitats in Andalusia. So far the project has been able to recover 16.3 ha of such habitats.

Another project that worked on the same habitat type, the Vendicari project (**LIFE02 NAT/IT/008533**) helped to halt the degradation of coastal dunes with junipers and improve the conservation status of the habitat along 3 km of coastline in south-east Sicily.

A number of LIFE projects in Sardinia have targeted coastal dunes with junipers. For instance, PROVIDUNE (**LIFE07 NAT/IT/000519**), which carried out restoration actions and ex-situ conservation of the botanical species of the dune habitat at the seed bank, Banca del Germoplasma della Sardegna. Two ongoing projects in Sardinia working to conserve this habitat are LIFE RES MARIS (**LIFE13 NAT/IT/000433**) and SOSS DUNES LIFE (**LIFE13 NAT/IT/001013**).

Conclusions

The combined impact of LIFE projects targeting coastal dunes with junipers is clear: they have made a major contribution to improving the conservation status of this habitat in the Mediterranean coastal Natura 2000 sites where the projects have taken place. The LIFE programme has established methodologies and shared best practices that will help to achieve the goals of the EU Biodiversity Strategy to 2020. However, the pressures on the dunes continue to build, and while projects have brought localised benefits, the conservation status for many habitats remains 'unfavourable-bad'.

Nevertheless, the featured LIFE projects are a good example of how to implement best practices which could be applied more widely across the biogeographic region, particular in terms of juniper germination and germplasm techniques. Future projects could be based on the useful data gathered by past projects, and on the tried and tested restoration techniques that have been shown to improve the status of these threatened habitats.

The large-fruited juniper (*Juniperus macrocarpa*)

The large-fruited juniper (*Juniperus macrocarpa*) is a dioecious species, that is, male and female flowers grow on different trees. Flowers bloom between February and March and produce cones, which usually contain three seeds that mature between September and October of the following year. The rooting system is deep and branched into an abundant and an extensive network of surface roots.

The large-fruited juniper grows in a pyramidal shape as a shrub or a tree or in a multi-trunk group of clones originating probably from a single parent tree. It is a long-living species which may exceed 400 years of age.

Although many seeds germinate, the survival rate of the seedlings is very low due to the effects of grazing, trampling and particularly due to adverse environmental conditions.

Photo: LIFE07 NAT/GR/000296/Remoundou Ilektra

DUNES

Restoring Flemish coastal dunes

Just 65 kilometres long, the Belgian coast is heavily developed. This severely degrades and disrupts the natural dynamics of its coastal habitats, including coastal dune systems. Successive LIFE projects, however, have formed part of a long-term plan to restore and protect these important systems.

Photo: LIFE06 NAT/B/000087/vildafoto/Yves Adams

Zwin coastal dune system restored by LIFE project actions

Urban and port development and tourism has led to the disappearance of more than 60% of Belgium's original coastal dune ecosystems. Many of those that remain are listed in Annex I of the Habitats Directive, but are often in an 'unfavourable' conservation status.

In 1996, the Flemish nature and forest agency (now called Natuur en Bos) secured co-funding from LIFE for a project to restore key coastal areas. The ICCI (Integrated Coastal Conservation Initiative - **LIFE96 NAT/B/003032**) was a ground-breaking project because it marked a policy shift away from intensive coastal tourism and exploitation in favour of actions to safeguard threatened coastal habitats and species and, where necessary, restore biotopes. The project demolished an abandoned naval base on the Yser estuary in order to restore tidal mudflats, salt marsh and coastal sand dune habitats. ICCI also kicked off the process of creating marine protected areas in Belgium.

The project implemented management plans for two nature reserves (De Westhoek and De Houtsaegerduinen in De Panne) and drafted a management plan for a third (Hannecartbos) that was implemented by the follow-up project FEYDRA (Fossil Estuary of the Yser Dunes Restoration Action - **LIFE02 NAT/B/008591**).

Photos: LIFE02 NAT/B/008591

The FEYDRA project demolished a defunct water treatment plant (left - before), resulting in a humid dune slack (right - after)

Among other conservation measures, the ICCI project cleared thickets and exotic tree plantations (poplars and pines) over an area of 32 ha to restore humid dune slacks and grey dunes. It also carried out soil removal and excavated 17 permanent pools for amphibians such as the natterjack toad (*Bufo calamita*) and the great crested newt (*Triturus cristatus*).

Another groundbreaking aspect of the Integrated Coastal Conservation Initiative was its use of land purchase to bring areas under the agency's control within the Natura 2000 network. Some 115 ha were acquired between 1997 and 2001, including 22 ha paid for by LIFE. The project was the catalyst for the Flemish government's creation in 1998 of an acquisition instrument for coastal dunes that is still in use today and which drives all dune restoration projects in Flanders, including LIFE projects.

The project also purchased Shetland and Konik ponies that, along with Highland cattle, donkeys and sheep, were set to work grazing a newly-fenced off area of 140 ha of dunes. Where grazing was insufficient, mowing was carried out. In turn, LIFE helped the beneficiary gain a better understanding of grazing in dune habitats through networking. The project participated in a seminar organised by the Sefton Coast LIFE-Nature project (**LIFE95 NAT/UK/000818**) and there were mutual site visits between the two – in fact, the decision to also use sheep to graze fragile dunes was taken based on the experiences of the UK project.

Finally, ICCI contributed to efforts to address the conflict between drinking water extraction from the phreatic water table beneath the dunes and dune conservation, by organising a symposium bringing together all parties involved and hosting a site visit for executives from the local water utility company.

The FEYDRA project

Launched in 2002, FEYDRA focused on the former western branch of the medieval Yser estuary that was dammed in the 14th Century creating an area of land known as Ter IJde and the Lens Polder. Ter IJde, including Hannecartbos at Oostduinkerke, along with the Groenendijk nature reserve at Nieuwpoort, made up the project site within the Natura 2000 network. At Groenendijk, the project restored 5 ha of humid dune slack grasslands and marshes by demolishing the town of Nieuwpoort's derelict water treatment plant and excavating the land. Since 2003, the land has been managed according to a regime of mowing followed by grazing. This has encouraged the growth of vegetation including orchids.

At the Hannecartbos reserve, restoration of a particular type of peaty old humid dune slack habitat was carried out, paying special attention to sedge vegetation that is a valuable habitat for the Desmoulin's whorl snail (*Vertigo moulinsiana*). To restore the original dune alkaline fen, the project removed 6 ha of dying alders and poplars, taking care not to apply too much pressure to the damp, boggy soil. The deforested area has been mowed since 2005 to allow flower-rich hay meadows to develop. The mowing is followed during the winter half year by grazing with Shetland ponies. In a similar physical environment, an old and peaty humid dune slack, another management regime consisted of quite intensive grazing and trampling by Konik horses. It has resulted in a short turf in which a large population of creeping marshwort (*Apium repens*) thrives.

To manage the water levels here and elsewhere in the Ter IJde dune system, two adjustable barrages were constructed on the Beek-zonder-Naam

("Brook-without-name"). The placing of barrages was preceded by the removal of nutrient-rich sludge deposits from the bottom of the brook in which formerly domestic wastewater from an adjacent residential area had been discharged, thus creating the right condition for stonewort vegetation to grow – an ideal habitat for the great crested newt (*Triturus cristatus*).

The management plan for the Ter IJde reserve focused on open dune restoration. An enclosed hectare of scrub land on the edge of the dune slacks was removed to counter the invasion of sea buckthorn (*Hippophaë rhamnoides*). To further develop the area for orchid dune slacks (0.5 ha on the western side), the project cut down a small birch and willow wood and a row of poplars. It also removed sea buckthorn and cut away an underlying layer of humus from 3 ha of dry dune slope to encourage the free movement of sand. Prevailing northwest winds, the agency hoped, would create blow outs evolving into dune slacks and horseshoe-shaped dunes around those dune slacks – though this action is curtailed by prevailing debris from demolished buildings and regrowth of European dewberry (*Rubus caesius*). To maintain the sand drift regular mechanical removal of debris and vegetation regrowth is needed.

Parallel to the LIFE project, in 2004 a concrete dyke between dunes and beach foreshore of the nature reserve De Westhoek was partially removed to allow the sea to penetrate depressions behind the fore dunes.

Areas of dune grassland recently purchased by LIFE in Oostvoorduinen-West being managed by mowing

Photo: LIFE12 NAT/BE/000631

Cross-border cooperation

LIFE has been instrumental in developing cooperation on coastal habitat management between the French and Belgian authorities. The Département du Nord, which manages the dunes owned by the French state, and the Conservatoire du Littoral et des Rivages Lacustres, which purchased dunes in France, are, together with the Flemish Agency for Nature and Forests, partners in the project, Life FLANDRE (**LIFE12 NAT/BE/000631**). "With this project, it is the first time we have cooperated on both sides of the border for a masterplan for the whole cross-border region," says Jean-Louis Herrier, the project manager. The project established an advisory board to supervise the drawing up of a cross-border management plan and a legal basis for cross-border cooperation for the management of the dune belt from Dunkirk to Westende.

At the Dune du Perroquet, in France, encroaching shrubs were removed to restore grey dunes and humid dune slacks. The French side is less fragmented by urbanisation than the Belgian side, and some natural dynamism has returned – but it is still limited owing to the continuing presence of old World War II bunkers and other human interference.

The project fixed mobile dunes on both sides of the border to protect campsites and other uses of the land. The stronger spatial fragmentation due to urbanisation of the dune belt on the Belgian side means there is stronger spatial fragmentation on the Belgian side of the border and consequently, "more widespread proliferation of invasive alien plant species in the Belgian dunes sites than in the French dunes sites," says Mr Herrier. Another threat to the dynamic dune ecosystem on both sides of the border is the rapidly increasing spontaneous fixation of the mobile white dunes by Marram grass (*Ammophila arenaria*) and sea buckthorn. The fixation of the dunes by the expansion of the vegetation has been accelerated since the mid-1990 by climate change, increased atmospheric nitrogen deposition and the decline of the rabbit population.

Water extraction has been a major cause of the degradation of habitats on the Belgian coast. The Life FLANDRE project enabled 2 ha of humid dune slack habitat to be restored and three ponds to be created as good aquatic habitats in the Oostvoorduinen. Further land acquisition for nature

conservation purposes has also taken place, and management plans are being drawn up for those areas purchased between 2005 and 2016. On the French side, the project expects to purchase more dunes and to create 10 ponds as well as optimise 3.6 ha of habitat for the narrow-mouthed whorl snail (*Vertigo angustior*). Here 54 ha of scrub will be removed and grazing management installed over a total of 30 ha to restore grey dunes and humid dune slacks.

Photo: LIFE06 NAT/B/000087/ANB

Ongoing dune grassland Natura 2000 site management is achieved by livestock grazing

Zwin estuary dune restoration

The Zwin estuary consists of a present-day tidal flood plain, coastal dunes and a large transition area between dunes and polders situated in a part of the estuary that was reclaimed in 1872. The remaining tidal floodplain and its tidal creeks, however, have filled with sand deposits, while dams have reduced the size of the estuary, adversely impacting on the tidal dynamics. The Flemish Agency for Nature and Forests has launched two LIFE projects in the Zwin estuary since the Flemish government purchased the area, which includes the 'Zwindunes and Zwinpolders' Natura 2000 network site, in 2002. As well as actions to restore salt marshes and mud flats (see pp. 29-33), the agency has mobilised LIFE funding to restore coastal dune habitats.

As part of the ZENO project (**LIFE06 NAT/B/000087**), it removed tree plantations and scrub to restore humid dune slacks and grey dune habitat. Topsoil was excavated and 17 ponds and a dune brook were cleared. An important achievement of the project was to restore strong populations of the European tree frog (*Hyla arborea*) and great crested newt that both had been locally nearly extinct.

The ZENO project team also removed inappropriate infrastructure (including concrete installations and 17 km of barbed wire), replacing it with more natural landscape features such as pools. This opened up the nature reserve's landscape so the course of the dune brook became visible once again. Ongoing site management has been achieved through the introduction of different types of grazing livestock breeds on 168 ha of the site. Mowing is also taking place using equipment purchased by the project.

In the central and eastern parts of the site (Kleyne Vlakte) the (artificially-levelled) topography has been changed drastically by local excavation of differentiated ponds, creeks, shallow depressions and the reconstruction of low dunes and heights. This facilitated wet habitats that can sustain the growth of rare plants and wetland animals.

Humid dune slacks are restored by removing topsoil

Photo: LIFE06 NAT/B/000087/ANB

DUNES

Atlantic Dune **conservation through LIFE**

Measures carried out by LIFE have shown how the conservation status of Atlantic dunes habitats can be improved.

The Atlantic biogeographic region is home to large dune systems along the Aquitaine Coast of the Bay of Biscay, the Dutch mainland, the Wadden Islands, and the west coast of Jutland. Nine types of dune habitat found exclusively in the Atlantic biogeographic region are listed in Annex I of the EU Habitats Directive. A further three protected habitats in the region are also common to the Mediterranean biogeographic region (e.g. coastal dunes with *Juniperus* spp., which are found in Denmark and the UK, as well as in the Mediterranean).

Since 1992, 244 LIFE projects have targeted dunes habitats in the Atlantic biogeographic region. Most of these implemented concrete conservation actions that aimed to improve the conservation status of mobile primary and fixed grey dunes habitats and inter-dune wet habitats ("dune slacks") – see Figure 1.

The Danish coastline bordering the North Sea is in fact famed for its long stretches of white sandy beaches and extensive dunes. Nevertheless, these dunes have suffered as a result of inappropriate land use and over-stabilisation, along with the large-scale invasion of alien species such as creeping pine (*Pinus mugo*), lodgepole pine (*Pinus contorta*) and Japanese rose (*Rosa rugosa*). The dunes stopped functioning as natural dynamic systems and became covered with non-original vegetation displacing fixed dune habitats, such as grey and decalcified dunes.

The Danish coast, however, is now benefiting from actions carried out under the LIFE programme, first through the Hulsig Heath LIFE project (**LIFE96 NAT/DK/003000**), then the Dune Habitats project (**LIFE02 NAT/DK/008584**) and now its follow-up project, REDCOHA-LIFE (**LIFE12 NAT/DK/001073**). The grey dunes and other habitats of Hulsig Heath at the tip of the Jutland peninsular were the focus of the earliest LIFE project (**LIFE96 NAT/DK/003000**). The grey dunes here had been invaded by conifer species, and the LIFE project cleared an area of 574 hectares to ensure a favourable conservation status of white and grey dunes along

Figure 1: **LIFE projects in Atlantic dune habitats**

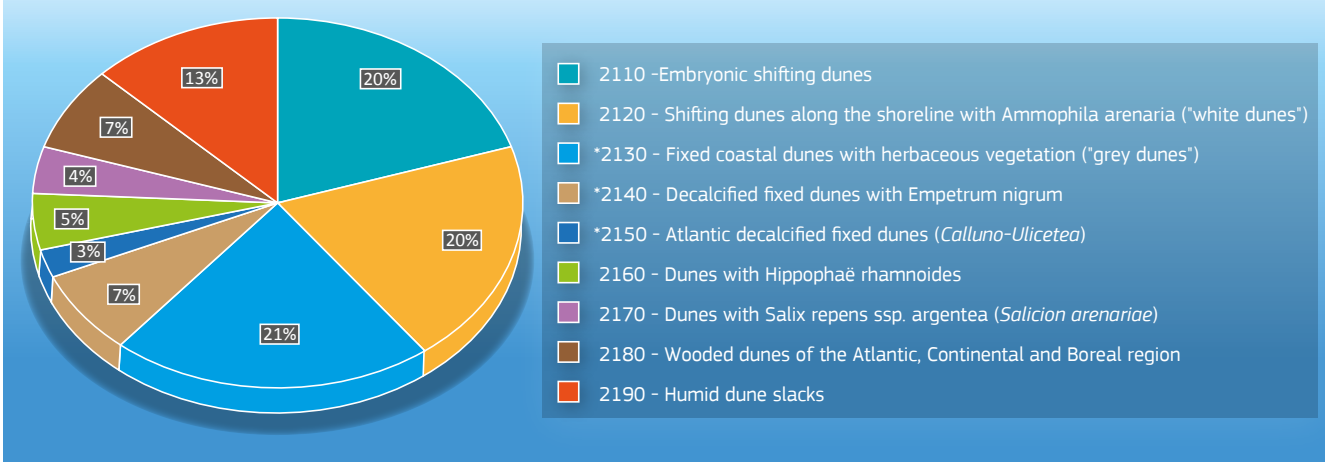


Photo: LIFE12 NAT/DK/001073

Allowing goats to graze can stop dunes becoming overgrown

with decalcified fixed dunes with *Empetrum nigrum*. Techniques used involved removal, burning and crushing.

The clearing measures were, however, more expensive than foreseen. Aerial photographs had been used to estimate the extent of the overgrowth, but on the ground it was found to be more widespread than expected. Furthermore, the project team found the work more time consuming than anticipated due to the difficult terrain and the wet weather they encountered. Nevertheless, the project served as a valuable 'pilot' initiative for the subsequent Dune Habitats project, which also set out to clear invasive vegetation and non-indigenous trees in order to encourage the restoration of dune heath habitats. The project was vast in scale, clearing 388 ha of plantations, 516 ha of dense overgrowth and 4 972 ha of encroaching trees.

It added grazing as a means of controlling overgrowth and moreover closed drainage trenches in three project sites to retain surface water in the area for longer in the summer and restore the natural hydrology. This raised the water table thus helping to keep the area clear of invading trees, while maintaining the natural dynamics and diversifying the dune heath habitats. The project methodologies moreover were extensively monitored and used to draw up Best Management Practice Guidelines that have been applied in other dune heath areas.

Tackling habitat fragmentation

Launched a decade later, the REDCOHA-LIFE project is addressing the ongoing threats to dune habitats along the 400 km western coastline of Denmark. The project is building on the earlier initiative by tackling such additional long-term threats as the fragmentation of habitats and loss of breeding and foraging areas for key animals. Though it is also addressing the problem of invasive plant species – it is targeting the removal of Scots lovage (*Ligusticum scothicum*) and seashore false bindweed (*Calystegia soldanella*) – the project is helping improve conditions for a range of fauna species such as the natterjack toad (*Bufo calamita*), sand lizard (*Lacerta agilis*) and wood sandpiper (*Tringa glareola*).

Again, the project targeted the cutting of a large tree plantation (105.56 ha) in order to develop fixed dunes and humid dune slacks habitats. Another key measure being employed is the fencing off of an area of 17 ha to allow different priority habitat types to develop. In line with the previous project, REDCOHA-LIFE is also aiming to improve

hydrological conditions in the area. The target was to improve and restore 51 areas as well as carry out feasibility studies on 529 ha and 5.5 km of watercourses.

The problem of the presence of the invasive species Japanese rose (*Rosa rugosa*), creeping pine (*Pinus mugo*) and Sitka spruce (*Picea sitchensis*) is also being tackled. The project is carrying out remote sensing in order to develop GIS maps of the location and distribution. Though occupying not much than one percent of the area, that is enough plants to cover 136.5 ha. One of the main objectives was thus to remove Japanese rose from 23 ha.

Restoring humid dunes

Humid dunes are an extremely rich habitat – subtypes range from dune-slack grasslands and pools to dune-slack pioneer swards and fens – but they are much threatened by lowering water levels, leading to their conservation status being declared 'unfavourable-bad' in the Atlantic bioregion, except in Denmark, Germany and the Netherlands where it is 'unfavourable-inadequate'. Among other places, they are found along the 30 km long coastline of Skagen Odde in northern Denmark, but this large headland has suffered from invasive plants, poor hydrological conditions and traffic disturbance. The REWETDUNE-LIFE project (**LIFE13 NAT/DK/001357**) is nevertheless tackling these threats, particularly with the aim of creating favourable conditions for the Eurasian bittern (*Botaurus stellaris*) and wood sandpiper (*Tringa glareola*). Its target is to restore the natural hydrological conditions by closing 44.1 km of ditches, leading to the improved status of an area of 1 137 ha. Mapping and clearing of Japanese rose and giant hogweed (*Heracleum mantegazzianum*) is being carried out, along with the removal of encroaching trees from an area of 1 000 ha.

Photo: Karsten Frisk

Also in the Atlantic bioregion, the Cantabrian coast of northern Spain is home to several priority sand dune habitats, including grey and white dunes and embryonic shifting dunes. Tourism and recreational activities are a particular threat to habitats in this area, along with a lack of knowledge of their conservation status. LIFE+ARCOS (**LIFE13 NAT/ES/000883**) was launched to improve the conservation status of 10 dune systems within 10 Natura 2000 network sites in Asturias, Cantabria and the Basque Country.

This ongoing LIFE project is aligned with the objectives and conservation priorities in the Prioritised Action Framework (PAF) for Natura 2000 in Spain. It will contribute to the conservation plans of the targeted Natura 2000 network sites with the goal of helping them to achieve a 'favourable' status for protected habitats and species.

As in Denmark, specific conservation actions involve the removal of invasive plant and tree species (in this case from a 120 ha area). In addition, the project is implementing several restoration actions targeting the recovery of flora native to fixed and primary dunes habitats. LIFE+ ARCOS aims to plant more than a half a million European beach grass (*Ammophila arenaria*) and sand-couch grass (*Elymus farctus*) plants to restore natural dune ecosystem dynamics to 50 ha of fixed coastal dunes with herbaceous vegetation (habitat type *2130) and at least 65 ha of shifting dunes along the shoreline (habitat type 2120).

The project team will also set up a seedbank for at least 28 native plant species to ensure their availability in restoration actions and define plant reproduction and germination protocols for at least 10 species that will be incorporated into the parallel ex-situ conservation project, 'Phoenix', as well as germination protocols for at least 15 rare or threatened species. Results will be published in the online database of the European Native Seed Conservation Network (ENSCONET).

In order to reduce and protect the target habitats from human disturbance the project will construct 5 000 m of wooden walkways and rope fences. Finally, LIFE+ ARCOS will deliver a monitoring plan for the conservation status of the restored sites. The project foresees that this plan will be applicable to the other dune systems in northern Spain and transferable to all the dune habitats in the Atlantic bioregion.

DUNES

Restoring and reviving Dutch coastal dunes

The LIFE programme is helping to improve the conservation status of Atlantic dunes in the Netherlands, changing perceptions of coastal management in the country.

Photo: LIFE09 NAT/NL/000418/Martin Wittelveldt

Reactivating blowing dunes (blow outs) restores dune dynamics and can lead to newly-created white dune (pictured)

The Netherlands is home to 10% of all EU coastal dunes. Although these are among the best preserved Atlantic dunes they face a number of threats including eutrophication and desiccation. Since 2005, LIFE has supported four Nature projects designed to restore some of the country's dune habitats to a 'favourable' conservation status.

The first of these was Dutch Coastal Dunes (**LIFE05 NAT/NL/000124**), an ambitious six-year project that carried out a set of related restoration measures on more than 4 700 ha of dunes covering eight Natura 2000 network sites along the length of the Dutch coast. This included restoration of some 1 550 ha of dune grasslands and heathlands through the removal of scrub and invasive non-native species, followed by extensive grazing. These actions have benefitted two priority dune types: 'fixed grey dunes' and 'decalcified fixed dunes with *Empetrum nigrum*', also known as 'white dunes'.

Another key action was the restoration of some 1 100 ha of wet and humid dune areas ("dune slacks"), primarily through the restoration of natural

Photos: LIFE05 NAT/NL/000124/Staatsbosbeheer

Before (left) and after (right) dune slack habitats were restored through returning natural hydrology, sod cutting and the removal of shrubs

hydrology, sod cutting and the removal of shrubs. On the Frisian Islands of Texel and Terschelling and at Hollands Duin and the Kop van Schouwen, the project removed trees and bushes from humid dune slacks to create more space for young vegetation and to make the landscape more open and varied.

While the dunes are still in an early stage of recovery, the initial signs give reason for optimism. On Texel, wet and moist pioneer communities (*Littorellion uniflorae and Nanocyperion flavescentis*) have been observed. On Terschelling, conservationists have noted the presence of 15 IUCN Dutch Red List species, including shoreweed (*Littorella uniflora*), round-leaved sundew (*Drosera rotundifolia*), bog myrtle (Myrica gale), lesser water-plantain (*Baldellia ranunculoides*) and yellow centaury (*Cicendia filiformis*). In rehydrated valleys on Vlieland, black bog-rush (*Schoenus nigricans*) and early marsh orchid (*Dactylorhiza incarnata*) were observed for the first time in decades.

From grey infrastructure to grey dunes

The Revitalising Noordduinen project, which ran from 2010 to 2013, took place primarily in a dune area of South Holland that was used for military training from 1881 to 2000. There the project demolished and removed abandoned buildings and other infrastructure to restore dune dynamics and recreate grey dune habitats. It also introduced measures to develop humid dune slacks by stopping desiccation and reconverting agricultural land, and removing the invasive alien species Japanese rose (*Rosa rugosa*) from some 4 ha of dune habitat.

Another important aspect of the project focused on making parts of the former military area accessible to the public, while diverting visitors away from ecologically-sensitive zones. This meant, among other things, removing an existing viewpoint that was poorly located in nature conservation terms and rebuilding a former military command tower next to a hiking and cycling path as a new observation point for visitors.

The project area was left for succession in a step-by-step approach that would allow spontaneous sand drift at the same time as preventing large drifts that could damage adjacent buildings and farmland. Drifting sand was identified as a problem early in the project and steps were taken to remedy this, including planting European marram grass (Ammophila arenaria), which stabilises dunes, and installing straw screens.

Opening the fore dunes

Through centuries of coastal protection structures and dykes and the recent atmospheric nitrogen-deposition, dunes had become overgrown and acidified at a rapid rate. Characteristic types of grey dunes

habitats (*2130) almost disappeared and the majority of white dunes (2120) were lost. Along the Dutch coast still more than 50% of the fore dunes are non-dynamic, so not allowing sand-sharing between beach and dunes.

The 2009 LIFE project Dutch dune revival (**LIFE09 NAT/NL/000418**) set out to enlarge and restore habitats and increase the presence of rare and characteristic species at three well-known Dutch dune complexes in the Natura 2000 network: Voornes Duin, Duinen Goeree and Kwade Hoek, and Kennemerland-Zuid. At all three sites, work involved removing scrub, forest and grassy vegetation in order to create good conditions for the development of species-rich grey dunes, white dunes and humid dune slacks. The project was indicative of a new approach to coastal management in the Netherlands that promises to boost dune dynamics and habitats and the ecosystem services they provide (see box).

Natura 2000 dunes safeguarding Amsterdam's drinking water

An ongoing LIFE Nature dune restoration project near Amsterdam also has ecosystem services at its heart. The Amsterdam Dune project (**LIFE11 NAT/NL/000776**) is led by the Waternet Foundation, the body responsible for the provision of water-related services for the municipality of Amsterdam, one of whose main tasks is the management of the Amersterdamse Waterleidingsduinen ("Amsterdam watersupply dunes"), a 3 400 ha area that is the main source of drinking water for the Dutch capital.

"This is a very important location for fresh water: the only location where we have good, fresh water in the western part of the Netherlands," explains Luc Geelen, a researcher with Waternet who is part of the team working on the LIFE project. It is also an area subject to significant recreational and tourist pressures.

Sea change in coastal defence

"We have changed our philosophy of how to manage the coast a little bit. Before we only paid attention to the fore dunes – when you have good fore dunes you have a good sea defence. Now we think in a broader, more systemic way," explains Marieke Kuipers from project partner PWN, the water company that is also responsible for dune management in Noord-Holland province.

At Kennemerland-Zuid, the project team, coordinated by Vereniging Natuurmonumenten, opened the fore dune barrier by removing old built structures and large amounts of sand (200 000 m^3) from fore dunes at five locations in order to reactivate blowing dunes (blow-outs) which are vital to maintain and improve the conservation status of white dunes (2120) and grey dunes habitats (*2130) and to create good conditions for the development of new humid dune slacks. The project opened five gigantic 100-150-metre wide holes in the fixed fore dune in order to once again give the wind free rein and allow the dunes to drift. By also setting five dune complexes further inland free on the wind, a large-scale, dynamic dune landscape has been created with characteristic habitats of white dunes, grey dunes and humid dune slacks. These restoration project actions are unique in the world.

Before the LIFE project, the fore dunes were effectively "a sand dyke", recalls Ms Kuipers. "The dune behind was completely green: there was no sand anymore because of nitrogen deposition."

For the Dutch dune revival project, "We wanted to make five notches about 100 m wide in the sand dyke. We wanted to get the wind going through them, tunnelling and taking the sand and the salt into the dunes. We also wanted to make more dynamic dunes in the hinterland - when the wind is moving fast through the notches and you mobilise those dunes, they will have more opportunity to grow and become active," says Ms Kuipers.

A researcher in the faculty of Geoscience at the University of Utrecht monitored the results using aerial photographs and laser scanning data. These revealed that there is 30% more wind in some places behind the notches and the dune body is growing more quickly than anticipated: "After three months we had a deposition which was quite spectacular; after three years we have a deposition wall which is 100 metres," explains Ms Kuipers.

"That's very interesting in terms of climate change - to know that if you make a hole in your fore dune, your dune is growing. That's very interesting for Holland," she adds.

Photo: LIFE09 NAT/NL/000418/Martin Wittelveldt

The dunes targeted by the project developed over several ages, with young dunes in the west (coastal side) and older dunes to the east. "This diversity means that we have a lot of habitats in our region - about 40% is open habitats with wide dunes on the dyke, some grasslands, heather and dune slacks. But also in the middle and inland dunes we have woodlands, shrubs and plantations of pine and black cherry (*Prunus serotina*)."

In order to restore characteristic and priority habitat types, the LIFE project has focused on actions targeting the effects of desiccation and eutrophication, such as the removal of the nitrogen-rich top layer of soil and the invasive black cherry, restoration of ponds and site management through mowing and grazing by sheep. In total, the work is expected to restore 350 ha of priority habitat types to a 'favourable' conservation status.

Preliminary results are positive. "We have changed the landscape significantly," reports Mr Geelen. "We found there were small shrubs that we never knew were there because of the black cherry trees...We made the inland dunes more open." However, the restoration work has not been without controversy. There were some protests about the removal of plantations: "Some people like trees and they don't like sand and they don't like industrial ways of managing clearing work. We have to organise knowledge exchange: the public has to know about dunes and that they are worth more than pines," he says.

Another challenge has been an explosion in the fallow deer population, which necessitates a cull, another management issue that required "a long period of political discussion" before it was approved, says Mr Geelen.

To help demonstrate the long-term benefits of its actions, the project has commissioned a student at Leiden University to map all the different ecosystem services delivered by the Amersterdamse Waterleidingsduinen. Mr Geelen says Waternet believes that removing black cherry and other overgrowth should ultimately benefit water production. The company currently adds 4% to the cost of water to cover its nature management obligations.

Conclusions

The experience of these innovative Dutch LIFE projects on coastal dunes is relevant throughout the Atlantic biogeographic region (see p. 51). The current Natura 2000 biogeographical process provides a means of transferring the knowledge the projects have gathered on improving conservation dune habitats. By carrying out restoration actions that fit within the framework of Natura 2000 network site management plans and an integrated coastal defence policy, these projects are excellent examples of a nature-based approach to coastal defence that is adaptive to climate change and capable of providing ecosystem services for millions of people.

Before (left) and after (right) scrub removal activities and the control of overgrowth by grazing on dune grasslands and slacks

Photos: LIFE11 NAT/NL/000776

DUNES

LIFE measures in **support of Boreal and Continental dunes**

Actions such as land acquisition, control of invasive species and grazing have been demonstrated by LIFE projects to be successful in protecting Boreal and Continental dune areas.

Photo: LIFE05 NAT/LT/000095

Removing pine overgrowth from grey dune habitats on the Lithuanian coast

Many of the dune habitats found in the Boreal and Continental bioregions are EU priority habitats. Annex I of the Habitats Directive lists a range of different coastal sea dunes of the Atlantic, North Sea and Baltic coasts – from embryonic shifting dunes and grey dunes to wooded dunes and humid dune slacks. All are threatened by a similar set of problems: coastal erosion, invasive plant vegetation, changes in land use and human interference.

Boreal LIFE

The Boreal biogeographic region includes Estonia, Finland, Latvia, Lithuania and most of Sweden. This region includes the highest drifting sand dunes in Europe, which are found on the Curonian Spit on the Lithuanian coast. Erosion is threating these dunes, so LIFE backed the LITCOAST project (**LIFE05 NAT/LT/000095**), which was set up to reinforce vulnerable dunes along a 20 km strip, covering an area of 300 000 m^2. In total, the project restored around 1 600 ha of shore habitats, including coastal grasslands and dunes. These included several priority habitats:

- Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes);
- Fixed coastal dunes with herbaceous vegetation (grey dunes);
- Decalcified fixed dunes with *Empetrum nigrum*; and
- Dunes with *Salix repens ssp. argentea* (*Salicion arenariae*).

The LITCOAST team implemented measures that have proven successful in a range of restoration initiatives, namely constructing wooden pathways

and steps to lessen the impact of visitors and reintroducing grazing (in this case with sheep) to control plant growth.

In neighbouring Latvia, the government has made almost half of the coastline part of a national park or nature reserve. Nevertheless, the country's grey, white and wooded dunes are under pressure from continued coastal development and tourism. The LIFE project LV coastal habitats (**LIFE02 NAT/LV/008498**) created demonstration sites to show how measures such as new paths for tourists and the return of grazing can help protect these habitats. In this way, coastal municipalities and landowners were able to learn about sustainable coastal management through the project. Another key aspect of the project was the digital mapping of the habitats and distribution of these maps to stakeholders to ensure that conservation aims are considered in future development plans.

Military cooperation

Dune restoration on the Finnish coast has focused mostly on the Vattaja Military Area, which is almost completely enclosed by a 1 200 ha Natura 2000 site. In fact, the area is now managed by Metsähallitus, the Finnish Administration of Forests and the beneficiary of two LIFE projects that have targeted the protection of boreal dune habitats.

Military personnel were directly involved in the project's dune restoration actions, such as removing pines to prevent regrowth

Photo: LIFE03 NAT/FIN/000104/Marko Sievänen

The site is home to key habitats, accounting for more than one third of Finland's grey dunes. It is moreover the largest boreal dune area in Europe. These dunes host crowberry (*Empetrum nigrum*), willow (*Salix repens*) and the endemic Baltic rush (*Juncus balticus*). A wide area of sandbanks is found in front of the dunes, the highest of which are more than 15 m high. But these habitats are constantly changing due to land upheaval – around 8-9 mm per year.

The southern part of the site consists of wide bays and lush coastal meadows, while several small ponds and wetlands are fixed behind the dunes, representing the flada (narrow inlets) and gloe lake development stage of coastal land upheaval. Shortly after taking over management of the area, Metsähallitus launched the project Vattajan dyyni LIFE (**LIFE05 NAT/FIN/000104**) in 2005. One of the aims was to ensure that military use of the land did not harm the administration's conservation efforts.

Success therefore depended on establishing a good relationship and understanding with the military in order to ensure that training exercises did not take place in nature-sensitive areas. The solution was to draft a management and restoration plan for the whole area that clearly identified areas to avoid. In support of the plan, the Finnish army installed signs and warning poles to limit access to the dunes. As a result, military use of priority sand dune habitats decreased by 90% and by at least 50% for other habitats.

Thanks to the project, the code of conduct for training exercises incorporated new nature conservation guidelines. Military personnel were also directly involved in many of the project's restoration actions, helping to clear 15.4 ha of wooded pastures and 8.5 ha of coastal meadows and to remove stumps and young pines from 70 ha. One of the major problems affecting the habitats had been the decline in grazing and the increase of wooded pine areas. EU agri-schemes are available to incentivise farmers to adopt sheep grazing on the dunes to thin out vegetation and maintain the different dune types occurring in the area. Nevertheless, uptake has been limited and some areas previously used by the military are not considered desirable.

Another issue is that sheep do not remove unwanted pine saplings and many have recurred on dune habitats following the project. Päivi Virnes of

Metsähallitus says that the project may have been too effective in controlling erosion. "I don't think that stopping all the erosion and removing all the vegetation is good for this habitat...but it's difficult to assess in advance what the right amount of erosion might be," she says.

She suggests that creating more open sand banks would restore the natural dynamic of the land and reduce the need for manual control of vegetation. Pollution might also be a factor contributing to the return of pine saplings in cleared areas. Recent research has shown that nitrates that drain into the sea can return inland as nitrogen deposition; they thus increase the fertility of the dunes and the survival rates of the pine saplings. Metsähallitus is also considering ways that the military might be of further use. "Many things that you think might be bad for the habitat can actually be quite useful like trampling [down vegetation] with army vehicles," says Ms Virnes.

In non-military areas, the project helped owners of summer cottages and cabins to relocate by offering the opportunity to build on land in a less sensitive area. It also built boardwalks to limit damage to the dunes caused by visitors to the sandy beach at Ohtakari. Here too, however, pine saplings have returned. Clearly, there needs to be a trade-off, as the Finnish authorities recognise: "We could have left some area open to create drifts. Atlantic dune restoration has opened the landscape up more radically and that's something that we could do," says Ms Virnes.

She is working on the ongoing project Light & Fire (**LIFE13 NAT/FI/000099**), which is building on the lessons of the earlier LIFE project. This habitat restoration project is also targeting some coastal areas, namely around 6.6 ha of Baltic sandy beaches (five sites). The plan to remove invasive alien species is thus attempting to strike a balance between combating coastal erosion and the desire to produce sustainable results.

Removing IAS from Continental dunes

The Continental biogeographic region includes mainland Europe as well as southern parts of Sweden. Coastal dunes in the Continental and Boreal regions face a common problem: the spread of invasive alien species (IAS) following the loss of traditional grazing. Coastal areas along the Jutland peninsula in northern Denmark have been particularly affected. Among other aims, the LIFE LÆSØ project (**LIFE11 NAT/DK/000893**) was launched to control Japanese rose (Rosa rugosa), cord grass (Spartina anglica) and such exotic tree species as the dwarf mountain-pine (Pinus mugo), lodgepole pine (*Pinus contorta*), Sitka spruce (*Picea sitchensis*), and black cherry (*Prunus serotina*). Shrub removal and clearing activities are expected to improve the breeding success of the priority bird species that visit the project sites, such asdunlin (*Calidris alpina schinzii*) and avocet (*Recurvirostra avosetta*). The project is moreover attempting to prevent non-native species recolonising target sites by removing them from neighbouring areas as well.

Photo: LIFE11 NAT/DK/000893/Danish Nature Agency

Control of the invasive alien plant species, Japanese rose (Rosa rugosa)

Finally, across the water in Skåne, southern Sweden, the abandonment of sandy coastal areas has led to them becoming overgrown with invasive plants and trees. Here too, the aim is to clear woodlands and create bare sand areas, removing Japanese rose and managing heather. The Sand LIFE project (**LIFE11 NAT/SE/000849**) is carrying out restoration to achieve a mosaic of habitat types and thus boost biodiversity in the area. Moreover, the project is experimenting with controlled burning – first creating firebreaks – to achieve a 'favourable' conservation status for the habitats.

DUNES

Sharing knowledge of sand dune restoration

A LIFE Platform Meeting brought together sand dune restoration experts to share their experiences as part of the Natura 2000 biogeographical process.

Photo: LIFE09 NAT/NL/000418/Martin Wittelveldt

A Dutch LIFE project that carried out innovative reactivation of large dune dynamics shares its knowledge on a field trip at the LIFE platform meeting in Zandvoort

The LIFE platform meeting on coastal and inland dune restoration took place in Zandvoort, the Netherlands, in June 2016. The meeting, which brought together sand dune restoration projects from across Europe, helped to reinforce the conclusions of an earlier meeting, *Dynamic Dunes 2015*. These are as follows:

- That concerted efforts are needed to achieve the target of 'favourable' conservation status;
- That dunes should be higher on the European research agenda; and
- That project experience should be widely disseminated.

The meeting highlighted the need to recognise the impact of issues such as agricultural development, nitrogen deposition and ecosystem services.

Building better networks

The main theme to come out of the platform meeting was the value of networking and the need to better resource the 'engine rooms' which can make this happen. The development of a European Dune Network has been promoted by the Coastal & Marine Union-EUCC and, most recently, has been supported by the UK Sand Dune and Shingle Network. Following the meeting in Zandvoort, representatives from Denmark, the Netherlands and Germany, among others, expressed an interest in keeping such a network alive by encouraging networking and linking science and management.

A networking roadmap and calendar will be prepared as a contribution to the Natura 2000 biogeographical

process. The meeting gave opportunities to discuss strengthening links between Atlantic, Boreal and Continental initiatives, to promote cross-border projects or exchanges between Member States, to consider further exchange of coastal and inland experience and to identify research themes. In the gaps between large events such as Littoral 2017 in Liverpool and the international conference of the LIFE FLANDRE project in May-June 2018, there should be national and regional networking activity, project workshops and scientific seminars. It is hoped that the sharing of knowledge, within and between disciplines can be improved through a re-invigorated European Dune Network.

Project experiences

The platform meeting gave an opportunity for projects to present aspects of their work of wider relevance to policy or practice.

Project presentations addressed several themes:

- Control of invasive alien plant species: e.g. Japanese rose (*Rosa rugosa*) in Denmark, black cherry (*Prunus serotina*) in The Netherlands;
- Restoration of natural dynamics and bare sand in inland dunes: e.g. examples in Belgium, Poland and the Netherlands;
- Cross border projects: e.g. coastal projects in Belgium and France and inland projects between the Netherlands and Belgium;
- Large-scale dune rejuvenation: e.g. coastal projects in the Netherlands;
- Habitat restoration and management: e.g. projects in Sweden, Finland, Belgium and the Netherlands;
- Public attitudes to dune restoration actions such as removal of trees and reactivation of sand drift: e.g. projects in Sweden, the Netherlands and Belgium; and
- Communication with the public on the need to control invasive species and restoration actions. Other subjects covered included ex-situ plant nurseries for habitat restoration (featuring an example from northern Spain), the development of guidelines for management (Latvia) and national programmes for sand dune restoration (UK).

New opportunities

The meeting confirmed a number of opportunities.

1. Continue to engage with the biogeographical seminar process
   Inland dune habitats have not been so visible in the biogeographical process. Further networking between inland dune projects will help to raise the profile of these habitats.
2. Ensure that dune restoration and management is highlighted in the Prioritised Action Frameworks (PAFs)
   Practitioners should check whether their relevant PAFs are addressing the needs of dune habitat restoration. The Swedish PAF was recognised as an example of good practice for coastal and inland dunes.
3. Secure national and regional funding for conservation work.
4. Develop the European Dune Network - feedback from the meeting indicated that a coastal dune network is required and that a combined coastal/inland network would be too broad in its scope. Nevertheless, the Zandvoort meeting showed that there was much in common between the two.
   While LIFE is providing valuable support for dune restoration projects, it should be seen in the context of other regional, national and EU funds. LIFE at its best acts as a catalyst to help draw in other funds and can only ever be part of a wider programme.

Further opportunities include developing an international scientific programme and making use of the Natura 2000 Communication Platform, as well as continuing to submit applications to the LIFE programme.

Learning about the Amsterdam Dune project during the dunes platform meeting

Photo: NEEMO EEIG/Justin Toland

COASTAL GRASSLANDS AND MEADOWS

Biodiversity importance of machair

Actions of two LIFE projects are helping to secure the conservation value of machair, a rare and distinct type of coastal grassland habitat that is unique to western Scotland and Ireland.

Machair is an extremely rare coastal dune grassland habitat type that is found only in the Atlantic biogeographic region: on the western coasts of Scotland and Ireland over a total area in the EU of only around 19 000 hectares, with 70% of this occurring in western Scotland, mostly on the offshore islands and the remainder in western Ireland. The conservation status is 'unfavourable-bad', due to "structure and functions" and "future prospects" resulting from current agricultural practices. Range and area of habitat are favourable for the region, although its area is declining in Ireland, where it has priority status for conservation according to the Habitats Directive.

Seaweed kelp is spread as fertiliser on machair plots (top) and traditional reaper binder (bottom)

Photos: LIFE08 NAT/UK/000204

Formed by calcium-rich sand being blown onto acidic soil, machair (see box) has been keenly influenced by land management practices among the traditional crofting and farming communities, with extensive grazing regimes and low-intensity systems of rotational cropping. The machair landscape supports large populations of breeding birds and is particularly important for waders, such as dunlin (*Calidris alpina schinzii*); while also providing suitable habitat for a range of other species in Annex I of the EU Birds Directive such as the corncrake (*Crex crex*) and chough (*Pyrrhocorax pyrrhocorax*). A number of rare plant species are also associated with this habitat.

Intensive farming shift

In recent years, however, there has been a shift towards more intensive agriculture, with greater use of artificial fertilisers and pesticides, which threaten the condition of this unique habitat. The areas where machair are found also face problems of de-population, with people leaving farming to seek employment opportunities away from the rural community.

Two projects have received LIFE programme support to carry out specific actions favouring the habitat type and associated fauna and flora populations. The Scottish machair project (**LIFE08 NAT/UK/000204**) ran from January 2010 to March 2014, targeting machair and birdlife on the Hebridean Islands. A second project, LIFE Aran (**LIFE12 NAT/IE/000995**) is currently being carried out on

the Aran Islands – aiming for improvements in the conservation status of machair (priority) habitats, alongside two other Annex I habitat types.

The Scottish project, managed by the Royal Society for the Protection of Birds (RSPB), worked closely with local communities to show that traditional crofting practices (excellent examples of High Nature Value Farming) have a sustainable future. The project specifically focussed on improving the condition of approximately 3 500 ha of machair habitat – 70% of the UK total coverage – mostly on the Uists (islands in the Outer Hebrides).

Under the crofting systems, machair has been traditionally cropped with oats, barley, rye and grass to produce feed for cattle and sheep stock. Since the cropped land is left fallow for two to three years, it allows for the growth of annual and perennial plants that attract seed-eating birds, for example corncrakes, as well as nectar-loving insects. It also provides key nesting and feed sites for migratory wading birds.

However, changes in local agricultural practices have occurred that are now threatening the condition of the habitat and associated wildlife. The ability of crofters to maintain traditional practices is also increasingly under pressure. Contributing factors include loss of manpower to harvest and stack crops by reaper binder, and an increase in the greylag goose population, which causes damage to crops.

Working with crofters

The Scottish machair project was therefore organised to assist crofters in retaining their traditional practices – examples are the use of seaweed as fertiliser and of very shallow cultivation – in support of the machair's high diversity; while still maintaining viable crops for stock. Important objectives included: expanding the area of late harvested crop on arable machair; reducing the area of under-sown arable crop; introducing best practice arable crop production; and identifying and tackling constraints to active management. The project's remit also extended to monitoring key biodiversity affected by these changes.

The project achieved its main goals and in many cases far exceeded its own expectations. Site condition monitoring showed improved status on sites where actions were carried out. Detailed results of these studies, for example, indicate that maintaining traditional cropping patterns on the machair using crop-fallow rotations creates a small-scale habitat mosaic that maintains species of high nature-conservation value. Importantly, data collated over the project lifetime has helped to inform the new round of the Scottish Rural Development Programme (SRDP), and will continue to influence long-term agricultural policy and its effect on wildlife.

Conservationists in Ireland are drawing on the lessons of this project for the ongoing project, LIFE Aran, currently taking place in three Natura 2000 network sites on the Aran Islands, which are known for a range of intact priority habitats, including machair.

As with the Scottish project, the principal land use is low-intensity farming, which, combined with the minimal use of fertiliser, has helped to maintain the species-richness and high diversity of the islands' flora. Again, the economics of this farming system are under threat resulting in a serious decline in the condition of the machair. Among other targets – and working closely with local farmers – the project aims to develop and demonstrate best conservation management practices to improve the conservation status of 29 ha of machair.

What is machair?

Machair is generated by an exceptional blend of physical factors, including climate, substrate and topography, combined with longstanding human influences. It forms when sand with very high shell content blows landwards by prevailing westerly winds, creating a fertile, low-lying plain. For generations, man has worked and moulded machair in a low-intensity crofting system that has created a mosaic of open habitats. Working the machair is a huge part of Gaelic culture.

Source: Layman's report LIFE08 NAT/UK/000204 "Wildlife and the machair"

Photos: LIFE08 NAT/UK/000204

COASTAL GRASSLANDS AND MEADOWS

Preserving Boreal coastal meadows

Networking and inter-regional sharing of best practices is encouraging the adoption of land management practices favouring areas of rapidly declining Boreal Baltic coastal meadows.

Photo: LIFE00 NAT/EE/007083/Riit Kaljuste

Restored coastal meadow on Matsalu Island, Estonia

Boreal Baltic coastal meadows are priority for conservation habitat types, listed in Annex I of the EU Habitats Directive, that are found along the shores of the Baltic Sea in both the Boreal and Continental biogeographic regions. These habitats have suffered from destruction and degradation linked to inappropriate land use and abandonment of traditional agricultural practices such as mowing, reed cutting and grazing by cattle, sheep and horses. Their conservation status is assessed as 'unfavourable-bad' for both regions.

The re-establishment of traditional land management practices, however, could reverse the trend of decline and also help conserve rare birds, plants and amphibians that are dependent on the maintenance of the open character of the habitats. Examples are the lesser white-fronted goose (Anser erythropus), corncrake (*Crex crex*) and natterjack toad (*Bufo calamita*).

Estonian coastal meadow preservation

In Estonia, the estimated total area of Boreal coastal meadows has plummeted from 29 000 ha in the 1960s to around 5 100 ha today.

Responding to the drastic decline, the Estonian Ministry of the Environment initiated an ambitious

LIFE project, EE Coastal Meadows (**LIFE00 NAT/EE/007083**), to preserve 30% of the country's remaining Boreal coastal meadow areas (some 1 261 ha in total). Covering 16 sites, this included 1 191 ha for grazing and just over 70 ha for mowing. Preliminary actions involved arranging the signing of contractual and management agreements with landowners, and the purchase of cattle and sheep in order to secure a suitable number of grazing animals.

As interest in maintaining these semi-natural grasslands grew, the project was able to provide farmers with the livestock they needed. This enabled the project to bring 1 675 ha of coastal meadows under management, some 414 ha more than anticipated. A pilot compensation system introduced for farmers became increasingly popular over the course of the project. Since the end of the project in 2004, Estonia has introduced payments for the same kind of management measures under its national agri-environment schemes. These schemes are considered crucial to ensure the long-term success of the activities started under the project. Additionally, in order to share their experiences, the LIFE project team produced best practice guidelines for the management of the habitats and networked with other projects in Estonia, Finland and Sweden.

Continuing this work, another Estonian LIFE project, Silma (**LIFE03 NAT/EE/000181**) adopted a habitat-based approach over a large area (Silma Natural Park) and two coastal island sites. The project took actions to improve over 1 000 ha of coastal meadows, alongside several other valuable coastal habitat types that have been experiencing similar threats and declining at an accelerating rate.

Prior to the project, some work had already begun to engage local communities and re-establish livestock grazing on the wet meadows. This was continued and extended by the Silma team. The project also purchased livestock and machinery to help farmers re-instate suitable levels of mowing and grazing. This was funded through an annual management fee. Initial works involved the removal of the build-up of reed growth and scrub, and re-excavation of overgrown lagoons and shallow meadow depressions.

Coastal meadow management on sites with high numbers of visitors is a major challenge, and possibly due to lack of funds, it is also an area that has not been properly addressed to date. A new Estonian LIFE project, however, aims to change this, targeting conservation improvements (including for 50 ha of coastal meadows) in the popular coastal resort of Pärnu. Every summer, the city's population of 45 000 is bolstered by half a million visitors.

Launched in 2012, URBANCOWS (**LIFE10 NAT/EE/000107**) implemented restoration activities that included clearing vegetation (reed and brushwood), encouraging grazing by, for instance, creating fenced-off areas, and providing other necessary infrastructure such as public access to Pärnu Beach. The project also worked to raise awareness of the ecological and recreational importance of the city's nature reserve, by establishing visitor trails, observation platforms and information boards.

Changing land use and extensive drainage on Öland (an island off the east coast of Sweden) was a threat to the priority coastal meadows and other protected coastal habitats, to the extent that ranges had shrunk drastically, or even disappeared under a thick blanket of invading scrub. To address these challenges, the Öland project (**LIFE00 NAT/S/007117**) cleared some 1 000 ha of scrubland. A further 3 500 ha was financed under agri-environmental payments. This paved the way for improvements to a number of targeted habitats, including the restoration of 78 ha of priority coastal meadows. The project also led

URBANCOWS encouraged grazing in order to restore Baltic coastal meadows

PHoto: LIFE10 NAT/EE/000107

to positive impacts for various bird species whose populations had fallen. By raising awareness among the farming community, the project contributed to 38 farmers joining agri-environmental schemes.

Gulf of Finland

Another very successful LIFE project is Gulf of Finland (**LIFE03 NAT/FIN/000039**). This targeted the management of bird-rich wetlands (including coastal meadows) in 12 sites along the northern coast of the Gulf of Finland migratory flyway. The overall objective of the project (a Best of the Best LIFE project winner in 2007-2008) was to establish a functional network of Natura 2000 network coastal areas, and thus to secure a 'favourable' conservation status for a host of valuable species listed in the nature directives.

Removal of reedbeds from coastal meadows in Finland

Photo: LIFE03 NAT/FIN/000039

Important migratory bird species such as whooper swan (*Cygnus cygnus*) and whistling swan (C. columbianus) use these coastal areas for resting stops. Among the breeding species are corncrake and great bittern (*Botaurus stellaris*). These areas are also important for many protected plant and insect species.

The project reached all its targets. It drafted management plans for the project areas (totalling 3 353 ha) and carried out a number of restoration works. These included clearing trees and bushes from 87 ha and removing 185 ha of reedbeds from coastal meadows. After the project restarted grazing, the coordinating beneficiary secured the long-term management of the wet pastures through agri-environmental support agreements with local farmers.

Swedish archipelagos

Sweden's archipelagos are areas of very high nature conservation value, but because they are hard to reach, they were also the first areas to be abandoned when traditional farming became less profitable. As a consequence many habitats have become overgrown, which also threatens many associated rare species.

Another noteworthy project for coastal meadows of the Boreal and Continental regions is GRACE (**LIFE09 NAT/SE/000345**). This recently completed LIFE project set out to improve the conservation status of a host of semi-natural habitat types and associated species in Sweden's archipelagos. Encompassing 23 Natura 2000 sites spread across four counties, concrete management actions took place over a total of more than 1 800 ha. These works include clearance of trees and bushes, controlled burning, and the establishment of grazing. Many of the islands are of great importance for recreation so clearance of overgrown areas is also expected to result in increased accessibility for visitors. Participation of local farming communities in the habitat conservation work is expected to help secure 'favourable' conservation conditions for all the target habitats in the long term.

REEFS AND SEAGRASS MEADOWS

LIFE supports reef mapping and conservation solutions

Four LIFE projects have focused on mapping reef ecosystems under serious threat and finding solutions to restore these hotspots of biodiversity.

Reefs are among the oldest ecosystems on earth, and are not only hotspots for biodiversity, but also provide countless services and economic benefits to local communities. Yet reefs worldwide are in crisis. Over the last few decades, global stressors related to climate change have been recognised as a significant threat to reef ecosystems. This combined with local issues such as coastal development, overfishing and inland pollution has resulted in declining reef communities worldwide.

Coastal reef habitat (1170) is present in five of the EU's marine biogeographic regions (Atlantic, Baltic Sea, Black Sea, Mediterranean and Macaronesian). In the most recent Article 17 report, the habitat was found to be in a 'favourable' condition only in the marine Macaronesian region; it was assessed as 'unfavourable-inadequate' in the Marine Baltic region and 'unfavourable-bad' in the Atlantic region. The status of coastal reef habitat was unknown in the Mediterranean and Baltic Sea.

In the European Union, LIFE projects are making an important contribution to alleviating these threats, focusing in particular on the development and implementation of integrated management plans that seek to reconcile conservation with human activities, as well as on the mapping and restoration of damaged sites.

Reef restoration

Stone reefs are found in the ocean and developed during the ice Age. They rise from the surrounding seabed and vary in size and compactness. The most spectacular type of stone reefs are cavernous boulder reefs, which consist of large piles of similar-sized boulders. The BLUEREEF (**LIFE06 NAT/DK/000159**) project aimed to restore the cavernous boulder reef offshore habitat in the Kattegat, the narrow straits to the east of Jutland, to a 'favourable' conservation status. Denmark assessed its coastal reefs as being in an 'unfavourable-bad' condition in the most recent Habitats Directive Article 17 report.

Photo: LIFE07 NAT/FIN/000151/Parks & Wildlife Finland/Mats Westerboom

LIFE has made a crucial contribution to the mapping of reef habitats and the designation of marine and coastal Natura 2000 network sites

Photos: LIFE06 NAT/UK/000159/Aarhus University

Bare boulders placed at the bottom of the Kattegat in 2007 (top - before) and in 2012 when there was already marine life covering the boulders (bottom - after)

The offshore cavernous boulder reefs in shallow waters off the east coast of Denmark are important spawning and feeding grounds for fish and marine mammals and they support a thriving but threatened biodiversity. They are also a rare and biologically-important subtype of reef habitats listed in Annex I of the Habitats Directive. For years, however, they have been widely exploited and it was estimated, when the project started, that at least 34 km² of boulders from shallow cavernous reefs have been excavated from Danish waters (i.e. close to 100%). Denmark's national monitoring programme indicated that only 5 hectares were left untouched.

The BLUEREEF team therefore selected one Natura 2000 site in the Kattegat to be a sanctuary for donor populations and to provide a corridor linking sites within the Natura 2000 network. The restored site made a significant contribution to maintaining reef-dependent populations in Denmark. The project achieved this by restoring the target area using natural boulders from a quarry in Norway. The restoration is estimated to have resulted in 6 tonnes of macroalgal vegetation and 3 tonnes of bottom fauna, as well as a surplus of nearly 700 million individual fauna. The restoration work had an immediate effect on the fish community structure with the number of cod increasing by 300-600% in the reef area, particularly in the shallow part of the rebuilt cavernous reefs.

The Danish Nature Agency, which coordinated the project, expects both the conservation status of the reef to improve and for it to provide an increasing number and quality of ecosystem services, such as enhanced spawning grounds and improved stocks of commercial fish. Good news for the local fishing industry and its workers. The anticipated biomass and management suggests that restoration of cavernous boulder reefs may be a feasible tool for implementing the Marine Strategy Framework Directive.

BLUEREEF is in many ways a pioneer project. It produced best practice guidelines for the restoration of stone reefs, including advice on permits. The project also produced codes of conduct to inspire other areas in northern Europe to restore natural stone reefs. Many of the recommendations in the codes of conduct are relevant for the restoration of other marine nature types, such as biogenic reefs, that can be found elsewhere in the EU.

Portugal's experience

In Portugal, the Biomares project (**LIFE06 NAT/P/000192**) restored and managed the biodiversity of the Arrábida Marine Park, focusing in particular on rehabilitating rocks and reefs destroyed by over-fishing and unregulated mooring (as anchors drag along the seabed). The rocky substrates that constitute reefs are essential for marine life because they provide a fixed support for certain types of algae and animals. Reefs also provide protection against predators during important stages of animals' lives (e.g. reproduction). Many species associated with reefs are very sensitive to human disturbance and require many years to develop. While the reef area of the Arrábida Marine Park is one of the places in Portugal with the most marine biodiversity it has nonetheless suffered considerably from commercial fishing with trawl nets and pleasure boats dropping anchors and grapnels in a disorderly fashion on the sea floor.

The development of an active management strategy for reefs was a major achievement by the project since it reversed the tendency for overexploitation and damage to the sea floor. Mapping of the sea floor gave the fishing industry and pleasure boat operators the necessary information to fish or anchor in areas where they would avoid damaging the habitat.

Mapping reef habitats

Several marine LIFE Nature projects have focused on the important task of collating existing information to be better able to map reef habitats in order to define marine Natura 2000 sites and establish protection measures.

In Finland, FINMARINET (**LIFE07 NAT/FIN/000151**) set out to give a coherent overview of marine habitat types. In particular, the project produced inventories and maps for underwater habitat types and their flora and fauna in key marine Natura 2000 sites. It then used the collected data in geographical information systems (GIS) to model the distribution of these habitats and species. The project provided the Finnish Ministry of Environment with new information on how to extend the Natura 2000 network in marine areas. It also established an internet-based information service to provide marine spatial data and information to experts and the general public and to raise public awareness on marine habitats and their conservation. The practical steps FINMARINET took to increase public awareness on the issue led to increased appreciation for the underwater nature of the Baltic Sea across the Baltic states and boosted expertise on marine nature in those countries.

The LIFE BaĦAR for N2K project (**LIFE12 NAT/MT/000845**) is addressing the lack of information regarding Maltese benthic habitats by collating and analysing existing data and surveying marine areas. It has created a broad habitat map of Malta's marine area along with a number of more detailed maps of protected habitats. This has already helped the Maltese authorities to establish the distribution of marine habitats, including reefs, listed in Annex I of the Habitat Directive, with the aim of extending existing sites and identifying new sites to be included in the Natura 2000 network.

During surveys of deeper waters, scientists discovered various reefs (black and white corals, stone sponges) as well as forests of gorgonians (also known as sea whips or sea fans, which are closely related to corals) and rare yellow corals. The project will ensure these vulnerable species acquire protection through the designation of protected sites under Natura 2000.

Other projects that have mapped and monitored reefs as part of wider marine actions include the Spanish project INDEMARES (**LIFE07 NAT/E/000732**) and the Latvian projects Baltic MPAs (**LIFE05 NAT/LV/000100**) and MARMONI (**LIFE09 NAT/LV/000238**). These projects mapped and implemented monitoring protocols and conservation guidelines for reefs and other marine habitats and species, an action that served to support the designation of 49 marine Natura 2000 network sites in Spain and seven in Latvia.

The ecosystem approach adopted by the Spanish and Latvian projects is designed to achieve the MSFD target of good environmental status for waters through integrated management plans and monitoring.

A new soft coral species in the Mediterranean

As part of its work to increase knowledge and understanding of the marine ecosystems around Spain, INDEMARES conducted a survey of the Menorca Channel seabed – located between the Spanish islands of Mallorca and Menorca. Some notable scientific breakthroughs have been made during the project's Natura 2000 preparatory process. "So far we have discovered: coral reefs that are found in cold water; submarine structures made by leaking gases which host high biodiversity; large populations of different species of whales; not to mention the discovery of a new species of soft coral," explains project coordinator David Peña. The species has been named *Nidalia indemares* in honour of the LIFE project.

Diver surveying a reef off the coast of Malta to help establish new sites to be included in the Natura 2000 network

Photo: LIFE12 NAT/MT/000845/OCEANA/Carlos Minguell

REEFS AND SEAGRASS MEADOWS

Maintaining Neptune grass beds for a healthy marine environment

The LIFE programme is working in Natura 2000 sites throughout the Mediterranean to restore and protect beds of Neptune grass (*Posidonia oceanica*)

Neptune grass beds or 'meadows' are a priority habitat type for conservation listed in Annex I of the Habitats Directive (*1120). Endemic to the Mediterranean, it is the most common type of seagrass found in the region, typically occurring down to a depth of 35-40 m. Seagrasses are sometimes referred to as 'ecosystem engineers' because their physical characteristics create a self-sustaining habitat: the leaves slow down water flows and trap sediment, attracting species and nurturing a food chain. Through their roots and rhizomes, seagrasses also stabilise the seabed, thereby offering protection against coastal erosion. Seagrass beds are highly diverse ecosystems acting as host and food source to a variety of organisms, including sea turtles and seabirds. A number of commercial fish species spawn and nurse in Neptune grass beds. Dead leaves of Neptune grass accumulate on the shore seasonally and play an important role in minimising beach and dune erosion.

Neptune grass is a vital carbon sink, storing carbon dioxide (CO_2) for hundreds of years. Experts estimate that seagrass meadows account for more than 10% of the oceans' carbon storage, with seagrasses able to store twice as much CO_2 per hectare than rainforests. Seagrass meadows therefore have a vital role to play in mitigating climate change and limiting the acidification of the oceans (see box).

Some researchers estimate that there has been a 34% decline in the surface area of Neptune grass in the Mediterranean Sea over the last half century. Contributing factors include mechanical damage from trawling, coastal development, pollution,

More than 20 LIFE projects have focused on tackling degradation of Neptune grass habitats in the Mediterranean

Photo: LIFE00 NAT/E/007303

anchoring of boats, discharge of effluents and a general decline in water quality, as well as sedimentation. Although seagrasses are resilient and adaptable to changing marine temperatures, climate change threatens the future existence of this habitat.

The most recent Article 17 assessment, covering the period 2007-2012, concluded that Neptune grass beds remain in an 'unfavourable' conservation status, with no improvement on the previous assessment period (2001-2007).

The Article 17 report identified deteriorating water quality and tourism development as factors that negatively impact on the remaining Neptune grass meadows in the Mediterranean. Aquaculture, invasive plant species such as *Caulerpa taxifolia* and sand displacement for beach nourishment are also blamed for the progressive decline of Neptune grass. The species is also extremely sensitive to increases in salinity, which can prove fatal – meadows close to desalination plants where brine is returned to the sea are especially vulnerable.

Photo: LIFE13 NAT/IT/000433/Area Marina Protetta Capo Carbonara

Restoring Neptune grass beds by placing geotextiles with cuttings of the species on the seabed

Neptune grass is a good biological indicator of the quality of the marine environment and is considered a biological quality element in the implementation of the European Framework Water Directive and an indicator of good environmental status (GES) under the Marine Strategy Framework Directive.

LIFE protects seagrass habitats

LIFE has focused on tackling seagrass habitat degradation in the Mediterranean through more than 20 projects since 1992.

The Spanish coast is home to some 25% of the Neptune grass habitats in the Mediterranean. LIFE Posidonia Baleares (**LIFE00 NAT/E/007303**), which concluded in December 2006, set out to strengthen the sustainability and biological richness of this habitat in the Balearics. The project established three marine reserves to ensure the islands' remaining Neptune grass meadows would be better protected. As well as collecting detailed information about the health of the species, it established a network of volunteer scuba divers who monitored the meadows, watching out for the appearance of invasive marine plants. An exhibition to raise awareness of the importance of the role of seagrasses in marine biodiversity reached thousands of locals and tourists on the islands of Majorca, Menorca and Ibiza.

On Spain's southern coast, LIFE Posidonia Andalucia (**LIFE09 NAT/ES/000534**) sought to eliminate damage to Neptune grass by uncontrolled trawling – one element in a comprehensive approach that has led to the development of a management plan and regulatory framework to ensure the most appropriate protection measures for the Posidonia covering parts of the seabed in this region famed for its mass tourism. The project has placed emphasis on engaging local communities, building up volunteer groups and working with the fishing and tourism industries to ensure the sustainability of the local economy.

LIFE POSEIDONE (**LIFE09 NAT/IT/000176**), a project in Lazio in central Italy, focused on restoring Neptune grass meadows devastated by illegal trawling. In order for the species to recover, it was necessary to close off the most damaged sites by laying 550 concrete anti-trawling 'tetrapods' on the seabed. This had the effect not only of preventing illegal fishing but the added benefit of helping inshore fish stocks to recover. As well as the beneficiary and partners, the project involved the port authority and local fishing cooperatives. Stakeholder participation was crucial to gaining approval for management plans for the two marine Natura 2000 sites, and the consequent protection of an area of 2 874 ha of Neptune grass.

Photo: LIFE09 NAT/ES/000534

These safe mooring buoys do not damage Neptune grass beds

Anchors away

An ongoing four-year LIFE project around Cagliari, Sardinia, is aiming to reduce the damage caused to Neptune grass meadows by the anchors of boats during the summer tourist season. LIFE RES MARIS (**LIFE13 NAT/IT/000433**) is focusing on education and engagement with stakeholders including local authorities and tourism service providers in a bid to restore seagrass meadows and raise awareness of the harm ships' anchors can cause them. The project is also transplanting nursery-grown Neptune grass to restore the habitat in defined areas and is removing the invasive alien algae, Caulerpa taxifolia.

An earlier LIFE project, CILENTO IN RETE (**LIFE06 NAT/IT/000053**), on the south-western coast of Italy, addressed the problem of anchor damage by setting up a network of mooring buoys to which pleasure craft could attach. The project, centred on Cilento National Park, the second largest in Italy, also addressed the problem of disturbances to Neptune grass meadows caused by unregulated and uninformed scuba divers. The project devised an underwater route that allowed divers to enjoy the pristine marine environment without having a negative impact on the fragile seagrass meadows.

LIFE PRIME (**LIFE09 ENV/IT/000061**), a project in the Puglia region of Italy, focused on developing an integrated management system for decaying Neptune grass washed ashore. This happens as part of the species' natural lifecycle and has an important role in preventing coastal erosion, but decomposing leaves are both unsightly and smelly. The project sought to develop alternatives to what was then the norm: heavy vehicles scouring the sand, damaging the coastal environment and then dumping thousands of tonnes of Neptune grass in landfill. The beached biomass residues were turned into compost.

Quantifying carbon sequestration potential

LIFE Blue Natura (**LIFE14 CCM/ES/000957**) in Andalusia in southern Spain set out to quantify the carbon deposits and sequestration rates of various seagrass species along the Mediterranean coast. The project worked to create models that could be replicated in other areas to assess seagrasses' sequestration potential, their rate of carbon accumulation and the rate of carbon release in the event of habitat destruction. LIFE Blue Natura took this work one stage further by developing the 'blue carbon' project to analyse ways of integrating seagrass carbon sinks into carbon credit and offset markets. The project also fostered dialogue across the EU on how seagrass carbon sinks can be incorporated into national greenhouse gas inventories, raising awareness of the importance of seagrass meadow conservation and preservation.

REEFS AND SEAGRASS MEADOWS

Rejuvenating damaged seagrass habitats

The LIFE programme is working to protect and restore other types of damaged seagrass meadow, as well as Neptune grass beds. These actions help to rejuvenate sea life and ensure the sustainability of industries depending on the marine economy.

Photo: LIFE12 NAT/IT/000331

Eel-grass (Zostera spp.) in flower

Atlantic and Mediterranean seagrasses form dense and highly productive meadows or beds, which in open seas in clear water conditions can reach depths of over 40 m. In addition to Neptune grass (*Posidonia oceanica*), which is exclusively found in the Mediterranean, seagrass meadows can be formed by marine plants such as little Neptune grass (*Cymodocea nodosa*), eelgrasses (*Zostera* spp.), and, in transitional waters and coastal lagoons, by *Ruppia* spp. These meadows are listed in Annex I of the Habitats Directive under several coastal habitat codes such as sandbanks permanently covered with sea water (1110), Mudflats and sandflats not covered by seawater at low tide (1140), Large shallow inlets and bays (1160) and reefs (1170). As with Neptune grass meadows, these seagrass habitats are threatened by coastal development, dredging, eutrophication, localised damage from mooring and shellfishing.

Razor clams and scallops can make for a delicious lunch along the Portuguese coastline, but the cost of consuming them is not only borne by tourists in the summer season. The seagrass meadows in the shallow waters just south of the capital, Lisbon, were being progressively destroyed by unregulated and excessive dredging for bivalves, driven by demand from restauranteurs and visitors to the picturesque, rocky coastline of Arrábida-Espichel.

This Natura 2000 site was designated as a Site of Community Importance due to its rich biodiversity, including 1 100 species of marine flora and fauna. However, seagrass formations and permanently covered sandbank habitats had declined from an area of some 30 ha in 1983 to 0.006 ha in 2006 – the size of a small apartment. LIFE funding was secured to conserve this critically endangered habitat (European Red List assessment), the last surviving example of *Cymodocea nodosa* and *Zostera* spp. infralitoral meadows on the Atlantic Iberian coast.

LIFE Biomares (**LIFE06 NAT/P/000192**) began in 2007 with the intention to restore the area's seagrass meadows, specifically targeting three species: eelgrass (*Zostera marina*), dwarf eelgrass (*Zostera noltei*) and little Neptune grass (*Cymodocea nodosa*). The project team worked to reinvigorate the sea bed by repopulating the meadows using healthy specimens from donor areas, work that was carried out by scuba divers as the majority of the meadows are between 5 and 10 m below the surface. This strategy was supplemented by sowing seagrass seeds in the meadows and farming seagrass shoots in laboratories, which could then be transplanted to the recovering zones.

Challenges and benefits

The challenges to this approach were manifold, and the team found that transplanting seagrass taken or grown elsewhere into the meadows had limited success due to prevalent strong southern winds and swell in the restoration areas. Moreover, these areas are in the open ocean. Despite these challenges, by August 2012 one of the plantation areas had an established meadow of eelgrass.

Additionally, detailed cartography and spatial models have identified the full extent of the meadows and provided a means of estimating the time required for total rehabilitation of each area of seagrass.

Perhaps the greatest impact of LIFE Biomares was in engaging wider audiences about the importance of seagrass meadow conservation and promoting public involvement in monitoring the health of seagrass beds. As well as scuba divers, the project involved the local fishing industry and recreational sailors, focusing its messages on the benefits for these interest groups of restoring seagrass meadows and conserving the biodiversity of marine Natura 2000 sites.

Venice seagrass in peril

In Italy, an ongoing LIFE project in the Venetian lagoon is working to restore seagrass beds affected by human activity and constant water movement in the area, which is popular with pleasure boats and cruise ships alike. Despite rules that sought to reduce pressures by limiting nutrient discharges from the drainage basin and regulating the clam catch, the lagoon is still suffering from limited tidal dynamics, which hampers natural recolonisation by seagrass due to the absence of plants producing seeds. LIFE SeResto (**LIFE12 NAT/IT/000331**) aims not only to repair damaged seagrass meadows but to increase the area of sea bed carpeted by these species by 10 km^2 in a decade.

To this end, the project will transplant two types of eelgrass (*Zostera marina* and *Zostera noltei*) to small sites throughout the lagoon as a means of triggering recolonisation. This will be supported by planting seeds of both species.

LIFE SeResto's approach is innovative in a number of ways. By creating dispersed, small patches of eelgrass, the transplant procedure is low cost and can involve the local fishing community. The project partner Laguna Venexiana is training fishermen to do the transplants, an action that has the added benefit of raising ecological awareness among key stakeholders.

Eel-grass (Zostera marina and Zostera noltei) was transplanted to specific sites throughout the Venetian lagoon in order to trigger recolonisation

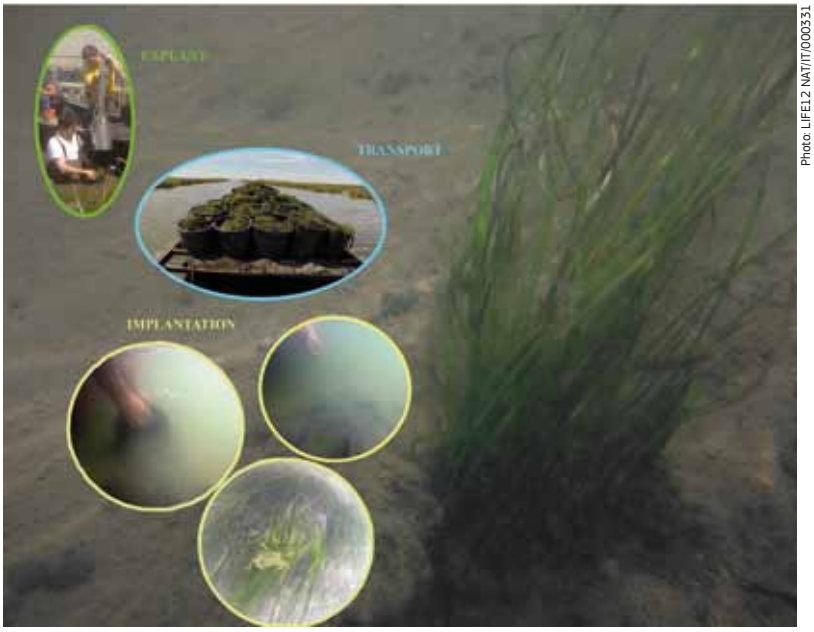


Photo: LIFE12 NAT/IT/000331

CROSS-CUTTING COASTAL MANAGEMENT ISSUES

Integrated management of the coastal **Natura 2000 network**

A number of LIFE Nature projects targeting the restoration and management of coastal habitats have applied an integrated, ecosystem-based approach, taking cross-cutting issues into account. This enables coherence between habitat conservation and economic growth. By integrating the needs of nature with the requirements of local stakeholders within a sustainable long-term strategy, not only are local conservation goals strengthened, the projects also provide a template for future restoration projects across the EU. The examples on the following pages include:

- Control and eradication of invasive alien species;
- Species conservation in the context of coastal habitats;
- Sustainable use of coastal habitats and associated ecosystem services to develop jobs and growth in rural areas, in line with the EU strategy for business and biodiversity; and
- Climate change adaptation planning.


Photo: LIFE07 NAT/FR/000193/Xavier Rufray


Photo: LIFE09 NAT/SI/000376


Photo: LIFE13 NAT/ES/001001


Photo: LIFE12 NAT/GR/000688/WWF Greece/C. Stefanou


Photo: LIFE05 NAT/IT/000037/Giacomo Lencioni


Photo: LIFE12 NAT/IT/001185

CROSS-CUTTING COASTAL MANAGEMENT ISSUES

Combating invasive alien species in coastal areas

Invasive alien species are a major threat to protected habitats in coastal areas. Two LIFE projects have targeted invaders with clearance efforts in Natura 2000 areas in Spain and Denmark.

Invasive alien species (IAS) are non-native species, including plants, animals, fungi and micro-organisms, which pose a threat to biodiversity and disrupt the function of and services provided by ecosystems. They are the second biggest cause of biodiversity loss worldwide, behind habitat loss and fragmentation, and are responsible for some €12.5 billion worth of damage in the EU every year. Invasive species can harm native ones in several ways: by competing for food, eating native species, spreading diseases, causing genetic changes through interbreeding with native species, and disrupting the food web and the physical environment.

Some 12 000 alien species have been registered in Europe, around 15% of which are invasive, and their numbers are rising rapidly. Ecosystems are increasingly vulnerable to invasions by non-native species due to pressures such as habitat loss, degradation, fragmentation, over-exploitation and climate change. Globalisation has also boosted the number and type of alien species arriving in Europe, in particular due to more trade and tourism; coastal and marine areas are being significantly affected by IAS due to increased shipping and the building of canals between isolated seas.

Control of invasive sea myrtle (Baccharis halmifolia) in Basque Country estuaries

Photos: LIFE08 NAT/E/000055/Basque Government

Since 1992, more than 50 LIFE projects targeting coastal habitats have included measures to control and eradicate IAS. The majority of these projects targeted invasive plants that spread on dunes and in coastal wetlands. The main IAS targeted were Japanese rose (*Rosa rugosa*), the cactus genus Opuntia spp., Yucca spp., ice plant (*Carpobrotus edulis*) and black cherry (*Prunus serotina*) in dune habitats, and sea myrtle (*Baccharis halmifolia*) in coastal wetlands. Some LIFE projects targeting Neptune grass conservation (see pp. 57-59) included actions to remove invasive alien algae, such as *Caulerpa taxifolia*.

Tackling Basque coastal threat

IAS are a major threat to the conservation of estuarine habitats in Spain's Basque Country. These ecosystems are fragile and becoming more and more scarce, under pressure from urbanisation, pollution and agricultural use. They are an important reservoir of biodiversity and provide essential ecosystem services such as water regulation, helping to prevent and alleviate flooding. The invasive sea myrtle is particularly dangerous. Native to North America, it was introduced on the French coast in the 19th century as an ornamental plant and is now present across the whole European Atlantic coast, from Brittany in France to Asturias in Spain. On Spain's Cantabrian coast sea myrtle has an invasion front of about 300 km and it can be

found across all estuaries in the Basque Country. The plant's main effects are seen in marsh, dune and cliff habitats; it forms dense masses that displace native vegetation, modifying the structure of these habitats which are essential for the conservation of endangered species of birds and flora.

The Basque government began combating sea myrtle in the early 2000s, studying its distribution and impact in the Urdaibai reserve and carrying out pilots to eliminate the species. The fight received a boost with the launch of the LIFE project Estuarios del Pais Vasco (**LIFE08 NAT/E/000055**) in 2010. This aimed to remove the invasive shrub and restore habitats of Community interest in three estuaries of the Basque Country's Natura 2000 network, including lowland hay meadows, Spartina swards, Atlantic salt meadows, and Mediterranean and thermo-Atlantic halophilous scrubs.

Estuarios del Pais Vasco implemented an ambitious campaign to control the species in the Urdaibai, Lea and Txingudi estuaries. Eradication work consisted of pulling up seedlings by hand (on 590 ha) and cutting larger specimens by chainsaw, applying herbicide to the stumps (on 192 ha). In addition, herbicide was applied to re-sprouting shrubs and female specimens were selectively cleared before the flowering season to prevent seed dispersal. Some 570 000 adult specimens were treated and over 5 million seedlings removed, clearing the invasive plant from around 212 ha.

The work resulted in a significant environmental improvement in over 300 ha of valuable estuarine habitats (also benefiting the bird species living in these ecosystems) and cut sea myrtle's capacity for expansion along the Basque coast. The project contributed significantly to the conservation of several habitat types in the three estuaries, mainly sea rush (*Juncus maritimus*), marsh rushes, reedbeds of the perennial grass *Phragmites australis*, sea couch (*Elytrigia atherica*), and saline pastures. It also led to the improvement of other habitats such as dunes, alders and coastal lagoons by preventing invasion, while the amount of mudflat and sandflat habitat increased considerably.

In Spain, the project LIFE CONHABIT ANDALUCÍA (**LIFE13 NAT/ES/000586**) is removing IAS such as the cactus species *Opuntia dillenii* and beach evening-primrose (*Oenothera drummondii*) from 14 areas across seven Natura 2000 sites. These cover a total area of 106 ha.

Photo: LIFE12 NAT/DK/001073

The Danish project REDCOHA-LIFE is controlling the spread of Japanese rose (Rosa rugosa) by covering small bushes with plastic

Danish headland menaced

Another area threatened by invasive alien species is Skagen Odde, a 30 km-long sandy peninsula which forms the northernmost part of Denmark. One of the world's biggest headlands, it contains one of the largest coherent areas of grey dunes and dune heath in Europe and is an important part of Denmark's natural and cultural heritage. However, the nutrient-poor and vulnerable headland's habitats are threatened by two invasive plant species, Japanese rose and giant hogweed (*Heracleum mantegazzianum*), as well as a lack of natural hydrological conditions, the degradation of sensitive areas due to traffic, and the loss of and disturbance to breeding areas for key animal species.

The REWETDUNE-LIFE project (**LIFE13 NAT/DK/001357**) aims to address these threats and significantly improve the conservation status of the wet and dune habitats in Denmark's two most northerly Natura 2000 sites. The habitats in question are: fixed dunes with herbaceous vegetation ('grey dunes'), decalcified fixed dunes with *Empetrum nigrum* and humid dune slacks. The locations of *Rosa rugosa* and *Heracleum mantegazzianum*, which cover 4 704 ha in both project areas, have been mapped. These maps are being used to decide where to focus clearance efforts. REWETDUNE-LIFE expects to control stands of Japanese rose on 27.5 ha and clear both invasive plants from an additional 170 ha by the end of the project in July 2019. This should help create favourable conditions for two protected bird species, the wood sandpiper (*Tringa glareola*) and great bittern (*Botaurus stellaris*).

CROSS-CUTTING COASTAL MANAGEMENT ISSUES

Protecting species through coastal habitats conservation

Several LIFE projects are helping to conserve the Mediterranean monk seal and the loggerhead turtle, through restoration of coastal habitats in key nesting areas.

Photos: LIFE12 NAT/IT/001185/Mingozzi

Maintaining coastal dunes and beach habitats in a 'favourable' conservation status is very important for nests of the loggerhead turtle (Caretta caretta)

Conserving coastal habitats has benefits for a number of protected species. LIFE projects have targeted foredunes, sandy beaches and sea caves favoured for nesting by the loggerhead turtle (*Caretta caretta*) and Mediterranean monk seal (*Monachus monachus*). The latter is one of the rarest species of seal globally, with an overall negative population trend. A priority species for conservation listed in Annexes II and IV of the Habitats Directive, it is categorised as critically endangered on the IUCN Red List..

Only small populations of the seal remain across the Mediterranean basin and the Atlantic coast of North Africa. The largest number lives and breeds in the Greek seas, where there is an estimated minimum population size of 200 individuals. Regular monitoring since 2004 has revealed that the Natura 2000 site 'Nisos Gyaros Kai Thalassia Zoni' hosts one of the species' most important breeding nuclei, with an observed pupping rate of around seven births per year (among the highest in the world). The Mediterranean monk seal has been observed occupying open beaches within the site for resting and reproducing, indicating both the existence of a large breeding colony in the area and excellent seal habitat. Nisos Gyaros Kai Thalassia Zoni is therefore of utmost importance for the survival of the species.

The Natura 2000 site consists of the island of Gyaros, in the northern Cyclades, and a surrounding marine area. Gyaros is estimated to have a Mediterranean monk seal population of approximately

70 individuals, excluding pups. However, the island is particularly confined with few coastal caves and beaches suitable for pupping. It is also close to other areas of intense human activities (such as fisheries, shipping and tourism) which presents a significant risk for the seal population. Hence there is a critical need to protect the island and its adjacent marine area.

Litter-free seal habitat

The CYCLADES Life project (**LIFE12 NAT/GR/000688**) set out to establish a unique protected area on Gyaros and its adjacent waters, which will help conserve and protect the local Mediterranean monk seal population. Specifically, it aims to protect and improve the conservation status of the seal's habitats, in particular beds of Neptune grass (Posidonia oceanica), reefs and partially submerged marine caves (all threatened with downgrading due to human pressures), thus improving the conservation status of Nisos Gyaros Kai Thalassia Zoni as a whole.

Thanks to CYCLADES Life, the Natura 2000 site and its adjacent waters have been legally designated as a wildlife refuge. Restoration of the target habitats has begun and conservation measures implemented for their protection. The work completed so far includes removing marine debris and abandoned fishing gear: the project team and volunteers cleared rubbish from open beaches and from the main submerged cave on Gyaros used for breeding by the local Mediterranean monk seal population, as well as removing marine litter and abandoned fishing nets lying on the seabed near the island's main breeding caves.

Restoring dune habitats in Calabria

Conservation and protection of coastal habitats is also positive for the loggerhead turtle, which is found across the Mediterranean. Considered to be endangered at both regional and global level, some 95% of its nesting sites are found on the Greek, Turkish, Cypriot, and Libyan coasts. Nesting of the species in southern Italy is thought to have been sporadic and irregular in the past few decades. But recently it was estimated that there are around 100 nesting sites in the region, of which 71 are in Calabria. No coordinated local strategies exist however to preserve loggerhead turtle populations, through actions such as habitat restoration and proper management of beaches with nesting sites.

LIFE Caretta Calabria (**LIFE12 NAT/IT/001185**) aims to address this in several ways. It will conserve and restore four key nesting areas in coastal habitats in Calabria and introduce integrated coastal zone management for the protection of Natura 2000 habitats (dune series) and loggerhead turtle habitats under high anthropogenic pressure. Other goals include: ensuring the coastal municipalities adopt a shared action plan for the conservation of the Ionian Coast of Calabria; updating the management plans for Natura 2000 sites in the project area; and disseminating best practices on the use of coastal areas where the turtle nests to local administrators and residents.

This LIFE project will restore the dune habitats in the four coastal areas of Calabria where loggerhead turtle nesting occurs. The restoration work is expected to improve the composition and structure of up to 80% of the dune vegetation and habitats.

A recently-started project, LIFE EUROTURTLES (**LIFE15 NAT/HR/000997**) aims to set up new regulations for the protection of 45 sea turtle nesting sites spread across Greece, Italy and Cyprus. Activities to protect nests will take place at 19 sites in the three countries. This is expected to result in 700 more nests being successfully protected each year, or some 3 500 nests over the course of the project, with more anticipated afterwards.

Mediterranean monk seal (Monachus monachus)

Photo: LIFE00 NAT/GR/007248

CROSS-CUTTING COASTAL MANAGEMENT ISSUES

Managing coastal tourism in Natura 2000 sites

With LIFE co-funding, the management and restoration of coastal Natura 2000 network sites is helping to reconcile tourism and nature conservation.

Photo: LIFE07 NAT/GR/000296

LIFE has enabled Natura 2000 site managers to control, manage and reduce the impact of tourism on endangered coastal habitats

Coastal tourism is by far the most significant contributor to the tourism industry in Europe, both in terms of visitor numbers and income. According to a European Environment Agency (EEA) report (No 12/2013), coastal tourism – beach tourism, diving, sailing, water and coastal sports – is worth some €144 billion/year and is expected to continue to grow in the coming years.

This growth varies across bioregions. In the North-East Atlantic region, says the report, the maritime economy (a third of which is generated by coastal tourism and shipping) provides an estimated 1.8% of GDP and 2.1% of employment. Tourism is also a main maritime economic activity in the Mediterranean region, having grown significantly in the last 20 years. Coastal Natura 2000 network sites can provide additional benefits to the local and regional economy, by attracting inward investment and enhancing the local image and quality of life. The benefits generated by visitors with affinity to Natura 2000 could support from 800 000 to 2 million full-time equivalent (FTE) jobs[1].

1 The Economic benefits of the Natura 2000 Network http://ec.europa.eu/environment/nature/natura2000/financing/docs/Economic%20Benefits%20Factsheet.pdf

Negative impacts of tourism on coastal ecosystems noted by the EEA report include trampling of plants and soil, people disturbing and removing wildlife, and littering.

LIFE has enabled Natura 2000 site managers to control, manage and reduce the impact of tourism, reconciling this important economic interest with the requirements of the Habitats and Birds Directives. Most commonly, this has involved controlling visitor access to coastal sites, including through new infrastructure, such as a boardwalk to access a beach. Other actions have focused on defining the carrying capacity of sites, involving tour operators and other interested parties in Natura 2000 network site management, raising the awareness of tourists of the nature values of coastal areas and setting up site management plans.

In the Baltic Sea, for instance, the Estonian project, URBANCOWS (**LIFE10 NAT/EE/000107**) is targeting the preservation of an area of coastal meadows in Pärnu, (see pp 51-53) a very popular holiday resort, which receives over half a million visitors every summer.

An EU Recommendation on Integrated Coastal Zone Management (ICZM) was adopted in 2002. This established basic principles for the management of coastal sites. These are still valid and include: stakeholder involvement, sensitivity of policy to local needs, the adoption of a long-term perspective, and the creation of links between all levels of governance, from local to European. Building on ICZM, new initiatives launched by the EU are Integrated Maritime Policy and coastal and marine issues of climate change adaptation.

In addition to European-level initiatives and the protection afforded to Natura 2000 sites by the Birds and Habitats Directives and the EU Biodiversity Strategy to 2020, countries are developing their own integrated coastal management strategies adapted to local needs. For example, in the Mediterranean region, under the framework of the trans-border MC-SALT project (**LIFE10 NAT/IT/000256**), the Camargue National Park authority in the South of France has identified measures that balance nature protection requirements with the presence of growing numbers of kitesurfers visiting one of the country's last remaining completely wild beach areas (see box).

To conclude, LIFE Nature projects provide knowledge and best practices about how to adapt to the challenges from tourism in coastal regions. These strategies often adopt a long-term perspective, taking into account local social-economic conditions and working with natural processes to ensure coherence between planning and management in a participatory approach involving all relevant stakeholders, and as well integrating EU policies that coincide in coastal areas. The integration of biodiversity conservation in coastal areas into business activities, taking into account economic constraints and environmental benefits is in line with the European Business and Biodiversity (B@B) Platform, which provides an EU level forum for sustained and strategic dialogue on the links between business and biodiversity.

Kitesurfing next to nature

"If you take something away, such as access to an area of the beach, then you have to give something back," says Stéphan Arnassant, spokesman for the Camargue Regional Natural Park, a French partner of the Italian-led MC-SALT project (see pp. 67-69). He explains that in order to protect a nesting islet created under the project to encourage birdlife, a number of management measures have been introduced at Beauduc Beach in Camargue, since 2012. These include only allowing camping in a certain area, and prohibiting vehicles over 2 m wide. Although the latter measure has been difficult to implement, he admits (i.e. a concrete road-block is regularly vandalised) – it is necessary, as before this, campervans would drive onto and remain on the beach, causing disturbance to rare coastal and dune habitats, and especially to nesting gulls, terns and avocets. On the other hand, a parking area is now provided (away from the beach) and another part of the beach has been specifically allocated for kitesurfing – a sport that is growing in popularity and attracting regional and international visitors, due to the area's renowned fierce winds.

Photo: Fred Bigio/Flickr/CC BY 2.0

CROSS-CUTTING COASTAL MANAGEMENT ISSUES

Salt benefits business and biodiversity

Salt has been produced in the Mediterranean region since ancient times. In coastal areas where harvesting continues, such as the south of France, or has been revived, for example in Slovenia, saltworks harbour many protected habitats and species. LIFE demonstrates how the business supports biodiversity.

The flexibility of the LIFE Nature programme means that it can be used relatively easily by businesses to further biodiversity; while helping to contribute to company growth and profitability. One example is the Salins Group – one of Europe's largest commercial salt producers ('Le Saunier de Camargue Fleur de Sel' and 'La Baleine' brands) – a French partner of the Italian-led MC-SALT project (**LIFE10 NAT/IT/000256**).

Dominique Dupeux, environmental manager at the Salins du Midi, Aigues-Mortes saltworks in the Camargue, explains the reason for involvement in the LIFE project: "It's good publicity to be able to show in our advertising that we are actively involved in the conservation of biodiversity," he says, adding: It's also good for business."

Situated at the foot of the medieval city walls, the Aigues-Mortes salt marshes – part of the 'Petite Camargue' Natura 2000 network site – encompass over 8 000 ha of valuable habitats, in particular coastal lagoons (a priority for conservation under the Habitats Directive), more than 7 600 ha of which has been improved under the 2011-16 LIFE project. Salt has been produced at this location, birthplace of the Salins Group, since 1856. Today, the site produces some 200 000 tonnes/year of sea salt.

Human intervention

Project actions include hydraulic restoration works to preserve the highly specific nature of these coastal habitats (see box) – created through man-made interventions (e.g. reconstruction of sluices and drainage channels) to control the flow of seawater and maintain salt gradient across the evaporation ponds – which have become degraded, with consequent negative impacts on the huge numbers of bird species feeding or breeding there.

Salt production is an example of how the conservation of Natura 2000 sites can go hand in hand with boosting the local economy

Photo: LIFE10 NAT/IT/000256/Salins/Th.Vezon

"Preserving the natural environment is enormously important for salt, and the maintenance of the good condition of the special nature of the habitats is an important part of this," says Mr. Dupeux. Moreover, he continues, salt is becoming "increasingly important" for the development of tourism associated with its production. This involves being able to show the act of producing salt helps protect the land – this is very important for the group, he says. He emphasises that the traditional sauniers (salt workers) have always acknowledged this: "They've been born into this environment and I would say that they've been the first to recognise the necessity of protecting our exceptional heritage."

Aigues-Mortes is one of 10 Natura 2000 sites involved in MC-SALT, a trans-border project, which as well as France, has partners in Italy (the coordinating beneficiary) and Bulgaria. Importantly, all the sites host saltworks, all the context varies from the fully operational (Aigues-Mortes), to the recently restored (Comacchio, Italy) to the recently-closed (Beauduc).

Main goals

Priority coastal lagoon habitat is present at all 10 sites. The project's overall goals were to reinforce the protection and recognition of the ecological value of working and non-working areas of saltworks (improving a total of some 11 000 ha of coastal habitats, the majority in France), and of huge numbers of associated birdlife. The site managers all face similar conservation issues that are being addressed: a progressive decline in water circulation capacity; habitat degradation; loss of feeding and nesting habitat; and loss of attractiveness or historic/cultural value.

Another French partner is the Camargue Regional Natural Park – which together with Tour de Valat, a research centre for Mediterranean wetlands – was responsible for the restoration of a further 5 000 ha of target habitats at the former 'Anciens Salins de Beauduc' saltworks; as well as the creation of breeding grounds targeting in particular, seven Birds Directive species including gulls, terns and avocets.

Here, the hydrology of the lagoons has been improved, by, for instance, restoration of a number of natural connections, locally called 'gazes', removal of stretches of embankments and control or removal of vegetation overgrowth. An artificial nesting islet has also been created on nearby Beauduc Beach, targeting especially little tern, with accompanying information and guidance for kitesurfers and other beach users (see pp. 76-77).

Photo: LIFE10 NAT/IT/000256/Graziano Caramori

LIFE actions include improving the hydrology of the lagoons by restoring a number of natural connections with the sea

Without the habitat actions "the whole area will eventually dry out for prolonged periods, resulting in increased degradation of the priority habitat and the complete loss of suitable conditions for breeding waterbirds," explains Stéphan Arnassant, responsible for biodiversity and natural heritage at the Camargue Park. Other target Mediterranean habitat types such as salt steppes, salt meadows, and Salicornia and other annuals colonising mud and sand, also stand to benefit.

As well as the expected individual site improvements, activities involve networking with other European salt producers and participation in annual workshops. A key deliverable is the planned publication (in four languages) of management guidelines for working and non-working saltworks of the Mediterranean and Black Sea regions.

LIFE has provided a conduit for salt producers involved in different projects. For instance, Salins du Midi, a partner in MC-SALT and producer of the Camargue Fleur de Sel helped Black Sea Salinas Ltd, a partner in the Salt of Life project (**LIFE11 NAT/BG/000362** - see pp. 16-18) to develop its own "100% natural salt product", an upmarket alternative to table salt for the Bulgarian market.

Slovenian salt pans

On the other side of the Adriatic, LIFE Sečovlje (**LIFE03 NAT/SLO/000076**) was a 2003-06 project in the 650 ha salt marsh area on the southernmost stretch of the Slovenian coastline. Since the 1990s commercial salt-making had all but ceased at the location, with the market destroyed by cheaply produced salt from north Africa. Working with new site operator, Soline, a wholly-owned subsidiary of mobile phone company, Mobitel – which provided funds for the restoration of salt-making and biodiversity in exchange for marketing opportunities – the project successfully demonstrated an integrated approach to site management. The LIFE project helped kick start restoration of the hydrology system of dykes and embankments. At the same time, conditions were improved for birds (e.g. creation of nesting islets for terns). Importantly, the project drafted a 10-year management plan for the site.

The long-term perspective of this project fed into a follow-up conservation project, MANSALT (**LIFE09 NAT/SI/000376**) which, together with Soline, has continued the restoration of the Sečovlje saltworks in a nature-friendly way. This project has ensured control over the water regime and hydraulic management via sea-defence (dykes) and construction of embankments and internal channels. Today, up to 3 000 tonnes/year is produced using traditional, artisanal methods.

Special nature of salt habitats

Salt marshes, shaped by salt-making, harbour important habitats of the EU Habitats Directive, in particular priority coastal lagoons – all of which are considered 'unfavourable-bad' across the Mediterranean biogeographic region. The specific landscape provides ideal conditions for many rare migratory water birds, such as the greater flamingo (*Phoenicopterus roseus*) and for several species of gulls, terns and waders listed in Annex I of the Birds Directive.

Photo: LIFE10 NAT/IT/000256/Salins/JM.Favre

Did you know?

Salt has some 14 000 uses: it's a commercial food, an essential animal feed, one of the best preserving agents, used in water treatment, a key raw material for the chemicals industry, and the best solution in terms of availability, efficiency and price for road de-icing ...

Source: Salins Group website

Other saltworks in Natura 2000 sites

Interest in the launch of MC-SALT was triggered by the experiences of the coordinating beneficiary, the Po Delta Regional Park, under the Comacchio project (**LIFE00 NAT/IT/007215**). It was through this project that small-scale, low-impact salt harvesting was restarted to ensure the conservation of a 550 ha area of the former Comacchio saltworks, closed in 1984. The closure had meant the flow of seawater to the evaporation ponds was no longer regulated. In addition to actions to restore abandoned infrastructure and improve water circulation, the project drafted a management plan prioritising conservation of the site, including conservation of its industrial heritage through the construction of a 'salinetta' (little saltworks) on a 4 ha area, where salt production using traditional practices has been restarted.

Finally, in Spain salt production in the salt lake of Torrevieja, (Valencia region) has for more than two centuries maintained a stable water level. In recent times, however, progressive silting was causing concern. The CIRCUREVIEJA project (**LIFE08 NAT/E/000077**) worked to reduce, by 66% of volume, the residual salts (brine) discharged into the lake, which was causing deterioration and flooding of surrounding land. Improving the condition of the lagoon habitat has also helped improve conditions for rare nesting bird species, such as Audouin's gull (*Larus audouinii*). The beneficiary, the Salinas de Torrevieja saltworks (Salins Group) has also considerably improved the environmental management of stockpiled residual salt materials. This in turn, has improved conditions for colonisation by other important Mediterranean coastal habitats.

CROSS-CUTTING COASTAL MANAGEMENT ISSUES

Shoreline sites adapt to climate change

With LIFE's support, Natura 2000 network site managers are developing climate adaptation plans to reduce impacts of sea-level rise, erosion and other climate changes on vulnerable EU coastal sites, habitats and species.

Photo: LIFE11 NAT/BG/000362/Spas Uzunov

Coastal habitats are under pressure due to climate change impacts

Climate change is already affecting Europe's coastal regions in four main ways: sea-level rise, increased coastal erosion, storm surges, and loss of specific habitats. Coastal zones across Europe have different sensitivities. For example, to sea-level rise and increased risk of storms, the extensive, low-lying coastal zones of Belgium, the Netherlands, Germany, and Poland are highly sensitive; while other Member States (e.g. France) have specific regions that are particularly sensitive. In the Mediterranean, concern is focused on impacts on the high nature value beaches and low-lying deltas. In such places, climate change is amplifying other pressures and threats that coastal ecosystems have been already facing.

As part of the EU Strategy on adaptation to climate change, the European Commission has produced guidelines for Natura 2000 site managers dealing with the impact of climate change on the management of areas of high biodiversity value[1]. This 2013 study identifies the main climate change impacts in the different biogeographic regions (see

1 "Guidelines on Climate Change and Natura 2000" http://ec.europa.eu/environment/nature/climatechange/pdf/Guidance%20document.pdf

Figure 1: **Climate change impacts by biogeographic region**

Arctic region
Temperature rise much larger than global average
Decrease in Arctic sea ice coverage
Decrease in Greenland ice sheet
Decrease in permafrost areas
Increasing risk of biodiversity loss
Some new opportunities for the exploitation of natural resources and for sea transportation
Risks to the livelihoods of indigenous peoples

Atlantic region
Increase in heavy precipitation events
Increase in river flow
Increasing risk of river and coastal flooding
Increasing damage risk from winter storms
Decrease in energy demand for heating
Increase in multiple climatic hazards

Mountain regions
Temperature rise larger than European average
Decrease in glacier extent and volume
Upward shift of plant and animal species
High risk of species extinctions
Increasing risk of forest pests
Increasing risk from rock falls and landslides
Changes in hydropower potential
Decrease in ski tourism

Coastal zones and regional seas
Sea level rise
Increase in sea surface temperatures
Increase in ocean acidity
Northward migration of marine species
Risks and some opportunities for fisheries
Changes in phytoplankton communities
Increasing number of marine dead zones
Increasing risk of water-borne diseases

Boreal region
Increase in heavy precipitation events
Decrease in snow, lake and river ice cover
Increase in precipitation and river flows
Increasing potential for forest growth and increasing risk of forest pests
Increasing damage risk from winter storms
Increase in crop yields
Decrease in energy demand for heating
Increase in hydropower potential
Increase in summer tourism

Continental region
Increase in heat extremes
Decrease in summer precipitation
Increasing risk of river floods
Increasing risk of forest fires
Decrease in economic value of forests
Increase in energy demand for cooling

Mediterranean region
Large increase in heat extremes
Decrease in precipitation and river flow
Increasing risk of droughts
Increasing risk of biodiversity loss
Increasing risk of forest fires
Increased competition between different water users
Increasing water demand for agriculture
Decrease in crop yields
Increasing risks for livestock production
Increase in mortality from heat waves
Expansion of habitats for southern disease vectors
Decreasing potential for energy production
Increase in energy demand for cooling
Decrease in summer tourism and potential increase in other seasons
Increase in multiple climatic hazards
Most economic sectors negatively affected
High vulnerability to spillover effects of climate change from outside Europe

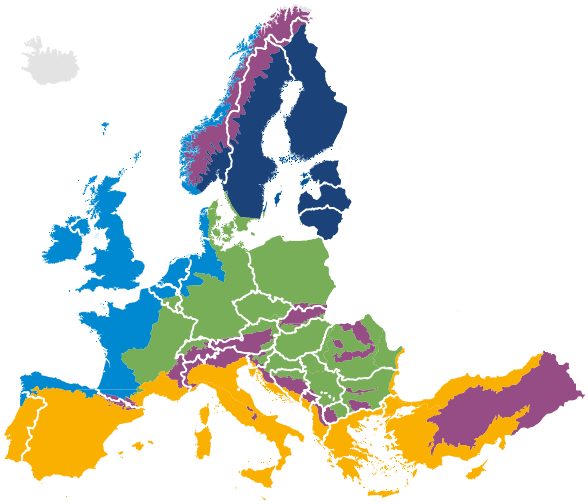


Figure 1). For instance, higher risk of coastal flooding is expected in the Atlantic region; whereas for the Mediterranean biogeographic region (including the Black Sea), there is a higher risk of biodiversity loss. In the Boreal region, meanwhile, there is a higher risk of damage from winter storms.

Biodiversity and ecosystem services help us to adapt to and mitigate climate change. They are therefore a crucial part of our effort to combat climate change. Working with nature, rather than against it, brings multiple benefits also for preserving our climate.

A Natura 2000 network that is effectively managed, functionally coherent and well connected can play a vital role in helping society adapt to, and mitigate, the impacts of climate change. In addition, habitats in a 'favourable' conservation status are more resilient to the impact of climate change. LIFE projects have been improving the conservation status of coastal habitats with restoration actions (as seen in this publication), and thus improving their capacity to cope with climate change. At the same time LIFE projects working with nature in an integrated way are protecting coastal habitats that work as buffer zones against extreme coastal storms and erosion.

LIFE actions

In 1999, the LIFE programme co-financed an influential UK project, Living with the Sea (**LIFE99 NAT/UK/006081**), tackling the long-term management and maintenance of 32 Natura 2000 network sites located along the shorelines of east and south-eastern England – one of Europe's fastest eroding coastal areas. Research has indicated that climate change and sea level rise will drive significant habitat change on these coastlines, with implications also for flood risk management.

Together, the sites feature 13 listed coastal habitat types of the EU Habitats Directive. For example, 'perennial vegetation of stony banks', whose conservation status is 'unfavourable-bad' across the Atlantic biogeographic region. According to the most recent Article 17 assessment of the conservation status of habitats, this is largely due to the UK situation, blamed on "a mix of human impact (such as gravel extraction) and also possibly linked to climate change". Another target habitat type is 'mudflats and sandflats not covered by seawater'. Again, its conservation condition is considered 'unfavourable-bad' for the whole Atlantic region, mainly due to "the poor situation in the UK".

Earlier attempts to combat erosion within the coastline areas to be targeted by the project had included the building of blockades and other artificial barriers. These, however, had simply shifted the problem elsewhere. So, when the LIFE project was drawn up, the adaptation plan was managed retreat, i.e. recognising loss of habitat in certain areas may be inevitable over the long term. But, by adopting a longer term strategy, losses in one area can be compensated for by gains elsewhere, for example through the re-creation of areas of similar habitats.

The project's primary objectives were to provide a strategic framework, guidance and practical mechanisms for the management of the habitats of dynamic coastlines in the long term. An important specific objective was to develop a model for coastal habitat management plans, known as 'CHaMPs', and to produce these for seven pilot areas encompassing all the target Natura 2000 network coastal sites.

CHaMPs vs super-CHaMPs

The 1999-2003 project successfully produced plans for the seven target coastline areas, e.g. the Essex coast and Estuaries, and Suffolk Coast and Estuaries. The process included predicted geomorphologic changes over a 30 to 100-year timescale on designated habitats by area. As the pilots progressed, however, it became clear that – in order to set a direction for conservation measures to address habitat net loss – 'super-CHaMPs' might be necessary considering possibly a whole coastal region, e.g. south-east England. Following completion, and using the results, revised guidelines to operating authorities were published by Defra – the Department for Environment Food & Rural Affairs.

Another significant UK LIFE project, Alde-Ore Estuary (**LIFE08 NAT/UK/000199**), had as its principle objective adapting two coastal Natura 2000 network sites to provide resilience to changing climatic conditions. The sites were Orford Ness and Havergate Island, both in East Anglia (see box).

Alde-Ore Estuary: securing a sustainable future for wildlife

On Orford Ness, new water management infrastructure has created an additional 3 ha of coastal lagoon habitat, along with 2.4 km of new ditches, a further 4 km of linear scrapes (foot drains) and three new sluices that allow water to be brought into the site from the estuary. The deepened scrapes and new ditches increase the water carrying capacity of the site, allowing it to hold water for longer into the summer and early autumn. Says project manager, Grant Lohoar, "The linked system allows improved management of water at appropriate times of the year to maintain optimum water levels for key bird species, in particular breeding and migrant avocet and redshank, spoonbill, and golden plover, along with many other species of waders and wildfowl for which the site is important." During the winter months, a new, more efficient pumping system can evacuate excess rainfall into the estuary system. This proved its value following a North Sea tidal surge in December 2013, which led to significant incursion of tidal water into the site.

On Havergate Island, the infrastructure and habitat conditions of the saline lagoons have been fully restored, nesting islands re-profiled and six tidal sluices replaced. This will ensure future sustainable management, until such time as rising sea levels make the site untenable, he says, adding: "The new sluices are functioning very well, being much easier and safer to use. These now allow a more efficient influx of river water to refresh the marshes, and reduce salinity." Among other things, this has improved the habitat for rare saltmarsh invertebrates such as the starlet sea anemone and increased the food supply for wading birds including avocet and spoonbill.

Photo: LIFE08 NAT/UK/000199/National Trust/RSPB

The Ebro Delta is an internationally important wetland area considered to be one of the coastal ecosystems most vulnerable to the effects of climate change in the Mediterranean biogeographic region and in the EU. At present the delta is experiencing a significant loss of wetlands and rice fields due to coastal regression, caused by the lack of input of river sediments which are retained by the river and reservoirs located upstream of the Ebro river. The problem has been worsened by sea-level rise and the natural subsidence of the delta plain.

From 2010-2015, the Spanish DELTA-LAGOON project (**LIFE09 NAT/ES/000520**) targeted two coastal lagoons located in the Ebro delta natural park. One, the Alfacada lagoon is especially vulnerable to the effects of climate change on the water and sediment flux of the Ebro river. Therefore, specific management and restoration measures were required to mitigate these negative effects. A main goal here was to improve the natural hydrological functioning of the lagoon, with consequent ecological improvements for priority habitats and species, including a number of habitats that are of particular conservation concern across the Mediterranean region.

The project ended in 2015, having improved the hydrological function of the Alfacada lagoon and also restored original lagoon areas that had been converted into rice fields. These measures have had a direct positive impact on the conservation condition of the 175 ha lagoon. In total, 18 ha of priority coastal lagoon habitats have been recovered. At the same time, saltmarsh areas of another lagoon, Tancada, have been restored. In both areas, the actions have also had a positive impact on wildlife including hibernating and resident Birds Directive-listed bird species.

In France, as in other Member States, public authorities are beginning to realise the important role that natural coastal habitats can play in providing protection against climatic events. Spearheading the issue is LIFE BARGE (**LIFE14 NAT/FR/000669**) located in the Aiguillon Bay, Marais Poitevin (salt marshes) in western France – a territory hit by devastating sea storms, Martin in 1999 and Xynthia in 2010.

Over the centuries, human activities around the bay have contributed to the diversification of coastal habitats. However, modern farming practices, together with coastal urbanisation and tourism have gradually increased pressures on the natural environment. Recent climatic disasters (e.g. during a violent windstorm named Xynthia in 2010, 51 people died when a seawall collapsed) and the prospect of global warming has accelerated the need for adaptation strategies.

Coordinated by the Marais Poitevin regional park authority, the project runs until 2020. Adopting an integrated approach, it aims to strengthen the ecological value of the bay, while encouraging in particular, natural coastal habitats as an efficient means of protecting lands against sea floods. Expected results include analysis of the geomorphological evolution of the bay and restoration of 100 ha of priority, mudflat habitats. In addition, 10 ha of salt marshes will be created at one site, encouraging also nesting habitats for valuable EU bird species. At another site, 800 m of dune habitats will be restored and protected, with public access provided to the beach.

Coastal habitats as blue carbon sinks

There are many coastal marshes and seagrass meadows along the Atlantic and Mediterranean coasts of Andalusia. The LIFE Climate Action project LIFE Blue Natura (**LIFE14 CCM/ES/000957**) aims to quantify their carbon deposits and sequestration rates. By calculating carbon stocks and carbon flows it will be possible to determine the environmental services created by these habitats and to select pilot sites for conservation and re-vegetation that will have the greatest impact in terms of climate change mitigation. The project will also develop tools and strategies for incorporating blue carbon sinks into the national inventory of greenhouse gases and into carbon trading markets.

Selected projects focusing on coastal habitats since 2006

The table below provides examples of some of the LIFE projects that have focused on coastal habitats since 2006. For more information on individual projects and projects before 2006 visit the online database at http://ec.europa.eu/environment/life/project/Projects/index.cfm.

PROJECT	TITLE
Coastal and halophytic habitats	
1110 - Sandbanks which are slightly covered by sea water all the time	
LIFE06 NAT/P/000192	Restoration and Management of Biodiversity in the Marine Park Site Arrábida-Espichel
LIFE07 NAT/E/000732	Inventory and designation of marine Natura 2000 areas in the Spanish sea
LIFE07 NAT/FIN/000151	Inventories and planning for the marine Natura 2000 network in Finland
LIFE09 NAT/LV/000238	Innovative approaches for marine biodiversity monitoring and assessment of conservation status of nature values in the Baltic Sea
LIFE12 NAT/IT/001185	Land-and-sea actions for conservation of *Caretta caretta* in its most important italian nesting ground (Ionian Calabria)
LIFE12 NAT/MT/000845	Life+ Benthic Habitat Research for marine Natura 2000 site designation
LIFE13 NAT/IT/000115	coAstal laGoon long teRm managEmEnt
LIFE14 NAT/ES/001213	Integration of human activities in the conservation objectives of the Natura 2000 Network in the littoral of Cantabria
***1120 - Posidonia beds (*Posidonion oceanicae*)**	
LIFE06 NAT/IT/000050	Urgent conservation measures for biodiversity of Central Mediterranean Sea
LIFE06 NAT/IT/000053	Management of the network of pSCIs and SPAs in the Cilento National Park
LIFE07 NAT/E/000732	Inventory and designation of marine Natura 2000 areas in the Spanish sea
LIFE09 NAT/ES/000534	Conservation of Posidonia oceanica meadows in Andalusian Mediterranean Sea
LIFE09 NAT/GR/000343	Actions for the conservation of coastal habitats and significant avifauna species in NATURA 2000 network sites of Epanomi and Aggelochori Laggons
LIFE09 NAT/IT/000176	Urgent conservation actions of *Posidonia beds of Northern Latium
LIFE10 NAT/GR/000637	Management of the SPA site of Andros Island to achieve a favourable conservation status for its priority species
LIFE12 NAT/GR/000688	CYCLADES “Integrated monk seal conservation in Northern Cyclades”
LIFE13 NAT/IT/000433	LIFE RES MARIS - Recovering Endangered habitatS in the Capo Carbonara MARIne area; Sardinia
1130 - Estuaries	
LIFE09 NAT/LV/000238	Innovative approaches for marine biodiversity monitoring and assessment of conservation status of nature values in the Baltic Sea
LIFE09 NAT/SE/000345	Grazing and restoration of archipelago and coastal environments
LIFE09 NAT/SI/000376	Man and Nature in Secovlje salt-pans
LIFE14 NAT/ES/001213	Integration of human activities in the conservation objectives of the Natura 2000 Network in the littoral of Cantabria
LIFE14 NAT/FR/000669	Preservation, restoration and valuation of coastal habitats of european interest of the Aiguillon Bay
1140 - Mudflats and sandflats not covered by seawater at low tide	
LIFE06 NAT/NL/000077	Salt Marsh restoration Eastern Scheldt
LIFE09 NAT/ES/000520	Habitat restoration and management in two coastal lagoons of the Ebro Delta: Alfacada y Tancada
LIFE09 NAT/LV/000238	Innovative approaches for marine biodiversity monitoring and assessment of conservation status of nature values in the Baltic Sea
LIFE09 NAT/SI/000376	Man and Nature in Secovlje salt-pans
LIFE12 NAT/IT/000331	Habitat *1150 (Coastal lagoon) recovery by SEagrass RESTOration. A new strategic approach to meet HD & WFD objectives
LIFE12 NAT/IT/001122	An integrated approach to the sustainable conservation of intertidal salt marshes in the lagoon of Venice
LIFE13 NAT/ES/000237	Migratory fish recovery and improved management in the final stretch of the Ebre River
LIFE14 NAT/ES/001213	Integration of human activities in the conservation objectives of the Natura 2000 Network in the littoral of Cantabria
LIFE14 NAT/FR/000669	Preservation, restoration and valuation of coastal habitats of european interest of the Aiguillon Bay

PROJECT	TITLE
***1150 - Coastal lagoons**	
LIFE06 NAT/F/000146	Preservation of the coast biodiversity on the Gâvres-Quiberon site
LIFE06 NAT/IT/000050	Urgent conservation measures for biodiversity of Central Mediterranean Sea
LIFE07 NAT/FIN/000151	Inventories and planning for the marine Natura 2000 network in Finland
LIFE08 NAT/BG/000277	Ensuring Conservation of Priority Bird Species and Coastal Habitats at the Bourgas Natura 2000 Wetland Sites
LIFE08 NAT/E/000077	Decantation circuit of residual salts and ecological recovery of the Natural Park of Las Lagunas de la Mata and Torrevieja
LIFE08 NAT/IT/000339	Oristanese land of waters: a network for the shared management of the SCIs/SPAs of the central-western coastal areas of Sardinia
LIFE08 NAT/UK/000199	The Alde-Ore Estuary - Securing a sustainable future for wildlife
LIFE09 NAT/DK/000371	Restoring dry grasslands at Bøjden Nor with a positive influence on vulnerable coastal lagoon habitat status
LIFE09 NAT/ES/000520	Habitat restoration and management in two coastal lagoons of the Ebro Delta: Alfacada y Tancada
LIFE09 NAT/GR/000343	Actions for the conservation of coastal habitats and significant avifauna species in NATURA 2000 network sites of Epanomi and Aggelochori Laggons, Greece
LIFE09 NAT/IT/000110	Conservation of habitats and species in the Natura 2000 sites in the Po Delta
LIFE09 NAT/IT/000150	Conservation actions of habitats in the coastal wetlands of SCI Wetlands of Capitanata
LIFE09 NAT/IT/000608	Restoration of Sentina coastal wetlands
LIFE10 NAT/EE/000107	Restoration and Public Access of Urban Coastal Meadow Complex in Parnu Town
LIFE10 NAT/IT/000244	LIFE+ Ponds: Environment and nature restoration in Casaraccio
LIFE10 NAT/IT/000256	Environmental Management and Restoration of Mediterranean Salt Works and Coastal Lagoons
LIFE11 NAT/BG/000362	Urgent Measures to Restore and Secure Long-term Preservation of the Atanasovsko Lake Coastal Lagoon
LIFE11 NAT/IT/000175	Habitat restoration actions in the SCI “Ofanto Valley - Lake Capacciotti”
LIFE12 NAT/IT/000331	Habitat *1150 (Coastal lagoon) recovery by SEagrass RESTOration. A new strategic approach to meet HD & WFD objectives
LIFE12 NAT/IT/001122	An integrated approach to the sustainable conservation of intertidal salt marshes in the lagoon of Venice
LIFE13 NAT/ES/000237	Migratory fish recovery and improved management in the final stretch of the Ebre River
LIFE13 NAT/ES/000586	Preservation and improvement in priority habits on the Andalusian coast
LIFE13 NAT/ES/001001	De-urbanizing and recovering the ecological functioning of the coastal systems of La Pletera
LIFE13 NAT/IT/000115	coAstal laGoon long teRm managEmEnt
1160 - Large shallow inlets and bays	
LIFE06 NAT/NL/000071	Restoration of Brackish Marsh for Root Vole, Waders and Terns
LIFE06 NAT/NL/000077	Salt Marsh restoration Eastern Scheldt
LIFE07 NAT/FIN/000151	Inventories and planning for the marine Natura 2000 network in Finland
1170 - Reefs	
LIFE06 NAT/DK/000159	Rebuilding of Marine Cavernous Boulder Reefs in Kattegat
LIFE06 NAT/P/000192	Restoration and Management of Biodiversity in the Marine Park Site Arrábida-Espichel
LIFE07 NAT/E/000732	Inventory and designation of marine Natura 2000 areas in the Spanish sea
LIFE07 NAT/FIN/000151	Inventories and planning for the marine Natura 2000 network in Finland
LIFE09 NAT/LV/000238	Innovative approaches for marine biodiversity monitoring and assessment of conservation status of nature values in the Baltic Sea
LIFE12 NAT/GR/000688	CYCLADES “Integrated monk seal conservation in Northern Cyclades”
LIFE12 NAT/IT/000370	SPIN Strategy for the Implementation of Natura 2000 in Sicily
LIFE12 NAT/IT/001185	Land-and-sea actions for conservation of *Caretta caretta* in its most important italian nesting ground (Ionian Calabria)
LIFE12 NAT/MT/000845	Life+ Benthic Habitat Research for marine Natura 2000 site designation
1180 - Submarine structures made by leaking gases	
LIFE07 NAT/E/000732	Inventory and designation of marine Natura 2000 areas in the Spanish sea
LIFE07 NAT/FIN/000151	Inventories and planning for the marine Natura 2000 network in Finland
1210 - Annual vegetation of drift lines	
LIFE06 NAT/F/000146	Preservation of the coast biodiversity on the Gâvres-Quiberon site
LIFE06 NAT/IT/000050	Urgent conservation measures for biodiversity of Central Mediterranean Sea
LIFE06 NAT/IT/000053	Management of the network of pSCIs and SPAs in the Cilento National Park
LIFE08 NAT/UK/000199	The Alde-Ore Estuary - Securing a sustainable future for wildlife
LIFE12 NAT/IT/001122	An integrated approach to the sustainable conservation of intertidal salt marshes in the lagoon of Venice

PROJECT	TITLE
LIFE12 NAT/IT/001185	Land-and-sea actions for conservation of *Caretta caretta* in its most important italian nesting ground (Ionian Calabria)
LIFE13 NAT/ES/000237	Migratory fish recovery and improved management in the final stretch of the Ebre River
LIFE13 NAT/ES/000883	In situ and Ex situ innovative combined techniques for coastal dune habitats restoration in SCIs of northern Spain
LIFE13 NAT/FI/000099	Light & Fire open the Doors for Biodiversity -LIFE
LIFE13 NAT/IT/000471	Island conservation in Tuscany, restoring habitat not only for birds
1220 - Perennial vegetation of stony banks	
LIFE08 NAT/UK/000199	The Alde-Ore Estuary - Securing a sustainable future for wildlife
LIFE13 NAT/FI/000099	Light & Fire open the Doors for Biodiversity -LIFE
1230 - Vegetated sea cliffs of the Atlantic and Baltic Coasts	
LIFE06 NAT/F/000146	Preservation of the coast biodiversity on the Gâvres-Quiberon site
1240 - Vegetated sea cliffs of the Mediterranean coasts with *endemic Limonium spp.*	
LIFE06 NAT/IT/000053	Management of the network of pSCIs and SPAs in the Cilento National Park
LIFE06 NAT/MT/000097	SPA Site and Sea Actions Saving Puffinus yelkouan in Malta
LIFE11 NAT/IT/000093	Conservation of the main European population of *Calonectris d. diomedea* and other pelagic birds on Pelagic Islands
LIFE13 NAT/IT/000471	Island conservation in Tuscany, restoring habitat not only for birds
LIFE14 NAT/IT/000544	Restoring the Pontine Archipelago ecosystem through management of rats and other invasive alien species
1250 - Vegetated sea cliffs with endemic flora of the Macaronesian coasts	
LIFE07 NAT/P/000649	Safe islands for seabirds/ Initiating the restoration of seabird-driven ecosystems in the Azores
LIFE09 NAT/PT/000041	Halt the loss of European Biodiversity through the recovery of habitats and species of the islets of Porto Santo and surrounding marine area
LIFE12 NAT/PT/000195	Recovery of the species and land habitats of the Natura 2000 sites Ponta de São Lourenço and Desertas Islands
1310 - Salicornia and other annuals colonizing mud and sand	
LIFE06 NAT/E/000213	Wetland restoration and management: Canal de Castilla Special Protection Area
LIFE06 NAT/IT/000050	Urgent conservation measures for biodiversity of Central Mediterranean Sea
LIFE06 NAT/NL/000071	Restoration of Brackish Marsh for Root Vole, Waders and Terns
LIFE06 NAT/NL/000077	Salt Marsh restoration Eastern Scheldt
LIFE08 NAT/E/000077	Decantation circuit of residual salts and ecological recovery of the Natural Park of Las Lagunas de la Mata and Torrevieja
LIFE08 NAT/IT/000339	Oristanese land of waters: a network for the shared management of the SCIs/SPAs of the central-western coastal areas of Sardinia
LIFE09 NAT/BE/000413	Zwin Tidal Area Restoration
LIFE09 NAT/IT/000110	Conservation of habitats and species in the Natura 2000 sites in the Po Delta
LIFE09 NAT/IT/000608	Restoration of Sentina coastal wetlands
LIFE09 NAT/SI/000376	Man and Nature in Secovlje salt-pans
LIFE10 NAT/ES/000563	Restoration of salt flats around 27 endorheic wetland areas in La Mancha
LIFE10 NAT/IT/000256	Environmental Management and Restoration of Mediterranean Salt Works and Coastal Lagoons
LIFE11 NAT/BG/000362	Urgent Measures to Restore and Secure Long-term Preservation of the Atanasovsko Lake Coastal Lagoon
LIFE12 NAT/BE/000252	Grassland restoration in the East Coast polders
LIFE12 NAT/BE/000631	FLemish And North-French Dunes REstoration
LIFE12 NAT/ES/000180	Monitoring network for plant species and habitats of Community interest in Aragón
LIFE12 NAT/IT/001122	An integrated approach to the sustainable conservation of intertidal salt marshes in the lagoon of Venice
LIFE13 NAT/ES/000237	Migratory fish recovery and improved management in the final stretch of the Ebre River
LIFE13 NAT/IT/000471	Island conservation in Tuscany, restoring habitat not only for birds
LIFE14 NAT/ES/001213	Integration of human activities in the conservation objectives of the Natura 2000 Network in the littoral of Cantabria
1320 - Spartina swards (*Spartinion maritimae*)	
LIFE06 NAT/NL/000077	Salt Marsh restoration Eastern Scheldt
LIFE08 NAT/IT/000339	Oristanese land of waters: a network for the shared management of the SCIs/SPAs of the central-western coastal areas of Sardinia.
LIFE09 NAT/SI/000376	Man and Nature in Secovlje salt-pans
LIFE12 NAT/IT/001122	An integrated approach to the sustainable conservation of intertidal salt marshes in the lagoon of Venice
LIFE13 NAT/ES/000237	Migratory fish recovery and improved management in the final stretch of the Ebre River
LIFE14 NAT/ES/001213	Integration of human activities in the conservation objectives of the Natura 2000 Network in the littoral of Cantabria

PROJECT	TITLE
1330 - Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	
LIFE06 NAT/B/000087	Zwindunes Ecological Nature Optimalisation
LIFE06 NAT/DK/000158	Restoration of Meadow Bird Habitats
LIFE06 NAT/F/000146	Preservation of the coast biodiversity on the Gâvres-Quiberon site
LIFE06 NAT/NL/000071	Restoration of Brackish Marsh for Root Vole, Waders and Terns
LIFE06 NAT/NL/000076	Restoration of brackish ecosystems in Westzaan polder
LIFE06 NAT/NL/000077	Salt Marsh restoration Eastern Scheldt
LIFE08 NAT/DK/000465	Restoring semi-natural habitat types to a total cover of site Helnæs
LIFE09 NAT/BE/000413	Zwin Tidal Area Restoration
LIFE09 NAT/DK/000371	Restoring dry grasslands at Bøjden Nor with a positive influence on vulnerable coastal lagoon habitat status
LIFE11 NAT/DK/000893	LIFE LAESOE - restoration of birdlife and natural habitats at Laesoe
LIFE12 NAT/BE/000252	Grassland restoration in the East Coast polders
LIFE12 NAT/BE/000631	FLemish And North-French Dunes REstoration
LIFE13 NAT/ES/000899	Biodiversity conservation in river Miera
LIFE14 NAT/ES/000699	Green Belt of Bay of Santander: connecting nature and city
LIFE14 NAT/ES/001213	Integration of human activities in the conservation objectives of the Natura 2000 Network in the littoral of Cantabria
LIFE14 NAT/FR/000669	Preservation, restoration and valuation of coastal habitats of european interest of the Aiguillon Bay
1410 - Mediterranean salt meadows (*Juncetalia maritimi*)	
LIFE06 NAT/E/000213	Wetland restoration and management: Canal de Castilla Special Protection Area
LIFE06 NAT/F/000147	Preservation and restoration of the Rochefort marshes biological functions
LIFE06 NAT/IT/000050	Urgent conservation measures for biodiversity of Central Mediterranean Sea
LIFE07 NAT/E/000756	Priority species' habitats restoration in the island of Menorca
LIFE07 NAT/F/000193	Creating an experimental and demonstrative network of lagoon and dune Natura 2000 sites on the mediterranean coastline of Languedoc-Roussillon
LIFE07 NAT/IT/000507	Conservation actions for priority bird life in Lake Salso Oasis
LIFE08 NAT/E/000055	Restoration of habitats of Community interest in the Basque Country's estuaries
LIFE08 NAT/IT/000339	Oristanese land of waters: a network for the shared management of the SCIs/SPAs of the central-western coastal areas of Sardinia
LIFE09 NAT/ES/000520	Habitat restoration and management in two coastal lagoons of the Ebro Delta: Alfacada y Tancada
LIFE09 NAT/IT/000110	Conservation of habitats and species in the Natura 2000 sites in the Po Delta
LIFE09 NAT/IT/000608	Restoration of Sentina coastal wetlands
LIFE09 NAT/SI/000376	Man and Nature in Secovlje salt-pans
LIFE10 NAT/ES/000563	Restoration of salt flats around 27 endorheic wetland areas in La Mancha
LIFE10 NAT/IT/000256	Environmental Management and Restoration of Mediterranean Salt Works and Coastal Lagoons
LIFE11 NAT/BG/000362	Urgent Measures to Restore and Secure Long-term Preservation of the Atanasovsko Lake Coastal Lagoon
LIFE11 NAT/ES/000707	Inland wetlands of Northern Iberian Peninsula: management and restoration of mires and wet environments
LIFE12 NAT/IT/001122	An integrated approach to the sustainable conservation of intertidal salt marshes in the lagoon of Venice
LIFE13 NAT/ES/000237	Migratory fish recovery and improved management in the final stretch of the Ebre River
LIFE13 NAT/ES/000899	Biodiversity conservation in river Miera
LIFE13 NAT/IT/000115	coAstal laGoon long teRm managEmEnt
LIFE14 NAT/ES/000699	Green Belt of Bay of Santander: connecting nature and city
1420 - Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)	
LIFE06 NAT/IT/000050	Urgent conservation measures for biodiversity of Central Mediterranean Sea
LIFE08 NAT/E/000055	Restoration of habitats of Community interest in the Basque Country's estuaries.
LIFE09 NAT/ES/000520	Habitat restoration and management in two coastal lagoons of the Ebro Delta: Alfacada y Tancada
LIFE09 NAT/IT/000110	Conservation of habitats and species in the Natura 2000 sites in the Po Delta
LIFE09 NAT/IT/000608	Restoration of Sentina coastal wetlands
LIFE09 NAT/SI/000376	Man and Nature in Secovlje salt-pans
LIFE10 NAT/IT/000256	Environmental Management and Restoration of Mediterranean Salt Works and Coastal Lagoons
LIFE12 NAT/IT/000331	Habitat *1150 (Coastal lagoon) recovery by SEagrass RESTOration. A new strategic approach to meet HD & WFD objectives

PROJECT	TITLE
LIFE13 NAT/ES/000237	Migratory fish recovery and improved management in the final stretch of the Ebre River
LIFE13 NAT/ES/000899	Biodiversity conservation in river Miera
LIFE14 NAT/ES/000699	Green Belt of Bay of Santander: connecting nature and city
LIFE14 NAT/ES/001213	Integration of human activities in the conservation objectives of the Natura 2000 Network in the littoral of Cantabria
1430 - Halo-nitrophilous scrubs (*Pegano-Salsoletea*)	
LIFE13 NAT/ES/000237	Migratory fish recovery and improved management in the final stretch of the Ebre River
***1510 - Mediterranean salt steppes (*Limonietalia*)**	
LIFE07 NAT/E/000756	Priority species' habitats restoration in the island of Menorca
LIFE08 NAT/E/000077	Decantation circuit of residual salts and ecological recovery of the Natural Park of Las Lagunas de la Mata and Torrevieja
LIFE08 NAT/IT/000339	Oristanese land of waters: a network for the shared management of the SCIs/SPAs of the central-western coastal areas of Sardinia
LIFE09 NAT/ES/000520	Habitat restoration and management in two coastal lagoons of the Ebro Delta: Alfacada y Tancada
LIFE09 NAT/GR/000343	Actions for the conservation of coastal habitats and significant avifauna species in NATURA 2000 network sites of Epanomi and Aggelochori Laggons, Greece
LIFE09 NAT/IT/000110	Conservation of habitats and species in the Natura 2000 sites in the Po Delta
LIFE09 NAT/IT/000150	Conservation actions of habitats in the coastal wetlands of SCI Wetlands of Capitanata
LIFE10 NAT/IT/000256	Environmental Management and Restoration of Mediterranean Salt Works and Coastal Lagoons
LIFE10 NAT/IT/000262	Actions for the recovery and the conservation of dune and back dune habitats in the Molise Region
LIFE11 NAT/IT/000175	Habitat restoration actions in the SCI "Ofanto Valley - Lake Capacciotti"
LIFE12 NAT/IT/000416	Protection of the largest population of Puffinus yelkouan on Earth and containment and eradication of invasive alien species
LIFE12 NAT/IT/001122	An integrated approach to the sustainable conservation of intertidal salt marshes in the lagoon of Venice
LIFE13 NAT/ES/000237	Migratory fish recovery and improved management in the final stretch of the Ebre River
LIFE13 NAT/ES/000586	Preservation and improvement in priority habits on the Andalusian coast
1610 - "Baltic esker islands with sandy, rocky and shingle beach vegetation and sublittoral vegetation"	
LIFE07 NAT/FIN/000151	Inventories and planning for the marine Natura 2000 network in Finland
LIFE08 NAT/S/000262	Traditionella fodermarker i mellansverige (Pastures and meadows in the middlemost part of Sweden)
LIFE13 NAT/FI/000099	Light & Fire open the Doors for Biodiversity -LIFE
1620 - Boreal Baltic islets and small islands	
LIFE07 NAT/FIN/000151	Inventories and planning for the marine Natura 2000 network in Finland
***1630 - Boreal Baltic coastal meadows**	
LIFE06 NAT/FIN/000129	From Ancient to the Present Estuary, Kokemäenjoki Wetland Chain
LIFE08 NAT/S/000262	Traditionella fodermarker i mellansverige (Pastures and meadows in the middlemost part of Sweden)
LIFE09 NAT/SE/000345	Grazing and restoration of archipelago and coastal environments
LIFE10 NAT/EE/000107	Restoration and Public Access of Urban Coastal Meadow Complex in Parnu Town
LIFE10 NAT/FI/000048	Improving the Conservation Status of Species-rich Habitats
LIFE12 NAT/SE/000131	Restoration of ancient agricultural landscape, natural forests and wetlands at the Baltic coast
LIFE13 NAT/FI/000099	Light & Fire open the Doors for Biodiversity -LIFE
1640 - Boreal Baltic sandy beaches with perennial vegetation	
LIFE13 NAT/FI/000099	Light & Fire open the Doors for Biodiversity -LIFE
1650 - Boreal Baltic narrow inlets	
LIFE07 NAT/FIN/000151	Inventories and planning for the marine Natura 2000 network in Finland
Coastal sand dunes and inland dunes	
2110 - Embryonic shifting dunes	
LIFE06 NAT/F/000146	Preservation of the coast biodiversity on the Gâvres-Quiberon site
LIFE06 NAT/IT/000050	Urgent conservation measures for biodiversity of Central Mediterranean Sea
LIFE07 NAT/F/000193	Creating an experimental and demonstrative network of lagoon and dune Natura 2000 sites on the mediterranean coastline of Languedoc-Roussillon
LIFE07 NAT/IT/000519	Conservation and recovery of dune priority habitats among the sites of Cagliari; Caserta; Matera provinces
LIFE11 NAT/BG/000362	Urgent Measures to Restore and Secure Long-term Preservation of the Atanasovsko Lake Coastal Lagoon
LIFE11 NAT/IT/000232	Dune habitats protection in the greenhouse landscape of the Gela Gulf for the safeguarding of Leopoldia gussonei

PROJECT	TITLE
LIFE12 NAT/BE/000631	FLemish And North-French Dunes REstoration
LIFE12 NAT/IT/001185	Land-and-sea actions for conservation of *Caretta caretta* in its most important italian nesting ground (Ionian Calabria)
LIFE13 NAT/ES/000237	Migratory fish recovery and improved management in the final stretch of the Ebre River
LIFE13 NAT/ES/000883	In situ and Ex situ innovative combined techniques for coastal dune habitats restoration in SCIs of northern Spain
LIFE13 NAT/ES/000899	Biodiversity conservation in river Miera
LIFE13 NAT/FI/000099	Light & Fire open the Doors for Biodiversity -LIFE
LIFE13 NAT/IT/000471	Island conservation in Tuscany; restoring habitat not only for birds
LIFE13 NAT/IT/001013	Safeguard and management Of South-western Sardinian Dunes - A project for the pilot area of Porto Pino
LIFE14 NAT/ES/000699	Green Belt of Bay of Santander: connecting nature and city
LIFE14 NAT/ES/001213	Integration of human activities in the conservation objectives of the Natura 2000 Network in the littoral of Cantabria
2120 - Shifting dunes along the shoreline with Ammophila arenaria ("white dunes")	
LIFE06 NAT/B/000087	Zwindunes Ecological Nature Optimalisation
LIFE06 NAT/F/000146	Preservation of the coast biodiversity on the Gâvres-Quiberon site
LIFE06 NAT/IT/000050	Urgent conservation measures for biodiversity of Central Mediterranean Sea
LIFE07 NAT/F/000193	Creating an experimental and demonstrative network of lagoon and dune Natura 2000 sites on the mediterranean coastline of Languedoc-Roussillon
LIFE07 NAT/IT/000519	Conservation and recovery of dune priority habitats among the sites of Cagliari; Caserta; Matera provinces
LIFE08 NAT/IT/000353	Montecristo 2010: eradication of invasive plant and animal aliens and conservation of species/habitats in the Tuscan Archipelago, Italy
LIFE09 NAT/BE/000413	Zwin Tidal Area Restoration
LIFE09 NAT/NL/000417	Revitalising the Noordduinen : from concrete surfaces to grey dune habitats
LIFE09 NAT/NL/000418	Realisation of Natura 2000 targets for calcareous white; grey dunes and dune slacks in three Dutch dune sites
LIFE10 NAT/IT/000256	Environmental Management and Restoration of Mediterranean Salt Works and Coastal Lagoons
LIFE11 NAT/IT/000232	Dune habitats protection in the greenhouse landscape of the Gela Gulf for the safeguarding of Leopoldia gussonei
LIFE12 NAT/BE/000631	FLemish And North-French Dunes REstoration
LIFE12 NAT/DK/001073	Restoration of Danish Coastal Habitats
LIFE12 NAT/IT/001185	Land-and-sea actions for conservation of *Caretta caretta* in its most important italian nesting ground (Ionian Calabria)
LIFE13 NAT/ES/000237	Migratory fish recovery and improved management in the final stretch of the Ebre River
LIFE13 NAT/ES/000883	In situ and Ex situ innovative combined techniques for coastal dune habitats restoration in SCIs of northern Spain
LIFE13 NAT/FI/000099	Light & Fire open the Doors for Biodiversity -LIFE
LIFE13 NAT/IT/001013	Safeguard and management Of South-western Sardinian Dunes - A project for the pilot area of Porto Pino
***2130 - Fixed coastal dunes with herbaceous vegetation ("grey dunes")**	
LIFE06 NAT/B/000087	Zwindunes Ecological Nature Optimalisation
LIFE06 NAT/F/000146	Preservation of the coast biodiversity on the Gâvres-Quiberon site
LIFE06 NAT/IT/000053	Management of the network of pSCIs and SPAs in the Cilento National Park
LIFE07 NAT/E/000756	Priority species' habitats restoration in the island of Menorca
LIFE08 NAT/DK/000464	Dry Grassland in Denmark - Restoration and Conservation
LIFE08 NAT/IT/000339	Oristanese land of waters: a network for the shared management of the SCIs/SPAs of the central-western coastal areas of Sardinia
LIFE09 NAT/BE/000413	Zwin Tidal Area Restoration
LIFE09 NAT/NL/000417	Revitalising the Noordduinen : from concrete surfaces to grey dune habitats
LIFE09 NAT/NL/000418	Realisation of Natura 2000 targets for calcareous white; grey dunes and dune slacks in three Dutch dune sites
LIFE11 NAT/DK/000893	LIFE LAESOE - restoration of birdlife and natural habitats at Laesoe
LIFE11 NAT/NL/000776	Amsterdam Dune project - 'Amsterdam Dunes - source for nature', dune habitat restoration project
LIFE11 NAT/SE/000849	Restoration of habitats on sandy soils in southern Sweden
LIFE12 NAT/BE/000631	FLemish And North-French Dunes REstoration
LIFE12 NAT/DK/000803	Restoration of Wet Habitats in the Jerup Beach Ridge Plain
LIFE12 NAT/DK/001073	Restoration of Danish Coastal Habitats
LIFE13 NAT/DK/001357	Restoration of wetlands in dune habitats
LIFE13 NAT/ES/000586	Preservation and improvement in priority habits on the Andalusian coast

PROJECT	TITLE
LIFE13 NAT/ES/000883	In situ and Ex situ innovative combined techniques for coastal dune habitats restoration in SCIs of northern Spain
LIFE13 NAT/ES/000899	Biodiversity conservation in river Miera
LIFE13 NAT/FI/000099	Light & Fire open the Doors for Biodiversity -LIFE
LIFE14 NAT/ES/000699	Green Belt of Bay of Santander: connecting nature and city
LIFE14 NAT/FR/000669	Preservation; restoration and valuation of coastal habitats of european interest of the Aiguillon Bay
2140 - Decalcified fixed dunes with *Empetrum nigrum	
LIFE08 NAT/DK/000464	Dry Grassland in Denmark - Restoration and Conservation
LIFE11 NAT/DK/000893	LIFE LAESOE - restoration of birdlife and natural habitats at Laesoe
LIFE11 NAT/SE/000849	Restoration of habitats on sandy soils in southern Sweden
LIFE12 NAT/DK/000803	Restoration of Wet Habitats in the Jerup Beach Ridge Plain
LIFE12 NAT/DK/001073	Restoration of Danish Coastal Habitats
LIFE13 NAT/DK/001357	Restoration of wetlands in dune habitats
LIFE13 NAT/FI/000099	Light & Fire open the Doors for Biodiversity -LIFE
***2150 - Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)**	
LIFE12 NAT/BE/000631	FLemish And North-French Dunes REstoration
LIFE13 NAT/ES/000586	Preservation and improvement in priority habits on the Andalusian coast
2160 - Dunes with *Hippophaë rhamnoides*	
LIFE06 NAT/RO/000177	Conservation and integrated management of Danube islands Romania
LIFE11 NAT/NL/000776	'Amsterdam Dunes - source for nature'; dune habitat restoration project
LIFE12 NAT/BE/000631	FLemish And North-French Dunes REstoration
2170 - Dunes with Salix repens ssp. argentea (*Salicion arenariae*)	
LIFE06 NAT/F/000146	Preservation of the coast biodiversity on the Gâvres-Quiberon site
LIFE12 NAT/BE/000631	FLemish And North-French Dunes REstoration
2180 - "Wooded dunes of the Atlantic; Continental and Boreal region"	
LIFE11 NAT/SE/000849	Restoration of habitats on sandy soils in southern Sweden
LIFE12 NAT/BE/000631	FLemish And North-French Dunes REstoration
LIFE12 NAT/DK/001073	Restoration of Danish Coastal Habitats
LIFE13 NAT/FI/000099	Light & Fire open the Doors for Biodiversity -LIFE
2190 - Humid dune slacks	
LIFE06 NAT/B/000087	Zwindunes Ecological Nature Optimalisation
LIFE06 NAT/F/000146	Preservation of the coast biodiversity on the Gâvres-Quiberon site
LIFE06 NAT/IT/000050	Urgent conservation measures for biodiversity of Central Mediterranean Sea
LIFE06 NAT/NL/000077	Salt Marsh restoration Eastern Scheldt
LIFE07 NAT/F/000193	Creating an experimental and demonstrative network of lagoon and dune Natura 2000 sites on the mediterranean coastline of Languedoc-Roussillon
LIFE09 NAT/BE/000413	Zwin Tidal Area Restoration
LIFE09 NAT/NL/000417	Revitalising the Noordduinen: from concrete surfaces to grey dune habitats
LIFE09 NAT/NL/000418	Realisation of Natura 2000 targets for calcareous white; grey dunes and dune slacks in three Dutch dune sites
LIFE11 NAT/NL/000776	'Amsterdam Dunes - source for nature'; dune habitat restoration project
LIFE11 NAT/SE/000849	Restoration of habitats on sandy soils in southern Sweden
LIFE12 NAT/BE/000631	FLemish And North-French Dunes REstoration
LIFE12 NAT/DK/000803	Restoration of Wet Habitats in the Jerup Beach Ridge Plain
LIFE12 NAT/DK/001073	Restoration of Danish Coastal Habitats
LIFE13 NAT/DK/001357	Restoration of wetlands in dune habitats
LIFE13 NAT/ES/000237	Migratory fish recovery and improved management in the final stretch of the Ebre River
LIFE13 NAT/FI/000099	Light & Fire open the Doors for Biodiversity -LIFE
21A0 - Machairs (* in Ireland)	
LIFE08 NAT/UK/000204	Conserving machair habitats and species in a suite of Scottish Natura sites
LIFE12 NAT/IE/000995	The sustainable management of the priority terrestrial Habitats Directive Annex 1 habitats of the Aran Islands

PROJECT	TITLE
2210 - Crucianellion maritimae fixed beach dunes	
LIFE06 NAT/IT/000050	Urgent conservation measures for biodiversity of Central Mediterranean Sea
LIFE07 NAT/F/000193	Creating an experimental and demonstrative network of lagoon and dune Natura 2000 sites on the mediterranean coastline of Languedoc-Roussillon
LIFE11 NAT/IT/000232	Dune habitats protection in the greenhouse landscape of the Gela Gulf for the safeguarding of Leopoldia gussonei
LIFE12 NAT/IT/000416	Protection of the largest population of Puffinus yelkouan on Earth and containment and eradication of invasive alien species
LIFE13 NAT/ES/000237	Migratory fish recovery and improved management in the final stretch of the Ebre River
LIFE13 NAT/IT/000471	Island conservation in Tuscany; restoring habitat not only for birds
LIFE13 NAT/IT/001013	Safeguard and management Of South-western Sardinian Dunes - A project for the pilot area of Porto Pino
2230 - Malcolmietalia dune grasslands	
LIFE06 NAT/B/000084	Large-scale Habitat Restoration in "Turnhouts Vennengebied"
LIFE06 NAT/IT/000050	Urgent conservation measures for biodiversity of Central Mediterranean Sea
LIFE08 NAT/IT/000339	Oristanese land of waters: a network for the shared management of the SCIs/SPAs of the central-western coastal areas of Sardinia
LIFE11 NAT/IT/000232	Dune habitats protection in the greenhouse landscape of the Gela Gulf for the safeguarding of Leopoldia gussonei
LIFE12 NAT/IT/000416	Protection of the largest population of Puffinus yelkouan on Earth and containment and eradication of invasive alien species
LIFE12 NAT/IT/001185	Land-and-sea actions for conservation of *Caretta caretta* in its most important italian nesting ground (Ionian Calabria)
LIFE13 NAT/ES/000237	Migratory fish recovery and improved management in the final stretch of the Ebre River
LIFE13 NAT/IT/000471	Island conservation in Tuscany; restoring habitat not only for birds
LIFE13 NAT/IT/001013	Safeguard and management Of South-western Sardinian Dunes - A project for the pilot area of Porto Pino
2240 - Brachypodietalia dune grasslands with annuals	
LIFE06 NAT/B/000081	Habitat restoration in Averbode Bos en Heide
LIFE06 NAT/IT/000050	Urgent conservation measures for biodiversity of Central Mediterranean Sea
2250 - Coastal dunes with *Juniperus spp.	
LIFE06 NAT/E/000209	Conservation and reintroduction of the Iberian lynx in Andalucia
LIFE06 NAT/IT/000050	Urgent conservation measures for biodiversity of Central Mediterranean Sea
LIFE06 NAT/IT/000053	Management of the network of pSCIs and SPAs in the Cilento National Park
LIFE07 NAT/F/000193	Creating an experimental and demonstrative network of lagoon and dune Natura 2000 sites on the mediterranean coastline of Languedoc-Roussillon
LIFE07 NAT/GR/000296	Actions for the conservation of coastal dunes with Juniperus spp. in Crete and the South Aegean (Greece)
LIFE07 NAT/IT/000519	Conservation and recovery of dune priority habitats among the sites of Cagliari; Caserta; Matera provinces
LIFE09 NAT/IT/000150	Conservation actions of habitats in the coastal wetlands of SCI Wetlands of Capitanata
LIFE10 NAT/IT/000262	Actions for the recovery and the conservation of dune and back dune habitats in the Molise Region
LIFE11 NAT/IT/000175	Habitat restoration actions in the SCI "Ofanto Valley - Lake Capacciotti"
LIFE11 NAT/IT/000232	Dune habitats protection in the greenhouse landscape of the Gela Gulf for the safeguarding of Leopoldia gussonei
LIFE12 NAT/IT/000416	Protection of the largest population of Puffinus yelkouan on Earth and containment and eradication of invasive alien species
LIFE13 NAT/IT/000433	LIFE RES MARIS - Recovering Endangered habitatS in the Capo Carbonara MARIne area; Sardinia
LIFE13 NAT/IT/000471	Island conservation in Tuscany; restoring habitat not only for birds
LIFE13 NAT/IT/001013	Safeguard and management Of South-western Sardinian Dunes - A project for the pilot area of Porto Pino
2260 - Cisto-Lavenduletalia dune sclerophyllous scrubs	
LIFE13 NAT/IT/000471	Island conservation in Tuscany; restoring habitat not only for birds
2270 - Wooded dunes with *Pinus pinea* and/or *Pinus pinaster	
LIFE06 NAT/IT/000050	Urgent conservation measures for biodiversity of Central Mediterranean Sea
LIFE06 NAT/IT/000053	Management of the network of pSCIs and SPAs in the Cilento National Park
LIFE07 NAT/F/000193	Creating an experimental and demonstrative network of lagoon and dune Natura 2000 sites on the mediterranean coastline of Languedoc-Roussillon
LIFE07 NAT/IT/000519	Conservation and recovery of dune priority habitats among the sites of Cagliari; Caserta; Matera provinces
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LIFE10 NAT/IT/000262	Actions for the recovery and the conservation of dune and back dune habitats in the Molise Region
LIFE13 NAT/ES/000586	Preservation and improvement in priority habits on the Andalusian coast
LIFE13 NAT/IT/000433	LIFE RES MARIS - Recovering Endangered habitatS in the Capo Carbonara MARIne area; Sardinia
LIFE13 NAT/IT/001013	Safeguard and management Of South-western Sardinian Dunes - A project for the pilot area of Porto Pino

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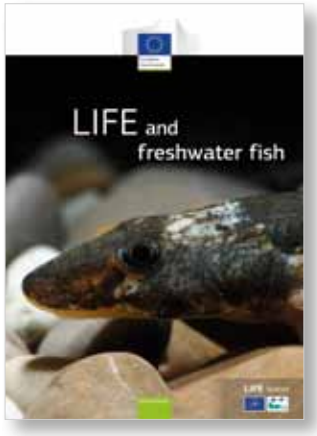

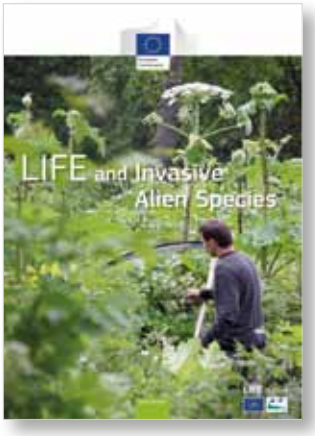

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LIFE "L'Instrument Financier pour l'Environnement" / The financial instrument for the environment

The LIFE programme is the EU's funding instrument for the environment and climate action

Period covered 2014-2020

EU funding available approximately €3.46 billion

Allocation of funds Of the €3.46 billion allocated to LIFE, €2.59 billion are for the Environment sub-programme, and €0.86 billion are for the Climate Action sub-programme. At least €2.8 billion (81% of the total budget) are earmarked for LIFE projects financed through action grants or innovative financial instruments. About €0.7 billion will go to integrated projects. At least 55% of the budgetary resources allocated to projects supported through action grants under the sub-programme for Environment will be used for projects supporting the conservation of nature and biodiversity. A maximum of €0.62 billion will be used directly by DG Environment and DG Climate Action for policy development and operating grants.

Types of projects Action Grants for the Environment and Climate Action sub-programmes are available for the following:

> "Traditional" projects – these may be best-practice, demonstration, pilot or information, awareness and dissemination projects in any of the following priority areas: LIFE Nature & Biodiversity; LIFE Environment & Resource Efficiency; LIFE Environmental Governance & Information; LIFE Climate Change Mitigation; LIFE Climate Change Adaptation; LIFE Climate Governance and Information.

> Preparatory projects – these address specific needs for the development and implementation of Union environmental or climate policy and legislation.

> Integrated projects – these implement on a large territorial scale environmental or climate plans or strategies required by specific Union environmental or climate legislation.

> Technical assistance projects – these provide financial support to help applicants prepare integrated projects.

> Capacity building projects – these provide financial support to activities required to build the capacity of Member States, including LIFE national or regional contact points, with a view to enabling Member States to participate more effectively in the LIFE programme.

Further information More information on LIFE is available at http://ec.europa.eu/life.

How to apply for LIFE funding The European Commission organises annual calls for proposals. Full details are available at http://ec.europa.eu/environment/life/funding/life.htm

Contact

European Commission – Directorate-General for the Environment – B-1049 Brussels (env-life@ec.europa.eu).
European Commission – Directorate-General for Climate Action – B-1049 Brussels (clima-life@ec.europa.eu).
European Commission – EASME – B-1049 Brussels (easme-life@ec.europa.eu).

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LIFE Publication / LIFE and Coastal Habitats

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