Seventh Framework Programme
Theme 6
Environment (including Climate Change)

Collaborative project

Deliverable D6.5

Public relation events at LTO sampling sites

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Overview

The dissemination of EcoFINDERS and relations to the public were approached in several different ways such as press releases, publicly available folders and appearances in the electronic media. One of the most important ways of communication was, however, public events at the Long Term Observatories (LTOs) at sampling events, where EcoFINDERS partners were gathered at the LTO and working in the field on sampling of soil, fauna and microorganisms and testing the soil for water infiltration. Two such events have taken place during the EcoFINDERS project and at such occasions the press and media persons as well as general public were present and participated to various degrees. In the present deliverable events taking place at the different LTOs at sampling events and at other times are reported as well as other broad reaching event are reported.

The Sardinian team (UNITO) has gained experience in the development of a framework to build up conductive science-policy interface and stakeholder involvement (see special issue on *Environ. Sci. Policy*, 2007, 10). The Berchidda LTO site is located in private farms and a number of farmers have already been directly involved in the ongoing SoilSink Italian project. Furthermore, an international “green” Jazz festival is scheduled every year in Berchidda town, which is attended by thousands of people and is developing environmental topics every year. In 2011 the topic was earth and soil. The local research team UNISS organized a jazz festival, activities for both children and adults and poster presentations in conjunction with a soil sampling event.

SLU at the LTO Lamborn organized a stakeholder symposium in Uppsala November 2014 entitled “New research on nitrogen, forest management, biodiversity and mycorrhizae” with attendance of 22 persons from the Swedish forest industry, farmer organizations, consultants, and extension services as well as researchers.

At the satellite LTO at Teagasc, Ireland, the partners published two popular papers in the in-house journal T-Research. T-Research is widely circulated amongst universities, colleges, SMEs and farmers and has in this way attracted attention to EcoFINDERS.

At the Atlantic LTO site, ACBB Lusignan, INRA organized a public event at the sampling occasion in October 2012. This event involved a wider audience, and the press, during field experiments and sampling at the site. Both written and electronic media were present and partners were interviewed in the French TV and radio in addition to several newspaper articles.

The present deliverable reports in detail how the four public events and a few more at other sites took place.

Introduction

Raising general public awareness of living soil and the EcoFINDERS project in order to increase the awareness of soil biodiversity, functioning and the importance of maintaining the ecosystem services of soil through sustainable use of soil is one of the most important dissemination aspects of EcoFINDERS. One strategy to do this in EcoFINDERS has been to organize public events at the LTO sites during sampling and at other relevant times. At such events, the local and national press were approached and interested general public were invited to the site with different activities. By these events the major objective was to communicate the results to the general public to enlighten and to raise awareness of the significance of biodiversity.

The identifications of LTOs were made already in the project proposal and after the start of the project the sampling intensity of the LTOs were modified and other LTOs were taken into the project. The dissemination activities at the LTOs by the national partners were dependent on the sampling events with attendance of many EcoFINDERS partners. Hence events only took place at two of the planned LTOs.

The events at the LTOs are additionally very dependent on the national partner and the awareness and interest from the local general public and press.

In addition to the events at the LTOs at Berchidda, Sardinia, Italy and Lusignan, France a seminar for stakeholders was held at the LTO Lamborn, SLU, Sweden and IMAR in Portugal organized together with a local school teaching and instructions for school kids. Finally, Teagasc, Ireland published two public articles in a local magazine for stakeholders on EcoFINDERS objectives and results while AU, Denmark presented EcoFINDERS at a conference in Sweden called Summer of Soil.

1. Public Event at LTO Berchidda, Sardinia, Italy

Coordinated by Pier Paolo Roggero, UNISS, and organized by Pier Paolo Roggero, UNISS; Simonetta Baggella, UNISS; Giovanna Seddaiu, UNISS; Mariangela Girlanda, UNITO

1.1. General objective

- to raise the public awareness and understanding on soil biodiversity and its functions and on the importance of maintaining the ecosystem services of soil through sustainable use

1.2. Specific objectives

- to explore and evaluate the role of scientific knowledge and its integration with artistic events to support social learning processes aiming to enhance the sustainable soil use
- to explore and evaluate new integrative modalities for connecting researchers and the wide public around soil biodiversity issues for supporting the implementation of policies to protect the soil biodiversity
- to evaluate the public perceptions on the soil biodiversity issues
- to generate curiosity in the wide public on the soil biodiversity issues
- to let the local community become aware of the research results from the Berchidda LTO

1.3. Research approach

The research approach is grounded on a framework developed to build up conducive science-policy interfaces and stakeholder involvement and it is based on social learning theories (see special issue on Environ. Sci. Policy, 2007, 10). Some researchers of the Sardinian team (UNISS) have gained experience on this topic through participating to a EU-FP5 project on social learning for the integrated and sustainable use of water at catchment scale (SLIM project, http://slim.open.uk/). In particular, the researchers analysed the potential of different tools to combine social learning with agri-ecological research practice for managing complex agri-environmental issues such as nitrate pollution (Toderi et al., 2007). Briefly, the main concepts that shaped the activities planned within WP6 are:

- In doing what each person does, he/she acts out of a particular tradition of understanding. Therefore, the change in a practice follows a change in understanding that it is associated to a learning process (es.: Russel and Ison, 2000; Steyaert and Jiggins, 2007).
- The capability to distinguish (and thus to interpret) offers new behavioral options between desirable and no desirable ones (Ison et al., 2007).
- The language matters. “We human beings exist in language, and as we language we can say nothing outside language” (Maturana, 1995; http://www.inteco.cl/biology/nature.htm). If something could not be expressed with the language, it is not perceived and it is not taken into account. The language that

one uses to express something makes the difference on what "one does with (on/for) it".

- Learning is facilitated by feeling emotions. In fact, "human beings are essentially made of emotions", thus breaking the paradigm that humans are intimately rational (Biology of Love and Biology of knowledge theories by Maturana). For example, these concepts informed the development of a theatre event organized by researchers from UNISS that aimed to emotionally engage the local community in a learning process around the complexity of the relationships between farming, society and nitrate water pollution (Toderi et al., 2007).

1.4. Activities

In the Berchidda LTO site, an international "green" Jazz festival (www.timeinjazz.it) is organized every year since 25 years, which is attended by thousands of people from every Region of Italy and also from abroad. The Festival develops environmental topics every year and in 2011 the topic was "Terra" ("earth" but also"soil" "land" or "ground" in Italian). The local research team was in contact with the festival organisation and developed a communication strategy along the festival for the Ecofinders project. Four main events/activities were carried out:

1) An Ecofinders' stand was opened every evening of the Festival in Berchidda town where posters were displayed and brochures and leaflets on soil biodiversity issues were delivered. The main objective was to communicate the Ecofinders activities and the main research outcomes to the local community and to the public.
2) A questionnaire was proposed to the visitors of the Ecofinders' stand to evaluate the public perceptions on the soil biodiversity issues. About 170 questionnaires were collected.
3) A mini-laboratory for children entitled "Tutti giù per terra!"[1] was organized at the public library in Berchidda every afternoon during the Festival (see the attached mini-lab flyer). A total of 45 children participated to the activities of which some 20 involved every day. The laboratory lasted six days and every day a different theme related to soil biodiversity was developed focussing on "plants", "insects", "microorganisms". A field survey was also organized in order to give the children the opportunity to experiencing the "soil life" directly in the field and to collect plants, insects and soil samples to be then analysed and to "play with" in the laboratory. The activities in the laboratory were planned and managed by researchers from different disciplines (agronomists, entomologists, botanists, microbiologists, sociologists) and by a group of theatre artists of the company "La Botte e il Cilindro" (www.bottecilindro.it) skilled on children educational activities. The children were involved in a learning exercise where the scientific knowledge was transformed into languages, suitable for children to be understood and analysed in order to create

[1] This is a metaphoric sentence since it means "everybody sit down" and it is part of a famous Italian song for children ("Turn, Turn around, the World is falling down, the earth is falling down, everybody sit down!" In Italian: "*Giro Girotondo, casa il mondo, casca la Terra, Tutti giù per Terra*!").

the opportunity to reflect and *learn by doing* (children were asked to play, to touch, to smell, to hear, to discover with soil and with some elements of the soil biodiversity).

4) The EcoFINDERS coordinator and the Berchidda LTO leader presented the main issues of the EcoFINDERS project before the final concert performed by the main jazz musician, Paolo Fresu, entitled “Zappa” (i.e., hoe). The speech was attended by some hundreds of people in a unique scenario in a vineyard.

The dissemination activities during the Festival were joined by the EcoFINDERS coordinator Philippe Lemanceau, Mariangela Girlanda (UNITO) and the UNISS staff. A snapshot of the activities is reported in the photos included at the end of this report. The original song “*La terra ha mille nomi*” (Earth has one thousand names) was also created by two local artists (text by Franco Castia; music by Mario Chessa) for this special occasion.

1.5. Assessment

The results of the questionnaire are being processed by clustering the answers to the open questions and identifying the variety and frequency of perspectives on soil biodiversity.

The laboratory was structured to make an ex-ante assessment through the creative drawings and hand crafts make by children in the first day of the laboratory. The ex-post assessment (which is in progress) was also designed to emerge from the children hand crafts and statements (written and oral) and from the minutes of the debriefings made collectively by artists and researchers soon after the laboratory. These revealed the main changes in understanding of the children that were actively involved in the laboratory activities.

The assessment outcomes and the whole project will be the subject of a paper on the public perception of biodiversity.

1.6. Ecofinders@Time in Jazz

One group of children sampling soil in the Berchidda LTO

Children at work in the “Tutti giù per terra” minilab.

Children joining soil respiration measurements during the field survey of the minilab “Tutti giù per terra”. The title of the lab has a double meaning: it is the last sentence of the “ring-a-ring-a-roses” game but can be also interpreted as “everyone for earth”.

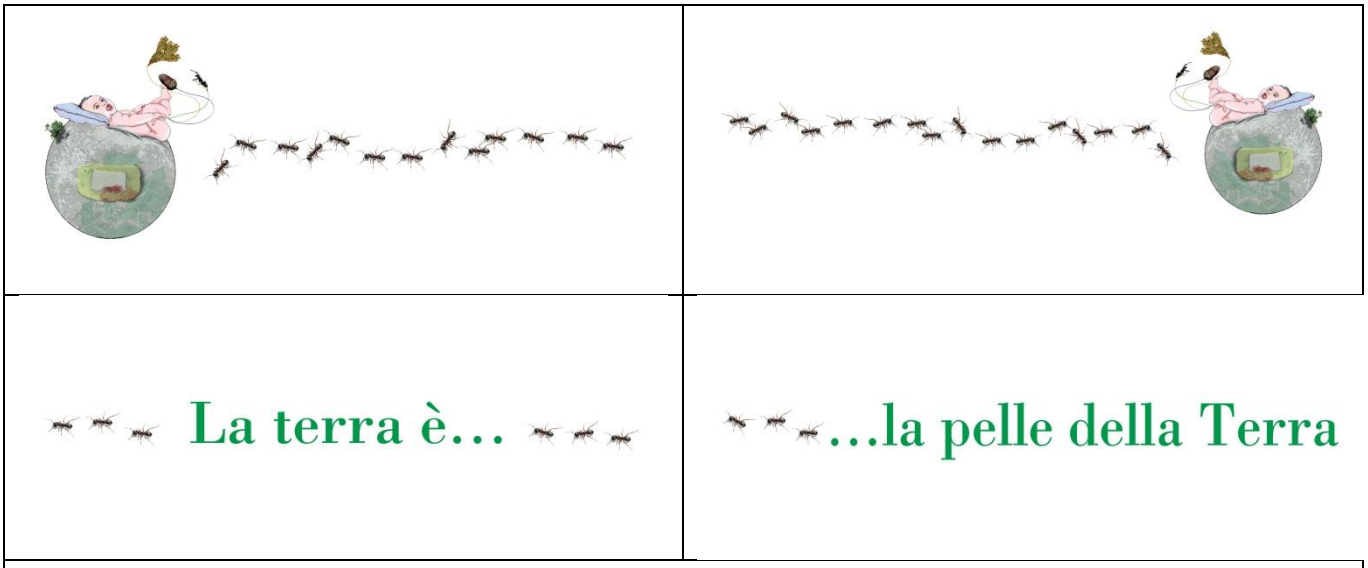
Insects lab at the microscope, managed by Marcello Verdinelli (CNR-ISE Sassari)

The minilab products made by the participant children were “published” in the show area beside the concert stage, which was located just in front of the Lab.

Public filling questionnaires at the EcoFINDERS stand during the concert interval. Some bottles of Vermentino, a local DOCG white wine, were drawn the last evening as prize for the participants.

Mariangela Girlanda, Philippe Lemanceau and Pier Paolo Roggero on the “stage” speaking before the final concert

The venue of the final concert “Zappa”. The concert name has a double meaning in Italian: hoe (three hoers were hoeing during the concert) and the surname of the famous pop star Frank Zappa.



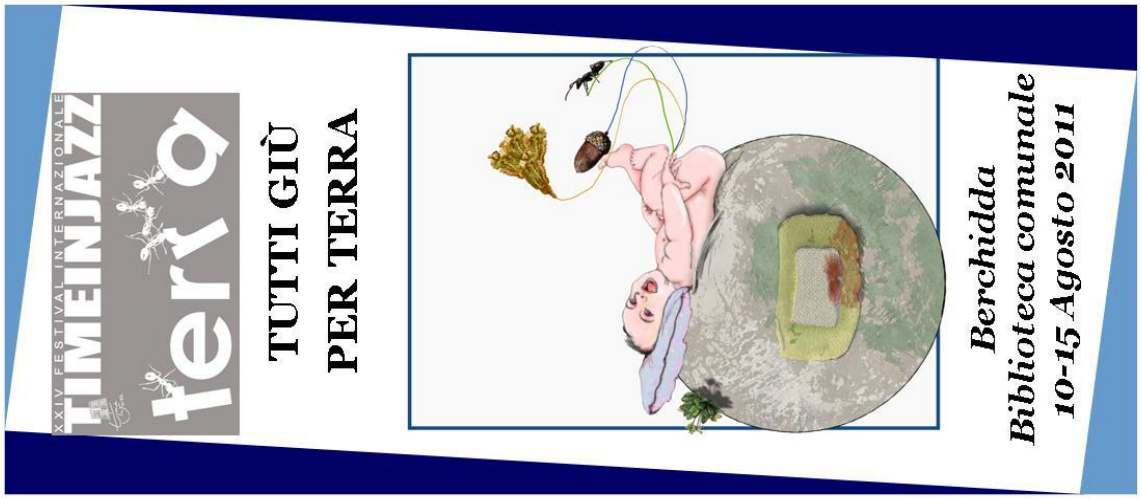
The 1,00 x 2,40 m Banners displayed outside the Lab. “Soil is… … the earth skin”. The Lab logo was designed by the scenographer Francesco Calcagnini

The little EcoFINDERS wore a T-shirt with the Lab and Ecofinders logo

The cover of the Time in Jazz tabloid distributed during the concert

The article published on the Time in Jazz tabloid that was distributed to the public.

1.7. Flyers distributed to the public during the Time in Jazz Festival



Terra, suolo, terreno, non ci pensi ma...

Il suolo è un ecosistema molto complesso che ospita una grande diversità di organismi viventi: batteri, protozoi, archea, nematodi, funghi, insetti, micro-mammiferi ecc. In 1 grammo di suolo si possono trovare molti miliardi di batteri e funghi di oltre 100 specie diverse e un piccolo volume di suolo può contenere diverse centinaia di specie animali (protozoi, nematodi, insetti e lombrichi). La loro presenza e diversità genetica ne influenza direttamente le fondamentali funzioni ecologiche, tanto che vengono considerati indicatori della qualità e dello stato di salute del suolo.

Gli organismi del suolo svolgono una serie di "servizi ecologici" essenziali per la vita sulla terra: controllano i cicli biogeochimici, regolano il bilancio idrico, conferiscono la struttura fisica necessaria per la vita delle piante e influiscono sulla biodiversità presente in superficie. Ancora oggi, solo una piccola porzione di ciò che vive nel suolo è nota e ben caratterizzata.

EcoFINDERS@TimeinJazz

Il tema ***"Terra"*** dell'edizione 2011 di Time in Jazz ha obiettivi convergenti con quelli del progetto "EcoFINDERS" (*Ecological Function and biodiversity INDicators in EuRopean Soils* www.ecofinders.eu).

EcoFINDERS è finanziato dal VII Programma quadro dell'Unione Europea, coinvolge 22 enti di ricerca e università europee e una cinese per lo studio del ruolo della biodiversità del suolo sul funzionamento degli ecosistemi agrari e forestali.

La sensibilità ambientale degli artisti di Time in Jazz e l'esigenza dei ricercatori di EcoFINDERS di creare nuovi spazi di apprendimento ha permesso di sviluppare questo progetto di integrazione tra scienza, arte e teatro, in collaborazione con la compagnia teatrale La Bote e il Cilindro di Sassari.

Il programma offrirà al pubblico numerosi spunti di riflessione sul ruolo della biodiversità del suolo.

Tutti giù per terra!

10 agosto
17.30-19.30 TUTTI GIÙ PER TERRA! - Introduzione e istruzioni per l'uso...

11 agosto
17.00-20.00 IN CAMPO! - Gli EcoFINDERS esplorano i misteri della biodiversità del suolo

12 agosto
17.30-19.30
IN-SETTI! - Lab di entomologia

13 agosto
17.30-19.30
PIANTA-LA! Lab di Botanica

14 agosto
17.30-19.30
BIO-DIVERSO o BIO-CONFUSO? Lab "Mondo invisibile"

15 agosto 17,30-19,30
TUTTI GIU' PER TERRA! - Conclusioni e pubblicazione dei risultati dei Lab

Iscrizioni riservate a EcoFINDERS dai 6 agli 11 anni presso lo stand EcoFINDERS davanti alla biblioteca comunale di Berchidda aperto dal 10 al 15 agosto 17,30-19,30.

Info: ecofinders@uniss.it

EcoFINDERS – FP7-ENV-2010-264465

EcoFINDERS è coordinato da Philippe Lemanceau, dall'INRA (www.inra.dijon.fr) e unisce 23 partner di 10 paesi europei ed 1 extraeuropeo (Cina).
Referenti scientifici italiani:
Paola Bonfante, Mariangela Girlanda e Valeria Bianciotto, Dipartimento di Biologia Vegetale, Università di Torino.
Pier Paolo Roggero, Nucleo di Ricerca sulla Desertificazione e Dipartimento di Scienze Agronomiche e Genetica Vegetale Agraria, Università di Sassari. Info: ecofinders@uniss.it
Partner di EcoFINDERS
Institut National de la recherche agronomique (INRA, F)
NERC Centre for Ecology and Hydrology (UK)
Aarhus University (DK)
ECT Oekotoxikologie GmbH (D)
Universitaetzu Köln (D)
Inra Transfert (F)
Joint Research Centre (EU)
Lund Universitet (S)
Nederlands Instituut voor Ecologie (NL)
Rijksinstituut voor Volksgezondheiden Milieu (NL)
Sveriges lantbruksuniversitet (S)
Teagasc Agriculture and FoodDevelopment Authority (IRL)
MAR—Instituto do Mar (P)
Università di Torino, Università di Sassari (I)
University College Dublin (IRL)
University of Aberdeen (UK)
University of Cambridge (UK)
University of Lancaster (UK)
Wageningen Universitet (NL)
Stichting Dienst Landbouwkundig Onderzoek (NL)
Inst for Forecasting of the Slovak Academy of Sciences (SK)
Chinese Agricultural University (CN)
Univerza v Ljubljani (SLO)
www.ecofinders.eu
EcoFINDERS
Ecological Function and biodiversity INDicators in EuROpean Soils
Indicatori di funzioni ecologiche e biodiversità nei suoli europei
www.ecofinders.eu

Il suolo

Il suolo è un ecosistema molto complesso che ospita una grande diversità di organismi viventi: batteri, protozoi, archea, nematodi, funghi, insetti, micro-mammiferi ecc. In 1 grammo di suolo si possono trovare molti miliardi di batteri e funghi di oltre 100 specie diverse e un piccolo volume di suolo può contenere diverse centinaia di specie animali (protozoi, nematodi, insetti e lombrichi). La loro presenza e diversità genetica ne influenza direttamente le fondamentali funzioni ecologiche, tanto che vengono considerati indicatori della qualità e dello stato di salute del suolo. Gli organismi del suolo svolgono una serie di "servizi ecologici" essenziali per la vita sulla terra: controllano i cicli biogeochimici, regolano il bilancio idrico, conferiscono la struttura fisica necessaria per la vita delle piante e influiscono sulla biodiversità presente in superficie. Ancora oggi, solo una piccola porzione di ciò che vive nel suolo è nota e ben caratterizzata.

Il progetto EcoFINDERS

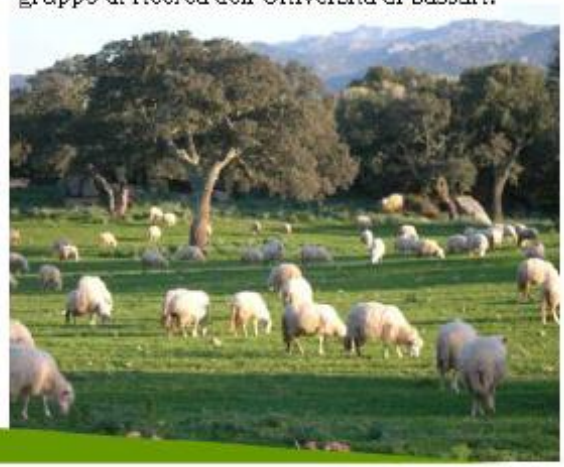
Il progetto, finanziato dal VII Programma quadro dell'Unione Europea, coinvolge 22 enti di ricerca e università europee e una cinese per lo studio del ruolo della biodiversità del suolo sul funzionamento degli ecosistemi agrari e forestali.

Obiettivi:

- caratterizzare la biodiversità (microbi e fauna) dei suoli europei attraverso osservatori di lungo termine (LTO) e transetti;
- analizzare le relazioni tra biodiversità, funzioni e servizi ecosistemici del suolo;
- sviluppare strumenti per la quantificazione e caratterizzazione della biodiversità che permetteranno di realizzare un database europeo della biodiversità del suolo;
- quantificare i benefici economici e sociali associati ai "servizi ecosistemici" garantiti da usi del suolo sostenibili.

Gli Osservatori di Lungo Termine (LTO):

Il monitoraggio della biodiversità e delle funzioni ecologiche del suolo richiede osservazioni ripetute a distanza di decenni. Per questo motivo EcoFINDERS ha individuato gli LTO in situazioni europee diverse per clima, tipo e uso del suolo (Irlanda, Francia, Olanda, Regno Unito, Svezia, Slovenia, Cina e Italia - Sardegna). L'osservatorio di Berchidda-Monti è rappresentativo dei suoli granitici e dei pascoli della zona Mediterranea ed è gestito dal gruppo di ricerca dell'Università di Sassari.



EcoFINDERS – FP7-ENV-2010-264465

TIMEINJAZZ
terra
TUTTI GIÙ PER TERRA
"The invisible world"
workshop
How is soil biodiversity studied?
Researchers of the EcoFINDERS project hunt for creatures hidden into soil
Berchidda
August 14, 2011

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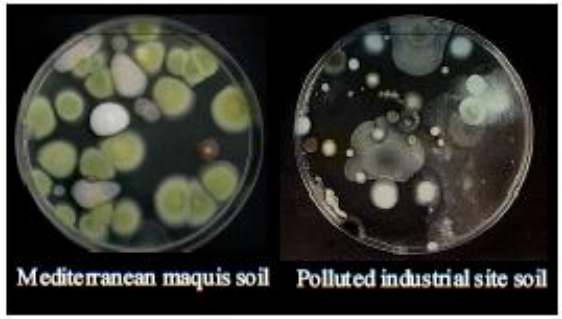
www.bottecilindro.it

Coordinators:
EcoFINDERS is coordinated by Philippe Lemanceau, INRA Dijon (www.inra.dijon.inra.fr).
Italian research groups:
Paola Bonfante, Mariangela Girlanda and Valeria Bianciotto, Dept. Biologia vegetale, University of Torino and IPP-CNR
Pier Paolo Roggero, Desertification Research Centre and Dept. Scienze Agronomiche e Genetica Vegetale Agraria, University of Sassari
EcoFINDERS at Time in Jazz was organized in collaboration with the theatre company "La Botte e il Cilindro". Concept by Pier Paolo Roggero and Sante Maurizi.
Time in Jazz representative:
Giannella Demuro
Collaborators:
Giovanna Seddaiu, Simonetta Bagella, Marcello Yeruluelli, Fluur Lai Nguyen, Facoltà di Agraria di Sassari, Silvia Baralla, Giacomo Calvia, Chiara Cappai, Maria Carmela Caria, Chiara Chelo, Clara Demurtas, Luca Doro, Angela Falchi, Roberto Lai, Laura Mula, Stefania Mura, Stefania Piras, Valeria Sanna, Ester Spissu, Antonello Zicconi.
Pier Paolo Concoru

The huge diversity of creatures inhabiting soil cannot be studied just by means of direct observation. Soil is indeed an opaque matrix; furthermore, many organisms (particularly the simplest microorganisms) lack morphological features allowing species identification.

Therefore, scientists have to rely on extraction methods.

Analyses of microarthropod (mesofauna) diversity, for instance, are often carried out by means of a special apparatus (the Berlese-Tullgren funnel), that exploits the avoidance response of animals to dryness caused by heating (by a small lamp at top of a funnel). This downward movement eventually causes the soil animals to fall into a container with preservative, from where they can be collected, counted and identified.



A classic method to assess the richness and diversity of bacteria and fungi consists in seeding soil, following dilution, on culture media into sterile containers (Petri dishes). After some days the development of microorganisms, able to feed on nutrients contained in the medium used, can be observed.
Comparison of Petri dishes prepared with different soils allows to appreciate differences in their biodiversity.

Progress in molecular biology offers new tools. It is nowadays possible to analyse directly the genetic material (DNA) of soil organisms. DNA is first extracted from soil and then specific portions of it are subjected to an amplification reaction (the so-called "Polymerase Chain Reaction", or PCR). Such a reaction yields, from a starting minimal quantity of DNA, an amount sufficient for analysis.
This technique enables researchers to address the diversity even of microorganisms that cannot be cultured on standard media.

The most recent technological advancements (454 pyrosequencing) yield hundreds of thousands DNA sequences in a very short time.

Researchers of the EcoFINDERS project will take advantage of the latter approach to analyse a variety of European soils, including soil from Berchidda-Monti.

Text by M. Girlanda

EcoFINDERS – FP7-ENV-2010-264465

A poster advertising the lab was displayed all over in Berchidda

1.8. Acknowledgements

The activities reported here were conducted in close collaboration with the theatre company “La Botte e Cilindro”, Sassari, in particular with Pier Paolo Conconi and Sante Maurizi. The activity of the theatre company was funded by UNITO (Mariangela Girlanda and Valeria Bianciotto). The costs of materials including posters, banners, brochures, T-shirts and lab tools were covered by NRD UNISS. The Faculty of Agriculture of UNISS provided logistics (minibus, microscopes etc.) and technical support (Antonello Zicconi) for the lab. Marcello Verdinelli (CNR-ISE Sassari) and Giacomo Calvia offered for free their expertise in designing and implementing the Enthomology and the Botany Lab respectively. The “Tutti giù per terra” Lab and the EcoFINDERS stand during the Festival were supported by the volunteer activity of the scientific and administrative staff of UNISS (see list in the Lab brochure). The Time in Jazz Festival organization offered the logistics, the prizes for the lottery linked to the questionnaire and the spaces for the EcoFINDERS stand. The Municipality of Berchidda offered the town library for the Lab activities.

1.9. References

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2. Dissemination and stakeholder meeting for work at LTO Lamborn, Sweden

Organizer: Roger Finlay, SLU

A special meeting for dissemination of the results of research in the EcoFINDERS and related research projects was organized at the Swedish National Forest Research Institute SkogForsk in Uppsala on November 13th, 2014. The symposium was entitled: 'New research on nitrogen, forest management, biodiversity and mycorrhizae'. The lectures were presented in Swedish to make the work available to a wide range of representatives from the forest sector. Twenty-two people took part in the meeting and participants were primarily from SkogForsk and SLU (Annex I). Many of the SkogForsk participants work in close association with different forest companies and private owners.

The EcoFINDERS research presented was from the long-term fertilization experiment at the Lamborn LTO, as well as parallel studies of rock associated communities.

The abstracts of the presentations are presented below and program and list of participants are presented in Annex I and II, respectively.

2.1. Effects of forest fertilisation on fungal and bacterial community structure and diversity in boreal forests.

Roger Finlay

Symbiotic ectomycorrhizal fungi form diverse communities in boreal forests, mobilising nutrients from organic polymers with different degrees of recalcitrance and from mineral substrates that are weathered at different rates. These fungi may also sequester photosynthetically-derived carbon in the soil, but the different roles of individual taxa and their location within the soil profile are still poorly understood. The structure and activity of soil microbial communities are influenced by both atmospheric nitrogen deposition and applications of fertilizer but detailed knowledge of the community dynamics of these responses is still lacking. High throughput, massively parallel sequencing provides a new tool with which to investigate these effects. In the present study we investigated fungal and bacterial community structure in different horizons of a boreal forest at Lamborn, Sweden. Previous studies of the effects of forest fertilisation using fruitbody inventories, morphotyping or first generation molecular methods with lower taxonomic resolution have shown temporary negative effects of N fertilisation on diversity of mycorrhizal communities.

In total 637 fungal operational taxonomic units (OTUs) were identified at the Lamborn field site. Different fungal communities colonise different soil horizons in boreal forest podzols. Differences in community structure between horizons are larger than those due to N fertilisation after 16 months.

In the O-horizon *Russula decolorans* & *Piloderma sphaerosporum* were most abundant, accounting for 20% of the total fungal community. In total about 40 fungal OTUs occurred at an individual frequency above 1%, in total accounting for 58%, 59% & 74% of the total reads in the O, E and B horizons respectively

Deeper sequencing of *both* roots *and* soil from the same samples unsurprisingly, revealed, significantly different fungal communities colonising soil and mycorrhizal roots.

In soil Chao-1 diversity indices declined significantly with depth and there was a significant positive effect of N fertilisation on diversity of soil fungi, particularly in the organic horizon.

In roots there was a significant negative effect of fertilisation on the diversity of fungi and a significant difference between community structure of fungi colonising roots in different soil horizons.

The negative effect of fertilisation appeared to be greater with increasing depth. *Russula decolorans*, *Suillus variegatus*, and *Piloderma sphaerosporum* occurred with high relative abundance in the O horizon, whereas *Meliniomyces bicolor* and *Russula paludosa* had higher relative abundance in the E horizon and *Piloderma lanatum*, *Tricholoma portentosum*, two unidentified *Piloderma* species and *Rhizopogon roseolus* and *R. bacillisporus* had higher relative abundance in the B horizon.

The community structure of bacteria associated with roots differed significantly from that associated with the soil, and also between the soil horizons (data not shown). Analyses of effects of N fertilisation on bacterial community structure and diversity are still in progress. The overall results suggest that analyses of both soil- and root-associated fungi must be conducted to detect effects of N fertilisation on diversity and community structure of fungi in boreal forests. Further analyses of root associated fungi at later time points are necessary to determine their resilience to N fertilisation.

2.2. The role of ectomycorrhiza for carbon storage in soil

Björn Lindahl

Ectomycorrhizal associations build fine hyphae that provide a direct link between three roots and the surrounding soil environment. The fungi live on the photosynthetic products of the host tree and transport large amounts of carbon into the soil to support the growing mycelial network. The mycelium mobilises nutrients from the soil that can then be translocated through the mycelium to the host trees. In boreal forests ectomycorrhizal fungi dominate the microbiological processes in the organic mor layer. Free-living decomposer fungi are mainly active in the fresh plant litter on the soil surface. In a large-scale investigation we have recently demonstrated a statistical relationship that suggests that mycorrhizal fungi play a key role in regulation of C storage in terrestrial ecosystems: even more important than plant production and climate change.

Mycorrhizal fungi can influence carbon storage in the soil.…

1) …positively by transporting C from photosynthetic assimilation to build up a carbon pool in the soil in the form of dead mycelium.

2) …positively through inhibiting the activity of decomposer fungi thereby reducing the loss of carbon from the soil.

3) …negatively by themselves acting as decomposers mineralising organic matter to carbon dioxide and water, or water-soluble compounds.

We are studying fungal communities and their interactions with the soil by analysing genetic species-markers, fungal gene-expression, their enzymes as well as their effects on the chemical composition and isotope signatures of the organic matter.

We have found experimental support for all of the above mechanisms. The mycorrhizal fungi play a key role in building up soil carbon pools that, to a large extent, consist of dead fungal mycelium. At the same time certain species, especially those in the genus *Cortinarius*, break down organic material in the soil and thus make nutrients available both to themselves and to their host trees. By acquiring soil nutrients, mycorrhizal fungi can inhibit litter decomposition by free-living fungi. The different mechanisms complement and counteract each other and the next great research challenge is to understand which processes dominate under different environmental conditions. Only when we understand these processes can we predict how the carbon sequestering ability of forests will be influenced by environmental changes caused by factors such as forestry, nitrogen deposition and climate changes.

2.3. Use of stable isotopes to study weathering of minerals by ectomycorrhizal fungi

Roger Finlay

In forest soils, symbiotic ectomycorrhizal fungi associated with tree roots link their plant hosts to organic and mineral substrates and play important roles in mobilising N and P from decomposing organic matter and supplying base cations from both organic and mineral substrates. One of the major challenges in quantifying biotic weathering is the need to distinguish the relative contributions of organic matter decomposition and mineral weathering to pools of base cations. Use of stable isotopes to track mobilisation of elements from substrates with different isotope ratios is one solution to this problem. The aim of this study is to explore the possibility of using variation in stable isotope natural abundance of certain elements (e.g. δ^{26}Mg) in ectomycorrhizal mycelium in order to trace the source/pathway of nutrient acquisition. Key questions were *Do ectomycorrhizal fungi fractionate Mg isotopes? Does Mg isotope fractionation occur during ectomycorrhizal weathering of minerals and decomposition of organic matter?* and *Do ectomycorrhizal and decomposer fungi differ in their elemental composition?*

There was considerable variation between fungal species in the patterns of elements mobilized from MMN medium and granite particles. *Cenococcum geophilum* accumulated high concentrations of P, whereas *Phlebiopsis gigantea* accumulated high concentrations of Ca. All of the mycorrhizal fungi were efficient in accumulation of P, Mg and K, often accumulating significantly higher concentrations than the saprotrophic species. Preliminary analysis of stable isotope signatures suggests that there is significant variation between species

2.4. Ongoing research on how the conservation value of pine forests can be conserved

Line Djupström

Effaråsen lies 30 km west of Mora, in the forests around Venjan. Here there are a number of pine stands that are included in one of Skogforsks long-term experimental sites. The purpose is to develop and evaluate conservation value in old pine forests. Old pine forests have different conservation value depending upon how the forests are managed but nearly all have traces of earlier felling and forest fires. Burnt wood, torrakaor, late grown trees and tar wood (tjärved) all provide unique wood structures that are important for a wide range of species, of which many are now threatened or rare.

Forest fires have largely ceased to occur and now very little dead wood is created. An acute shortage of suitable environments for a range of wood-dwelling species is thus likely to occur if active forest management is not practiced. The hypothesis is that old pine forests must be managed if their conservation value is to be developed within a reasonable time. The project in Effaråsen includes a total of about 140 ha of 100-150 year old pine forest. At harvest in the winter of 2012-2013 a number of forest areas with an average size of 5 ha and very different conservation strategies was created including harvesting of 0-95% of the stems. The conservation value consisted of different amounts of trees and dead and dying wood. Different amounts of dead and dying wood were left and controlled burning with or without harvesting of wood were examined, as well as how different plots with different amounts of dead wood differed from those stands where dead trees were created by the harvester. The effects of forest management and conservation have been evaluated by long-term monitoring of the development of dead wood and dying trees as well as repeated inventories of wood-dwelling fungi and insects, soil fungi and lichens. Cost estimates for the different levels of conservation are combined with data on the dead wood and form the basis for estimation of the cost-effectiveness of different levels of conservation.

2.5. Continuous cover forestry versus traditional felling – influence on fungal communities

Anders Dahlberg

The possibilities of managing the conservation value of different forests using continuous cover methods or traditional felling have been the subject of many discussions and debates, several investigations and some research during the last ten years. It has been suggested that the species diversity of mycorrhizal fungi would be stimulated by continuous cover forestry whilst that of wood dwelling decomposers would be negatively affected. The presentation will summarize the current state of knowledge based on recent research in Sweden.

New results on mycorrhizal fungi in pine and spruce forests in Jämtland will be presented and information given from ongoing studies in Norrbotten, Uppland and Dalarna, as well as a transect study from Norrbotten to Dalarna. A short new assessment of effects on wood-dwelling fungi will be presented based on studies in Finland and Sweden.

Further data in connection with these presentations has been placed on a web site and will be made available during December 2014.

3. Activities at LTO Teagasc

3.1. Developing and Evaluating Indicators for Biodiversity: The EcoFINDERS Project

Developing and Evaluating Indicators for Biodiversity: The EcoFINDERS Project

Rachel Creamer, Dote Stone

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Introduction

The majority of soil processes are mediated by the soil biota. Soil biodiversity is the engine driving soil based ecosystem services such as food production, nutrient cycling, carbon sequestration, and water purification (Wardle et al. 2004). The European Commission (DG ENV) acknowledge the importance of soil biodiversity in the role of ecosystem functioning and the Commission's soil strategy is to protect and enhance soil based ecosystem services, with a view to promoting sustainable intensification of agriculture. There is, however, not enough information available on soil biodiversity across Europe to allow informed policy decisions (Creamer et al. 2010).

The EcoFINDERS (FP7) project was set-up in 2011 to identify soil threats, harmonize methods for measuring biodiversity and to generate European datasets of soil biodiversity and ecosystem function. Teagasc is the lead partner in the work package dedicated to developing and evaluating such indicators.

Both known and novel indicators are being assessed across a range of land-uses and European climate zones. Large-scale sampling campaigns are underway to determine the normal operating range (NOR) of potential biodiversity indicators and their sensitivity to soil threats.

Materials and Methods

Indicators were selected by a vigorous sifting process known as a logical sieve which allowed the selection of indicators that would provide information meaningful and useful to end-users, such as policy makers and land managers (Ritz et al., 2009). The logical sieve was applied to a large pool of indicators culled from the literature. This took place at a workshop of experts gathered together in December 2011 and resulted in a list of indicators to be tested (Table 2)

Table 1. Indicators selected by Logical sieve and assessed by sampling LTOs and Transect sites

Biodiversity	Function
TRFLP (DNA)	
Protozoa (DNA)	
PLFA	
Fungi (ergosterol)	
FG nitrification (DNA)	
FG denitrification (DNA)	
Earthworms	
Enchytraeids	
Micro-arthropods	
Nematodes	
	Bait Lamina
	Water infiltration
	Resilience
	Nitrification
	HW-C & PM-N
	Micro-resp
	Enzyme Activity
	FG Supressiveness

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Using partner owned sites of long standing (Long Term Observatories or LTOs), the sensitivity of indicators to soil threats across 6 sites were assessed. The sites used incorporated different land uses and management practices.

In addition, a transect of 81 sites across Europe of varying land use and climatic zone were sampled for the presence of biodiversity indicators. Sites ranged from Mediterranean arable soils to Boreal forest soils and included Alpine pastures and wet Atlantic soils.

Results and Discussion

A list of most appropriate to measure indicators selected at the logical sieve workshop can be seen in Table 1 and was used in the Indicator-LTO testing.

The indicator-LTO sampling campaign was successfully carried out in the autumn of 2012. Six LTO sites were visited and samples taken from control plots and plots of the most extreme treatment (Table 2).

Table 2. Indicator-LTO sites

Land use	Treatment	Climate zone
Arable	conv/organic	Continental
Arable	till/no-till	Atlantic
Arable	till/no-till	Pannonian
Arable	cereal/fallow	Mediterranean
Grass	Intensive /extensive	Continental
Grass	Intensive /extensive	Atlantic

The Transect sampling campaign was successfully carried out in the Autumn of 2012. 81 sites were sampled over 3 months and analyses are currently underway across Europe at partner institutions (Figure 1).

Figure 1. Transect sample map

Conclusions

The dataset collected in this large-scale sampling campaign will allow the EcoFINDERS project to recommend specific indicators of biodiversity and ecosystem function to the EU for the purposes of policy development.

Acknowledgements

This work is part of the FP7 funded project EcoFINDERS.

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3.2. Breaking new ground on soil biodiversity across Europe

Soils Special

Breaking new ground on soil biodiversity across Europe







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The EcoFINDERS project is opening the black box of soil processes and studying how below-ground organisms govern the functionality of soils across Europe. The increase in knowledge from this large-scale sampling campaign, co-led by Teagasc, is priceless for policy development in the area of soil health and productivity, explains Dr Dorothy Stone.

Soil provides a wide range of services, including primary productivity, water purification, carbon sequestration and nutrient cycling, all of which have been described in the preceding articles. The majority of these soil processes are mediated by soil biota, which are the driving forces behind most soil based ecosystem services. The European Commission acknowledges the importance of soil biodiversity in the role of ecosystem functioning and the Commission's soil strategy is to protect and enhance soil-based ecosystem services, with a view to promoting sustainable intensification of agriculture. However, while we have a good idea of the role of soil organisms in many of the processes that take place in soils, there is very little information on the geographical distribution and variation in soil biodiversity or the functional capacity of these below-ground communities.

In light of this, the EcoFINDERS (FP7) project was set up in 2011 to address this lack of spatial information on soils and to generate European datasets of soil biodiversity and ecosystem function. Teagasc is the lead partner in the work package dedicated to developing and evaluating indicators of ecosystem functioning, based on the combined knowledge of experts from across Europe. These indicators were measured at 81 sites across Europe: a sampling campaign of unprecedented scale for soil biodiversity. The sites cover a range of biogeographical zones, representing climatic regions that include: Atlantic, Continental, Boreal, Alpine and Mediterranean. Encompassed in these zones are a range of land uses: arable, grass and forestry and a large spectrum of soil properties (represented by pH, organic carbon, total nitrogen and texture).

Selecting indicators

We selected a range of biological methods that provide information on the abundance, diversity and functional capacity of organisms found in soils across Europe. There are many biological methods available and therefore, it was essential to select methods that: (1) provide good descriptive information; (2) are cost-efficient; and, (3) are not too laborious to carry out in the field (at time of sampling) or laboratory (during analysis). Table 1 describes the range of methods selected and how they relate to biodiversity or soil functioning. Here, we give three examples that describe the microbial, faunal and functional behaviour of organisms in soil across Europe. These include: (1) fungal diversity; (2) the diversity of Enchytraeid (potworms); and, (3) respiration.

Fungal diversity (an example of microbial diversity)

Soil fungal diversity across Europe varies in terms of number of species, their relative abundance and distribution according to land use (forest, grassland and arable), soil and climatic parameters. Fungal diversity (Shannon index) was lowest in forestry sites and greatest in arable soils. The highest abundances of DNA (measured by quantitative qPCR) were found in Boreal forestry sites and lowest in Mediterranean soils and in arable sites. Soil pH had a significant impact on the community structures of fungal diversity, showing a positive response to diversity and a negative response to the abundance of fungi.

Biodiversity	Function
Microbial diversity by TRFLP (eDNA)	
Microbial diversity by PLFA	
Functional Genes [nitrification] (eDNA)	
Functional Genes [denitrification] e(DNA)	
Enchytraeid species diversity	
Micro-arthropod species diversity	
Nematode species diversity	
	Bait Lamina
	Nitrification potential
	Microbial Respiration: MSIR (Micro-resp)
	Enzyme Activity

Table 1. Indicators selected

Photo 1. *Enchytraeus albidus*.

Enchytraeid diversity (an example of soil fauna diversity)

Enchytraeidae (Oligochaeta, Annelida), also known as potworms, were measured as a key faunal group. More than 30,000 specimens of enchytraeids were extracted from 518 soil cores. Specimens were identified to species in vivo and then fixed for morphological scrutiny or DNA barcoding. About 170 species were registered, 79 of which had not previously been described. Most of the new species were found in previously unstudied regions of France, Slovenia or Portugal. Diversity patterns showed a regional component at the species but not at the genus level. Changes in enchytraeid communities (such as species abundance patterns) correlate with changes of soil parameters such as pH and C:N ratios, and they are strikingly paralleled by changes in the microbial communities, which suggest that patterns of soil biodiversity across Europe can be predicted based on soil properties and land use.

Soil respiration (a measure of soil functioning)

Soil respiration was measured using the MicroResp method, which measures the respiratory response of the soil microbial community to a range of carbon sources. We applied seven different carbon sources, from readily available carbon such as glucose, to complex recalcitrant carbon sources such as alpha ketogluterate. The Microresp method measures the microbial response to the range of carbon sources; microbial communities that can respire a wider range of carbon sources are considered to have a better functional capacity in relation to C cycling. Respiration was greatest in the forest soils of the Boreal region. This was due to the high organic status of these soils. pH and soil texture also had a significant impact on the respiration potential of the soils.

Implications

The data collected as part of this project has significantly increased knowledge of soil biodiversity and functioning across Europe. This information is vital to inform policy decisions on the quality of biodiversity in soils across Europe. In addition, this extensive sampling and analyses of soil biodiversity and function, has provided a blueprint of possible indicators for soil quality monitoring at both national and European scale.

Acknowledgements

This work is part of the FP7 funded project EcoFINDERS.

Paper in *Nature*

EcoFINDERS recently hit a high note when it published in Nature Climate Change on a new guild of microbes that mediate against climate change. Nitrous oxide (N_2O) is a major greenhouse gas and at least 30% can be attributed to microbial cycling of nitrogen in agriculture. Although the reduction of N_2O to nitrogen gas (N_2) by microorganisms is critical for mitigation, it remains uncertain what determines a soil's capacity to act as a source or sink for N_2O. A key experiment in EcoFINDERS, using soil from Teagasc experimental farms, demonstrated that the soil N_2O sink capacity is mostly explained by the abundance and phylogenetic diversity of a newly described N_2O-reducing microbial group, which mediate the influence of edaphic factors. These microbes convert N_2O to N_2, which is the benign component of atmospheric nitrogen. Analyses of interactions and niche preference similarities suggest niche differentiation or even competitive interactions between organisms with different types of the enzyme that converts N_2O to N_2. The study was recently published in *Nature Climate Change*: Jones *et al.* (2014) recently identified microbial guild mediates soil N_2O sink capacity. DOI: 10.1038/NCLIMATE2301

4. Public event at LTO Lusignan

Organizers Abad Chabbi & Philippe Lemanceau

4.1. LTO Lusignan event

Lusignan is one of the five EcoFINDERS LTOs. From the 15th to the 19th October 2012, five researcher teams (from France and The Netherlands) studied soil, performing soil sampling and field measurements. Scientists measured the agricultural and environmental services of soils and observe in which way soil biodiversity contributes to these services. Activities during this event contributed to the characterization of European soils biodiversity and functions taking into account climate change and soil management politics. Many EcoFINDERS people were part of this event.

The important soil function of water infiltration was measured in the field

Planning the sampling

Measuring air from soil pores

Earthworm sampling in the field

Meteorological measurements in the field

4.2. Press release of the PR event at LTO Lusignan (in French)

INRA
Centre Poitou-Charentes

© Inra – Christophe Maître

13 novembre 2012

L'INRA COORDONNE UN PROJET SCIENTIFIQUE POUR MIEUX CONNAITRE LA BIODIVERSITE ET LE FONCTIONNEMENT BIOLOGIQUE DES SOLS D'EUROPE

Indispensables pour leurs services agricoles et environnementaux, les sols subissent pourtant de multiples pressions : érosion, salinisation, compaction, diminution des surfaces agricoles... A Lusignan, l'Inra gère l'un des cinq observatoires européens du projet scientifique Ecofinders, pour caractériser la biodiversité et le fonctionnement biologique des sols en Europe. Du 15 au 19 octobre 2012, cinq équipes de chercheurs français et hollandais s'y sont installées pour passer au crible la terre mélusine.

Quelle biodiversité peut-on trouver sous une forêt, une prairie ou un champ cultivé ? Réponse : d'innombrables petits animaux comme les lombrics ou les insectes (1 à 5 tonnes par hectare), quantités de champignons (3,5t/ha) et de bactéries (1,5t/ha). Au delà de cette fantastique biomasse, ces organismes représentent une gigantesque biodiversité dont le fonctionnement contribue aux services agricoles et environnementaux délivrés par les sols : la croissance et la santé des plantes, la diminution de l'effet de serre grâce au stockage de carbone, la biodégradation des composés toxiques dans les sols contribuant à la filtration de l'eau, ou encore la prévention des inondations grâce à la régulation de l'eau.

L'Europe manque d'informations sur la biologie des sols

La Commission européenne veut préserver les fonctions du sol, les restaurer le cas échéant, et éviter de nouvelles dégradations. Mais pour mettre en place une politique de gestion durable des sols, elle a besoin de mieux connaître la biodiversité du sol et sa traduction en services agricoles et environnementaux selon le type de sol, le mode d'usage des sols (prairies, forêts ou cultures, permanentes ou temporaires, avec ou sans engrais) et le type de climat. C'est ce que propose le projet Ecofinders, coordonné par l'Inra et financé à hauteur de 7 millions d'euros par l'Union européenne pour 4 ans, de 2011 à 2014.

Lusignan : l'un des 5 observatoires européens de recherche en environnement

Plus de 200 chercheurs de 10 pays européens travaillent sur des échantillons de sol prélevés dans 85 points d'Europe, et sur 5 observatoires de longue durée représentatifs des différents climats, types et usages de sols européens : Lusignan en France, Lancaster en Angleterre, Lamborn en Suède, Veluwe aux Pays-Bas et Berchidda en Italie. Les scientifiques mesurent les services agricoles et environnementaux des sols et observent en quoi leur biodiversité contribue à ces services. Deux campagnes de mesures sont menées par an, au printemps et à l'automne. En octobre 2012, Lusignan a accueilli cinq équipes de recherche de l'Inra d'Orléans, Rennes, Dijon et Avignon, et une équipe hollandaise.

Prédire comment vont évoluer les sols selon différents paramètres

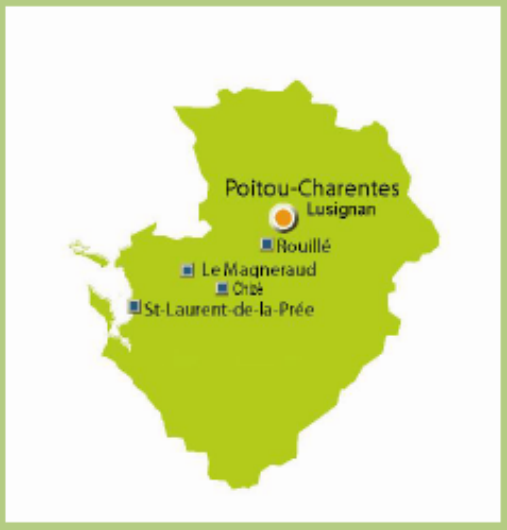
En laboratoire, les chercheurs font ensuite varier la température, l'humidité et la biodiversité de blocs de sol, pour évaluer l'impact de ces variations sur les services agricoles et environnementaux du sol. A la fin du projet, ils disposeront d'un référentiel permettant d'interpréter les résultats d'analyses biologiques des sols pour effectuer des diagnostic de l'état des sols et disposer d'éléments de prédiction de l'évolution de la biodiversité du sol et des services qu'elle apporte, en fonction de différents scénarios possibles faisant intervenir le climat et la politique de gestion des sols.

Le centre INRA Poitou-Charentes

240 agents travaillent dans une unité de recherche, une unité sous contrat INRA-CNRS et huit unités expérimentales réparties sur quatre sites et axées sur deux thématiques scientifiques :

• **Gestion durable des prairies, systèmes fourragers et territoires**. L'enjeu est de concevoir des prairies pour une agriculture compétitive et respectueuse de l'environnement. Les recherches visent à élaborer des solutions agricoles assurant la durabilité sociale et économique des exploitations et préservant l'environnement et la biodiversité.

• **Gestion durable des productions animales**. L'enjeu est de développer et diversifier les productions animales. Les activités visent à concevoir et évaluer des systèmes d'élevage et de production économiquement viables et respectueux de l'environnement et du bien-être animal.



A propos de l'INRA :

Etablissement public à caractère scientifique et technique (EPST), l'INRA est placé sous la tutelle des ministères en charge de la Recherche et de l'Agriculture. C'est le premier institut de recherche agronomique en Europe et il se situe au deuxième rang mondial pour ses publications en agronomie.

Au cœur des enjeux du développement durable, l'Institut mène une recherche publique finalisée pour :

- une alimentation saine et de qualité ;
- une agriculture compétitive et durable ;
- un environnement préservé.

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5. Soil: the invisible world at IMAR

Jose Paulo Sousa, IMAR

With the aim to raise awareness about soil biodiversity within a group of primary schools of the Óbidos Municipality (Central Portugal), a protocol was signed between IMAR-UC and the Municipality under the framework of EcoFINDERS project.

The aim was to develop a project to show the diversity of life forms in soil, and to show soil as a living entity, targeting children between 6 and 10 years old. The project was named "Soil: the invisible world" (Fig 5.1), and encompassed several phases:

Figure 5.1 *– Educational project "Soil: the invisible world"*

1. Training sessions on basic principles of soil ecology to primary school teachers and educators that will work directly with the children. This was done under 3 sessions, where soil as physical medium (soil components, structure and profiles) and as a living entity was presented. Afterwards the main life-forms in soil were presented, as well as their role in soil food-webs.
2. Presentation of the different activities planned for the project and training of the educators on these activities.
3. Working with the children in extracurricular workshops, developing the activities planned

During this first year of the project (school year 2012-2013), one major activity was developed. The aim was to make children aware of the large diversity of faunal groups living in soil. Therefore soil fauna collection via pitfall traps was undertaken in the grounds surrounding the schools where the project was implemented. Beforehand, a training session on how to construct and to install the pitfall traps was performed (Fig. 5.2).

Figure 5.2 *– Schematics of the logistics needed for the construction and implementation of the pitfall traps in the field.*

During the two field campaigns undertaken by the children, different soil macroarthropods were collected. The material was sorted at order level and preserved for further observations (Fig. 5.3).

Figure 5.3 *– Field campaign and identification of collected material*

Afterwards, the distinctive characteristics of the different organisms were studied by the children and drawings were made in order to better perceive those differences (Fig. 5.4).

Figure 5.4 *– Getting acquainted with the different morphological traits of the collected organisms and making creative drawings*

Future activities for this school year (2013-2014) will encompass the collection of soil cores for the extraction of soil microarthropods and the sampling of soil monoliths to collect earthworms. Furthermore, based on the morphological characteristics observed in the different organism groups collected during these two years, a soil panel with a soil profile will be installed in the atelier and an exercise about the position of the different organisms along the soil profile according to their morphological characteristics will be done. This will be based on the explanations given by the educators and will be done with the drawings made by the children using magnetic ink.

Furthermore, depending on the time allocated to this project by the school, other activities are planned, namely the performance of simple manipulative experiments dealing with the reaction of soil fauna to chemicals (sea salt will be used) and also with their role in decomposing organic matter (cafeteria tests with key detritivores).

6. Summer of Soil

Anne Winding, AU

At the Summer of Soil organized by Summer of Soil (http://www.summerofsoil.se/) at Järna, Sweden during the summer of 2013 this poster promoting EcoFINDERS was displayed.

EcoFINDERS

Ecological **F**unction and Biodiversity **Ind**icators in **E**uropean **S**oils

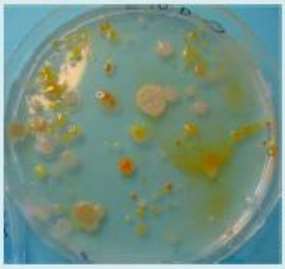
an EU FP7 project (2011-2015)

The EcoFINDERS (Ecological Function and Biodiversity Indicators in European Soils) project will result in:
• at the scientific level, increasing our knowledge of soil biodiversity and its role in ecosystem services across different soils, climate types and land uses;
• at the technological level, the standardization of methods and operating procedures for characterizing soil biodiversity and functioning, and the development of bioindicators;
• at the economic level, the assessment of the added value brought by cost-effective bioindicators, and of cost effectiveness of alternative ecosystem service maintenance policies.

Soil ecosystem services
Soils provide numerous essential ecosystem services such as:
• primary production (including agricultural and forestry products);
• regulation of biogeochemical cycles (with consequences for the climate);
• water filtration; resistance to diseases and pests;
• and regulation of above-ground biodiversity.
However, soils are subjected to many threats, so there is an urgent need to preserve this resource which is not renewable within Human time scale.

Soil biodiversity
Soils host a huge biodiversity of which our understanding remains very limited. The soil biodiversity studied includes microbes (archaea, bacteria, fungi) and fauna (protozoa, microarthropods, nematodes, oligochaeta), and their relation with above-ground biodiversity. Our lack of knowledge is related to: the small size of the soilborne organisms; their immense diversity; the difficulty in isolating them; and the great heterogeneity of their habitats across different scales. However, recent progress in the molecular characterization of soil biodiversity offers the exciting prospect of exploring its complexity and better understanding its functioning.

Approaches:
• description of soil biodiversity and of the relations between soil biodiversity, soil functions and ecosystem services, in long term observatories representative of soil types, climates and land uses across Europe,
• experiments to test the biodiversity patterns identified, the bioindicators developed and hypotheses related to connections between soil biodiversity and functions,
• metadata analyses to raise a biodiversity database at the European level, and modeling to decipher relations between soil biodiversity and functions, as well as putting a value on ecosystem services.



Perspectives
Scientific and technological knowledge on soil biodiversity and functioning in relation with the ecosystem services is required to define and adopt a Soil Framework Directive by the European Commission.

This European project, coordinated by INRA, France, gathers together 23 partners from 10 European countries plus China, to harness expertise in ecology, biodiversity, environmental economy, modeling, bioinformatics and database management.

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Annex I Programme of the symposium at LTO Lamborn, SLU (Sweden)

Halvdagsseminarium – Skogforsk, Uppsala, 13 november 2014

Nya forskningsrön kring kväve, skogsskötsel, biologisk mångfald och mykorrhiza

- resultat från pågående EU- och FORMASprojekt

Schedule

Tid	Titel	Ansvarig
13:00-13:20	Introduktion, fruktkroppsproduktion och kvävegödsling	Lars Högbom, Skogforsk
13:20-13:40	Nya sekvenseringsdata från kvävegödslingsförsöket Lamborn	Roger Finlay, SLU (ECOFINDERS)
13:40-14:00	Ektomykorrhizan roll för kollagring i marken	Björn Lindahl, SLU (IMPRESS)
14:00-14:20	Användning av stabila isotoper för att studera vittring av mineraler.	Roger Finlay SLU (QWARTS)
14:20-14:40	Kaffe	
14:40-15:00	Hur ska tallskogens naturvärden bevaras?	Line Djupström, Skogforsk
15:00-15:20	Hyggesfritt vs trakthyggesbruk – påverkan på svampsamhällen	Anders Dahlberg, SLU
15:20-16:00	Slutsatser och diskussion	

QWARTS

Annex II Participant list of the symposium at LTO Lamborn, SLU (Sweden)

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