



LIFE and coastal management



LIFE Environment

Environment



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Foreword



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Coastal zones are among the most productive areas in the world, enjoying high ecological and economic value. They offer a wide variety of valuable habitats and ecosystems services that have always attracted humans and human activities. Currently, more than 40% of European citizens live near coastlines, stretching from the North-East Atlantic and the Baltic to the Mediterranean and Black Sea. This intensive concentration of population and excessive exploitation of natural resources puts enormous pressure on our coastal ecosystems leading to biodiversity loss and habitat destruction.

Coastal zones are also among the most vulnerable areas to climate change. Risks include flooding, erosion, sea level rise as well as extreme weather events. These impacts are far reaching and are already changing the lives and livelihoods of coastal communities. Within the European Union, it is estimated that 13 million people are threatened with displacement if sea levels rise by one metre, with a yearly bill for inaction of up to €6 billion.

Because the well-being of populations and the economic viability of many businesses in coastal zones depend on the environmental status of these areas, it is essential to make use of long term management tools, such as Integrated Coastal Zone Management (ICZM), to enhance the protection of coastal resources whilst increasing the efficiency of their uses.

The EU, aware of these multiple and sensitive issues, has promoted, in particular through a Recommendation issued in 2002, the integrated, cross-sectoral management of coastal areas and cross-border cooperation. Indeed a sectoral approach and the lack of such cooperation lead to disconnected decisions that risk undermining each other and preclude synergies. The Recommendation on ICZM, and the ratification of the ICZM Protocol to the Barcelona Convention for the Mediterranean in 2010, offer harmonised policy tools facilitating the implementation of integrated policies.

Within this context, and within the larger framework of the Integrated Maritime Policy, the European Commission has launched and financed a number of projects and initiatives supporting or illustrating this approach. The LIFE programme (the EU's financial instrument for the Environment) is one of the main EU funding instruments supporting the adoption and implementation of concrete ICZM projects and the development of best practices in managing coastal zones.

This LIFE Focus brochure provides an overview of various projects that contribute to the knowledge, protection, and sustainable use of the coastline environment. It provides excellent examples of how policy has fed into practice for the benefit of Europe's coastal regions.

Astrid SCHOMAKER



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INTRODUCTION

Integrated coastal zone management policy

Coastal regions are of strategic and critical importance to the EU. However, increasing pressures on these regions are tending to deplete resources, resulting in conflicts over their use.

Coastal zones are a source of raw materials and ecosystems services, provide fundamental links for transport, trade, tourism and leisure activities, support important natural habitats and are home to a large percentage of European citizens – it is estimated that almost half of the EU's population lives within 50 km of the sea¹. The well-being of these citizens and the economic viability of the places where they live and work depend on the preservation of the bio-physical characteristics, natural resources, marine and terrestrial biodiversity, landscape and cultural heritage of Europe's coasts. This issue also affects EU citizens living in inland areas, since coastal zones are a vital source of food, raw materials and recreational activities and provide transport and trade links.

However, coastal areas face continuous pressures from human activities (tourism, trade, fishing, port activities, shipping, transport, energy production,

etc.), particularly where development exceeds the carrying capacity of the coastal zone, thus unbalancing delicate coastal ecosystems. Impacts from human activities include: the decline of fish stocks; sediment contamination from inland or marine pollution; issues of water quality as demand exceeds supply or wastewater treatment capacity; and the loss of coastal ecosystems such as coastal wetlands that are important buffer zones. Coastal regions are also increasingly vulnerable to the possible impacts of climate change, whether this be in the form of coastal flooding from rising sea levels; coastal erosion; water scarcity and droughts; salt-water infiltration of aquifers; habitat destruction; or loss of biodiversity. These negative environmental impacts usually lead to threats to key economic activities (such as the development of forms of sustainable energy, tourism and trade) and social issues, including unemployment and social instability, loss of development, destruction of cultural heritage and competition between stakeholders for resources.

¹ European Commission communication to the Council and the European Parliament on integrated coastal zone management: A strategy for Europe (COM (2000) 547).



The Lisbon Strategy and ICZM

The EU ICZM policy reinforces the sustainability considerations of the Lisbon Strategy and in this way also acts as a guardian for the reconciliation of social, economic and environmental interests. Although the Lisbon Strategy is mostly concerned with improving EU economic development and the labour market situation, it also focuses on environmental aspects and stresses how EU policies rely on sustainable development strategies that combine economic and ecological interests in a productive manner. ICZM embodies this vision and approaches coastal management in an integrated way, embracing the economic use of the coast, the demands of the people living along the coastlines, the labour market that is dependent on the coast and many other aspects¹.

1 Evaluation of Integrated Coastal Zone Management (ICZM) in Europe – Final Report

To tackle these concerns, since 1996 the European Commission has consistently promoted the concept of Integrated Coastal Zone Management (ICZM) as an approach to integrated planning and management, in which all policies, sectors and interests are properly taken into account to achieve sustainable coastal development. The EU ICZM Recommendation prompted the EU Coastal Member States to set up strategies to promote ICZM along their shorelines.

What is Integrated Coastal Zone Management?

Management of coastal areas has often lacked vision and has not been based on the true understanding of the processes and dynamics that rule them. Scientific research has frequently been used inappropriately by end-users in policy and planning. Legislation and policy has been approached by sector and implemented in an uncoordinated way, thus exacerbating the problem of coastal deterioration. Stakeholders have also been inad-

equately involved in processes of formulating and implementing solutions.

In order for EU coastal regions to effectively deal with the variety of overlapping challenges they face, a coordinated coastal policy was proposed. An integrated territorial approach was seen as the only instrument to ensure that the goals of individual sectors are effectively implemented and the only one that can maximise the long-term environmental, economic, social and cultural well-being of coastal zones.

ICZM forms part of the EU Coastal and Marine Policy. It is a process tool aiming to achieve integrated management of all policy processes affecting the coastal zone, including both the landward and seaward parts. ICZM is designed to link all the different policies that affect coastal regions by ensuring that coastal planning activities or development decisions are taken in an integrated way, rather than on a sectoral basis. Furthermore, it can complement coastal management and protection in areas where no EU legislation exists, e.g. on coastal erosion, adaptation to climate change and green infrastructure.

In promoting sustainable management for the whole coastal zone, ICZM covers the full cycle of information collection, planning, decision-making, management and monitoring of implementation. It aims to join up all policies that have an effect on coastal zones (environmental policies, spatial planning, industrial policies). Although the protection of natural ecosystems is at the core of ICZM, it doesn't only focus on environmental policies. ICZM also seeks to improve the economic and social well-being of coastal zones and to help to develop their full potential, transforming them into vibrant communities. ICZM is not a one-off solution, rather it is a flexible and evolving process that proposes approaches, tools, economic instruments and technical solutions

LIFE has brought together stakeholders from all over Europe on coastal management issues



Photo: LIFE99-EN/GR/000567

that can be adopted according to the specificity of the area and over time.

Towards an EU policy on ICZM

It was the UN Earth Summit of Rio de Janeiro in 1992 that started off the development of an EU policy on ICZM. The conclusions of the summit called on coastal states to set up ICZM strategies in Chapter 17 of the Agenda 21². Consecutively, the European Council adopted other resolutions on ICZM (in 1992 and 1994) where it urged the European Commission to come forward with proposals for action in Europe. This led to the creation by the Commission of a Demonstration Programme on ICZM (see below), which ran from 1996 to 1999 and was established to provide technical information about sustainable coastal zone management, and to stimulate a broad debate among the various actors involved in the planning, management or use of European coastal zones. In 2002, based on the experiences and outputs of the Demonstration Programme, the Recommendation on Integrated Coastal Zone Management (ICZM)³ was adopted. It defines the actions and policy elements that the Member States should consider in developing national strategies for ICZM⁴. An important step towards ICZM implementation in the EU was accomplished with the ratification by the EU of the ICZM Protocol of the Barcelona Convention⁵ for the protection of the marine and coastal environment in the Mediterranean.

Coastal and marine policy

ICZM as a tool contributes to the objectives of the Marine Strategy Framework Directive (MSFD), which calls for a comprehensive and integrated approach to the protection of all European coasts and marine waters. The MSFD is, furthermore, the environmental pillar of the Integrated Marine Policy (IMP), which aims to provide a more coherent approach to maritime issues and to develop a thriving maritime economy and the full potential of sea-based activities in an environmentally sustainable way.

² http://www.un.org/Depts/los/consultative_process/documents/A21-Ch17.htm

³ See <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:148:0024:0027:EN:PDF>

⁴ To support the implementation of the ICZM Recommendation, the Commission created an Expert Group in 2002. In addition, the Working Group on ICZM Indicators and Data was set up. This group has established two sets of indicators, one to measure progress in ICZM, the other measuring sustainability.

⁵ OJ L 34, 4.2.2009 p 19



Photo: LIFE98 NAT/PI003275

LIFE projects have demonstrated integrated approaches for the protection of European coasts and marine waters

Both the IMP and the MSFD call upon an integrated and collaborative approach to decision-making among the many different users of the sea so as to achieve the objective of a coherent policy framework that better allows for the sustainable development of sea-related activities. Maritime Spatial Planning (MSP) and ICZM have been identified as integrated management tools under the IMP and aim to contribute to such sustainable development.

MSP has a similar function for the sea as ICZM has for the land-sea space, namely to regulate all human uses while protecting ecosystems, to balance competing interests and to improve the quality of decision-making. There is a need for coherence between the two instruments in areas where they overlap (i.e. coastal waters). As a result, ICZM can be seen as a link between EU Maritime Policy and the MSFD on the marine side and the Water Framework Directive (WFD) and other relevant policy instruments on the land side. Thus, ICZM plays a crucial role in promoting a continuum of integrated planning and management of river basins, coastal zones, marine regions and regional seas, incorporating both the environmental and socio-economic aspects of planning.



Photo: LIFE05 NAT/IT/000037

LIFE played an important role in the development of ICZM through the Demonstration Programme

Funding demonstrates the value of ICZM

The LIFE programme is one of the main EU financial instruments that has been used to support the adoption and implementation of ICZM strategies and to develop best practices in managing coastal zones. Indeed, LIFE played an important role in the development of ICZM through the Demonstration Programme that ran from 1996 to 1999.

A total of 35 coastal zone management projects were funded under the ICZM Demonstration Programme. Of these, 13 received co-funding from LIFE, and each of the 35 studied the efficiency and operability of integrated management and cooperation procedures. The goal of the Demonstration Programme was to provide technical information on the factors that favour or discourage sustainable management of coastal areas. It was believed that a lack of integration and coordination was hampering the implementation of sustainable development and environmental policies.

The funded projects were based on the application of the principles of subsidiarity and integration, which form the basis of environmental and regional planning activities. They also revolved around the three concepts of coordination, cooperation and consultation. The Demonstration Programme stimulated a broad debate and exchange of information among the actors/stakeholders in coastal regions all over the EU. The debates led to a consensus on the necessary measures to develop ICZM in Europe.

LIFE was the main instrument for financing this demonstration process, accounting for around one-third

of the projects. One of the advantages of LIFE is its geographical reach. The funded projects were implemented in the Baltic Sea, the North Sea, the Atlantic area and the Mediterranean. These projects tested methods to improve integrated planning and management. For instance, the **LIFE96 ENV/UK/000401** project developed a management plan for an area of open coast in southern England, whereas **LIFE96 ENV/FIN/000071** developed land-use plans for the management of coastal areas, and contributed to the establishment of the Natura 2000 network.

Other projects focused more on identifying methodologies to improve cooperation and coordination among stakeholders. The Danish **LIFE96 ENV/DK/000012** project improved cooperation at an inter-regional and intergovernmental level, whilst **LIFE96 ENV/F/000434** improved coordination between five administrative divisions, four urban areas and more than 200 municipalities operating along 150 km of French coastline. In Greece, the two demonstration projects - **LIFE96 ENV/GR/000537** and **LIFE96 ENV/GR/000564** - provided best practice examples of cooperation between coastal zone scientists and managers.

The 'MARIA' project in Portugal's Aveiro lagoon (**LIFE96 ENV/P/000601** - see pp. 16-20) created innovative partnerships between stakeholders with different perspectives on the use of coastal areas from international, national, regional and local levels.

Local knowledge, data gathering and indicators are also important for clear informed decision-making. The Irish **LIFE97 ENV/IRL/000209** project integrated existing datasets into a community-driven GIS to provide environmental indicators to aid local decision-makers. In Italy, **LIFE97 ENV/IT/000072** developed methods for balancing human activities, economic development and coastal preservation.

The results of these projects fed into the Recommendation of 2002 and led to the development of the set of principles on which ICZM is based (more information can be found in the results page of the Demonstration Programme: <http://ec.europa.eu/environment/iczm/demopgm.htm>).

ICZM principles and approaches

Based on the experiences of the Demonstration Programme, eight principles (see box) were agreed as part of the EU ICZM Recommendation for good coastal planning and management. A set of key ap-

The eight principles of good ICZM

1. A broad 'holistic' perspective (thematic and geographic) which will take into account the interdependence and disparity of natural systems and human activities with an impact on coastal areas.
2. A long-term perspective which will take into account the precautionary principle and the needs of present and future generations.
3. Adaptive management during a gradual process which will facilitate adjustment as problems and knowledge develop. This implies the need for a sound scientific basis concerning the evolution of the coastal zone.
4. Reflect local specificity and the great diversity of European coastal zones, which will make it possible to respond to their practical needs with specific solutions and flexible measures.
5. Working with natural processes and respecting the carrying capacity of ecosystems. This will make human activities more environmentally friendly, socially responsible and economically sound in the long run.
6. Participatory planning that involves in the management process all the parties concerned (economic and social partners, the organisations representing coastal zone residents, non-governmental organisations and the business sector), for example by means of agreements and based on shared responsibility.
7. Support and involvement of relevant administrative bodies at national, regional and local level between which appropriate links should be established or maintained with the aim of improved coordination of the various existing policies. Partnership with and between regional and local authorities should apply when appropriate.
8. Use of a combination of instruments (law, economic instruments, voluntary agreements, information provision, technological solutions, research and education) designed to facilitate coherence among sectoral policy objectives and coherence between planning and management.

proaches have also been identified⁶ that, whilst leaving room for further development of the process, have been seen as the ones that work best in achieving ICZM objectives. They are:

Integration – the ways in which ICZM is organised and implemented across the different layers of governance. This means coherent and integrated legislation as well as institutional coordination between national and regional governments and local authorities. The local level of administration is key to the delivery of concrete integrated actions as it is best positioned to collect data about local conditions, to facilitate stakeholder participation and to ensure the integrated implementation of policies and legislation within ICZM.

Ecosystems based approach – an innovative 'holistic' management approach that considers the whole ecosystem, including both the human and ecological environments. It integrates ecological, social, and economic goals and recognises people as key components of ecosystems. It is a science-based approach that aims to sustain the resilience and health of ecosystems and allow the sustainable use of goods and services that they may provide.

Participatory approach – involving all stakeholders concerned in the planning and management process. This type of involvement identifies the real issues, harnesses local knowledge and builds commitment. It is based on shared responsibility, sharing of information, consensus-building and informed decision-making.

LIFE projects have developed technical solutions to understand the coastal environment and to tackle man-made or natural risks



Photo: LIFE08 ENV/5/000271

⁶ See the OURCOAST publication : Guidance based on collected ICZM cases <http://ec.europa.eu/ourcoast/download.cfm?fileID=1789>

The 'OURCOAST' project

As the 2008 evaluation of the implementation of the ICZM Recommendation illustrated, the application of Integrated Coastal Zone Management measures has been constrained to some extent by problems with dissemination of best practices and exchange of experiences. As a consequence, in 2008 the European Commission launched 'OURCOAST', a three-year project with the goal of establishing enduring information mechanisms to promote the sharing of ICZM experiences and practices across Europe. As a result, guidance has been developed for all coastal decision-makers,

policy-makers and users in order to support and implement sustainable planning and management of coastal areas, as well as a database containing some 350 concrete examples of ICZM: <http://ec.europa.eu/environment/iczm/ourcoast.htm>



Knowledge-based approach – this refers to the types of knowledge that are available for ICZM decision-makers. It is based on data collection and management: information has to be clear with a good scientific basis, include local solutions and be easily disseminated for the spreading of knowledge to enable more responsible and informed participation.

Socio-economic approach – this refers to the benefits and economic development that the coastal community will gain through the implementation of ICZM. This approach relates to aspects such as sustainable tourism, sustainable agricultural practices, fishing and aquaculture and activities that will enhance cultural diversity and natural heritage, ecosystems services and funding mechanisms.

Technical approach – this refers to the design and implementation of technical measures and solutions to understand the coastal environment and to tackle man-made or natural risks (i.e. oil spills, climate change adaptation risks and flooding).

Evaluating the impact of ICZM

In 2008, the Commission launched a review of the EU ICZM Recommendation based on Member States' national reports, the state-of-the-coast assessment and an external evaluation report.

As a result of this evaluation, the Commission is currently assessing different policy options in order to ensure sustainable management of the coastal areas in future. Given the vulnerability of coastal zones to the possible impacts of climate change, adaptation measures have to be considered when implementing ICZM⁷. So the integration of climate

.....
7 EU White Paper on Adaptation to Climate Change

change policy will be more prominent in future than it has been to date.

Ongoing LIFE support

The LIFE programme has continued funding a plethora of projects that have dealt with coastal issues and that have been carried out by a variety of different coastal Member States (mainly in the Mediterranean and Baltic areas). Building on the enthusiasm created by the Demonstration Programme, LIFE has continued to fund projects that have focused on the adoption and implementation of ICZM (see pp. 10-15).

As you will see from the following pages of this publication, other LIFE projects have developed best practices for dealing with coastal erosion, encouraging sustainable tourism, developing technology to tackle oil spills, implementing sustainable agricultural practices, integrating urban and rural communities with coastal habitats, generating 'blue' energy, developing aquaculture, introducing anti-fouling techniques, reducing the impact of port activities, enabling adaptation to climate change and improving the quality of coastal waters. Together these provide an excellent example of how policy has fed into practice for the benefit of Europe's coastal regions.

Mass tourism on of Chrissi Island



Photo: LIFE07 NAT/GR/000295



Photo: Darren Harman

Implementing coastal management

After playing an important role in demonstrating the effectiveness of Integrated Coastal Zone Management through its support for the EU’s ICZM Demonstration Programme, LIFE has continued to fund numerous projects that have applied the integrated approach outlined by the European Commission’s ICZM Recommendation. In this section we learn more about the aims and impact of some of these projects, which have achieved valuable results in coastal areas from the Atlantic to the Mediterranean to the Baltic Sea. This includes taking an in-depth look at the effects of the ‘Zantecoast’ project on the Greek tourist island of Zakynthos and of a pair of projects centred on the complex environment of Portugal’s Aveiro Lagoon.

IMPLEMENTING COASTAL MANAGEMENT

Building on the Demonstration effect

Following the success of the ICZM Demonstration Programme (1996-1999), LIFE has continued to be an important source of funding for projects aimed at implementing an integrated approach to managing Europe's coastal zones in line with the goals of the ICZM Recommendation.

The Mediterranean coast has been the target of several ICZM projects since 2000, such as the Greek 'Zantecoast' project (see pp. 12-15), each of which has attempted to use the principles of integrated management to lessen the impact of tourism and other coastal zone activities.

'MED-COASTS S-T' (LIFE00 ENV/IT/000167) addressed the need to manage the environmental footprint of tourists through ICZM, in this case both in and around the resort of Rimini on the Adriatic Coast, and through a project partnership with the Municipality of Calvià on the Spanish island of Majorca (see pp. 24-

26). To this end ICZM plans were drafted and adopted by both municipalities, which have continued to inform planning decisions after LIFE. The project also built on the work of an earlier Local Agenda 21 initiative in implementing pilot actions that demonstrated ways of improving the environment of coastal areas. These included publishing Green Purchasing/Ecolabel guides aimed at hotel owners and managers; promoting a car sharing service for tourists; launching a 'Green Beach' scheme; creating a sustainable tourism charter for Rimini (which was adopted by 500 participants); and setting up, with ICLEI, a 20-member network of cities for Sustainable Tourism dedicated to finding solutions to mass tourism at an international level.

Through the 'MED-COASTS S-T' project, ICZM plans were adopted for the Municipalities of Rimini and Calvià



Photo: LIFE00 ENV/IT/000167

A later Italian LIFE project, 'PHAROS' (LIFE04 ENV/IT/000437), led by the regional government of Liguria, tested and implemented new ICZM tools designed to improve the environmental management of two high-impact coastal activities: golf and marinas for recreational boating. The project produced a series of best practice guidelines for golf courses, addressing issues of greens management, water and energy savings, waste management and the protection of biodiversity; similar guidelines were also produced for tourist harbours, covering issues of water quality, waste management and energy savings. Two project partners – the La Filanda Golf Club and Marina Aregai – used these guidelines as the basis for their implementation of an Environmental Management System (EMS), according to the EMAS II regulation, and their achievement of ISO:14000 certification. The guidelines developed by PHAROS also provided a means of integrating EMS with local and regional policies in the context of 'Mediterranean coastline governance'. The guidelines have been applied in 10 different facilities and in seven cities, each of which demonstrated better EMS performance.

Dune recovery a priority

An ongoing LIFE+ project is showing how ICZM principles can be applied to the conservation and recovery of priority habitat coastal dunes in three Italian provinces (Cagliari, Caserta and Matera). The 'PROVIDUNE' project (**LIFE07 NAT/IT/000519**) is contributing to the implementation of the ICZM Recommendation in these provinces through a raft of integrated measures, such as monitoring the characteristics of the target coastal dunes, eliminating threats to the dunes arising from tourist pressures, coastal erosion, inadequate management and invasive alien species, and increasing people's awareness of the importance of these protected habitats.

New Baltic approaches

The Baltic Sea region of northern Europe may be geographically distant and distinct from the Mediterranean Sea, but many of the same challenges face EU Member States in those northern climes. With its archipelago of more than 2 000 small islands, the coast of south-west Finland presents a very different management challenge from the resorts of Greece, Italy or Spain, but one still revolving around the need to balance the demands of the economic activity (tourism, fishing, transport etc.) with environmental sustainability and nature protection. With the support of LIFE, the 'Coastra' project (**LIFE00 ENV/FIN/000666**) drew up an ICZM strategy for south-west Finland, which was piloted in the Uusi-kaupunki area and also served to inform the national ICZM strategy for Finland. Stakeholder participation and understanding was again recognised as essential to the success of coastal zone management. The project also prioritised data collection, making innovative use of an up-to-date Geographical Information System (GIS) and aerial photos, to more accurately identify conflict points in the area.

Another project from Northern Europe pioneered the application of an ICZM approach in forested areas. The Swedish 'Coastal Woodlands' project (**LIFE02 ENV/S/000355**) developed comprehensive recommendations for an ICZM strategy connecting forestry and nature protection issues by the Baltic Sea. This re-

sult was achieved through detailed consultations with stakeholders in coastal woodland areas and underpinned by science: the gathering of inventories within the project areas (these covered the coastal woodlands in Finland, Sweden and Estonia, with a core region located between Norrköping and Kalmar in the southern part of Sweden's east coast).

The joined-up thinking of the 'Coastal Woodlands' project also enabled it to develop effective links with other ICZM initiatives in the Baltic Sea region, including the regional 'Sustainable archipelago' programme. The project's cross-border strategy included field trips in Sweden, Finland, Estonia and Latvia, whilst local engagement was encouraged by means of Volunteer Environment Action Grants.

The extent of the integrated approach developed by this LIFE Environment project can be seen in its establishment of an Expert Advisory Group for the Baltic Sea Coastal Woodlands, comprising political, environmental, forestry and NGO stakeholders at trans-national, national, regional and local levels in the Baltic Sea region. The goal of this advisory body is to continue to develop effective and appropriate measures for the management of coastal woodlands, taking into account forestry policy and differing environmental, social and economic needs. Forestry certification was the basis for the granting of formal protection to more than 1 600 ha of coastal woodland during the project period.

The 'Coastal Woodlands' project succeeded in developing comprehensive recommendations for an ICZM strategy connecting forestry and nature protection issues by the Baltic Sea



IMPLEMENTING COASTAL MANAGEMENT

Increasing awareness on a Greek island

Mass tourism and a sectoral approach to planning economic activities have had a negative impact on the coast of the Greek island of Zakynthos (aka Zante). Using Integrated Coastal Zone Management (ICZM), the LIFE 'Zantecoast' project (LIFE00 ENV/GR/000751) initiated a dialogue between local authorities and other stakeholders to preserve the coastal area, including beaches that are among Europe's most important loggerhead turtle (*Caretta caretta*) nesting sites.



Photo: L.Sourbes/NMPZ

Gerakas beach is one of the most important nesting sites for sea turtles



In recent decades, Zakynthos, a Greek island in the Ionian Sea, has become a significant destination for mass tourism. Initially, however, little was done to manage the negative impacts that this tourist development could have on the coastal environment. This was especially problematic because Zakynthos has four beaches – most importantly Laganas, as well as Daphni, Gerakas, and one on the small island of Marathonisi – that are nesting sites for the loggerhead turtle. The island also hosts other important fauna such as the Mediterranean monk seal and protected species of birds and amphibians, as well as protected flora and dunes.

The first step towards addressing this conservation and environmental management issue was taken in 1999, with the establishment of the National Marine Park of Zakynthos (NMPZ), the first marine park in Greece. The NMPZ was created with the aim of protecting and preserving the loggerhead turtle and other species and habitats. The marine park immediately set about applying for LIFE funding to develop a project to address the environmental issues of the island. “We wanted to immediately be active and get our work known by the community,” recalls project manager, Laurent Sourbes.



Photo: L.Sourbes-NMPZ

The Greek island of Zakynthos hosts beaches that are among Europe's most important nesting sites for the loggerhead turtle (*Caretta caretta*)

The beneficiary selected ICZM as the management tool that would allow it to involve all the stakeholders and manage potentially competing activities and needs, including the needs of the island's turtles, in an integrated way.

One of the most important tasks was the immediate protection of the coast, the beaches and species; another important aspect was communication and cooperation with the island's residents, local and regional authorities (LRAs) and specific primary and tertiary sectors such as farmers, fishermen, hoteliers, tour operators and guides. "We wanted to develop effective public participation and raise awareness among them of the special value of the area: act where the pressure was more important was our first aim," explains Mr Sourbes.

Talking to farmers and fishermen

The LIFE team started a dialogue with the island's fishermen and farmers. This was important, says Mr Sourbes, because they were "quite resistant to change and to external bodies telling them how to conduct their activities."

Recognising that you cannot revolutionise a traditional activity in the duration of a three-year project, the beneficiary instead sought to raise awareness amongst farmers of the substances and methods they could use to reduce the impact of their cultivation and animal-rearing activities on (nutrient pollution levels in) coastal waters. To this end, the project developed a 'Code of Proper Agricultural Practice and Animal Rearing', which helps to sensitise the island's farmers to ways of safeguarding their income whilst protecting the environment. Training and awareness

sessions focused on individual farmers and agricultural cooperatives were (and have continued after LIFE). As a result of the code of practice, "local products that are produced in the marine park have acquired prestige and account for a business of €20 million per year," points out Mr Sourbes.

Actions involving fishermen were initially centred on raising awareness and letting them know the importance of the loggerhead turtle and the monk seal. "We had to spend a lot of time with them as you need personnel or volunteers that will go out there to speak to them on a regular basis," notes Mr Sourbes. "This is very time- and money-consuming," he adds.

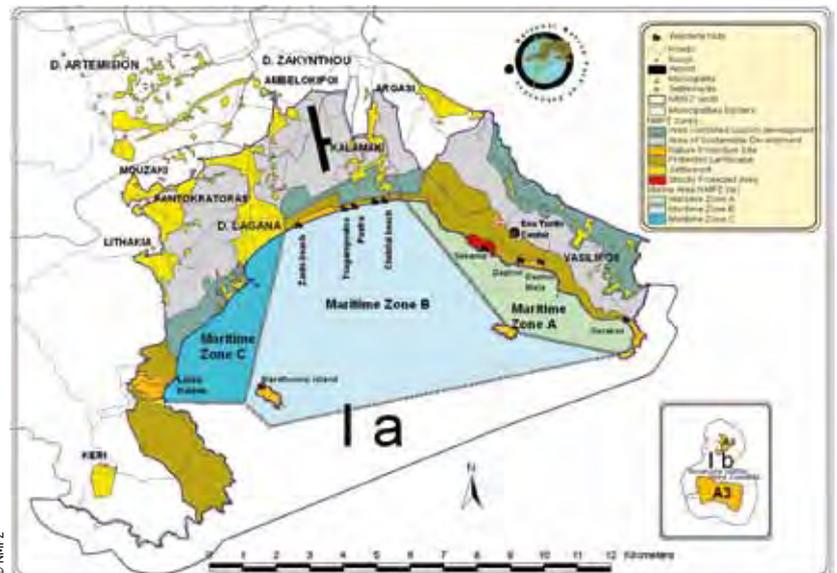
However, the time and money spent have paid off as 10 years down the line, the relationship between the NMPZ and the fishermen "is good," says Mr Sourbes. "The fishermen have understood that there are some areas during certain periods of time that one cannot go and fish given the designation of the marine area. They are really now working in respect of the marine area and of the turtles."

Tackling tourism troubles

Every year some 600 000 to 700 000 visitors come to Zakynthos during the five months of the tourist season, with numbers particularly concentrated in high season (July and August). This obviously creates great pressures on the resources of a small island whose resident population is some 40 000 people.

The 'Zantecoast' project initiated a dialogue involving LRAs, hoteliers, tour operators and tour guides

Map of the marine areas and nesting beaches of the sea loggerhead turtle



with the goal of changing the type of tourism on the island. This was “a very difficult task,” recalls Mr Sourbes. “You have to really make them understand that another type of tourism, more respectful of the environment, does not mean losing out economically. It was also very hard to make them understand that the coast and its waters are the main attraction and offer the ecosystems services that the tourism industry thrives on. With their deterioration, tourism also will suffer.”

Nevertheless, ‘Zantecoast’ achieved some significant results, including producing a code of conduct for developing eco-tourism activities that would sustain the coastal ecosystem and cultural authenticity of the NMPZ. The beneficiary also published a code of good environmental behaviour for tour operators, which included actions such as giving advice on environmental criteria for accommodation and on the existence of complementary eco-activities and awareness trips.

Furthermore, the project also developed a good practice code for turtle spotting in collaboration with boat companies that organise marine excursions in the Laganas bay for that purpose. The guidelines for harmless turtle observation covered such factors as: approach distance, observation time for any one turtle, boat speed, maximum number of boats and appropriate behaviour on the boats.

This action was linked to a wider strategy for marking the limits of the marine area and controlling recreational boat access, so as to avoid endangering the sea turtles and the rest of the ecosystem. However, the process of marking the controlled zone was a

A wardening system with the aim of protecting the marine and forest area and nesting beaches was created through LIFE funding



*The ‘harmony anchorage system’ was used in the delineation of marine areas and to protect the sea bed of *Posidonia oceanica**

delicate one since the project team had to do so without destroying a seagrass (*Posidonia oceanica*) meadow. To avoid damaging this important marine plant, the project used the so-called ‘harmony anchorage system’, which consisted of drilling a special steel coil into the sea bed, so that it does not destroy the network of seagrass roots. An anchor ring is attached to the coil and at the end of the line there is a demarcation buoy that visually marks off the controlled areas to boats and fishermen. The coordinates of each buoy were noted using GPS and written into a GIS software system that was created by the LIFE project specifically for monitoring the marine park area. This was also used to create maps of the area.

Turtle-friendly beaches

Using LIFE funds, the marine park developed a wardening system, covering nesting beaches, forested areas and the park in general. The trained wardens are present all year round. One of their main tasks, especially in winter, is to remove potential harmful waste from the turtle beaches (see pp. 63-65). More wardens are on duty during the summer months, preventing tourist disturbance of nesting sites and providing information about the loggerhead turtles. Information boards with maps mark the limits of each nesting beach, providing further guidance to ensure the successful coexistence of turtle and human visitors to Zakynthos. A visitor centre highlighting the work of the NMPZ was also established by the LIFE project, attracting tourists, local residents and school groups from the mainland.

The project decided to trial an innovative method of reducing tourist pressure on one nesting beach – Gerakas – by limiting the number of visitors during July and August to 350 at any one time. “We gave each tourist a ticket with the time of their entry and the time of when they should leave. The wardens

explained to them the reasons and we were very astonished to see that the majority (95%) respected the rules,” reveals Mr Sourbes.

To further reduce the impact of tourism on the turtles, the project drew up lighting guidelines which make it obligatory in certain areas of the NMPZ to use artificial lights that mimic the effect of moonlight – standard artificial lighting from buildings and roads can disorientate new-born turtles that need to find their way to the sea.

The network of sand dunes behind the island’s beaches was also targeted. The project created trails to ensure that tourists do not trample all over this important habitat. Cars were banned from parking on beaches and new car parks built next to resorts. An awareness-raising campaign was also launched to persuade locals not to walk across the 3.5 km of sand dunes at Laganas, which had been a popular winter activity on the island. This campaign has been a success, says Mr Sourbes, “for changing mentalities and bringing the residents closer to the work of the NMPZ.”

Zakynthos looks ahead

“The LIFE project addressed the emergency issues that we were faced with when the park was created,” says Mr Sourbes. The project actions have since become mainstream and the NMPZ has been able to address other issues, such as assessing coastal water quality and comprehensively monitoring the turtles. The project manager notes that environmental benefits have emerged as there has been a more effective conservation of the sea turtle and other (marine and terrestrial) fauna and flora. Furthermore, the ‘Zantecoast’ project initiated more eco-friendly activities by local operators, controlled tourism pressure on the island’s beaches and began a process of constructive dialogue and cooperation between all stakeholders.

“They are processes which take time and changes in behaviour do not happen overnight. However, the



Photo: L. Sourbes-NMPZ

project helped us to start a more integrated planning with other economic activities, to talk and find solutions that are more respectful of our coastal environment,” believes Mr Sourbes. “The project promoted the idea of ICZM and sustainable development among the people who are economically active in the area and ensured that the local population and visitors are correctly informed about the importance of the local habitats,” he adds.

Zantecoast initiated an improvement in the marine park’s relationship with the fishermen and, by helping to reduce pollution from agriculture and other sources, has led to an improvement

in the quality of coastal waters. This has been confirmed by improved monitoring after-LIFE. Yet while the LIFE project established strong foundations, Mr Sourbes says “we need more action and more people” to change ingrained mentalities and patterns of behaviour. For this, he says, “you need serious investments in people and alternative solutions supported by LRAs.”

The ‘Zantecoast’ project has been successful in the conservation of marine flora and fauna, such as starfish

“The project helped us to start a more integrated planning with other economic activities, to talk and find solutions that are more respectful of our coastal environment”

Project number: LIFE00 ENV/GR/000751

Title: Zantecoast - ICZM: Demonstration actions in the National Marine Park of Zakynthos

Beneficiary: Management Agency of the National Marine Park of Zakynthos

Contact: Laurent Sourbes

Email: info@nmp-zak.org

Website: http://www.nmp-zak.org/Life_Env/

Period: 01-Jun-2001 to 30-Nov-2004

Total budget: €1 438 000

LIFE contribution: €679 000



IMPLEMENTING COASTAL MANAGEMENT

A long-term approach to the Aveiro Lagoon

Involvement in the LIFE ICZM Demonstration Programme was the starting point for an integrated approach to the management of the Aveiro Lagoon in central Portugal. This has been carried on through a follow-up LIFE project and later initiatives to the present day.

The 11 000-ha Aveiro Lagoon ('Ria de Aveiro') is an area of unique and complex environmental, cultural and socio-economic characteristics. A Natura 2000 network site that houses important wetlands and associated species listed in the annexes of the EU Birds Directive, the lagoon ecosystem has been shaped both by nature and by human activities including salt production, seaweed harvesting, shellfish gathering, fishing, aquaculture and agriculture.

With its busy sea port, growing urban and industrial area and significant tourist infrastructure (the city of Aveiro is sometimes called 'The Venice of Portugal' because of its canals), the lagoon also faces significant pressures that, because of the complexity of the different demands on it, require very careful management.

Such care has not always been taken, however. In the 2001 publication *EU focus on coastal zones*, the

The Aveiro Lagoon has been shaped by nature and human activities



Photo: Justin Toland



Photo: Salgado Ferveira

LIFE's restoration of boating infrastructure has helped to preserve the cultural heritage of the lagoon

European Commission wrote that “in the past, battles against the sea have sometimes ended up aggravating problems facing coastal zones rather than resolving them. For example, engineering works to improve port facilities in Aveiro in Portugal led to an increase in erosion of the adjacent shoreline because they disrupted local tidal flows, which had not been adequately considered in the planning phase.” The failure of this action and of subsequent attempts to protect the coastline using concrete and steel defences was thus cited as an example of what can happen when the left hand doesn't know what the right hand is doing. “If more integrated thinking had been applied to the port project from the outset, it would probably not have been necessary to build the extra sea defences,” the Commission concluded.

The need for an integrated approach had already been recognised locally and led to the decision to apply for LIFE funding for a project, ‘MARIA’ (LIFE96 ENV/P/000601), that formed part of the Integrated Coastal Zone Management (ICZM) Demonstration Programme (1996-1999 – see pp.3-8). Filomema Martins, Associate Professor within the Department of Environment and Planning at the University of Aveiro, who has been involved in efforts to introduce ICZM in the lagoon since the 1990s, explains the background to the project: “The first problem was that the lagoon is connected to the municipalities, but the municipalities had no power to decide on the use of the lagoon.” Responsibility lay with the

harbour authority, whose main interest, even when it took actions for the general good of the lagoon or particular communities within it (such as rehabilitating salt pans), lay in transportation of merchandise. “It was a love and a hate between the people and the harbour [authority],” remembers Prof. Martins.

Building on the experience of collaboration on an earlier ENVIREG project dealing with sewage infrastructure, the harbour authority and the 11 municipal authorities within the water basin of the lagoon decided to work together on the ‘MARIA’ project with the goal of defining an integrated management structure for the Aveiro Lagoon, which, as well as enabling the sustainable development of the coastal zone, would also provide a model for similar coastal areas in Europe.

‘MARIA’ builds links

The main achievement of the project was in bringing together, for the first time, a wide-range of stakeholders from both public and private sectors, thus kick-starting a new partnership approach to the management of the coastal zone. Partners were drawn from local, regional and national administrative levels and also included representatives of NGOs and other interest groups, such as farmers, the fishing and aquaculture sector and salt pan owners and workers; all coordinated by the University of Aveiro, the project beneficiary.

For the municipalities and other partners, “the first step was to know what each other is doing, to discuss and find out if we can combine efforts to do the same thing. And then to see how to make a vision for the lagoon, how to develop something around the lagoon to profit everyone,” says Prof Martins. The importance of knowing what each other was doing was highlighted by the fact that at the start of the project, one municipality was planning to build a cycle trail around the lagoon that, rather than being joined on to the end of an existing cycle trail in a neighbouring municipality, would start in a completely different location!

To avoid such mistakes in future, the first phase of the project involved using a Geographical Information System (GIS) to identify and systematise existing information about the environmental status of the lagoon and its territorial planning. Despite taking longer than expected to gather – partly a consequence of the earlier lack of cooperation between different administrative bodies bordering the lagoon – the information produced by this process was then used to define different thematic areas (including territorial planning; infrastructure and equipment; environment and environmental education; agriculture; and tourism and GIS) that would form the basis for discussion and problem solving, provide the basis for a set of proposed pilot projects and help define an integrated management structure for the lagoon (see Figure 1).

LIFE funding has helped continue the tradition of salt panning in the Aveiro Lagoon.

In that second phase of discussion, the 11 local authorities joined forces in a Ría de Aveiro municipal association, which started meeting on a regular basis to discuss issues of joint concern around the management of the lagoon. Despite this achievement, Prof. Martins recalls the project as being only a qualified success: “We expected too much in the beginning. We thought if we knew each other, if we had a common vision, if we could manage to organise ourselves, we could probably propose a local board or administration to run the [lagoon] area. But we really didn’t pay much attention to the legal and juridical requirements for that,” she explains.

Nevertheless, all the project partners signed a ‘Letter of Principles’, through which they agreed to ‘maintain and intensify’ the partnership process started by the LIFE project. They also recognised that through the links and structures built by this ICZM Demonstration project, “[they] could at least be a voice in the process (of managing the lagoon),” says Prof Martins.

Implementing the pilot projects

Another important result of ‘MARIA’ was that the project partners were able to agree on areas of common interest and to propose some pilot projects incorporating ICZM principles that could be jointly implemented around the lagoon, thereby testing the Integrated Management Structure outlined by the



LIFE project. “They said we need a project to challenge us, to see if we can do in our municipalities, each one of us, a part of a common project,” remembers Prof. Martins. “This was the idea: ‘to have one larger project which unites us and see if we can really work together.’”

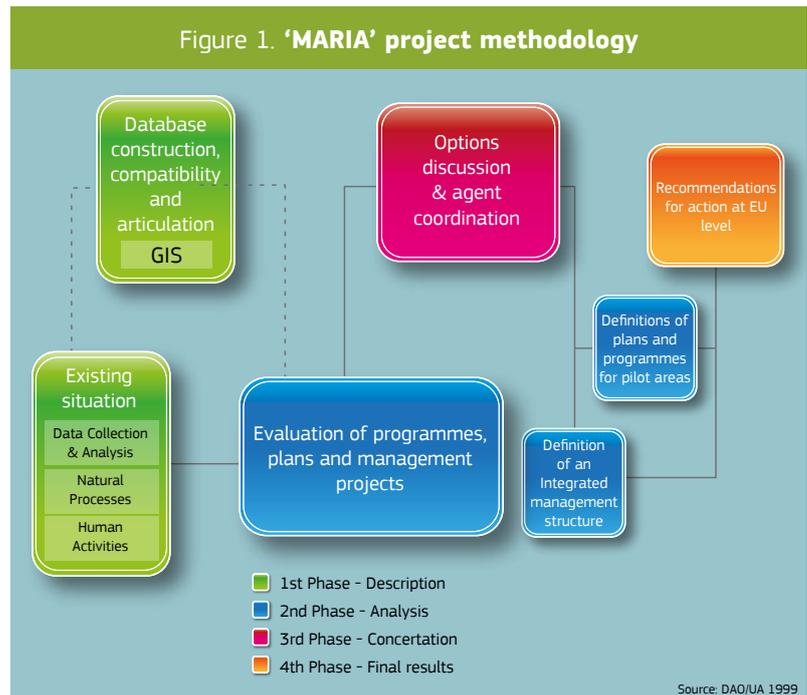
LIFE co-funding was secured for this implementation work, with the follow-up ‘ESGIRA-MARIA’ project (LIFE99 ENV/P/000673) commencing in September 1999. The first of the four pilot projects selected involved the recuperation and optimisation of old quays within the lagoon that had fallen into disrepair and disuse with the growth of road transport. The municipalities all agreed that the renovation of this boating infrastructure could open up new opportunities for tourism, whilst respecting the cultural heritage and environment of the lagoon.

Similarly, some of the municipalities had salt pans, some had salt storage houses and others only archaeological remains or a historical interest, but all agreed that “salt is one of the products that identifies the lagoon,” says Prof Martins. As a result, the second pilot project was dedicated to ‘the recuperation of the Aveiro salt pans’. This involved drawing up a programme for their future management so as to make continued salt production economically viable whilst safeguarding the natural and landscape value of the wetlands within the Natura 2000 network site.

A third pilot action promoted the classification and integrated management of the mouth of the river Cáster as a Protected Landscape Area (APP). Prof Martins describes much of this work as a kind of “environmental education process...we developed several trails and we involved schools, showing them how they could use the area to train and inform citizens...to make them see that these areas could also have a value and that even if that value cannot be connected with the individual income of the owners of each of the fields, [people] will profit from the existence of that area.”

Overcoming setbacks

These three pilot projects were successfully carried out according to the stated objectives of ‘ESGIRA-MARIA’, however, the fourth was only partially completed. The aim of this action was to draft a programme for the ‘Integrated management of the agricultural fields of the Baixo-Vouga’ that would provide a means of meeting farmers’ economic needs, whilst allowing conservation-friendly low-



intensity farming to take place, for instance by developing a market for certified products. However, as Prof Martins recalls, this part of the project was significantly delayed by the lack of a Portuguese land registry. “So we spent a great part of the time – two and a half years – to find out who owned the land and geo-referencing it all and passing on the information so that the official records were updated. It took so much time that in the end we had only six months [for the pilot project].”

Despite this failure, she points out that the regional department of agriculture still maintains and updates the land ownership database created by ‘ESGIRA-MARIA’, “so I think [this pilot project] had a good impact, in the sense that we achieved a useful outcome, even if it was not the one we were supposed to reach.”

Prof Martins believes that the most important impact of ‘ESGIRA-MARIA’ was a result of all the people it involved: “Agriculture associations...environmental groups...parishes...we even involved the priests to tell people that something is going on and we want to talk with them...If nothing else, as a democratic process it made people interact and become aware of the issues.” And, she says, as a consequence of this active stakeholder involvement, ordinary people still remember the project actions

“ The two projects were a key element in the process. What we have done since has been because ‘MARIA’ and ‘ESGIRA-MARIA’ were done ”



Photo: Justin Toland

The tidal lagoon is a Natura 2000 site that is rich in bird life

from more than a decade ago. “Even if they don’t know the name, they know something about that project about the salt, or that project about the boats - it stuck with people.”

The lagoon after LIFE

Following the conclusion of ‘ESGIRA-MARIA’ in 2002, the integrated structures forged by the two LIFE projects, most notably, the municipal association, have continued to help manage the Aveiro Lagoon to the present day. Further EU-funded projects have continued or extended some of the pilot actions implemented through LIFE (One now finished project called Uni@Ria – ‘link the lagoon’ – restored more of the old quays and added new walking trails. A second, still ongoing, region-wide initiative called Polis Litoral “took ideas from the ‘MARIA’ and ‘ESGIRA-MARIA’ projects and developed them,” notes Prof Martins. Again small harbour restoration, based on the lessons of the LIFE pilots, has been one of the outcomes).

Overall, the lagoon is in much better shape than 20 years ago. For instance, pollution is now a “controlled problem”, believes Prof. Martins. “We still have some

problems with mercury, but the evolution is a good evolution. The quality of the water is improving; in some parts more than in others.”

LIFE, says Prof. Martins played an important role in improving lagoon life. “The two projects were a key element in the process. What we have done since has been because ‘MARIA’ and ‘ESGIRA-MARIA’ were done, I have no doubt about it. It’s not only my own interpretation of the facts; this is stated by the municipalities – either by the politicians or by the technicians – they say [LIFE] was very important.”

The resulting growth in contact and knowledge among the actors and the reinforcement of their willingness and ability to take action “is an absolute winner in the process”, says Prof Martins. The municipalities are continuing the democratic and integrated process started by LIFE and are hopeful that, when Polis Litoral closes later this year, their municipal association will finally be granted the power of governance over the management of the lagoon. “It’s been a very slow, snaky process,” smiles Prof Martins. “But it has been a continuous process; it hasn’t broken at any time.”



Project number: LIFE96 ENV/P/000601

Title: MARIA – Integrated Management Programme for Ria de Aveiro

Beneficiary: Universidade de Aveiro - Departamento de Ambiente e Ordenamento (“University of Aveiro – Department of Environment and Land-use Planning”)

Contact: Celeste Coelho

Email: coelho@dao.ua.pt

Website: <http://www.dao.ua.pt/maria/>

Period: 01-Feb-1997 to 01-Feb-1999

Total budget: €441 000

LIFE contribution: €209 000



Photo: Paire & Viro

Activities impacting on coastal areas

Tourism, fishing, aquaculture, agriculture, energy and other economic and leisure activities can all have a significant impact on Europe's coastal areas. LIFE projects across the EU are pioneering integrated approaches to the management of coastal activities. Linking policy initiatives such as the ICZM Recommendation and the Water Framework Directive with national strategies and regional and local stakeholder actions, these projects provide best practice examples of how it is possible to sustainably manage the demands of urban and rural development, allowing people to go about their daily lives and business in ways that lessen the impact on the environment and actively promote nature conservation.

ACTIVITIES IMPACTING ON COASTAL AREAS

Helping to ‘green’ coastal industries

Positive environmental contributions from coastal industries such as fishing, aquaculture and energy production are all possible, and LIFE projects have been at the forefront of launching new technologies using innovative methodologies in these marine domains.



Photo: LIFE06 ENV/EU/000119

LIFE projects have pioneered new techniques for improving the sustainability of fishing fleets

Our coasts are inextricably linked with the seas that shape them and the marine industries that affect them. Different sectors of the coastal economy can have different impacts and LIFE has been involved in helping ensure that marine sectors both mitigate potential negative impacts on coastal environments, as well as improve opportunities for positive impacts across the socio-economic and environmental spectrum.

LIFE's role here is making useful contributions to the EU's objectives for its Marine and Coastal Poli-

cy. For instance, LIFE projects focused on reducing the environmental footprint of aquaculture or increasing the use and generation of renewable energy complement EU goals for Integrated Coastal Zone Management (ICZM). Similarly, sustainable development principles drive and underlay other LIFE projects that have been successful in pioneering new techniques for improving the sustainability of fishing fleets. These types of approaches are highly relevant to the EU's Marine Strategy Framework Directive (MSFD), the Common Fisheries Policy (CFP), as well as wider over-arching EU



LIFE08 ENV/E/000119

Onboard selection of the fish by-catch before it arrives in the port to be sold

policy frameworks such as the EU 2020 strategy for growth.

Good environmental status

A core priority of these EU policies is the safeguarding of good environmental status for our seas and coasts. This is to be achieved by ensuring that we know how to properly look after the goods and services provided by marine and coastal environments for future generations, including, amongst others, stocks of commercial fish and shellfish – and thereby underpin the important role of fishing communities in coastal areas in the long term. Over-fishing and by-catch can lead to the loss of fisheries resources and ICZM aims to work with fishing crews and their unions and port authorities to find ways of halting such decline, which can have significant negative impacts on the entire socio-economic fabric of traditional coastal communities. Secondly, we need to apply the knowledge we gain in such subjects to properly conserve and protect these valuable and vital coastal resources.

LIFE has been pro-active in its use of EU funds to demonstrate how to balance the quest for coastal waters that have a “good” environmental status with the development needs of fishing communities. Looking at the case of making fishing operations more resource-efficient, for example, highlights LIFE’s beneficial role in helping reduce problems associated with ‘by-catches’ and at the same time identifying new income streams for fishing crews that can reduce the economic hardship many fishing communities are facing.

LIFE finds a use for by-catch

‘By-catch’ refers to unwanted fish that are caught by fishing boats. These may not have been the species that the nets, lines or creels were targeting. They may also not have been the type of species that fishing crews thought had any economic value. The result is that both of these types of by-catch are often discarded and thrown overboard as dead waste. A European Commission Communication on a policy to reduce unwanted by-catches and eliminate discards in European fisheries notes that such practices have serious consequences in terms of: wasting societal resources; lowering future catch opportunities by fishing juvenile species; causing immediate reductions in the spawning biomass if mature individuals are caught; and having an overall negative impact on the marine ecosystem, its biodiversity and environmental status.

The LIFE ‘BE-FAIR’ project (**LIFE05 ENV/E/000267**) and its follow-on, ‘FAROS’ (**LIFE08 ENV/E/000119**) were launched to help to address these challenges through the demonstration of new and smart tools for reducing by-catch waste. Both projects were based on the north-west coast of Spain, and involved working with fishing crews, port authorities, fish auctions, and other businesses involved in the fish-product supply chain from across the country.

The successes of ‘BE-FAIR’ included validation of good practice methods for reusing by-catch and waste matter from long-liners, trawlers, fish auctions, and the food processing industry. Five new waste management processes and four different prototypes were



Photo: LIFE05 ENV/E/000267

The 'BE-FAIR' project validated smart management solutions for the separation, handling, conservation and pre-treatment of by-product species.

established covering on-board storage or conservation solutions, as well as new shore-based recycling and valorisation processing lines. Other LIFE-funded innovations included smart management solutions for separation, classification, handling, conservation and pre-treatment of by-product species.

New technologies were tested to demonstrate the economic value of by-catch matter and commercial markets were identified for products such as fish oils, hyaluronic acid, gelatine from fish skins, and chondroitin sulphate from cartilage.

Such innovative outcomes offer useful transferability for other EU fishing fleets and the project's Manual of Good Practices (supported by a DVD) can be used to help adapt fishing practices towards more sustainable production systems. Participation of French and Portuguese partners in 'BE-FAIR' further facilitated uptake of the project results.

'FAROS' was introduced in 2008 as a LIFE+ project in recognition of the additional benefits that could be obtained by building on the findings of 'BE-FAIR'. In this project, fishing crews are cooperating by working with on-board technology that retrieves real time data on fish being harvested. This is helping to

produce maps of activity and resources at sea. Results can also be used to predict areas where rates of by-catch and discards are likely to be higher, so that these areas can be avoided or closed off during spawning periods or if numbers of certain fish species have reduced.

'FAROS' will run until January 2013 and it remains on course to complete its objective of improving knowledge about fish behaviour in order to help the fisheries sector better target species more selectively. 'FAROS' is also expanding our understanding about new ways of generating value from fish species that are commonly treated as 'waste', thus sustaining the socio-economic fabric of traditional coastal communities whilst managing the effects of fishing on marine resources and ecosystems (discarded by-catch can, for instance, lead to an accumulation of pollutants). Ways of profitably reusing by-catch will become increasingly important tools to help the fishing industry contribute to the objectives of the MSFD and ICZM Recommendation.

Reducing waste from fishing boats

Minimising marine waste of a different kind is the focus of the '3R-FISH' project (LIFE07 ENV/E/000814).

This is demonstrating how fishing crews can improve the environmental status of marine and coastal areas by reducing the amount of damaging solid waste found in our seas such as fishing nets, expanded polystyrene and batteries or lighting devices. These create environmental hazards for marine life and adversely impact on sea bed habitats, reefs and coastal ecosystems. This sort of solid waste from fishing boats can also kill fish or other wildlife through suffocation, strangulation and poisoning.

The LIFE project adopted measures to tackle solid waste problems caused by fishing fleets with the aim of developing an integrated management and recycling system for the main three types of solid waste from fishing and port activities. New approaches to encouraging the recycling and treatment of devices and equipment used in the fishing industry are being piloted, and corresponding actions are underway in an ambitious programme of waste collection in the waters around a number of ports. Training schemes are also part of this project, which is raising awareness and increasing cooperation among harbour authorities and fishing crews about how and why to reduce solid waste volumes. The economic benefits of reducing environmental hazards form part of the training.

Sustainable aquaculture

Aquaculture, which is mainly practiced in coastal waters, can have a positive impact on coastal zones, as it demands good water quality and a clean environment. Fish farms and shellfish beds can also be a tourist attraction and a source of fresh seafood for local hotels and restaurants. However, aquaculture can also have negative environmental impacts, since it competes for limited water space, creates issues of waste disposal and can be a source of pollution. LIFE has been able to help this sector strengthen its green credentials through projects such as Germany's 'ECOSMA' (LIFE07 ENV/D/000229), which is redressing concerns about water eutrophication, use of antibiotics, and loss of ecologically valuable areas. The project team is implementing a coordinated series of actions, such as guidelines for aquaculturists, to promote better water quality around the Baltic Sea coast through ecological certification of products from sustainable marine aquaculture. Results fit well with remarks about the future of aquaculture by Maria Damanaki, European Commissioner for Maritime Affairs and Fisheries, who stressed recently that "aquaculture has to develop in line with high environmental, animal health and food safety standards."

Managing competition

EU coastal zones also serve functions related to job creation, economic growth and quality of life. Competition between economic activities can emerge and energy generation is a typical example. Energy production facilities for both traditional sources, such as oil and gas, as well as renewable wind and tidal power create challenges for the integrated management of coastal zones. ICZM's focus on stakeholder collaboration methodologies, however, provides a useful means of ensuring that such activities do not conflict with the overall economic prosperity and environmental sustainability of our coastal areas.

The 'BLUETEC' tidal energy project (LIFE09 ENV/NL/000426) is a case in point, demonstrating how this sort of socio-economic activity can be taken forward in a balanced and harmonised manner. Sourcing more of our power from renewable energy is a high priority for the EU and, in this currently active project, LIFE funding is being used to test the possibilities for generating 'blue energy' from a full-scale, high-tech tidal wave device. Considerable benefits are anticipated from the project which is identifying valuable knowledge that could be applied and replicated around the EU's coasts.

LIFE funding has been used to develop an integrated management and recycling system from solid waste such as fishing nets



PHOTO: LIFE07 ENV/D/000229

ACTIVITIES IMPACTING ON COASTAL AREAS

Sustainable agriculture in coastal environments

LIFE offers opportunities for strengthening environmental management approaches in coastal areas and project experiences from around Europe highlight how farm-based actions can make positive contributions to coastal zones.

Agriculture contributes to local economies, social cohesion and the maintenance of the cultural traditions of a society. At the same time, intensive agriculture can have a significant environmental impact. For instance, it can create issues of water scarcity because of the amount of water extracted to grow crops. Over-extraction can then lead to issues such as salt water intrusion and erosion. Agriculture is also a source of pollution for our coastal waters. Residues from fertilisers, pesticides and other agricultural chemicals can easily enter marine and estuarine habitats either through groundwater absorption, or more directly via run-off into rivers as well as discharges from effluent pipes and drainage channels. Ensuing pollution then adversely affects the ecological status of coastal waters. It can lead to algal blooms and eutrophication, which have negative impacts on marine habitats and also pose problems for tourism linked to lower bathing water quality.

The starting point for European policy aimed at the problem of coastal water pollution is the individual

river basin. Under the terms of the Water Framework Directive (WFD), EU Member States must take coherent steps to tackle all sources of pollution, whether from the land or the sea. The legislation gives governments a 15-year deadline for achieving good quality coastal waters through coherent water quality policies within River Basin Management Plan (RBMPs).

Along with tourism, transport, industry and urbanisation, agriculture is one of a number of competing land-use activities in coastal areas that needs to be addressed by Integrated Coastal Zone Management (ICZM) plans. National agricultural plans and RBMP also need to take ICZM into account and should pursue a participatory approach that balances related policies and the needs of different ICZM stakeholders.

The LIFE programme provides good examples of how farmers might be included in participatory approaches to (coastal) water management that balance their interests with environmental best practice.



One such example comes from Greece's River Evrotas area, where the 'EnviFriendly' project (**LIFE05 ENV/GR/000245**) highlighted the effectiveness of different tools for strengthening the environmental sustainability of local farming operations. Results helped to reverse threats to coastal waters from agri-pollution sources and were credited by the European Commission through a LIFE "Best" project award in 2009.

Greening Greek agriculture

Taking in some of the southernmost points on Greece's mainland, the River Evrotas basin is home to a busy agricultural community. Olive and livestock farms dominate local landscapes throughout the Evrotas rural catchment area and these have been a source of downstream pollution problems in the river delta and Mediterranean coastal zone. The LIFE project showed how farm-related pollution threats to the coastal waters and environment could be dramatically reduced (by as much as 98% for phosphorus and an equally significant 96% for nitrogen).

Previously, environmental technologies had been implemented with a "surgical" approach without any concern for the impact on the river basin or coastal area as a whole. By contrast, the 'EnviFriendly' project managed to implement environmentally-friendly technologies for the minimisation of non-point source pollution from agricultural lands in conjunction with the adoption of the first RBMP in Greece and coastal zone management plans. The "tool box" of environmental technologies for the minimisation of non-point source pollution from agricultural lands was integrated into the river basin plans and Evrotas's coastal zone.

The project demonstrated several technologies, including 'monitored natural attenuation', a natural remediation technique that uses naturally occurring processes that "destroy" or immobilise contaminants. One such technique involved strategically positioning reed beds, which provided a low impact and natural method for limiting the amount of pollutants entering drainage channels. Other pilot initiatives involved different techniques for treating pollution sources. Several prototype techniques for mitigating negative impacts from oil mill waste products were adopted. One of the test sites harnessed the fast growing root systems of poplars to prevent pollutants reaching ground waters. Another of the project's novel LIFE-funded techniques used lime to help separate solid and liquid particles in the oil mill waste. Both were



Photo: LIFE05 ENV/GR/000245

then used on agricultural land, increasing yields of maize. A third approach used electrolysis to treat wastewater with high biological oxygen demand (BOD) from processing olives in brine, which reduced the BOD content by 50%.

Such impressive results were achieved thanks to the territorial planning approach that balanced and supported six key areas of interest, namely: agriculture, drinking water, irrigation, pollution reduction, flood and drought responses, and biodiversity protection. A Local Development Observatory was established in Laconia to oversee the management plan's implementation, which included participatory approaches similar to those encouraged by ICZM methodologies. This involved consultations with farmers and unions from five different municipalities in order to help secure their commitments to, and cooperation in, the six areas of interest.

Overall findings from this "Best" LIFE Environment project were collated in a collection of 10 environmentally-friendly farming techniques that have been adopted by the public sector as quality standards for beneficiaries of agricultural aid.

Tools like those developed through this Greek project provide useful contributions to the implementation of the WFD and demonstrate how agricultural considerations can be integrated in RBMPs and coastal

'EnviFriendly' showed how farm-related pollution threats to the coastal waters and environment could be dramatically reduced

management. Other LIFE work in this field, such as the nature conservation projects in machair habitats found on Scottish and Irish coastlines, have also pioneered low impact and participatory agricultural approaches. These have positive impacts on EU coastal environments and include ICZM-type methodologies that may be replicated elsewhere.

Sustainable farming systems

Machair is one of Europe's unique coastal habitat types. It is entirely dependent on traditional farming methods that have been applied for centuries by farmers on the north-western fringe of Europe in Scotland and Ireland. The machair habitat forms when sand with a very high shell content is blown landwards by prevailing westerly winds. This results in a fertile, low-lying plain, which is subsequently used for a mix of crops and livestock that are produced on a rotational basis in a mosaic pattern. Natural sources of fertiliser, including seaweed, are used to boost the machair's productivity. This helps to maintain the natural balance of nutrients in the coastal area, thus reducing eutrophication risks. The use of these natural fertilisers and low intensive farming practices have the effect of creating a balance between the agricultural economy, social and cultural value and the protection of natural habitats and species.

That is why wildlife thrives in machair habitats, which in Scotland are home to species included in the Habitats and Birds directives. Despite the machair's value as an important natural resource, changes to

Seaweed is used to boost the productivity of the machair coastal habitat that is unique to Scotland and Ireland



Photo: LIFE05 ENV/GR/000245

Treated wastewater from olive oil processing was used on agricultural land, increasing yields of maize

traditional land use practices have put its existence under threat in Scotland. The LIFE-funded 'Scottish machair' project (**LIFE08 NAT/UK/000204**) is supporting efforts to prevent the decline of this unique habitat by implementing a series of measures promoting greater participation in machair conservation by local farmers.

A vital part of the project strategy involves identifying coastal habitat management practices that are compatible with the development needs and aspirations of small-scale farmers (known as crofters) in the machair. The forging of close working relations between the LIFE team and local crofters was therefore seen as crucial for the project's success. This active participation and consultation in conformity with the guidelines of ICZM has been achieved and is helping the project to meet its targets for conserving nearly 3 200 ha of machair, in 13 Natura 2000 network sites.

In addition, a previous project developed in Ireland (**LIFE00 NAT/IRL/007128**) has also promoted sustainable coastal farming systems in machair habitats through participatory techniques with landowners. Taking place in the Termoncarragh Meadows of County Mayo, this project helped to reverse the negative impact on this Natura 2000 network site of previous local farming practices.

LIFE funding provided the incentive for bringing together farming interests and nature conservation bodies in a forum that allowed everyone involved to better understand each other's position.

Photo: LIFE08 NAT/UK/000204

ACTIVITIES IMPACTING ON COASTAL AREAS

LIFE supports ‘big picture’ approach to coastal planning

Working to support ICZM policy, LIFE projects have developed methods and implemented various actions to reduce the environmental problems of some of Europe’s more heavily populated coastal areas. Importantly, the problems are not addressed in isolation, but take account of the bigger picture.

Almost half of the European Union’s population lives within 50 kilometres of the sea (source: European Commission: 2000¹) and coastal zone resources produce much of Europe’s economic wealth. However, the increasing pressures on these regions – notably from over-urbanisation and ever-expanding tourism, but also from maritime activities (ports, transport, ship building) and to a lesser extent, fishing, aquaculture and agriculture – is leading to their degradation, with environmental, social and economic consequences.

The challenge for policy-makers is to develop a sustainable and integrated approach to urban and rural planning that can work in harmony with the

¹ A strategy for Europe (COM (2000) 547)

coastal environment. EU policies addressing coastal landscapes call for a coordinated and participatory approach, which is why Member States have been called upon to put in place national strategies towards integrated coastal zone management (ICZM). One of the key principles of an effective ICZM policy is to have a view of the problems faced by coastal areas in a wide context. ICZM therefore encourages national, regional and local authorities to take up measures proposed under specific ‘Thematic Strategies’ e.g. the Thematic Strategy on Urban Environment (TSUE) and to develop them for the wider coastal environment.

A common problem faced by Europe’s coastal regions is how to balance the requirements of the coastal environment with the surrounding agricul-

The ‘Prosit’ project implemented a model of recovery of the coastal terraced landscape





Photo: Elym B.

The LIFE 'Prosit' project implemented various practical measures to recover and promote the recultivation of traditional terraced systems

tural or rural landscape. Coastal areas attract tourism that has often been allowed to develop in an unregulated and unsustainable way. This can produce knock-on effects on the surrounding countryside i.e., resulting in environmental and socio-economical problems. For example, uncontrolled tourism often causes hugely inflated house prices (mainly because of demand from second home owners) and this can lead to the abandonment of the area by its original residents. These changes can have a huge impact upon the land, resulting in the gradual abandonment of farming activities that have helped safeguard and maintain the traditional landscapes.

Lemons and other products were cultivated using organic farming methods, which helped boost the rural-urban economy



Photo: Italy Chronicles Photos

Typical terracing

This is exactly what has occurred along the Cinque Terre coastline in Liguria, Northern Italy – a once typical Mediterranean coastal agricultural landscape characterised by dry-stone wall terracing that created suitable conditions for the cultivation of vines on the steep slopes and also helped guard against soil erosion.

The main objectives of the LIFE 'Prosit' project (**LIFE00 ENV/IT/000191**) – carried out in the Cinque Terre national park – was to recover areas of the degraded coastal agricultural landscape and create a balanced link between coastal activities (mainly tourism) and the adjacent hinterland rural areas, which were also then able to prosper as a destination for tourism. It did this through sustainable integrated planning of agriculture, tourism and landscape policies; and by enhancing the integrated management of the coastal areas. Such an approach reverses the abandonment of rural towns and villages, requalifying them as places to work and live and enabling the forging of positive and prosperous links between the coast and rural-urban areas.

The project implemented various practical measures to counteract the abandonment of the terraces, which presented a hydro-geological risk to neighbouring rural areas, and to recover degraded areas of the rural coastal landscape. Under a pilot phase it used GIS mapping to identify plots of land within the park area that would be suitable for the recovery of terraces and their re-cultivation. A total of 35 ha of uncultivated / abandoned land was selected and

then planted with four trial crops (basil, olive trees, vines and lemons) using organic farming methods. The cultivation of basil and olive oil proved especially successful, as such products help meet a growing demand for high-quality organic products. Moreover, since pesto sauce is produced locally, this provides an immediate market for the basil and another boost to the rural-urban economy.

As a result of the recovery of the ancient terracing system, the project team also discovered a network of paths between the plots of land. This has encouraged the development of hiking tourism and has helped divert some of the pressures away from the area's beaches. It also highlights possibilities for a more sustainable and integrated tourism strategy for the future.

Finally, participation of all stakeholders was fundamental to the success of the project. Visitors and local people were informed through a forum and regular meetings were organised with the project partners (the park municipalities, the local agricultural cooperative and promoters of tourism). Each meeting focused on a specific theme: from viticulture, organic farming and wild boar management to managing the transport network. The overall aim was to encourage active participation so that people would feel empowered and responsible for the active protection of 'their' territory. By the end of the project, more than 4 500 people had expressed their support for the initiative.

Transport links

Good transport infrastructure is fundamental to successful land-use management. Well-planned transport networks are essential for coastal municipalities looking to reap the full benefits from tourism and to sustain other local businesses. Some coastal regions have made the mistake of only creating good transport links for the peak tourism periods and have ignored the needs of local residents during the rest of the year. In other cases, transport systems have been designed in an unsustainable or fragmented way with no connection with the spatial development policy of the coastal area and without taking into account business needs. This leads to pollution, over-crowding and habitat destruction. Sustainable transport planning needs to be integrated with other coastal urban and rural planning measures.

Another Italian LIFE project, located on the idyllic Mediterranean island of Elba (**LIFE09 ENV/**

IT/000111) is developing an eco-sustainable and integrated transport system for the island and the mainland. Coastal tourism is a primary asset for Elba's economy, but the increased traffic flows have created negative environmental pressures. The project, which runs until 2013, is looking to make use of eco-friendly vehicles (e.g., electric vans and minibuses) and to offer more flexible transport services (i.e. available on demand). The overall objective is to design and demonstrate integrated mobility schemes to cope with the significant ebbs and flows of people and goods. This should alleviate pressures on small islands (and coastal environments more generally), whilst preserving, or even improving, the quality of services offered to tourists, residents and freight operators. This model will also be implemented on a Greek island.

Ports and harbours

Ports and harbours act as key economic drivers in the regional dynamics of Europe's coastal areas. They should be well integrated within the coastal urban context to avoid economic or social problems. Planning should also take environmental concerns on-board and find ways of managing them to minimise pollution, habitat destruction and coastal erosion.

Issues of port capacity, maritime access, hinterland connections and the quality of life in and around port towns and cities must all be addressed when integrating urban planning policies with coastal management.

The LIFE 'Elefsina 2020' project (**LIFE05 ENV/GR/000242**) was developed to regenerate the degraded port and urban area of Elefsina Bay, one of

Eco-friendly vehicles are used by the Elba project to alleviate the pressure from the coast caused by flows of tourists and goods



Photo: LIFE09 ENV/IT/000111



Photo: LIFE05 ENV/GR/00242

LIFE has helped transform Elefsina into an ecological port, compliant with ECO-PORTS-EMAS regulations

the most industrialised and environmentally troublesome regions in Greece. Quality of life and economic development was being adversely affected by pollution and hazards from the port and industrial activities, as well as from uncontrolled urbanisation, which had limited the number of communal spaces and constrained access to the seafront.

The goal of the project was to propose a strategy for the integrated socio-economic regeneration of the Elefsina urban area up until 2020. There had been interventions in the past, but these actions were not part of a coordinated plan for the area. The LIFE project proposal was based on 'Deliberate Community Visioning', a method of supporting participatory processes and promoting joint stakeholder action. To this end, the project led to the formation of two committees: the Elefsina Bay 2020 Committee, which

provided technical and scientific support; and the Neighbourhood Committee, which consisted of local community representatives, who discussed concerns, provided feedback and disseminated information to the community. With the support of these committees, the project was able to devise and implement an integrated 'action plan' for the regeneration of the whole area by 2020 – with measures targeting both the port area and the city of Elefsina.

The "Elefsina 2020" Action Plan was thus able to present a 'common vision' supported by all stakeholders. The plan summarises all the measures necessary to achieve the sustainable development of the area by 2020.

The project also took practical steps to regenerate both the urban area and port of Elefsina. In the case of the former, these included pedestrianising the route from an archaeological site to the coast, renovating a square, promoting sustainable mobility by limiting traffic in some streets and creating specific recreational areas. In the case of the latter, the project aimed to transform Elefsina into an ecological port, compliant with ECOPORTS-EMAS regulations. This would also serve as a demonstration model for other Greek ports of similar size and capacity. The LIFE team cooperated with the staff of the Valencia Port Authority and the Port Institute of Studies and Cooperation (FEPORIS) and, as a result, established an environmental management system and obtained EMAS certification. The project also installed a system to track the movements of ships in the bay, to identify hazardous loads, and communicate with ship operators in the event of an accident.

A strategy for the integrated socio-economic regeneration of the Elefsina urban area up until 2020 was also adopted



Photo: LIFE05 ENV/GR/00242

ACTIVITIES IMPACTING ON COASTAL AREAS

Managing tourism for the wider good

Tourism is the main economic and social activity of many coastal zones in Europe. However, regional and local actors that rely on tourism for jobs and investment must also consider the impact of tourism on the coastal environment. LIFE projects have provided some good examples of including tourism within an integrated approach to coastal zone management.



Photo: LIFE00 ENV/IT/000167

Tourism infrastructure and the movements and actions of tourists can have a detrimental effect on coastal habitats and species. Tourism also needs to adapt to climate change-related issues such as coastal erosion, rising sea levels, floods and droughts. Scarcer resources, in general, may lead to conflict with other activities, which could adversely affect the future stability of the industry.

A complex sector

Tourism contributes 7% of the EU's GDP and coastal tourism is a major part of this, generating millions of

jobs. When managed properly, tourism can be beneficial for the preservation of fragile coastal areas as well as boosting the local economy. Whilst recognising the importance of the sector and favouring its expansion, the EU has stressed the need in several communications and resolutions for tourist development to be sustainable. Tourism is a Member State competence, with no clear mandate for EU-level policy action. Thus, if the sustainability of the sector is to be attained, decision-makers must work together with all stakeholders (hotels, restaurateurs, tour operators, park authorities etc.) to devise and implement those measures that address the specific

'MED-COASTS ST' adapted a bathing establishment to reduce water and energy consumption in a quantifiable way for the first time

capacity and limited resources of the coastal area in an integrated way.

Integrated Coastal Zone Management (ICZM), which plays an important role in defining coastal management policies and in coordinating local activities, can be used by the tourism sector to better plan and manage its activities in coastal zones. This is not an easy task, since there are competing development demands on these fragile environments. However, ICZM's multi-sectoral approach is increasingly recognised by decision-makers and tourism operators as a tool that can help deliver sustainable coastal tourism, particularly when tools such as Strategic Environmental Assessment (SEA), Carrying Capacity Assessment (CCA), Environmental Impact Assessment (EIA) and the Eco-Management and Audit Scheme (EMAS) are applied within a defined regulatory framework.

LIFE and the tourist sector

LIFE projects have helped to show that sustainable tourism can be achieved by engaging decision-makers, tourism operators and local stakeholders in finding appropriate solutions that benefit the environment and local businesses. Project goals have ranged from developing integrated environmental management systems for tourism-focused municipalities to demonstrating better practices for specific tourism industry activities.

LIFE Environment projects have worked with municipalities affected by mass tourism – particularly in the Mediterranean – to develop coherent and integrated approaches to managing coastal areas and the impacts of tourism.

The 'ETICA' project (**LIFE04 ENV/IT/000488**) worked with seven participating coastal municipalities in the province of Teramo, (Abruzzi, Italy) to explore the use of EMAS for ensuring sustainable tourism inland and in coastal areas. The municipalities have a combined population of some 100 000 people, but this can increase threefold during the summer months. With 120 km of shoreline, seaside tourism is a key part of the regional economy. The LIFE project aimed to implement initiatives to protect the coastal environment whilst developing an economically-viable and sustainable approach to tourist development.

ETICA involved different levels of government and management institutions - including three seaside operator associations - working towards compliance



Photo: LIFE04 ENV/IT/000488

The "Green Beach" scheme launched by the 'MED-COASTS ST' project improved waste recycling at beach installations

with the combined principles of ICZM and sustainable tourism. A major focus was on data collection to understand the environmental situation of coastal tourist areas and ecosystems, and current management practices. Staff at the seven municipalities were trained in the use of an Environmental Management System (EMS), with the goal of integrating competing demands on the coast so as to improve environmental interventions. Awareness-raising activities on the relationship between tourism and the environment were also carried out in order to guarantee transparency towards all stakeholders and citizens.

By the end of the project, two coastal municipalities had fully adopted EMAS and five had obtained ISO:14000 certification, showing good practice in implementing ICZM. The municipalities were able to use a model to assess the inter-relationships between tourism, the environment and the economy. These processes supported improved coastal management planning and monitoring of environmental matters by the participating authorities.

Benefits of the project included a shift from environmental 'crisis management' to more sustainable planning, greater environmental understanding supported by data and the identification and realisation of significant energy saving possibilities. EMAS certification could also increase opportunities for ecotourism.

Pioneering better practices

The 'MED-COASTS ST' project (**LIFE00 ENV/IT/000167**) saw the town of Rimini in Italy working with Calvià in Spain to share ideas and approaches for reducing tourist pressures on the natural environment and improving the environmental quality of their respective coastlines.

In both areas, pilot actions demonstrated the feasibility of improving the environmental quality of coastal areas. In Rimini these included promoting a car-sharing service for tourists; improving the water quality of the Marano creek using phyto-depuration techniques; and launching a 'green beach' scheme centred on energy/waste flows at beach installations and the use of photovoltaic cells to generate solar energy. The 'MED-COASTS ST' team also adapted a bathing establishment to reduce water and energy consumption in a quantifiable way for the first time.

Working with Italy's National Agency for Environment Protection (APAT), the project team developed a toolbox for hotel owners and managers to introduce more environmentally sustainable practices - notably more ecological purchasing and simplified environmental management - to obtain the European eco-label. Furthermore, the project devised 'Ten Golden Rules of the Sustainable Tourist', part of a broader educational kit for the tourism industry and tourists.

The LIFE project drew on the work of an earlier Local Agenda 21 initiative, bringing together the two municipalities with a major research institute, hotel managers' representatives and other public and private sector stakeholders to create a sustainable

tourism charter for Rimini (which was adopted by 500 participants).

The project also assessed the carrying capacity of Rimini, a process that was recognised by the United Nations Environment Programme (UNEP) as an example of good practice. Based on this and other preparatory work, the two municipalities developed a new model of tourism development using ICZM and considering the environment as a primary resource for every tourist destination. In recognition of the project's achievements, in 2003 the beneficiary was awarded first prize in the 'Carmen Díez de Rivera' European Award for Sustainable Tourism.

A lasting achievement of 'MED-COASTS ST' was the establishment, with the association of local governments for sustainability (ICLEI), of a network of Cities for Sustainable Tourism dedicated to finding solutions to mass tourism at an international level. This network continues today, comprising 16 members from across the Mediterranean region (Israel, Turkey, Greece, Italy, Tunisia and Spain).

Other LIFE projects have also experimented with pilot actions to improve the environmental performance of more sustainable tourism. The 'ShMILE' project (**LIFE04 ENV/FR/000340**) focused on improving the sustainability of hotels in the Mediterranean, also with a view to the achievement of the EU eco-label for tourist accommodation (ELTAS). It tackled the lack of information and support structures for hotels to implement existing good practice by designing a toolbox for tourism professionals to work towards ELTAS accreditation. This contained an audit tool, a cost-benefit analysis methodology, examples

The 'DUNETOSCA' project created authorised paths allowing tourist access in a more controlled and sustainable way

Photo: LIFE05 NAT/IT/000037





Photo: Cátia Nicolau - LIFE07 NAT/P/000646

Photo-identification of bottlenose dolphins from onboard a research vessel during the 'CetaceosMadeira II' project

of good practice and a decision-making tool. Pilot sites in France (Corsica), Italy (Sardinia) and Greece (Halkidiki) tested the toolbox. The project team also published a guide to developing a 'green' marketing strategy, aimed at the hotel sector, along with educational modules on tourism quality management, architecture and engineering (of renewable energy and water saving technologies).

Reducing habitat interference

Many, if not all, LIFE Nature projects working in coastal areas have contained an element focused on controlling tourist pressures in fragile habitats. This typically involves drafting management

plans for Natura 2000 network sites that set the boundaries of tourist areas, thereby helping to reconcile tourism activities with nature conservation. These plans are backed up by concrete conservation actions, including fencing off particularly vulnerable areas, constructing designated walkways over dunes and coastal wetlands habitats to provide more controlled (and often better) public access; and providing signboards, leaflets and other information to raise understanding of the importance of the surrounding coastal habitats.

The 'DUNETOSCA' project (**LIFE05 NAT/IT/000037**) improved some 80 ha of coastal ecosystems in northern Tuscany. As part of these efforts, it closed around 100 unauthorised paths, installed 19 wooden platforms and green fences over 4 ha, and produced brochures, information panels and a website on coastal habitats. These actions prevented inappropriate human interference, whilst allowing tourist access in a more controlled and sustainable way.

Similarly, the 'Strofylia-Kotychi' project (**LIFE02 NAT/GR/008491**) contained important elements of tourist management within broader habitat restoration interventions. The project, which improved the conservation status of coastal habitats including lagoons, dunes and pine forests, fenced areas of forest and dune to prevent inappropriate access, blocked illegal roads, designated limited areas for parking and beach access, and placed information boards, all with the aim of reducing negative impacts whilst maintaining the full tourist experience.

Whale-watching

Tourism in coastal areas includes an important marine element, and one of the most popular and growing sectors is whale-watching. The French project 'LINDA' (**LIFE03 NAT/F/000104**) promoted whale- and dolphin-watching activities around Corsica as a means of encouraging fishermen to abandon bad fishing practices and reduce conflict with aquatic mammals. The Spanish project 'Cetáceos Mediterráneo' (**LIFE02 NAT/E/008610**) also encouraged whale-watching as an alternative venture for fishermen in the Canaries.

However, in many cases whale-watching operations have started with little or no oversight and several LIFE projects have addressed this problem through engagement with the key stakeholders. 'LINDA' agreed a code of conduct for whale operators in Corsica, whilst 'Cetáceos Mediterráneo' developed new local regulations. The Italian project 'Santuario Cetacei' (**LIFE03 NAT/IT/000148**) introduced an inventory

of operators and established a voluntary code of behaviour with them. The Portuguese project 'Zonas costeiras' (**LIFE98 NAT/P/005275**) developed a code of conduct in cooperation with operators in the Azores through public meetings. In return, the operators received training on environmental issues as well as first aid and business promotion.

The ongoing Portuguese project 'CetaceosMadeira II' (**LIFE07 NAT/P/000646**) is working to define appropriate areas and the corresponding carrying capacity of the natural environment for whale-watching activities around the delicate Madeira archipelago.

The key to the success of LIFE's interventions has been to assess the biological and socio-economic impact of whale-watching and to engage early with operators and potential operators. That way both tourism and the marine coastal environment can prosper.



Sustainable shipping and harbours

Ports have an important part to play in Europe's economy, not only for their role in facilitating trade, but also, with the growth of the cruise ship industry, increasingly as tourist destinations. LIFE has promoted a joined-up approach to harbour management and sustainable shipping via projects that demonstrate best practices and build networks to help implement them. Through its support for technological solutions to environmental problems, such as systems for limiting the effects of oil spills, anti-fouling paints that cut pollution from ships and ways of reusing dredged materials from harbours, the LIFE programme is at the forefront of efforts to manage ports and ships in an integrated way.

SUSTAINABLE SHIPPING AND HARBOURS

LIFE develops sustainable ports

LIFE funding is helping implement sustainable and integrated approaches to the management of Europe's ports that can deliver long-term economic and environmental benefits.



Photo: LIFE05 ENV/NL/000018

'NoMePorts' developed an innovative approach to mapping and managing noise in industrial port areas

More than one thousand ports line Europe's coasts, handling some 40% by weight of the EU's internal trade. They have therefore a major role to play in the cohesive running of the EU. Not only are ports important hubs for trade, but they are also increasingly becoming key areas for the tourism industry thanks to the growth in popularity of cruises. The European Commission published a 'Communication on a European Ports Policy' (COM/2007/0616) that outlines the challenges port authorities face and how an integrated approach can lead to desired outcomes: a reduction in greenhouse gas production; better redevelopment and the shifting of traffic away from congested city centres; cleaner operations; and

the development of constructive dialogue among stakeholders.

In a wider context, the more widespread use of ports can help the EU achieve its climate change targets. Less fuel is required to move the same volume of goods by maritime transport than terrestrial transport, leading to a significant decrease in greenhouse gas emissions. The Commission's White Paper on "European Transport Policy for 2010: Time to Decide" thus promotes 'intermodal' solutions that combine maritime transport with inland waterways and railways as an alternative to congested road networks for freight.

Such solutions will require the creation of a genuine trans-European shipping network, which enables the revival of 'short-sea' shipping between ports through the creation of 'sea motorways'. This will depend upon better connections between ports and the rail and inland waterway networks together with improvements in the quality of port services. But growth must be sustainable, and ports and harbours are already responsible for much noise and air pollution, landscape degradation and waste production.

An ongoing Italian project 'LCA4PORTS - European Ports Life Cycle Assessment (LCA)' (**LIFE10 ENV/IT/000369**) is a good example of how an integrated approach to port management can be achieved through the involvement of stakeholders at every stage of a port's development – from its design to day-to-day operations. The objective is to establish the port of Anzio on the coast of Lazio, Italy, as a model of LCA application and eco-design.

Its specific targets are ambitious: a 50% reduction in energy consumption in the port area and 100% energy efficiency for the external and internal lighting. The port buildings are also expected to be fully energy self-sufficient and all the excavated material will be reused. Furthermore, the project aims to optimise wastewater treatment, implement rainwater recovery systems and separate sewerage and drainage systems. Non-drinking water will be used to irrigate green areas.

Assessing the environmental impact of all steps in the 'life' of a port is one approach to implementing EU policy on Integrated Coastal Zone Management (ICZM). Another approach is to introduce Environment Management Systems (EMS), which many port authorities in Europe have undertaken and several LIFE projects have helped facilitate (see pp.30-32). The port of Livorno, Italy, was the subject of the 'EMASPOLI' project (**LIFE02 ENV/IT/000015**), which involved stakeholders in the sustainable development of the port. EMAS, which was tested and registered during the project, along with the ISO:14001 certification that was also achieved, is ensuring that the port authority continues to evaluate and limit the port's impact on the environment.

Targeting environmental hazards

Other LIFE projects have addressed some of the specific problems that are associated with ports, namely noise management, the treatment of storm water and the management of waste. The Dutch project



Photo: LIFE02 ENV/IT/000015

'NoMEPorts - Noise Management in European Ports' (**LIFE05 ENV/NL/000018**) developed a structured approach for mapping and managing noise in industrial port areas. Its results contributed to the drawing up of a guideline for other ports in order to further the implementation of the Environmental Noise Directive (2002/49/EC), which specifies that industrial port areas near large agglomerations must be included in noise maps.

The guidelines were disseminated throughout the ECOPORTS network, which is made up of more than 350 European ports. The 'NoMEPorts' project was developed for six European port areas (Amsterdam, Livorno, Hamburg, Copenhagen, Civitavecchia and Valencia) and provided noise maps and action plans to mitigate noise problems in urban areas close to the ports. Such plans were shown to be highly effective. At the Port of Amsterdam, for example, a reduction of noise of more than 30% was achieved through the implementation of the plan developed during the project.

Another European directive – 2000/59/EC – also has a direct bearing on port operations. The directive con-

The 'e-COPORT' system enabled ship-generated waste to be identified, tracked and traced from collection to disposal



Photo: LIFE05 ENV/IT/000369

The port of Anzio aims to become a model of LCA application and eco-design

cerns the management of ship waste, obliging ships to declare to port authorities 24 hours ahead of time the nature and quantity of their waste. It also states that ports must provide the facilities to receive such waste (the cost to be covered by a charge paid by every ship) and that Member States must carry out inspections of up to 25% of shipping.

The French 'E-COPORT - e-coport' project (**LIFE05 ENV/F/000630**) demonstrated at the port of Le Havre how the objectives of this directive can be met, thus reducing the volume of waste dumped in the sea and reinforcing protection of the marine environment. The port authority cooperated with 15 local public and private partners in the design of the e-COPORT system: an Internet-based server facilitating real-time relations among the various

actors involved in the control and management of ship-generated waste – i.e. the ship via its shipping agent; the harbour master's office; waste collection and processing companies; and governmental agencies in charge of supervising shipping, collecting waste fees and applying regulations. The e-COPORT software forecasts and controls rubbish/cargo waste flow in real time and immediately transmits this information across the waste management network.

Storm water runoff in urban areas can be very polluted, and the 'ESTRUS' project (**LIFE05 ENV/IT/000894**) aimed to demonstrate the sustainability and cost-effectiveness of existing Distributed Treatment Solutions (DTS) systems for storm water runoff in harbour infrastructure and industrial sites. It developed a full-scale treatment solution (hydraulic and chemical/physical) using an approach that had been tested initially in the laboratory.

The new technology can be regarded as a valid alternative to end-of-pipe treatment and can be applied in situations where an end-of-pipe treatment plant cannot be constructed. DTS allows the storm water to be treated before it reaches the drainage tubes and is particularly effective in the treatment of highly polluted first flush water. Moreover, the DTS methodology can be applied to other environmental problems such as the protection of seawater quality for bathing and other recreational purposes by treating the water along the coast that discharges into the sea.

LIFE projects have addressed most environmental problems associated with ports, from noise management to waste and energy consumption



Photo: LIFE05 ENV/IT/000271

SUSTAINABLE SHIPPING AND HARBOURS

Showing the way to integrated port management

The LIFE programme has been instrumental to the Valencia Port Authority's introduction of environmental management systems (EMS), particularly the Eco-Management and Audit Scheme (EMAS). Through LIFE, the port has implemented clean-up operations, monitored their impact and engaged the city in the life of the harbour, as part of an integrated approach to coastal management.

Ports are engines of growth and development for cities. At the same time the vitality of port cities is fundamental in developing the ports themselves. This can be a source of tension as urban development and other land uses clash with the needs of port expansion. The port and city also share the coastal environment and both place specific demands on it. Since environmental issues do not have administrative boundaries, this can mean that negative impacts created by the port – e.g. air pollution, noise or 'visual pollution' – can have adverse effects on the city (and vice versa), hence the need for models of compromise that will allow for the sustainable growth of both port and city.

The LIFE programme has helped develop such models, for instance, the 'SIMPYC' project (LIFE04 ENV/ES/000216) in the port city of Valencia (Spain) demonstrated how a harmonious relationship between port, city residents and other interested parties can be fostered through integrated monitoring and action plans.

The project focused on three of the environmental issues that arise in coastal areas at the port city interface: air quality, noise and landscape development. The environmental integration of smaller ports (marinas and fishing ports) was also studied in order to give solutions for specialised small-scale environments.

An important first step was to find out how the city viewed the port, and the project beneficiary, the port authority, worked with the University of Valencia to produce questionnaires. "We wanted to do a project that focused on the relationships between all the players in the port and to distinguish those problems



The port of Valencia demonstrated how EMAS can create harmonious relationships between a port, a city and its residents

that are [caused by] the port [from] those that are not," explains project manager, Federico Torres.

The university analysed the survey results both to gain an insight into residents' knowledge of the environmental protection of the port area and to help define priority areas for intervention. As a result, specific groups within the population were identified and targeted by actions to help improve their knowledge, with particular attention paid to port workers, regular port users and younger people.

Monitoring played a key role in this aspect of the project, as Mr Torres recalls: "We had a lot of meetings with all the stakeholders, and with the unions, in order to show them the results of the projects and that we don't have problems with noise, visual impact and air quality. In the past, these were topics that people said were important. Life next to the port was not so good, they said. We wanted to show that there is no reason to say that."



Air quality monitoring networks were established in the ports of Livorno, Toulon and Valencia

'SIMPYC' was able to draw on the experiences of other ports in Europe, one of the reasons behind the port authority's application for a LIFE project, according to Rafael Company of Valenciaport. "The best option is to cooperate between countries, so LIFE is a good way

“The best option is to cooperate between countries, so LIFE is a good way to make contact with ports that have the same problems”

to make contact with ports that have the same problems," he says. The port developed contacts with the ports of Rotterdam and Amsterdam amongst others.

Acknowledging that the same problems are present across Europe, the 'SIMPYC' project furthered the development of a European standard of reference in port-city relationships from an environmental perspective. This aim was achieved through the expansion of air quality and noise pollution monitoring networks in Livorno (Italy) and Toulon (France), as well as Valencia. Use of compatible equipment has made easier data comparison and communication of results, which thus can be transferred and applied to other port areas. A system to evaluate the landscape impact of the port infrastructure in the three cities was also introduced.

In order to evaluate the effectiveness of the measures a set of 10 environmental indicators was created for monitoring and improvement of the system. The indicators take account of a series of parameters,

including emission sources, air quality, noise levels, landscape impact and resident perception.

Real-time monitoring

The monitoring information that the port works with needs to be effectively managed to be of use. In cooperation with the city's university and through the implementation of EMS, the port authority is now able to know "what's happening at the port 24 hours a day and can take corrective steps. We monitor noise levels for example, and then if we detect a problem (it's too high) we implement measures. So we have real-time monitoring of the different aspects," says Mr Torres.

The gathering of this information was to a large degree helped by the development of a 'guideline' for EMS, which was based on EMAS requirements and ISO 14001 standards. "Ports are very complex areas because of the number of companies with different sizes and different activities," highlights Mr Company. "The idea was to use the environmental management systems in order to derive information in a useable framework."

Two fishing ports managed by the regional government of Valencia - Denia and Villajoyosa - piloted the application of EMS, using systems specifically created for their needs and which took into account integration with the city of Valencia. Both ports were ISO:14001 certified and the knowledge gained led to the publication of an Implementation Guide for use by other European fishing ports and marinas.

One of the key aspects of the project was the collaboration it engendered among different administrative bodies. The collaborative efforts of port administrations, local agencies, local and regional authorities enabled a leap forward in the coordination of actions for the environmental protection of the port-city area. Specific agreements were drawn up in the three countries (Spain, Italy and France) that will help to formalise the project's actions and ensure their continuity after-LIFE. Furthermore, the project results can be passed on to more than 1.5 million European citizens living in these three port city areas.

Creating an 'ecoport'

Devising an EMS suitable for a port was the main aim of the earlier 'ECOPORT' project (**LIFE98 ENV/E/000426**), the first LIFE project carried out by Valenciaport. The project team tested its EMS for ports

in seven companies, an action backed up by a wide-ranging information campaign and training activities.

Under the 'ECOPORT' model, companies and organisations can participate on an individual basis and agree voluntarily to abide by its rules and monitoring systems. The model also provided an umbrella framework for the development of an overall environment management strategy for the whole port area. It provides a detailed, step-by-step methodology for implementing EMS in a port company, backed by detailed tools and instruments.

After a company agrees to join the system, an initial assessment is made of its impact on the environment. Next, the company develops an environmental plan and drafts documentary support (i.e. a manual, procedures and technical instructions) that are then tried out on a trial basis before being fully implemented. The next step is the audit and monitoring stage, which aims to encourage continued improvement in performance.

Finally, an environmental statement is issued by the company. Although this step was made optional during the project, recommendations were offered as a reference for the companies, based on the requirements and recommendations of the EU Regulation 1836/93. The framework structure aimed to provide a joint image for the port area and establish similar environmental standards for often competing companies and encourage them to make use of economies of scale by developing joint approaches. This 'Environmental Code of Conduct' involved a declaration of environmental commitment from the port, the drawing up of an environmental plan with a common auditing element, a set of general standards and guides and the development of an environmental management structure.

According to the port authority, 19 companies are now signed up to the Ecoport "brand", representing some 50% of the port's transport of goods. These companies meet every month to discuss ways of meeting "environmental goals – for example, if we



want to obtain ISO certification then the port gives support," says Mr Torres.

Moreover, the port is continuing to improve its environmental performance and is one of six Mediterranean ports involved in an EU-funded initiative to reduce the production of greenhouse gases. It is also planning to test out new ways of making its operations more energy efficient. "We are producing a specific guide for energy efficiency for a lot of container companies, but this guide is useful for a lot of companies working in the port," points out Mr Torres. "The idea of using the university is that they can implement the guide in the industrial sector in general."

At the Climeport Conference in Valencia in March 2012, Dr Victor Cloquell Pallester of the University of Valencia said: "We are integrating our environmental management with our energy management, and this has helped us to believe that the 2020 [climate change] target is achievable."

Collaboration between administrative bodies enabled a leap forward in coordinating the environmental protection of the port-city area

Project number: LIFE04 ENV/ES/000216

Title: SIMPYC - Environmental integration for ports and cities

Beneficiary: Valencia Port Authority (Valenciaport)

Contact: Federico Torres Montfort

Email: ftorres@valenciaport.com

Website: www.simpyc.info

Period: 01-Aug-2004 to 31-Jan-2008

Total budget: €1 720 000

LIFE contribution: €830 000



SUSTAINABLE SHIPPING AND HARBOURS

Recycling dredged materials

Dredging is essential for safe navigation in ports, harbours and marinas. However, dredged material often contains pollutants, which, when disturbed, can have a harmful impact on coastal flora and fauna and water quality and typically must be landfilled. Several LIFE-funded projects provide examples of ways of turning this waste material into a resource.

The SedNet European network estimates that the total amount of sediment dredged in Europe is between 100 and 200 million m³/yr. Although no EU legislation specifically targets dredging, the activity is regulated by a number of directives, including the Waste Directive, Landfill Directive and Water Framework Directive. Ports are often located near or adjacent to Natura 2000 network sites and dredging also has to be conducted in compliance with the Habitats and Birds directives.

Two ongoing Italian LIFE projects are establishing an integrated approach to the management of dredged sediment that takes into account the requirements of the port and the environment.

The Port of Ravenna's 'SEDI.PORT.SIL' project (**LIFE09 ENV/IT/000158**) is aiming to demonstrate the viability of recycling material following dredging. The organisers believe that decontaminated sediment could be suitable as a raw material in the infrastructure and environmental engineering sectors. The project is also investigating the feasibility of extracting silicon from polluted sediment. Such integrated action is in line with the ICZM plan that the regional authority adopted in 2003. The project also intends to assess whether its processes trialled at the Italian port can be transferred to the port of Midia (Romania).

Also in Italy's Emilia-Romagna region, the 'COAST-BEST' project (**LIFE08 ENV/IT/000426**) is employing an integrated approach that is expected to lead to the implementation of a network-based system involving nine small harbours. This network of harbours will carry out all the sediment-related activities – i.e. dredging, separation/treatment, reuse and disposal. Recycled materials could be used to reinforce and reconstruct beaches, thus limiting erosion.

This approach will help to reduce the final amount of sediment disposed in landfill sites, as well as the consumption of natural primary resources. The development of an integrated sediment management system and the implementation of appropriate treatment techniques will prevent some 50 000 m³/yr of sediment ending up as landfill. Another expected environmental benefit will be the removal of polluted materials from harbour sites, which will reduce the exposure of coastal ecosystems to hazardous waste.

An earlier Finnish LIFE project, 'STABLE' (**LIFE06 ENV/FIN/000195**) pioneered ways to reuse dredged materials. It developed a means of mixing sludge, fly ash and cement to make a stable, non-leaching substance that can be used in construction. Dredged material has been used to extend the harbour wall at the port of Turku. This both benefits the port and illustrates the balancing of interests that underpin integrated management plans.

The project also developed a method for precise dredging that has a reduced impact on the environment, an output that could be transferred to other coastal regions in the EU.

Analysis of samples of dredged material that are used for beach reinforcement after decontamination



Photo: LIFE08 ENV/IT/000426

SUSTAINABLE SHIPPING AND HARBOURS

Lessening the impact of ships' paints

Hazardous compounds used in ships' antifouling paints pose particular problems to Europe's coastal environments. LIFE projects have helped to mitigate such threats.

Smart and sustainable approaches to the development of EU business sectors are core goals of the high-level Europe 2020 strategy. These principles apply to coastal industries such as shipping and significant scope exists for using innovative technologies to improve the environmental sustainability of EU shipping fleets.

Reducing pollution caused by shipping is a target for Member States as part of their commitment to the EU's Common Implementation Strategy for the Water Framework Directive. There is a need for technological solutions to ship-related pollution that are capable of improving the ecological status of coastal waters, and at the same time supporting the competitiveness of the EU's shipping industry.

In its Communication on ICZM¹, the European Commission stressed the importance of finding global solutions to sediment pollution caused by ships' antifouling paints through more environmentally-friendly antifouling technology. It noted that antifouling paints using tributyltin (TBT) posed particularly hazardous threats to marine life and a ban on TBT has been in force in the EU since 2003.

However, potentially hazardous materials such as TBT and copper may still be found in antifouling compounds on some hulls. (Moored boats, ports, ship repair yards and facilities that service recreational and commercial vessels have been found to be the major sources of TBT in the aquatic environment). These can cause environmental problems as their toxins leach into the water continuously. The risk is especially acute when ships' hulls are cleaned or repaired, since both processes often lead to antifouling particles entering the water where they can contaminate seabed sediments. Such

toxic sediments remain problematic because port and harbour authorities need to dredge sediment to keep their shipping lanes open, and, as TBT is adsorbed by sediment particles, effective removal and treatment methods for TBT-contaminated sediments need to be implemented simultaneously.

In-water cleaning of ship hulls was therefore forbidden on environmental grounds, which meant that ships incurred increased costs from dry dock cleaning. Finding alternative solutions to tackle this ICZM challenge had previously been difficult, but successful outcomes from the following LIFE projects have demonstrated that smart and sustainable options do now exist.

TBT CLEAN

Treating contaminated port sediment was the focus of the 'TBT CLEAN' project (LIFE02 ENV/B/000341). This project invested around developed an integrated approach to the removal of TBT from Belgium's coastal zones.

Prevention, treatment and reuse of dredged sediments containing TBT contaminants were all core goals of the project. An increasing body of evidence was emerging that highlighted the hazards of TBT in coastal environments. French oyster farmers had been badly affected by TBT's tendency to thicken shells and reproduction problems in other commercial fish species were also linked to increased TBT levels in coastal waters.

Dredging operations analysed the TBT concentrations in different aqueous phases



Photo: LIFE02 ENV/B/000341

¹ European Commission communication to the Council and the European Parliament on integrated coastal zone management: A strategy for Europe (COM (2000) 547).



The treated sediment was reused as a raw material in landscaping, dike reinforcement and construction

The LIFE project team set out to mitigate such threats through testing new techniques for removing and treating TBT contaminated sediments. Dredging operations were simulated on a pilot-scale as an initial step to analyse TBT concentrations in aqueous phases. Different water conditions were tested including very muddy and turbid waters. Comparisons with tests made in clearer and cleaner water samples made it possible to correlate TBT levels with the turbidity of water.

Other LIFE-funded experiments on sediment re-suspension in harbour waters provided evidence that environmental conditions (such as pH, salinity and temperature) each have specific influences on the amount of TBT that leaches from sediment into coastal waters. Acidic and alkaline conditions were considered to represent high risk situations for TBT-release and so dredging within these parameters was seen safer. Lower water temperatures and reduced salinity were also deemed more favourable factors in limiting the risks from TBT leaching.

Results from these tests confirmed that winter dredging operations represented the least hazardous option, and this data was used to design a new dredging time schedule which has dramatically diminished TBT release in the project area. The leaching tests were complemented by more studies aimed at determining the best methods for treating dredged sediment (the methods can also be applied to other contaminants).

Some 2000 m² of TBT contaminated sediment was dredged from the Port of Antwerp to provide the raw material for a series of treatment experiments using thermal methods, bioremediation, washing and separation, phytoremediation and electrochemical actions.

TBT removal rates for each technique were evaluated to reveal that bio-remediation and thermal treatment offered potentially useful options for treating contaminated sediments which could go on to be reused in landscaping, dike reinforcement and construction. These findings from 'TBT CLEAN' helped in the planning of the €480 million Amoras treatment plant, which is able to safely process 500 000 tonnes/yr of dried dredge sediment from docks in the Antwerp coastal zone.

Recycling dock waste

Another treatment system for recycling TBT-contaminated dock waste was developed by the German LIFE project (**LIFE99 ENV/D/000414**). This sought to find effective ways for dealing with the large volumes of wastewater collected from high-pressure water jets used in dry docks during antifouling maintenance on ship hulls. High concentrations of TBT and other hazards can accumulate in such wastewater and LIFE funds were used to corroborate a new technique for sanitising these toxins.

The project was able to verify a new photo-oxidation technology that combined UV-light with oxygen peroxide (H₂O₂) treatments which, as a result, made safe water pollutants from antifouling paints including TBT, copper, zinc and other toxic elements. The resultant cleaned water could be recycled for use in water jets or released back into the River Elbe.

Both of these LIFE projects provide valuable new know-how in methods for minimising issues linked to antifouling pollution, and the following article features an even bigger step forward in this domain by a LIFE project which launched a complete alternative to antifouling paint.

Sustainable cruises

Coastal pollution associated with cruise ship waste is being targeted by the 'Sustainable Cruise' project (**LIFE10 ENV/IT/000367**). This Italian project is currently applying Life Cycle Analysis to detect, test, evaluate and ultimately disseminate smart, sustainable procedures for minimising on-board waste from packaging, paper and organic matter. Energy efficiency, onshore waste disposal and certification systems are also within the remit of a project that is designed to help shipping firms comply with the EU's Waste Framework Directive.



SUSTAINABLE SHIPPING AND HARBOURS

Reducing the environmental footprint of EU shipping

A LIFE project in Belgium has helped bring to market a cost-effective cleaning technology for ships' hulls that offers an environmentally-friendly alternative to the toxic compounds used in antifouling paints.



One of the first LIFE projects to involve invertebrates as environmental indicators was 'SOWAP' ("Soil and surface water protection using conservation tillage in Northern and Central Europe" - LIFE03 ENV/UK/000617), a transnational project led by beneficiary Syngenta UK's Jealott's Hill International Research Centre. The goal of SOWAP was to collect data from demonstration plots at sites in Belgium, Hungary and the UK to assess the advantages and disadvantages of using conservation agriculture

techniques. This knowledge could then be used to inform land use management decisions by farmers and politicians.

The European Commission's Communication on Integrated Coastal Zone Management (ICZM) noted that antifouling paints using tributyltin (TBT) posed particularly hazardous threats to marine life and TBT has since been banned by the International Maritime Organisation. However, other potentially hazardous

The 'ECOTEC-STC' project demonstrated a non-toxic antifouling paint for ships' hulls with a significantly reduced environmental impact

materials such as copper are still used as antifoul compounds by the shipping industry. These can cause environmental problems when ship hulls are cleaned or repaired (see pp. 45-46).

Finding alternative solutions to tackle this ICZM challenge had previously been difficult. Ships need to keep their hulls clean to remain competitive but environmental concerns were now making this more expensive. Manuef Hof from Hydrex, a Belgian company specialised in ship cleaning technology explains why. “Antifouling was introduced to improve the efficiency of a ship’s hull by preventing the natural build up of marine growth. Algae, seaweeds and shellfish find ways to attach themselves to structures in a marine environment and after a number of years the build up of this marine growth can start to slow a ship down. Ships then need to use more power to maintain their required speed. Holding a constant speed is very important because most commercial ships, such as container vessels, work to tight time schedules.

“So ships have used antifouling paints which contain biocide elements that discourage marine growth. Biocides have a limited lifespan though and after a number of years every ship needs to have its hull cleaned. The ban on in-water cleaning of ships that use biocide antifouls means that ships now have to be out of operation on a more regular basis than

before while they are cleaned in dry dock. Due to the characteristics of the antifoul paint it can become dislodged during hull cleaning and so necessitate re-painting as well.”

Hydrex was aware that benefits could be created from a more durable and biocide-free type of hull protection paint that could be exempt from the in-water cleaning ban. The LIFE programme provided Hydrex with the means to do this through funding support to demonstrate an innovative hull cleaning system that was both environmentally-sensitive and commercially competitive.

Getting up to Ecospeed

This new system combined an alternative ‘Ecospeed’ paint product that had been developed by Hydrex with specialised underwater cleaning technology. LIFE providing co-funding for the ‘ECOTEC STC’ project (**LIFE06 ENV/B/000362**), which brought together a partnership of key stakeholders including port authorities, national legislators, ship owners and scientific experts. “Our choice of partners was a definite success factor for the project,” says Mr Hof. “We needed all these organisations on board and their support was extremely valuable. Each partner had a vital role to play in helping us to achieve our end results.”

“We were pleased to have a number of shipping companies in the project who allowed us to use their vessels for testing the commercial performance of our new hull cleaning system. Ecospeed paint was applied to seven ships of various types including container carriers, general cargo vessels, an LPG tanker, and a split hopper barge. These test vessels worked in different seas and in different shipping sectors, so monitoring data from the LIFE project’s test fleet was able to give us information about the hull cleaning system’s potential in a broad range of situations.”

Information was recorded about the ships’ fuel consumption so the LIFE project team could calculate how much cleaning a biocide-free hull needed to provide the same fuel efficiency as a hull coated with a standard antifoul. If the cleaning costs were less than the costs of a standard dry dock operation then ‘ECOTEC-STC’ would be commercially competitive. The secret to achieving economical cleaning costs was to be a new automated underwater cleaning system, but before this could be tested the team first needed to secure Ecospeed’s exemption from the in-port cleaning ban.

The Ecospeed paint needs to be applied once every 25 years and emits 13 times fewer VOCs than standard antifouling paints





Changing the law

“Coordinating the timing of the different project components was another of our success factors,” remarks Mr Hof. “We needed to get the cleaning system approved as a priority so we could then use it during the tests. In order to get it approved we had to demonstrate that the cleaning system was non-hazardous. All this work was carefully planned in advance and we also included some contingency timing because we knew we were working in an imperfect world where unexpected issues can arise.

“It was very useful for us to be able to use LIFE funds to offset costs of testing Ecospeed’s environmental impact. Our partners in the science institutes carried out lab tests to assess whether Ecospeed paint would be dislodged during cleaning. These showed Ecospeed to be very durable and the risk of paint entering port sediments was low. Furthermore, other independent tests financed with LIFE’s help confirmed objectively that Ecospeed did not contain any compounds that were considered toxic. This meant we could apply for exemption of the underwater-cleaning ban, and because we had the Dutch government’s legislators involved as a partner from the start, this made the approval process easier.”

By keeping the Dutch government up to speed with Ecospeed’s environmental performance, the project enabled the legislators to carry out checks in a timely

manner. Ongoing knowledge about the tests helped to provide them with reassurances that the results were credible. Approval was then given to change the law, which was followed by a public consultation and hearing that concluded in a legal decision to make Ecospeed exempt from the ban on underwater cleaning.

Mr Hof stresses the importance of such a project milestone: “Ecospeed’s exemption from the ban was a major breakthrough for us. It meant we could now concentrate on the next phase of the development work which involved demonstrating new automated cleaning equipment.” The success of the equipment was equally critical because it would determine the overall costs of a ship’s hull cleaning requirements using Ecospeed. This would provide the information needed to compare the full cost-benefit performance of the ‘ECOTEC-STC’ system against environmentally-hazardous, biocide-containing methods.

Underwater cleaning

LIFE funding was invested in improving the design of specialised cleaning units that used an underwater robotic system linked to a remotely operated vehicle (ROV). Initial prototypes of the technology featured an aluminium frame; the LIFE project supported the development of improved equipment made from lighter and easier to handle materials. Tests showed that this new approach was very

Regular underwater treatment using Ecospeed is a Best Available Technology to minimise the risk of transferring non-indigenous marine species



Extensive tests with underwater cleaning equipment were carried out during the project

effective at removing marine growth. It provided a good hull cleaning effect that did not damage the Ecospeed hull protection.

'ECOTEC-STC' cleaning technology was then applied to the seven test vessels which were cleaned regularly to clear marine growth and facilitate competitive fuel consumption. Analysis of all the data showed that the LIFE project had established a successful and cost-effective alternative to biocide paints.

“The LIFE project has shown that Ecospeed is fit for purpose”

“We were very happy with the results of our project studies,” says Mr Hof. “Our partnership had achieved its goal of demonstrating and validating a system that can qualify as a new ‘Best Available Technology’ which had no harmful effects on the environment and which was financially viable. The LIFE project has shown that Ecospeed is fit for purpose as a durable hull protection paint that can withstand regular cleaning and requires virtually no maintenance compared to biocide-based antifoul paints. We estimate that the new system can double the length of time that a ship can stay operational before it needs a dry dock service, and this represents a major economical advantage.

“Ships that use the ‘ECOTEC-STC’ system’s mix of Ecospeed paint and specialised underwater cleaning units do need to have the marine growth removed on a regular basis, but an increasing number of our clients recognise that this approach is more cost-efficient in the long-term than having vessels out of service in dry-dock. For example, we have a cruise liner company which uses ‘ECOTEC-STC’ and it has its’ ships’ hulls cleaned six times each year. They tell us that this allows them to operate more profitably because they can shut down one of the engines but still sail at the same speed. This client’s fuel savings clearly outweigh the costs associated with additional cleaning and lowering fuel consumption is also good for the environment because it means fewer greenhouse gas emissions.”

The LIFE project forecast that if 80% of the world fleet switched to ‘ECOTEC-STC’ there would be an annual saving of 28.5 million tonnes of fuel and 90 million tonnes of CO₂, as well as 12 million litres of biocide paint. These benefits were explained to shipping stakeholders during the project’s dissemination activities which included a well-attended event where staff from shipping companies, dry docks, port authorities and public bodies came to Antwerp to see the results in person.

Ecospeed to market

Some 100 ships are now benefitting from ‘ECOTEC-STC’ cleaning and Hydrex continues to promote its potential. “Without the LIFE funding it would have taken much longer to introduce our technology and the EU’s support helped us attract the right type of partners that we needed. The majority of Dutch and Belgian ports now allow underwater cleaning if the strict ‘ECOTEC-STC’ specifications are applied. This official approval gives us credibility to help secure more approvals for other ports in Europe and around the world. LIFE’s help has been very much appreciated here because it means the market now has confidence in our innovative product which the project showed to be reliable as a financially-friendly and environmentally-sensitive alternative to antifoul biocides,” concludes Mr Hof.



Project number: LIFE06 ENV/B/000362

Title: ECOTEC-STC – Demonstration of a 100% non-toxic hull protection and anti-fouling system contribution to zero emissions to the aquatic environment and saving 3-8% heavy fuels

Beneficiary: Hydrex N.V. (BE)

Contact: Kristof Adam

Email: life@hydrex.be

Website: www.hydrex.be

Period: 01-Jun-2006 to 01-Dec-2009

Total budget: €5 201 000

LIFE contribution: €1 525 000

SUSTAINABLE SHIPPING AND HARBOURS

Improving oil spill interventions

The LIFE programme has facilitated the development of innovative new technologies for detecting and tackling oil spills, with implications for policy-makers and the planning of response systems.

As a result of the severe local damage that can be caused by routine operational oil spills and the frequency of major accidents, The International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC) was initiated in 1990.

The OPRC obliges contracting parties to put in place emergency plans for tankers and other ships, offshore gas or oil platforms, seaports and oil handling facilities. Also included in the Convention are national contingency plans, national and regional systems for preparation and response to oil spills, combat equipment, cooperation plans and R&D.

At EU level, the sinking of the oil tanker Erika led to the adoption of a Commission Communication on the safety of the seaborne oil trade, together with a number of proposals for specific measures to prevent such accidents happening again. With 90% of EU trade with third countries being seaborne, and with the impact of maritime accidents and oil spills being so significant, the EU adopted a Directive (2002/59/EC) that establishes a Community vessel traffic monitoring and information system. This provided the means to monitor and control traffic off EU coasts and respond quickly in the event of critical situations arising at sea.

The Commission's proposal for a Regulation for Oil Pollution in European Waters complements the existing international regime on liability and compensation for oil pollution damage by tankers by creating a European supplementary fund to compensate victims of oil spills in European waters.

Today, techniques for dealing with the accidental discharge of oil are widely available, while early detection systems and long-term monitoring are hot research topics. LIFE co-funding has been particularly beneficial in helping OSIS International, a small Danish technology orientated development company, to develop two early detection systems.



Photo: LIFE02 ENV/DK/000151

Early detection

The first of the OSIS projects, 'Osis off shore' (LIFE02 ENV/DK/000151), sought to address the lack of efficient surveillance methods for offshore installations. In the late 1990s, the OSPAR (Convention for the Protection of the Marine Environment of the Northeast Atlantic) Commission called for the development of such technologies as OSIS – an oil spill identification system.

The Danish project's solution is a 'round-the-clock' online surveillance system that has been tested and installed on fixed offshore installations, mainly oil rigs. The OSIS sensor is able to identify oil-films of a thickness of 0.02 to 2 mm on the water surface. It can estimate the leaked volumes to around 20% accuracy in normal weather conditions and to around 40% accuracy on rough seas. Numerous tests were conducted over a three-year period, including missions with the Danish environmental survey ship, as well with German and Dutch oil combat services in

The OSIS sensor identifies oil films of a thickness of 0.02 to 2 mm on the water surface

the North Sea. Leaks can be monitored within a distance of 1-1.5 km from the sensor.

The valuable data on leaks can be transferred via satellite to onshore decision-makers. Using this information together with GIS data enables the authorities to coordinate the most effective response action. This OSIS system is inexpensive compared with aerial surveys, the traditional assessment procedure. It is also much more accurate than a satellite image-based system.

The same beneficiary launched a second LIFE project, 'Oil Spill Identification System for Marine Transport' (**LIFE04 ENV/DK/000076**), to adapt the OSIS system for ships. Such an adaptation is highly desirable given that marine transportation is estimated to account for one third of global oil pollution.

The end result was the OSIS Sensor Pack, a low-cost, highly reliable and efficient method for on-the-spot monitoring of oil pollution. The system is based on data transmission and sensors that can be used on moving vessels. It uses electromagnetic sensors with different frequencies that are able to detect as little as 0.02 mm of oil on the water surface. The system also has a pivoted support that allows the sensor to rotate around a single axis to enable measurements from a moving vessel. The software is embedded.

The beneficiary focused on integrating sensor data into ship-bridge electronics to allow for data analysis and a presentation system according to the needs of the end user. The system thus has commercial applications as well as the potential to be used by regional authorities to further ICZM objectives. The project moreover worked closely with the Danish navy in performance specifications, design and testing. To reach

The antipollution boat lowers a magnetic drum in the sea to collect the 'CleanMag' material



Photo: LIFE04 ENV/DK/000076

Through a second project the OSIS sensor was adapted to ships

other groups, OSIS produced a demonstration DVD and leaflet and presented the project at various trade events. Following on from its LIFE projects, in 2012, OSIS launched a commercial version of the technology.

Cleaning up

The risk of oil spills is particularly high in Greece, because of its location at the crossroads of oil transportation sea routes. Hundreds of kilometres of bathing beaches on numerous islands, tourist establishments and coastal fisheries are all vulnerable to the effects of potential tanker accidents as well as routine oil releases. In the past, many locations in the Peloponnese, Crete and Attica have suffered severe and extensive damage from oil spills.

A LIFE project, 'CLEANMAG' (**LIFE99 ENV/GR/000567**), however, demonstrated the large-scale application at open sea of a new technique for cleaning up waterborne oil spills.

This technique is based on the magnetic separation method of two liquid phases (one water and the other oil), using a recently discovered and patented oleophilic magnetic oil absorbing material, CleanMag. A prototype anti-pollution boat was also constructed during the project. The boat has a specially designed magnetic drum which is lowered into the water to collect the CleanMag material once it has absorbed the oil spill.

Similar to the OSIS projects, efforts were made to promote interest in the technology among a wide range of stakeholders in order to further its application and use. The Union of Boatmen and Loaders of Santorini has established an environmental station on the island for the protection of oil spills using the CleanMag technology and a prototype anti-pollution boat, 'CleanMag 1-NANCY'. The technology has also won three awards and generated significant international interest, including a US distribution deal.

Photo: LIFE99 ENV/GR/000567



Photo: Richard of England

Coastal climate change adaptation

The vulnerability of coastal areas to the effects of climate change has prompted the EU to begin the process of revising its Recommendation on ICZM in order to promote a greater focus on climate change adaptation at local and regional level. A number of completed and continuing LIFE projects offer useful lessons for the ICZM process in this area. For instance, projects demonstrating how local and regional authorities can incorporate climate change data and scenarios into coastal risk mapping and long-term planning; or projects taking action on saltwater intrusion by working with, rather than against, nature to strengthen the resilience of coastal ecosystems and communities. A knowledge-based approach, involving all key stakeholders has been an essential element of LIFE projects' efforts.

COASTAL CLIMATE CHANGE ADAPTATION

Guiding the process of adapting to climate change

Coastal areas are particularly vulnerable to the effects of climate change. The EU is revising its Recommendation on ICZM so as to strengthen the response to these effects by promoting a greater focus on climate change adaptation at local and regional level. A number of LIFE projects already provide some valuable guidance for the ICZM process.

Many coastal areas in Europe are already confronted with problems of flooding, erosion, saline intrusion, and the loss of natural ecosystems such as wetlands. The effects of climate change, and in particular sea-level rise and extreme weather events, are expected to significantly increase the incidence and intensity of these events in the coming decades.

The European Environment Agency estimates that the economic cost to Europe's coastal areas could be in the order of €12-18 billion per year in 2080. However, appropriate adaptation measures could be implemented at a cost of only €2 billion per year.

The EU White Paper on adapting to climate change provides the framework for a comprehensive

adaptation strategy at EU level, whilst also encouraging Member States to adopt national strategies by 2012. Given the diversity of Europe's coastal areas, and the urgent need for tailored, local responses, the European Commission proposes that adaptation strategies should be developed and implemented as part of the ICZM process.

Mapping risks

Improving knowledge and understanding of the effects of climate change at local and regional level is a prerequisite to developing effective adaptation strategies in coastal areas. By incorporating climate change data and scenarios into coastal risk mapping and long-term planning, local and regional authorities can take steps to avert or minimise the negative impacts.

The 'RESPONSE' project (**LIFE03 ENV/UK/000611**) developed an innovative, regional-scale mapping technique to assess current and future risks in five study coastline areas in the UK, Italy and France. Going beyond previous macro-scale classifications, the project showed how a local stretch of coast could be divided into 'Coastal Behaviour Systems', defining patterns of behaviour, sensitivity to climate change, and the associated risks and consequences.

A sequence of coastal evolution and risk maps were produced for each of the five study areas, which helped local authorities and other stakeholder groups to make informed decisions on local and regional-level land-use development and shoreline management. The maps enable engineers, planners and decision-makers to anticipate impacts that could emerge over future decades and plan responses to minimise the risks or to mitigate possible consequences. This

Risk maps developed by the 'RESPONSE' project, enabled engineers and decision-makers to anticipate impacts of climate change on the coastal area



PHOTO: LIFE03 ENV/UK/000611



Photo: LIFE07 ENV/FIN/000141 - Mats Westerborn

Climate change affects biodiversity, for example by causing desalination, which leads to a decline of the blue mussel population

focus on prevention will help avoid the higher future costs of emergency action and remediation that would inevitably result from inaction.

The recently-launched 'CYPADAPT' project (**LIFE10 ENV/CY/000723**) is looking at ways to use this kind of information to assess the likely impacts on specific socio-economic sectors. This will then be used by the beneficiary, the Cypriot Ministry for Agriculture, Natural Resources and the Environment, to develop a national strategy for climate change adaptation.

The project is using modelling techniques to identify the sectors most at risk in Cyprus, assess their adaptive capacities and identify appropriate adaptation measures. To facilitate this, an innovative multi-criteria analysis (MCA) tool is to be developed, which will incorporate information on a range of adaptation measures being undertaken elsewhere.

Taking action on saltwater intrusion

Saline intrusion represents one of the greatest risks for many coastal areas in Europe, especially along the Mediterranean coast, where over-abstraction of groundwater reserves is affecting the freshwater-saltwater balance. In the future, longer drought periods, rising sea levels and more frequent storm surges are expected to further exacerbate this problem. The 'SALT' project (**LIFE07 ENV/IT/000497**) is looking at ways of tackling this problem in the area around the Esino River and aquifer, in Italy's Marche region. Groundwater resources in the project area are already

under severe pressure from intensive agricultural and industrial activities and this is expected to intensify in the future as climate change impacts on natural groundwater recharge and saltwater intrusion.

The project aims to analyse the trends of saltwater intrusion into the Esino River and aquifer and its effects. It will also simulate future scenarios of saltwater intrusion, using remote sensing, GIS, and river and aquifer models, which will then be used to define appropriate remediation actions. A tool to evaluate the impact of different management options on the quality and quantity of water in the aquifer will also be developed.

Coastal ecosystems

Without intervention, saline intrusion, and other climate change effects present a serious threat to coastal ecosystems in Europe. The European Science Foundation estimates that wetland losses, for example, could be in the order of 17% along the Atlantic coast, 31-100% along the Mediterranean coast and 84-98% along the Baltic coast.

The LIFE 'VACCIA' project (**LIFE07 ENV/FIN/000141**) investigated the vulnerability and adaptability of nine different types of ecosystem to climate change, including coastal areas in southern and western parts of Finland. The results show that changes are occurring in these coastal areas: humidity conditions in low-lying meadows have already changed and wind-raise floods are expected to become much more frequent. To address these changes, which are endangering the living environment of many threatened species, the project team worked with local and regional administrations and stakeholders to propose possible adaptation measures.

'VACCIA' and other LIFE projects focusing on climate change highlight some important factors for successful adaptation in coastal areas, notably, the need for a knowledge-based approach, with a focus on a local stretch of coastline, and involving all relevant stakeholders in defining a coherent mix of measures. LIFE projects also underline the importance of understanding natural processes and working with nature to strengthen the resilience of both coastal ecosystems and coastal communities.

CLIMATE-ADAPT (<http://climate-adapt.eea.europa.eu>) is a publicly accessible, web-based platform designed to support policy-makers at EU, national, regional and local levels in the development of adaptation measures and policies.

COASTAL CLIMATE CHANGE ADAPTATION

LIFE on the Norfolk coast

A successful LIFE project has simulated the impact of coastal changes and used the results of computer modelling as the basis for measures to protect vital habitats on the UK's North Norfolk coast from the effects of climate change.



Photo: Mike Page

The project site covered a range of habitat types from salt to freshwater

From the 1700s, much of the North Norfolk coast was protected by seawalls to provide agricultural land for crops and animals. However, in 1953, a huge surge tide breached these seawalls, resulting in one of the most devastating natural disasters ever recorded in the UK and leaving large tracts of land without any protection from the sea.

Along one part of the coast, in an area known as Titchwell, continued tidal flooding through the breached seawall gradually turned the land to salt marsh, which was subsequently inhabited by important bird species, such as the marsh harrier (*Circus aeruginosus*). This newly formed Titchwell Marsh was purchased by the Royal Society for the Protection of Birds (RSPB) and shortly after, in 1973, it was designated as a Site of Special Scientific Interest (SSSI).

The impact of climate change

Between 1973 and 1994, the RSPB successfully managed the 40 ha marsh in a way that provided areas of freshwater reedbed, freshwater marsh and

brackish marsh. However, in 1994 the tide breached the sand dunes that protected the marsh habitats and, while little damage was caused, this was interpreted as an early warning that climate change was going to pose an increasing threat.

The RSPB built a wave barrier to try to prevent erosion of the northern sea bank – the last line of defence for the freshwater habitats. However, as Robert Coleman, the senior site manager for the RSPB, explains, worse was to come. "In 1996, there was another huge surge tide and saltwater penetrated the bank, entering the freshwater marsh. Thankfully, it wasn't enough to destroy the ecosystem, but it was another warning. Other areas of the North Norfolk coast were devastated by this surge.

"We spent 18 months looking internally at how we could respond to these threats, increasing our monitoring of bird numbers, water levels and tidal events." This also included studies of coastline change, which revealed that a sandbank further down the coast, which was growing as a result of climate-change-

exacerbated longshore drift, would reach Titchwell in less than 30 years. This sandbank would, therefore, offer natural protection from further sand erosion.

“This was really important,” stresses Mr Coleman, “because it meant that if we could protect our priority habitats for the next 30 years it should become self-sustaining in the long run.” In other words, this was not about fighting a losing battle with the sea, but about adopting urgent measures in the short term in order to provide long-term sustainability for valuable, graduated coastal habitats.

Returning to LIFE

The RSPB devised a plan aimed at bridging this 30 year gap. Having already worked on three LIFE projects in the area: ‘Living with the Sea’ (**LIFE99 NAT/UK/006081**), which had established coastal habitat management plans for the North Norfolk coast; ‘Saline lagoons’ (**LIFE99 NAT/UK/006086**), which linked actions to restore this priority habitat with the UK’s Biodiversity Action Plan for lagoons; and the ‘Bittern in Europe’ project (**LIFE02 NAT/UK/008527**), which developed a strategic network of SPA reedbeds for *Botaurus stellaris*, it was decided once again to look to the LIFE programme for support.

“The RSPB does not have much money for big infrastructure projects, so this support was very important,” believes Mr Coleman. The eventual approval of LIFE funding for the ‘TaCTICS’ project (**LIFE07 NAT/UK/000938**) also triggered further support from bodies such as the Crown Estate and organisations that redistribute landfill taxes to good environmental projects.

The new project’s actions involved breaching the existing sea wall to allow the brackish marsh to be naturally converted to mostly tidal marsh, which now acts as a first line of defence in absorbing pressure from the sea. Further inland, the bank that previously separated the brackish from the freshwater marsh was rebuilt and strengthened to become the new sea wall. Behind this, the area of freshwater habitat was managed to ensure a mix of freshwater marsh, islands and reedbeds to provide for all the habitat needs of the local wildlife.

One of the major challenges of the project was that work could only be conducted outside the breeding and wintering seasons of the birds, which in practice meant a three-month period from August to October. “In the first year, we were lucky as the weather was



Photo: Paul Ede (RSPB)

excellent,” recalls Mr Coleman, “but in the second year we lost more than half of our available time because of rain.”

To rebuild the inner bank, innovative techniques were used, involving the laying of carr stone, stabilised layers of clay, with the insertion of vertical band drains to draw water away from the material being laid. This allowed the work to be completed in just two months.

The material used for the bank was taken from a meadow further inland and as it was removed, the subcontractor was able to sculpt the land according to RSPB designs, to create an ideal topography for different species as well as enhancing visitor access.

The project involved considerable use of heavy machinery, not only to build and reinforce the sea defence, but also to remove reeds to ensure that the entire area did not tend to a monoculture. Because the marsh had previously been used as a military firing range, specialist contractors also had to be called in to remove potentially dangerous materials.

Working with stakeholders

From the start, the project team realised that successfully engaging the local community and other key stakeholders would be essential for the success of such a big infrastructure project. To raise awareness locally, a leaflet was sent to every household in three communities along the coast, explaining the problem and the proposed solutions. The project team also attended community meetings and organ-

To rebuild the inner bank, material was removed from the inland meadow creating suitable habitats for different species



Mud flats in the estuary create resting and nesting sites for birds

ised local engagement workshops and free monthly coastal walks, all supported by LIFE.

The beneficiary also engaged individually with the other relevant stakeholders, including landowners on either side of the reserve, as well as with the relevant statutory bodies. “We had to negotiate with Natural England and the Environment Agency about what we could and should do with the sea walls. We wanted to provide protection against a 1-in-50-years storm event, but to fit with their overall strategy focused on natural approaches, we agreed protection based on

a 1-in-30-years storm event in 25 years’ time,” explains Mr Coleman.

As a result of this inclusive approach, the planning application for this €2 million project,

involving heavy engineering in a designated area, received no letters of objection and two letters of support from local community councils. The application was, therefore, approved without any delays. Neighbouring landowners were also very cooperative and provided access for machinery during the implementation phase.

Promising results

While the effectiveness of the project actions will continue to be monitored by the beneficiary, there are already some very positive indicators of success.

“The project has made sure that the freshwater habitats remain for the next 30 years. You can already see the presence of important bird species such as the marsh harrier, avocet and bearded tit, as well as other species that thrive in freshwater reedbeds, including endangered moths, insects and the water vole,” enthuses Mr Coleman.

The work has also been endorsed by the agency responsible for developing a Shoreline Management Plan for the North Norfolk coast, which has adopted the RSPB’s work as the most appropriate for this stretch of coastline, commending the fact that it was “science-based” and “well executed”.

Climate change will continue to impact on the North Norfolk coast, but LIFE project actions have helped to establish a natural protective infrastructure and a collective will among local stakeholders that should now ensure the survival of the Titchwell Marsh SPA and its rich diversity of coastal habitats.

“The project has ensured that the freshwater habitats remain for the next 30 years”



Project number: LIFE07 NAT/UK/000938

Title: TaCTICS - Tackling Climate Change-Related Threats to an Important Coastal SPA in Eastern England

Beneficiary: The Royal Society for the Protection of Birds (RSPB)

Contact: Helen Deavin

Email: helen.deavin@rspb.org.uk

Website: <http://www.rspb.org.uk/reserves/guide/t/titchwellmarsh/coastalchange/>

Period: 01-Jan-2009 to 31-Dec-2012

Total budget: €2 010 000

LIFE contribution: €1 005 000



Photo: Sarah Gregg

Improving the coastal environment

LIFE projects have taken the lead in efforts to demonstrate more effective means of improving Europe’s coastal environments. These include projects that have linked policy on coastal erosion with practical actions on the ground to prevent this phenomenon. They also include projects highlighting integrated approaches to beach management that provide new ways of tackling commonplace problems such as litter and organic waste on beaches or the harmful effects of light pollution on turtles and other species. LIFE has also helped to improve the quality of coastal waters through projects such as the featured case study from the Normandy coast: ‘MARECLEAN’ (pp. 69-72).

IMPROVING THE COASTAL ENVIRONMENT

LIFE supports 'softer' coastal defence solutions

Coastal erosion is a natural phenomenon that has been occurring for millions of years. However, the gradual natural erosion processes have become accelerated in recent years by factors such as climate change and human activities. Today, in the European Union, as in other areas of the world, there are particular regions where coastal erosion poses serious problems threatening homes, towns and even livelihoods. Using ICZM, LIFE projects promote the coordinated planning and management of these vulnerable areas.



Photo Parque Natural de l'Albufera de València

Rising sea levels, storms and poor management all contribute to coastal erosion

There are no easy solutions for tackling coastal erosion, which is adversely affected by human activities such as sand extraction or poor coastal management, and climate change which causes rising sea levels and heavier storms (see pp. 53-58). Numerous interventions have failed to resolve the associated environmental, social and economic problems. Indeed, some traditional engineering works, including structures built for coastal defence, such as dykes or concrete sea-walls, may actually have worsened the deterioration, especially in the long term.

In some Member States, land-use planners have begun to accept that trying to halt natural erosion

may actually be futile: instead of using engineering works to try to stabilise the shoreline, some are opting for a policy of managed retreat from especially vulnerable areas i.e. scaling down, or even abandoning altogether human activity. This is the case in certain areas along the United Kingdom's South Coast (for example, near Eastbourne in Sussex) where cliff top properties have had to be abandoned and left to slowly crumble into the sea.

In areas where this kind of *laissez-faire* strategy is not viable, e.g. sites of high cultural or economic value, local or regional authorities have opted for various 'softer' coastal defence measures, including improving coastal sand dunes and coastal wetlands.

These act as natural defences by restoring native habitats that can help slow down the erosion processes (or work as a buffer to rising tides).

Challenge

The challenge for policy-makers at the local, regional, national and international level is to devise and implement appropriate and ecologically responsible coastal protection measures that balance economic, social and environmental concerns. EU policies intended to address coastal erosion call for a coordinated and participatory approach, which is why Member States have been called upon to put in place national strategies towards integrated coastal zone management (ICZM).

Working to support the ICZM policy, LIFE projects have developed methods and implemented various practical actions to tackle the diverse problems associated with erosion of Europe's coastlines.

Several LIFE Nature projects, by restoring specific coastal habitats, notably sand dunes and coastal lagoons (see pp. 73-88) are helping to prevent

coastal erosion in areas that have not been overdeveloped. Moreover, a number of projects have devised and implemented innovative beach and dune management measures to combat erosion and other environmental problems.

Two notable LIFE Nature projects targeting beach and dune management are the French project, 'Maintbiodiv' (**LIFE06 NAT/F/000146**) and 'Dunas Laida' from Spain (**LIFE04 NAT/ES/000031**).

Tourism troubles

Located in Brittany, the French project is working to conserve a sand dune area of nearly 2 500 ha running from Gâvres to Quiberon. Within this area are almost 1 000 ha of fixed, stable sand dunes ('grey dunes' habitat). More and more tourists are visiting the area every year. The high visitor numbers, as well as particular activities such as horse-riding and quad biking are damaging the dunes, which in turn is increasing the coastal erosion. To combat these threats, the project is redirecting tourists away from sensitive areas and is restoring habitats to try to limit the damage. The beneficiary is also trying out

The 'Dunas Laida' project targeted the regeneration of dunes at Laida Beach using fences





Photo: LIFE06 NAT/FR000146 - Syndicat mixte Grand site Gávres-Quiberon

The 'Maintbiodiv' project used fences and designated walkways to redirect tourists away from sensitive areas

a range of erosion prevention techniques (see the project website for further details: www.site-gavres-quiberon.fr).

The Spanish project targeted the regeneration of sand dunes at Laida Beach on the Bay of Biscay coast. There, 80% of the site's original dunes have eroded, partly as a result of intensive tourist pressure in the summer months and partly because of the dumping of silt (dredged for the maintenance of shipping routes) in some areas of the beach. Another possible threat comes from climate change, i.e. rising temperatures may lead to an increase in sea-storms and thus increased damage to the dunes.

Once a dune is destroyed and the vegetation is lost, natural regeneration is almost impossible. The project's main actions therefore included putting up 'sand fences' (made of dry willow branches or wicker) facing into the prevailing wind. These act as barriers helping to trap the sand and enabling 'dune belts' to build up over time. Once a sufficient volume of fine sand had been established, species typical of coastal dune environments, such as European beach-grass (*Ammophila arenaria*) and sand couch (*Elymus farctus*), were then planted. In order to ensure the recovery of the dune systems, a perimeter enclosure was erected and notices regulating public access were posted.

Another LIFE Nature example comes from the Lithuanian project, 'LITCOAST' (LIFE05 NAT/LT/000095), which covered a total of 60 000 ha of the country's coastal areas. Among its wide-ranging actions was the successful reinforcement of a 20 km-stretch of vulnerable dune areas particularly threatened by erosion.

In most projects concerning the conservation of sand dunes, public education and participation is an important element of the work – and also a principal requirement of ICZM. This was also the case in a pioneering LIFE Environment project in Northern and north-west Ireland (LIFE96 ENV/UK/000404).

Led by the University of Ulster in partnership with local authorities and local communities, the project developed plans for the sustainable management of dunes and beaches in Northern Ireland and neighbouring Donegal in the Republic of Ireland. It pioneered an integrated approach to the management of Ulster's coastline and widely distributed and promoted the good practice guidelines produced. Coming at the beginning of the formalisation of the EU approach to ICZM, these guidelines were also used to inform and influence coastal policy at the European level.

Finally, another LIFE Environment project examining coastal erosion (and also pollution) is 'SELSY' (LIFE00 ENV/IT/000090). This Italian project adopted an integrated approach to addressing the environmental protection and management problems presented along the 400 km stretch of coastline of the provinces of Taranto, Brindisi and Lecce in Puglia (southern Italy). In these areas the presence of heavy urbanisation and industrialisation has increased the risk of exposure of the coast to the combined effects of pollution and coastal erosion.

Among a number of actions (see also pp.66-68), the project carried out studies and pilot actions tackling the management of erosion and dunes. Importantly, the project provided the three provinces with data on the conservation status of the dunes along their coastlines. Modelling and maps for the areas will enable the provinces to adopt an integrated approach to tackling sites of particular risk. The project team also developed a participation plan to encourage environmental awareness among local people. This included an opinion poll of people living, working or holidaying on the coasts of the three provinces. Its results, including the interviewees' proposals on what should be done to protect the coastline, will feed into future coastal planning policies. It is hoped that not only will this promote eco-compatible lifestyles, it will also guarantee their implementation since the policies will be based on the suggestions made by local people (integrating citizens' proposals generates responsibility).

IMPROVING THE COASTAL ENVIRONMENT

Keeping beaches clean and healthy

An important element of managing coastal areas is beach management and cleaning. LIFE projects have addressed many forms of pollution and waste that can negatively affect the often delicate coastal ecosystems based around beaches. Keeping beaches clean allows them to sustain themselves more naturally.

The varied functions of beaches – recreation, coastal defence, conservation etc. – can lead to conflicts of interest. Successful and sustainable beach management applies many of the principles of Integrated Coastal Zone Management (ICZM), but at a more local level (administrative and/or physical), thus complementing the coastal management of a particular area.

In essence, beach management aims to achieve the sustainable physical use and development of the resources that form the natural environment of the beach, whilst satisfying the uses and needs that the ecosystems services of the beach offer to society. This can only be achieved by encouraging communication between different interests and fostering a sense of responsibility for beach management.

One of the major environmental challenges facing beaches is the accumulation of waste. Dirty beaches are bad for the environment and bad for the tourism industry, which relies on attractive holiday destinations. Waste doesn't only come from litter left by tourists and debris washed ashore from boats or blown in by the wind, it also has an organic source.

The problem of organic waste on beaches

Drifting organic material, such as algae, kelp and seagrass, often presents a greater environmental challenge to beaches than litter and man-made debris. These and other types of organic debris are deposited by storms and wave action on beaches.

'P.R.I.M.E.' is identifying the best way of recovering Posidonia oceanica residues and using them as an organic fertiliser for agricultural soils



Such material is necessary for the development and maintenance of dune ecosystems and plays an important role in beach ecology, as the invertebrates that live in it provide food for bird populations. However, rotting seaweed, if left on a beach, decomposes, releasing the greenhouse gas methane, creating unpleasant odours and attracting insects. The negative impact on tourism, an industry on which many coastal communities rely, can be significant. As a result, the organic waste material is usually removed by the coastal authorities, often in connection with the cleaning programme that they are required to do under the European Blue Flag Initiative¹.

Mechanical cleaning (e.g. by tractor) should be avoided because the removal of large amounts of seaweed can damage a beach. Instead, the organic waste should be removed by hand. To ensure the health of coastal ecosystems, where seaweed is removed from the busiest part of a beach it should be left in place elsewhere.

Beached seagrass is a particular problem for many coastal communities and habitats in Europe. Grasses grow in often dense and extensive underwater meadows from the Mediterranean to the Baltic Sea. During their lifecycle, these meadows will result in thousands of tonnes of very slowly decomposing dead organic material being deposited naturally onto beaches. LIFE projects in Italy and Germany have focused on this specific problem.

¹ The criteria for Blue Flag beaches state that "No algal or other vegetation may accumulate and be left to decay on the beach, except in areas designated for a specific use" (see the Blue Flag guidelines at <http://www.blueflag.org>).



Artists used Neptune grass (*Posidonia oceanica*) to make art works during the 'P.R.I.M.E.' awareness campaigns

The Italian project 'P.R.I.M.E.' (LIFE09 ENV/IT/000061) – led by the local authority of Mola di Bari, in Puglia – has addressed the fact that many coastal municipalities were faced with expensive bills for the removal of the beached seagrass (*Posidonia oceanica*). Typically involving heavy machinery and simple disposal of the collected material in landfill, the methods employed provided no added value beyond the cleanliness of the beaches.

The project has been demonstrating an environmentally sustainable management model for the seagrass deposits that prioritises re-use of the material in agriculture through composting. By demonstrating the potential value of the *posidonia*, the project has not only provided an economic incentive for more beach cleaning, but also reduced demand for less environmentally friendly fertilisers and reduced the amount of organic material going to landfill.

Key to the success of the project has been engagement with the different stakeholders. By bringing together the local authorities, bathing establishments, beach users, waste disposal services, compost producers and farmers, the project has helped find a sustainable process that rationalises interventions on the beaches according to specifically agreed guidelines.

As a direct result of 'P.R.I.M.E.' and other initiatives announced by coastal regions and local authorities, the Italian environmental law (152/06) has been changed to allow the removal and use of *P. oceanica* residues for energy production or agricultural purposes "provided the methods and processes do not damage the environment or pose a threat to human health."



The German 'Regional Cycle' project (**LIFE00 ENV/D/000312**) explored another way of adding value to beached seagrass. *Zostera marina* is found in large quantities in the Baltic Sea and presents largely the same challenges to Baltic beaches as *Posidonia* in the Mediterranean.

Using sites in Mecklenburg (Germany), the island of Møn (Denmark) and the Basin of Arcachon (France), the project demonstrated techniques for collecting, drying, separating and processing organic matter from beaches to create added-value products. It demonstrated the suitability of these materials for industrial uses including in construction, as insulating material and as paper.

The project showed how an integrated approach to coastal zone management could provide environmental benefits through a cleaner beach and reduced waste, as well as economic benefits through more tourist-friendly beaches and new products from waste materials. The project led to a viable business based on beach management, which won entrepreneurial awards.

Controlling human causes of dirty beaches

Beach cleaning presents high costs and, whenever possible, it is most advantageous to use volunteer schemes as it presents the advantage of creating a sense of ownership of the beach and responsibility. A smarter way to manage beaches is to prevent them becoming dirty in the first place. To this end, many LIFE Nature projects have prevented access to key protection sites through features such as fences and



Photo: LIFE06 NAT/F/000146

designated walkways to prevent human disturbance and the impact of litter.

'Maintbiodiv' promoted waste collection and prevention campaigns to protect coastal habitats

The French project 'Maintbiodiv' (**LIFE06 NAT/F/000146**) has shown the value of specific waste collection and prevention activities as part of a wider plan to protect biodiversity in coastal habitats – including dunes, humid dune slacks, vegetated sea cliffs and heaths. It organised waste collection, including the removal of illegal rubbish tips, which can become self-perpetuating, and worked hard to inform tourists about the impact of litter on delicate ecosystems. Beach cleaning is now done regularly by hand, not mechanically, and at a lower cost.

Combating light pollution

Light pollution has a significant impact on coastal ecosystems. Focused on supporting human activities, lighting on or around beaches can disorientate many nocturnal creatures that rely on the moon, or the reflected moon and starlight, for navigation. One of the most well-known cases is the impact that light pollution has in confusing turtle hatchlings that need to find their way quickly and safely to the sea (see pp.12-15).

The LIFE project 'Caretta caretta' (**LIFE98 NAT/GR/005262**) introduced key management actions to support turtles in the coastal zone of southern Kyparissia Bay in Greece. A key action for the success of the project saw both public and private light sources on or near the beach switched off at night and especial-

ly during the hatching season. A similar project in Crete (**LIFE95 NAT/GR/001115**) also shaded beaches and painted streetlights on the beach side to help turtle hatchlings.

The Spanish project 'ECOLIGHT' (**LIFE03 ENV/E/000118**) addressed light pollution coming from the city of Valencia, which was identified as affecting 21 habitats of Community interest along the east coast of Spain. It showed that adaptations to public lighting systems and the promotion of legislation to prevent future pollution benefitted many nocturnal species along the coast – including bats, insects and owls – whilst still fulfilling human lighting requirements for pedestrians and vehicles.

IMPROVING THE COASTAL ENVIRONMENT

Providing measures to combat coastal pollution

Many of the driving forces creating pressures on Europe's coastal zones, including human-induced problems of water quality, are actually located upstream in the river basin. WFD implementation – supported by practical actions co-funded by LIFE – can also show improvements in the quality of coastal waters and beach areas.

Despite the wide diversity among the coastal regions of Europe, many coastal systems share problems of water contamination. Many coastal areas and beaches are home to resorts where there is either no mains sewerage or where the existing system is old and designed for small resident populations, becoming overloaded during the tourist season. In the worst cases completely untreated raw sewage, or partially treated sewage, is released into the sea near beaches.

Streams that carry agricultural effluents from slurry or silage into the sea or close to beaches are another source of coastal pollution. There can also be natural threats to water quality, e.g. algal blooms.

The Water Framework Directive (WFD) 2000 sets out a timetable of actions for Member States to follow in order to achieve good status of waters by 2015. The directive establishes a framework for the protection of all waters within each river basin – including inland

surface waters, transitional waters¹, coastal waters and groundwater. Many of the problems are interrelated (i.e. caused by biological, physical and human impacts), but may require different solutions at local, regional, national and international levels. As there is no simple management solution, a coordinated, participative and flexible strategy is therefore needed in tackling pollution. Furthermore, under the Bathing Water Directive, Member States are obliged to draw up a list of "identified beaches" where bathing is either officially authorised or traditionally practised. The water at these locations must meet prescribed standards for 19 physical, chemical and microbiological parameters.

The WFD and ICZM Recommendation provide opportunities for coupling coastal zone management with catchment basin management. Such freshwater-marine system coupling has a good prospect of resulting in lower pollutant loads and improved conditions in estuaries. Furthermore, the application of the WFD to coastal waters up to one nautical mile on the seaward side beyond the national baseline goes some way to minimising an earlier uncoordinated sectoral approach to water quality management.

Looking locally

Within the ICZM process, a number of LIFE projects have sought to tackle specific problems e.g. developing new tools for measuring contamination, or methodologies for improved aeration of coastal waters. Whilst such projects mainly target local problems and conditions, they also need to be flexible and may

'SELSY' developed a floating platform to carry out real-time monitoring of coastal waters



Photo: LIFE00 ENV/IT/000090

¹ Transitional waters are bodies of surface water in the vicinity of river mouths that are partly saline in character as a result of their proximity to coastal waters but which are substantially influenced by freshwater flows

serve as models for addressing similar problems in other vulnerable coastal areas.

Demonstrating an integrated approach to tackling coastal pollution, as well as erosion, is the Italian 'SELSY' project (**LIFE00 ENV/IT/000090**) located along the 400 km-stretch of coastline in Apulia in southern Italy. In this area, the presence of heavy urbanisation and industrialisation has increased the risk of exposure of the coast to the combined effects of pollution and erosion.

Amongst a number of results (see also pp. 60-62), a floating platform was successfully developed and launched, with wireless applications to carry out real-time monitoring of water quality along the coast. This component of the project attracted interest from several public and private stakeholders and testifies to its potential for replication in other coastal zones.

Another result was the construction of a pilot wastewater treatment plant using a new, chlorine-free disinfectant process. Tests carried out at the pilot plant, which was built alongside the existing municipal treatment works in Taranto, demonstrated the disinfectant process – using peracetic acid (PAA) with secondary settled effluent – as a viable alternative to chlorine products. Moreover, the treated water can be reused in agriculture, an important issue in a region that is chronically affected by water shortages.

Launched in the same year was the Finnish 'Bothnian Bay LIFE' project (**LIFE00 ENV/FIN/000646**). Located between Finland and Sweden, the Bothnian Bay is the northernmost basin of the Baltic Sea. The bay, which

freezes over for several months of the year, is particularly vulnerable because of the scarcity of species living in it, its Arctic conditions and its shallow, brackish waters. Moreover, the bay is affected by agricultural and forestry practices and peat mining and exposed to pollution from the local steel, pulp and paper industries, as well as from sewage treatment plants. Localised construction work related to sea transport also has some impact on coastal zones.

Many different national and regional bodies monitor environmental conditions in the bay, and the award-winning project (a "Best" LIFE Environment project in 2005-2006) identified the need to pool together the various information sources. An important achievement was the development of an extensive online database featuring various indicators of water quality in the bay. These include data from observation points on the material transport and water discharges of 31 rivers and their catchments areas; and information about all the industrial facilities and wastewater treatment plants discharging into the bay.

The project also developed a model for estimating the impact of human actions on the coastal areas. This allows experts to assess the impact of loading on water quality. Assessments are made by calculating likely changes to the concentration of soluble nutrients and algae.

Tackling hypoxia

Two notable LIFE Environment projects (one completed, the other ongoing) examine innovative techniques for dealing with coastal regions suffering

The 'Bothnian Bay' project developed a model for estimating the impact of human activities on the coastal area



from oxygen depletion – hypoxia – a problem that has increased dramatically since the 1960s. Such a situation has serious consequences for ecosystem functioning. Hypoxia is a direct consequence of nutrient pollution and eutrophication. It is therefore essential to reduce the amount of nutrient loads to marine environments. Upstream nutrient reductions, however, are difficult and not sufficient as it takes a very long time before effects in marine environments are observed. Moreover, global warming is expected to increase hypoxia.

Oxygen-depleted areas are known as ‘dead zones’ and exist in more than 400 aquatic systems worldwide – of which one is the Baltic Sea – affecting a total area of more than 245 000 km². Mitigation measures that lead to direct improvements in dead zones are required. Recent research by the Swedish ‘WEBAP’ project (**LIFE08 ENV/S/000271**) suggests that a new technology, the ‘Wave energized Baltic aeration pump’ could be a suitable solution technically, economically and environmentally.

The LIFE+ project, which closes at the end of 2012, aims to demonstrate the technical feasibility of the pump for the aeration of coastal zones and open seas suffering oxygen depletion. The pump exclusively uses the natural resources of oxygen-rich

surface water and wave energy to improve the oxygen situation in hypoxic bottom water layers by enhanced ventilation and mixing. The project team is preparing and assembling a prototype pump, including fine-tuning of the system to the local conditions. The system will be demonstrated through tests at two complementary sites in the Baltic Sea: one to show its effects on hypoxic bottom water layers; and another in the real environment. (For more information, see the project website: <http://webap.ivl.se>).

The ‘EMMA’ model

An earlier Italian project, ‘EMMA’ (**LIFE04 ENV/IT/000479**) successfully developed a local integrated model designed to help local authorities tackle hypoxia and/or anoxic seasonal pollution in the marine and coastal waters of the North Adriatic Sea. The project’s complex scientific and technical know-how was conveyed in a straightforward manner to local authorities and people working in the fishing and tourism industries through training sessions and seminars targeted at a non-specialist audience. The project’s dissemination activities enabled these stakeholders to counteract the degradation of the marine ecosystems. Importantly, the findings are applicable throughout Italy and in other threatened European coastal areas.

A wave-powered device - WEBAP - is being used for the aeration of coastal zones and open seas suffering oxygen depletion



Photo: LIFE08 ENV/S/000271

IMPROVING THE COASTAL ENVIRONMENT

Models for cleaner coastal waters

The beaches around Granville, Normandy, were some of the most vulnerable in Europe. The LIFE programme, however, has allowed the local public body to carry out comprehensive studies to determine the reasons for the high level of pollutants in the seawater after rainfall and to take effective and targeted measures to improve the cleanliness of its beaches.



The 'MARECLEAN' project (LIFE06 ENV/F/000136) provided the essential impetus for achieving a 'good' status for targeted beaches in the Basse-Normandie region of France – a popular tourist destination and major source of seafood. The project site itself is home to 38 registered bathing locations and 15 production areas for mussels and oysters, including the largest site in France. Shellfish breeding is an €85 million-a-year industry and tourism in the project area brings in €115 million annually. Clean beaches are thus vital to the local economy.

However, the higher standards for coastal waters demanded by the new Bathing Water Directive (2006/7/EC), led to a downgrade in the status of several beaches in the region. In the area managed by the SMBCG (Association of Environmental Authorities in

the Granville Coastal Basin) five of the 23 beaches (including four out of 10 beaches in the Granville-Jullouville Bay) did not conform to the new directive. The bay is particularly vulnerable as it does not have the right hydrological conditions – the currents are weak – to easily disperse the pollution. In response, the SMBCG launched a LIFE project to devise methods of reducing the risk of contamination by identifying those initiatives that should be prioritised in future programmes of water quality management; and putting in place preventive measures and promoting 'active' management.

The SMBCG, a public institution for cooperation between local councils, was created specifically in 2003 for the improvement of quality in coastal and inland waters. According to the SMBCG president, Gérard

'MARECLEAN' adopted a pollution management plan for a 40 km stretch of coast with the aim of reducing point source pollution by 90%



Photo: SMBCG

The new sewage plant improved water quality at Granville

Dieudonne, the construction of a new sewage plant at Granville in the 1990s and the extension of the sewage collection system “led to a major improvement in the quality of water” – particularly in dry weather. But microbiological pollution remained a problem in wet weather. Thanks to the assessments carried out as part of the LIFE project, the beneficiary was able to gain a clearer picture of the sources of this pollution. The project identified coastal rivers – which carry pollution of agricultural origin (such as inland pasturing) and some domestic pollution coming from individual sewer installations – as the most significant contributor, followed by overflowing sewers and salt marsh grazing.

‘MARECLEAN’ helped to improve the quality of beaches and coastal waters in the project area, avoiding the downgrading of certain shellfish production sites

Risk assessments

Assessments were based on more than 1 500 samples taken from the rivers and sea. The agricultural contamination of freshwater is the result of animal excrement leaching from pasture lands, livestock entering water courses and overflows from slurry pits. The project provided the beneficiary with accurate data showing the impact of agriculture, and it is now able to demonstrate to farmers the environmental benefits of modifying their activities – for example, providing sources of water for cattle other than streams and rivers. “We have a technical expert that explains to farmers the problem of grazing animals and [who] can suggest which type of equipment to use to prevent direct dirtying of rivers,” says Nathalie Genin of SMBCG.

Analysis of the samples also underscored the importance of short-term rainfall forecasts in predicting pollution loads. “When the weather is good, the water quality is good. Problems occur when it is raining,” explains Ms Genin. “If we have too much rain, we can call the mayor and explain to him the risk of bathing water contamination. With this information, he can decide whether or not to stop bathing activity and inform oyster breeders – normally for three or four days.”

One of the main outcomes of the project was a software tool for managing such beach closures: the SAERS (human risk evaluation assistance system) simulates 32 wet weather scenarios and 72 dry weather scenarios for infrastructure failures. The software allows the intensity of the contamination phenomena to be visualised for any site, along with its duration.



Photo: Philippe HOUZARD



Photo: Philippe HOUZARD

Submersion of salt meadows grazed by sheep can cause shellfish contamination and coastal pollution

The benefits of this tool were demonstrated in the summer of 2009 following heavy rainfall in Granville-Jullouville Bay and following the malfunction of the sewage collection system in the Hacqueville catchment area. As a result of the SAERS programme, it was possible to limit the number of beaches subject to a temporary bathing ban.

Shellfish protection

The classification and monitoring of shellfish production zones has also been modified. The European Regulation (2004/854/EC) imposes stricter constraints on breeders. 'MARECLEAN' calculated that if no action had been taken to improve the quality of beaches and coastal waters in the project area, this would have led to the downgrading of certain shellfish production sites and an estimated loss to the economy of €23 million.

The region's tidal marsh areas, those zones where freshwater from the rivers reach the sea, are rich habitats for shellfish. These tidal estuaries, known locally as 'havres' are exposed to pollution flows when leaching occurs in the catchment areas of the rivers and in the salt meadows grazed by sheep – this traditional agricultural activity is particularly prevalent at La Vanlée. Studies carried out by the project underlined the impact of sheep grazing: 29% of the cases of shellfish contamination in the period 2006-2008 were caused by submersion (i.e. high tides) while 42% of cases were caused by precipitation.

The measurement process established by the project confirmed the extent of the degradation of coastal water quality because of sheep grazing, as well as

that coming from cattle grazing and sewage. River bank protection is one action that significantly reduces the impact of grazing. Protecting the estuaries from the tidal impact is another effective measure that could reduce pollution from grazing, but it is one that further raises questions about interfering with natural coastal processes.

Pumping problems

The pollution risks stemming from sewage in the area come mainly from pumping stations, as upgrades to treatment works were already completed before the project. "Pumps can break down, and if they are not repaired immediately, sewage water can seep into the river," points out Ms Genin.

Map of the 'MARECLEAN' project area





Photo: SMBCG

Crossing points for livestock were installed to avoid them entering and contaminating fresh watercourses

Assessments carried out by the project classified 18 of the 117 pumping stations in the area as posing an overall (technical and environmental) risk of overflow. Such appraisals will enable the local authorities that own these installations to target the least secure stations by prioritising investments. Measures such as the fitting of telemonitoring devices, the installation of equipment to measure overflows and the construction of storage ponds reduce the risk of malfunctions.

In wet weather conditions, the sewage system can reach its hydraulic limit. The likelihood of an overflow is increased by the presence of extraneous rain or groundwater. Through the analysis of the project, the network of local authorities is now able to limit the amount of this water from entering the system. To this end, those stations in catchment areas that are affected most by wet weather can be first in line to receive emergency overflow tanks.

In addition, the project tested procedures for improving the management of installations. It created a management tool to reduce beach pollution based on making full use of storage facilities and the preferential discharge to less sensitive areas. The tool regulates pumping according to the capacity of the station to which the water is being sent, and when overflows are unavoidable, the water is sent to catchment areas with the lowest

impact on valuable sites for tourism and shellfish production.

Continued efforts

According to Ms Genin, the project presented the public body with a great opportunity to work with partners in the private sector. These partners, however, were needed to carry out the wide range of evaluation and modelling activities undertaken in the course of the project. The models developed for analysing watershed load (MAREFLUX) and sea dispersion (MARS) are both highly transferable. Countries with similar basins and shellfish production include the Netherlands, Spain and the UK. The results of the 'MARECLEAN' project were communicated in specialist journals, brochures and over a two-day conference in Granville in 2009.

The support of local actors is vital to the success of integrated approaches to coastal zone management. It is therefore heartening to hear Mr Dieudonne say that "the ['MARECLEAN'] project helps to convince local authorities that it is worthwhile continuing activities to improve water." Though the wet summers of 2007-2009 meant that the impact of the project on the sea water was slow to show up in tests, by 2012 the number of beaches in Granville-Jullouville Bay that didn't comply with EU regulation had been reduced from four to one.

Project number: LIFE06 ENV/F/000136

Title: MARECLEAN - Risk based reduction of microbial pollution discharge to coastal waters

Beneficiary: Syndicat mixte des Bassins Versants des Côtiers Granvillais (SMBCG)

Contact: Nathalie Genin

Email: nathalie.genin@ville-granville.fr

Website: <http://www.smbcg-mareclean.eu>

Period: 01-Oct-2006 to 31-Dec-2009

Total budget: €1 569 000

LIFE contribution: €783 000





Photo LIFE05 NAT F 000146

Integrated coastal habitat actions

The ICZM approach developed with the input of LIFE Environment has also been incorporated into LIFE Nature projects targeting the restoration and management of coastal habitats. Amongst the habitat types that have benefitted are the Atlantic, Baltic and Mediterranean dunes, seagrass meadows, coastal lagoons and estuaries, coastal meadows and salt pans and salt marshes. In all cases, actions to conserve threatened ecosystems have been aided by integrating the needs of nature with the requirements of local stakeholders within a sustainable long-term strategy, providing a template for future restoration projects across the EU.

INTEGRATED COASTAL HABITAT ACTIONS

Protecting Atlantic dunes through integrated actions

Though home to rare flora and fauna, the conservation status of many dunes in the Atlantic region is classified as “bad”¹. These Atlantic dunes, which contain such priority habitats as white and grey dunes, are threatened by pollution, erosion, increasing tourist pressure and coastal development. However, several LIFE projects have shown that an integrated management approach can help restore these coastal habitats to a “favourable” condition.



Photo: LIFE06 NAT/F/00146 Syndicat mixte Grand site Gâvres-Quiberon

Fences protecting primary dunes from tourist pressure in Brittany, France

One such project, the 'Integral Coastal Conservation Initiative' (LIFE96 NAT/B/003032), though carried out on a relatively small area of the Flemish coast of Belgium had a far-reaching impact. As well as taking restoration actions – such as scrub clearance to restore humid dune slacks and 'grey' dunes and the removal of soil for the restoration of humid dune slacks – the project initiated discussion on the purchase of dunes for conservation, and in 1998 the Flemish government introduced a legal instrument for acquiring dunes. Consensus building among stakeholders was necessary for the acceptance and application of this local legislation.

A major problem for dune conservation in Flanders, moreover, has been the construction of artificial sea defences, dykes and other infrastructure, some of which dates back to the First and Second World Wars. The Belgian authorities have attempted to replace sea defences with alternative structures that can absorb the sea's energy, for example replanted sand dunes. Concrete installations and 17 km of

¹ Report on the Conservation Status of Habitat Types and Species as required under Article 17 of the Habitats Directive (2009) http://ec.europa.eu/environment/nature/knowledge/rep_habitats/index_en.htm



Photo: Mijdel Dec

Restoration of dune habitats on the Belgian coast

barbed wire were removed and replaced by more natural landscape features such as pools as part of the recently closed 'Zwindunes Ecological Nature Optimisation' project (**LIFE06 NAT/B/000087**).

Sustainably managed activities

The project beneficiary, the regional government, drew on the experience of the previous LIFE projects that have focused on coastal habitats, including the benefits of grazing – the initial project had purchased Shetland ponies and other animals. A similar mix of livestock breeds was introduced to the 'Zwindunes and polders' nature reserve to restore the habitat to a more natural condition. Actions carried out to inform the public about the conservation of the coastal area – the production of information boards, publicity material and web content – also highlighted those local recreation opportunities opened up by the project that are not harmful to habitat protection, thus fulfilling the Commission's focus on integration.

Increasing visitor numbers is also a problem in Brittany, which boasts almost uninterrupted dunes on a stretch of nearly 2 500 ha from Gâvres to Quiberon, the largest area of dunes in this French region. One of the main aims of the 'Maintbiodiv' project (**LIFE06 NAT/F/000146**), was to redirect recreational activities – such as horse riding and quad biking – away from sensitive areas: the project area included nearly 1 000 ha the priority habitat 'grey dunes'. The

erection of signposts in threatened areas is allowing habitats to be restored to their natural state.

The Brittany project highlights another major threat to Atlantic dunes: invasion of non-native species. The dunes at the Gavres-Quiberon site contain a wide range of flora, including the blue-eyed Mary genus (*Omphalodes littoralis*) and the fen orchid (*Liparis loeselii*), among other protected species. These priority species are threatened by the spread of non-native plants, the control of which was a key action of the project. In particular, the groundsel tree (*Baccharis halimifolia*), which thrives in the humid dune slacks, was removed. The project also created a database on invasive species that can be used for other large-scale projects.

Dune regeneration

Laida beach dunes in the Basque country are part of the Urdaibai Biosphere Reserve, a large natural expanse covering 22 ha, located between the capes of Matxitxako and Ogoño. Though the site is also protected as part of the Natura 2000 network, it too is threatened by tourist pressure. Some 80% of coastal dunes have disappeared in the Basque Country. The LIFE Nature 'Dunas Laida' project (**LIFE04 NAT/ES/000031**) attempted to regenerate dunes through bio-engineering – when plants (in this case) help to regenerate or build the dunes – and by raising awareness among the local population of the value and need to protect these ecosystems.



Photo: Airhoa Darquistade Fadrigue (MOT, Astaie GEIE - (DOM) LIFE04 NAT/ES/000031

General view of the restored dunes in the Basque Country, Spain

It established dune belts by placing sand trappers (dry willow branches or wicker) in perpendicular lines facing into the prevailing wind. These barriers helped to trap the sand to enable it to build up over time. Once a sufficient volume of fine sand had been built up, sand trapping species such as European beachgrass (*Ammophila arenaria*) and sand couch (*Elymus farctus*) were then planted. Again, it was also important to manage tourist numbers.

This project also has the potential to have a wide-reaching impact, since it yielded knowledge that can be used to develop similar projects in zones with similar characteristics. Along with other Atlantic dune conservation projects, the LIFE programme has generated management models that take into account all conservation factors and offer a way of protecting habitats in Europe in the long term.

Baltic Sea dunes

Recreational pressures, development and erosion are also having an adverse impact on dunes in the Baltic region. The highest moving (drifting) sand dunes in Europe can be found on the Lithuanian coast along the Curonian Spit, a UNESCO World Heritage Site. The 'LITCOAST' project (**LIFE05 NAT/LT/000095**) was set up in order to restore and conserve habitats along more than 1 600 ha of shoreline that are facing extinction, including some 50% of all Lithuanian coastal grasslands and dunes. Particularly vulnerable dunes threatened by erosion were reinforced along a stretch of 20 km.

The largest boreal dune area in Europe is located in the Vattaja Natura 2000 site in Finland. The site also accounts for 37% of the country's grey dunes. However, Vattaja has been one of the most important military exercise and artillery practice areas of the Finnish Defence Forces since the 1950s and is increasingly used for recreation. The 'Vattajan dyyni LIFE' project (**LIFE05 NAT/FIN/000104**) demonstrated how it could be possible to meet the interests of conservation in conjunction with the continued use of the site. A management plan was drawn up that combines restoration with adjusted military and recreational activities.



Photo: LIFE05 NAT/FIN/000104

INTEGRATED COASTAL HABITAT ACTIONS

Saving Valencia's dunes from destruction

By reversing the negative impacts of earlier tourist and urban development, two LIFE projects led by the City of Valencia have revived an important coastal dune habitat and provided a template for integrated and sustainable management of similar threatened ecosystems elsewhere in Europe.

South of the city of Valencia in Spain, a sandbar stretches for almost 30 km. Formed by sediments carried by the rivers Turia and Júcar, as well as the effect of the north-south sea current, this ridge of sand is responsible for the existence of Valencia's Albufera lagoon. The La Devesa del Saler coastline, as it is known, comprises significant areas of dune systems, with temporary coastal lagoons and salt marshes known locally as 'malladas', which house priority for conservation habitats included in Annex I of the Habitats Directive.

Prior to the 1960s, the La Devesa dune ecosystem was in a pristine state. However, two decades of unsustainable development saw the destruction of much of its area to build hotels, campsites, golf courses and other tourist and urban development infrastructure, including roads, car parks, sewage treatment pipes and a seafront promenade. As well as the direct impact on the conservation status of the dunes, as a consequence of the clearing of the first and second dune ridges, which acted as a natural buffer against sea erosion, the coastline started receding, further threatening coastal habitats.

The effects of the tourist infrastructure and the urban development plan that supported it were clearly visible to the people of Valencia, many of whom had a strong affection for the dunes of La Devesa. This led to significant public protests and the rejection of the continuation of the urban development plan in the 1970s. Later the dune site was designated a natural park in 1986 and a Natura 2000 network site ('Albufera') in 2001.

By the time this latter legal protection was granted, however, the area had been significantly degraded by development. To counteract this, the local



Photo: Anhoo Darquistade Fadrigue (Mot, Astrale GEE - IDOM)

authority led two LIFE Nature projects (**LIFE00 NAT/E/0007339** and **LIFE04 NAT/ES/000044**) that, between 2001 and 2008, re-established the dune ridge system and its habitats, from scratch, back to its original state, covering an area of more than 55 ha of coast.

View of the first dune ridge restored with LIFE's support

Rebuilding the primary dune

The first obstacle to the rebuilding of the primary dune was a man-made one: abandoned infrastructure built in the 1970s covered a large area and was both an eyesore and prevented the dune from restoring itself. As well as disrupting the natural sand and water dynamics, the structures were also enhancing coastal erosion. The first goal of the first



Dunes habitats before and after restoration (from 1 to 4): View before restoration, 1995; first LIFE project primary dune restoration ('LIFE Duna'); 'LIFE Enebro' - secondary dune and intra-dune restoration; and fully restored dunes habitats

LIFE project was thus to dismantle and remove obsolete infrastructure, including roads, car parks and the underground sewage network. In total, the project removed more than 2.1 km of promenade, 30 159 m² of roads and parking plots and 10 km of underground pipelines.

With the site cleared, the project team was able to start re-establishing the primary dune by piling up sand and stabilising the first ridge. Biodegradable sand retention structures called 'bardisas' were installed over an area of 30 000 m². Each bardisa consisted of 5m x 5m squares of cane (*Arundo donax*) and *Spartina versicolor* (known locally as 'borró', a plant cut either from the malladas or the Albufera lagoon).

Following this step, the dunes were planted with more than 2 million plants of 27 different species, as well as 52 618 transplanted individuals of seven different plant species that had been rescued from the intervention area before the works started. In total, more than 13.5 ha were restored, including 2.1 km of dune fringe, over 1.5 ha of lagoons were created and a 2.1 km-long (non-car) access trail to the beach was built in an area previously devastated by urban development.

To prevent heavy sea erosion and to give a margin for sand deposition and recovery of the sand dynamics, the primary dune ridge was restored further inland than the original one. To date, the restored dunes have survived the impact of several storms. It is also possible, for the first time in decades, to see embryonic dunes developing. These results confirm that the restoration was a success.

Full recovery of the coastal system

The second LIFE project continued the work of the first and followed straight after. This second phase was necessary to accomplish the full recovery of the coastal area, with work centred on the restoration of the second dune ridge. This ridge was mainly characterised by Annex I-listed "Coastal dunes with *Juniperus spp*" and a network of salt marsh and lagoon depression malladas. After the removal of further redundant infrastructure from the 1970s, the project rebuilt the topography of the area, raising dunes and opening the depressions, again using bardisas.

To establish the dune vegetation, the project raised maritime juniper (*Juniperus oxycedrus spp. Macrocarpa*) in the Valencia municipal nursery,

including some obtained by means of new germination techniques. More than 2 500 of these maritime juniper plants were then planted at the project site, along with accompanying species (*Phyllereo-Rhamnetum subsp. Juniperetosum*). In addition, more than 6 000 previously collected dune plants were planted and several million seeds of 38 characteristic species of the dune habitats were sowed.

From the previous project it was known that the dune habitats have a natural regeneration and balanced plant species composition in four or five years and that the bardisas degrade within three-to-four years, resulting in a dune with a natural appearance.

Both projects used a predictive model developed by the project beneficiary to reforest the Devesa dunes. This easy-to-use, low-cost application allowed the beneficiary to infer the spatial distribution of the vegetal formations in the Devesa dune ecosystem before its destruction in the 1970s on the basis of parameters including distance from the sea, orientation, solar radiation, wind influence and height above sea level. The application has also been an effective tool for decision-makers working to restore and manage the Albufera Devesa protected area, since actual plant growth has matched predictions and sowing and planting have taken place in appropriate areas.

A further aspect of the two LIFE projects was the restocking of two restored depression lagoons with some 300 specimens of Valencian toothcarp (*Valencia hispanica*), raised at the 'El Palmar' fish farm, which had been established by an earlier LIFE project (**LIFE92 NAT/E/014400**).

Changing patterns of use

One consequence of the two LIFE projects has been a change in the type of tourists the area attracts, as project manager Antonio Vizcaino explains: "Prior to the restoration, and with easy access and plenty of parking, the beach was packed with 'domingueros'

(weekend tourists). Now we have different tourists, from birdwatchers to more eco-conscious tourists. The beach now is more isolated, and has become a nudist area!"

These changing patterns of use are being welcomed by businesses in the surrounding municipalities, since the new types of tourist "leave more money: in restaurants, hotels, etc. The weekend ones just brought everything from home," says Mr Vizcaino.

This change in tourist patterns was in part thanks to the active dissemination activities of the LIFE projects, which organised workshops and guided visits and polled beach users about their opinions of the project's restoration works.

Widespread public support for the Devesa dune projects was crucial to their success, believes Mr Vizcaino, along with the political support of Valencia city council.

The success of the two projects offers a significant demonstration value for those involved in implementing ICZM, both in Spain and elsewhere. For instance, the methodology for specific project actions can be exported, namely: how the project went about the earth movements and reconstruction of dune structures; the reconstruction of the dune hills and depression; the fixing of regenerated dune structures; the elimination of obsolete infrastructure and treatment of residues; the construction of new infrastructure with materials and shapes that do not have a great impact; the collection, conservation, production and planting of the regenerated area with native vegetation; the elimination of alien species; and the dissemination of resources among citizens to increase awareness.

All these factors resulted in the integrated management of a complex dune system with great natural value that sits in close proximity to a large city in an area of heavy tourist pressures and changing land use. By finding a balance between conservation and human activities in such an area, these two LIFE projects offer a great example of ICZM in action.

Project number: LIFE04 NAT/ES/000044

Title: Enebro Valencia - Recovery of the littoral sand dunes with Juniper spp in Valencia

Beneficiary: Ayuntamiento de Valencia. Concejalía de Dehesa-Albufera

Contact: Don Antonio Vizcaino Casarredonda

Email: avizcaino@valencia.es

Website: <http://www.albuferadevalencia.com/lifeenebro/>

Period: 01-Oct-2004 to 30-Jun-2008

Total budget: €3 278 000

LIFE contribution: €1 639 000



INTEGRATED COASTAL HABITAT ACTIONS

Protecting vulnerable Mediterranean dunes

Mediterranean dunes form a complex mosaic of endemic coastal habitats. Shaped by the wind, sand and their distance from the sea, they help stabilise shifting sands and thus guard against flooding and erosion. LIFE actions are helping to ensure their survival in some localised and especially vulnerable coastal areas.

Mediterranean dunes are characterised by a gradient of species-rich habitats, stretching inland from the beach. Examples include the priority coastal juniper dunes and umbrella pine dunes, as well as dunes with hard-leaf evergreen scrubs. These habitats are under threat from several directions. Most damaging is their direct destruction by urban sprawl, followed by sand extraction and disturbance, all of which are linked to the explosion of mass tourism in Mediterranean countries. There are other, more recent threats, such as the spread of non-native plant species (used for stabilising shifting sands), and rising sea levels as a result of global warming.

Fences to avoid over-trampling and erosion caused by tourist activities



Photo: LIFE05 NAT/IT/000037

People pressure

More than 20 LIFE projects have targeted Mediterranean dune habitats. In all cases, the main objective was the restoration of habitats that had been transformed by human pressure. Actions undertaken by the various projects include restoration and re-vegetation of the dune systems. 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 are specially adapted to sand such as umbrella pines (*Pinus pinea*) – or installing artificial barriers. In other cases, dunes have been rehabilitated by controlling access to them, or by eradicating non-native species.

For example, the Italian 'DUNETOSCA' project (LIFE05 NAT/IT/000037) successfully improved an area of some 80 ha of coastal dunes and wetlands in northern Tuscany. These included the priority habitats coastal dunes with juniper species (*Juniperus spp*) and wooded dunes with *Pinus pinea* and/or *Pinus pinaster*. Specific measures targeting the dunes focused on combating the spread of exotic invasive plant species in the 'Selva Pisana' and 'Dune litoranee di Torre del Lago' Natura 2000 sites within the Migliarino-San Rossore nature park. Invasive *Yucca gloriosa* plants were removed and replaced with some 2 000 native sand species.

The integrated approach of the project also saw the closure of many existing pathways through the dunes and the construction of new footpaths and fences, so as to reduce the threat of over-trampling by tourists. Monitoring of key indicator species ensured the validity of the restoration actions, whilst the five-year dunes action plan produced and approved by the beneficiary ensures their continuity after LIFE.



Photo: COSTA ITHANOS

Restored juniper dunes in Crete

Another notable Italian project, which started in the same year, is 'HABI.COAST' (**LIFE05 NAT/IT/000050**), on the country's Adriatic coast. The project targeted the conservation of rare and endangered coastal habitats on over 30 ha of Torre Guaceto – a site of Community importance (SCI) within the Natura 2000 network. The proximity of this site to the city of Brindisi and its surroundings means that it is threatened by heavy beach and tourism activities.

Specific dune restoration techniques involved the elimination of non-native species and re-planting of areas with native plants grown in a local nursery; and the purchase of land bordering the site. Allowed to naturalise, it is hoped that this land will act as a buffer against the impacts of tourism and help to improve the ecological balance of the most valuable habitats. The project also helped raise stakeholder awareness and understanding of the importance of environmental protection measures needed in order to sustain biodiversity within the site and in particular, of the need to reduce human-induced pressures.

The project succeeded in enlarging the SCI and its management plan for the nature reserve was approved at regional level and by the Ministry of Environment. Another important result (not directly foreseen by the project) was the closure to vehicles of one of the access roads to the beach; a car park was established inland and an electric road-train was made available in order to transport visitors to the beach.

Greek experience

In Greece, areas of juniper coastal dunes can still be found mainly along the sandy beaches of the South Aegean and Crete. The priority habitat, however, is under threat from factors such as restricted natural regeneration, tourism, forest fires and a lack of public awareness. Moreover, global climatic changes are also thought to be having an adverse impact on this increasingly rare habitat type. The ongoing 'JUNICOAST' project (**LIFE07 NAT/GR/000296**) is aiming to promote the long-term conservation of juniper coastal dunes in four Natura 2000 sites in Crete: Gavdos, Kedrodasos, Chrysi and Falasama.

Measures under way are targeting: i) consolidating a knowledge base for protection, restoration and monitoring; ii) halting natural and human-induced threats and implementing protection and restoration actions; and iii) providing support for better environmental management of the sites through stakeholder involvement and training.

In addition, the LIFE+ project is carrying out public awareness and dissemination activities in four sites in the South Aegean: the islands of Rhodes, Naxos, Polyaiagos and Milos. To support these activities, the project has engaged in some innovative dissemination activities, including a YouTube clip on the priority habitat and an interactive 'Junicoast radio spot', featuring news and announcements about project actions (both are available to download from the project website (www.junicoast.gr)).

INTEGRATED COASTAL HABITAT ACTIONS

Minding the meadows

Seagrass meadows, a vital part of the marine ecosystem and an important “carbon sink”, are under threat from a variety of human activities. LIFE projects are working with different stakeholder groups to promote an integrated approach to the identification and targeting of harmful practices.

Seagrasses are an integral part of the marine ecosystem. Not only do they play an essential role in oxygenating seawater and providing a refuge, feeding and breeding area for a large number of marine species, they also help to stabilise the sea bed, prevent coastal erosion, maintain the water’s cleanliness and act as a “carbon sink”, absorbing carbon dioxide (CO₂) from the atmosphere and thereby helping to slow down the effects of climate change.

However, seagrass meadows are under threat from human activities, in particular land-based sources of pollution, such as nitrates from agriculture and industrial effluents, illegal trawler-fishing, fish-farming, the mooring of pleasure boats, construction in coastal areas and, to a lesser extent, competition from invasive species. LIFE projects are making an important contribution to alleviating these threats, focusing in particular on the development and im-

plementation of integrated management plans that seek to reconcile conservation with human activities, as well as on the restoration of damaged sites.

Integrated management

A good example is the LIFE ‘*Posidonia Baleares*’ project (LIFE00 NAT/E/007303), which succeeded in developing management plans for the conservation of the seagrass, *Posidonia oceanica* (which is commonly known as Neptune grass), in 14 marine Natura 2000 network sites around the Balearic Islands. The project, which was carried out by the Environment Department of the Balearic Islands Government, also led to the creation of three new marine reserves.

Posidonia oceanica meadows are a priority habitat listed in Annex I of the Habitats Directive and are found only in the Mediterranean, growing on sandy substrates down to a depth of 35–40 metres. A considerable proportion of the Balearic coast has been proposed for inclusion in the Natura 2000 network because of the presence of Neptune grass beds and other endangered species.

During the project, detailed data was gathered on factors affecting the Neptune grass and its biological status in the project area. High quality GIS maps of the project sites were also produced. This information allowed the project team to prepare comprehensive site management plans that now provide the Balearic Government with the core set of conservation tools required to manage the Neptune grass meadows in a sustainable manner.

Some of the other main actions undertaken by the project include the installation of environment-friendly moorings, to address damage caused by the anchoring of pleasure craft (see box), and the estab-

Posidonia oceanica meadow in El Calón (Almería, Spain)



Photo: Consejería de Medio Ambiente - Junta de Andalucía

ishment of a network of volunteer scuba divers to monitor the Neptune grass meadows.

Two more recent LIFE projects are also focusing on the conservation of *Posidonia oceanica*. The 'Posidonia Andalusia' project (**LIFE09 NAT/ES/000534**) aims to develop site management plans for the conservation of Neptune grass meadows in six Natura 2000 sites off the coast of Andalusia. Collectively, these sites account for some 95% of the Neptune grass meadows in Andalusia, so the project actions will make a significant contribution to the conservation of this important species.

The 'POSEIDONE' project (**LIFE09 NAT/IT/000176**) aims to safeguard and restore *Posidonia oceanica* beds in two marine Natura 2000 sites in the Lazio region of Italy. This project is also focusing on the development of site management plans, involving key stakeholders such as the Province of Viterbo and local fishing associations. The project team will also test the implementation of certain conservation actions, including the installation of 550 submarine structures to combat illegal bottom-trawling, identified as the main threat to Neptune grass meadows in the project areas.

Restoration

Restoration of damaged seagrass meadows is another area of focus of LIFE projects. The 'Biomares'

project (**LIFE06 NAT/P/000192**), for example, helped to restore lost meadows in the Arrábida-Espichel marine park, one of the last non-estuarine *Zostera marina* meadows on the Portuguese coast.

A reduction in the area of seagrass meadows, from 30 ha in 1983 to 0.006 ha in 2006, was mainly attributed to illegal fishing practices (dredging for bivalves), as well as the anchoring and mooring of pleasure craft. A management plan for the area, which was approved in 2005, now regulates these activities, but the limited genetic diversity that remained within the site did not allow for the natural regeneration of meadows.

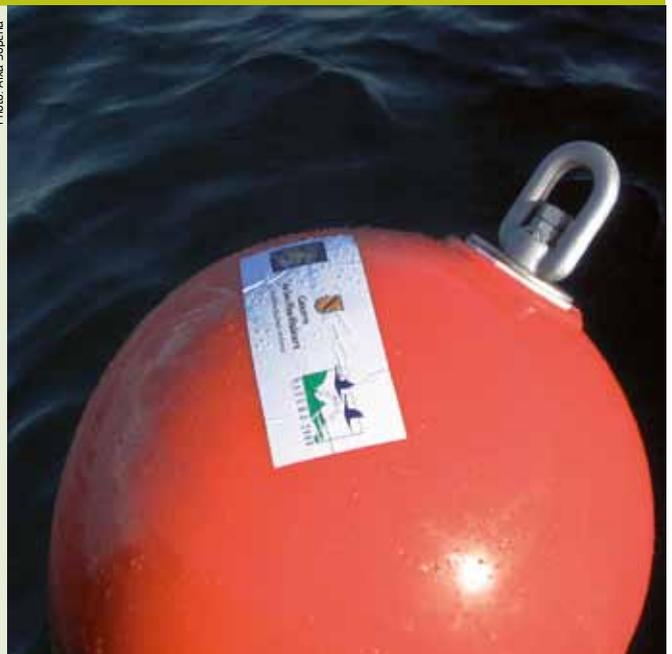
The project therefore developed an active restoration strategy that included the transplanting of seagrasses from donor populations, the cultivation of seagrass from seeds and the propagation of seagrass shoots to be used in the transplanting. This has helped to strengthen the genetic structure of the population and to reduce local harvesting impacts on already stressed donor populations.

Whilst monitoring of the transplanted areas showed a high mortality rate in the first year, this was attributed to natural processes and better results were expected in year two. However, the presence of large quantities of toxic red algae (*Asparagopsis armata*) and strong grazing pressure from herbivores such as sea urchins have been identified as possible threats to the recovery process.

Seagrass-friendly moorings

Damage caused by the anchoring of pleasure craft presents a major threat to seagrass meadows, and alternative and less destructive techniques have been explored by a number of LIFE projects. The 'Posidonia Baleares' project tested three different systems, which were successfully adapted to different sea floor conditions: concrete block footholds on sand substrate with no Neptune grass meadows; ecological screws on sand with *Posidonia oceanica* beds; and chemical mass on rocky sea floors, with or without *Posidonia*. As a result of this project, a new regulation controlling mooring in seven protected areas was introduced. The 'Biomares' project tested the use of surface mooring buoys, connected to mid-water buoys by a system of cables and turnbuckles to avoid damage caused by cables dragging over the seafloor. Other projects, such as the 'ACCOLAGOONS' project (**LIFE09 NAT/GR/000343**) in Greece, and the 'Posidonia Andalusia' and 'POSEIDONE' projects will also test the use of similar environment-friendly moorings.

Photo: Alva Sopenha



INTEGRATED COASTAL HABITAT ACTIONS

Positive action at the interface

Tidal estuaries and coastal lagoons account for more than 13% of the world's coastline. As well as their importance to the economy through tourism, fisheries and aquaculture, lagoons and estuaries provide unique and valuable habitats for a range of plants and animals. LIFE projects have developed equally specific approaches for the integrated management of these areas.



Photo: LIFE05 NAT/D/000152

Aerial photo of a Baltic coastal lagoon

Coastal lagoons and estuaries sit at the interface between coastal and inland water habitats. They are hugely dynamic areas, experiencing periods underwater and periods exposed to the sun and air. They are typified by graduated habitats which present very different characteristics over a relatively small area, depending on the extent to which they are influenced by tides and the flow of saltwater/freshwater, as well as other factors such as sediments. In many cases, it is this dynamism that explains their high productivity and ecological importance.

In combination with the requirements of the Natura 2000 network (Habitats and Birds directives), European policy concerning coastal zone management (the ICZM Recommendation) and integrated river basin management (the Water Framework Directive) provides appropriate instruments to lower pollutant loads and to improve the conditions and conservation status in coastal lagoons and estuaries

These special environments provide a niche for many different creatures, including fish, wading birds, migrating birds, invertebrates, amphibians and aquatic mammals. This makes their protection so important and is why several LIFE projects have focused on these coastal lagoons and estuaries.

Protecting coastal lagoons

The ambitious German project 'BALTCOAST' (LIFE05 NAT/D/000152) implemented wide-ranging habitat restoration actions for Baltic coastal lagoons. The Baltic Sea area forms an extremely varied habitat complex, associated with high levels of biodiversity. In particular, it provides an important breeding habitat for endangered wading birds and Annex II, Habitats Directive-listed plants and amphibians.

One of the challenges for the integrated management of such a complex habitat is the involvement of several stakeholders in many countries. This project cov-

ered habitats under the authority of Germany, Denmark, Sweden, Lithuania and Estonia. One of the key results of the project has been to develop a coastal lagoon management network amongst these countries that should take forward long-term integrated management of the wider Baltic coastal lagoon area. The project set up so-called 'expert visits' that had a key function: a small group of experts visited one project site after another and talked to local managers and conservationists about problems and ways of improving things in Natura 2000 network sites. The findings of these visits were exchanged through conferences, seminars and workshops.

To guide and inform the long-term approach to lagoon management, the project intervened in 34 Natura 2000 network sites, where it tested and demonstrated habitat management and restoration actions. Re-establishing the water balance and dynamic is extremely important for the lagoons and salt meadows along the Baltic coast. This was done by blocking drainage ditches and deepening pools of water in some places and by building up land in others. The project also removed reed beds, bushes and invasive alien species – and re-introduced grazing as a way of controlling overgrowth of these species.

The Spanish project 'Humedales Andaluces' (**LIFE03 NAT/E/000055**) included specific work on coastal lagoons within a broader project to restore wetlands in Andalusia. Notably, interventions at the Odiel Marshes focused on restoring natural water-flow dynamics that are enough to restore habitat suitable for a variety of aquatic and semi-aquatic life, as well as birds. This meant restoring an area that had previously been converted into a salt pan.

At Odiel and another project site (the Fuente de Piedra SPA), actions to restore tidal dynamics were complemented by the creation or recovery of freshwater lagoons nearby. Again, this helps create the variation and gradation of habitat on which biodiversity can thrive.

Restoring a tidal estuary in the Netherlands

A Dutch LIFE Nature project targeting the restoration of valuable estuarine habitats presented another set of challenges. The '10GEMETEN' project (**LIFE04 NAT/NL/000202**) concerned an estuary that had ceased to be tidal since the introduction of a dam in 1970. The intertidal surface area had shrunk significantly with the loss of important graded habitats including characteristic mud flats and salt marshes.

The project formed part of an ambitious plan by the Dutch government to designate Tiengemeten – a 1 000 ha island estuary of the rivers Rhine and Meuse – as a nature reserve. This decision was already radical as it meant the end to farming on the 700 ha of then arable land on the island, but, in addition, the LIFE project sought to restore flooding to the island.

Apart from the engineering challenge of redesigning dams and dykes, a key challenge of the project was achieving social acceptance for the changes. Led by the national water authority, the project actively involved the local authorities and a major NGO, which owned the land. Compromises and agreements were reached that saw human settlements protected by dams and an impressive new visitors' centre constructed, whilst the project turned 660 ha of the island into a freshwater tidal ecosystem. Some 40 ha of land was restored to traditional farmland by supplementary funding to recognise the cultural history of the island.

The changes brought about with LIFE's support mean that the central part of the island holds water more naturally and has already developed shallow marshes that provide a large open expanse of water in the winter, but which dry out in late summer – perfect habitat for numerous wintering and wading bird species. In the long term, the project is part of a wider scheme to restore a more natural and important tidal regime. The project site is linked to the Haringvliet estuary by a large tidal creek and future plans to open the Haringvliet floodgates will increase the tidal range at Tiengemeten, contributing to a well-managed and gradual shift to more natural intertidal ecosystems of marshes and creeks.

Restored tidal flooded habitats on the estuary island Tiengemeten



Photo: LIFE04 NAT/NL/000202

INTEGRATED COASTAL HABITAT ACTIONS

Farmer involvement aids coastal meadows restoration

Boreal Baltic coastal meadows are a priority habitat found close to the shores of the Baltic Sea in Sweden, Finland and the Baltic States. They provide important breeding grounds and habitats for many waterfowl, help protect against flooding and maintain coastal water quality. LIFE has pioneered a participatory and integrated approach to the restoration of these habitats.

Integrated management is vital for boreal Baltic coastal meadows. Most of the areas where this habitat type occurs were traditionally managed by grazing or mowing, keeping the vegetation low and rich in vascular plants, and therefore particularly suitable for nesting waders and other wildlife. The decline of grazing and mowing activities has meant that these habitats have become overgrown with high vegetation reed beds and suffer from increased nutrient levels (eutrophication). In some places, the process is so advanced that trees and bushes have also started to encroach, further accelerating the deterioration (siltation) of the coastal meadows (which become land instead of coast). Sustainable human activity is therefore essential to preserve these habitats, prevent siltation and maintain water quality.

Two notable LIFE Nature projects that have targeted the conservation of Boreal Baltic coastal meadows were the Estonian project 'EE Coastal Meadows' (**LIFE00 NAT/EE/007083**) and the Finnish 'Gulf of Finland' project (**LIFE03 NAT/FIN/000039**).

The estimated total area of coastal meadows in Estonia has declined from 29 000 ha in the 1960s to some 5 100 ha today. This has adversely affected various species listed in Annex I of the Birds Directive, including the ruff (*Philomachus pugnax*), little tern (*Sterna albifrons*) and corncrake (*Crex crex*).

Drastic decline

Responding to this drastic decline, 'EE Coastal Meadows' aimed to preserve 30% of the country's remaining coastal meadows (i.e. a total of 1 572 ha over 16 sites).

The participation of local farmers and landowners was important in achieving the project's goals. As interest in maintaining the coastal meadows grew, the project was able to provide farmers with the necessary know-how and support. National agri-environment schemes were also introduced. To share the experiences gained, the project produced best practice guidelines for the management of coastal meadows. Successful networking activities with other LIFE projects were also organised.

The Finnish project (a "Best" LIFE Nature project 2007-2008) was able to improve the management of important bird resting and breeding sites along the migratory areas of the Gulf of Finland. The project also re-established areas of coastal meadows that had become dominated by reed beds, cutting the reeds and reintroducing grazing.

A key innovation, adapted from two earlier Finnish LIFE projects, was crushing and rotoation of reed roots, which was more economical than standard mechanical cutting and could also be used in places where the siltation process was already advanced.

Both projects included an important participatory element – highlighted under ICZM as crucial for success of all coastal management actions. Similar approaches have been adopted by other LIFE Nature projects in Finland, Sweden and the Baltic States, such as **LIFE09 NAT/SE/000345**. Importantly, the long-term management of these threatened coastal habitats has been secured by involving local farmers in their management and encouraging them to apply for agri-environmental support.

LIFE re-established areas of coastal meadows that had become dominated by reed beds by cutting the reeds and reintroducing grazing



Photo: LIFE03 NAT/FIN/000039

INTEGRATED COASTAL HABITAT ACTIONS

Maintaining Mediterranean salt pan habitats

In earlier times, salt production was an important industry in Mediterranean coastal areas of Europe. In areas where they remain, such as the coast of Slovenia, they are home to a number of protected habitats and bird species, providing an excellent example of how an integrated approach to coastal management allows sustainable human activity and nature conservation to co-exist.



Photo: Iva Rossi

Salt pan pool divided for salt production

Once widespread along Slovenia's 46-km long Adriatic Coast, active 'salinas' (salt pans) are today largely restricted to Sečovlje, on the estuary of the Dragonja river close to the Croatian border. Designated a national park in 1990, the Sečovlje salt-pans harbour important coastal habitats and provide a breeding site for several species of gulls, terns and waders listed in Annex I of the Birds Directive.

Preservation of these species and habitats requires the maintenance of embankments and dykes to prevent uncontrolled flooding and changes in salinity. To support this costly work, Soline Pridelava soli, a business which is responsible both for pro-

ducing salt from the remaining pans and for managing the national park, applied for LIFE co-funding for its 'Secovlje' project (**LIFE03 NAT/SLO/000076**), which demonstrated an integrated approach to the management of salt pan areas. As well as carrying out actions to restore the system of dykes and embankments, the project team created nesting islands for terns by covering artificial structures built for a planned commercial fish-farm. New channels were also dug alongside the edges of the salt pans, providing additional protected spaces for birds and reducing the possibility of human disturbance and mammalian nest predation. In all, some 2 000 m² of the most valuable habitat area was protected by the



Photo: Iva Rossi

Glasswort (Salicornia) habitat benefiting from salt pan restoration in Italy

control of high tides and flooding and wading bird species such as the great flamingo (*Phoenicopterus ruber*) were observed on site for the first time, in addition to target species such as the black-winged stilt (*Himantopus himantopus*).

Importantly, the project also drafted a 10-year site management plan with the involvement of regional representatives and engaged in widespread public awareness activities. The long-term perspective of the initial project has fed into a follow-up LIFE+ Nature project – ‘MANSALT’ (**LIFE09 NAT/SI/000376**) – which is continuing restoration and conservation work based around the philosophy of man and nature coexisting in the Sečovlje salt pans.

The flamingo (Phoenicopterus roseus) benefits from integrated salt pan restoration actions



Photo: LIFE09 NAT/SI/000376

On the Italian side of the Adriatic, a similar philosophy was applied by the ‘Comacchio’ project (**LIFE00 NAT/IT/007215**), which restarted small-scale, low impact salt panning as part of a project to restore the 550 ha area of the former Comacchio salt works (closed in 1984). The closure of the works, which is located within the Po Delta Regional Park in north-east Italy, had meant the flow of seawater to the evaporation basins was no longer regulated. This led to a freshening of the lagoon and altered the composition of the vegetation, as well as threatening nesting sites for protected gulls and terns (such as the Mediterranean gull – *Larus melanocephalus*). In addition to actions to restore abandoned infrastructure and improve water circulation (e.g. digging canals, rebuilding dykes and installing drains, pumps, sluice gates and an innovative system to monitor the chemical and physical properties of the water in the lagoon), it also drafted a management plan prioritising conservation of the site, including conservation of its industrial heritage through the construction of a ‘salinetta’ (little salt works) across 4 ha, where salt production using traditional practices began in the last two years of the LIFE project. This integrated approach has paid dividends, with recorded increases in the numbers of targeted bird species (e.g. black-headed gull – *Larus ridibundus*).

Lessons from the ‘Comacchio’ project have also fed into a current LIFE+ Nature project in Italy (**LIFE07 NAT/IT/000507**) which is targeting the recovery of salt meadow habitat in the Lago Salso nature reserve (Gargano National Park).

Project list

The table below provides the complete list of LIFE projects on coastal management mentioned in this publication. For more information on individual projects, visit the online database at: <http://ec.europa.eu/environment/life/project/projects/index.cfm>

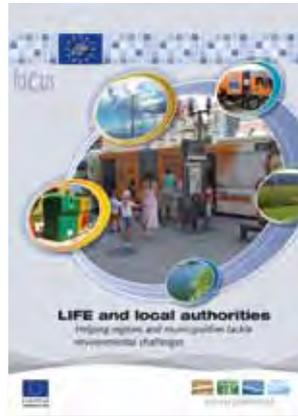
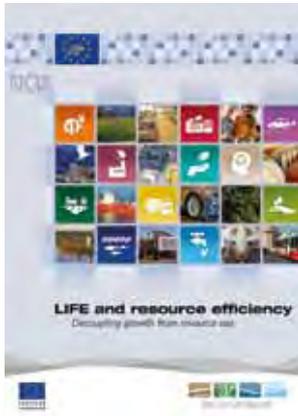
PROJECT REFERENCE	ACRONYM	TITLE	PAGE
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