



# Science for Environment Policy

THEMATIC ISSUE:

## **LIFE Projects**

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## Science for Environment Policy

### LIFE Projects

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## EDITORIAL

# LIFE: improving nature conservation and environmental protection over 20 years

*Europe's wildlife and natural resources have benefited from LIFE funding for over 20 years. In 1992, LIFE, the EU's funding instrument for the environment, began to co-finance projects involved in implementing European environmental policy. Much of the initial work concentrated on launching actions through the then 12 Member States of the EU to establish an embryonic Natura 2000<sup>1</sup> network.*

Since then, LIFE's mandate has grown and flourished. It has strengthened its focus on nature conservation and expanded its reach to a wide range of environmental protection and information dissemination services. Today, LIFE operates in all 28 Member States, where it continues to build on its impressive portfolio of results by tackling key challenges such as biodiversity decline, habitat loss, resource efficiency, water protection and climate action.

LIFE is the sole funding programme for the environment in the EU and has co-financed some 3950 projects with a total budget of €7.2 billion, contributing approximately €3 billion to the protection of the environment. LIFE+, the current phase of the programme, runs from 2007-2013 and has a budget of €2.143 billion. Its beneficiaries include public authorities, NGOs, private companies (mainly small and medium enterprises) and academic institutions.

This Thematic Issue of Science for Environment Policy presents the findings of peer-reviewed research which has taken place under a selection of environmental projects, co-financed by LIFE under two of its three funding strands: LIFE+ Environment Policy and Governance and LIFE+ Nature and Biodiversity.

The LIFE+ Environment Policy and Governance strand co-finances innovative or demonstration projects

that contribute to the implementation of European environmental policy, while the LIFE+ Nature and Biodiversity strand co-finances best practice, innovative or demonstration nature conservation projects that contribute to the implementation of the Birds<sup>2</sup> and Habitats<sup>3</sup> Directives, the Natura 2000 network and the Commission Communication on Biodiversity<sup>4</sup>. At least half of the LIFE+ funding for project co-financing has to be spent on Nature and Biodiversity projects. The third funding stream of LIFE is devoted to communication of environmental projects and campaigns.

Although LIFE does not fund research projects *per se*, it plays an important role in research by subsidising applied research projects and those that can demonstrate an innovative technology, technique or method, such as those featured in this Thematic Issue. In addition, LIFE projects sometimes stem from research or, in other cases, given that they sometimes demonstrate partial results, the project beneficiaries have turned to research after the project has ended.

LIFE has overseen technically coherent, viable and profitable projects that have developed best practice and innovative technological knowledge related to the environmental goals of the EU. Thus, LIFE projects have influenced policy and the implementation of EU environmental legislation, including the Birds and the Habitats Directives.

The first half of this issue is dedicated to LIFE Environment Policy projects and water sector projects form an important part of this theme. The article **‘New tool assesses the effects of global change on water resources’** describes a LIFE Environment Policy funded project which responded to one of the requirements outlined by the EU’s Water Framework Directive (WFD)<sup>5</sup> in combating water scarcity and droughts and the effects that climate change has on water resources. By modelling the impact of global change (i.e. climate change, changes in land use and changes in water consumption), the project proposed different scenarios of cost-efficient adaptation measures, such as greywater reuse and subsidies for efficient domestic water fixtures, to deal with global change’s impacts on water resources.

The project presented in the article **‘Bacterial remediation of groundwater depends on environmental conditions’** responded to the importance placed by the WFD on chemical status when it comes to achieving a good ecological quality of groundwater and in providing simple and cost-efficient measures that prevent or limit pollutants in groundwater, as outlined by the Groundwater Directive. This objective was achieved by demonstrating low-cost *in situ* techniques which use bacteria to immobilise toxic metals and convert them into harmless solids (precipitates) that cannot dissolve into groundwater.

Wastewater treatment plants face recurrent problems, such as sludge production and the toxicity of treated effluents. Technological solutions have already been tested at research scale with significant results, but many barriers to overcoming these problems still exist, particularly in terms of sludge production. **‘New wastewater treatment technology to produce less sludge’** showcases the Sequencing Batch Biofilter Granular Reactor (SBBGR) technology, co-funded by LIFE, for treating municipal and/or industrial wastewater. The technology results in a highly effective wastewater purification process, leading to a reduction of sludge production by up to 10 times in the case of municipal wastewater, a 50% reduction in treated effluent toxicity and a 40% saving in operating costs.

The second most targeted environmental theme by LIFE Environment projects is waste. As well as tackling waste management issues through new recycling and reuse solutions, and ways to reduce landfilling and raise public awareness, LIFE projects have also addressed different waste streams. One of these is construction and demolition waste (CDW), a priority waste stream which is one of the heaviest and most voluminous generated

in the EU. There is a high potential for recycling and reuse of CDW, since some of its components have a high value. In particular, there is a reuse market for aggregates derived from CDW waste in roads, drainage and other construction projects.

The article **‘Better management of construction waste needed to improve recycling rates in Lisbon’** presents a project which successfully engaged 61% of CDW producers in Lisbon in a recycling scheme. The project group designed and implemented a collection system so that CDW waste could be separated at source into the inert fraction for recycling and other fractions that could also be recycled or reused. During 16 months of regular operation, 3976 tonnes of waste provided 3690 tonnes of aggregates that were used in road construction.

The final LIFE Environment project covered in this Thematic Issue is described in the article **‘Environmental benefits of textile-reinforced concrete demonstrated’**. This also concerns the construction sector, but in terms of resource efficiency, CO<sub>2</sub> reduction and energy consumption. The project minimised the amount of concrete necessary in the construction of facades by using a high-tech, thermally-insulated, textile-reinforced concrete (TRC) technology. The new system could enable the construction of thinner walled buildings that offer a superior insulating performance than comparable materials, as they maintain heat in the winter and create cooler temperatures in the summer. The project demonstrated the economic and environmentally friendly benefits of the TRC technology in a full-scale industrial application: the construction of a large public building’s facade.

Important developments have occurred across all of LIFE Environment’s projects, for example, some have sparked off new ideas for technological development and innovation, some have demonstrated gaps in policy that have required further research and funding and others help to monitor pressures on the environment – which includes the long-term monitoring of forests.

LIFE Nature and Biodiversity projects carry out extensive monitoring to assess the impacts of restoration and management actions they have implemented. Monitoring species populations’ evolution and habitat conservation status before, during, and after a project ends, often results in new scientific findings, and provides new management tools and techniques that can be replicated. For example, the project SOS Freira Do Bugio<sup>5</sup>, which monitored the reproduction and ecology of an endangered bird, the Bugio petrel, on the

Island of Bugio in the Madeira archipelago, resulted in a management plan for the islands and an action plan for the protection of the bird, which included the replanting of natural vegetation.

LIFE Nature projects, covered in the second half of this special issue, have implemented restoration actions that have benefited endangered species and habitats in several EU Natura 2000 network sites. For example, in some cases, endangered species in boreal forest habitats may benefit from controlled fires. The article **'Boreal forests may benefit from controlled fires, depending on forest management'** discusses a project that showed that controlled fires can help restore habitats for some species in intensively managed forests in Finland. While its results indicate that fire can be an effective conservation measure, the impact depends on a region's history and context.

In other cases, research has shown that LIFE project restoration actions do not affect local socio-economic activities. For example, the article **'The quality of sheep grazing is not reduced by upland bog restoration'**, details a project in Wales, UK, which deliberately blocked drainage channels, and found that this did not affect the quality of grazing areas for sheep. It has shown that drainage does not encourage the growth of plants favoured by sheep, nor do sheep use drained areas more.

The article **'The value of seed harboured in Mediterranean temporary ponds'**, which presents a LIFE Nature project from Crete, has demonstrated that these ponds contain varied collections of seeds and that these 'seed banks' could play an important role in vegetation recovery after droughts. The findings show

that these ponds' large seed banks can serve as a reservoir of plant diversity and that changes to the structure or water conditions of these temporary ponds should be avoided.

**'Litter size of European mink less than half that of invasive American mink'** discusses a project which revealed that high rates of reproduction in the invasive American mink are likely to result in rapid population growth, which can have detrimental effects on native European mink through increased competition, or transmission of diseases. The project highlights the urgent need for effective control of American mink, especially within the European mink habitat range.

The article **'Translocation for conservation: helping or harming wild populations?'** presents a LIFE Nature project that raises questions about the value of moving animals or plants from a stable population into one that is endangered or even extinct. The project examined two endangered fire-bellied toad populations that were subject to population reinforcement. Research conducted as part of this project shows that even when individual toads were translocated great distances, the population was able to genetically adapt to local conditions within a few generations.

The LIFE programme has been an important tool in applied environmental research and science-based nature conservation - as demonstrated by the projects showcased in the articles in this issue. The findings of the projects supported by LIFE can be replicated, applied at different levels and scaled up with benefits for the environment, green technologies, EU policies and legislation and in creating green jobs.

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1. <http://ec.europa.eu/environment/nature/natura2000/>
2. <http://ec.europa.eu/environment/nature/legislation/birdsdirective/>
3. <http://ec.europa.eu/environment/nature/legislation/habitatsdirective/>
4. COM (2011) 244 Final – *Our life insurance, our natural capital: an EU biodiversity strategy to 2020*  
<http://ec.europa.eu/environment/nature/biodiversity/comm2006/2020.htm>
5. <http://ec.europa.eu/environment/water/water-framework/>
6. [http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n\\_proj\\_id=3161](http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=3161)

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Theme(s): Climate change and energy, Water

# New tool assesses the effects of global change on water resources

*Water resource management needs to adapt to changes in climate, water demand and land use. A new tool has been developed by the LIFE+ Water Change Project to assess these 'global change' impacts on water resources and inform decisions on optimal adaptation strategies. A recent study has applied the tool to a river basin in Spain.*

*"The tool is useful for river basin agencies and water companies to develop long-term water resource management plans that consider future changes in climate, land use and demand."*

**The quality and quantity of water** is strongly affected by long-term human-induced climate change and natural climate variability; changes in land use (such as urban sprawl and deforestation) and changes in water demand (e.g. induced by population growth or consumption change). Together, these are known as 'Global Change'. The potential cost of water scarcity and drought in Europe has been estimated at €100 billion and an awareness of the future trends in Global Change and its impacts on water resources can help decision-makers and stakeholders implement measures to avoid or minimise negative consequences.

Research in this area has a range of techniques, such as scenario analysis, modelling and cost-benefit analysis, but it tends to use just one of these techniques or limit itself to one domain of study, such as hydrology or water quality. The LIFE+ Water Change Project<sup>1</sup> aimed to integrate and link different methods and models in order to provide a user-friendly means to assess the impacts of Global Change and provide strategies to deal with them.

The first step in the project's methodology is the representation of the impacts of Global Change on resources, supply system and the end-users. This is done using the DPSIR (Driving forces, Pressures, State, Impacts, Responses) framework. The use of this framework provides a clear idea of the many links between initial drivers and final impacts. In a second step, a new tool developed in the project, called the Water Change Modelling System (WCMS), is used to link existing models and to develop Global Change scenarios. The tool has a Graphical User Interface, allowing users to execute and analyse simulation results of the possible Global Change scenarios.

The WCMS provides decision-makers with a long-term view of how supply and quality of water will be affected under different Global Change conditions. On this basis, different adaptation strategies are developed, consisting of alternative sets of measures and policies. Examples are: introduction of a desalination plant, greywater reuse and subsidies for efficient domestic water fixtures. The Water Change tool evaluates these using a cost-benefit analysis to assess economic and social aspects.

The project applied the tool to the case study of the Llobregat river basin in Catalonia, Spain. A set of 65 different Global Change scenarios were used and various adaptation strategies were developed. The results indicated that, the damages caused by the expected water shortages have considerable economic impact for most of the scenarios, so adaptation is in general desirable. Strategies that provide the desired water availability with the minimum cost, involved demand-side management, such as efficient water use.

In general the results highlight the difficulty of choosing one 'winning' adaptation strategy. The researchers suggest that it will depend on priorities in the area under consideration, for example, whether stakeholders want to minimise the damages of the drought or minimise the cost of intervention for an uncertain adaptation strategy. The tool is useful for river basin agencies and water companies to develop long-term water resource management plans that consider future changes in climate, land use and demand and take into account the goals of the users.

**Source:** Pouget, L., Escaler, I., Guiu, R., *et al.* (2012). Global change adaptation in water resources management: The Water Change project. *Science of the Total Environment*. 440:186-193. DOI: 10.1016/j.scitotenv.2012.07.036.

1. See: [www.life-waterchange.eu](http://www.life-waterchange.eu)

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Theme(s): Biotechnology, Environmental technologies, Waste, Water

# Bacterial remediation of groundwater depends on environmental conditions

New low cost methods using bacteria to remove toxic metals from groundwater have been investigated using both actual contaminated groundwater and artificially controlled systems. Environmental conditions, such as changing levels of acidity or alkalinity, can have a significant effect on the removal of toxins, results show.

*"It has been estimated that more than 60% of contaminated brownfield sites are polluted with hazardous metals, which can then leach into local groundwater, presenting serious health risks."*

**Contamination of soils** and groundwater with toxic metals, such as lead and zinc, is now a global concern. It has been estimated that more than 60% of contaminated brownfield sites are polluted with these hazardous metals, which can then leach into local groundwater, presenting serious health risks. Most current remediation methods for polluted groundwater are based on pumping the water through a treatment facility. However, this is costly and impractical if the contamination is spread over a wide area, and the volumes of groundwater are large.

In this study, partly conducted under the LIFE project INSIMEP<sup>1</sup>, researchers investigate low-cost *in situ* techniques which use bacteria to immobilise toxic metals and convert them into harmless solids (precipitates), which cannot dissolve into groundwater. These bacteria do not change the quantity of toxic metals, but can safely remove them from water.

One important aspect of the treatment is the stability of the precipitates produced by the bacteria under different environmental conditions. If stability is high, these metal compounds will not be able to revert to their former state, however, low stability could mean that toxic metals are able to dissolve back into the groundwater.

Researchers used two different systems, one artificially controlled and one natural, to examine the stability of precipitates. The artificially controlled system was a mix of sand, a source of carbon for bacterial growth, and water contaminated with specific concentrations of zinc. The natural system consisted of sediment and groundwater collected from three sites in Belgium that were known to be contaminated with both zinc and cobalt.

These solutions were then left for five to nine months, to allow the bacteria time to produce the precipitates. To examine the effect of environmental conditions on the stability of the precipitate compounds, researchers altered the pH of the solution to more or less acidic, and the availability of oxygen, both of which can affect the chemical reactions within the solution. In the natural system, the source of carbon for the bacteria, such as glycerol, soy oil or molasses, was also altered.

The results showed that stability of the precipitates was good regardless of the availability of oxygen. However, lowering the pH to 5 resulted in a significant loss of stability and resulted in 58% of zinc being released back into the groundwater. In natural systems, the source of carbon also had an effect on the stability of precipitates, however, this varied between contaminated sites. Researchers conclude that although such approaches are promising, bio-precipitation methods should be careful to take into account changing environmental conditions, such as pH, because this can substantially influence the outcome.

**Source:** Satyawali, Y., Schols, E., Van Roy, S., *et al.* (2010). Stability investigations of zinc and cobalt precipitates immobilized by *in situ* bioprecipitation (ISBP) process. *Journal of Hazardous Materials*. 181: 217–225.  
DOI: 10.1016/j.jhazmat.2010.04.119.

1. [http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.createPage&s\\_ref=LIFE05%20ENV/B/000517&area=2&yr=2005&n\\_proj\\_id=2857&cfid=136396&cfioken=cf08e43e2395bc26-9CFB8288-9935-7D83-D78CB23BDE269874&mode=print&menu=false](http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.createPage&s_ref=LIFE05%20ENV/B/000517&area=2&yr=2005&n_proj_id=2857&cfid=136396&cfioken=cf08e43e2395bc26-9CFB8288-9935-7D83-D78CB23BDE269874&mode=print&menu=false)

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Theme(s): Environmental technologies, Waste, Water

# New wastewater treatment technology to produce less sludge

*A major environmental challenge for wastewater treatment is the disposal of excess sludge produced during the process. The LIFE Perbiof project has been developing and testing a technology that will help to overcome this challenge. Results demonstrate it can perform highly effective treatment of municipal wastewater (removing 80% of the organic content) while producing low levels of sludge.*

*"Sludge production is increasing in Europe and so are the disposal costs, so its reduction is a priority."*

**Central to wastewater treatment** is the removal of organic matter occurring in the biological unit of the plant. This is usually performed by microbes (mainly bacteria) that degrade the organic matter under controlled conditions. However, this produces a sludge of the resulting biomass from the microbes (biological sludge) in addition to the sludge produced in the primary treatment unit (primary sludge). This sludge must undergo further treatment and disposal and can account for up to 60% of the operating costs of a wastewater treatment plant. Sludge production is increasing in Europe and so are the disposal costs, so its reduction is a priority.

The LIFE Perbiof project<sup>1</sup> has funded the continuing development of a new technology called the Sequencing Batch Biofilter Granular Reactor (SBBGR). SBBGR is a unique system because it allows the microbes to grow in the form of a mixture of biofilm and high-density granules which are packed in a plastic filling material in the reactor. This allows a longer retention and greater concentration of microbial biomass in the reactor, which means it does not have to be subjected to an additional clarifying process. As the sludge remains longer in the system, the production of biological sludge is reduced.

The technology has previously been tested at laboratory level, and the project went one step further to evaluate its effectiveness on a demonstration unit for treating municipal and tannery wastewater after primary treatment from the town of Bari in Italy. The plant operated on a succession of treatment cycles, each consisting of three consecutive phases: the wastewater was pumped into the reactor (filling phase) and circulated through the filling material of plastic pieces (reaction phase) before the effluent was discharged (drawing phase). For this study researchers varied the organic loading (a measure of the amount of organic matter) of the wastewater.

The results indicated that the SBBGR removed about 80% of the organic matter, (suspended solids and nitrogen content in the wastewater), regardless of the organic loading in the wastewater. In addition, organic content and suspended solids were removed in the first two hours of the cycle, so it is likely that the plant would be able to treat greater volumes of wastewater. The system also had a very low sludge production; only 0.12 to 0.14 kilogrammes of biomass for every kilogramme of organic content it removed.

The results of the project highlight the effectiveness of the SBBGR system for treating wastewater while producing a low amount of sludge and therefore lowering environmental impacts.

**Source:** Di Iaconi, C., De Sanctis, M., Rossetti, S., *et al.* (2010). SBBGR technology for minimizing excess sludge production in biological processes. *Water Research*. 44:1825-1832. DOI: 10.1016/j.watres.2009.12.007.

1. <http://www.perbiof-europe.com/> 7

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Theme(s): Sustainable consumption and production, Waste

# Better management of construction waste needed to improve recycling rates in Lisbon

*Management of waste from construction and demolition sites is a major concern, particularly in urban areas where large volumes of materials are generated. A recent study on the construction and demolition waste (CDW) produced in Lisbon, Portugal, suggests that improved municipal collection systems are needed to reduce the amount of waste ending up in landfill or illegal disposal sites.*

*“Improvement of the urban collection system, the promotion of recycling and encouragement of greater responsibility by all stakeholders are necessary to reduce the amount of construction and demolition waste ending up in landfill or in illegal sites.”*

**In Portugal**, new legislation specifically covering CDW came into force in 2008. Under this legislation a chain of responsibility involving all parties must be established to ensure the waste produced is properly managed. The legislation includes planning and management measures to reduce the amount of CDW generated, to separate at source, and to recycle and reuse this waste.

In this study, conducted under the LIFE project, REAGIR – Recycling and re-use of CDW as a part of Integrated Waste Management<sup>1</sup>, the researchers estimated the amount of CDW produced in the Lisbon Metropolitan Area (LMA), Portugal, for the years 2006 and 2007, before implementation of the new legislation. Knowing the amount, type, source and destination of CDW in the LMA provides a basis for managing CDW in a more sustainable way.

The amount of CDW produced in the LMA was estimated from information on the construction of new buildings and the remodelling of existing buildings, but excluded soil waste from excavations. Remodelling includes the expansion, alteration, rebuilding and demolition of existing properties. Calculations of the overall volumes of CDW produced were based on the surface area of completed projects, removal of CDW by collection and transportation firms and dumping at illegal sites, which can pose a risk to the local environment and people living nearby.

Results reveal that in the LMA as a whole, about 90% of construction work in 2006-2007 consisted of new buildings and nearly 10% was remodelling work. In contrast, in one of the municipalities in the LMA, the municipality of Lisbon, 17% of work was new construction and 83% was remodelling. During these two years, collection and transport companies in the LMA were estimated to have moved around 3456 tons (t) of CDW a day, with about 60% of the CDW handled by these companies coming from remodelling jobs. In addition, nearly 81 t/day of CDW from remodelling jobs were collected by municipalities and about 28 t/day of CDW were also voluntarily delivered to eco-recycling centres.

For the municipality of Lisbon, CDW waste generated in 2007 was about 40% higher than CDW estimates in 1997. Nevertheless, over the decade, the composition of the CDW waste did not change much, consisting mainly of concrete, bricks, tiles, wood, glass, plastics, iron and steel.

The destination of only approximately 32% of the CDW produced in the LMA could be identified. Of the remainder, about 5% is reused in recycled aggregates for building, and about 79% of the CDW collected is disposed of in landfill. Despite treatment, disposal and landfill facilities being located within 23 km from the centre of Lisbon, it appears that the Lisbon municipal collection system, in particular, is inadequate to deal with the volumes of CDW generated and some of the waste is dumped in illegal sites. Improvement of the urban collection system, the promotion of recycling and encouragement of greater responsibility by all stakeholders are necessary to reduce the amount of CDW ending up in landfill or in illegal sites.

**Source:** De Melo, A. B., Gonçalves, A.F. & Martins, I. M. (2011). Construction and demolition waste generation and management in Lisbon (Portugal). *Resources, Conservation and Recycling*, 55: 1252-1264. Doi:10.1016/j.resconrec.2011.06.010.

1. [http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n\\_proj\\_id=2345&docType=pdf](http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=2345&docType=pdf)

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 Theme(s): Sustainable consumption and production

# Environmental benefits of textile-reinforced concrete demonstrated

*A new concrete-reinforcement system, used by the LIFE INSU-SHELL<sup>1</sup> project, replaces steel rods with non-corrosive textile structures to reduce the amount of concrete needed in construction. This nearly halves the global warming potential of traditional steel-reinforced concrete which is the largest producer of CO<sub>2</sub> emissions in the building industry.*

*“Transport costs for INSU-SHELL are about a third of the costs for traditional concrete as it weighs much less.”*

**The good mechanical properties** and low cost of concrete have made it the world’s most popular building material. However, although it can bear high pressure, it does not perform well at resisting ‘tensile’ forces; the vertical forces that tend to tear apart or split materials. As such, concrete requires reinforcement, which traditionally uses steel rods. In order to avoid corrosion of these steel rods, a minimal concrete layer of 3.5 cm is needed. This is not required from a structural point of view but to protect the steel.

However, the use of textile reinforcement made from non-corrosive materials, such as carbon and glass can reduce the required concrete material by up to 85%. This is known as Textile Reinforced Concrete (TRC).

Sandwich panels are a composite structure in which two stiff outer sheets are bonded to a lightweight core and are used in industrial and multi-storey buildings. The technology of sandwich panels made of TRC has been applied in laboratory research, but the INSU-SHELL project was one of the first to use it in a large-scale building project in Aachen, Germany. Using data collected from this project, the study assessed the structural, environmental and economic performance of TRC.

The panels were made of concrete reinforced with glass textiles and fixed to a rigid polyurethane foam core inside the ‘sandwich’. The heat transfer was at a level far below the critical value of current regulations and the panels exceeded the demanded design values in terms of capacity to bear horizontal loads and tensile forces.

Using life cycle analysis, the study compared the global warming potential of the INSU-SHELL TRC sandwich panel to traditional steel-reinforced concrete panel. To make a fair comparison, the study compared TRC to a traditional wall panel with the same bearing capacity and heat transition per m<sup>2</sup> façade.

The INSU-SHELL façade weighs about 17% of the conventional façade and its energy consumption during production is just over 1000 MJ (megajoules) per m<sup>2</sup>, which is just over half (54%) the energy consumption of traditional concrete design. In terms of environmental impact, the global warming potential of the INSU-SHELL façade is 69.34 kg of CO<sub>2</sub> equivalent per m<sup>2</sup> which is 47% of the global warming potential of its traditional counterpart.

The study estimated that the INSU-SHELL panel would cost €487.5 for 3 m<sup>2</sup>, over twice as much as traditional concrete, which would cost €208.32 for the same amount. However, this high value is because this method of concrete reinforcement is in an early, prototype stage of its development. Once the production has been optimised, with standardised elements for mass production, the costs should fall. It should also be noted transport costs for INSU-SHELL are about a third of the costs for traditional concrete as it weighs much less. As future developments occur, such as vacuum insulation panels, the INSU-SHELL prototype has the potential to make even more financial and environmental savings.

**Source:** Tomoscheit, S., Gries, T., Horstmann, M. *et al.* (2011). Project Life INSUSHELL: Reducing the Carbon Footprint in Concrete Construction. *SUSB Journal* 2(2): 162-169. DOI: 10.5390/SUSB.2011.2.2.162.

1. [www.life-insushell.de](http://www.life-insushell.de)

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Theme(s): Biodiversity, Forests

# Boreal forests may benefit from controlled fires, depending on forest management

*Controlled fires could help the regeneration capacity of some insects in regions of intensively managed forests, according to a recent study of Finnish forests that are part of an EU LIFE restoration project. Results indicated that fire can be an effective conservation measure but its impact depends on the region's history and context.*

*“Natural forests and the species that inhabit them are disappearing at high rates in many parts of the world.”*

**Natural forests** and the species that inhabit them are disappearing at high rates in many parts of the world. Often forests that are intensively managed for timber production have little variation in the age or type of trees and there is little in the way of fallen trees and debris to provide habitat. However, management also suppresses natural disturbances in forests such as fire, which influence the availability of habitat for some species. The controlled re-introduction of fire in forests can have profound effects on the pattern of species, encouraging those that are rare and prefer recently burned areas to re-colonise in places where they had been dwindling or non-existent.

The study was carried out in nine coniferous forests sites in southern Finland that were part of the EU LIFE project Restoration of Boreal Forests and Forest-covered Mires<sup>1</sup>. The forests consisted mainly of the tree *Pinus sylvestris* and were located in two distinct regions: the western region where intensive forestry has prevailed for several centuries and the eastern region, which had a shorter management history (about 60 years).

At each site a single stand (group of similar trees) was burned and the number and range of forest insects (beetles and flatbugs) were sampled. The study focused on insect species that were pyrophilous (i.e. grow or thrive in recently burned areas) and red-listed species (i.e. those identified as rare). Sites were not sampled before burning because previous research by the authors in 2006 has shown that intensively managed Finnish boreal forests that lack deadwood and fire-scarred trees contain no rare or pyrophilous species.

Altogether 956 individual insects were sampled that belonged to 29 pyrophilous or red-listed species. A total of 17 species were pyrophilous and 21 species were red-listed, meaning 9 were both pyrophilous and red-listed. A total of 12 species were red-listed - but not pyrophilous - and these were species that prefer habitats with deadwood that is often provided by burning. All species colonised the burned sites quickly but there was a clear difference in the species richness (or range of species) between the east and west regions. The eastern forests harboured a greater number of species with an average of 13.7 species per site, whereas the western forests harboured only 5 species per site. This was also reflected in the different species groups, where eastern sites harboured on average 9.7 pyrophilous species and 8.7 red-listed species whilst western sites harboured on average 3.8 pyrophilous species and 2.3 red-listed species.

This indicates that restoration using controlled fire is less effective in forests with a longer history of intensive management. This may be due to the far-reaching changes to the ecosystems caused by a lengthy duration of intensive management. The effect of controlled fire on non pyrophilous species is likely to be due to the presence of deadwood left after burning. However, if the forest management strategy leaves a substantial amount of deadwood, then the benefit of controlled fire to these species may not be so great. There was some debate as to the origin of the colonisers. It is almost impossible to show exactly where they came from, but the study suggests a major source area is likely to be the eastern part of Finland or Russia. This could be a reason why the eastern sites harboured more species. The difference between the two regions has implications for successful restoration, which must take into account the ecological history of the landscape and possibly the proximity of areas harbouring the species. The researchers point out that more work needs to be done, focusing on a broader range of species and covering longer time spans.

**Source:** Kouki, J., Hyvärinen, E., Lappalainen, H. *et al.* (2012). Landscape context affects the success of habitat restoration: large-scale colonisation patterns of saproxylic and fire-associated species in boreal forests. *Diversity and Distributions*. 18:348-355. DOI: 10.1111/j.1472-4642.2011.00839.x.

1. See: <http://www.metsa.fi/SIVUSTOT/METSAIEN/PROJECTS/LIFENATUREPROJECTS/FORESTLIFE/Sivut/RestorationofBorealForestsandForestcoveredMiresForestLife112200231122007.aspx>

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 Theme(s): Agriculture

# The quality of sheep grazing is not reduced by upland bog restoration

*Restoration of upland bog habitats by blocking drainage channels has caused concern among some sheep farmers that this will reduce the quality of grazing areas. However, UK researchers have shown that drainage does not encourage growth of plants favoured by sheep, nor do sheep use drained areas more. Therefore they conclude such restoration measures are unlikely to detrimentally affect sheep grazing.*

*“Upland blanket bogs are important for clean water supplies, carbon storage and biodiversity protection and have been recognised as in need of protection by the EU Habitats Directive.”*

**Upland blanket bogs** are important for clean water supplies, carbon storage and biodiversity protection and have been recognised as in need of protection by the EU Habitats Directive<sup>1</sup>. In the UK, which contains around 13% of the world's blanket bog peat, such habitats have been extensively drained in order to improve grazing for livestock, a process that damages bog vegetation. However, there have been very few studies into whether such drainage practices actually do provide improved grazing.

In this study, conducted under the LIFE Active Blanket Bogs in Wales project<sup>2</sup>, researchers examined a case study of an upland bog in Wales which has been drained in the past but is now undergoing restoration involving blocking drainage ditches. The researchers investigated two main factors: whether drainage ditches increased sheep's use of these wetter areas, and whether the presence of ditches increased the amount of grasses preferred by sheep.

Five sites were chosen within the area, totalling 4,743 hectares. At each site researchers laid out 30 transects, 15 of which spanned drainage ditches and the remaining 15 were at least 20 m from ditches. Ten 1 m<sup>2</sup> plots spaced along these transects were examined for evidence of sheep grazing and the percentage cover of different species of plants was also recorded.

The results demonstrated that the percentage cover of plants preferred by sheep did not differ between plots, regardless of how near they were to a drainage ditch. Furthermore, sheep tended to prefer areas without drainage ditches. The researchers stress that there are limitations to this study, for example, the measure of sheep grazing preferences was very basic and more in-depth behavioural studies would be beneficial. However, these results indicate that the value of blanket bogs as grazing areas is not significantly improved by drainage.

There is an urgent need to address landowners' and farmers' concerns regarding blocking drainage channels in upland bogs, since this is the main tool for restoring these valuable habitats. This study provides some reassurance that drainage ditches have not substantially made bog habitats more favourable for grazing sheep and therefore there will be no damaging effects if they are blocked. The researchers also go further to discuss the possibility that blocking ditches may have a positive effect, by reducing erosion of such ditches into deep gullies in which livestock can become trapped.

**Source:** Wilson, L., Wilson, J. M. & Johnstone, I. (2011). The effect of blanket bog drainage on habitat condition and on sheep grazing, evidence from a Welsh upland bog. *Biological Conservation*. 144: 193–201. DOI: 10.1016/j.biocon.2010.08.015.

1. <http://ec.europa.eu/environment/nature/legislation/habitatsdirective/>  
 2. <http://www.blanketbogswales.org/>

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# The value of seed harboured in Mediterranean temporary ponds

*Temporary ponds and their varying water levels provide the conditions for valuable wildlife habitat. A study in Crete, conducted under the LIFE-Nature project<sup>1</sup> Actions for the Conservation of Mediterranean Temporary Ponds in Crete, has demonstrated these ponds contain varied collections of seeds and that these 'seed banks' could play an important role in vegetation recovery after droughts.*

*"...temporary ponds often shelter rare species. However, this role of temporary ponds can be neglected and bad management practices, such as soil extraction, land drainage or over-grazing, can damage these vulnerable habitats."*

**In order for plants to survive** the alternation of flooding and drying out, they create a soil seed bank so seeds can germinate when conditions become favourable. Conservation of a healthy diversity of plants relies on this strategy and temporary ponds often shelter rare species. However, this role of temporary ponds can be neglected and bad management practices, such as soil extraction, land drainage or over-grazing, can damage these vulnerable habitats. These impacts can be made worse by climate change, particularly in the Mediterranean area.

This project, Actions for the Conservation of Mediterranean Temporary Ponds in Crete<sup>2</sup>, aimed to establish a deeper understanding of the potential for temporary ponds to maintain biodiversity. It studied several areas in Crete which included Omalos and Elafonisos, both which are within the boundaries of Natura 2000<sup>3</sup> sites. Soil cores were collected from a large pond in Omalos and four smaller ponds in Elafonisos at regular intervals. Soils were spread on seedling trays in a greenhouse and emerged seedlings were identified. The study also recorded the species of the standing vegetation in the ponds.

There was a high density of seeds in both sites: on average 75,662 seeds per m<sup>2</sup> were found in Omalos and 22,941 seeds per m<sup>2</sup> were found in Elafonisos. Both sites had a similar level of species richness, i.e. a large diversity of species, but there was a difference in the species composition. The seeds in the Omalos pond were dominated (73%) by species that grow in water or moist conditions (hydrophytes), whereas virtually all the seeds in the Elafonisos pond (99%) were from plants with seeds that have the ability to overwinter (therophytes). In general, there was a low number of perennials (plants that live for more than one year).

There was also a significant difference in the species found in the soil seed bank and the standing vegetation. A large percentage of seeds recorded in the seed bank were absent from the vegetation and vice versa. A total of 22% and 45% of species, sheltered in the seed bank of the ponds in Omalos and Elafonisos respectively, were not present in standing vegetation. Half of these species were plants that survived for one year only or dwarf shrubs. In contrast, perennials tended to dominate the vegetation. This indicates that the ponds' soil seed banks harbour a different range of species that cannot be supported by the standing vegetation.

Approximately 60% of the species found in the temporary pond seed banks were classified as rare. For example, the Omalos seed bank hosted three species identified as priority species under the Habitats Directive. The Elafonisos ponds provided habitat for the *Crepis pusilla* communities that have recently been included in the Habitats Directive.

The study demonstrated that both sites housed large seed banks that can serve as a reservoir of plant diversity. As such, activities that change the structure or water conditions of these temporary ponds should be avoided and measures taken to protect these valuable seed banks.

**Source:** Aponte, C., Kazakis, G., Ghosn, D. *et al.* (2010) Characteristics of the soil seed bank in Mediterranean temporary ponds and its role in ecosystem dynamics. *Wetlands Ecological Management*. 18:243-253. DOI: 10.1007/s11273-009-9163-5

1. [http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n\\_proj\\_id=2674](http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=2674)
2. See [http://www.life-medponds.gr/EN/index\\_en.htm](http://www.life-medponds.gr/EN/index_en.htm)
3. <http://www.natura.org>

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# Litter size of European mink less than half that of invasive American mink

*The litter size of the endangered European mink is less than half of that of its main competitor, the invasive American mink, research shows. The higher fertility of the American mink may allow rapid population growth of this species, threatening European mink with extinction.*

*“...high rates of reproduction in American mink are likely to result in rapid population growth. This can have detrimental effects on European mink through increasing competition, or transmission of diseases.”*

**Populations of European mink** have declined dramatically over the last century and only three populations remain: one in northern Spain and south western France, one in Romania, and a larger one in Russia and Belarus. American mink, which originally escaped from fur farms in Europe, are thought to play a large part in this decline mostly because of competition for resources.

In this study, partly conducted under the LIFE GERVE project<sup>1</sup> in western and south-western France and Navarra, Spain, researchers measured the embryonic litter size of both European and American mink, to provide vital information to understand population growth rates.

Measuring the litter size of such elusive species is not easy because it is almost impossible to gather data by observing them in the wild. Researchers therefore used dead specimens of free-ranging European and American mink which had been collected by volunteers. The 21 European mink had generally been killed by road collisions, whereas the majority of the 100 American mink used were trapped as part of invasive species control measures.

Once the specimens had been collected, they were dissected and, for each one, the uterus was removed and stained. This staining technique aids the counting of placental scars from the year's breeding season, formed each time a pup is implanted/carried. In cases where females were still pregnant when they died, researchers counted the number of embryos as a record of litter size.

To test the reliability of this technique, the researchers had previously studied 49 American females taken from fur farms in south-western France. By using farmed animals, the researchers were able to access farmers' records of the litter sizes of the females and check this against the staining results. The staining method was proven to be reliable, as long as the specimens were dissected no longer than seven months after giving birth.

The results showed that the average litter size of European mink was 3.4 pups; however, the American mink had an average litter size of 7.5. Such high rates of reproduction in American mink are likely to result in rapid population growth. This can have detrimental effects on European mink through increasing competition, or transmission of diseases. The researchers conclude that this study highlights the urgent need for effective control of American mink, especially within the European mink habitat range.

**Source:** Fournier-Chambrillon, C., Bifolchi, A., Mazzola-Rossi, E., *et al.* (2010). Reliability of stained placental scar counts in farmed American mink and application to free-ranging mustelids. *Journal of Mammalogy*. 91(4):818–826. DOI:10.1644/09-MAMM-A-297.1.

1. [http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n\\_proj\\_id=2925&docType=pdf](http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=2925&docType=pdf)

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# Translocation for conservation: helping or harming wild populations?

*The value of moving animals or plants from a stable population into one that is endangered or even extinct has been questioned, with some suggesting that it will mean that the new population is not well adapted to its environment. However, research on an endangered toad has shown that even when individuals were translocated from great distances, the population was able to genetically adapt to local conditions within a few generations.*

*"The European fire-bellied toad is a critically endangered amphibian inhabiting the agricultural landscape surrounding the Baltic Sea."*

**The European fire-bellied toad** is a critically endangered amphibian inhabiting the agricultural landscape surrounding the Baltic Sea. Translocation has been used as a conservation tool to support some of its smaller endangered populations. However, there is concern that individuals not genetically adapted to their new environment will pass on their maladapted genes.

In this study, partly conducted under the LIFE-Bombina project, researchers examined the genetics of two populations (Stodthagen and Höggsdorf) in Schleswig-Holstein, the northernmost state of Germany. Both populations were thought to be supplemented using individuals from local populations; Stodthagen in 2004 under the LIFE-Bombina project, and Höggsdorf in 2001 under a private initiative. The researchers took saliva or toe clipping samples of 18 individuals in Stodthagen and 30 in Höggsdorf.

The researchers then examined the genetics in two different ways. Firstly, they looked at DNA which was associated with the function of the immune system and therefore likely to be extremely important for adaptation to local pathogens. Secondly, they examined 'neutral' DNA, which does not affect the animal or its adaptation to the environment, and therefore can be used to trace its ancestral origins.

The results demonstrated that the genetics of the Stodthagen population was as expected; because it was founded using individuals from nearby populations, the toads had very similar genes to those in the local area. However, using the neutral DNA to trace the origins of the Höggsdorf population, researchers showed that many individuals used to found the population had not been local, and in fact, were almost certainly from Austria, many hundreds of miles away.

The authors speculate that this may have been the result of illegal releases, either at the Höggsdorf site or in other populations which were used to supply individuals for the translocation project. However, a particularly important result was shown when they examined the immune system DNA of Höggsdorf individuals. Despite the likely Austrian ancestors, their immune genes resembled the local populations much more closely than those in Austria.

This suggests that because of the strong advantages of local adaptation, individuals with locally-adapted genes were more likely to survive, and therefore the population overall maintained a good level of local adaptation. This implies that translocations may not actually be a threat to populations; however, researchers do caution that to ensure success, translocated individuals should always be in the minority within the local area.

**Source:** Schröder, C., Pokorny, I., Dolgener, N., *et al.* (2012). Allochthonous individuals in managed populations of the fire-bellied toad *Bombina orientalis*: Genetic detection and conservation implications. *Limnologia*. 42: 291-298. DOI:10.1016/j.limno.2012.08.008

