Use of prescribed burning for restoration and maintenance of ecological conditions: Predicting and managing fire injury and tree mortality

Kevin Ryan, Eric Rigolot, Francisco Rego, Herminio Botelho, Jose Antonio Vega Hildago, Paulo Fernandes, Tatiana Sofronova

CONFERENCE PROGRAMME ABSTRACT BOOK

7th SER European Conference
on **Ecological Restoration**
23-27 AUGUST 2010
AVIGNON **FRANCE**

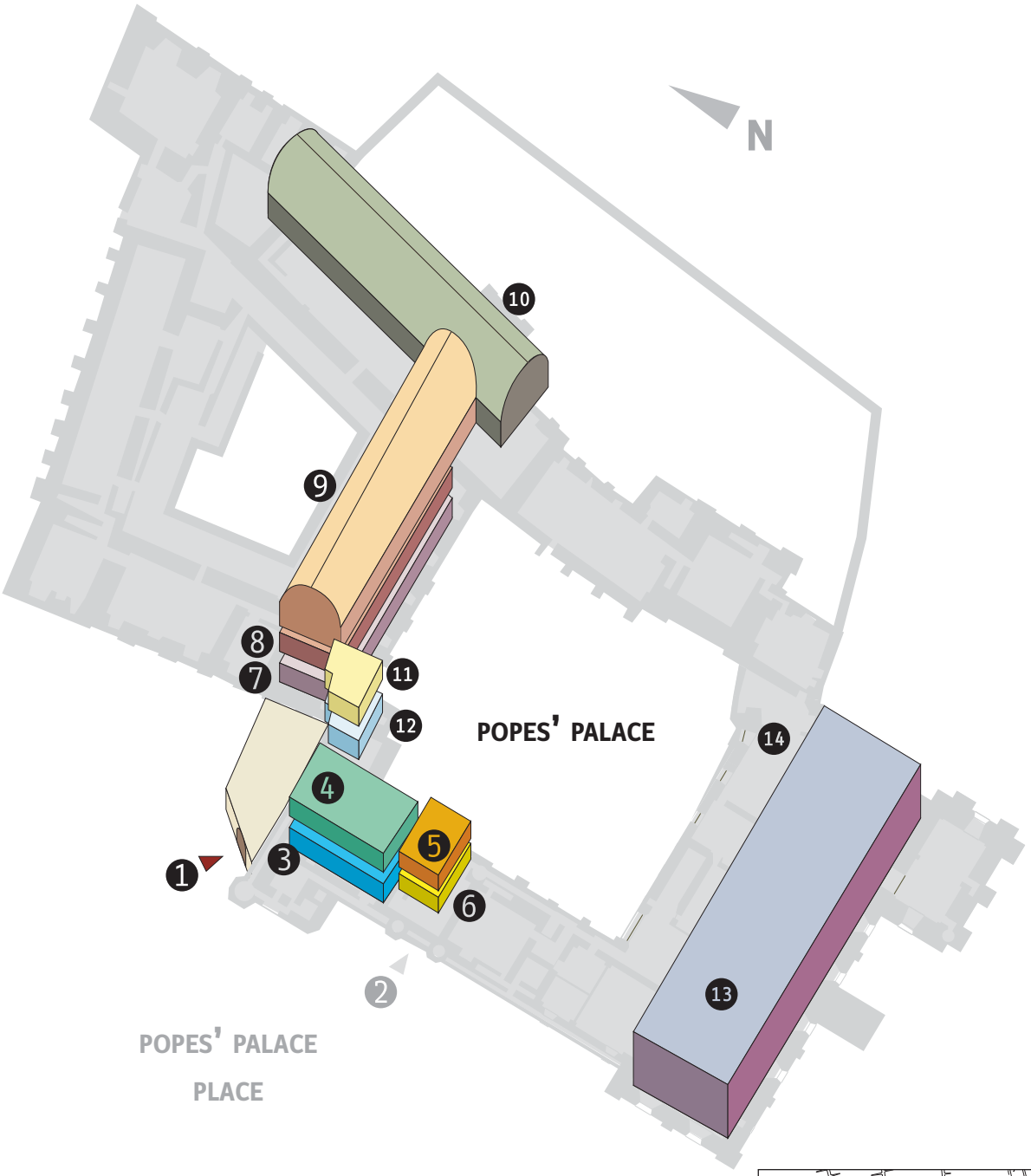
ECOLOGICAL RESTORATION AND SUSTAINABLE DEVELOPMENT

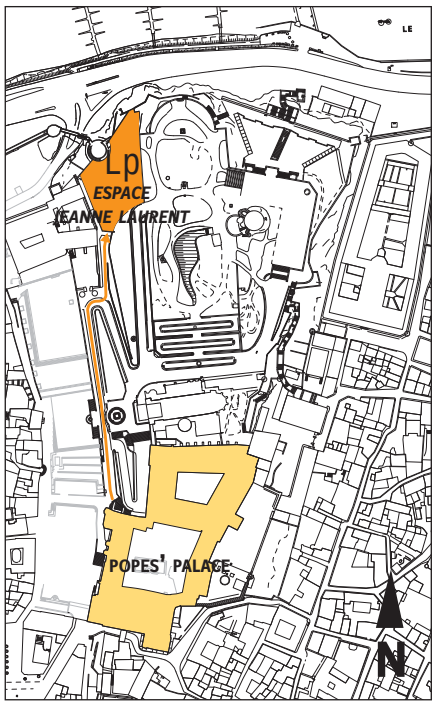
ESTABLISHING LINKS ACROSS FRONTIERS

7e Conférence Européenne SER
*en **Ecologie de la Restauration***
23-27 AOUT 2010
*AVIGNON **FRANCE***

ECOLOGIE DE LA RESTAURATION ET DEVELOPPEMENT DURABLE

DEPASSER LES FRONTIERES





1 - Centre des Congrès entrance
2 - Public entrance

3 - Salle des Gardes *(registrations, informations, changing room)*
4 - Salle du Trésorier
5 - Cubiculaire
6 - Herse Champeaux
7 - Cellier Benoît XII
8 - Paneterie (1 to 4) *(Paneterie 4 = preview room)*
9 - Conclave *(Plenary sessions, opening and closing ceremony)*
10 - Grand Tinel - Great Tinel Hall *(Gala dinner)*
11 - Chambre aux Quatre Fenêtres *(internet wireless)*
12 - Herses Notre-Dame *(meetings)*
13 - Grande Audience *(exhibitions, breaks)*
14 - Bouteillerie *(wine cellar)*

15 - Espace Jeanne Laurent *(lunch)*

Preface

Dear colleagues,

It is a great honour for me to welcome in the name of the organizing committee, at the 7th European Conference in Ecological Restoration, placed under the auspices of the International Society of Ecological Restoration, chapter Europe. It is also a real pride for us to have been chosen to organize this event because too few international congresses in ecology have been organized in France these past years.

It has now been two years that we work so that this event can take place for the first time in France and in the prestigious place of the International Popes' Palace Conference Center in Avignon. This place was not chosen at random! Indeed, it constitutes a successful example of restoration and preservation of one of the most visited historic monuments in Europe, combined with new functions of which perpetuity is guaranteed by a new economic activity. What a striking parallel with the ecological restoration of natural ecosystems of which the rehabilitated features inevitably have to be incorporated in a new socio-economic framework!

The theme chosen "*Ecological Restoration and Sustainable development: Establishing Links Across Frontiers*" is at the heart of the environmental concerns in Europe and more particularly in its southern part where global changes have particularly impacted ecosystems weakened by centuries of overexploitation in a region constituting however one of the 34 biodiversity hot-spots of the planet.

Significant projects of restoration are starting. Nevertheless, a considerable amount of work is still needed to integrate them in the life of the local populations and make them sustainable ecologically and economically. The objectives of this conference are thus to multiply the contacts between researchers and professionals of the different European countries in particular to facilitate the exchanges between the north and south coasts of the Mediterranean Sea.

For that purpose, more than 200 oral presentations are proposed in 64 sessions among which 8 special sessions and 5 workshops. More than 100 posters are also visible as well as 10 stands. 8 plenary speakers will come to make us benefit from their experience and 10 mid-field trips are proposed for a better approach of concrete examples of restoration or projects of ecological restoration in the region Provence-Alpes-Côte-d'Azur.

This congress would not have come into existence without the support of the Mediterranean Institute of Ecology and Palaeoecology as well as the University of Avignon, co-organizers of this conference. Numerous partners also allowed its realization : researches institutes (CNRS - INEE - National Center for Scientific Research -, IRD - Research Institute for Development, IUT- University Institute of Technology of Avignon, Paul Cézanne University, Provence University), administrations (Region of Provence-Alpes-Côte d'Azur, General Council of Vaucluse, DREAL - PACA - Regional Department for the Environment Provence-Alpes-Côte-d'Azur, PRIDES ICP), private foundations (MAVA, Tour of the Valat), NGO (WWF) and private companies (GRT Gaz, CDC- Biodiversité, Gagneraud Constructions, EcoMed, Naturalia Environnement, Island Press).

Beyond institutions are also men and women who individually from their motivation and implication brought a successful conclusion of this project. We thank a lot the members of the organizing committee and of the scientific committee, the organizers of field trips, the voluntary students, the managers of the International Popes' Palace Conference Center and the University of Avignon for their availability and enthusiasm. I shall not forget to thank for ending, all the contributors in this conference as well as the participants who due to their presence, make it a success.

I wish you not only a good conference but also a good stay in Avignon within this magnificent region that is the southeast of France.

Pr. Dr. Thierry Dutoit
Chair of the organizing committee

Préface

Chers collègues,

C'est un grand honneur pour moi, d'accueillir au nom du comité d'organisation, le 7ème Congrès Européen en Ecologie de la Restauration, section Europe de la Société Internationale d'Ecologie de la Restauration. C'est également une réelle fierté pour nous d'avoir été choisi pour faire cette manifestation car trop peu de colloques internationaux dans le domaine de l'écologie ont été organisés en France ces dernières années. Nous travaillons ainsi depuis deux ans pour que cet événement puisse se dérouler pour la première fois en France et dans le cadre prestigieux du centre des congrès du Palais des Papes en Avignon. Ce cadre n'a pas été choisi au hasard car il constitue un exemple réussi de restauration et de conservation architecturale combiné avec de nouvelles fonctions dont la pérennité est assurée par une nouvelle activité économique. Quel parallèle saisissant avec la restauration écologique des écosystèmes dont les fonctionnalités réhabilitées doivent nécessairement s'incorporer dans de nouveaux cadres socio-économiques !

*La thématique choisie "*Ecologie de la restauration et développement durable : dépasser les frontières*" est au cœur des préoccupations environnementales en Europe et plus particulièrement dans sa partie sud où l'impact des changements globaux sont particulièrement ressentis par des écosystèmes fragilisés suite à de longs siècles de surexploitation d'une région constituant cependant un des 34 points chauds de biodiversité sur la planète. Si des projets significatifs de restauration commencent à y voir le jour, un travail considérable reste à faire pour intégrer dans ces projets, la vie des populations locales et rendre durable écologiquement et économiquement ces projets. Les objectifs de ce congrès sont donc de multiplier les contacts entre chercheurs et professionnels des divers pays européens et notamment de favoriser les échanges entre rives nord et sud de la méditerranée. Pour cela, plus de 200 présentations orales sont proposées dans 64 sessions dont 8 sessions spéciales et 4 ateliers. Plus de 100 affiches sont également visibles ainsi que 10 stands. 8 conférenciers pléniers viendront nous faire bénéficier de leur expérience et 10 sorties de terrain sont proposées à mi-parcours du congrès pour une meilleure approche d'exemples concrets de restauration ou de projets de restauration écologique dans la région Provence-Alpes-Côte-d'Azur.*

Ce congrès n'aurait pu voir le jour sans le soutien de l'Institut Méditerranéen d'Ecologie et de Paléoécologie ainsi que l'université d'Avignon, co-organisateurs de cette manifestation. De nombreux partenaires ont également permis sa réalisation tant au niveau des instituts de recherches et d'enseignements français (CNRS - INEE, IRD, IUT d'Avignon, université Paul Cézanne, université de Provence), des administrations (Région PACA, CG 84, DREAL PACA, PRIDES - ICP), des fondations privées (MAVA, Tour du Valat), des ONG (WWF) que des professionnels (GRT GAZ, Gagneraud Constructions, EcoMed, Naturalia Environnement, Island Press). Au-delà des institutions se sont également des hommes et des femmes qui individuellement de part leur motivation et implication ont permis de mener à bien ce projet. Que soient donc ici vivement remerciés les membres du comité d'organisation et du comité scientifique, les organisateurs de sortie, les étudiants bénévoles, l'équipe du Centre des Congrès du Palais des Papes et de l'université d'Avignon pour leur disponibilité et enthousiasme. Je n'oublierai pas de remercier pour terminer, tous les contributeurs à ce colloque ainsi que les participants qui, de par leur présence, en font un succès.

Je vous souhaite non seulement un bon congrès mais également un bon séjour en Avignon au sein de cette magnifique région qu'est le sud-est de la France.

Pr. Dr. Thierry Dutoit
Président du comité d'organisation

Welcome letter from the Chair of the scientific committee

Welcome to the 7th conference of the Society for Ecological Restoration - Europe Chapter !
Having attended the successful previous SER - Europe Chapter conferences, I am honored of having been appointed as the scientific chair of this 7th conference.
Trying to come up with ideas which would make this event special, I am delighted to announce six keynote speakers who mainly / partly work or have worked in Mediterranean ecosystems on top of two others from the Netherlands and Canada (Roland Bobbink from B-WARE & Karen Keenleyside from Parks Canada): Frédéric Médail from the IMEP / Paul Cézanne University in Marseille, southern France; Jordi Cortina Segarra from Alicante University in Spain; José Mª Rey Benayas from Alcalá University in Spain; Vasilios P. Papanastasis from the University of Thessaloniki in Greece; Daniel Vallauri from the WWF in Marseille, southern France & James Aronson from the CNRS-CEFE in Montpellier, southern France.
Within the framework of the "Union for the Mediterranean" and the "international year of biodiversity - 2010" and the increasing interest for sustainable development, two of the key topics for this 7th conference are establishing links across frontiers and developing a sustainable ecological restoration, which I hope will be at the heart of discussions.
We accepted more than 200 oral presentations, more than 100 poster presentations and have 5 workshops being organized. I am looking forward to this stimulating program and to meeting you and hope that a lot of you will join us.
I would like to thank the scientific committee for this great work and the organizing committee for putting together this event, which is not an easy task!
Looking forward to welcoming you in Avignon.

Dr. Elise Buisson
Chair of the scientific committee

Bienvenue à la 7ème conférence de la Société pour la Restauration Ecologique, section Europe!
J'ai assisté avec intérêt aux précédentes conférences de la SER - section Europe en tant qu'intervenante et je suis aujourd'hui honorée d'avoir été nommée à la présidence scientifique de cette 7ème conférence.
Pour donner à cet évènement la place qu'il mérite, je suis heureuse d'avoir pu m'assurer de la participation de six conférenciers qui travaillent ou ont travaillé partiellement ou principalement dans les biomes méditerranéens : Frédéric Médail de l'IMEP / Université Paul Cézanne à Marseille, sud de la France; Jordi Cortina Segarra de l'Université d'Alicante en Espagne, José M ª Rey Benayas de l'Université de Alcalá en Espagne; Vasilios P. Papanastasis de l'Université de Thessalonique en Grèce, Daniel Vallauri du WWF à Marseille, sud de la France et James Aronson du CNRS-CEFE, Montpellier, sud de la France. A ces six conférenciers se joindront deux autres intervenants l'un venant des Pays-Bas (Roland Bobbink de B-WARE), l'autre du Canada (Karen Keenleyside de Parcs Canada).
Dans le cadre de "l'Union pour la Méditerranée» et de «l'année internationale de la biodiversité - 2010 » et parce qu'il y a un intérêt général croissant pour le développement durable, deux des principaux sujets de cette 7ème conférence, qui seront, je le souhaite, au cœur des discussions, traiteront de l'établissement des liens à travers les frontières et du développement d'une restauration écologique durable.
Nous avons accepté plus de 200 présentations orales, plus de 100 présentations de posters et nous disposerons de 5 ateliers organisés. Je me réjouis de vous rencontrer et j'espère que beaucoup d'entre vous pourront se joindre à nous pour découvrir ce programme attrayant.
Je tiens à remercier le comité scientifique pour tout le travail effectué et le comité d'organisation pour avoir préparé cette manifestation, ce qui n'est pas une tâche facile!
Au plaisir de vous accueillir en Avignon.

Dr. Elise Buisson Elise
Présidente du comité scientifique

Welcome letter from the President of SER-Europe

Dear Colleagues,

On behalf the board of the European Chapter of the Society for Ecological Restoration SER International I welcome you to the 7th European Conference on Ecological Restoration in Avignon.

During the past decade ecological restoration aiming at the rehabilitation and sustainable management of degraded ecosystems has become an international movement of rapidly rising significance. This is reflected by a constantly growing number of practitioners and scientists attending the biannual conferences organized by the European Chapter of SER since 1996. This year, we are awaiting for the first time more than 450 participants, which means that our conference has become a European prime event in the field of ecology and environmental conservation.

The conference is hosted in the Mediterranean area, a region facing severe environmental problems under global climate and land-use changes. Several plenary and parallel sessions will specifically address the problems related to the restoration of Mediterranean ecosystems. Moreover, we hope to stimulate the exchange of ideas and knowledge on ecological restoration not only between northern and southern Europe but also with Northern Africa and the Middle East.

Thanks to the early and ambitious activities of Thierry Dutoit that started almost two years ago, the conference will be hosted in Avignon's medieval Pope Place at the edge of the old town, probably one of the most scenic locations for a conference one can imagine. I would like to thank Thierry and the whole organizing team, the sponsors and everybody else involved in the conference organization for their support, idealism and commitment, which are essential to make such an event possible.

Beyond the scientific program, the conference is spiced with excursions to the lovely and highly diverse cultural landscape of the Provence, delicious French cuisine and vine – you should not miss a glass of the famous Châteauneuf-du-Pape, probably one of the finest vines in the world.

I wish you a pleasant and inspiring stay in Avignon and hope to see you again for the 8th European Conference on Ecological Restoration, which will be held in 2012 in the Czech Republic in the city of České Budějovice.

Pr. Dr. Norbert Hölzel
President of SER Europe

Objectives of the Conference

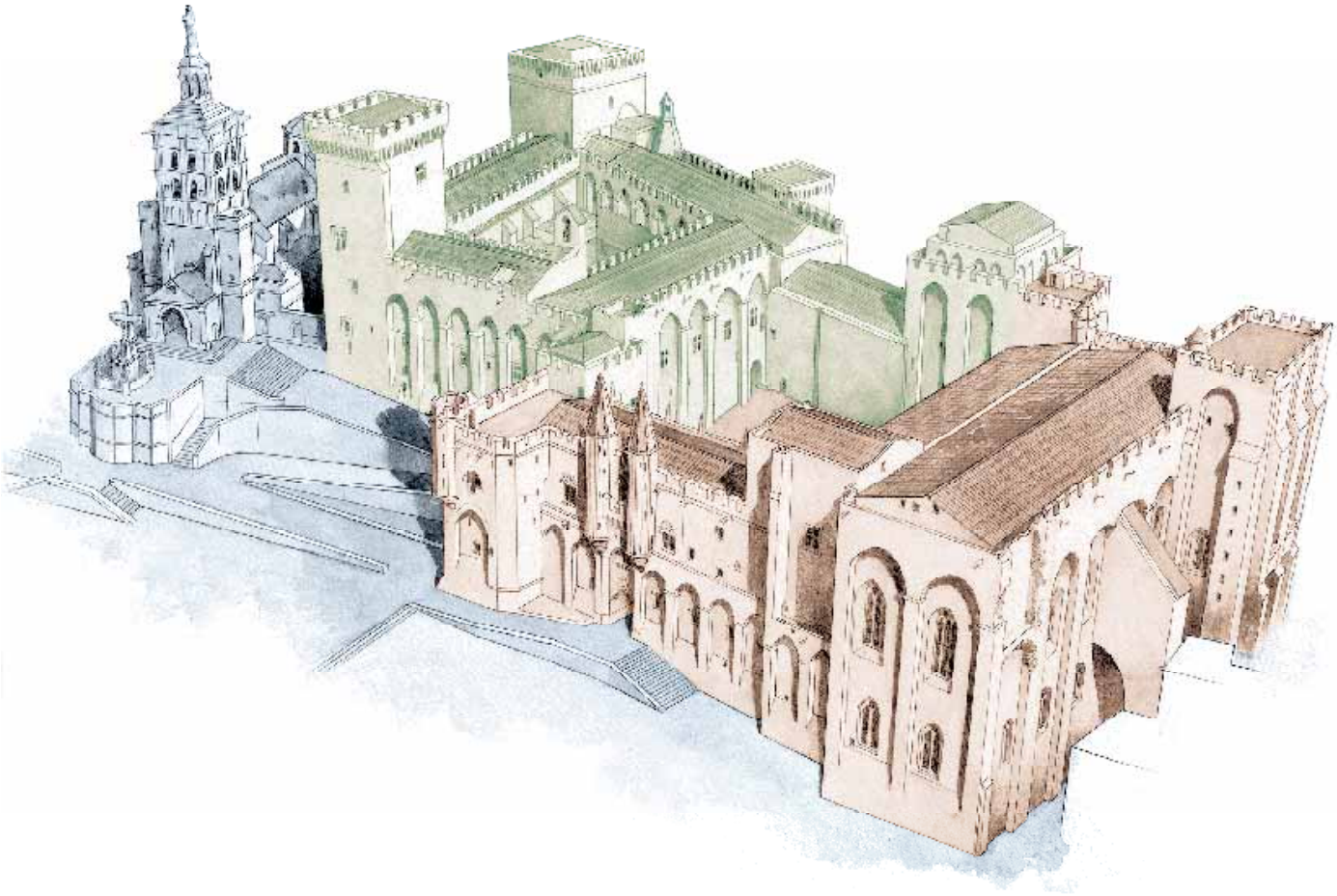
The biological conservation and ecological restoration of natural and semi-natural habitats are both essential in Europe. The aim of the conference is to present and assess the state-of-the-art in ecological restoration and to bring together scientists, policy makers, practitioners and stakeholders for mutual exchange and synergy. Through lectures, workshops, poster sessions and excursions, the conference will offer an outstanding opportunity for transboundary contacts and exchanges of knowledge, experiences, and "best" or at least successful practices in ecological restoration, an emerging field and profession at the crossroads of applied ecology, ecological and environmental economics. Without consideration of the "special" ecological and economical aspects of the Mediterranean environment, the sustainability of restoration processes and restored ecosystems cannot be achieved. Cooperation is essential as well. The recently established "Mediterranean Union" will facilitate transboundary cooperation among the 24 countries of the Mediterranean Basin, and between the Mediterranean Union and the other countries of the European Union. Restoring and improving the ecological health and sustainability of habitats, ecosystems, ecosystem services, and landscapes in Europe is a major challenge, particularly in the face of increasing pressures due to global changes including land use, demography, socio-economic, and climate changes.

Avignon, South-Eastern France - The Host City

Avignon is one of the most beautiful and famous cities in France and well-known around the world thanks to the famous song about the bridge of Avignon. Its beautiful and typically medieval city centre on both banks of the Rhône river attracts millions of tourists each year. Avignon in Southeastern France, provides an ideal destination for SER European conference delegates. Located within Mediterranean global biodiversity hotspot, Avignon is the centre for one of the major national restoration initiative: the restoration of 360 ha of Mediterranean steppe. The conference will provide an international focus for the world-class restoration issues and initiatives underway in South-Eastern France while exposing SER European delegates to a meeting in the Mediterranean Basin global biodiversity hotspot, world-renowned for its unique flora and fauna with a high level of species endemism, and acknowledged to support around 75% of France's rich plant life. The south-Eastern part of France, the Provence region boasts the greatest plant diversity in France within very ancient landscapes. Named the City of the Popes or Altera Roma, Avignon retains the indelible mark of the Popes' stay in the city, which was for a while the capital of the Medieval western world. Today, it is a prestigious cultural capital with its world-renowned Theatre Festival. Within a short time, the tourist can visit the most various sites: Pont du Gard, Nîmes, Arles, the Camargue, Luberon and Ventoux, Baux de Provence, St Rémy and the Alpilles are close to the town. The variety of attractions and sites to visit can enrich your trip to Provence. The era of the Popes somewhat eclipses other events in what is a long and tumultuous history. At the crossroads of the big trade and migratory routes between northern and southern Europe and between Italy and Spain, the city played a major role in European history. A Phoenician trading post during the High Antiquity, Avignon then became a flourishing Roman town. It suffered greatly from the barbarian invasions, followed by those of the Moors and the Francs in the High Middle Ages. With the expansion of trade, and benefiting from its strategic position and its bridge over the Rhône, it had the status of a free town, strong and arrogant enough to defy the King of France. The presence of the Popes made Avignon the capital of the Medieval western world in the 14th century. A papal territory up until the French Revolution, the city actually benefited little from the first Industrial Revolution. It entered into relative anonymity in the 19th century only to come back as a cultural capital in the 20th century. Avignon is the cradle of the Félibrige, a revival of Provençal literature and its Theatre Festival, started in 1946 by Jean Vilar, gives it international prestige.

The International Conference Center in the Popes' Palace

During the 14th century, the city of Avignon was part of the Pontifical States, and as such was sheltered from war and destruction. Since the High Middle Ages, Avignon has been a vital intellectual and commercial cross-road in Europe, a choice location for exchange, meetings and discussions. Today, its internationally-known cultural influence and attraction have made it one of the most prestigious conference sites in the world. The International Congress Center was created in 1976 within the outstanding premises of the Palace of the Popes and hosts many events throughout the entire year. The Congress Center, designed for conventions, seminars, and meetings for 10 to 550 persons, now occupies two wings of the Popes' Palace. The Jeanne Laurent Building, an outlying building just outside the Popes' Palace Congress Center, is located in the former papal gardens and can host working meals or exhibits relating to congresses held in the Congress Center. The Jeanne Laurent building is made up of four vaulted rooms in exposed stone, with magnificent views over the Rhône river, offering a splendid panorama of the Rhône Valley. The International Congress Center, a palace open to the modern world: the magnificent setting, the location in the very heart of the historical, cultural and university town of Avignon, the easy access (airport, TGV train station, direct motorways), the effortless parking (underground 810-place car park), all make the International Congress Center a choice destination.



Co-organisers

Major Sponsors

Other Sponsors

Organising committee

Thierry Dutoit (Chair), IMEP, University of Avignon, IUT, France
Céline Gallard, Popes'Palace Conference Center, Avignon, France
Claude Charpy-Roubaud, IMEP- IRD, University Paul Cézanne, Marseille, France
Dominique Boulard, University of Avignon, France
Florence Jullian, Popes'Palace Conference Center, Avignon, France
François Mesleard, IMEP - Tour du Valat, France
Hervé Heimburger, University of Avignon, IUT, France
Isabelle Laffont-Schwob, IMEP, Université de Provence, France
James Aronson, CEFE, CNRS, Montpellier, France
Julie Mélin, Popes'Palace Conference Center, Avignon, France
Kris Decleer, INBO, Ghent, Belgium
Renaud Jaunatre, IMEP, University of Avignon, IUT, France
Teddy Baumberger, IMEP, University Paul Cézanne, Marseille, France
Véronique Masotti, IMEP, Université de Provence, France

Scientific committee

Elise Buisson (Chair), IMEP, Université d'Avignon, IUT, France
Alain Pagano, Université d'Angers, France
Daniel Vallauri, WWF, France
Didier Alard, Université de Bordeaux 1, France
Francis Isselin-Nondedeu, Université Blaise Pascal, INRA, Clermont-Ferrand, France
Francisco A. Comín, Instituto Pirenaico de Ecología, Spain
Freddy Rey, CEMAGREF, Grenoble, France
Gudrun Bornette, CNRS Lyon, France
Hervé Daniel, Institut National d'Horticulture d'Angers, France
Isabelle Combroux, Université de Strasbourg, France
Ivan Bernez, Agrocampus, INRA, Rennes, France
Jim Harris, Cranfield University, UK
Katalin Török, Institute of Ecology and Botany, Hungary
Kathrin Kiehl, University of Applied Sciences Osnabrueck, Germany
Norbert Hölzel, (Chair SER Europe), University of Münster, Germany
Peter Poschlod, University of Regensburg, Germany
Rudy Van Diggelen, University of Antwerp, Belgium
Sabine Tischew, Hochschule Anhalt, Germany
Sébastien Gallet, Institut de Géoarchitecture de Brest, France
Thierry Dutoit, IMEP, Université d'Avignon, IUT, France
Tiemo Timmermann, University of Greifswald, Germany

Half-day field trip committee

Renaud Jaunatre (chair), IMEP, University of Avignon, IUT, Avignon
Arne Saatkamp, IMEP, University Paul Cézanne, Marseille
Bruno Fady, INRA, University Paul Cézanne, Marseille
Elise Buisson, IMEP, University of Avignon, IUT, Avignon
Elodie Debize, Marais du Vigueirat, Mas Thibert
François Mesléard, IMEP - Tour du Valat - University of Avignon, IUT, Avignon
Isabelle Laffont-Schwob, IMEP, University of Provence, Marseille
Jérôme Orgeas, IMEP, University Paul Cézanne, Marseille
Stéphanie Mari, Conseil Général du Vaucluse, Avignon
Simon Dufour, University of Provence, Marseille
Teddy Baumberger, IMEP, University Paul Cézanne, Marseille

About SER International

The Society for Ecological Restoration (SER) International is a non-profit organization infused with the energy of 2300 members – individuals and organizations who are actively engaged in ecologically-sensitive repair and management of ecosystems through an unusually broad array of experience, knowledge sets and cultural perspectives. They are scientists, planners, administrators, ecological consultants, first peoples, landscape architects, philosophers, teachers, engineers, natural area managers, writers, growers, community activists, and volunteers, among others.

Founded in 1988, the SER International now boasts members in 37 countries and all 50 US states, with 14 chapters serving regions of North America, England, Europe, Australia and India. Recognized by public and private enterprises as the source for expertise on restoration science, practice and policy, the Society achieves its objectives through cooperation with partner organizations and the work of its worldwide membership. The Society for Ecological Restoration International is a registered not-for-profit organization under Section 501(c)3 of the US Internal Revenue Code, and all contributions are fully tax-deductible.
SER International does not engage itself in restoration projects; its mission is: "to promote ecological restoration as a means of sustaining the diversity of life on Earth and reestablishing an ecologically healthy relationship between nature and culture."

To that end, the Society serves the growing field of Ecological Restoration through facilitating dialogue among restorationists; encouraging research; promoting awareness of and public support for restoration and restorative management; contributing to public policy discussions; recognizing those who have made outstanding contributions to the field of restoration; and, of course, promoting ecological restoration around the globe through.

Conferences are the lifeblood of the Society, where members convene to exchange ideas and information, and participate in SER workshops, fieldtrips and other activities. The Society hosts and cosponsors several conferences a year, and many SER chapters also offer regional conferences and meetings.

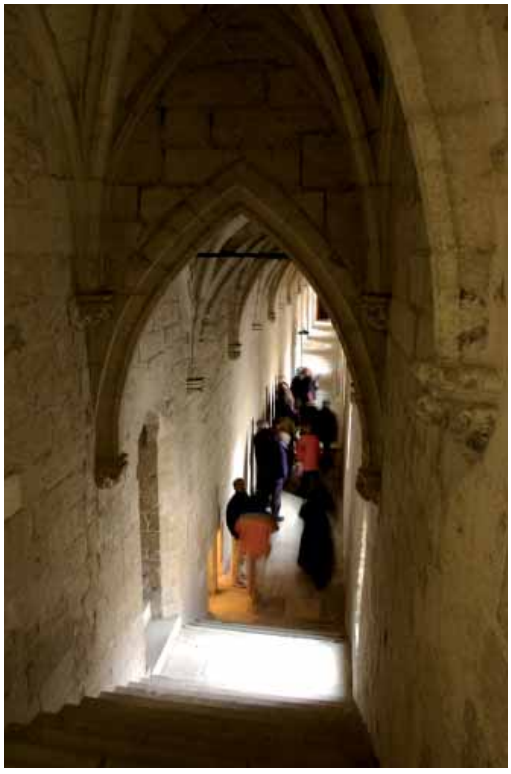
Journals have steadily defined and refined the field. Restoration Ecology, initiated by the Society in 1993, is offered to SER members at reduced rates. The Society\'s scientific and technical journal, it is peer-reviewed by a 30-member Editorial Board which includes eminent scholars from around the world. Primary emphases include: research on restoration and ecological principles that help explain restoration processes, descriptions of techniques that the authors have pioneered and that are likely to be of use to other practicing restorationists, and reviews of articles that summarize literature on specialized aspects of restoration. Ecological Restoration, the indispensible practitioner's guide, has served the field since 1981, summarizing current projects and techniques, and offering thought-provoking philosophical essays. Subscription to ER is provided as a service to SER members. Both journals are published quarterly.

Restoration Networks are fast becoming the heart of this emerging field which is now recognized as an essential element in the solution to our global environmental crisis. The Indigenous Peoples' Restoration Network (IPRN) was created in order to promote the appropriate uses of traditional ecological knowledge as a guiding principle in restoring the environment and culture of indigenous peoples. The Global Restoration Network (GRN) offers a comprehensive web portal to every aspect of ecological restoration, including case studies, databases, scientific papers, resource and expertise directories as well as podcasts and webcasts on a wide range of topics related to ecological degradation, conservation and restoration.

Website, Newsletter & eBulletin continue to evolve as important forums for communication, outreach and the exchange of vital information. The SER International website, which includes the IPRN and GRN websites, provides the general public with an invaluable and comprehensive resource on ecological restoration and related issues. The quarterly Newsletter keeps members up-to-date on the good work of the Society and its chapters while the weekly eBulletin - RESTORE - offers annotated links to the latest news stories from around the world.

Committees & Working Groups provide leadership opportunities within the Society and steer the following programs: Awards honors and recognizes those who have made outstanding contributions to the field; Education & Training advances the field by overseeing the Training Program and initiating educational programs for the Society; Publications advances the field by producing and overseeing publications on key restoration topics; and Science & Policy promotes excellence in research and contributes to the policy dialogue on ecological restoration as a conservation tool.

For more information, please contact: Society for Ecological Restoration International, 285 W. 18th Street, Suite 1, Tucson, Arizona 85701 USA,520.622.5485 phone / 270.626.5485 fax or visit www.ser.org



Office hour of desks

Please collect your satchel, program book, name badge from the registration desk. The registration desk will open at the "*Salle des Gardes*" before and during the Welcome Reception Cocktail Party on Monday 23 August 2010. Thereafter, the registration desk will be open during the four scientific program days:

Monday 23 August 2010, 4 pm - 8 pm
Tuesday 24 August 2010, 8 am - 6 pm
Wednesday 25 August 2010, 8 am - 6 pm
Thursday 26 August 2010, 8 am - 6pm
Friday 27 August 2010, 8 am - 5 pm

Information on Conference Social Events is available at desks. Tickets for booked social events (Free Wine tasting, Visit of the Popes'Palace, Gala Dinner, etc.) are included in your registration documentation. If you cannot attend an event, please, return, your ticket to the information desk.

Official language

The official languages of the congress are English and French according to the laws of the French republic on the use of the French language. Simultaneous translations are available during the plenary sessions, introduction and closing ceremony only. For technical reasons with the nature of ancient memorial of the center of the Popes' Palace Conference Center, it was not possible to use simultaneous translation during parralell, special sessions and workshops. The oral communications and the posters can be in French, in that case, their summary and title are presented in French in the program and the book of summaries.

Student staff

Voluntary students will be at your disposal to welcome you, guide you in the center of the Popes' Palace Conference Center, during the sessions and the excursions. Do not hesitate to seek them, they are recognizable in their T-shirt with the logo of the SER 2010 Avignon congress.

Badges

For security and regulation reasons, please wear your name badge at all times. It is your admission to all sessions, breaks in the "*Grande Audience*" room, lunches in Jeanne Laurent Building and the mid-conference excursions

Coffee breaks

Morning and afternoon coffee breaks will be served only in the "*Grande Audience*" room. Participants are not allowed to carry out drinks or food in working rooms.

Climate and Clothes

The weather in Avignon at the end of August is generally very sunny and warm with temperatures around 30°C and a pluviometry of only 30 mm for this month. For the field trips, do not forget to bring "field trip clothes" consisting of ample clothes and including good shoes, a hat or a cap, sunscreen, a spray against mosquitoes and a gourd of water.

Time zone

The time zone in Avignon is GMT + 1.

Banks

Please, note that there will be no exchange facilities at the International Conference Center. Lots of banks are present in Avignon center all around the Popes'Palace Conference Center.

Electricity

The voltage in France is 220V, 50hz.

Cellular phones

Cellular phones must be switched off in the conference rooms.

Lost and Found

For lost and found personnal belongings, please contact the information desk in the "*Salle des Gardes*".

First Aid

In case of emergency, please, contact the information desk.

Hotline

Under this phone number you can reach the desk at all office hours:
+ 33 490 27 51 50

Contacts

Please feel welcome to provide the Local Organising Committee with any feedback or to ask for clarification of any information.
- Registration queries, please contact Ms. Céline Gallard by email c.gallard@palais-des-papes.com or phone + 33 490 27 50 57
- Scientific queries, please contact Dr. Elise Buisson by email elise.buisson@univ-avignon.fr or mobil phone + 33 6 65 00 80 67
- Field trip queries, please contact Mr. Renaud Jaunatre by email. renaud.jaunatre@etd.univ-avignon.fr or mobil phone + 33 6 25 50 51 39
- Conference organisation queries, please contact Pr. Dr. Thierry Dutoit by email thierry.dutoit@univ-avignon.fr or mobil phone + 33 06 82 20 64 31
- Practical queries, please contact the coordinator of the Popes'Palace Conference Center (informations desk, lost property): phone: + 33 490 27 50 60 or 50 43
- Informatics or others practical queries in working rooms, please contact technicians of the Popes'Palace Conference Center : phone: + 33 490 27 51 04 or 50 46

Smoking

Please remember that smoking is not allowed in the congress center.

Internet

During the conference, computers with Internet facilities will be available for public use, free of charge, in the "*Paneterie 4*" room and "*Chambre des quatre fenêtres*" room will be assigned for wireless Internet access available to all participants with computers.

Changing room

A changing room will be open throughout the conference in the main entrance near the "*Salle des gardes*". It will be possible to store luggage in this changing room area.

Toilets

They are situated near the "*Salle des Gardes*", between the "*Paneterie*" and The "*Conclave*" hall, in "*Jeanne Laurent*" Building and near the "*Grande Audience*".

Exhibitions

During the whole conference, exhibitions are installed in the "*Grande Audience*" room where posters are also installed and where all the breaks are taken.
- SER - International and SER Europe, co-organiser of the conference
- IMEP - Mediterranean Institute of Ecology and Palaeoecology, co-organiser of the conference
- REVER – French National Network on Ecological Restoration
- WWF – Worl Wildlife Fundation, France (sponsor of the conference)
- General Council of Vaucluse (sponsor of the conference)
- Tour du Valat Research Fundation (sponsor of the conference)
- GRT Gaz Company (sponsor of the conference)
- Island Press
- Gaié - The Ecosystem Engineering Applications Group
- AgéBio - French Association of Bioengineering for Soil Erosion Control

Instructions for chairpersons, oral presentations and posters

Instructions for session organisers and chairpersons

Please be in the room at last 10 minutes before the session starts and make contact with your speakers. There will be a projectionist (student staff) who will open the room 15 minutes ahead of start and will technically control the projections. Please notify clearly the speakers that they have a 15 minute speaking time and 5 minutes for discussion in all parallel sessions. You are requested to show a yellow paper to the speaker after 14 minutes and a red paper after 15 minutes to allow some discussion. Please do NOT allow any discussion if the speaker has used all his/her time.

Uploading your Oral Presentation/s

To upload your oral presentation/s, either as part of the plenary session, invited sessions (symposia, organised oral sessions, special sessions or workshops) or contributed oral sessions, please make your way to "*Paneterie 4*". If interested, you can view your presentation before uploading by accessing one dedicated computer in this room. Once you are happy with your presentation, please visit the computer technician of the room where you will give your oral presentation. He is responsible for uploading your presentation/s. Please upload your presentation/s during the break before your session. It is attended that you will use a PowerPoint presentation. Nevertheless, if you use classic slides, oveheads or a paper board, please notify us as early as possible in advance before the conference, or latest at your registration at the desk.

Oral presentations

The timing of your presentation is of almost importance. The length of your talk should be 15 minutes, after 5 minutes are reserved for discussion, which is considered as important as your talk. All speakers are requested to be in the room of their session 10 minutes before the session starts and to contact the session chairperson and the projectionist from the student staff. We will be following a very strict time schedule at the conference which will require your full cooperation. Please be responsive to the indications by the chair on the timing near the end of your talk. Your chairperson will show you a yellow paper if you have only one minute left of your oral presentation time. You are resquested to quickly wrap up your talk then, to allow some time for discussion. If your chair shows you a red paper, you have used all your time and need to end your talk immediately. If you are not able to do that and continue your presentation 5 minutes more, there will be no possibility for you to answer on questions.

Posting your Poster Presentation/s

Posters have been allocated in the "*Grande Audience*" room. Posters will need to be posted during registration open hours on Monday 23 August 2010 (4pm - 8pm), or on Tuesday morning 24 August 2010, prior to the Tuesday afternoon poster session. Each poster has been allocated a code within a theme - this code will be located in your conference program book. When you receive your conference program book at the conference, please locate the poster pages, then your theme and lastly your name within the theme to source your code. To post your poster on the poster boards, please follow the coding system, which will appear alphabetically on the poster boards. To assist you, a map of the coding system will be located in the "*Salle des Gardes*" and the "*Grande Audience*" rooms. Posters will be displayed for the duration of the conference so that interested people can view the poster even when presenters are not in attendance. Each day, the poster sessions will enable presenters to discuss their presentations. Presenters are required to be present for this scheduled during their poster sessions

Poster dimensions and orientation

Poster presentations should be no larger than A0 size (900 mm x 1530 mm). Poster boards will only cater for portrait, not landscape, format. Pushpins and/or velcro will be supplied, and are the only method of attaching the poster to the board.

Hearing (oral) and Visiting (poster) Presentations

On Tuesday 24 August 2010, please make your way to the "*Conclave*" to hear the opening ceremony at 9:00am. During all the congress, and during the poster sessions, please visit the "*Grande Audience*" room to have a look and to talk to the poster presenters during the poster sessions. From Tuesday 24th to Friday 27th 2010, you will have the opportunity to select from several concurrent oral or special sessions which will be hosted in height rooms.

Biographical sketches of keynote speakers

James Aronson, trained in tropical botany and applied plant ecology of arid, semi-arid and mediterranean- climate regions, his current efforts concern both conceptual and methodological aspects of the restoration of all sorts of damaged ecosystems, both natural and socio-ecological. To construct meaningful references and select realistic objectives and tools to guide and carry out ecological restoration, a study of both past and present human ecology is crucial, especially when working in developing countries. Accordingly, emphasis is given to collaboration and integration of ecosystem ecology, ecological engineering and the social sciences, notably economy, environmental ethics and law. Issues related to energy, water and global climate change also increasingly emerge as transversal themes, under the general rubrics Restoring Natural Capital and Restoring Social Capital. Additionally, I continue a long-standing study of the ecology, biogeography and potential for restoration of tree canopies in arid, semi-arid and Mediterranean climate zones around the world.

Frédéric Médail is a professor of plant ecology and biogeography at the University Paul Cézanne Aix-Marseille III, and the leader of a scientific department at the Mediterranean Institute of Ecology and Palaeoecology (IMEP, UMR CNRS-IRD 6116). His broad research interests include the ecology, biogeography and conservation of plants around the Mediterranean Basin and adjacent regions. How to better preserve plant biodiversity at several geographical scales, from conservation genetics and phylogeography to community ecology, constitutes the vital lead of his investigations. The major aims are identifying important conservation areas (regional hotspots of diversity and endemism, glacial refugia) at the scale of Mediterranean Basin or at a regional scale (Maritim Alps, Corsica...), and exploring the patterns and processes related to plant richness and endemism. He has also performed several researches devoted to insular ecology and about the ecological and evolutionary consequences of biological invasion induced by alien plants on coastal and island habitats. His current researches are focused on the biogeographical processes linked to the origin and evolution of the Mediterranean flora, and their implications towards a conservation biogeography framework in the Mediterranean isoclimatic area.

Daniel Vallauri is 41 year-old and gets its PhD of the University of Marseille in forest restoration (1997). After several experiences abroad, he is, since 2000, responsible for WWF of the forest conservation program. He is acting nationaly and abroad. Its carreer and achievements concern forest ecology, conservation and restoration in France, the Mediteranean basin and tropical countries (Malaysai, Madagascar, overseas territories of France). He is the main author of various research publications and reports, has been co-editor of three recent books (including one on forest restoration worldwide) and coordinator of several conferences on naturalness. He is currently both working on forest restoration and forest wilderness areas.

Jordi Cortina Segarra, during is doctorate (University of Barcelona) and the post-doctorate (Colorado State University), he studied various aspects of the relations ground - plant and specially the effects of plants on the properties of the ground. From his incorporation in the University of Alicante he concentrated his research in the study of the degradation of ecosystems and their restoration. He study at present the functioning of some Mediterranean ecosystems, as well as techniques for the restoration of degraded ecosystems, by including some phases of the production of plants and the use of organic waste for the recovery of the fertility of degraded grounds.

José M. Rey Benayas is Professor at the University of Alcala. He completed his PhD at the Universidad Autónoma de Madrid in 1990; his Thesis was awarded by the University. He post-doc at the Northern Illinois University and at GeoEcoArc Research in the US when he held a Fulbright Scholarship. He has been working for the Universidad de Alcalá since 1994. His research is focused on the restoration of biodiversity and ecosystem services in agricultural landscapes. He currently leads the "Spanish Master in Ecosystem Restoration" and the PhD Program in "Ecology. Conservation and restoration of ecosystems". He founded with other colleagues from different countries in the world the International Foundation for Ecosystem Restoration intended to transfer the academic knowledge to the society.

Vasilios P. Papanastasis is full professor in the Faculty of Forestry and Natural Environment of the Aristotle University of Thessaloniki, Greece, and head of the Laboratory of Rangeland Ecology. He did his graduate studies (M.Sc., Ph.D.) at the University of California, Berkeley, in USA. He teaches several undergraduate and graduate courses related to grazing ecology, range development, silvo-pastoral management and desertification. He has a great experience in the ecology and management of Mediterranean rangelands and written more than 300 papers. He has been an active member of the FAO subnetwork on Mediterranean Pastures and Fodder Crops and the European Grassland Federation. He has participated in several national and international meetings on pastures and rangelands and has served for 8 years as a member of the continuing committee for the organization of international rangeland congresses.

Roland Bobbink is director and senior scientist at B-WARE Research Centre, Radboud University, Nijmegen, the Netherlands. He completed his PhD at Utrecht University, the Netherlands in 1989. His main research topic are the ecological consequences of environmental stresses (especially of atmospheric N deposition) on the structure and functioning of semi-natural ecosystems. In the last 20 years, ecological restoration of natural areas became the second major aim of his research. He did research in calcareous and acidic grasslands, dry and wet heaths, species-rich wetlands and shallow softwater lakes. He is (co) author of more than 100 peer-reviewed scientific papers and around 90 publications in Dutch. Furthermore, he has been co-editor of three recent books. He is member of the national committee on ecological restoration in the Netherlands, chair of the Netherlands-Flanders Ecological Society and leader of the empirical critical N loads approach within the UNECE.

Karen Keenleyside is currently a senior science and policy advisor with Parks Canada's Ecological Integrity Branch. She led the development of national guidance for ecological restoration in Canada's protected areas and is currently contributing to a similar initiative internationally. Her other responsibilities include the development of strategic policy direction on climate change for Parks Canada as well as guidance on other park management issues. Keenleyside has completed numerous strategic plans, policy documents, scientific reviews, and original research in subject areas as diverse as ecological restoration, climate change, protected areas, environmental quality guidelines, environmental indicators, invasive alien species, northern circumpolar issues, environmental monitoring, environmental toxicology, and human and ecosystem health. Her greatest achievement is helping to raise two daughters and continuing to cook tasty meals for her family while making significant contributions to ecosystem management in Canada.

1.

Food quality as bottleneck for fauna communities

Arnold Van den Burg & Eva Remke

Ecological restoration may be successful in restoring plant communities, but often fails at the same time in recreating a suitable habitat for target fauna species. Causes for this may be factors like unsuitable microclimate conditions and lack of required mosaic vegetation patterns. There is increasing evidence that poor food quality can also be a factor limiting the success of restoration management. In this session, speakers will address the questions as to under which environmental conditions food quality is adversely affected, what compounds of food quality are involved, and what the consequences are for fauna communities as a whole, from herbivores to top-predators. From this, possible solutions for nature management will be proposed and discussed; as yet, there is little experience with managing food-quality problems in nature restoration efforts. For example, in the Netherlands, strong effects in terms of plant quality are seen from nitrogen deposition. Restoring e.g. grass-encroached heathlands often does not provide heather plants that are edible for moth caterpillars. Additional nitrogen in the system alters the nitrogen allocation of plants into different compounds, some of which have anti-feedant properties. Hence, the restoration of moth populations fails. Poor plant quality is relayed in the food chain by decreased amounts and quality of food for predators. Restoration is now mainly focused on balancing plant nutrients, so that plants experience less excess nitrogen.

2.

Ecological restoration based on biogeochemical key processes

Jan Roelofs

Ecosystem restoration has, to a large extent, been based on a trial and error approach. By presenting research on the restoration of variety of ecosystem types this session will show the strong advantages of an approach based on biogeochemical research. This method, focusing on key factors and key processes, provides insight into the actual causal relationships between environmental changes and ecosystem responses. In addition, it indicates the target processes for restoration, and thereby enables scientists and nature managers to predict restoration prospects for locations that differ with respect to their initial conditions.

3.

Restoration and sustainable developement of high elevation ecosystems

Francis Isselin-Nondedeu & Alain Bédécarrats

High elevation ecosystems provide many ecosystem services including food and water, and are also spots of biodiversity and wildlife habitats. Human activities such as agriculture, farming and forest management have shaped the mountain landscapes as we know them. However, in addition to these historical land-uses the mountain ecosystems are increasingly disturbed by the construction of ski trails and roads within ski resorts, recreational trails, mine sites, changes of the water networks, and filling or drainage of wetlands. Proper restoration of high-altitude ecosystems is difficult to achieve because of harsh environmental conditions: intense weather episodes, long period of snow, strong winds, intense rainfalls, steep slopes, avalanche... This particular context requires to set up particular conceptual frameworks and restoration techniques in order to restore both the structure and the functions of the degraded ecosystems. Also various actors must be involved in the restoration projects, such as scientists, practitioners, ski resorts managers, technical staff, natural park managers, farmers, or people from local associations. The objective of this special session is to bring together scientists working in different mountain ranges and dealing with degraded terrestrial ecosystems or wetlands from high elevation. This will be a great opportunity to gather state of the art from various places and to share experiences about the restoration concepts and techniques, the success and the failures of restoration projects. Special attention will be given to interdisciplinary works, restoration practices and long-term monitoring. This will raise questions about assessing the restoration success: How evaluate if the restored ecosystem is in the good trajectory? What indicators are used or should be used to assess the success of a restoration project: biological indicators, species diversity, functional diversity, water quality, wilderness...? What future for the restored ecosystems in a changing world (global changes, including climatic and socio-economic aspects)?

4.

Plant introduction in ecological restoration – opportunities and risks

Armin Bischoff & Barbara Smith

Species introduction is a widely used method to accelerate the restoration of habitats or to re-establish locally extinct populations. However, as there is genetic differentiation and sometimes strong adaptation to local environmental conditions in plant and animal populations, the origin and quality of source populations must be carefully considered if re-introduction is to be successful. The use of non-local source populations may not only compromise the success of restoration measures, but may also have negative consequences on existing populations, potentially disrupting ecosystem function. Unfortunately, our understanding of the scale of adaptation and differentiation in most species is poor, and we have no universal answers to questions about the ecological effects of seed origin in restoration schemes. Nevertheless, restoration managers need information today and, despite the gaps, require a summary of current knowledge of both the risks and opportunities of species reintroduction. This is the topic of our special session. The speakers will present research on the risks of introducing non-local genotypes, in particular on the potential effects of introduced plants on herbivore communities, a relatively new research topic. Their talks will discuss work done at different scales, on a range of species, each focused on the complex decision making associated with choosing source populations. The studies were carried out in a variety of different ecosystems from grasslands, limestone quarries, mountainous habitats of the French Pyrenees, agro-ecosystems to riverine woodlands. They show interdisciplinary collaboration between researchers, restoration managers and suppliers of plant material in order to set up a more local provisioning system that also considers economic questions – an excellent example for the establishment of links across frontiers of different disciplines. There will be a structured discussion at the end of the session. 4 questions will be put to the audience. 1. Can we prioritise opportunities? What are highest priority knowledge gaps? 2. Are there current practices in restoration ecology that are inherently risky? 3. What are the critical messages to communicate to policy makers? 4. What is the potential for collaboration between scientists and practitioners? 5. How can we realize a more local seed provisioning?

5.

Sustainable management and restoration of Mediterranean riparian zones: the importance of International cooperation

Paula C. Dias & Ana I. Mendes

"Cooperation" is "the act or instance of working or acting together for a common purpose or benefit". This concept can apply to many fields, e.g. economical ("the combination of persons for purposes of production, purchase, or distribution for their joint benefit"), sociological ("activity shared for mutual benefit"), or ecological ("mutually beneficial interaction among organisms living in a limited area"). Riparian areas and associated characteristic vegetation play an untold number of environmental roles, like filtering pollutants, stabilizing soil against erosion and functioning as a refuge and ecological corridor for plant communities and wildlife.The "European Spatial Development Perspective" recognizes that biodiversity cannot be preserved with just a network of protected areas, but also needs the development of ecological corridors. Riparian areas are not common ecological corridors: they do not only have a linear structure, but they also show a specific up-stream/down-stream organization shaped by ecological processes which change gradually from spring to estuary. River Restoration projects and cooperation among different actors play a vital role in promoting ecological environmental restoration. On the other hand, the know-how from Northern/Central European countries in river restoration is considered high when compared with countries from the Mediterranean region. The goal of this special session is two-fold:

a) to present examples of international projects focussed on Mediterranean rivers, developed by different kind of actors (scientific institutions, regional authorities, practitioners...) including scientific studies, methodological developments, and pilot restoration projects;

b) to contribute to improve cooperation on river restoration bringing together actors from Mediterranean region and Northern/Central European countries.

6.

Farming for Restoration: building bridges for native seeds

Berta Youtie & Sabine Tischew

In the United States as well as in Europe a shortage of native plant material considerably restricts success in restoring ecosystems. Commercial seed mixtures containing foreign ecotypes and genetically uniform varieties are threatening local biodiversity. Therefore, the development of strategies for the propagation of native seeds for ecological restoration is of great importance. Challenges in developing native plant programs at local or regional scales include: 1) identification of species suitable for agricultural seed production; 2) development of genetically diverse, ecologically adapted materials; 3) strategies for tracking the identity of plant materials from wildland harvest through agricultural production and managing stock seed; 4) seed technology for diverse grass, forb and shrub species; 5) breeding systems; 6) pollinator requirements and the potential for managing wild pollinators in seed fields; 7) cultural practices for maximizing seed production; 8) insect pest and disease control. Major obstacles include sustaining funding for research and development, creating new market niches for seed growers, and creating and maintaining the bridges among researchers, seed regulatory agencies, the private seed industry, and land managers and other end users. In the western U.S. livestock grazing, annual weed invasions, and increased wildfire frequency have negatively impacted extensive semi-arid grassland and shrubland landscapes. A shortage of native plant materials needed to restore land health for multiple resource values increased revegetation costs and precluded their use in many areas. In response the U.S. Congress launched the Interagency Native Plant Materials Development Program for a semi-arid Mediterranean landscape scale restoration. Native seed programs established earlier in the last decade are now serving as models for newer programs, though issues, goals, and collaborators vary across the country. In Europe, the production of native plant material is often restricted due to high costs, lack of experiences in propagating native plants and lack of administrative support in restricting the use of non-native plant material. However, in the last years several projects were supported by the European Union to improve the knowledge about propagating native plants and their successful application in ecological restoration of degraded ecosystems. Both European practitioners and scientist working in this field will present their results. This session will provide an overview of success and challenges encountered while producing and using native plant material. We want to initiate the exchange of ideas and experiences between practitioners and scientists in the U.S. and in Europe.

7.

Future of the best ecological restoration practices & sustainable management in European atlantic rivers

Ivan Bernez & Dylan Bright

The principal objective of the session is to initiate a discussion between people involved in river management and river ecological restoration and to draw the future of best practices in ecological river restoration. The focus on salmon rivers will give the opportunity to establish links, at the European level, between researchers and managers working on Atlantic salmon population and/or their habitats. The model of partnership around a targeted species and habitat could be extending to other species or others aquatic habitats. Scales approaches in ecological restoration will be an important point of the session. Links with actual debates are encouraged in this session: e.g. resource protection to sustainable economic development though a Paid Ecosystem Service model, as recommended by the Millennium Ecosystem Assessment and IUCN via the Ecosystem Approach. Cultural, Economic and Environmental issues will be embraced to deliver sustainable resource protection. A central focus will be culturally and economically important migratory fish species which link water marine, coastal and freshwater resources, which are currently managed separately. Contacted speakers own to research and management institutions, they all have a background in targeted river basins, networked by regional river observatories: In this session there is a possibility to focus on migratory stocks of protected species which have economic, cultural and environmental value but which currently fall outside the scope of regional protection due to their migratory habit, which causes them to cross political and economic boundaries.

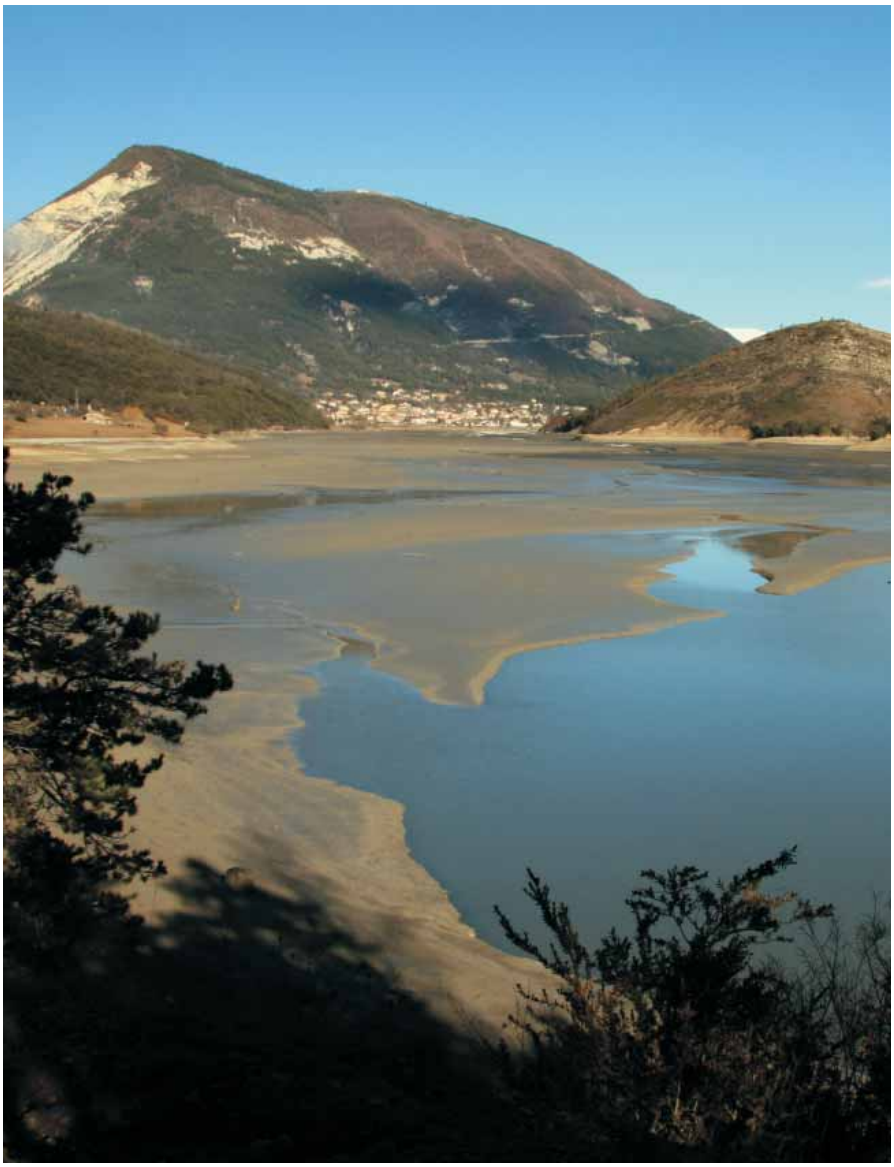
The migratory fish stocks in question utilise freshwater estuarine, coastal and international marine habitat. The species are: Shad, Atlantic Salmon, Sea Trout, Sea Lamprey, European Eel, Smelt and Eel. The perspective of the session could be how we will ecologically restore, protect and enhance fishery resources sustainably and long into the future? Could we use some innovative genetic techniques for defining the species migration paths and annual movements to evaluate the restoration? At which scales? Could development of aquaculture processes support reintroductions and supportive stocking? What improvement of natal spawning habitat under pressure from agriculture and climate change?

8.

Eroded areas: ecological restoration or not? Different solutions for different ecological and socio-economic issues in river catchments.

Freddy Rey

In different places in Europe and in countries with Mediterranean type of climate, two opposite kinds of practice co-exist concerning the management of erosion. In some catchments, re-elevation of river floors is observed; this phenomenon is due to excessive suspended load in the river. Habitats for fish reproduction may be damaged, inundation risks may therefore increase, and hydroelectric dams can be fullfilled of sediment. At the opposite, other catchments are concerned with lack of bedload in the river. As a consequence, the level of alluvial nappes may decrease, and incision of river floors occurs which can cause damages such as bridge destabilisation. The vegetation cover is an important factor controlling erosion responsible for sediment yield in rivers. Therefore, when excessive sediment load exists, erosion control on slopes and riverbanks is encouraged by leading operations of ecological restoration or rehabilitation, in particular using bioengineering techniques. Whereas in deficit situation, erosion reactivation is preferred, by destructing vegetation on soils highly erodible. Sometimes, both situations can co-exist within the catchment basin of one river. This influence of vegetation on sediment production of rivers, especially in mountainous areas, is often not understandable, especially by the practitioners. Scientists should discuss and better assess the knowledge on this topic. The objective of this special session is therefore to bring together scientists, from both restoration ecology and geomorphology, to present their own experience and point of view, in order to better understand why actions of ecological restoration of eroded areas should be considered or not. This will be the opportunity to review several places in Europe where different ecological and socio-economic issues may call different solutions in the management of erosion.



Institute of Ecology and Environment

Understanding the biosphere to act

An interface institute at the crossroads of human and universe sciences, earth and life sciences, based on eco-sciences and human and environmental relationships.

Missions and goals

The mission of the INEE is to promote and coordinate toplevel fundamental research in global ecology conducted by research units in the fields of ecology and environment, including biodiversity and human-environment interactions.
This research will provide answers to issues related to global change, to the consequences of human activity on the environment and its impact on health. One of the main goals of the institute is to ally various disciplines in order to promote the development of environmental sciences as an integrated scientific field. Based on this knowledge, it would be possible to reach the societal demand on matters of environmental engineering, assessment, assistance in environmental remediation and, more generally, the challenges of sustainable development.

Strategic directions

- To promote creativity and studies in environmental sciences.
- To support and implement tools for the scientific missions of the institute.
- To bring research closer to action.

Fields of research

5 main research topics :
- Biodiversity and functional ecology
- Analysis and management of ecosystem-related services
- Retroaction of ecological systems on global changes
- Adaptation, adaptability and evolution in variable environments
- From anthropisation to artificialisation of environment

10 interface research topics :
- Environmental assessment
- Environmental sustainability
- From ecology to global ecology
- From human impact to artificial environments
- Biodiversity, structure, dynamics and functionality
- Mechanisms of adaptation and evolution
- Ecological and environmental engineering
- New biomes - major anthroposystems
- Environment and health
- Chemical ecology and ecologic chemistry

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Partnerships

Cooperation with other CNRS institutes is based on complementary features and is realised along scientific axes that are jointly defined. In addition, the INEE is also developing partnerships with other French research organisations involved in environmental sciences. With higher education establishments, such cooperation is carried out via so-called Partnership Arrangements for
Ecology and Environment (DIPEE), which is a unique and innovative partnership mechanism created by the INEE.

1.

Water Hyacinth, Problems and opportunities

Sevastianos Roussos

During this meeting we would like to organize a workshop on Water Hyacinth, "Water Hyacinth: Problems and opportunities of this invasive plant"; the aim of this workshop is to establish an update on the following topics:
Biogeography and diversity of water hyacinth
Dynamics of populations related to environment
Economic and ecological consequences of this water invasive plant
Study cases of Water Hyacinth biomass utilization and restoration of ecosystems for a sustainable development
The aim of this workshop is to present the state-of-the art on Water Hyacinth and to bring together scientists, policy markers, practitioners and stakeholders for mutual exchange and synergy on ecological restoration and on the biotechnological upgrading of this plant biomass. First day and second day. Open session for all people attending the meeting SerAvignon 2010 with conferences, round tables and poster presentations. Third day : closed sessions for the researchers involved in the European project FONCICYT from Spain, France and Mexico.

2.

Exchange of experiences on restoration and conservation of critical sites for migratory birds along the East Atlantic flyway: Balancing transboundary ecology with rural development

Guus Schutjes & Fokke Fennema

Critical sites for migratory birds form a vast ecological network; connecting North and South, crossing the outer EU borders. This network of critical sites is becoming more and more fragmented, deteriorating within and especially outside the EU. Western European countries have difficulty in maintaining migratory bird populations (especially going south). There are problems along the flyway in Europe but also in West Africa. This causes problems for all European countries harboring migratory birds in critical sites (Natura 2000 sites, national/ regional protected areas and agricultural land harboring high nature value). If each separate country focuses its policy for maintaining migratory bird populations only on restoration of, and agri-environment for its own critical sites along the flyway, these investments will be inefficient if at the same time other critical sites in other countries along the flyway are deteriorating. Therefore, cooperation along de flyways is necessary for maintaining migratory bird populations. The objectives of the Workshop will be :
- Creating a quick overview of the status of critical sites along the East Atlantic Flyway bearing in mind economic development and the importance of these sites for "European' migratory birds.
- Sharing different national experiences among relevant organizations on critical site restoration and agri-environment along the flyway in relation to rural development.
- Investigate points of common interest in methods used, points of view, best practices in policy and implementation, regarding critical site restoration and agri-environment.
- Creating a network of policy makers and practitioners for attuned activities on ecological restoration and rural development in each country and sharing knowledge, experience and best practices relevant to this subject.

3.

Defining and sharing success criteria for single-species reintroduction

François Sarrazin, Christian Kerbiriou & Bruno Colas

Many reintroductions have been set up outside of the framework of restoration ecology. However, they face various challenges that have already been identified in this framework. Among them, one of the most important is the lack of agreement on reintroduction success criteria, despite the existence of numerous recommendations and meta-analyses. Restoration ecology already set up a list of success criteria for ecosystem restoration that could provide directions for reintroductions. Indeed, sustainability, resilience and connection clearly remind us that long term population viability is the ultimate goal of these programs. Nevertheless, if all agree that reintroduced populations should be viable, we still need general approaches, targets and threshold to define their success. We propose simple elements that may help to structure these issues and may be widely used among reintroduction programs. First, we distinguish reintroductions run for conservation issues from other programs that, in some cases, may have their own ad hoc criteria. Second, it seems necessary to distinguish between 'global' versus 'local' conservation targets. In the first case, reintroduction is necessary for the conservation of a globally threatened species. In the second one, reintroduction concerns a species that is not globally threatened. Third, we can split reintroduced population dynamics in three basic phases: settlement, growth and regulation. Their duration may vary and they can even overlap but in each phase, PVA approaches may help to define success criteria accounting for individual and environmental quality.

Finally, the ultimate long term success rely on the third phase where IUCN red list criteria for viability may be used at a global or a regional scale according to the type of target previously defined. The workshop will have the following aims:
- The improvement of the connection between reintroduction practices, conservation status and restoration ecology.
- The presentation of new success criteria followed by a wide discussion open to the presentation of alternatives.
- The evaluation of their potential relevance for a wide range of taxa and situations.
- The implication of the criteria for the a priori definition of reintroduction aims and the monitoring of reintroduced populations.
- The proposal of the set up of national and European networks to exchange monitoring information and apply the criteria on a wide range of reintroduction programs, in connection with other initiatives set up at an international level.

4.

Eyes wide open: building bridges and crossing them

Richard Scott
& Peter Abrutat Whitbread

For restoration to make a successful bridge between project work and the social/political world outside, we have to excite a wider audience to show ecological restoration can contribute to a richer society. This workshop highlights two unique Millennium projects in Englands North and South West. The Eden Project in Cornwall and the National Wildflower Centre in Liverpool have both shown possible pathways for this to happen, each of which can show by creative means, how the environment can lead in a new kind of restoration. Measurable in many millions of pounds, to the local economies, and by generating local pride in these regions. It addresses the importance of engaging new conversations with a broad spectrum of fields, professions, and social groups, beyond a narrow base of research priorities. Most importantly this workshop will deliver, and present a fun and stimulating consultation, which by vox pop will invite others to share their thoughts and practice of breaking barriers between strict science and the social world outside (this will be done by entertaining short interview and questionnaire during the first two days of the conference. For this reason it is best to stage the workshop towards the end of the conference).These finding will be presented at the workshop, in a creative manner, to ensure topical debate, and be used to produce a statement of social action which will be presented to the SER Europe Committee as a stimulating conference output.

5.

Addressing a Ramsar need through the identification and assessment of available practical guidance for the restoration of wetlands

Kevin L. Erwin, Rob McInnes, Royal C. Gardiner & Nick Davidson

Ramsar's Scientific and Technical Review Panel (STRP) is currently updating and expanding the existing Ramsar guidance on restoration and rehabilitation of lost or degraded wetlands, in the context of Resolution X.16 on "A Framework for processes of detecting, reporting and responding to change in ecological character, including approaches to prioritization and links with other Ramsar tools and guidance, inter alia those on climate change and on economic values of ecosystem services." The existing guidance, which is fairly generic, was adopted by resolution of the member parties at COP VIII in 2000. This workshop is planned to be one of several held around the world through 2010 and 2011 that will seek input from various end users including managers and restoration experts, with the final proposal presented for adoption at COP 11 in early 2012. The workshop attendees will first discuss the utility of the existing Ramsar guidance. This will assist in verifying the outcomes previously expressed by the STRP working group. The wetland restoration experts present will then be invited to identify existing guidance on wetland restoration by habitat types, who uses it, does it work, are there any obvious gaps and finally provide good examples of the application of the guidance as case studies. The outputs from the workshop will feed into the proposed updating of Ramsar's guidance on wetland restoration and rehabilitation

SER Meetings

Monday 23 August 2010, "Herses Notre-Dame" (5 – 7 pm)

SER European Board meeting

This meeting is open only to the members of the SER Europe board and will concern legal registration of SER Europe chapter, board election, constitution of a SER Europe office, etc.

Tuesday 24 August 2010, "Cellier Benoît XII" (6:30 - 7:30 pm)

SER Europe memberships Meeting

This meeting is open only to members of SER Europe and SER International. A presentation of past and future activities of SER Europe will be done.

Thursday 26 August 2010, "Cubiculaire" (6:30 – 7:30 pm)

Organising and Scientific committee joint meeting

This meeting is open only to members of the organising and scientific committee of the 7th European Conference of Ecological Restoration and invited participants. During this meeting, the final declaration of the conference will be discussed as the proceedings possibilities for the congress.

Thursday 26 August 2010, "Cubiculaire" (7:30 – 8:30 pm)

Meeting of French Networks on Ecological Restoration (REVER, AgéBio, Gaié) (in French)

This meeting is open to delegates involved or interested in the organization of French networks on ecological restoration.

Meetings upon request

The "Herses Notre-Dame" (max 20 people) is a dedicated room for all meetings upon request of the participants during the five scientific days, commencing on Monday 23 August 2010 at 4 pm. Please contact the registration desk to book this room.

Tuesday 24 August 2010, "Herses Notre-dame" (2:50 - 6:30 pm)

Computational Sustainability

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Computational Sustainability is a newly emerging interdisciplinary field that aims to apply techniques from computer science, information science, operations research, applied mathematics, and statistics for balancing environmental, economic, and societal needs for sustainable development. The main focus is on developing computational and mathematical models and methods for helping the decision process in biodiversity conservation. Bringing in advanced computational methods as a tool to solve these large-scale ecological problems holds tremendous promise for the enrichment of all involved fields. A first goal of this talk is to present two starting projects in the topic of computational sustainability: a project which aims at modeling and optimizing biodiversity in the metacommunities of lakes networks; and a project which aims at modeling and controlling dispersion risks of invasive species along natural and anthropogenic corridors. A second goal of this talk is to call for a network of researchers interested in ecology and computer science in order to facilitate the exchange of ideas and the emergence of a new research field dealing with computational methods for modeling and optimizing biodiversity conservation. Interested researchers could be involved in the elaboration of a European cost action, which will aim to formalize the theoretical and scientific framework of the network. The last step could be the elaboration of a FET flagship proposal.

FIELD TRIPS

Wednesday 25 August 2010

Departure Time : 13:00
Meeting Point : Bus Parking of the Avignon'Bridge (Parking Ferruce), please follow carefully the indications of the student staff.
Return Time : 6:30 pm – 7 pm

Caution : For the field trips, do not forget to bring a "field trip clothes" consisting of ample clothes and including good shoes, a hat or a cap, sunscreen, a spray against mosquitoes and a gourd of water.

1.

Conservation of plant diversity in agricultural systems: cereal fields and pastures in the Luberon Area

Arne Saatkamp

This field trip will go to the Luberon mountain ridge east of Avignon and the agricultural landscapes south of it. The Luberon area has a long history of human occupation and continuous pasture and cereal cultivation until today lead to a considerable part of plant diversity bound to traditional agricultural practices. A program of the Regional Natural Parc (Parc Naturel Régional du Luberon) and regional conservation associations (CEEP) maintains traditional agriculture to protect this diversity. Our visit will lead us through dry calcareous grasslands and very species rich agricultural area on the Plateau de Vaucluse in the region of Lagarde d'Apt.

2.

Restoration of mountain forests in the Mont Ventoux

Bruno Fady

Mount Ventoux, as well as large areas in the French Southern Alps, was the scene of large scale reforestation at the end of the 19th century and during the first half of the 20th century: soil erosion was successfully controlled and forests devastated by overexploitation and overgrazing were successfully restored. This restoration is moving into a second, dynamic phase as, for several decades now, Beech (*Fagus silvatica*) and Silver fir (*Abies alba*), which had remained within residual stands, are recolonizing the planted pine (*Pinus nigra*, *P. sylvestris*, *P. uncinata*) stands. The new, mostly heterogeneous and mixed stands which result from this "maturation process" form a complex landscape mosaic that opens interesting prospects for the sustainability of forest trees and their associated biodiversity. However, climate change constitutes a new, very real threat, which consequences are already obvious on Mount Ventoux. The challenge for foresters is to anticipate as much as possible and to adjust forest management to this evolution. Mount Ventoux is not only a MAB reserve and a Natura 2000 site, it is also a unique and original natural scientific laboratory. The current - and inescapable in the short term - forest decline in some areas requires a new approach to ecological restoration which will benefit from current research at INRA Avignon within the framework of international networks.

3.

Restoration of salt marshs and former rice fields Camargue

François Mesléard

The Camargue, a deltaic plain created by the sediments from the Rhône River, is one of the largest wetland areas in Western Europe. Human activities such grazing, rice growing and salt production have largely shaped this mosaic of habitats influencing the rich biodiversity, especially avifauna. After a general introduction of the Camargue context, this excursion will focus on Salinas as an example of interaction between economic activities and nature conservation. The Salinas of Giraud, a complex of 12 000 ha, represent a feeding and nesting area for many water birds including the emblematic Greater Flamingo. The restoration of a breeding site in the 1970's boosted the Flamingo reproduction, which interruption was a threat for the whole Mediterranean population. Over time, various actions were made in favour of other patrimonial waterbirds, such as the Slender-billed Gull. The Mediterranean Salinas heritage value depends on the existence of a relative instability which strengthens the richness of these artificial wetlands. Today, Salinas are at a turning point of their history. Facing numerous constraints, some, such as the Salinas of Giraud, are becoming partially inactive. In order to conserve their biological richness, innovative measures must be found to maintain a dynamic of ad hoc habitats.

4.

Restoration of Mediterranean steppic vegetation in the Crau area

Elise Buisson

The Nature Reserve of "Coussouls de Crau" is one of the last xeric steppe of Europe. This species rich vegetation host many steppic birds and some endemic arthropods. Almost 80% of the original area disappeared due to human activities (dump, military airport, cropping...). For ten years, experiments have been conducted to assess restoration techniques. The dominant perennial species (*Brachypodium retusum*) was transplanted on a filled quarry to assess its effect on plant community assembly. To mitigate future damages, an experiment was carried out on an underground pipeline where hay was transferred to accelerate steppe vegetation colonization. An abandoned 350 ha orchard is being rehabilitated in a steppic like habitat: nurses species seeding, soil excavation and translocation and hay transfer are assessed with the long-term objective to restore the steppe vegetation in term of species richness, structure and composition. The field trip will firstly focus on the original steppe ecosystem and then on the experimentation plots.

6.

Industrialised coast dunes: is it possible to conciliate industrial activities and preservation of salt marsh ecosystems using restoration ecology?

Teddy Baumberger

The expansion of the industrial area of Marseilles Fos Port Authority induces the destruction of salt marshes ecosystems, habitats and vegetation. Those ecosystems show patrimonial interests as they present typical salt marshes vegetation communities containing rare, threatened and/or endemic species. Amongst them, Limonium girardianum, which is protected at national scale, presents several populations living on current and future work sites. Indeed, since 60s, those human exploited salt marshes, for salt production, have been under high disturbance and habitat destruction pressures. In our case, the Electrabel society is building an electric power plant on large populations of Limonium girardianum. As compensatory measures, Electrabel finances for three years, a study dealing with Limonium girardianum ecology, population biology and restoration measures of their disturbed or even destructed populations on Fos-sur-mer. Limonium girardianum is a perennial herbaceous species which lives on sandy substrates of salt marshes. Our observations show that the favorable habitat of this species corresponding to intermediate micro altitudes between often flooded areas called "sansouire" and more drought and never flooded areas corresponding to more or less fixed sand dunes. This species tolerate relatively high salt concentrations, and more or less long flooded or drought periods. The aim of our study is to understand the presence of the species and its populations status in order to apply restoration, reinforcement and conservation measures taking account the industrial context and disturbance pressures. We assessed the habitat and the ecology of the species and we set in situ restoration experimentations in order to evaluate reimplantation capacities of the species according to different environmental conditions and ontogenic stages. This type of habitats within lives our species consist of dynamics ecosystems, i.e. sand dunes are not fixed for the long term. Indeed, the wind power and flood events lead to create and destruct potential habitat for Limonium girardianum. That why, we consider restoration of Limonium girardianum populations as "dynamics restoration". We investigate those questions: do the disturbances due to human constructions favour maintain of Limonium girardianum populations in space and time? Or, did still exist populations in the future, after salt marshes infilling, hence disappearance of its habitats by dune fixation?

8.

L'Escalette (Marseille): post-industrial polluted site in one of the Mediterranean hot-spot of biodiversity: how to deal with this paradox?

Isabelle Laffont-Schwob

With a floristic richness of exception, the Mediterranean coast is however heavily threatened by urban development and pollution. This region, known as one of the hotspot of biodiversity, is also one of the hotspot of demography growth and become one of the highly sensitive ecosystems. Thus, the Mediterranean coast engenders a paradoxical situation i.e. high endemism and rarity of the flora under environmental and anthropic growing perturbations. A appropriate illustration is given by the Marseilles South-East coast. At the beginning of the Calanques hills, Mediterranean coastal ecosystems interface pollution from abandoned industrial sites and polluted sea sprays from urban effluents at Cortiou. Occurrence of heavy metals from past industrial activities such as lead and arsenic was detected over the site. A restoration program has begun to deal with the requirement of the National Park of Calanques creation programmed to be effective in 2010. During this excursion, the pollutant fluxes at the level of the different compartments (soil, water, plants) and the biocoenose relationships will be discussed and the up-to-date project to lead to plant conservation and multi-polluted soil restoration will be explained.

9.

Can we deal with multiple objectives in fluvial margins and former channel rehabilitation: example along the lower Rhône River (France, SE)?

Simon Dufour

Regulated since the middle of the 19th century, to fight flooding, improve navigation and irrigation, and produce electricity, the Rhône River is characterized on a large part of its French course by a fixed landscape inherited from an active channel dynamics. As a result of morphological adjustment generated by regulation works, significant changes in flooding conditions are now observed. A rehabilitation project has been initiated by the National Company of the Rhône to combine both a decrease in local flood risk (by enlarging flood-carrying capacity) and an enhancement of geomorphological and ecological properties of the margins into the reach (sediment reworking, pioneer species regeneration…). The aim of this field trip is to present the project developed since 2007 for fluvial margins and former channel rehabilitation along the lower Rhône River reach. Because of this reach specificities (i.e. multiplicity of issues and stakeholders), a particular framework has been developed. The rehabilitation project of the lower Rhône River concerns a 70 km length reach where several issues are overlaid. On one hand, the instream introduction of sediments stored in the floodplain could cause negative consequences to others aspects such as private land erosion, navigation, and polluted sediments introduction. On the other hand, this action could benefit sediment supply to coastal area or ecological functioning of the floodplain. Moreover, the vulnerability to inundation is concentrated only in the first kilometres of the reach and not in the Camargues delta. To increase erosion, channel gradient is also more favourable upstream from Arles. As a result, few sites appear to be potentially rehabilitated (2 to 4 sites along 70 km). One site is going to be used to discuss several issues raised by the project: how to definel reference conditions? How can we choose sites to test the actions? How to design these actions? Which kind of ecosystems can be expected under Mediterranean climate (composition, recovery rate, presence of exotic species…)?

10.

Active restoration of the Vigueirat Mediterranean wetland: Invasive plant species control

Elodie Debize

The Marshlands of Vigueirat are a mosaic of Mediterranean natural wetland habitats with a great biological richness (290 bird species have been recorded, including many rare species with high conservation value). The field trip will lead you to be actively involved in an invasive species management program on this ecosystem: the water primrose's control and removal. Water primrose (*Ludwigia* spp, Onagraceae family) is an aquatic weed originally from South America. This species reduce biodiversity and degrade water quality by decreasing pH and dissolved oxygen content. Moreover, water primrose can quickly block waterways, interfering with human uses of water systems such as navigation, fishing, hunting and pasturage. They create a serious problem for the aquatic environment, which they colonise to the detriment of the local flora and fauna.

12.

Restoration of Mediterranean islands

Jérôme Orgeas

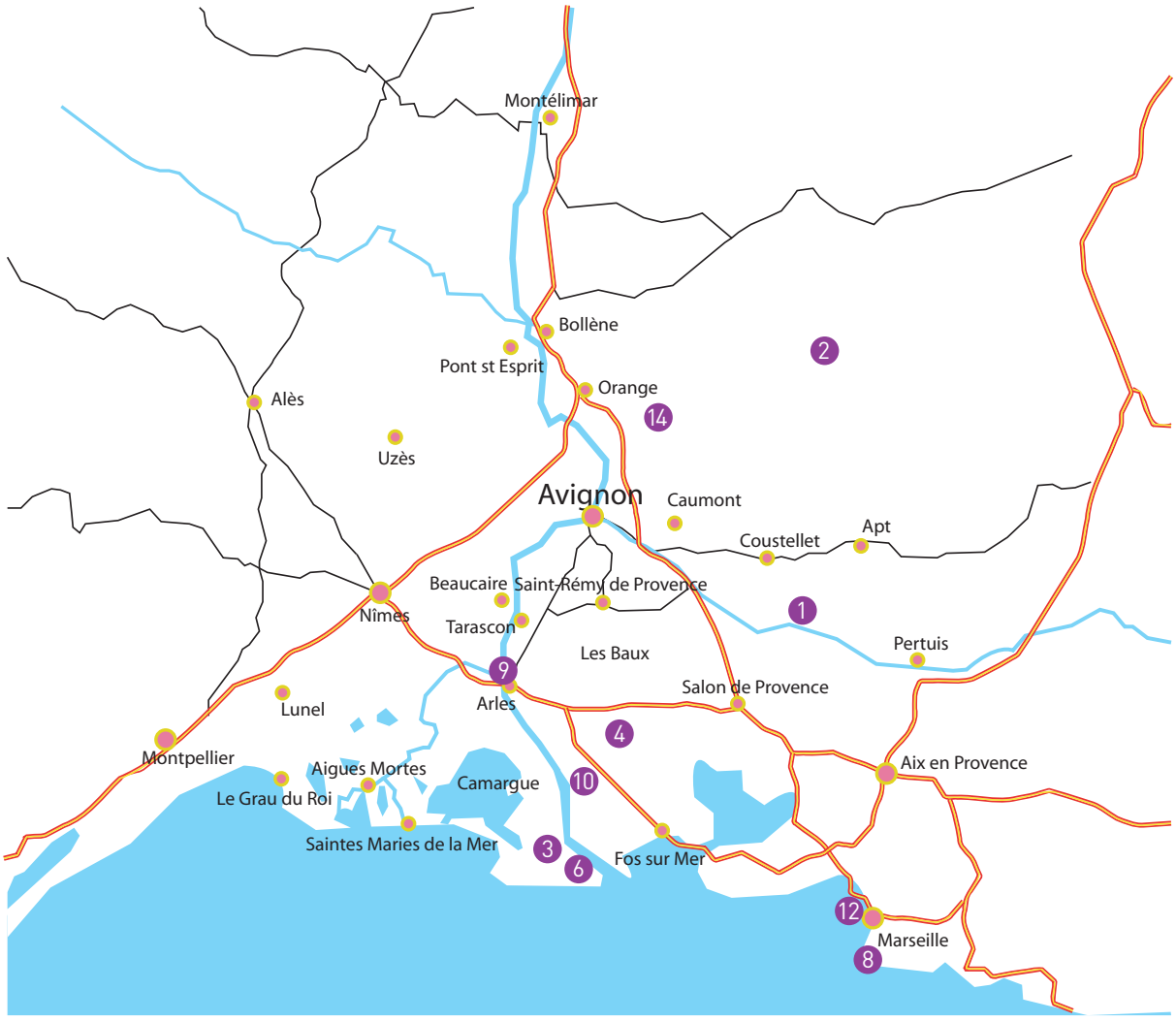
The Frioul archipelago encompasses four islands counting for a total of 200 hectares, and distant of 4 km of Marseille. Before being part of the town, the archipelago has experienced a heavy past of history and was early established as an outpost of Marseille military defence. This long occupation by humans has now turned into mass tourism activities and urban expansion. The human pressure has raised conservation issues for a great number of valuable species found on the set of islands. Many birds and plants are indeed rare and protected, which most of them show sharp adaptations to the harsh coastal Mediterranean environments. The conference field trip will propose a walk around the main two islands of the archipelago (Pomègue and Ratonneau) where history, ecology and conservation issues will be presented across few stops. Impacts of human-use on native species and the spread of invasive ones (rats, rabbits and feral cats) will be particularly highlighted. Management policy of this original area will be discussed as part of conservation programs and future protection.

14.

Restoration of Mediterranean riparian vegetation in the Arboretum of Beauregard

Stéphanie Mari

The Beauregard Arboretum serve as an experimental site for research which has been conducted with the Porquerolles Botanical Conservatory for the past four years, for genetic amelioration and improvement of the natural landscape for damaged natural habitats (riverbank woods, hedges and related habitats). The positive results obtained by this program will be a reference; showcasing what can be done with native vegetation fo (1) salvaging vanishing natural habitats or genetic amelioration of damaged habitats, (2) reviving and restoring habitats upset by infrastructure installlations (roads, etc.) and (3) ornamental planting adapted to the soils, climates and landscapes of the Provence area.



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During all the conference, exhibitions are installed in the "*Grande Audience*" where posters are also installed and where all the breaks are taken. Feel free to visit and discuss with people involved in the different presentations of ONG, private fundations, companies and librarians.

1. SER International and SER Europe

The Society for Ecological Restoration (SER) International is a non-profit organization infused with the energy of 2300 members – individuals and organizations who are actively engaged in ecologically-sensitive repair and management of ecosystems through an unusually broad array of experience, knowledge sets and cultural perspectives. They are scientists, planners, administrators, ecological consultants, first peoples, landscape architects, philosophers, teachers, engineers, natural areas managers, writers, growers, community activists, and volunteers, among others.
The roles of SER Europe are to promote ecological restoration as a means of sustaining the diversity of life on Earth and re-establishing an ecologically healthy relationship between nature and culture in the European geographical area.

2. IMEP, Mediterranean Institute of Ecology and Palaeoecology

The main goal of the IMEP is to elucidate how ecosystems, especially those in the Mediterranean Basin, are shaped by interactions between local disturbances and global constraints. Patterns of biodiversity are being investigated at our institute on various timescales and spatial scales, focusing in particular on the vulnerability of ecological systems and species. Our Institute is involved in the management of natural resources, in close collaboration with regional, national and international networks dedicated to the protection of natural resources. Members of the IMEP also carry out University lecturing activities in the fields of biology, ecology and environmental science, at Bachelor's and Master's degree level. The IMEP also provides occupational training in research in both the public and private sectors, and strongly favours interdisciplinary approaches. The IMEP focuses mainly on the Mediterranean Basin, but keeps the whole world in sight.

3. REVER, French National Network on Ecological Restoration

REVER is the acronym for the French-speaking network on ecological restoration. Created thanks to CNRS / CEMAGREF funds promoting networks in 2008-09, its aim is to improve communication between managers, practitioners, students and scientists working in the fields of restoration ecology and / or ecological restoration. More details can be found at www.reseau-rever.org

4. WWF, World Wildlife Fund (France)

WWF is one of the worldwide conservation organizations. It's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, promoting the reduction of pollution and wasteful consumption. As the importance of degraded lanscape (for both biodiversity and ressources) continues to grow, the need to integrate the restoration of forest functions into landscape conservation plans become more pregnant. Thus, WWF has made forest landscape restoration a key topic and priority for its forest work together with protected areas and sustainable management. Due to the WWF's extensive global reach, and together with its many partners and counterparts, it has acquired a significant level of experience on the topic of forest restoration at large scales in various part of the world. WWF run restoration programs in many countries. It has coordonated publications to gather the collective body of knowledge and experience of WWF and its many partners (Mansourian et al. 2005). In France, WWF participates to the restoration efforts particularly in New Caledonia (dry tropical forest), Madagascar (tropical humid forest) or the Mediterranean areas.

5.
General Council of Vaucluse

The department is named after Vallis Closa, the "closed valley" from which emerges Fountain Vaucluse, the source of river Sorgue. Fountain Vaucluse is known by hydrologists worldwide as the model of "Vauclusian resurgence". The department of Vaucluse was created as the 87th French department by Decree of 25 June 1793. The area surface is 3 567 square kilometers. The population count is of 533 000 persons. The density of the population is 149 persons by square meter. The General Council of Vaucluse integrates 3 Districts, with 24 sub districts. You will find 151 Town Halls under the General Council Vaucluse.

6.
Tour du Valat Research Fundation

La Tour du Valat, located on a 2600ha estate in the heart of the Camargue, is a private research organization with the legal form of a public-benefit foundation since 1978. Convinced that wetlands can be preserved only if human activities and the protection of the natural heritage can be reconciled, the Tour du Valat has been developing multidisciplinary research programmes for more than 50 years on ecology and management of Mediterranean wetlands. The Tour du Valat shares with Ramsar and other organizations in the Mediterranean region the mission to halt the loss and the degradation of Mediterranean wetlands and of their natural resources, and to restore them. The Tour du Valat employs around 60 staff including a scientific team made of 30 specialists in biological sciences (plant ecology, ornithology, ichthyology ...), hydrology, geography, socio-economics, integrated management and training. The team implements research and conservation projects throughout the Mediterranean region. The results are communicated via training, partnerships, and the implementation of innovative projects carried out in collaboration with a wide range of partners. The Tour du Valat Estate includes all the natural habitats representative of central Camargue among which 1844ha benefit from the status of Regional Nature Reserve. In addition to biodiversity conservation, the estate is used as an experimental site for research on management of wetlands and as a show case for transfer of results. The Tour du Valat, has a unique bibliographical resource centre in the Mediterranean, specialized in Wetlands Ecology, Ornithology, Zoology, Mammalogy, Ichtyology, Herpetology, Botany. Each year, hundreds of researchers, teachers and students from the Mediterranean basin come and consult the library's reference materials.

7.
GRT Gaz Company

GRTgaz's environmental policy covers the legal requirements in numerous fields of environmental protection: air, water, waste, noise, energy, natural heritage. GRTgaz applies these requirements in its different industrial activities (compressor stations and transmission facilities for GRTgaz) and administrative functions (offices, vehicles, procurement, etc.). This policy is implemented through appropriately planned initiatives designed to achieve environmental objectives covered in the component processes of the management system. GRTgaz also works to reduce the environmental impact from engineering works and from the operation of its facilities.

8.
Island Press

Since 1984, Island Press has been a leading publisher of books about the environment for professionals, students, and general readers. Our titles reflect the breadth and immediacy of global environmental problems and the range of appropriate responses to them, from solutions-oriented books for working professionals to books on ideas that inform and inspire.

Welcome Reception
Monday 23 August 2010

A welcome reception cocktail party will officially open the conference on the evening of Monday, 23 August 2010. The cocktail party will be hosted from 4 pm - 8 pm in the Popes'Palace Convention Center in the Grande Audience room where delegates can enjoy the spirit of the former "Court of the Popes". Drinks and nibbles will be served. The afternoon will also provide delegates an opportunity to visit the registration desk open from 4 pm - 8 pm in the "*Salle des Gardes*" formerly the "Guardroom" of the Popes' Palace.

Opening ceremony
Tuesday 24 August 2010
9 am - 11 am

There will be welcome addresses of Pr. Norbert Hotzël (Chair of SER Europe), Pr. Emmanuel Ethis (President of the University of Avignon); Pr. Thierry Tatoni (Director of the Mediterranean Institute of Ecology and Paleoecology).
Additionallly some practical information will be given. After this open ceremony, there will be the plenary sessions of Dr. James Aronson and Pr. Frédéric Médail.

Visit of Avignon City Center
Tuesday 24 August 2010
10 am - 12:30 am

Strolling in the streets of Avignon with the tour guides of the Tourist Office, you will discover the different facets of the town. They will make you love Avignon, telling you the great history (medieval Bridge, and Palace, churches, mansions...) as well as the little story. This city tour discusses also the extraordinary development Avignon underwent due to the arrival of the Popes in the 14th century (city planning, cardinals' palaces, city mansions, the Jewish presence and the Synagogue, organisation of the city and city life at the time, the trades, the markets...).

Visit of the University of Avignon
Thursday 26 August 2010
10 am - 12:30 am

Established more than 700 years ago, the University of Avignon is partly settled since 1997 in the ancient Saint - Marthe hospital, that was built between 1605 and 1835. Today, 7 000 students are present in the campus city center dedicated to Education and Research, these buildings counting among the most beautiful of France !

Visit of the Popes' Palace
Thursday 26 August 2010
7:30 pm - 8:30 pm

Visits of the Popes'Palace will be organised in English or French on Thursday 26 August 2010 at 7:30 pm for delegates and accompanying persons. Let's meet in the Salle des Gardes at 7:30 pm to start the visit. The skyline of Avignon is a magnificent urban landscape.Overlooking the city and the Rhône river, the Rocher des Doms presents an exceptional set of monuments including the Saint Bénezet Bridge, (the famous « Pont d'Avignon »), the Ramparts, the Petit Palais, the Cathedral and the impressive walls of the Popes' Palace flanked by four mighty towers. This architectural group has been ranked by UNESCO: « world heritage for humanity ». The Palace of the Popes stands as the mighty symbol of the church's influence throughout the western Christian world in the 14th century. Construction was started in 1335 and completed in less than twenty years under the leadership of two builder popes, Benedict XII and his successor Clement VI. The Popes' Palace is the biggest Gothic palace in all of Europe (15,000 m^2 of floor space, which is the equivalent of 4 Gothic cathedrals). The visitor can see over 20 rooms, scenes of historic events, in particular the pope's private chambers and the frescoes painted by the Italian artist Matteo Giovannetti. The Popes' Palace also offers the visitor continuous cultural activities throughout the year. A major art exhibit is displayed in the Great Chapel during the summer, and the most prestigious performances of the Avignon Theater Festival, created by Jean Vilar in 1947, are given in the Honor Courtyard of the Popes' Palace during the month of July. The Popes' Palace has welcomed more than 650,000 visitors. It is one of the most visited monuments in all of France.

Gala Dinner
Thursday 26 August 2010
9 pm – 11:30 pm

A conference dinner in the Great Tinel Hall (formerly the "Room of the feasts") will be organised during the congress on Thursday, 26 August 2010. Please arrive between 8:45 pm and 9 pm in the *Salle des Gardes* before starting the dinner. During this dinner several awards, "*the keys of the Popes'Palace*" will be given to the winners of the Ph.D. students best posters.

The "Bouteillerie" Wine Cellar at the Popes' Palace
23 – 27 August 2010.
Opening hours : 10 am - 7 pm

The "Bouteillerie" will be open during all the congress, and you can try a selection from 63 Côtes du Rhône at cellar prices.The wines grown along the banks of the Rhone river have undergone many changes since the Middle Ages and the Côtes du Rhône vineyards now stand among the greatest French AOC regions. The city of Avignon, capital of the Côtes du Rhône wines, quite naturally promotes these wines which are an inherent part of its culture. The Wine Cellar at the Palace of the Popes, known as the "Bouteillerie", has taken a resolutely educational approach to the Côtes du Rhône wines, offering the public a "guided" wine tasting of over forty wine choices selected by a committee of wine professionals_and enthusiastic amateurs in a blind selection process.The objective at the Bouteillerie is to help the visitors to the Palace of the Popes, who come from around the world, to learn more about the quality and diversity of the Côtes du Rhône wines, thus enabling them to be ambassadors upon their return to their home countries.However, the Bouteillerie at the Palace of the Popes is by no means reserved for tourists ! Local Avignon residents find excellent wine choices, and can get advice and recommendations from the professional staff, thus continuing to discover Côtes du Rhône wines and making judicious choices. The Bouteillerie has been set up in the former Artillery Room at the back of the palace. Open since July 1999, it provides a very friendly, pleasant space where sommeliers are at your service 365 days a year. The Bouteillerie is open every day during Palace visiting hours. Entrance is free of charge (Access via the Place de l'Amirande, or through the main entrance to the Palace).

Visit of the Requien'Museum
Friday 27 August 2010
10 am to 12:30 am

Since the end of the twentieth century the collections of the Musée Requien have been enriched by many donations from local collectors and throught the museum's own efforts. Among the most remarkable are Requien's, Loiseleur-Deslongchamps'and Jean-Henri Fabre's herbaria, Bulot's series of mid-Cretaceous ammonites, Pélissier's carabids, and the brown bear fossils from Mont Ventoux. Esprit Requien (1788- 1852) a devoted botanist from an early age, whose herbarium rapidly gained and international reputation. As a forerunner of phytosociology, he described the levels of vegetation of Mount Ventoux. His eclecticism extended more or less into all branches of science. The great savants of his day paid him homage by naming species after him, and himself discovered of several genera. Besides his scientific pursuits, he was the inspector of historical monuments.In this capacity, along with his friend Prosper Mérimée, he opposed the plans to demolish Avignon's ramparts, which are today one of the highlights of the papal city. The Musée Requien maintains two permanent exhibitions, Plongée dans le temps (Submerged in time) and Faune vauclusienne (The Fauna of the Vaucluse). From gypsum crystal to a giant white shark, delicate starfish to fish imprinted on stone, Plongée dans le temps bears witness to the evolution of paleo- and bio-diversity before the advent of human influence on the environment. Faune vauclusienne offers views of the richness of the two main animal habitats of the region, those of the rockly bluffs and riverside, and divulges the habits of the last great indigenous predators of the nineteenth century, the bear and the wolf.

Closing ceremony
Friday 27 August 2010
2 pm – 3:30pm

After the plenary session of Karen Keeleyside, closing remarks and statement will be made, and the 'Avignon resolution'will be presented. Futhermore, the venue of the 4th SER International World Conference on Ecological Restoration, 21 – 25th August 2011 in Mérida, Yucatán, México will be announced by Francisco A. Comin (Instituto Pirenaico de Ecología) as the 8th European Conference on Ecological Restoration, 9 – 14th September 2012 in České Budějovice will be announced by Pr. Karel Prach (University of South Bohemia). Some announcements for proceedings (extended abstracts and special issue of international scientific journals) will be also made by guest editors of each pecial issue (*Applied Vegetation Science, Freshwater Biology, KMAE, ecologia mediterranea*).

Relevé floristique le long d'une bande de servitude signalée par une borne jaune.

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Dans les espaces naturels, les bandes de servitude le long des canalisations de transport sont un terrain favorable au développement de la biodiversité.

Après trois ans d'étude, le Conservatoire botanique national du Bassin parisien a publié ses conclusions début 2010. Elles confirment que ces bandes herbeuses peuvent constituer, particulièrement en milieu forestier, des continuités écologiques en reliant des espaces naturels entre eux.

Partenaire de l'ONF et de la Fédération des parcs naturels régionaux de France, GRTgaz fait évoluer ses pratiques dans le cadre de ces coopérations pleines d'avenir… pour préserver la biodiversité !

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Construisons le transport de demain

PROGRAMME OVERVIEW

Monday 23 August	
16 : 00 – 20 : 00	Registration "*Salle des Gardes*"
16 : 00 – 20 : 00	Free wine tasting "*Grande Audience*"
17 : 00 – 19 : 00	SER Europe Board Meeting "*Herses Notre - Dame*"

Tuesday 24 August	
8 : 00 – 18 : 00	Registration/information desk "*Salle des Gardes*"
9 : 00 – 9 : 30	Opening ceremony "*Conclave*"
9 : 30 – 10 : 15	Plenary session 1 : Dr. James Aronson
10 : 15 – 11 : 00	Plenary session 2 : Pr. Dr. Frédéric Médail
11 : 00 – 11 : 20	Coffee Break
11 : 20 – 12 : 40	Sessions 1 to 8 1. Restoration as the bridge builder (1/4) "*Conclave*" 2. Restoration of herbaceous ecosystems (1/6) "*Cellier Benoît XII*" 3. Restoration of peatlands, bogs, fens, mires, etc. (1/4) "*Paneterie 1*" 5. Restoration of industrial areas and mines (1/4) "*Paneterie 3*" 6 Special session 1 : Food quality as bottleneck for fauna communities "*Cubiculaire*" 7. Restoration of rivers and riparian ecosystems (1/4) *"Chambre du trésorier"* 8. Workshop 1. Water Hyacinth, problems and opportunities (1/7) *"Herses Champeaux"*
12 : 40 – 14 : 00	Lunch "*Espace Jeanne Laurent*"
14 : 00 – 14 : 45	Plenary session 3 : Dr. Daniel Vallauri "*Conclave*"
14 : 45 – 14 : 50	Transition time
14 : 50 – 16 : 10	Sessions 9 to 16 9. Restoration as the bridge builder (2/4) "*Conclave*" 10. Restoration of herbaceous ecosystems (2/6) "*Cellier Benoît XII*" 11. Restoration of peatlands, bogs, fens, mires, etc. (2/5) "*Paneterie 1*" 12. Restoration of heathlands and artic ecosystems "*Paneterie 2*" 13. Restoration of industrial areas and mines (2/4) "*Paneterie 3*" 14. Use of prescribed burns and fires in ecological restoration (1/1) "*Cubiculaire*" 15. Restoration of rivers and riparian ecosystems (2/4) *"Chambre du trésorier"* 16. Workshop 1. Water Hyacinth, problems and opportunities (2/7) *"Herses Champeaux"*
16 : 10 – 17 : 10	Poster session 1 + Coffee break "*Grande Audience*"
17 : 10 - 18 : 30	Sessions 17 to 24 17. Restoration as the bridge builder (3/4) "*Conclave*" 18. Restoration of herbaceous ecosystems (3/6) "*Cellier Benoît XII*" 19. Restoration of peatlands, bogs, fens, mires, etc. (3/4) "*Paneterie 1*" 21. Restoration of industrial areas and mines (3/4) "*Paneterie 3*" 22. Restoration of marine ecosystems "*Cubiculaire*" 23. Restoration of rivers and riparian ecosystems (3/4) *"Chambre du trésorier"* 24. Workshop 1. Water Hyacinth, problems and opportunities (3/7) *"Herses Champeaux"*
18 : 30 – 19 : 30	SER Europe Membership Meeting " *Cellier Benoît XII*"

Wednesday 25 August	
8 : 00 – 12 : 30	Registration/information desk "*Salle des Gardes*"
9 : 00 – 9 : 45	Plenary session 4 : Pr. Dr. Jordi Cortina Segarra "*Conclave*"
9: 45 – 10 : 30	Poster session 2 + Coffee break "*Grande Audience*"
10 : 30 – 12 : 30	Sessions 25 to 32 25. Restoration as the bridge builder (4/4) "*Conclave*" 26. Restoration of herbaceous ecosystems (4/5) "*Cellier Benoît XII*" 27. Restoration of peatlands, bogs, fens, mires, etc. (4/4) "*Paneterie 1*" 28. Special session 2. Ecological restoration based on biogeochemical key processes "*Paneterie 2*" 29. Restoration of polluted mines and industrial areas (4/4) "*Paneterie 3*" 30. Special session 3. Restoration and sustainable developement of high elevation ecosystems "*Cubiculaire*" 31. Special session 3. Restoration of rivers and riparian ecosystems (4/4) *"Chambre du trésorier"* 32. Workshop 1. Water Hyacinth, problems and opportunities (4/7) *"Herses Champeaux"*
12 : 30 – 19 : 00	Excursions

Thursday 26 August	
8 : 00 – 18 : 00	Registration/information desk " *Salle des Gardes*"
9 : 00 – 9 : 45	Plenary session 5 : Pr. Dr. José rey Benayas "*Conclave*"
9 : 45 – 10 : 30	Poster session 3 + Coffee break "*Grande Audience*
10 : 30 – 12 : 30	Sessions 33 to 40 33. Fragmentation, connectivity, and ecological restoration in Europe "*Conclave*" 34. Restoration of herbaceous ecosystems (5/6) "*Cellier Benoît XII*" 35. Restoration of coastal and dune ecosystems (1/2) "*Paneterie 1*" 36. Restoration of forest ecosystems (1/2) "*Paneterie 2*" 37. Special session 4. Plant introduction in ecological restoration – opportunities and risks "*Paneterie 3*" 38. Workshop 2. Exchange of experiences on restoration and conservation of critical sites for migratory birds (1/3) "*Cubiculaire*" 39. Special session 5. Sustainable management and restoration of Mediterranean riparian zones: the importance of International cooperation *"Chambre du trésorier"* 40. Workshop 1. Water Hyacinth, problems and opportunities (5/7) *"Herses Champeaux"*
12 : 30 -14 : 00	Lunch "*Espace Jeanne Laurent*"
14 : 00 – 14 : 45	Plenary session 6 : Pr. Dr. Vasilios P. Papanastasis "*Conclave*"
14 : 45 – 14 : 50	Transition time
14 : 50 – 16 : 10	Sessions 41 to 48 41 Socio-economic, policy and design issues in ecological restoration (1/2) "*Conclave*" 42 Restoration of herbaceous ecosystems (6/6) "*Cellier Benoît XII*" 43. Restoration of coastal and dune ecosystems (2/2) "*Paneterie 1*" 44. Restoration of forest ecosystems (2/2) "*Paneterie 2*" 45. Special session 6. Farming for Restoration: building bridges for native seeds (1/2) "*Paneterie 3*" 46. Workshop 2. Exchange of experiences on restoration. And conservation of critical sites for migratory birds (2/3) "*Cubiculaire*" 47. Special session 7. Future of the best ecological restoration practices in European atlantic rivers (1/2) *"Chambre du trésorier"* 48. Workshop 1. Water Hyacinth, problems and opportunities (6/7) *"Herses Champeaux"*

16 : 10 – 17 : 10	Poster session 4 + Coffee break "*Grande Audience*"
17 : 10 - 18 : 30	Sessions 49 to 56 49 Socio-economic, policy and design issues in ecological restoration (2/2) "*Conclave*" 50. Key-species and facilitation in restoration ecology "*Cellier Benoît XII*" 53. Special session 6. Farming for Restoration: building bridges for native seeds (2/2) "*Paneterie 3*" 54. Workshop 2. Exchange of experiences on restoration. And conservation of critical sites for migratory birds (3/3) "*Cubiculaire*" 55. Special session 7. Future of the best ecological restoration practices in European atlantic rivers (2/2) *"Chambre du trésorier"* 56. Workshop 1. Water Hyacinth, problems and opportunities (7/7) *"Herses Champeaux"*
18 : 30 – 19: 30	Organising and Scientific Joint Committee Meeting "*Cubiculaire*"
19 :30 - 20 : 30	French Network on Ecological Restoration Meeting "*Cubiculaire*"
19 : 30 – 20 : 45	Visit of the Popes'Palace
21 : 00 – 23 :30	Gala Diner and Poster Price Ceremony "*Grand Tinel*"

Friday 27 August	
8 : 00 – 16 : 00	Registration/information desk "*Salle des Gardes*"
9 : 00 – 9 : 45	Plenary session 7 : Dr. Roland Bobbink "*Conclave*"
9 : 45 – 10 : 30	Poster session 5 + Coffee break "*Grande Audience*"
10 : 30 – 12 : 30	Sessions 57 to 64 57. Atmospheric nitrogen as a constraint to ecological restoration "*Conclave"* 58. Restoration of Mediterranean ecosystems and arid lands "*Cellier Benoît XII*" 59. Restoration of wetlands, lakes and ponds "*Paneterie 1*" 60. Linking restoration and ecological succession "*Paneterie 2*" 61. Workshop 3. Defining and sharing success criteria for single-species reintroduction "*Paneterie 3* 62. Workshop 4. Eyes wide open: building bridges and crossing them"*Cubiculaire*" 63. Special session 8. Eroded areas: ecological restoration or not? Different solutions for different ecological and socio-economic issues in river catchments *"Chambre du trésorier"* 64. Workshop 5. Addressing a Ramsar need through the identification and assessment of available practical guidance for the restoration of wetlands *"Herses Champeaux"*
12 : 30 - 14 : 00	Lunch "*Espace Jeanne Laurent*"
14 : 00 – 14 : 45	Plenary session 8 : Dr. Karen Keenleyside "*Conclave*"
14 : 45 – 15 : 30	Closing Ceremony "*Conclave"*

	Tuesday 24 August 2010							
Rooms	CONCLAVE	CELLIER BENOIT XII	PANETERIE 1	PANETERIE 2	PANETERIE 3	CUBICULAIRE	CHAMBRE DU TRÉSORIER	HERSES CHAMPEAUX
Sessions	Restoration as the bridge builder (1/4)	Restoration of herbaceous ecosystems (1/6)	Restoration of peatlands, bogs, fens, mires, etc. (1/4)		Restoration of industrial areas and mines (1/4)	Special session 1. Food quality as bottleneck for fauna communities (1/1)	Restoration of rivers & riparian ecosystems (1/4)	Workshop 1.
11h20 - 11h40	03 Is Ecological Science really sufficient to effectively restore Mediterranean ecosystems?	07 Assisted migration in urban demolishing sites: conversion of wasteland into low-maintenance meadows	11 Restoring key-biogeochemical features of groundwater-fed rich fens: a pilot study		15 Influence of large scale topography on plant colonisation of post-industrial spoil	18 Does nitrogen deposition cause decline of butterflies by changes in host plant quality?	22 Biodiversity in riverbank techniques for erosion control: assessment of animal and plant species diversity along a natural gradient	
11h40 - 12h00	04 Linking restoration evaluation and knowledge exchange to combat desertification	08 Long-term assessment of grassland restoration by topsoil removal and diaspore transfer with hay – the importance of environmental filters and founder effects	12 Restoration of fens and peat lakes: a biogeochemical approach		16 A geomorphic reclamation model of 'catchments on slopes' for the ecological restoration of surface contour mining	19 Direct effects of acidification and eutrophication on heathland fauna species	23 Applying river restoration knowledge in flood mitigation schemes : RIVERSCAPES as supports for dialog between dry dam designers and biologists	Water Hyacinth, problems and opportunities (1/7)
12h00 - 12h20	05 From 'Why ?' to 'What ?' and 'How ?': developing intercultural principles and strategies in ecological restoration	09 Do nutrient-rich soils impede the restoration of species-rich mesophilous grassland? Long-year experiences on hay transfer in lowland and mountainous meadows	13 Control of seepage flux and soil organic matter dynamics on restoration of basiophilous fen meadows		17 Construction wastes, green waste compost and Switchgrass (*Panicum virgatum* L.) used for landfill cover restoration	20 Contrasting effects of high nitrogen deposition and aeolian dynamics on food quality of Grey Hairgrass (*Corynephorus canescens*) in drift sand ecosystems	24 Characterization of the cost of aquatic ecosystems restoration for river basin management under the Water Framework Directive in Spain	
12h20 - 12h40	06 Reaching a favourable conservation status within the EU: making ecological restoration a 'hot' issue	10 Wet grassland restoration: effects of soil type, rewetting and techniques on recruitment and ground light availability	14 Restoration of drained mires in the Šumava National Park, Czech Republic		General discussion	21 Restoration of degraded Dutch forests and remediation of micronutrient deficiencies	25 River Meuse restoration project from the air	

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Rooms	CONCLAVE	CELLIER BENOIT XII	PANETERIE 1	PANETERIE 2	PANETERIE 3	CUBICULAIRE	CHAMBRE DU TRÉSORIER	HERSES CHAMPEAUX
Sessions	Restoration as the bridge builder (2/4)	Restoration of herbaceous ecosystems (2/6)	Restoration of peatlands, bogs, fens, mires, etc. (2/4)	Restoration of heathlands & arctic ecosystems (1/1)	Restoration of industrial areas and mines (2/4)	Use of prescribed burns and fire in ecological restoration (1/1)	Restoration of rivers & riparian ecosystems (2/4)	Workshop 1.
14h50 - 15h10	27 Green Infrastructure as a tool for a new European Biodiversity Strategy	31 Regrassing with regional seed mixtures in the Bile Karpaty Mountains, Czech Republic	35 Fluctuating water tables as potential restoration measure for floating rich fens	39 From arable fields to lowland heathland supporting Silver Studded Blue butterfly	43 What are the main influential factors on vegetation succession on reclaimed coal wastes in Spain?	47 Use of prescribed burning for restoration and maintenance of ecological conditions: Predicting and managing fire injury and tree mortality	51 Ecological responses to management actions: Flow alteration – vegetation response relationships	
15h10 - 15h30	28 Enhancing social and economic sustainability of restored areas: case studies from Brazil	32 Grassland restoration in floodplains of East German rivers	36 The effects of peatland restoration on water-table depth, elemental concentrations and vegetation: 10 years of changes.	40 Restoration options for a Thames Basin heath	44 Hay transfer, mulch seeding and spontaneous succession – ten years after slope restoration in a post-mining site	48 Compost amendment in a Mediterranean ecosystem after fire: effects on soil, micro-organisms and vegetation	52 River and watershed restoration through the assessment of ecosystem services	
15h30 - 15h50	29 From 'Why ?' to 'What ?' and 'How ?': developing intercultural principles and strategies in ecological restoration	33 Ecological restoration of a wet meadow on peat soil: a case study in the estuary of Seine River (France).	37 Blanket bog water tables: How much of an impact did drains have, and what influences responses to restoration?	41 Impacts of phenological shifts on the restoration of upland heath ecosystems in Scotland: practical problems and moral dilemmas	45 Strategies for natural woodland development in mined sites based on germination and establishment studies with Betula pendula Roth	49 Effects of post-fire silvicultural treatments related to the burned wood on the soil nutrient availability and soil carbon sequesration.	53 *Restauration hydroécologique de la Veyle au droit de la gravière de St-Denis-les-Bourg, département de l'Ain, France*	Water Hyacinth, problems and opportunities (2/7)
15h50 - 16h10	30 Reaching a favourable conservation status within the EU: making ecological restoration a 'hot' issue	34 Ecological re-creation of a wet meadow on peat soil: comparison of vegetation natural dynamics, sowing, mowing and transplantation experiment	38 Restoring drained blanket bogs : involving and informing the hill farming community.	42 Growth of rare plant with "home" and "away" mycorrhizal fungal assemblages	46 Ecological restoration of grassland on alkaline, sodic industrial residue	50 An experimental test of the impact of post-fire salvage logging on community regeneration	54 *La revitalisation de l'Aire (Genève, Suisse)*	

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Sessions	Restoration as the bridge builder (3/4)	Restoration of herbaceous ecosystems (3/6)	Restoration of peatlands, bogs, fens, mires, etc. (3/4)		Restoration of industrial areas and mines (3/4)	Marine ecosystems (1/1)	Restoration of rivers & riparian ecosystems (3/4)	Workshop 1.
17h10 - 17h30	81 Adjusting restoration actions to the community's needs and preferences	85 Restoration of agricultural landscape diversity by creation of small water ponds and perennial grassland habitats	89 Spontaneous vegetation succession in extracted peatlands: a multi-site study		93 Soil fauna in mine restoration: example of endemic earthworms in a New Zealand coal mine	97 Algal forests and the replenishment of Mediterranean rocky fishes	101 Role of phosphorus in recolonisation processes after restoration of connectivity in Rhine side channels.	Water Hyacinth, problems and opportunities (3/7)
17h30 - 17h50	82 Wetland Restoration in the Hunter River Estuary NSW Australia:	86 Promoting target plant species on former agricultural land by soil inoculations	90 Success of peatland restoration in northern Finland		94 Less obvious interaction in plant succession on derelict sites - effect of soil fauna and dominant trees	98 Marine vegetation restoration in coastal ecosystems in the Mediterranean Sea	102 Potential impact of dam levelling onto controlled equilibrium of nutrient availability in river	
17h50 - 18h10	83 Brittany «Grand Site» rehabilitation: material and immaterial consideration	87 Evaluation of the hydroseeding as indoor plant restoration technique in slopes of roads in southern Bolivia	91 Long-term monitoring of the structure and diversity of the vegetation of a peat-bog after restoration (Québec Canada).		95 Molecular diet analysis of keystone snail species associated with mine rehabilitation	99 BioRestore : a 3-Step Process to Restore Marine Ecosystem Integrity, Resilience and Biodiversity	103 Vegetation dynamics after restoration of connectivity in Rhine side channels	
18h10 - 18h30	84 Landuse as Foundation for Ecological Restoration - Development of a methodological Framework	88 Twenty-eight years of vegetation monitoring in 4 permanent plots on the Montagne Saint-Pierre (Belgium)	92 Restoration of raised bogs: don't forget the species and habitat diversity		96 Soil carbon storage in post mining site, the effect of vegetation and soil fauna	100 Marine restoration in Florida (USA): how to scoring the ecosystemic function losses and the gains from compensatory restoration?	104 Restoration of fluvial dynamics in ancient stream channels of the Danube floodplain in Bavaria (Germany)	

	Wednesday 25 August 2010							
Rooms	CONCLAVE	CELLIER BENOIT XII	PANETERIE 1	PANETERIE 2	PANETERIE 3	CUBICULAIRE	CHAMBRE DU TRÉSORIER	HERSES CHAMPEAUX
Sessions	Restoration as the bridge builder (4/4)	Restoration of herbaceous ecosystems (2/6)	Restoration of peatlands, bogs, fens, mires, etc. (2/4)	Restoration of heathlands & arctic ecosystems (1/1)	Restoration of industrial areas and mines (2/4)	Use of prescribed burns and fire in ecological restoration (1/1)	Restoration of rivers & riparian ecosystems (2/4)	Workshop 1.
10h30 - 10h50	123 Boundary work in ecological restoration and conservation	129 Restoration and management to conserve biodiversity at the landscape scale	134 Evaluating large-scale, open-ended habitat creation projects: the example of the Wicken Vision Project, Cambridgeshire, UK	140 The swamp thing; biogeochemical drivers of fen restoration	145 Soil-plants relations diversity in extreme ecosystems and implications for restoration: the case of the cupriferous vegetation, in Katanga, D. R. Congo	151 Introduction note: current situation in the French Alps and opening questions	156 Riparian vegetation metrics as tools for guiding ecological restoration in riverscapes	Water Hyacinth, problems and opportunities (4/7)
10h50 - 11h10	124 The processes of social participation in the projects in river restoration adaptative management models (Spain)	130 Restoration of species-rich grasslands on former arable land by spontaneous colonization and hay transfer and with grazing of megaherbivores	135 Relationships between age, the soil seed bank and standing vegetation across a landscape-scale wetland restoration project	141 Biodiversity Conservation and Mining: a Study Case of Ecosystem Reconstruction in Katanga (DRC)	146 Biodiversity Conservation and Mining: a Study Case of Ecosystem Reconstruction in Katanga (DRC)	152 The use of natural processes for the restoration of drastically disturbed upper elevation sites	157 River restoration of small lowland streams: evaluation of the success for macrofauna and fish	
11h10 - 11h30	125 Stakeholder views on restoring depleted cereal fallows in arid Tunisia: societal barriers and possible crevices	131 Is large-scale, low-intensity grazing an applicable tool for promoting biodiversity in river valleys?	136 Restoration of fen grasslands by mulching - experriments on alkaline fens in Slovakia	142 An ecophysiological view on the importance of carbon dioxide in the re-establishment of Sphagnum: a case study	147 Restoration of nature by the post mining land use strategies; suggestions for kure copper mine	153 Biodiversity and erosion control: restoration of disturbed alpine sites	158 Individuation of fluvial areas needing restoration through the analysis of a target species, the Eurasian otter (*Lutra lutra* L.)	
11h30 - 11h50	126 An evaluation of restoration actions using ecosystem services in a semi-arid steppe	132 Impact of soil, seasonality and consumers on biomass quality in chalk grasslands	137 Cutaway bog rehabilitation and habitat creation in Ireland	143 Ecological restoration of agricultural areas: experiences from the Netherlands	148 May Rare Metallophytes Benefit from Disturbed Soils Following Mining Activity?	154 Critical ecological processes for peatland restoration in changing climate	159 *Protocole d'éradication de l'écrevisse de Californie par stérilisation mécanique des mâles*	
11h50 - 12h10	127 Initiatives of Polish artists shaping respective attitude towards nature – importance of tree in ecological art	133 Exclosure as restoration technique for degraded arid rangelands	138 The spontaneous re-vegetation of the milled and block-cut peatlands on the example of Rabivere and Viru bogs in northern Estonia	144 Restoration of softwater lakes based on carbon and phosphorus limitation	149 Restoration of mining sites in New Caledonia: history and development of new technics.	155 Towards the development of an integrative strategy for the restoration of degraded high mountain ecosystems	160 *Ecologie et Perspectives de restauration et de valorisation d'écosystèmes envahis par des* Ludwigia *sp. : état de l'art*	
12h10 - 12h30	128 Is ecological restoration an option for Lebanese calcareous quarries rehabilitation? From legal framework to field applications	General discussion	139 Planning for restoration of disturbed peatlands in Australia – a triage approach incorporating resilience assessments, peat profiling and hydrological modelling	General discussion	150 Soil seed bank of calamine sites in Belgium: what could be learned for original metallophytes communities restoration?	General discussion	General discussion	

	Thursday 26 August 2010							
Rooms	CONCLAVE	CELLIER BENOIT XII	PANETERIE 1	PANETERIE 2	PANETERIE 3	CUBICULAIRE	CHAMBRE DU TRÉSORIER	HERSES CHAMPEAUX
Sessions	Fragmentation, connectivity and ecological restoration in Europe (1/1)	Restoration of herbaceous ecosystems (5/6)	Restoration of coastal & dune ecosystems (1/2)	Restoration of forest ecosystems (1/2)	Special session 4. Plant introduction in ecological restoration – opportunities and risks (1/1)	Workshop 2.	Special session 5. Sustainable management and restoration of Mediterranean riparian zones: the importance of International cooperation (1/1)	Workshop 1.
10h30 - 10h50	178 Restoring the web of life – Ecological networks for more biodiversity in the Alps	183 Extinction debt and colonization credit? When both phenomena are mingled.	189 The importance of restoring dynamic coastal sand dunes for fauna	195 Assessment of forest stand history using pedoanthracology: a precious tool to definite a forest system "reference", at the local scale	200 Ecosystem effects of introducing non-local plants: genetic introgression into local populations and interactions with other organisms		205 The importance of Interregional cooperation on river restoration: Ripidurable and Ricover case studies.	
10h50 - 11h10	179 Surveys and evaluation of restoration operations	184 Restoration of calcareous grassland on ex-arable land: the importance of establishment microsites and longer-term management	190 Evaluation of Dutch coastal wetlands restoration: effects of weather conditions	196 Characteristics of reference ecosystems in defining restoration targets: static vs. dynamic approach	201 Local versus non local: managing in the face of uncertainty		206 River restoration approaches in SUDOE Europe: problems and pitfalls. Experience in the Ter River, Catalonia, north-east of Iberian Peninsula	
11h10 - 11h30	180 Certification for ecological restoration practitioners	185 Preliminary results of multi-treatments steppe restoration processes in La Crau (Provence, France)	191 Rate of soil organic matter accumulation: a key factor in succesfull restoration of dune slacks on the Dutch Wadden Sea Islands	197 Conservation and restoration models of non-homogenous forest habitats	202 Plant introduction in restoration projects: Implications for dependent insect populations	Exchange of experiences on restoration and conservation of critical sites for migratory birds along the East Atlantic flyway; balancing transboundary ecology with rural development (1/3)	207 Birds as bio-indicators and as tools to evaluate restoration measures	Water Hyacinth, problems and opportunities (5/7)
11h30 - 11h50	181 Implementing the Habitats Directive: Management Planning in Germany	186 The fate of herbaceous seeds during topsoil stockpiling: germination rate and viability	192 Elucidating the beneficial and toxic endpoints of a soil conditioning agent (commercial humic acid) in coastal plant restoration	198 Can we restore natural habitats after plant invasion? Lessons from years of management	203 Native seed production and use for restoration of Pyrenean habitats: implications and limitations		208 The importance of Interreg Initiative as a financial instrument for promoting ecological restorations projects	
11h50 - 12h10	182 Limitations of large-scale nature restoration practices for species typical for the protected Natura 2000 habitats - the Dutch perspective	187 Restoration of rupestrian fields, physiognomy of Cerrado threatened by land use changes	193 Evaluation of humic acid amendment in facilitating plant establishment in coastal environments	199 Restoration of plant populations and communities – does arbuscular mycorrhiza matter?	204 Social acceptability of population restoration of endangered species: the question of species autochthony and nature artificialization.		209 Assessing the role of riparian vegetation and land use on river ecological status using remote sensing and spatial modelling.	
12h10 - 12h30	General discussion	188 Transfer of one population of a rare orchid in Corsica	194 Site Selection for sustainable Coastal Tourism Destination: A Delphi approach	General discussion	General discussion		General discussion	

	Thursday 26 August 2010							
Rooms	CONCLAVE	CELLIER BENOIT XII	PANETERIE 1	PANETERIE 2	PANETERIE 3	CUBICULAIRE	CHAMBRE DU TRÉSORIER	HERSES CHAMPEAUX
Sessions	Socio-economic, policy and design issues in ecological restoration (1/2)	Restoration of herbaceous ecosystems (6/6)	Restoration of coastal & dune ecosystems (2/2)	Restoration of forest ecosystems (2/2)	Special session 6. Farming for Restoration: building bridges for native seeds (1/2)	Workshop 2	Special session 7. Future of the best ecological restoration practices & sustainable management in European Atlantic rivers (1/2)	Workshop 1.
14h50 - 15h10	211 Intervention ecology: managing and restoring ecosystems in the 21st century	215 Comparative examination of potential biotic and abiotic influences on the dynamic of dry grasslands in Brandenburg, Germany	219 The role of drought years in forecasting restoration success – case studies from Hungary	223 Chemical and biochemical properties of the soil as potential tools for monitoring woodland restoration in south western Western Australia.	226 National native plant materials development program: ensuring options in a changing climate	Exchange of experiences on restoration and conservation of critical sites for migratory birds along the East Atlantic flyway; balancing transboundary ecology with rural development (2/3)	230 Restoration and enhancement of Atlantic salmon populations: what we have learned from North Iberian rivers	Water Hyacinth, problems and opportunities (6/7)
15h10 - 15h30	212 Determining environmental investment priorities – a new framework	216 Subordinate plant species and mycorrhizal fungi: Preferential symbiosis association?	220 Restoration of the tidal lagoon of the Zwin	224 Resilience of the transition forest following slash-and-burn cultivation near Andohahela National Park, Southeastern Madagascar	227 Building bridges between researchers, farmers and NGOs to develop a collaborative native seed program		231 Ecological restoration of Atlantic salmon according in the Adour catchment with special references to biogeographical structure	
15h30 - 15h50	213 Wild design: principles to guide ecological restoration in protected natural areas	217 Preliminary results of monitoring the changes in field layer of restored wooded meadow	221 A long term ecological restoration project for the dune habitats in northern Tuscany	225 Post-logging ban timber tree planting in south-eastern Asia: cases of Philippines & Thailand	228 Seed certification tracks the natives from wildlands to restoration		232 Multidimensio-nal ecological modeling applied to the management of *Loendro Laurisilva* habitat in northern Portugal	
15h50 - 16h10	214 Ecological restoration in Belgium, a practical approach by an NGO	218 Pioneer conditions are steering for river grassland restoration	222 Environmental filters effects in spontaneous succession. What implications for restoration of maritime cliff-top vegetation?	General discussion	229 The complex business of farming native seed		233 Consideration of population genetic structure and local adaptation for increasing the chances of success in Atlantic salmon population restoration programmes	

	Thursday 26 August 2010							
Rooms	CONCLAVE	CELLIER BENOIT XII	PANETERIE 1	PANETERIE 2	PANETERIE 3	CUBICULAIRE	CHAMBRE DU TRÉSORIER	HERSES CHAMPEAUX
Sessions	Socio-economic, policy and design issues in ecological restoration (2/2)	Key-species and facilitation in restoration ecology (1/1)			Special session 6. Farming for Restoration: building bridges for native seeds (2/2)	Workshop 2.	Special session 7. Future of the best ecological restoration practices & sustainable management in European Atlantic rivers (2/2)	Workshop 1.
17h10 - 17h30	259 Role of adjacent surrounding vegetation during succession in sites disturbed by mining: additional potential for restoration?	263 Ranking of plant species: from dominant to subordinate, what's effect of root competition?			267 From buds to seeds: bees are key		272 Some novel ideas on Payments for Ecosystem Services to fund restoration of areas targeted through whole catchment surveys and modelling	
17h30 - 17h50	260 Reed margins along drainage dikes in an intensive agricultural landscape: valuable or negligible ecological structures for marshland invertebrates?	264 Restoration of Mediterranean dry grasslands by sowing structuring species			268 Farming native seeds for site specific mixtures and the importance of quality-standards in the wild seed market in Europe		273 Headwater stream riparian restoration: landscape structure importance on the success of ecological restoration of salmon rivers in Normandy, France	
17h50 - 18h10	261 Mapping, avoidance, mitigation and restoration in environmental impact assessments	265 Physical and biological structure of woody patches determine establishment success of a Mediterranean key species			269 Seed multiplication: making the most of natural assets – By their fruits we shall know them!	Exchange of experiences on restoration and conservation of critical sites for migratory birds along the East Atlantic flyway; balancing transboundary ecology with rural development (3/3)	274 Building a collection of river hydromorphology restoration examples in France	Water Hyacinth, problems and opportunities (7/7)
18h10 - 18h30	262 Biological and technical variables associated with successful plant reintroduction programs	266 Role of rangeland shrubs as safe sites for the restoration projects			270 The EU-Salvere Project: producing native seeds using threshing material and species-rich hay from grasslands		General discussion	
18h30 - 18h50					271 «Native seed production» Seed production of native grasses and herbs in Austria			

	Friday 27 August 2010							
Rooms	CONCLAVE	CELLIER BENOIT XII	PANETERIE 1	PANETERIE 2	PANETERIE 3	CUBICULAIRE	CHAMBRE DU TRÉSORIER	HERSES CHAMPEAUX
Sessions	Atmospheric nitrogen as a constraint to ecological restoration (1/1)	Restoration of Mediterranean ecosystems & arid lands (1/1)	Restoration of wetlands, lakes & ponds (1/1)	Linking restoration and ecological succession (1/1)	Workshop 3.	Workshop 4.	Special session 8. Eroded areas: ecological restoration or not? Different solutions for different ecological and socio-economic issues in river catchments	Workshop 5.
10h30 - 10h50	294 Cumulative effects of nitrogen deposition on dry inland dune ecosystems	298 Restoring South African mediterranean-type ecosystems following alien plant invasion	304 *Aménagement écologique de l'Alzette au Dumontshaff*	309 Measuring the restoration process: the mean species trait approach	Defining and sharing success criteria for single-species reintroduction (1/1)	Eyes wide open: building bridges and crossing them (1/1)	314 Soil bioengineering treatments for degraded riparian ecosystems	Addressing a Ramsar need through the identification and assessment of available practical guidance for the restoration of wetlands (1/1)
10h50 - 11h10	295 Early indicators of atmospheric nitrogen deposition impact on lichen-rich, coastal dune grasslands	299 Effects of light and exogenous plant growth regulators on seedling establishment of four autochthonous shrubby plants from high Mediterranean mountain, Sierra Nevada (S Spain)	305 Ecological restoration of coastal wetlands in the central Mediterranean area	310 Near-natural restoration of mining sites. A multi-site comparison			315 Eco-engineering: initial plant diversity and soil stability	
11h10 - 11h30	296 Ecological restoration in grey dunes: the role of N-deposition in different soils	300 Multi-criteria evaluation of forest restoration projects in the northern Mediterranean	306 Restoration of an old agricultural estate in Doñana National Park (SW Spain): a six year vegetation study of a transformed marsh	311 Restoration of target communities in the course of spontaneous succession in old fields: a multi - site study from central Europe			316 Anthropogenic alterations of solid transport in rivers: how can they be resolved?	
11h30 - 11h50	297 Butterfly population response to reduced nitrogen deposition and site restoration	301 Environmental drivers of seedling performance in *Quercus ilex* plantations.	307 Long term effects of liming on biogeochemistry of Norwegian softwater lakes: restoration of the vegetation by introducing an eco-engineer?	312 Secondary succession in roadside slopes: the role of plant-soil interactions to improve ecosystem restoration			317 Bedload deficit alters river floodplains: consequences of river incision on functioning and biodiversity of riverine wetlands	
11h50 - 12h10	General discussion	302 Fine-scale genetic structure in two micro-catchments from southeastern of Spain	308 Recovery of anuran community diversity following habitat replacement II: A long term survey allows	313 Investigation of communities in mining areas at different scales: the organisms' potential as bio-indicators and for accelerating the secondary succession			General discussion	
12h10 - 12h30	General discussion	303 Ecological strategy of species involved and water availability modulate the outcome of grass-shrub interactions in degraded semi-arid systems	General discussion	General discussion			General discussion	

MONDAY 23 AUGUST 2010

	6 : 00 – 20 : 00	*Salle des Gardes*	Registration
	16 : 00 – 20 : 00	*Grande Audience*	Welcome Reception – Free Wines Tasting
	17 : 00 – 19 : 00	*Herses Notre-Dame*	SER Europe Board meeting

TUESDAY 24 AUGUST 2010

	9 : 00 – 9 : 30	*Conclave*	Opening ceremony
01	**9 : 30 – 10 : 15**	Plenary session 1	**Restoring natural capital - a priority for global society: getting scientists, economists and politicians to work together** James Aronson
02	**10 : 15 – 11 : 00**	Plenary session 2	**Eco-biogeographical features and threats within the Mediterranean Basin biodiversity hotspot** Frédéric Médail
	11 : 00 – 11 : 20	Coffee Break	
	11 : 20 – 12 : 40	Parallel sessions	
		Conclave	
		Parallel session 1	**Restoration as the bridge builder between nature conservation and sustainable local economic development (1/4)** Chair: An Cliquet
03	**11 : 20**		**Is ecological science really sufficient to effectively restore Mediterranean ecosystems?** Carla Khater, Valerie Raevel, John Thompson, Mouin Hamze, Arnaud Martin
04	**11 : 40**		**Linking restoration evaluation and knowledge exchange to combat desertification** Susana Bautista, Barron Joseph Orr, V. Ramón Vallejo
05	**12 : 00**		**From 'Why ?' to 'What ?' and 'How ?': developing intercultural principles and strategies in ecological restoration** Tiemo Timmermann
06	**12 : 20**		**Reaching a favourable conservation status within the EU: making ecological restoration a 'hot' issue** An Cliquet

Cellier Benoît XII

Parallel session 2 — **Restoration of herbaceous ecosystems, grasslands, meadows, etc. (1/6)**
Chair: Rainer Buchwald

07 **11 : 20** **Assisted migration in urban demolishing sites: conversion of wasteland into low-maintenance meadows**
Leonie K. Fischer, Moritz von der Lippe, Ingo Kowarik

08 **11 : 40** **Long-term assessment of grassland restoration by topsoil removal and diaspore transfer with hay – the importance of environmental filters and founder effects**
Norbert Hölzel

09 **12 : 00** **Do nutrient-rich soils impede the restoration of species-rich mesophilous grassland? Long-year experiences on hay transfer in lowland and mountainous meadows**
Rainer Buchwald, Tim Rosskamp, Luisa Steiner, Melanie Willen

10 **12 : 20** **Wet grassland restoration: effects of soil type, rewetting and techniques on recruitment and ground light availability**
Jelte Pieter Dijkstra, Rudy van Diggelen, Jan van der Burg, Alex Verschoor, Bram van Ballaer, Hans Backx

Paneterie 1

Parallel session 3 — **Restoration of peatlands, bogs, fens, mires, etc. (1/4)**
Chair: Rudy Van Diggelen

11 **11 : 20** **Restoring key-biogeochemical features of groundwater-fed rich fens: a pilot study**
Rudy Van Diggelen, Camiel Aggenbach, Ab Grootjans, Fons Smolders, Leon Lamers

12 **11 : 40** **Restoration of fens and peat lakes: a biogeochemical approach**
Jeroen Geurts, Fons Smolders, Jan Roelofs, Leon Lamers

13 **12 : 00** **Control of seepage flux and soil organic matter dynamics on restoration of basiophilous fen meadows**
Camiel Aggenbach, Ab Grootjans, Pieter Stuyfzand, André Jansen, Bikila Dullo

14 **12 : 20** **Restoration of drained mires in the Šumava National Park, Czech Republic**
Ivana Bufková, Frantisek Stibal, Eva Mikulaskova

Paneterie 2

Paneterie 3

Parallel session 4 — **Restoration of industrial areas and mines (1/4)**
Chair: Isabelle Laffont-Schwob

15 **11 : 20** **Influence of large scale topography on plant colonisation of post-industrial spoil**
Barbra Harvie, Graham Russell, Colin Legg

16 **11 : 40** **A geomorphic reclamation model of 'catchments on slopes' for the ecological restoration of surface contour mining**
María Feria, José Francisco Martín Duque, Cristina Martín Moreno, José Manuel Nicolau, Miguel Ángel Sanz Santos, Luis Balaguer

17 **12 : 00** **Construction wastes, green waste compost and Switchgrass (*Panicum virgatum* L.) used for landfill cover restoration**
Lubomir Ruzek, Michaela Ruzkova, Karel Vorisek, Martin Koudela

12 : 20 **General discussion**

Cubiculaire

Special session 1 — **Food quality as bottleneck for fauna communities (1/1)**
Chairs: Arnold Van den Burg & Eva Remke

18 **11 : 20** **Does nitrogen deposition cause decline of butterflies by changes in host plant quality?**
Gert-Jan van Duinen, C. Turlure, Michiel Wallis de Vries, Arnold van den Burg

19 **11 : 40** **Direct effects of acidification and eutrophication on heathland fauna species**
Joost Vogels, Bart Wouters, Arnold van den Burg, Eva Remke

20 **12 : 00** **Contrasting effects of high nitrogen deposition and aeolian dynamics on food quality of Grey Hairgrass (*Corynephorus canescens*) in drift sand ecosystems**
Marijn Nijssen, Arnold van den Burg, Henk Siepel

21 **12 : 20** **Restoration of degraded Dutch forests and remediation of micronutrient deficiencies**
Arnold van den Burg

Chambre du trésorier

Parallel session 7 — **Restoration of rivers and riparian ecosystems (1/4)**
Chair: André Evette

22 **11 : 20** **Biodiversity in riverbank techniques for erosion control: assessment of animal and plant species diversity along a natural gradient**
André Evette, Paul Cavaillé

23 **11 : 40** **Applying river restoration knowledge in flood mitigation schemes: RIVERSCAPES as supports for dialog between dry dam designers and biologists**
Christine Poulard, Michel Lafont, Anna Lenar-Matyas, Marta Łapuszek, Jerzy Ratomski, Céline Jézéquel, Pascal Breil

24 **12 : 00** **Characterization of the cost of aquatic ecosystems restoration for river basin management under the Water Framework Directive in Spain**
Marta Catalinas Pérez, M. Estrella Alonso Tejedor, Ángel García Cantón

25 **12: 20** **River Meuse restoration project from the air**
Kris Van Looy, Herman Gielen

Herses Champeaux

Workshop 1
Water Hyacinth, problems and opportunities (1/7)
Chair: Sevastianos Roussos

espace Jeanne Laurent

12 : 40 – 14 : 00 Lunch break

Conclave

26 **14 : 00 – 14 : 45** Plenary session 3 — **Restoring forest wilderness areas in Europe: over passing oxymorons to face well-founded stakes.**
Daniel Vallauri

14 : 45 – 14 : 50 Transition time to parallel sessions

14 : 50 – 16 : 10 Parallel sessions

Conclave

Parallel session 9 — **Restoration as the bridge builder between nature conservation and sustainable local economic development (2/4)**
Chair: Sébastien Gallet

27 **14 : 50** **Green infrastructure as a tool for a new European biodiversity strategy**
Ladislav Miko

28 **15 : 10** **Enhancing social and economic sustainability of restored areas: case studies from Brazil**
Vera Lex Engel, John A. Parrotta

29 **15 : 30** **Community-based restoration: a case study from the Camargue**
Lisa Ernoul, Nicolas Beck

30 **15 : 50** **Grassland and wetland restoration of Olsavica Valley (Eastern Slovakia)**
Jan Seffer, Viera Sefferova Stanova, Rastislav Lasak

Cellier Benoît XII

Parallel session 10 — **Restoration of herbaceous ecosystems, grasslands, meadows, etc. (2/6)**
Chair: Armin Bischoff

31 **14 : 50** **Regrassing with regional seed mixtures in the Bile Karpaty Mountains, Czech Republic**
Ivana Jongepierová, Jonathan Mitchley

32 **15 : 10** **Grassland restoration in floodplains of East German rivers**
Armin Bischoff, Guido Warthemann, Nadja Winter

33 **15 : 30** **Ecological restoration of a wet meadow on peat soil: a case study in the estuary of Seine River (France).**
Fabrice Bureau, Chockri Mchergui, Estelle Langlois, Michael Aubert, Marthe Akpa-Vinceslas, Aurélie Husté, Pierre Margerie, Matthieu Chauvat, Sandrine Samson

34 **15 : 50** **Ecological recreation of a wet meadow on peat soil: comparison of vegetation natural dynamics, sowing, mowing and transplantation experiment**
Estelle Langlois, Pierre Margerie, Fabrice Bureau, Estelle Forey, Michael Aubert, Aurélie Husté, Matthieu Chauvat, Sandrine Samson

Paneterie 1

Parallel session 11 — **Restoration of peatlands, bogs, fens, mires, etc. (2/4)**
Chair: Tiemo Timmermann

35 **14 : 50** **Fluctuating water tables as potential restoration measure for floating rich fens**
Casper Cusell, Annemieke Kooijman, Leon Lamers

36 **15 : 10** **The effects of peatland restoration on water-table depth, elemental concentrations and vegetation: 10 years of changes.**
Tuomas Haapalehto, Harri Vasander, Sinikka Jauhiainen, Teemu Tahvanainen, Janne Kotiaho

37 **15 : 30** **Blanket bog water tables: How much of an impact did drains have, and what influences responses to restoration ?**
Lorraine Wilson, Jared Wilson, Joseph Holden, Ian Johnstone, Mike Morris

38 **15 : 50** **Restoring drained blanket bogs: involving and informing the hill farming community**
Mike Morris, Lorraine Wilson, Ian Johnstone, Jared Wilson

Paneterie 2

Parallel session 12 **Restoration of heathlands and artic ecosystems (1/1)**
Chair: Mike Le Duc

39 **14 : 50** **From arable fields to lowland heathland supporting Silver Studded Blue butterfly**
Philip Putwain, Stephen Lewis, Gill Haynes

40 **15 : 10** **Restoration options for a Thames Basin heath**
Mike Le Duc, Phil Putwain

41 **15 : 30** **Impacts of phenological shifts on the restoration of upland heath ecosystems in Scotland: practical problems and moral dilemmas**
Barbra Harvie

42 **15 : 50** **Growth of rare plant with "home" and "away" mycorrhizal fungal assemblages**
Maarja Öpik, Merili Simmer, Kadri Karp, Ülle Reier

Paneterie 3

Parallel session 13 **Restoration of industrial areas and mines (2/4)**
Chair: Sabine Tischew

43 **14 : 50** **What are the main influential factors on vegetation succession on reclaimed coal wastes in Spain?**
Josu Gonzalez Alday, Rob H. Marrs, Carolina Martinez-Ruiz

44 **15 : 10** **Hay transfer, mulch seeding and spontaneous succession – ten years after slope restoration in a post-mining site**
Annett Baasch, Anita Kirmer, Sabine Tischew

45 **15 : 30** **Strategies for natural woodland development in mined sites based on germination and establishment studies with** ***Betula pendula*** **Roth**
Antje Lorenz, Sabine Tischew, Sven Wagner

46 **15 : 50** **Ecological restoration of grassland on alkaline, sodic industrial residue**
Ronan Courtney, Tom Harrington

Cubiculaire

Parallel session 14 **Use of prescribed burns and fires in ecological restoration (1/1)**
Chair: Eric Rigolot

47 **14 : 50** **Use of prescribed burning for restoration and maintenance of ecological conditions: Predicting and managing fire injury and tree mortality**
Kevin Ryan, Eric Rigolot, Francisco Rego, Herminio Botelho, Jose Antonio Vega Hildago, Paulo Fernandes, Tatiana Sofronova

48 **15 : 10** **Compost amendment in a Mediterranean ecosystem after fire: effects on soil, micro-organisms and vegetation**
Antoine Cellier, Christine Ballini, Virginie Baldy, Raphaël Gros, Nicolas Montès, Thierry Gauquelin

49 **15 : 30** **Effects of post-fire silvicultural treatments related to the burned wood on the soil nutrient availability and soil carbon sequestration**
Sara Marañón-Jiménez, Jorge Castro, Andrew S. Kowalski, Regino Zamora

50 **15 : 50** **An experimental test of the impact of post-fire salvage logging on community regeneration**
Jorge Castro

Chambre du trésorier

Parallel session 15 **Restoration of rivers and riparian ecosystems (2/4)**
Chair: Francisco A. Comin

51 **14 : 50** **Ecological responses to management actions: flow alteration – vegetation response relationships**
María Dolores Bejarano, Christer Nilsson, Marta González del Tánago, Miguel Marchamalo

52 **15 : 10** **River and watershed restoration through the assessment of ecosystem services**
Francisco A. Comín, R. Sorando, B. Miranda, L. Guaras, S. Molinero, A. Calvo

53 **15 : 30** ***Restauration hydroécologique de la Veyle au droit de la gravière de St-Denis-les-Bourg, département de l'Ain, France***
Julien Corget, Philippe Adam

54 **15 : 50** ***La revitalisation de l'Aire (Genève, Suisse)***
François Gerber, Alexandre Wisard

Herses Champeaux

Workshop 1 **Water Hyacinth, problems and opportunities (2/7)**
Chair: Sevastianos Roussos

16 : 10 – 17 : 10 *Grande Audience*

Coffee Break and Poster session 1

-Restoration of industrial areas, polluted areas and mines-

55 **Algal and cyanobacterial monitoring in a remediation process by salinity variations in an hypereutrophic Mediterranean pond**
Julia Vergalli, Céline Bertrand, Katia Comte, Alain Maasri, Evelyne Franquet, Stéphanie Fayolle

56 **Conservation value and ecogeographic revisions of copper endemic flora in Katanga (D. R. Congo). What are conservation priorities?**
Michel-Pierre Faucon, Arthur Meersseman, Mylor Ngoy Shutcha, Grégory Mahy, Michel Ngongo Luhembwe, François Malaisse, Pierre Meerts

57 **Contribution to the study of antioxidant enzymes in Dodonaea viscosa as biomarkers of diesel pollution**
Tania Volke-Sepulveda, Ma. del Rosario Peralta-Perez

58 **Getting real: a methodology for self-evaluation of quarry restorations**
Vicenç Carabassa, Marc Vizcano, Esteve Serra, Oriol Ortiz, Josep Maria Alcañiz

59 ***Hordeum* sp. a potential crop for phytoremediation and its biomass utilization**
Adela Jurjescu, Smaranda Masu, Paul Pirsan, Florin Imbrea, Valeria RusJurjescu

60 **Improvement of lead-phytoremediation by the association of *Dodonaea viscosa* and the saprophytic fungus *Lewia* sp., in a model soil**
Tania Volke, Cesar Rojas-Loria, Rosario Peralta-Perez, Leticia Buendía-Gonzalez

61 **Knowledge on symbioses of *Astragalus tragacantha* (Fabaceae), an endangered plant species, for ecological restoration purpose**
Isabelle Laffont-Schwob, Pierre-Jean Dumas, Jacques Rabier, Lucie Miché, Laurence Affre, Thierry Tatoni

62 **Phytoremediation of soils polluted with mine tailings using compost**
Lixandru Benoni, Dragomir Neculai, Pricop Anca, Patroescu Viorel, Bogatu Cornel

63 **Restoration of gravel pits disturbed by several invasive macrophytes**
Jacques Haury, Michel Bozec, Julie Coudreuse

64 **Revegetation strategies for covering fly ash dump with suitable plant species**
Pricop Anca, Lixandru Benoni, Masu Smaranda, Dragomir Neculai, Morariu Florica

65 **Soil preparation approach for vegetation recovery in gypsum quarries in Granada, SE Spain**
Eva Cañadas, Miguel Ballesteros, Ana Foronda, Julio Peñas, Juan Lorite

66 **The growth and response of some herbaceous plant species to oil treatments**
Kee Dae Kim, Tae Yup, Ha Nuel, Byeong Kyu, Jun Tae Choi

67 **The indigenous tuff influence for reducing the fly ash toxicity in the revegetation process**
Masu Smaranda, Pricop Anca, Morariu

68 **Toxicity of post mining soil after field and laboratory conditions**
Jan Frouz, Ondrej Mufrák, Kristýna Kristýna HrQková

69 **Use of *Myriophyllum alterniflorum* (Haloragaceae) for restoration of heavy-metal-polluted freshwater environments: preliminary results.**
David Delmail, Pascal Labroussse, Philippe Hourdin, Michel Botineau

70 **Biological activity in soils of coal-waste heaps of the mining basin of Provence**
Mélanie Clouard

-Restoration of herbaceous ecosystems, grasslands, meadows, etc.-

71 **Calcareous grassland restoration in the Calestienne area (Belgium): a functional approach**
Lucia Ferroni, Julien Piqueray, Gregory Mahy, Maria Speranza

72 ***Caractérisation des formations steppiques dans la commune de Maamora (Wilaya de Saida). Proposition pour la restauration écologique de ces espaces perturbés.***
Amine Habib Borsali, Hasnaoui Okacha, Raphaël Gros

73 **Development of frequently applied grassland restoration treatments and consequences for subsequent management**
Mareike Conrad, Sabine Tischew

74 **Ecological restoration of the Kalmykian Steppe (Lower Volga Delta, Russia) as a natural result of the discontinued soviet agronomy, detected in remote sensing data from 1962 – 2007**
Sergej Bergsträsser, Torsten Prinz, Norbert Hölzel

75 **On the use of soil organisms to assess restoration of wet meadows on peat soil in place of sandpit.**
Matthieu Chauvat, Gabriel Perez, Pierre Margerie, Estelle Langlois, Michaël Aubert, Fabrice Bureau

76 **Preliminary results on Orthoptera of multi-treatments steppe restoration processes in La Crau (Provence, France)**
Jean-François Alignan, Jean-François Debras, Thierry Dutoit

77 **Restoration management in wet grasslands – results from a 20 year-lasting field experiment**
Till Kleinebecker, Yvonne Oelmann, Peter Schwarze, Gabriele Broll, Kathrin Poptcheva, Verena Möllenbeck, Andreas Vogel, Norbert Hölzel

78 **SALVERE - Semi-natural grassland as a source of biodiversity improvement - a Central Europe Project**
Anita Kirmer, Sandra Mann, Birgit Feucht, Albin Blaschka

79 **Soil seed bank in successional calcareous alvar grassland in northern Estonia**
Rein Kalamees, Kersti Püssa

80 **Vegetation recovery in floodplain meadows in Estonia**
Jaak Albert Metsoja, Silvia Pihu, Kai Vellak

17 : 10 – 18 : 30 Parallel sessions

Conclave

Parallel session 17 **Restoration as the bridge builder between nature conservation and sustainable local economic development (3/4)**
Chair: Ivan Bernez

81 **17 : 10** **Adjusting restoration actions to the community's needs and preferences**
Thorunn Petursdottir, Asa Aradottir

82 **17 : 30** **Wetland restoration in the Hunter River Estuary NSW Australia**
Peggy Paradice

83 **17 : 50** **Brittany "Grand Site" rehabilitation: material and immaterial consideration**
Yann Le fur, Frédérique Chlous-Ducharme

84 **18 : 10** **Landuse as foundation for ecological restoration - development of a methodological Framework**
Albin Blaschka, Thomas Guggenberger

Cellier Benoît XII

Parallel session 18 **Restoration of herbaceous ecosystems, grasslands, meadows, etc. (3/6)**
Chair: Norbert Hölzel

85 **17 : 10** **Restoration of agricultural landscape diversity by creation of small water ponds and perennial grassland habitats**
Jurate Sendzikaite, Romas Pakalnis, Dalia Aviziene, Leonas Jarasius

86 **17 : 30** **Promoting target plant species on former agricultural land by soil inoculations**
Vanesa Carbajo Vázquez, Gerlinde B. De Deyn, Wim H. van der Putten

87 **17 : 50** **Evaluation of the hydroseeding as indoor plant restoration technique in slopes of roads in southern Bolivia**
Kelly Garcete, Francisco Serrano-Bernardo, María Beltrán-Hermoso, Jose J. de la Torre-Betts, Jose L. Rósua-Campos

88 **18 : 10** **Twenty-eight years of vegetation monitoring in four permanent Plots on the Montagne Saint-Pierre (Belgium).**
Martine Lejeune, Willy Verbeke

Paneterie 1

Parallel session 19 — **Restoration of peatlands, bogs, fens, mires, etc. (3/4)**
Chair: Francis Isselin-Nondedeu

89 **17 : 10** **Spontaneous vegetation succession in extracted peatlands: a multi-site study**
Petra Konvalinkova

90 **17 : 30** **Success of peatland restoration in northern Finland**
Anne Tolvanen, Marja-Leena Päätalo, Anna Laine, Mirva Leppälä, Oili Tarvainen

91 **17 : 50** **Long-term monitoring of the structure and diversity of the vegetation of a peat-bog after restoration (Québec Canada)**
Francis Isselin-Nondedeu, Line Rochefort, Monique Poulin

92 **18 : 10** **Restoration of raised bogs: Don't forget the species and habitat diversity**
Gert-Jan van Duinen, Hein van Kleef, Wilco Verberk

Paneterie 3

Parallel session 21 — **Restoration of industrial areas and mines (3/4)**
Chair: Véronique Masotti

93 **17 : 10** **Soil fauna in mine restoration: example of endemic earthworms in a New Zealand coal mine**
Stephane Boyer, Stephen Wratten

94 **17 : 30** **Less obvious interaction in plant succession on derelict sites – effect of soil fauna and dominant trees**
Ondrej Mudrak, Jan Frouz

95 **17 : 50** **Molecular diet analysis of keystone snail species associated with mine rehabilitation**
Stephane Boyer, Steve Wratten, Andrew Holyoake, Robert Cruickshank, Jawad Abdelkrim

96 **18 : 10** **Soil carbon storage in post mining site, the effect of vegetation and soil fauna**
Jan Frouz

Cubiculaire

Parallel session 22 — **Restoration of marine ecosystems (1/1)**
Chair: Elise Buisson

97 **17 : 10** **Algal forests and the replenishment of Mediterranean rocky fishes**
Adrien Cheminée, Luisa Mangialajo, Patrice Francour

98 **17 : 30** **Marine vegetation restoration in coastal ecosystems in the Mediterranean Sea**
Luisa Mangialajo, Patrice Francour, Alexandre Meinesz, Heike Molenaar, Marie-Lucie Susini, Thierry Thibaut

99 **17 : 50** **BioRestore : a 3-Step Process to Restore Marine Ecosystem Integrity, Resilience and Biodiversity**
Gilles Lecaillon, Séverine Pristchepa, Eric Blin

100 **18 : 10** **Marine restoration in Florida (USA): how to scoring the ecosystemic function losses and the gains from compensatory restoration?**
Sylvain Pioch, Harold Levrel

Chambre du trésorier

Parallel session 23 — **Restoration of rivers and riparian ecosystems (3/4)**
Chair: Isabelle Combroux-Lazar

101 **17 : 10** **Role of phosphorus in recolonisation processes after restoration of connectivity in Rhine side channels**
Albin Meyer, Isabelle Combroux-Lazar, Michèle Trémolières

102 **17 : 30** **Potential impact of dam levelling onto controlled equilibrium of nutrient availability in river**
Rudy Nicolau, Bastien Doraphe, Christophe Jeannin, Yoann Brizard

103 **17 : 50** **Vegetation dynamics after restoration of connectivity in Rhine side channels**
Isabelle Combroux-Lazar, Albin Meyer Corinne Grac, Michèle Trémolières

104 **18 : 10** **Restoration of fluvial dynamics in ancient stream channels of the Danube floodplain in Bavaria (Germany)**
Kathrin Kiehl, André Schwab

Herses Champeaux

Workshop 1 — **Water Hyacinth, problems and opportunities (3/7)**
Chair: Sevastianos Roussos

18 : 30 – 19- 30 *Cellier Benoît XII*

SER Europe Membership Meeting

WEDNESDAY 25 AUGUST 2010-05-28

105 **9 : 00 – 9 : 45** Plenary session 4 — **Making Science happen. Linking research and practice to restore degraded drylands**
Jordi Cortina Segarra

9: 45 – 10 : 30 *Grande Audience*

Coffee Break and poster session 2

-Restoration of rivers and riparian ecosystems-

106 **Assessing the ecological benefits in a Mediterranean river after a physical restoration**
Bernard Montuelle, Virginie Archaimbault, Evelyne Trichet, Bernard Dumont, Christian Chauvin, Alain Dutartre

107 **Environmental flows in a context of ecological restoration: a case study of rivers Arga and Aragon (Navarra, Spain)**
Judit Maroto, Diego García de Jalón, Marta González del Tánago

108 **How to restore riverbanks in natural ecosystems with many people using ecological services at the same time?**
Pedro Joaquín Gutiérrez-Yurrita

109 **Integrated analyses for a better calibration of fluvial habitats restoration interventions**
Maria Teresa Carone, Tiziana Simoniello, Anna Loy, Maria Laura

110 **Mediterranean riparian vegetation: tools to improve studies, management and restoration**
Simon Dufour, Élise Buisson, Vincent Tamisier, Émilie Deschamps, Noëllie Fonvieille

111 **Morphodynamics restoration and redynamisation of the bypassed section of the Rhine downstream Kembs dam - Interreg / EDF projects**
Piégay H., Aelbrecht D., Béal D., Arnaud F., Hoenen D., Johnstone K., Schmitt L., Rollet A.-J., Alonso C., Barillier A., Bouchard J.-P., Clutier A., El Kadi Abderrazzak K., Garnier A., Pinte K., Gantzer L., Vinel D., Armburster J., Spaeth V., Blanchard B., Burlet D., Pleis B., Béraud C., Camenen B., Lecoz J., Paquier A., Billard C., Dietrich L., Trautmann T., Dittrich A., Koll K., Huppmann O., Meineke J., Ostermann R., Pfarr U., Seitz B.-J, Knibiely P., Merckling L., Combroux I., Trémolières M., Piquette E., Wintz M.

112 **Special session 4: Birds & sustainable management in Mediterranean riparian areas: Bird studies in the RIPIDURABLE project**
João E. Rabaça, Ana Mendes, Paula C. Dias, Carlos Godinho, Jean E. Roché, Bernard Frochot, Bruno Faivre, Eric Dincuff, Philippe Perret, Pierre-André Crochet, Inês Roque, Alexandre Vaz

113 **Special session 4: Restoration of the Drugeon basin**
Jean-Noël Resch, Geneviève Magnon, François Degiorgi, Hervé Decourcières

114 **Special session 4: The project RICOVER: River Recovery in the SUDOE Region**
Ana Mendes, Maria Teresa Ferreira, António Albuquerque, Maria Helena Almeida, Jordi Camprodon, Paulo Cruz, Sofia Delgado, André Fabião, António Fabião, Carla Faria, Rosário Fernandes, David Gu

115 **Special session 4: The RIPIDURABLE project – sustainable management of riparian areas**
A Mendes, MH Almeida, K Arvanitis, D Arizpe, Y Chatzinikolaou, PA Crochet, PC Dias, P Dimopoulos, E Dincuff, A Fabião, B Faivre, C Faria, MR Fernandes, MT Ferreira, B Frochot, S Giakoumi, C Godinho, R Hipólito, N Koutsikos, I Loi, F Pais, C Pereira, Ph Perret, MA Prada, JE Rabaça, JE Roché, I Roque, J Viana, S Zogaris **(*)**
(*) authors in alphabetical order except A Mendes

116 **The River Enningdalselva, a biological diverse watershed along the border, well suited for teaching purposes**
Marit Eriksen, Louise Buhre, Andreas Bäckstrand, Margareta Nordström, Bjørn Walseng

-Species focused restoration-

117 **Conservation of *Bromus bromoideus*: feasibility study of the reintroduction of a plant extinct in the wild**
Sandrine Godefroid, Julien Piqueray, Kathy Danhieux, Christine Poelaert, Benoît Delpeuch, Abigail de Martynoff, Maïté Deplechin, Florence Hecq, Marie Legast, Bernard Bodson, Louis-Marie Delescaille, Gilles Colinet, Thierry Vanderborght, Grégory Mahy

118 **GENMEDA: Network of Mediterranean Plant Conservation Centres**
Myriam Virevaire

119 ***Impact de* Ludwigia grandiflora *sur les micro-organismes et détermination des molécules bio-actives responsables : restauration d'écosystèmes et valorisation de la biomasse végétale.***
Imen Smida, Jean Le Petit, Gérard Audran, Isabelle Giffard, Claude Charpy-Roubaud

120 **RESTOGEN: Restoring Habitats and Plant Genetic Diversity**
Alexandre Henry, Michel Boutaud, Eric Collin, Yves Gabory, Pascal Laigle, Hervé Le Bouler, Damien Provendier, Nathalie Frascaria-Lacoste

121 ***Rhinanthus minor* as a tool for grassland restoration: establishment and effects on vegetation composition**
Markus Wagner, Matt Heard, Jodey Peyton, James Bullock, Richard Pywell

122 **Silene portensis *L.: déplacement d'une population à partir de sa banque de semences du sol.***
Myriam Virevaire

10 : 30 – 12 : 30 Parallel sessions

Conclave

Parallel session 25 **Restoration as the bridge builder between nature conservation and sustainable local economic development (4/4)**
Chair: Hervé Daniel

123 **10 : 30** **Boundary work in ecological restoration and conservation**
Jac. A.A.Swart, Henny J. van der Windt

124 **10 : 50** **The processes of social participation in the projects in river restoration adaptative management models (Spain)**
Lara L.Rodríguez, Pérez M.A. Fernández, Mora P. Mc Ginity

125 **11 : 10** **Stakeholder views on restoring depleted cereal fallows in arid Tunisia: societal barriers and possible crevices**
Marjolein Visser

126 **11 : 30** **An evaluation of restoration actions using ecosystem services in a semi-arid steppe**
Mchich Derak, Jordi Cortina

127 **11 : 50** **Initiatives of Polish artists shaping respective attitude towards nature – importance of tree in ecological art**
Magdalena Worlowska, Maria Marko-Worlowska

128 **12 : 10** **Is ecological restoration an option for Lebanese calcareous quarries rehabilitation? From legal framework to field applications**
Layla Saad, Grégory Mahy, Benoit Delpeuch, Patricia Chedrawi, Antonio Francis, Carla Khater

Cellier Benoît XII

Parallel session 26 **Restoration of herbaceous ecosystems, grasslands, meadows, etc. (4/6)**
Chair: Didier Alard

129 **10 : 30** **Restoration and management to conserve biodiversity at the landscape scale**
Szabolcs Lengyel, Katalin Varga, Eszter Déri, László Lontay Aggtelek, Béla Tóthmérész

130 **10 : 50** **Restoration of species-rich grasslands on former arable land by spontaneous colonization and hay transfer and with grazing of megaherbivores**
Sandra Mann, Sabine Tischew

131 **11 : 10** **Is large-scale, low-intensity grazing an applicable tool for promoting biodiversity in river valleys?**
Joachim Schrautzer, Veronika Breuer, Michael Breuer, Kai Jensen

132 **11 : 30** **Impact of soil, seasonality and consumers on biomass quality in chalk grasslands**
Till Kleinebecker, Heidi Weber, Norbert Hölzel

133 **11 : 50** **Exclosure as restoration technique for degraded arid rangelands**
Ahmed Aidoud, Halima Slimani, Françoise Rozé

12 : 10 **General discussion**

Paneterie 1

Parallel session 27 **Restoration of peatlands, bogs, fens, mires, etc. (4/4)**
Chair: François Mesléard

134 **10 : 30** **Evaluating large-scale, open-ended habitat creation projects: the example of the Wicken Vision Project, Cambridgeshire, UK**
Francine Hughes, Pete Stroh, William M. Adams

135 **10 : 50** **Relationships between age, the soil seed bank and standing vegetation across a landscape-scale wetland restoration project**
Pete Stroh, Francine Hughes, Owen Mountford, Tim Sparks

136 **11 : 10** **Restoration of fen grasslands by mulching – experriments on alkaline fens in Slovakia**
Dobromil Galvánek, Tomáš Dražil, Daniel Dítě, Rudolf Šoltés Poprad, Anna Leskovjanská Spišská Nová Ves, Marta Mutňanová, Ján Ripka

137 **11 : 30** **Cutaway bog rehabilitation and habitat creation in Ireland**
Catherine Farrell

138 **11 : 50** **The spontaneous re-vegetation of the milled and block-cut peatlands on the example of Rabivere and Viru bogs in northern Estonia**
Edgar Karofeld, Triin Triisberg, Jaanus Paal

139 **12 : 10** **Planning for restoration of disturbed peatlands in Australia – a triage approach incorporating resilience assessments, peat profiling and hydrological modelling**
Anita Wild

Paneterie 2

Special session 2 **Ecological restoration based on biogeochemical key processes (1/1)**
Chair: Jan Roelofs

140 **10 : 30** **The swamp thing; biogeochemical drivers of fen restoration**
Leon P.M. Lamers, Jeroen J.M. Geurts, José M.H. van Diggelen, Esther C.H.E.T. Lucassen, Alfons J.P. Smolders, Jan G.M. Roelofs

141 **10 : 50** **Biogeochemistry, decline and restoration of metallophyte vegetation in floodplain grasslands**
Esther C.H.E.T. Lucassen, Jan G.M. Roelofs

142 **11 : 10** **An ecophysiological view on the importance of carbon dioxide in the re-establishment of *Sphagnum*: a case study**
Wouter Patberg, Gert Jan Baaijens, Fons Smolders, Ab Grootjans, Theo Elzenga

143 **11 : 30** **Ecological restoration of agricultural areas: experiences from the Netherlands**
Alfons J.P. Smolders, Esther C.H.E.T. Lucassen, Mark van Mullekom, Hilde B.M. Tomassen, Emiel Brouwer, Jan G.M. Roelofs

144 **11 : 50** **Restoration of softwater lakes based on carbon and phosphorus limitation**
Jan G.M. Roelofs, Emiel Brouwer

12 : 10 **General discussion**

Paneterie 3

Parallel session 29 — **Restoration of industrial areas and mines (4/4)**
Chair: Grégory Mahy

145 **10 : 30** **Soil-plants relations diversity in extreme ecosystems and implications for restoration: the case of the cupriferous vegetation, in Katanga (DRC)**
Maxime Seleck, Lebrun Julie, Guillaume Arielle, Piqueray Julien, Mahy Grégory

146 **10 : 50** **Biodiversity conservation and mining: a study case of ecosystem reconstruction in Katanga (DRC)**
Julie Lebrun, Semereab Ezana, Rensonnet Audrey, Handjila Guylain, Malaisse François, Grégory Mahy

147 **11 : 10** **Restoration of nature by the post mining land use strategies, suggestions for Kure Copper Mine**
Ayse Kalayci

148 **11 : 30** **May rare metallophytes benefit from disturbed soils following mining activity ?**
Michel-Pierre Faucon, Ingrid Parmentier, Grégory Mahy, Gilles Colinet, Michel Ngongo Luhembwe, Pierre Meerts

149 **11 : 50** **Restoration of mining sites in New Caledonia: history and development of new technics.**
Adrien Wulff, Laurent L'Huillier, Jacques Rabier, Bruno Fogliani

150 **12 : 10** **Soil seed bank of calamine sites in Belgium: what could be learned for original metallophytes communities restoration?**
Jean-philippe Bizoux, Grégory Mahy

Cubiculaire

Special session 3 — **Restoration and sustainable developement of high elevation ecosystems (1/1)**
Chairs: Francis Isselin-Nondedeu & Alain Bédécarrats

151 **10 : 30** **Introduction note: current situation in the French Alps and opening questions**
Francis Isselin-Nondedeu, Stéphanie Gaucherand

152 **10 : 50** **The use of natural processes for the restoration of drastically disturbed upper elevation sites**
David Polster

153 **11 : 10** **Biodiversity and erosion control: restoration of disturbed alpine sites**
Christian Rixen

154 **11 : 30** **Critical ecological processes for peatland restoration in changing climate**
Alexandre Buttler, L. Bragazza, A. Siegenthale

155 **11 : 50** **Towards the development of an integrative strategy for the restoration of degraded high mountain ecosystems**
Francisco A. Comín, J.M. Nicolau

12 : 10 **General discussion**

Chambre du trésorier

Parallel session 31 — **Restoration of rivers and riparian ecosystems (4/4)**
Chair: Gudrun Bornette

156 **10 : 30** **Riparian vegetation metrics as tools for guiding ecological restoration in riverscapes**
Francisca Aguiar, Teresa Ferreira, Rosário Fernandes

157 **10 : 50** **River restoration of small lowland streams: evaluation of the success for macro-fauna and fish**
Bram Van Ballaer, Chris Van Liefferinge, Olivier Beauchard, Eric de Deckere, Patrick Meire

158 **11 : 10** **Individuation of fluvial areas needing restoration through the analysis of a target species, the Eurasian otter (*Lutra lutra* L.)**
Maria Teresa Carone, Tiziana Simoniello, Anna Loy, Maria Laura Carranza

159 **11 : 30** ***Protocole d'éradication de l'écrevisse de Californie par stérilisation mécanique des mâles***
Théo Duperray

160 **11 : 50** ***Ecologie et perspectives de restauration et de valorisation d'écosystèmes envahis par des* Ludwigia *sp. : Etat de l'art***
Imen Smida, Jean Le Petit, Claude Charpy-Roubaud

12 : 10 **General discussion**

Herses Champeaux

Workshop 1 — **Water Hyacinth, Problems and opportunities (4/7)**
Chair: Sevastianos Roussos

12 : 30 – 18 : 30 Excursions

1. **Rare arable weeds in the Luberon**

2. **Mountain forests in the Mont Ventoux**

3. **Salt marshs and former rice fields in Camargue**

4. **Mediterranean steppe vegetation in the Crau**

6. **Salt marshs and coastal dunes near Fos-sur-Mer**

8. **Polluted sites in the Calanques near Marseille**

9. **Fluvial margins, former channel Rhone River**

10. **Mediterranean wetland of the Vigueirat**

12. **Frioul Archipelago near Marseille**

14. **Restoration of riparian vegetation in the Arboreteum of Beauregard**

THURSDAY 26 AUGUST 2010-05-28

161 **9 : 00 – 9 : 45** Plenary session 5

Perspectives in restoration of biodiversity and ecosystem services in Mediterranean agricultural landscapes
José Mª Rey Benayas

9: 45 – 10 : 30 *Grande Audience*

Coffee Break and poster session 3

-Restoration of forests, matorrals & heathlands-

162 **An afforestation activity by Mediterranean shrubs in Sardinia**
Giovanbattista de Dato, Paolo De Angelis, Riccardo Valentini

163 **Analysis of the Estonian Forest Conservation Area Network**
Henn Korjus, Diana Laarmann, Janely Leemets

164 **Analysis of woodland plant and bird community richness along a rural-urban gradient - Opportunities to maintain and restore biodiversity in urban areas**
Clémence Gault, Joséphine Pithon, Jeanne Vallet, Véronique Beaujouan, Hervé Daniel

165 **Can wet heaths dominated by *Erica tetralix* be restored from a species-poor abandoned meadow?**
Rainer Buchwald

166 **Compensatory Measurements associated with the construction of the Breña II dam: infestation level assessment of the woodborers in oak forests from the southern Iberian Peninsula**
Ana M. Cárdenas; Patricia Gallardo, Lourdes Moyano, Juan M. Hidalgo

167 **Evaluation of restoration potential using transfer of seed-containing plant material in herbaceous layer vegetation of secondary woodland**
Susumu Yamada

168 **Forest ecosystem restoration patterns on abandoned oil-shale mining areas in Estonia**
Diana Laarmann, Henn Korjus, Allan Sims, Ahto Kangur

169 **Influence of traditional forest management on demographic structure and spatial distribution of *Caesalpinia spinosa***
Irene Cordero, Cristina Herrero-Jáuregui, María Dolores Jiménez, Juan Antonio Delgado, Luis Villegas, Percy Jiménez, Luis Balaguer

170 **Influence silvoarable agroforestry system on diversity patterns of ground-beetles (Carabidae) and vascular plant in agricultural landscapes**
Michel-Pierre Faucon, David Grandgirard, Jean-Didier Clément

171 **Macrofauna of the soil, pine bark and topsoil as the bio-indicators of change in forest ecosystem**
Maria Marko-Worlowska, Anna Chrzan, Tomasz Laciak

172 **Need of restoration in urban boreal forests?**
Oili Tarvainen, Rauni Strömmer, Annamari Markkola

173 **Reintroduction and reinforcement of endangered woody species populations in Tapia woodland, Mount Ibity, Madagascar**
Swanni T. Alvarado Romero, Elise Buisson, Harison Rabarison, Charlotte Rajeriarison, Chris Birkinshaw, Porter P. Lowry II

174 **Restoring natural communities after pine forestry**
Rachael Ord, Deanna Rokich, Shane Turner, Jason Stevens, Kingsley Dixon

175 **Restoration of a transition forest using soil and seed rain transfers near Andohahela National Park, Southeastern Madagascar**
Fanambinantsoa Noromiarylanto, Ramanoelina Harijaona, Harison Rabarison, Fidisoa Ratovoson, Jimmy Randrianaivo, Porter P. Lowry II, Elise Buisson

176 **Sequence of facilitation, allelopathy and competition within a single growth season between an aridland shrub and its understory grass**
Mohammad Jankju, Parvaneh Abrishamchi, Azam Maghamnia, Asieh Behdad

177 **The effect of a restoration program on the Orthopteran Diversity from a protected area in the southern Iberian Peninsula**
Ana M. Cárdenas, Juan M. Hidalgo, Lourdes Moyano and Patricia Gallardo

10 : 30 – 12 : 30 Parallel sessions

Conclave

Parallel session 33 **Fragmentation, connectivity, and ecological restoration in Europe (1/1)**
Chair: Kris Decleer

178 **10 : 30** **Restoring the web of life – Ecological networks for more biodiversity in the Alps**
Yann Kohler

179 **10 : 50** **Surveys and evaluation of restoration operations**
Sébastien Gallet, Jérôme Sawtschuk, Frédéric Bioret

180 **11 : 10** **Certification for ecological restoration practitioners**
Sasha Alexander, John Stanley, Andre Clewell

181 **11 : 30** **Implementing the habitats directive: management planning in Germany**
Anne Böhnke-Henrichs, Torsten Lipp

182 **11 : 50** **Limitations of large-scale nature restoration practices for species typical for the protected Natura 2000 habitats - the Dutch perspective**
Agata Klimkowska, Han van Dobben

12 : 10 **General discussion**

Cellier Benoît XII

Parallel session 34 **Restoration of herbaceous ecosystems, grasslands, meadows, etc. (5/6)**
Chair: Renaud Jaunatre

183 **10 : 30** **Extinction debt and colonization credit? When both phenomena are mingled**
Julien Piqueray, Sara Cristofoli, Emmanuelle Bisteau, Rodolphe Palm, Grégory Mahy

184 **10 : 50** **Restoration of calcareous grassland on ex-arable land: the importance of establishment microsites and longer-term management**
Markus Wagner, Jodey Peyton, Lucy Hulmes, Sarah Hulmes, Ben Woodcock, Matt Heard James Bullock, Richard Pywell

185 **11 : 10** **Preliminary results of multi-treatments steppe restoration processes in La Crau (Provence, France)**
Renaud Jaunatre, Elise Buisson, Thierry Dutoit

186 **11 : 30** **The fate of herbaceous seeds during topsoil stockpiling: germination rate and viability.**
Desirée Rivera Garcia, Berta Jáuregui, Gabriel De la Rosa, Begoña Peco

187 **11 : 50** **Restoration of rupestrian fields, physiognomy of Cerrado threatened by land use changes.**
Soizig Le Stradic, Elise Buisson, Geraldo Wilson Fernandes

188 **12 : 10** **Transfer of one population of a rare orchid in Corsica**
Richard Franck, Kaczmar Michaël, Laetitia Hugot, Schatz Bertrand

Paneterie 1

Parallel session 35 **Restoration of coastal and dune ecosystems (1/2)**
Chair: Teddy Baumberger

189 **10 : 30** **The importance of restoring dynamic coastal sand dunes for fauna**
Bart Wouters

190 **10 : 50** **Evaluation of Dutch coastal wetlands restoration: effects of weather conditions**
Bikila Warkineh Dullo, Ab Grootjans

191 **11 : 10** **Rate of soil organic matter accumulation: a key factor in succesfull restoration of dune slacks on the Dutch Wadden Sea Islands**
Rohani Shahrudin, Bikila Warkineh Dullo, Ab Grootjans

192 **11 : 30** **Elucidating the beneficial and toxic endpoints of a soil conditioning agent (commercial humic acid) in coastal plant restoration**
Jonathan Willis, Michael Dupuis, Mark Hester

193 **11 : 50** **Evaluation of humic acid amendment in facilitating plant establishment in coastal environments**
Mark Hester, Mike Dupuis, Christine Pickens, Jonathan Willis

194 **12 : 10** **Suitable site selection for sustainable coastal tourism based on ecological criteria (with GIS and delphi method). Case study: Caspian Sea Coast of Southern Iran**
Mahsa Hakimi Abed, Masood Monavari, Abdolreza Karbasi

Paneterie 2

Parallel Session 36 — **Restoration of forest ecosystems (1/2)**
Chair: Daniel Vallauri

195 **10 : 30** **Assessment of forest stand history using pedoanthracology: a precious tool to definite a forest system "reference", at the local scale**
Vincent Robin, Oliver Nelle, Brigitte Talon

196 **10 : 50** **Characteristics of reference ecosystems in defining restoration targets: static vs. dynamic approach**
Ekaterina Shorohova, I. Vanha-Majamaa

197 **11 : 10** **Conservation and restoration models of non-homogenous forest habitats**
David Hladnik, Lado Kutnar

198 **11 : 30** **Can we restore natural habitats after plant invasion? Lessons from years of management**
Gwenn Frisson, Mathieu Halford, Emmanuel Delbart, Grégory Mahy

199 **11 : 50** **Restoration of plant populations and communities – does arbuscular mycorrhiza matter?**
Martin Zobel, Mari Moora, Maarja Öpik, Kadri Koorem

12 : 10 **General discussion**

Paneterie 3

Special session 4 — **Plant introduction in ecological restoration – opportunities and risks**
Chairs: Armin Bischoff & Barbara Smith

200 **10 : 30** **Ecosystem effects of introducing non-local plants: Genetic introgression into local populations and interactions with other organisms**
Lisèle Crémieux, Armin Bischoff, Heinz Müller-Schärer, Thomas Steinger

201 **10 : 50** **Local versus non local: managing in the face of uncertainty**
Nathalie Frascaria-Lacoste

202 **11 : 10** **Plant introduction in restoration projects: implications for dependent insect populations**
Barbara Smith

203 **11 : 30** **Native seed production and use for restoration of Pyrenean habitats: implications and limitations**
Sandra Malaval

204 **11 : 50** **Social acceptability of population restoration of endangered species: the question of species autochthony and nature artificialization**
Anne-Claire Maurice

12 : 10 **General discussion**

Cubiculaire

Workshop 2 — **Exchange of experiences on restoration and conservation of critical sites for migratory birds along the East Atlantic flyway; balancing transboundary ecology with rural development (1/3)**
Chairs: Guus Schutjes & Fokke Fennema

Chambre du trésorier

Special session 5 — **Sustainable management and restoration of Mediterranean riparian zones: the importance of International cooperation (1/1)**
Chairs: Paula C. Dias & Ana I. Mendes

205 **10 : 30** **The importance of interregional cooperation on river restoration: Ripidurable and Ricover case studies.**
Ana Mendes

206 **10 : 50** **River restoration approaches in SUDOE Europe: problems and pitfalls. Experience in the Ter River, Catalonia, north-east of Iberian Peninsula**
Jordi Camprodon, Marc Ordeix, David Guixé, Francesc Llach, Laia Jiménez, Núria Sellarès

207 **11 : 10** **Birds as bio-indicators and as tools to evaluate restoration measures**
Jean Roché, Carlos Godinho, João E. Rabaça, Bernard Frochot, Bruno Faivre, Ana Mendes, Paula C. Dias

208 **11 : 30** **The importance of Interreg Initiative as a financial instrument for promoting ecological restorations projects**
Fernando Nogueira, Ana Mendes

209 **11 : 50** **Assessing the role of riparian vegetation and land use on river ecological status using remote sensing and spatial modelling**
Pascal Kosuth, Thierry Tormos, Flavie Cernesson, Nathalie Lalande

12 : 10 **General discussion**

Herses Champeaux

Workshop 1 — **Water Hyacinth, problems and opportunities (5/7)**
Chair: Sevastianos Roussos

12 : 30 – 14 : 00 Lunch break (espace Jeanne Laurent)

Conclave

210 **14 : 00 – 14 : 45** Plenary session 6 — **Restoration of degraded Mediterranean rangelands**
Vasilios P. Papanastasis

14 : 45 – 14 : 50 Transition time to parallel sessions

14 : 50 – 16 : 10 Parallel sessions

Conclave

Parallel session 41 — **Socio-economic, policy and design issues in ecological restoration (1/2)**
Chair: Jim Harris

211 **14 : 50** **Intervention ecology: managing and restoring ecosystems in the 21st century**
Richard Hobbs

212 **15 : 10** **Determining environmental investment priorities – a new framework**
Melanie Strang, David J. Pannell, Anna M. Roberts, Geoff Park, Jennifer Alexander

213 **15 : 30** **Wild Design: principles to guide ecological restoration in protected natural areas**
Eric Higgs, Richard Hobbs

214 **15 : 50** **Ecological restoration in Belgium, a practical approach by an NGO**
Willem Laermans, Tom Andries

Cellier Benoît XII

Parallel session 42 **Restoration of herbaceous ecosystems (6/6)**
Chair: Kathrin Kiehl

215 **14 : 50** **Comparative examination of potential biotic and abiotic influences on the dynamic of dry grasslands in Brandenburg, Germany**
Kristin Meier, Torsten Lipp, Volker Otte

216 **15 : 10** **Subordinate plant species and mycorrhizal fungi: preferential symbiosis association?**
Pierre Mariotte, Claire Meugnier, Charlotte Vandenberghe, Edward Mitchell, Alexandre Buttler

217 **15 : 30** **Preliminary results of monitoring the changes in field layer of restored wooded meadow**
Elle Roosaluste

218 **15 : 50** **Pioneer conditions are steering for river grassland restoration**
Kris Van Looy

Paneterie 1

Parallel session 43 **Restoration of coastal and dune ecosystems (2/2)**
Chair: Katalin Török

219 **14 : 50** **The role of drought years in forecasting restoration success – case studies from Hungary**
Katalin Török, Rebeka Szabó, Katalin Szitár, Balint Czúcz, Tibor Szili-Kovács

220 **15 : 10** **Restoration of the tidal lagoon of the Zwin**
Jean-Louis Herrier, Marc Leten

221 **15 : 30** **A long term ecological restoration project for the dune habitats in northern Tuscany**
Antonio Perfetti, Leonardo Lombardi, Francesca Logli, Luca Puglisi, Linda Colligiani, Andrea Porchera, Olga Mastroianni, Mariaceleste Labriola

222 **15 : 50** **Environmental filters effects in spontaneous succession. What implications for restoration of maritime cliff-top vegetation?**
Jérôme Sawtschuk, Fréderic Bioret, Sébastien Gallet

Paneterie 2

Parallel session 44 **Restoration of forest ecosystems (2/2)**
Chair: Martin Zobel

223 **14 : 50** **Chemical and biochemical properties of the soil as potential tools for monitoring woodland restoration in south western Western Australia**
Katarzyna Bialkowski, Robert Archibald, Giles Hardy, Treena Burgess

224 **15 : 10** **Resilience of the transition forest following slash-and-burn cultivation near Andohahela National Park, Southeastern Madagascar**
Melissa De Wilde, Elise Buisson, Fidisoa Ratovoson, Richard Randrianaivo, Jimmy Andrianirina, Stéphanie M. Carrière, Pete P. Lowry II

225 **15 : 30** **Post-logging ban timber tree planting in south-eastern Asia: cases of Philippines & Thailand**
Yonariza

15 : 50 **General discussion**

Paneterie 3

Special session 6 — **Farming for Restoration: building bridges for native seeds (1/2)**
Chairs: Berta Youtie & Sabine Tischew

226 **14 : 50** **National native plant materials development program: ensuring options in a changing climate**
Peggy Olwell

227 **15 : 10** **Building bridges between researchers, farmers and NGOs to develop a collaborative native seed program**
Nancy Shaw, Berta Youtie

228 **15 : 30** **Seed certification tracks the natives from wildlands to restoration**
Stanford Young

229 **15 : 50** **The Complex business of farming native seed**
Jerry Benson

Cubiculaire

Workshop 2 — **Exchange of experiences on restoration and conservation of critical sites for migratory birds along the East Atlantic flyway; balancing transboundary ecology with rural development (2/3)**
Chairs: Guus Schutjes & Fokke Fennema

Chambre du trésorier

Special session 7 — **Future of the best ecological restoration practices & sustainable management in European Atlantic rivers (1/2)**
Chairs: Ivan Bernez & Dylan Bright

230 **14 : 50** **Restoration and enhancement of Atlantic salmon populations: what we have learned from North Iberian rivers.**
José Luis Horreo, Gonsalo Machado-Schiaffino, Ivan Gonsales Pola, Eva Garcia-Vazquez

231 **15 : 10** **Ecological restoration of Atlantic salmon according in the Adour catchment with special references to biogeographical structure**
Jérôme Le Gentil, David Barracou, Jean-Claude Salvado

232 **15 : 30** **Multidimensional ecological modeling applied to the management of *Loendro Laurisilva* habitat in northern Portugal**
Paulo Miguel Pereira

233 **15 : 50** **Consideration of population genetic structure and local adaptation for increasing the chances of success in Atlantic salmon population restoration programmes**
Philip McGinnity, Jamie Coughlan,Tom Cross

Herses Champeaux

Workshop 1 — **Water Hyacinth, problems and opportunities (6/7)**
Chair: Sevastianos Roussos

16 : 10 – 17 : 10 *Grande Audience*

Coffee Break and Poster session 4

-Restoration of wetlands, peatlands, coastal ecosystems & dunes-

234 **Change and recovery of plant after flooding events, Upo Wetland**
Gu Yeon Kim, Hyun Hee Son, Gee Jae Joo

235 **Changes in landscape ecological structure and diversity of plant associations 15 years after the restoration process of Lake Piskory**
Chmielewski T. J., Sender J., Chmielewski Sz., Kolejko M.

236 **Development of a tool for restoring and managing wetlands within a ski area – example of the ski resort of Val-Thorens**
Stéphanie Gaucherand, Alain Bédécarrats, Francis Isselin-Nondedeu

237 **Ecological Restoration and rehabilitation needs of Bolkar moutains lakes, Turkey**
Gulsun Omeroglu

238 **Ecological restoration of the Lower Prut Floodplain Natural Park – through the project LIFE 05 NAT/RO/000155**
Gina Alina, Anastasia Lescai, Viorica Capatin

239 **Ecology and conservation genetics of the endangered banded newt** *Triturus vittatus vittatus* **in northern Israel**
Oren Pearlson

240 **Effect of phosphorus and nitrogen on the growth of two forms of** *Warnstorfia fluitans* **(Hedw.) Loeske**
Kairi Sepp, Mati Ilomets

241 **Evaluation of large scale bog restoration in northwestern Germany – lessons from 30 years of practice**
Birgit Sieg, Norbert Hölzel, Till Kleinebecker

242 **Influence of lowbush blueberry plantation age on natural biodiversity on abandoned peat production area**
Marge Starast, Tea Tasa, Katrin Jõgar

243 **Is aquatic vegetation removal as management technique a bless or a curse?**
Annelies Boerema, Kris Bal, Hans Backx, Kerst Buis, Eric de Deckere, Ilse Loots, Patrick Meire, Jonas Schoelynck

244 **Macroinvertebrate community in restored salt marshes with** *Spartina maritima*
Guillermo Curado, Enrique Figueroa, Jesús M. Castillo

245 **Monitoring and assessment of a coastal dune restoration, Canet-en-Roussillon France**
Stéphanie Grosset, Philippe Richard, Hugues Heurtefeux

246 **Natural propagule sources for wetland restoration on Rhine's Island (Upper Rhine Floodplain)**
Isabelle Combroux-Lazar, Marlène Biessy, Michèle Trémolières

247 **Overcoming seed limitation in degraded inland sand ecosystems by epizoochorous dispersal: a five-year restoration project**
Linda Freund, Saskia Wessels, Iris Retta, Carsten Eichberg, Christian Storm, Angelika Schwabe

248 **Recovery of anuran community diversity following habitat replacement**
Alain Pagano, Lesbarrères D., Fowler M., Lodé T.

249 **Restoration of species-rich wetland by topsoil removal and seed transfer**
Marcus Fritsch, Juliane Drobnik, Christian Storm, Angelika Schwabe

250 **Restoration of the habitat 'humid dune slacks' in 'Hannecart-wood' at Oostduinkerke**
Jean-Louis Herrier, Marc Leten, Hannah Van Nieuwenhuyse

251 **Soft shoreline engineering: We built it, have they come?**
Michael Zarull, John Hartig, Anna Cook, Mary Bohling

252 **Vegetation development in the restored tidal estuarine wetland**
Gu Yeon Kim, Gee Jae Joo, Hee Sun Park, Hyun Hee Son, Ji Yoon Kim

253 **Restoring sponges in the Belgian Ardennes**
Martine Lejeune

-Restoration of roadsides-

254 **Factors controlling the vegetation dynamic at the roadside: application to new restoration protocols**
Enrique García, Ignacio Mola, Maria Dolores Jiménez, Miguel Angel Casado, Luis Balaguer

255 **Ground cover estimation on roadslopes: A method using digital photographs analysis**
Luis Eduardo SanJoaquin, María Dolores Jiménez, Miguel Ángel Casado, Ignacio Mola, Rocío Torre, Ana Vázquez, Luis Balaguer

256 **Habitat suitability models for species selection in ecological restoration: an application to legume shrubs selection for roadside revegetation**
Gastón A., García-Viñas J.I., Maroto J., Herrero B., Ropero C.

257 **Roadslopes soil restoration: the role of decomposer edaphic fauna and soil physic and chemical parameters**
Mónica Gutiérrez-López, Dolores Trigo, Mónica Otero, Miguel Berdugo, Ignacio Mola

258 **Role of plant-plant and plant-animal interaction in roadside reclamation**
Rocio Torre, Álvaro Ramírez, María Dolores Jiménez, Ignacio Mola, Ana Vázquez, Miguel Ángel Casado, Silvia Murillo, Luis Balaguer

17 : 10 – 18 : 30 Parallel sessions

Conclave

Parallel session 49 **Socio-economic, policy and design issues in ecological restoration (2/2)**
Chair: Freddy Rey

259 **17 : 10** **Role of adjacent surrounding vegetation during succession in sites disturbed by mining: additional potential for restoration?**
Klára Řehounková, Romana Trnková, Petra Karešová, Helena Dvořáková, Karel, Prach

260 **17 : 30** **Reed margins along drainage dikes in an intensive agricultural landscape: valuable or negligible ecological structures for marshland invertebrates ?**
Kris Decleer, Johan Baetens, Patrick Grootaert, Didier Drugmand, Leon Baert, Wouter Deconinck, Marc Pollet, Rudy Van Diggelen, Dries Bonte

261 **17 : 50** **Mapping, avoidance, mitigation and restoration in environmental impact assessments**
Annebeth Hoffmann, Anne Eiby, Jan Rasmussen

262 **18 : 10** **Biological and technical variables associated with successful plant reintroduction programmes**
Sandrine Godefroid, Thierry Vanderborght

Cellier Benoît XII

Parallel session 50 **Key-species and facilitation in restoration ecology (1/1)**
Chair: Clémentine Coiffait-Gombault

263 **17 : 10** **Ranking of plant species: from dominant to subordinate, what's effect of root competition?**
Pierre Mariotte, Charlotte Vandenberghe, Alexandre Buttler

264 **17 : 30** **Restoration of Mediterranean dry grasslands by sowing structuring species**
Clémentine Coiffait-Gombault, Elise Buisson, Thierry Dutoit

265 **17 : 50** **Physical and biological structure of woody patches determine establishment success of a Mediterranean key species**
Beatriz Amat, Jordi Cortina

266 **18 : 10** **Role of rangeland shrubs as safe sites for the restoration projects**
Mohammad Jankju, Hamid Ejtehadi

Paneterie 3

Special session 6 **Farming for Restoration: building bridges for native seeds (2/2)**
Chairs: Berta Youtie & Sabine Tischew

267 **17 : 10** **From buds to seeds: bees are key**
James Cane

268 **17 : 30** **Farming native seeds for site specific mixtures and the importance of quality-standards in the wild seed market in Europe**
Birgit Feucht

269 **17 : 50** **Seed multiplication: making the most of natural assets – by their fruits we shall know them!**
Richard Scott

270 **18 : 10** **The EU-Salvere project: producing native seeds using threshing material and species-rich hay from grasslands**
Anita Kirmer, Sabine Tischew

271 **18 : 30** **"Native seed production" Seed production of native grasses and herbs in Austria**
Bernhard Krautzer, Albin Blaschka

Cubiculaire

Workshop 2 — **Exchange of experiences on restoration and conservation of critical sites for migratory birds along the East Atlantic flyway; balancing transboundary ecology with rural development (3/3)**
Chairs: Guus Schutjes & Fokke Fennema

Chambre du trésorier

Special session 7 — **Future of the best ecological restoration practices & sustainable management in European Atlantic rivers (2/2)**
Chairs: Ivan Bernez & Dylan Bright

272 **17 : 10** **Some novel ideas on payments for ecosystem services to fund restoration of areas targeted through whole catchment surveys and modeling**
Dylan Bright

273 **17 : 30** **Headwater stream riparian restoration: landscape structure importance on the success of ecological restoration of salmon rivers in Normandy, France**
Ivan Bernez, Maryline Kneveler, Amandine Merlin, Yannick Delettre, Didier Le Coeur

274 **17 : 50** **Building a collection of river hydromorphology restoration examples in France**
Josée Peress

18 : 10 **General discussion**

Herses Champeaux

Workshop 1 — **Water Hyacinth, problems and opportunities (7/7)**
Chair: Sevastianos Roussos

18 : 30 – 19 : 30 *Cubiculaire*
Organising and Scientific Joint Committee

19 : 30 – 20 : 30 *Cubiculaire*
French Networks on Ecological Restoration Meeting (in French)

19 : 30 – 20 : 45 *Salle des Gardes*
Visit of The Pope's Palace

21 : 00 – 23 : 30 *Salle des Gardes and Grand Tinel*
Gala Diner and Poster Price Ceremony

FRIDAY 27 AUGUST 2010

275 **9 : 00 – 9 : 45** Plenary session 7

Biogeochemical constraints and restoration perspectives after degradation by atmospheric nitrogen deposition
Roland Bobbink

9: 45 – 10 : 30 *Grande Audience*

Coffee Break and poster session 5

-Monitoring, tools & models for restoration-

276 **A national monitoring scheme for restoration of traditional rural biotopes in Finland**
Carina Järvinen, Katja Raatikainen

277 **A simulation model for the restoration of the vegetation on ski trails under various scenarios of restoration procedures and management**
Francis Isselin-Nondedeu, Alain Bédécarrats

278 **Application of Terrestrial Laser Scanner for monitoring geomorphic evolution of roadslopes under different restoration strategies**
Estela Barroso, Fernando Barbero, José Francisco Martín Duque, Saturnino De Alba

279 **Applying Australian-developed monitoring procedure to investigate soil disturbance level in boreal zone**
Oili Tarvainen, Anne Tolvanen

280 **Error analysis and calibration of data collected with a Terrestrial Laser Scanner (TLS). Implications for monitoring surfaces evolution of roadslopes**
Estela Barroso, Fernando Barbero, José Francisco Martín Duque, Saturnino De Alba

281 **Near-Infrared Spectroscopy (NIRS) as a time- and cost-saving tool in restoration ecology**
Valentin H. Klaus, Till Kleinebecker, Norbert Hölzel

282 **Vegetation mapping methodology for monitoring and assessing success of ecological restoration operations.**
Frédéric Bioret, Sébastien Gallet

-Linking restoration and ecological succession-

283 **Are functional groups and dispersal modes an option to predict vegetation dynamics on reclaimed mines?**
Josu Gonzalez Alday, Yesica Pallavicini, Rob H. Marrs, Carolina Martinez-Ruiz

284 **Is chronosequence correct approach for the prediction of succession?**
Ondrej Mudrak

285 **Prediction of vegetation succession in a sand-pit: A basis for restoration**
Věra Zemanová, Klára Řehounková, Karel Prach

-Restoration of arid ecosystems-

286 **The use of waste water for agro-forestry multipurpose systems in desert Oases**
Paolo De Angelis, Cristina Monteverdi, Sara Da Canal, Hocine Larbi, Federico Chiani, Riccardo Valentini

287 **Landscape-scale spatial variability in dryland restoration success. The combined role of site conditions and technological effort**
Haroun Kribeche, Esteban Chirino, Alberto Vilagrosa, Susana Bautista

-Miscellaneous-

288 **Climate change and changes in spatial nature structures in Flanders: adaptation strategies**
Frederic Stragier

289 **Collaboration among scientists, landscape planners and practitioners to solve problems of "industrialized" urban mini plot viticulture**
Thomas Siegmar

290 **Effectiveness of restoration measures for WFD and Natura 2000**
Wendy Liefveld, Bart Reeze Arcadis, Marieke Ohm

291 **Impact mitigation of the Chiaiano's dump on the environment of the Park of Naples hills (South Italy)**
Maria F. Caliendo, Lucilla Fusco, Valerio Mele

292 **Indication of archaeological features by soil chemical properties and by plant species composition in ancient medieval village in the Czech republic**
Jiri Ondráček

293 **Summer Schools on Restoration Ecology – Bringing together young scientists and practitioners throughout Europe**
Verena Möllenbeck, Norbert Hölzel

10 : 30 – 12 : 30 Parallel sessions

Conclave

Parallel session 57 **Atmospheric nitrogen as a constraint to ecological restoration (1/1)**
Chair: Roland Bobbink

294 **10 : 30** **Cumulative effects of nitrogen deposition on dry inland dune ecosystems**
Marijn Nijssen

295 **10 : 50** **Early indicators of atmospheric nitrogen deposition impact on lichen-rich, coastal dune grasslands**
Eva Remke, Emiel Brouwer, Jan G.M. Roelofs, Irmgard Blindow, Annemieke Kooijman

296 **11 : 10** **Ecological restoration in grey dunes: the role of N-deposition in different soils**
Kooijman A.M., Noordijk H., Hinsberg A. Van, Cusell C., Til M. Van

297 **11 : 30** **Butterfly population response to reduced nitrogen deposition and site restoration**
Alan Feest

11 : 50 **General discussion**

12 : 10 **General discussion**

Cellier Benoît XII

Parallel session 58 **Restoration of Mediterranean ecosystems and arid lands (1/1)**
Chair: Jordi Cortina

298 **10 : 30** **Restoring South African mediterranean-type ecosystems following alien plant invasion**
Karen Esler

299 **10 : 50** **Effects of light and exogenous plant growth regulators on seedling establishment of four autochthonous shrubby plants from high Mediterranean mountain, Sierra Nevada (S Spain)**
Francisco Serrano-Bernardo, Kelly Garcete, María Beltrán-Hermoso, José Juan de la Torre-Betts, José Luis Rosúa-Campos

300 **11 : 10** **Multi-criteria evaluation of forest restoration projects in the northern Mediterranean**
Anahi Ocampo-Melgar, Susana Bautista, Jose Antonio Alloza, Barron Joseph Orr, Ramon Vallejo

301 **11 : 30** **Environmental drivers of seedling performance in *Quercus ilex* plantations**
Jaume Tormo, Jorge Monerris, Jordi Cortina

302 **11 : 50** **Fine-scale genetic structure in two micro-catchments from southeastern of Spain**
Karen Disante, Beatriz Amat, Jordi Cortina

303 **12 : 10** **Ecological strategy of species involved and water availability modulate the outcome of grass-shrub interactions in degraded semi-arid systems**
Santiago Soliveres, Pablo García-Palacios, Fernando T. Maestre, Jorge Monerris, Jordi Cortina, Adrián Escudero, Fernando Valladares

Paneterie 1

Parallel session 59 **Restoration of wetlands, lakes and ponds (1/1)**
Chair: Alain Pagano

304 **10 : 30** ***Aménagement écologique de l'Alzette au Dumontshaff***
Micha Bunusevac, Jean-Claude Kirpach

305 **10 : 50** **Ecological restoration of coastal wetlands in the central Mediterranean area**
Antonio Perfetti, Stefano Cavalli, Leonardo Lombardi, Pietro Gattai, Pasquale Vernina, Mariaceleste Labriola, Olga Mastroianni, Alessio Favilla, Luca Puglisi

306 **11 : 10** **Restoration of an old agricultural estate in Doñana National Park (SW Spain): a six year vegetation study of a transformed marsh**
Alberto Vélez-Martín, Carlos J. Luque, Manuel Coca, Anthony J. Davy, Eloy M. Castellanos

307 **11 : 30** **Long term effects of liming on biogeochemistry of Norwegian softwater lakes: restoration of the vegetation by introducing an eco-engineer**
Esther C.H.E.T. Lucassen, Alfons J.P., Jan G.M. Roelofs

308 **11 : 50** **Recovery of anuran community diversity following habitat replacement II: A long term survey allows**
Alain Pagano, F. Foussard, D. Lesbarrères

12 : 10 **General discussion**

Paneterie 2

Parallel session 60 — **Linking restoration and ecological succession**
Chair: Karel Prach

309 **10 : 30** **Measuring the restoration process: the mean species trait approach**
Isabelle Le Viol, Christian Kerbiriou

310 **10 : 50** **Near-natural restoration of mining sites. A multi-site comparison**
Karel Prach

311 **11 : 10** **Restoration of target communities in the course of spontaneous succession in old fields: a multi - site study from central Europe**
Alena Jírová

312 **11 : 30** **Secondary succession in roadside slopes: the role of plant-soil interactions to improve ecosystem restoration**
Pablo García-Palacios, Fernando T. Maestre, Santiago Soliveres, Fernando Valladares, Adrián Escudero

313 **11 : 50** **Investigation of communities in mining areas at different scales: the organisms' potential as bio-indicators and for accelerating the secondary succession**
Virgil Iordache, Marilena Onete, Mihaela Pauca, Ioana Gomoiu, Dorina Purice, Ioana Cobzaru, Liliana Oromulu, Viorica Honciuc, Aurora Neagoe

12 : 10 **General discussion**

Paneterie 3

Workshop 3 — **Defining and sharing success criteria for single-species reintroduction**
Chairs: François Sarrazin,Christian Kerbiriou & Bruno Colas

Cubiculaire

Workshop 4 — **Eyes wide open: building bridges and crossing them**
Chairs: Richard Scott & Peter Abrutat Whitbread

Chambre du trésorier

Special session 8 — **Eroded areas: ecological restoration or not? Different solutions for different ecological and socio-economic issues in river catchments**
Chair: Freddy Rey

314 **10 : 30** **Soil bioengineering treatments for degraded riparian ecosystems**
David Polster

315 **10 : 50** **Eco-engineering: initial plant diversity and soil stability**
Frank Graf

316 **11 : 10** **Anthropogenic alterations of solid transport in rivers: how can they be resolved?**
Jean-René Malavoi, Norbert Landon

317 **11 : 30** **Bedload deficit alters river floodplains: consequences of river incision on functioning and biodiversity of riverine wetlands**
Gudrun Bornette

11 : 50 **General discussion**

12 : 10 **General discussion**

Herses Champeaux

Workshop 5 — **Addressing a Ramsar need through the identification and assessment of available practical guidance for the restoration of wetlands (1/1)**
Chairs: Kevin L. Erwin, Rob McInnes, Royal C. Gardiner & Nick Davidson

12 : 30 – 14 : 00 Lunch break (espace Jeanne Laurent)

Conclave

318 **14 : 00 – 14 : 45** Plenary session 8 — **A global approach to ecological restoration in protected areas**
Karen Keenleyside

Conclave

14: 45 – 15 : 30 Closing ceremony
Conference conclusions
Announcement for proceedings (extended abstracts and special issue of international scientific journals)
Announcement forthcoming SER events and conferences

15 : 30 – 16 : 00 Coffee Break and Farewell

ABSTRACTS

01

Restoring natural capital - a priority for global society: getting scientists, economists and politicians to work together

James Aronson

Increasing human population growth and resource consumption place ever-greater stresses and demands on all ecosystems to deliver goods and services from them. Thus, we must alter consumption patterns and increase our ability and our will to restore impaired ecosystems and enhance their ability to maintain biodiversity and provide goods and services. This will require new paradigms about our relationship with Nature, and long-term investments in restoring natural capital (RNC). Like conservation, restoration should be seen as an investment rather than a cost. And, both of them pay well, when total economic value is considered, and when human wellbeing and true wealth are given greater priority than GDP or other measures of non-economic growth. Examples from the Mediterranean region, the European Community, and elsewhere, will be used to show that economists, engineers, applied ecologists and everyone concerned with ecosystem services and the environment need to – and can - work together and seek the way forward towards a sustainable and desirable future. By making explicit the mutually-reinforcing linkages between environmental and economic well-being, the multiple benefits achieved through RNC can play a crucial role in bridging ideological or professional divides and can open a promising road toward policies of sustainability.

02

Eco-biogeographical features and threats within the Mediterranean Basin biodiversity hotspot

Frédéric Médail

The biotic originality of Mediterranean ecosystems can be explained by complex interaction between a highly heterogeneous historical biogeography and unique ecological processes. If the Mediterranean Basin is among the 34 hotspots of species diversity in the world, this ecoregion constitutes also an hotspot of human population density and growth, which inevitably raises serious conservation problems. What characterises Mediterranean landscapes and habitats much more than in any other region in the world is their long-lasting common history with humans. Most of the ups and downs in Mediterranean biodiversity are therefore closely linked with human population pressures, which have changed many times through the long common history of ecological systems and human societies. At present, the Mediterranean ecoregion is faced to rapid and previously unknown global environmental changes, with important repercussions in structure and function. Since one century, habitat destruction and fragmentation are increasing, notably along the coasts inducing severe population depletion and profound changes in the dynamics of biological interactions. The 10 regional hotspots of plant biodiversity are indeed seriously threatened by the severity of the current and forecasted environmental changes. Due to the quickness of these impacts, it is necessary to launch a conservation biogeography framework at the Mediterranean Basin scale. Biogeography can furnish the requisite tools to identify crucial conservation areas in today's context of global change. This is the case of the about fifty "glacial" refugia that have provided suitable habitats for plants during unfavourable climatic periods. Refugia preservation may be critical for an optimal evolutive conservation, because they encompass the bulk of genetic diversity and endemism of Mediterranean plants. Thus, a better understanding of ecological processes of the past, including the less often studied local persistance of species, should improve management decisions related to conservation and restoration ecology.

03

Is Ecological Science really sufficient to effectively restore Mediterranean ecosystems?

Carla Khater, Valerie Raevel, John Thompson, Mouin Hamze, Arnaud Martin

Mediterranean landscapes are complex units where complex mosaics of natural and man made ecosystems dominated by socio-economic, cultural, and land-use changes. While current land use planning practices are rather based on the utilitarian role of ecosystems, while scientists discuss ecological sciences, and practionners focus on economically sound and short terms outputs, we present the two dichotomies underlying the effective restoration of Mediterranean ecosystems as an inherent need for a double integration of disciplines (1) the one between ecological theory and management practice and (2) the one between ecology and socioeconomy. The resulting Mediterranean trilogy requires innovative methods for restoration that will acknowledge not only the need to integrate much firmer ecological foundation for developing and implementing restoration programs but also the fact that habitat restoration in the Mediterranean should admit and account for human activity and in extenso, ecosystem services. Aiming to set up and implement an ecologically sound, economically feasible, and socially acceptable restoration programme, we identify ways to more efficiently integrate ecological knowledge into effective restoration practice for Mediterranean ecosystems.

04

Linking restoration evaluation and knowledge exchange to combat desertification

Susana Bautista, Barron Joseph Orr, V. Ramón Vallejo

Essential knowledge on the feasibility and cost-effectiveness of prevention and restoration actions to combat desertification remains scarce. There is a growing demand for land management assessment, which ultimately can provide essential inputs for decision-making. To address these needs, we have launched a multinational project (PRACTICE - Prevention and Restoration Actions to Combat Desertification. An Integrated Assessment), funded by the European Commission. PRACTICE approach is to link project assessment and evaluation with training, education, and knowledge exchange through a participatory process involving scientists, managers, financial officers, and members of the public who are/were impacted by the restoration projects. PRACTICE assessment protocol assumes the mutual human-environment interactions in land-use change and simultaneously considers both biophysical and socio-economic attributes. The protocol is based on (1) key common indicators that represent overall ecosystem and human-environmental system functioning, (2) site-specific indicators identified by local stakeholders that are relevant to the objectives and the particular context conditions, and (3) stakeholder perspectives. Site-specific indicators are grouped into categories representing ecosystem services and biodiversity. Multicriteria decision models are used for integrating the information provided by the various indicators and for integrating the stakeholder perspectives. The process is iterative, provides a framework for knowledge exchange and a path towards consensus building. The participatory assessment process is developed through local meetings and, where possible, internet-based communication. It captures scientific and local knowledge while documenting the changes in perceptions and learning that take place throughout the process.

05

From 'Why ?' to 'What ?' and 'How ?': Developing intercultural principles and strategies in ecological restoration

Tiemo Timmermann

The global view on restoration practices shows a large variety of target ecosystems and specific ecological services, restoration strategies and tools. Responsible for this are not only the large differences of the ecosystem types, land use methods and specific threats but also different cultural backgrounds, motivations and traditions. This paper focuses this variety by relating several case studies of restoration practice from Europe and Asia. Comparing western and eastern perspectives significant differences are identified and a framework of common values and principles is developed.

06

Reaching a favourable conservation status within the EU: making ecological restoration a 'hot' issue

An Cliquet

The main aim of nature conservation legislation in the European Union (EU), the Birds and Habitats Directives, is to reach a favourable conservation status of species and habitats within the EU. Most member states are currently involved in a process of developing conservation measures for designated protected sites under the Natura 2000 network. As a lot of habitats and species are in an unfavourable status of conservation, measures for ecological restoration will be required in order to fulfil the EU obligations. A lot of ecologists involved in the process of the management of Natura 2000 areas are confronted with the precise scope of legal obligations. This presentation will elaborate on the legal obligations in the EU relating to ecological restoration. More particularly the presentation will focus on the following items (defining conservation objectives and priorities; species and habitats for which measures must be taken; measures outside the Natura 2000 sites (connectivity); evaluation of the conservation status (legal requirements on the level of evaluation); EU guidelines for assessing favourable conservation status; legal obligations for restoration in case of local extinction; legal obligations for restoration in case of a partial deterioration of a site; transboundary management of Natura 2000 sites). The research for this presentation is based on EU legislation, interpretation guides by the European Commission, case law by the European Court of Justice and legal literature.

07

Assisted migration in urban demolishing sites: conversion of wasteland into low-maintenance meadows

Leonie K. Fischer, Moritz von der Lippe, Ingo Kowarik

Species-rich meadows are sharply decreasing within many cultural landscapes due to intensified agricultural practices. Simultaneously, enormous free spaces evolve in shrinking cities. We hypothesise that these areas have great potential for developing extensively managed meadows because conservation objectives can here be combined with the aim of low-maintenance greening. In a long-term project, we assessed whether disused urban areas can serve as substitute habitats for species of extensively managed meadows. Our field experiment is situated directly in large-scale housing areas in Berlin. From the beginning, local planners, land owners and residents were involved. As these urban sites were highly isolated from existing meadows we tested different ways of 'assisted migration' to overcome dispersal limitation: (1) hay transfer from regional nature conservation sites and (2) sowing of regional seed mixtures. We compared plant species richness and diversity of the different treatments, and related environmental variables to the establishment success of target species. The results of the first year were promising: we revealed higher species richness in sown plots compared to control plots. In the sowing treatments, 18 of the 26 sown target species were already found. Treatments with hay transfer also showed higher species diversity than the control plots. Comparing these results with upcoming data will reveal how different treatments foster the establishment of target species and show the potential of assisted migration for the development of meadows in urban settings.

08

Long-term assessment of grassland restoration by topsoil removal and diaspore transfer with hay – the importance of environmental filters and founder effects

Norbert Hölzel

Restoration measures aiming at the recreation of low productive alluvial grassland by topsoil removal and the transfer of various types of seed containing hay from target communities have been monitored for 12 years between 1998 and 2009. Overall vegetation development during the first four years was characterized by a rapid decline of ruderals followed by a constant and ongoing spread of species transferred with hay. Origin of plant material and flooding frequency as an environmental filter were key factors for the differentiation of vegetation within the restoration site. After 12 years species composition strongly resembled those of the donar sites and up to now only a limited exchange between treatments that received hay from different origin was observed. More than 110 species could establish from the transferred hay, among them numerous endangered target species. Some species, especially sedges, showed a strongly delayed establishment whereas only single species disappeared after successful recruitment. During the second half of

the observation period a massive spread of N-fixing legumes such as *Genista tinctoria* and *Ononis spinosa* occurred, reflecting the strong nutrient impoverishment by topsoil removal. Overall, the obtained results approved topsoil removal combined with hay transfer being an extremely successful method for the long-term establishment of species-rich nutrient poor grassland ecosystems.

09

Do nutrient-rich soils impede the restoration of species-rich mesophilous grassland? Long-year experiences on hay transfer in lowland and mountainous meadows

Rainer Buchwald, Tim Rosskamp, Luisa Steiner, Melanie Willen

From 2004 to 2008 we carried out 24 hay transfer measures from species-rich mesophilous donor meadows (belonging mostly to *Arrhenatherion* and *Trisetion*) to species-poor meadows and former or actually used fields in SW- and NW-Germany. The recipient sites showed a great variability in chemical parameters of the upper soil layers, like pH, content of K and P as well as C/N-relation. The pH values extend from rather low (3,9 4,7) to moderately alkaline (6,8-7,3), while the contents of soluble potassium vary from low (4-11mg) to very high (45-50mg) K_2O per 100g soil. Furthermore, we found low (4-11mg) to very high (37-45mg) concentrations of soluble phosphate (P_2O_5 per 100g soil) in the recipient sites. However, the amplitude in the N contents are clearly smaller, extending from soils rich in nitrogene (C/N 9,7-11,4) to rather poor (C/N 23,7-28,4, one site 40,5). We assessed the success of the 24 transfer measures by means of some parameters, as the number of transferred plant species and the floristic similarity between the donor meadow and the restored meadow some years after hay transfer. We found that the success of hay transfer does not strongly depend on the soil chemistry of the recipient site, while the technique of the transfer as well as the phonological stage and the floristical composition of the donor sites might be of great importance. From the four soil chemical parameters, probably the content of phosphate is the most relevant factor as regards the restoration success.

10

Wet grassland restoration: effects of soil type, rewetting and techniques on recruitment and ground light availability

Jelte Pieter Dijkstra, Rudy van Diggelen, Jan van der Burg, Alex Verschoor, Bram van Ballaer, Hans Backx

The aim of an experiment on former agricultural grassland was analysis of measures for their efficiency to oppose the major biotic bottlenecks in grassland restoration: limitation in seed dispersal, recruitment and light competition by swards. Treatments were: 3 soil types, propagule introduction (hay vs. seeds) of 6 vegetation types, 3 contrasting recruitment conditions and 3 rewetting regimes. During 4 years of monitoring, 76% of the species recorded at donor sites were found at receiving sites and could be attributed to propagule introduction. However, in 3m x 3m subplots, mean proportions of transferred species at year 4 were small: 6%, 12% and 11% for the three chosen soil types: clay-on-peat, peat-on-sand and sand. For recruitment conditions, top soil removal showed highest proportions of transferred species as well as highest frequencies of species rare in donor sites and in the Netherlands. Rewetting showed no (or a rather negative) effect, neither did the hay vs. seeds treatment. The proportion of species with viable seeds in hay ranged from 30% to 65% per vegetation type. Relative ground light availability correlated negatively with cover and biomass. Too low levels of ground light availability (around 5%) might have caused the lower recruitment in existing swards, whereas in newly established swards on TSR plots the 5% was exceeded by far. Under these light conditions new propagule introductions are recommended. Though TSR was most promising, further research should focus on removal of existing swards by less radical techniques.

11 **Restoring key-biogeochemical features of groundwater-fed rich fens: a pilot study**

Rudy Van Diggelen, Camiel Aggenbach, Ab Grootjans, Fons Smolders, Leon Lamers

Rich fens belong to the most species-rich communities and are categorized as EU priority habitats. Because of heavy deterioration fen restoration has a high priority in the Netherlands and Belgium and many brook valleys are being rewetted. Unfortunately the outcomes are often not as planned and the reasons for the outcome are poorly understood. We carried out a pilot study to determine optima and tolerances in key biogeochemical constraints for mesotrophic fen peat formation. We recorded soil and water chemistry at 22 restoration sites in the Netherlands and Belgium and in reference areas in Poland, together with vegetation composition and soil profile. Our sites comprise a wide range in humification, chemistry and vegetation. Nutrient availability appeared to be much higher in most restoration areas than in the reference sites and consequently these were covered with species-poor high-productive vegetation. Sites rewetted with Fe-rich groundwater, on the contrary, were low-productive but species-poor, probably because of Fe-toxicity. Not only high Fe-concentrations of the interstitial water but also lack of source populations in the close vicinity may hamper the reestablishment of characteristic species in restored sites. Recent peat formation was only found at acidifying sites, not suitable for rich fen development. We conclude that restoration of optimal conditions for rich fen remains extremely difficult. The study also showed there is great demand for further research on the interaction of biogeochemical conditions, recruitment of peat forming brown mosses and vegetation management. Especially the development of micro-structures seems to be important.

12 **Restoration of fens and peat lakes: a biogeochemical approach**

Jeroen Geurts, Fons Smolders, Jan Roelofs, Leon Lamers

Worldwide, fens and peat lakes are being threatened by multiple environmental problems, such as desiccation, eutrophication, pollution and global warming. This has led to increased peat decomposition and sludge production, disappearance of macrophyte species, biodiversity losses and hampered terrestrialization. This presentation emphasizes the essential role of biogeochemical knowledge in the ecological restoration of fens and peat lakes. The regulation of PO4 mobilization, SO4 reduction, sulphide toxicity and peat decomposition all have important implications for water and sediment quality, and for vegetation development. As indicators of both biogeochemical processes and potential biodiversity, sediment and sediment pore water ratios provide valuable diagnostic and prognostic tools for the restoration of fens and peat lakes. These ratios are not only useful for risk assessment, but also for selecting the most promising measures. In many cases, however, it turns out to be difficult to tackle the high P concentrations present by P immobilization methods or dredging. Besides decreasing the influx of nutrient-rich water, it is therefore important to prevent the influx of alkaline and S-rich water, because this hydrological measure will slow down decomposition processes and internal mobilization of nutrients. It can be concluded that if the right measures are chosen on the basis of simple measurements, it is certainly possible to restore the biodiversity in declined fens and peat lakes.

13 **Control of seepage flux and soil organic matter dynamics on restoration of basiophilous fen meadows**

Camiel Aggenbach, Ab Grootjans, Pieter Stuyfzand, André Jansen, Bikila Dullo

In Europe much effort is invested in restoration of base-rich, mesotrophic wet meadows and fens, which are hot spots of biodiversity. This restoration is often focused on restoring groundwater discharge by hydrological measures and/or by removing the eutrophic and acidified top soil. In our study we deal with the interaction of soil organic matter (SOM) dynamics and base fluxes by seepage on the base chemistry of the top soil during 1-2 decades after restoration measures. We collected long term monitoring data on SOM accumulation and base chemistry from a wide range of restoration projects in fens and fen meadows carried out in the Netherlands. We found that success or failure of restoration projects was not only dependent on the seepage intensities at the restoration sites, but more so, on the rate of SOM accumulation after sod cutting. Restoration projects were unsuccessful when rates of SOM accumulation were high and seepage intensities low. Restoration projects were successful when seepage intensities were sufficiently high to buffer internal acidification processes in the organic layer, even when accumulation rates were high.

After top soil removal restoration sites can temporally have a high base status during decomposition of the remaining SOM, but acidify when SOM starts to re-accumulate. Based on the analysis of long term monitoring data, we developed a conceptual model on the interaction between seepage intensities and SOM dynamics, which could be helpful in the planning of future restoration projects.

14 **Restoration of drained mires in the Šumava National Park, Czech Republic**

Ivana Bufková, Frantisek Stibal, Eva Mikulaskova

About 70% of mires in the Šumava National Park have been influenced by past drainage for forestry, agriculture and peat extraction. Since 1999, a "Mire Restoration Programme" started to be implemented in the area with the aim to restore disturbed hydrology and to stop mire degradation. The main restoration technique used was blocking of drainage ditches. Since 2005, monitoring project aimed at studying the degradation changes caused by drainage and evaluating the success of restoration started to be implemented in the area. Water table fluctuation, hydrochemistry, amount of precipitation, vegetation on permanent plots and runoff from subcatchments were monitored. Three year of pre-restoration monitoring shows that water table was maintained in a lower position than a natural system and exhibited higher fluctuations in direct relation to the amount of precipitation received on drained sites. Recession of hollow and lawn vegetation and expansion of competitive grasses or trees towards the bog expanse were recorded on drained sites. Restoration was performed in 2008. The first results from the early post-restoration phase suggested that damming has had a positive effect on the hydrology. The mean water table increased and its fluctuations were reduced, especially in the dwarf-shrub bog sites and wet forests. Changes in water chemistry after restoration are also presented.

15 **Influence of large scale topography on plant colonisation of post-industrial spoil**

Barbra Harvie, Graham Russell, Colin Legg

Studies of vegetation succession and dynamics on post-industrial waste and spoil heaps rarely consider large-scale topography. These sites are typically high and steep-sided yet colonisation is habitually studied in relation to the soil chemistry and structure of the substrate and reclamation is planned accordingly. Floristic and environmental data collected from multiple industrial waste sites in West Lothian, Scotland were used to quantify the impact of topography on species distribution. Groups of species were identified as being unique to, or strongly associated with, ranges of elevation, aspect and slope. The number of species in many of these groups was significantly smaller than expected by chance (Monte Carlo analysis). The species recorded in individual divisions of these measures of topography shared mechanisms of dispersal, growth form and other ecological traits. The distribution of ecologically similar species was shown to be significantly determined by variation in topography both within and between sites. Previous multivariate analyses of the data from these sites demonstrated that species distribution explained by topography was equal to and independent from that explained by soil chemistry. We question the effectiveness of conventional land forming restoration of post-industrial sites and conclude that reclamation and management of sites need to take into account topography; particularly when planning for amenity space and biodiversity.

16 **A geomorphic reclamation model of 'catchments on slopes' for the ecological restoration of surface contour mining**

María Feria, José Francisco Martín Duque, Cristina Martín Moreno, José Manuel Nicolau, Miguel Ángel Sanz Santos, Luis Balaguer

This work describes an ecological restoration design which follows geomorphic principles and criteria. The model is designed for the ecological restoration of areas affected by mining activities, specifically when these are located on slope terrain. The restoration model, called 'catchments on slopes', relies on an expert management of open-cast mining runoff. But not through artificial measures, as it happens in the traditional mining reclamation practises, but through an integrated geomorphic reconstruction. The foundation of the model consists on the design of stable surfaces, which splits off the slope landforms in small catchemts. Thus, topographic remodeling, together with the reconstruction of spoils, surficial deposits and soils, return the hydro-balance of the system. The new conditions created after the restoration permit the establishment of soils and plant cover, the latter being favoured by the seeds' dispersal from the vegetation communities in the vicinity. A

clay slope quarry reclamation carried out under this model was executed during the Autumn of 2008 at La Higuera (Segovia province, Central Spain). The monitoring of the reclaimed surface up to now shows a success of the reclamation, both in ecological and economic terms.

17

Construction wastes, green waste compost and Switchgrass (*Panicum virgatum* L.) used for landfill cover restoration

Lubomir Ruzek, Michaela Ruzkova, Karel Vorisek, Martin Koudela

Switchgrass (*Panicum virgatum* L.) was used as plant cover of the mixture consisting of clayey excavations (43% by weight), the finest fraction from demolitions (20% by weight) and green waste compost (37% by weight) during landfill cover restoration. The described mixture provides favorable conditions for Switchgrass roots development. Fresh root mass 24.71 g in one liter of the mixture guarantees well-developed rootage both in drought and waterlogged conditions, as well as good erosion control. The problem at our experimental site was Barnyard grass (*Echinochloa crusgalli* L.) which plants it very aggressively and herbicide use on landfill cover was impossible. The characterized mixture (all analyses relate to field-moist soil samples from landfill cover of 0-200mm) was above standard. Soil organic carbon (Corg) and microbial biomass carbon (MBC) determined by microwave irradiation methods reached 7.06% and 927 mg C/kg DM (= dry matter) respectively. Other characteristics appeared similarly: available organic carbon extractable by 0.5mol/L K_2SO_4 (C-K_2SO_4) 88.3 mg C/kg DM; biomass specific available organic carbon ((C-K_2SO_4)/MBC) 9.5%; metabolical active organic carbon (MBC/Corg) 1.3%; dehydrogenase activity 48.5 mg TPF (=triphenylformazan)/kg DM/h and arylsulfatase activity 105.0 mg PNP (=para-nitrophenol)/kg DM/h.

18

Does nitrogen deposition cause decline of butterflies by changes in host plant quality?

Gert-Jan van Duinen, C. Turlure, Michiel Wallis de Vries, Arnold van den Burg

The typical butterfly species *Coenonympha tullia*, Boloria aquilonaris and Plebeius optilete of nutrient poor raised and transitional mires show a strong decline in parts of their distribution area, while their respective host plants (*Eriophorum vaginatum*, other grasses, *Oxycoccus palustre*, and related species) are still present. We hypothesize that decreased availability of particular minerals as a result of acidification and drainage, as well as increased availability of nitrogen compounds due to increased atmospheric nitrogen deposition cause imbalances between nitrogen and essential minerals and amino acids in host plants that are fatal to the caterpillars. To test this hypothesis we performed a comparative study on host plant quality between sites with different atmospheric nitrogen deposition and ground water supply. In young leaves of *Oxycoccus* the content of calcium, manganese and amino acids decreases with increasing nitrogen content. These imbalances could indeed result in deficiencies to the caterpillars of *B. aquilonaris* and *P. optilete*. However, the grasses did not show this pattern. Results of a bio-assay and additional investigations on growth rate and quality of young *Oxycoccus* leaves during the development period of caterpillars give further insight in the importance of these imbalances.

19

Direct effects of acidification and eutrophication on heathland fauna species

Joost Vogels, Bart Wouters, Arnold van den Burg, Eva Remke

Research on direct effects of changes in soil and vegetation chemistry as a result of S and N deposition on heathland fauna species performance is scarce. Here, we present current research on this topic on two heathland species in the Netherlands; the sand lizard (Lacerta agilis) and the field cricket (Gryllus campestris). It is hypothesised that the high demand for calcium and magnesium in the sand lizard, needed for egg shell formation, limits the distribution of sand lizards to soils with higher availability of these elements. Acidification and subsequent leaching of calcium and magnesium in these soils could explain the population decline in 1970 and current discrepancies in performance in calcium richer environments compared to calcium poor heathland populations. First results of fitness data are given for a comparison between 1970 and 2010 in an inland, lime poor heathland population and from a lime rich coastal dune population. The decline of populations of field crickets will be explained as an interplay between loss of optimal habitat (nutrient poor acidic grasslands) and degradation of suboptimal habitat (dry, acidic, Calluna vulgaris

dominated stands). Field experiments showed a significant reduction in fitness between individuals raised on Calluna stands compared to individuals raised on nutrient poor, acidic grassland. Feeding experiments with vegetation from both locations showed a significant reduction in reproductive potential, when fed with vegetation from Calluna stands. These results stress the need for developing restoration measures that not only restore vegetation composition but also functional relationships between soil processes and fauna species.

20

Contrasting effects of high nitrogen deposition and aeolian dynamics on food quality of Grey Hairgrass (*Corynephorus canescens*) in drift sand ecosystems

Marijn Nijssen, Arnold van den Burg, Henk Siepel

Inland drift sand areas are very poor in nutrients. Therefore it is expected that a high input of airborne nitrogen will have strong effects on growth strategy and chemical composition of plants. The most important food plant in drift sands is Grey Hairgrass (Corynephorus canescens), which is present from pioneer vegetation to old stabilised grasslands. Only in pioneer vegetation it is partly buried by sand and growth is constantly stimulated. In older, stabilised vegetation high N deposition correlated with high N concentrations in green leafs of Grey Hairgrass, though levels of amino acids did not differ between sites. This suggests that surplus of nitrogen is stored in other, non-protein chemical compounds (NPN), which might lower food quality for herbivores. This is supported by a 20% smaller size of herbivorous grasshoppers Myrmeleotettix maculata on sites where Grey hairgrass has high levels of NPN. Deposition of sand on Grey Hairgrass vegetation in dynamic sites increases the total amount of amino acids and decreases NPN in leafs. Aeolian dynamics might therefore be a process diminishing effects of high nitrogen deposition on food plant quality.

21

Restoration of degraded Dutch forests and remediation of micronutrient deficiencies

Arnold van den Burg

In the Netherlands, forests on poor sandy soils have become degraded due to acid and nitrogen deposition, resulting in losses of biodiversity and changes in the vegetation, such as grass and moss encroachment. Evidence from the food chain of the Sparrowhawk (*Accipiter nisus*) shows that food quality has become a limiting factor for animal populations and the entire forest community. In the Sparrowhawk, which declined by 75% in breeding numbers, amino acid limitation has become apparent from egg amino acid investments and the decline of breast muscle size in the period of egg laying. There is no evidence that the amounts of food have become less, as there are no trends with body weights of breeding hens, laying dates or clutch sizes. In Pied Flycatchers (*Ficedula hypoleuca*) inhabiting the same forests, egg protein (amino acid) and vitamin B2 investments become less if the birds take longer between arrival and egg laying, indicating that food consumed within the forest is of poor quality. Caterpillars of Operophtera brumata develop poorly on Common Oak (*Quercus robur*) leaves in degraded forests, and caterpillars are less able to accumulate essential nutrients, such as vitamin B2. Nowadays, acid and nitrogen deposition have become less, which opens the possibilities for restoration. Soil quality modulates the effects of additional nitrogen. An experimental strategy may be to balance the level of nitrogen with other plant nutrients, to improve plant physiology and edibility by herbivores. However, this acts against the naturally poor status of the forest.

22

Biodiversity in riverbank techniques for erosion control: assessment of animal and plant species diversity along a natural gradient

André Evette, Paul Cavaillé

Riverbanks are characterised by high levels of both species-richness and anthropic pressure. Erosion controls on riverbanks often involve installations to protect human investments (i.e. buildings, public amenities-etc.). However, whether such installations can accommodate natural biodiversity has not been well assessed and subsequently seldom taken into account in the choice of technique. The aim of this study was to assess animal and plant species diversity on the natural gradient of various riverbank protection systems, from entirely stone riprap, through combined constructions (mixing riprap and bioengineering), to purely

vegetative bioengineering structures. We compared plant species diversity and animal taxonomic diversity above ground (beetles) and below ground (mites) on five installations in each category. Vegetation was sampled along three longitudinal transects using the point contact method. Fauna were sampled in the soil, air and herbaceous layers by trapping (yellow bowl trap, pitfalls and Berlese-Tullgren extractor). The fifteen sites sampled were located in the Rhône-Alpes region (South East France). 148 plant species, 78 beetle genera and 8 mite families were recorded. We found a significantly lower animal and plant diversity in riprap constructions than in the other two types. Surprisingly, diversity was higher, even if not significantly, in combined works than in purely vegetative ones. Furthermore, riprap techniques were more subject to exotic invasions than techniques using bioengineering. This study gives new insights into the animal and plant biodiversity of riverbank protections against erosion, ranging from entirely mineral to purely vegetative constructions. It also provides useful information to help practitioners choose techniques in relation to their future impact on biodiversity.

23

Applying river restoration knowledge in flood mitigation schemes: RIVERSCAPES as supports for dialog between dry dam designers and biologists

Christine Poulard, Michel Lafont, Anna Lenar-Matyas, Marta Łapuszek, Jerzy Ratomski, Céline Jézéquel, Pascal Breil

River restoration benefits from the increasing knowledge on the relationships between geomorphological contexts, habitats, biodiversity and river systems functions. However, this knowledge should be used more widely, in particular for flood mitigation projects. Indeed, except mostly for research projects, the impact on a project on the environment is merely assessed after the design is completed. We state that flood mitigation project should be multidisciplinary from early stages to achieve a good compromise between flood protection and biodiversity preservation. In practise, involving specialists with very different backgrounds and objectives in a common project is easier said than done. Concretely, it requires to share common conceptual views; we suggest to use a case-specific typology of riverscapes and their associated biodiversity. Biologists will carry out a careful local analysis and formulate the results as riverscape types, both natural and artificial. For each type, they will describe the potential biodiversity and a view of the processes. This typology is a support for concrete and quick actions. Indeed, comparing the shift of types caused by different solutions will guide the technical choices. We defined a riverscape typology on Polish mountain rivers and applied it to study dry dams design. We checked that referring to riverscapes facilitates negotiations to reduce the impacts; they also serve as a basis to discuss further adaptations in cross-sections. We enlarged this use to river training, which cover a larger area, and are now applying the approach in other contexts, such a the Yzeron catchment nearby Lyon.

24

Characterization of the cost of aquatic ecosystems restoration for river basin management under the Water Framework Directive in Spain

Marta Catalinas Pérez, M. Estrella Alonso Tejedor, Ángel García Cantón,

The Centre for Hydrographic Studies of the CEDEX has developed a characterization of the cost of aquatic ecosystems restoration at a planning level under a contract for the Spanish Ministry of the Environment and Rural and Marine Affairs. The cost characterization is intended as a tool for the planning process under the Water Framework Directive and has been made available for the Spanish River Basin Authorities, who are to select the most cost-effective combination of measures to be implemented in the river basin management plans to achieve the environmental objectives of the Directive. The measures characterized regarding river restoration include embankment removal, river bank shaping, bioengineering techniques, instream habitat improvement, riparian vegetation restoration and fish passage construction, and those related to wetland restoration include activities related to morphology and hydrology restoration. Additionally, other measures characterized include the prevention and control of invasive alien species such as *Dreissena polymorpha* and *Eichornia crassipes*.The costs of the measures have been evaluated basically from data obtained from the detailed analysis of restoration projects developed in Spain (a total of approximately 200 projects have been analysed) or alternatively from schedules of rates of common application in Spain. The results obtained allow for cost estimation at a planning level, either from simple predictive models with parameters

that can be estimated at the planning stage or from a reference to the order of magnitude of the cost, in both cases with different degrees of uncertainty depending on the measure considered.

25 **River Meuse restoration project from the air**

Kris Van Looy, Herman Gielen

A fascinating view from above with a set of aerial images shows the unique features of the Common Meuse restoration project; a project without equal for its size and measures. The 50 km river stretch on the Belgian-Dutch border had a channelized, deeply incised river bed, but its potential was still unaffected as this stretch is the only free flowing part of this large river and no shipping is present. After nearly 20 years of planning, the large-scale cross border restoration programme has come to its conclusion, the actual measures in the area are fully operational. Summer banks and silted floodplain is lowered with 5 to 7meter. Gravel (supply) is replenished in the river bed, finer material is used to restore gravel pits in the area. In the river larger riffle structures are build to restore the regional groundwater level. All these aspects of the project are clearly brought alive in aerial imagery that will be presented with an explanation during film projection.

26 **Restoring forest wilderness areas in Europe: over passing oxymorons to face well-founded stakes**

Daniel Vallauri, Erika Stanciu

In a motion voted in Febuary 2009, the European Parliament calls the Commission to develop actions on wilderness areas, including the goal of "where necessary restoration of Europe's last wilderness areas (...)". A conference hosted during the Czech presidency of the Council of EU (Prague, May 2009) followed and aimed to "(i) raise the profile of wilderness and wild areas in Europe; (ii) recommend an agenda for protection and restoration of such areas (...)". On a scientific and practical point of view, the problem of aiming to restore wilderness in Europe has been criticised by some as an oxymoron, for two main reasons (i) the common culture in the Old World, especially western and mediterranean countries of Europe, emphasises the millenary-long history of nature transformation. The questions of a European definition of wilderness (ecologically and culturally relevant, aims for such policy and also how much wilderness is left today), require some development and clarifications in order to avoid mis-understandings and (ii) considering main bioengineering and restoration approaches implemented in some part of Europe, in terms of goals chosen (rehabilitation or reallocation > restoration ; cultural landscapes > spontaneaous dynamics) and methods implemented (active > passive), the compatibility between restoration science and wilderness could question restorationists. In the paper, based on forest ecosystems, we will first synthesise and discuss 1) the available data on forest wilderness areas in Europe ; 2) the multiple concepts behind wilderness (gradient of naturalness, of human footprint, of wildness ; maturity, ancientness, spontaneous dynamics, connectivity, functional integrity...) ; 3) develop links with ecological restoration concepts (reference ecosystem, irreversibility threshold, target ecosystem, restoration trajectory, landscape approach) ; 4) present some european or global field examples to discuss the variety of stakes, goals and approaches for forest lansdcape restoration. WWF believe those developments could help to find a way out from these apparent oxymorons and help developing the scientific basis of a EU policy on wilderness areas.

27 **Green infrastructure as a tool for a new European biodiversity strategy**

Ladislav Miko

The assessment of the delivery of the current 2010 biodiversity policy states that even though much progress has been achieved the EU has not met the 2010 target of halting biodiversity loss. Across its frontieres, Europe has faced more ecosystem fragmentation than any other continent, in particular due to the replacement of sustainable land use practices with more intensive activities, especially in the agricultural and forestry sectors, and the transformation of vast areas into urban zones and fragmentation through transport infrastructure. All of this is exacerbated by Climate Change impacts. This has major consequences for biodiversity and ecosystem services and on the economic and social activities based upon. Ecosystems that are small or isolated may stop providing us with valuable services such as food,

freshwater, water or climate regulation etc. This also puts into question the long term functioning and viability of EU protected area networks (in particular Natura 2000) – and thus broader EU biodiversity objectives as well. Therefore the call for ecological restoration and sustainable development. As key part of the response to the fragmentation threat and the overall need to devise policies that will sustain the ecosystem services upon which our welfare depends. Green Infrastructure will be a major tool for the implementation of a new European Biodiversity Strategy after 2010. Green Infrastructure calls for an integrated planning approach and for strategic restoration on the limited land which is available in Europe.

28

Enhancing social and economic sustainability of restored areas: case studies from Brazil

Vera Lex Engel, John A. Parrotta

During the two last decades, we have observed an outstanding development of both science and practice of ecological restoration in Brazil. Nevertheless, most restoration efforts are focused only on biodiversity conservation and they have failed to contribute to increased flows of environmental services and tangible benefits for private stakeholders. This situation limits volunteer initiatives and directs restoration efforts mainly for big companies that are searching for certification, or else to public agencies, and landowners who are obligated by law to undertake restoration. The scope of our research was to test some restoration alternative systems using mixed plantings to stimulate natural regeneration of native vegetation at the same time that they provide direct benefits for stakeholders. The systems include direct seeding techniques, agroforestry systems, and mixed plantations of native tree species with commercial value. The systems being tested are designed to be managed for timber, firewood, non-timber-forest-products in the short and medium time, while permitting the re-assembly of a fully recovered native forest over a longer time span. Starting 12 years ago, our results indicate that most of the objectives are being reached, both in ecological and socio-economic spheres. We have demonstrated that the plantings foster autogenic restoration of both plant and animal biodiversity, help recover functioning and yield direct benefits like crops, fruits, firewood, timber and medicinal plants. We also argue that having a "menu" of options may help convince land owners to cooperate as full partners and not play the role of brakers for forest restoration.

29

Community-based restoration: a case study from the Camargue

Lisa Ernoul, Nicolas Beck

Community-based conservation empowers local people in the management process through partnerships in planning and implementation of conservation projects in the hopes of creating accountability and ownership of conservation objectives. We have taken this concept a step further, using the principles of community-based conservation in the planning, implementation and monitoring of a wetland restoration project in Camargue (southern France). The Tour du Valat (scientists and landowner), with active collaboration from a local community, has recovered 120 ha of natural wetlands that had been converted into fish farming. The conservation objective was to recover the principle habitats traditional to the Camargue with a move from artificial marsh exploitation with high, continual water levels to a more "natural management" with seasonal fluctuations in water levels. The results of the participatory monitoring have shown a return of traditional flora and fauna, with the recovery of permanent and temporary marshes, reed beds stands, pastoral vegetation and bush lands. The project evaluation showed that stakeholders appreciated their involvement in a co-learning process where habitat management, plant ecology, local uses of plants and game birds were discussed in depth with scientists and villagers. The recovered land now hosts a variety of multi-use activities for the villagers including grazing, hunting, fishing, hiking, bird watching and educational visits. Now, six years after the initiation of the project, we have shifted from a community based restoration project to a joint community managed project.

30 Grassland and wetland restoration of Olsavica Valley (Eastern Slovakia)

Jan Seffer, Viera Sefferova Stanova, Rastislav Lasak

The Olsavica Valley (1,367 ha) is located in Carpathian part of Eastern Slovakia. Consequence of agricultural collectivization was the removal of terraces and the conversion of small-scale farming into large, intensively managed blocks of arable soils. Large-scale drainage schemes were completed in 1987. In the early 1990s, negative effect of agricultural practices culminated in flood damage to Olsavica village. The effort to reverse this situation started in 1999 and was finalised in 2007. Key activity of first phase was work with main stakeholders – local municipality and management of cooperative farm - to support the idea of large-scale ecological restoration. After few years of hesitation, the flooding and high erosion, which regularly affected village, has convinced them. In the same time ecologists and experts for hydrology and soil management join the effort in order to elaborate restoration plan. In order to decrease area of intensive agriculture, the restoration of 120 ha semi-natural grassland on arable soil was proposed. The grassland areas and belts along the channels were effective tool, which decreased magnitude of floods and erosion. This phase was finalised in 2003. Second phase of restoration effort was focused on stream and wetland restoration. The main channel of Olsavica creek converted into drainage canal was deeply eroded. Small dam has been built to stop erosion and to serve for other benefits of local community. Upstream of dam the drainage canal was revitalised into natural stream (350 m). New created alluvium was planted by local species of trees and shrubs.

31 Regrassing with regional seed mixtures in the Bile Karpaty Mountains, Czech Republic

Ivana Jongepierová, Jonathan Mitchley

In the Bílé Karpaty (White Carpathians) Protected Landscape Area (PLA), regional seed mixtures have been used to re-create grasslands on ex-arable land since 1999. This programme was started in the early 1990s, led by a local NGO in collaboration with the PLA Administration, Zubrí Grassland Research Station, and several local farmers. In the first stage, seeds were collected in species-rich meadows and reproduced in seedbeds. Since 2000 a combine harvester and since 2007 also a brush harvester have been used to obtain enough local seed to meet the demands for restoration of grasslands which had previously been ploughed and for stabilisation of erosion-susceptible arable land. The seed production capacity is currently set to regrassing about 60 ha of arable land annually, using a seed rate of 20 kg/ha. To date, over 450 hectares of arable land have been regrassed with regional seed mixtures at a total of 35 localities. Since 1999, the grassland restoration project has been accompanied by research on different regrassing methods, properties of target species (germination, seed ripening, production, etc.) and plant establishment in the restored fields. Results of the studies of regarding regrassing methods and plant establishment are presented in this paper.

32 Grassland restoration in floodplains of East German rivers

Armin Bischoff, Guido Warthemann, Nadja Winter

Intensive management has resulted in a loss of plant diversity in European floodplain grasslands. Agri-environmental schemes have been implemented since the early 1990ies to restore the original species richness. However, recent research has shown that dispersal limitation and low establishment rates often hamper the re-establishment of target species. We established a long-term study to quantify dispersal and colonisation of target species from still existing source populations into restored grasslands. We further tested hay transfer as a method to overcome dispersal limitation and to accelerate the restoration of target communities. A factorial experiment was set up combining different transfer dates (early, late and both together) and soil disturbance treatments (control, harrowing, ploughing). Seed transfer rates were measured by analysing the number of transferred seeds counted in seed traps in relation to the corresponding seed density in the source community. Finally, we sowed a subset of target species to the different soil disturbance plots in order to examine establishment rates. The transect analysis showed a slow colonisation of restoration sites from adjacent species-rich reference communities with large populations of target species. Even nineteen years after re-conversion to traditional management, the density of target species was far below that of reference grasslands.

Hay transfer was efficient in re-establishing a part of the target species. The number of transferred seeds was very promising while establishment rates were extremely low for several species. Both hay transfer and direct sowing were only successful when combined with previous soil disturbance.

33

Ecological restoration of a wet meadow on peat soil: a case study in the estuary of Seine River (France).

Fabrice Bureau, Chockri Mchergui, Estelle Langlois, Michael Aubert, Marthe Akpa-Vinceslas, Aurélie Husté, Pierre Margerie, Matthieu Chauvat, Sandrine Samson

The restoration of biodiversity and its functions in human-disturbed wetlands is an important ecological topic today. As requested by the "Grand Port Maritime de Rouen", we surveyed the ecological restoration of a sandpit in the low valley of the Seine River. Further to its exploitation, this sandpit was first filled with dredging sediments of the Seine River. These sediments were then covered with some characteristic alkaline peat of the Seine valley. The ecological restoration aims to recreate several wet ecosystems and in particular a wet meadow on a peat soil. The goal of our study was to follow the spontaneous re-colonization of the new peat soil since May 2008. Several ecological parameters were assessed and more specifically both structural parameters (physico-chemical characteristics of reconstituted soil, characteristics of plants, collembola and earthworms communities) and functional parameters (plants biomass, C and N mineralization, denitrification process). We will focus in this presentation on characteristics and functioning of the restored peat soil. The restoration of the sandpit leads to the formation of two types of peat soil in terms of physico-chemicals characteristics. This result is related to the variability of sediments and the peat deposition by hydraulic way. These two soils show differences in their functioning in relation with C and N dynamics. This initial heterogeneity in soil physico-chemical characteristics has consequences on the spontaneous colonization in the first stage of succession. We will discuss how the initial soil characteristics and soil functioning can be controlling factors for the future dynamic trajectories. This experiment is an original study on the possibilities of ecological restoration in a human-disturbed estuarine system. It should provide fundamental results on the dynamics of restored peat soils and associated ecological processes.

34

Ecological recreation of a wet meadow on peat soil: comparison of vegetation natural dynamics, sowing, mowing and transplantation experiment

Estelle Langlois, Pierre Margerie, Fabrice Bureau, Estelle Forey, Michael Aubert, Aurélie Husté, Matthieu Chauvat, Sandrine Samson

The restoration of biodiversity and its functions in human-disturbed wetlands is an important ecological topic today. In accordance with the "Grand Port Maritime de Rouen", we surveyed the ecological restoration of a sandpit in the lower valley of the Seine River. The main objective is to re-create on a peat anthroposoil a wet meadow floristically similar to neighbouring unmined grasslands. Along with physicochemical changes in peat soils deposited since 24 months, vegetation changes have been recorded. Natural vegetation dynamics as well as experimental design of vegetation forcing are followed. Dynamics is sampled using a spatially explicit pattern. Experimental designs are (i) transplantation of meadow vegetation banks from a parcel to be destroyed and considered as representative of a fonctional objective (ii) sowing of two grassland seed sets and (iii) mowing and biomass exportation of spontaneous vegetation. First results are (i) a fast colonization of the area (76% of covering after 16 months) (ii) a strong response of vegetation since the beginning to an inundation gradient controlled by topography. Specific richness shows a weak turnover. A dynamical discrepancy appears between wetter areas and mesophilic, slower-growing ones. Vegetation banks exhibit high survival rates and no differential specific survival but a weak vegetative expansion is recorded. It thus does not appear as a realistic altenative to natural, even if controlled, vegetation dynamics. Sowing does not exhibit consistent growth, even if establishment is acknowledged. First mowing occurred in summer 2009, results are to be observed in 2010 growing season.

35 **Fluctuating water tables as potential restoration measure for floating rich fens**

Casper Cusell, Annemieke Kooijman, Leon Lamers

The Netherlands is characterized by extensive peatland areas, which are eutrophicated and/or acidified by natural succession and human impact. To counteract these processes, the waterboard of National Park Weerribben-Wieden wanted to reintroduce more flexible water levels, after keeping them artificially constant for 80 years. Lower summer levels would supposedly reduce input of nutrient-rich water, and higher winter levels would result in inundation of floating fens with base-rich water. In theory, this would lead to lower eutrophication and improvement of base status. Field experiments started in 2008, in two areas of several ha. In summer, water levels were lowered with 10 cm and in winter increased by 20 cm, in both cases for one week. In addition, a six-month mesocosm experiment was performed at two temperatures, to test potential effects of different water levels in summer and winter, and differences in water chemistry. Preliminary results suggest that effects of more fluctuating levels are less clear than expected. Water levels in the field hardly dropped during the summer. In winter, one area was indeed inundated, but the other kept floating. In the flooded area, some superficial exchange of calcium occurred with the moss layer, but base-rich water did not enter deeper layers. However, high levels in mesocosm experiments did result in increased pH-values. Furthermore, low temperature in mesocosm experiment led to higher reduction and, in relevant applications, toxic levels of sulfide or ammonium, and reduced growth of characteristic moss species. At summer temperature, low water levels even led to death of mosses.

36 **The effects of peatland restoration on water-table depth, elemental concentrations and vegetation: 10 years of changes.**

Tuomas Haapalehto, Harri Vasander, Sinikka Jauhiainen, Teemu Tahvanainen, Janne Kotiaho

We studied the effects of restoration on water-table depth, element concentrations of peat and vegetation composition of peatlands drained for forestry in southern Finland. The restoration aimed to return the trajectory of vegetation succession towards that of undisturbed systems through the blockage of ditches and the removal of trees. Permanent plots established on a bog and a fen were sampled one year before, and one, two, three and ten years after the restoration. The restoration resulted in a long-term rise of the water-table in both peatlands. Ten years after restoration, the mineral element concentrations (Ca, K, Mg, Mn and P) of peat corresponded to those reported from comparable pristine peatlands. In particular, the increase of K and Mn concentrations at both sites suggests the recovery of ecosystem functionality in terms of nutrient cycling between peat and plants. The restoration resulted in the succession of plant communities towards the targeted peatland vegetation of wetter condition at both sites. This was evident from the decreased abundance of species benefiting from drainage and the corresponding increase of peatland species. However, many species typical of pristine peatlands were missing ten years after restoration. We conclude that the restoration led to a reversal of the effects of drainage in vegetation and studied habitat conditions. However, due to the slow recovery of peatland ecosystems and the possibility that certain failures in the restoration measures may become apparent only after extended time periods, long-term monitoring is needed to determine whether the goals of restoration will be met.

37 **Blanket bog water tables: how much of an impact did drains have, and what influences responses to restoration ?**

Lorraine Wilson, Jared Wilson, Joseph Holden, Ian Johnstone, Mike Morris

Although peatland science increasingly focuses on the need to restore peatlands to achieve several potential benefits, there remains much uncertainty around both the extent of drainage impacts, and the ability of habitats to recover. The vast majority of restoration funding stems from legislative requirements to return designated habitats to 'good ecological condition', but the impact of drainage on vegetation communities is poorly documented, and restoration decisions are largely based on ecological assumptions. In common with many of the other hoped-for benefits of peatland restoration, such as Carbon storage and water quality improvements, habitat recovery is thought to depend on a reinstatement of high water tables. However, water table responses are hard to predict and mechanistic understanding of hydrological responses to restoration is limited. This study reports on

vegetation and water table responses to drainage; and water table responses to drain blocking restoration of a Welsh upland blanket bog. An information theoretic approach to examining the data provided evidence of a 'dry zone' adjacent to grips that had exerted a detrimental effect on key blanket bog plants. We also demonstrate increases in water retention and water tables within the bog after restoration, and highlight the importance of small and large scale topography in determining the degree of these responses. Crucially, this study showed strong catchment scale differences in response, and a very gradual recovery of water tables, both of which highlight the need for more studies to be carried out at the landscape scale and over longer time periods.

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Restoring drained blanket bogs: involving and informing the hill farming community

Mike Morris, Lorraine Wilson, Ian Johnstone, Jared Wilson

Although peatland science increasingly focuses on the need to restore peatlands to achieve several potential benefits, there remains much uncertainty around both the extent of drainage impacts, and the ability of habitats to recover. This in turn leads to uncertainty in its benefits to the farming community. This uncertainty, and specific concerns held by livestock managers, must be addressed if restoration is to become an accepted practice in hill farming areas. This study carried out extensive advocacy amongst the local hill farming community, to assess the priority concerns likely to hamper efforts to promote restoration. To address some of these issues, we report on vegetation and sheep responses to drainage on a Welsh upland blanket bog. An information theoretic approach to examining the data provided evidence that drainage has not, overall been successful in drying areas around ditches to match surrounding habitats and that drains installed in the blanket bog have not significantly increased the amount of palatable plants available to livestock. We also demonstrate that, though livestock usually avoid drained areas, when within these areas, they tend to stay near grips. This has significant implications on livestock safety in drained areas. It is possible to predict that restoration at this site is not going to have a detrimental impact on the grazing available to sheep. These results represent an important step in informing the farming community, work underway to address other key issues is also discussed.

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From arable fields to lowland heathland supporting Silver Studded Blue butterfly

Philip Putwain, Stephen Lewis, Gill Haynes

Prees Heath Common Reserve in Shropshire, UK, supports the last colony of the Silver-Studded Blue butterfly (*Plebeius argus*) in the English Midlands on a small area of relict heathland. Large scale restoration of lowland heathland at Prees Heath commenced in March 2007. The aim is to create lowland heathland and acid grassland mosaic communities on former fertile arable land, on which crops of beans, wheat and potatoes were grown, in order to provide a greatly increased area of suitable habitat for the existing colony of Plebeius argus. Phase I of the programme of heathland re-creation commenced in March 2007. This involved deep ploughing an area of 6.5 ha to invert the existing soil profile to a depth of 90cm exposing underlying infertile sand and gravel. This was followed by incorporating sulphur prills (1.25 t/ha) and spreading heather brash (15.48t/ha) bearing ripe seed capsules of ling heather in November. Surface soil pH dropped to 3.7- 4.1 by summer 2009. The mean density (n=24 x 2m^2) of established heather seedlings in October 2009 was 50.8/m^2 (range 0-372m^2). The results to date suggest that heathland will develop successfully over the next few years to the benefit of Plebeius argus.

40

Restoration options for a Thames Basin heath

Mike Le Duc, Philip Putwain

The English Thames Basin heaths are of high conservation priority. Piecemeal development in the surrounding land, and inadequate management response, has left a number of serious problems including weed invasion, eutrophication and fragmentation. This paper deals with a vegetation survey carried out to estimate the extent of the problems for conservation. The survey results uncovered some of the extent of damage to the heathland communities, and enabled recommendations for future management. The results suggested that the commonly used standard condition assessment methods reflect little of the actual problems.

41 Impacts of phenological shifts on the restoration of upland heath ecosystems in Scotland: practical problems and moral dilemmas

Barbra Harvie

Scotland is home to 12 upland heath communities all of which are listed under the European Union directive on the conservation of natural habitats. Some of the dilemmas resulting from a rapidly changing environment will be discussed in the context of restoring and maintaining the diversity of these heathland habitats and their related species in this International Year of Biodiversity. Ecological restoration applies scientific understanding of successional processes and the autecological characteristics of species within a damaged ecosystem to assist the recovery of that system to a functioning and sustainable habitat. Interspecific differences in phenological shifts of both plants and animals as a response to changes in climate can affect interactions between species within an ecosystem to such an extent that the system may no longer function. The implications of the potential functional collapse of key heathland habitats in Scotland are highlighted.

42 Growth of rare plant with "home" and "away" mycorrhizal fungal assemblages

Maarja Öpik, Merili Simmer, Kadri Karp, Ülle Reier

Root symbiotic arbuscular mycorrhizal fungi (AMF) affect plant performance and productivity in natural habitats. Growth and competitive ability of rare plants can be negatively influenced by the lack of suitable symbionts or presence of unsuitable ones. We investigated the effects of natural assemblages of AMF from present ("home") and potential ("away") habitats of rare Rubus arcticus L. on the growth of this plant in pot experiment conditions. Mycorrhizal inoculum was added as whole soil to include all naturally occurring AM fungi irrespective of their culturability and to include all types of propagules (spores, mycelium, root fragments). Micro-propagated plants originating from the same population as the "home" soil inoculum were used to exclude effect of plant genetic variability. Plant growth was strongly inhibited in the control treatment without mycorrhizal inoculation, indicating that this plant species is highly mycorrhiza dependent. Plants grew smaller with "home" inoculum than "away" inoculum, suggesting a potential negative feedback between the native assemblages of mycorrhizal fungi in the remaining few habitats of the rare plant. This finding suggests that reintroduction efforts of this rare plant species could benefit from changed mycorrhizal symbionts as compared to the native fungi in the plant's present populations in order to ensure efficient establishment. This measure could be applied as inoculation of pre-grown micro-propagated plantlets.

43 What are the main influential factors on vegetation succession on reclaimed coal wastes in Spain?

Josu Gonzalez Alday, Rob H. Marrs, Carolina Martinez-Ruiz

Vegetation succession has been proved as a tool to solve the practical problems in ecological restoration. In this way, the inclusion of succesional concepts and processes in management actions are improving the restoration of self-sustaining ecosystems on degraded land. Here, we characterized the vegetation succession on reclaimed coal mines in Spain, relating the successional changes with common reclamation processes used and environmental and soil factors to identify limiting ones. The 31 coal mines comprised stages of different age from 1-40 years since reclamation started and had been reclaimed using two methods (topsoil addition or not). Over these mines vascular plant species cover was monitored. The reclamation method used affected plant succession; where topsoil was added succession was influenced by age since reclamation and soil pH, whereas when no topsoil was added only soil factors as sand and sodium were significant. At micro-scale the rockiness of plots reduced the number of species arresting the successional process. Our results suggest that the topsoil addition improved the restoration process, developing a native shrub community in 15 years and a young forest in 30 years. However, where topsoil was not added, the soil amelioration to improve water holding capacity and structure might assist succession.

44 **Hay transfer, mulch seeding and spontaneous succession – ten years after slope restoration in a post-mining site**

Annett Baasch, Anita Kirmer, Sabine Tischew

The ecological restoration of highly disturbed areas, such as surface-mined land, is usually aimed at the purposeful acceleration and/or manipulation of vegetation development. Studies on primary succession have shown that rates and trajectories of vegetation development are not only affected by environmental site factors but also by the proximity to colonists and local dominance patterns. In the post-mining landscapes of Eastern Germany first-comer effects of plants with clonal growth (e.g. *Calamagrostis epigejos*) or high seed production (e.g. *Betula pendula*) play a decisive role for vegetation development on sites of intermediate site quality. In the former lignite mining area Roßbach, different restoration methods were used to initiate vegetation development on unvegetated slopes in the vicinity of birch pioneer forest, dry grasslands and dominance stands of *Calamagrostis epigejos*. In September 2000, two experimental treatments were started: application of fresh, diaspore-rich green hay and mulch seeding. Over the last decade, the development of vegetation has been monitored. Compared to untreated control plots, vegetation development was much faster on treated sites with a higher share of target species. Control plots showed a higher amount of ruderal species both on number of species and on total coverage. On untreated plots, *Calamagrostis epigejos* was able to immigrate via seed rain from adjacent dominance stands steadily increasing its coverage with ongoing time. Application of diaspore-rich green hay and seeding of regional seed mixtures accelerate the pace of succession and alter its direction leading to the development of species-rich grasslands, thus contributing to the preservation of regional biodiversity.

45 **Strategies for natural woodland development in mined sites based on germination and establishment studies with *Betula pendula* Roth**

Antje Lorenz, Sabine Tischew, Sven Wagner

In Central Europe, Silver birch (*Betula pendula* Roth) plays a decisive role in spontaneous woodland development in surface-mined land. On several dumped sites, a delayed colonization indicates difficulties in germination and / or establishment of Silver birch. Therefore, the identification and characterization of microsites favourable for the establishment of Silver birch was the objective of an experimental field study. In three mined sites in eastern Germany, *Betula pendula* was sown on different substrates (sandy, clayey) and with different competitive pressures. All three study sites are not influenced by the groundwater table. Immediately after germination, about 500 seedlings were marked to investigate their individual fate until the second growth period. We distinguished between microsites with and without successful germination and establishment of birch. We recorded parameters which describe substrate conditions and competition terms. Clay content of the humus-free substrate in combination with a high water storage capability and the availability of raw soil proved to have a significant effect on germination and establishment of birch (GLM-Analysis). In addition, the establishment of *Betula pendula* is influenced by the litter layer. A thin litter layer results in a lower mortality because of a more balanced microclimate (air moisture and temperature on soil surface). Based on the results of this investigation we recommend restoration strategies for near-natural woodland development in mined sites. Dependent on site conditions different methods of assisted site recovery are proposed.

46 **Ecological restoration of grassland on alkaline, sodic industrial residue**

Ronan Courtney, Tom Harrington

The establishment of vegetation cover on a highly alkaline bauxite residue was assessed in trials over a 5-year period. Obstacles to achieving direct vegetation establishment included pH values of up to 12, high levels of exchangeable sodium (ESP) and poor nutrient status. The predominance of the fine fraction was an additional constraint, because low permeability hindered drainage and inhibited plant growth. In laboratory, greenhouse and field trials a methodology was developed for direct revegetation on amended residue. Amendments with gypsum, sand fraction and organic matter were found to support the growth of several grassland species on the residue. Substrate conditions achieved were dependant on initial residue characteristics, application rates of amendments, and the period of

leaching. A variety of grassland species were established on the residue in pilot trials. After a 5-year period, revegetated areas were examined and assessed for substrate and vegetation quality. Selected substrate parameters had improved from previous levels. Additionally, grassland botanical diversity increased and invertebrate diversity and activity was enhanced on revegetated areas. On the basis of these trials, revegetation of the residue is now being demonstrated in a dedicated large-scale trial. A monitoring programme has been established that will assess ecosystem restoration success.

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Use of prescribed burning for restoration and maintenance of ecological conditions: predicting and managing fire injury and tree mortality

Kevin Ryan, Eric Rigolot, Francisco Rego, Herminio Botelho, Jose Antonio Vega Hildago, Paulo Fernandes, Tatiana Sofronova

Managers and scientists often seek to use fire to restore and maintain historic or natural species composition, stand structure, wildlife habitat, landscape pattern and ecological functioning. Successful use of under-burning in forests and woodlands requires integration of fire behavior and fire effects knowledge into the planning, implementation, and monitoring of restoration projects. Trees consist of three highly integrated organs: crown, roots, and stem or bole. These organs have differing physiological functions and morphological properties that are important considerations in prescribed burning. Fires burning in various vegetative fuel complexes, and under differing weather conditions, have typical energy release characteristics and associated temperature histories, which when integrated with plant attributes can be used to predict fire effects. Managers need guidelines on how to safely and effectively apply fire to meet desired restoration goals. These guidelines need to be based on knowledge of the interactions between fuel consumption, fire behavior and tree morphological characteristics that confer resistance to thermal injury. Likewise knowledge is needed on how burn injuries affect survival and growth. This paper reviews and synthesizes the biophysical processes controlling fire injury and the physiological responses to injury. Models of fuel consumption, fire behavior and heat transfer are integrated with data from field burning experiments from Eurasia and North America to illustrate fire injury mechanisms and physiological responses. Changes in fire resistance and resilience associated with species and age/morphology differences are discussed. The theoretical and empirical knowledge are integrated into guidelines for the effective planning, implementation, and monitoring of fire restoration projects.

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Compost amendment in a Mediterranean ecosystem after fire: effects on soil, micro-organisms and vegetation

Antoine Cellier, Christine Ballini, Virginie Baldy, Raphaël Gros, Nicolas Montès, Thierry Gauquelin

Mediterranean climate is characterized by long dry summers and strong winds favouring recurrent forest fires. Fires induce partial or total destruction of vegetation cover and loss of superficial soil organic layers. This leads to slowing down plant cover regeneration. Adding compost is considered a solution to this process. The objective of this study is to determine, over a period of 2 years, the effect of in situ input of mulched sewage sludge compost on a recently burnt shrubland ecosystem in calcareous Provence. Evolution of soil chemical and physical parameters is evaluated every 3 months from the date of application. Microbial biomass, functional diversity and enzyme activity were determined with the same step time as indicators of compost effect on soil biological properties. Annual vegetation production is estimated by measuring biomass of the dominant plant species in March and July by the point intercept method. First results, 6 months after amendment, showed that compost input increased K, P, Mg and Na soil content but had no effect on CEC. It maintained soil moisture in the first 20 cm after rainfall and induced a more important development of the microbial biomass. However, no significant effects were observed on the microbial community and their activities. Concerning vegetation, 11 months after amendment, compost input favoured biomass production of the dominant herb species *Brachypodium ramosum*, of the shrub species *Cistus albidus* and *Cistus salviaefolius* but did not impact the growth of *Quercus coccifera*, the main structural species of the garrigue.

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Effects of post-fire silvicultural treatments related to the burned wood on the soil nutrient availability and soil carbon sequestration

Sara Marañón-Jiménez, Jorge Castro, Andrew S. Kowalski, Regino Zamora

Post-fire salvage logging is currently the most frequent silvicultural practice after wildfire in Mediterranean areas. However, the extraction of the logs and coarse woody debris implies the removal of nutrients contained in the burned wood that otherwise would be reincorporated to the soil through decomposition. In this study we intend to determine the role of the burned wood for nutrient cycling and soil fertility in a burnt forest area of a Mediterranean mountain (Sierra Nevada National Park, SE Spain). We established four plots along an altitudinal gradient where cut logs and branches were left in situ. At each plot we determined: 1) Initial nutrient content in burned wood, 2) Decomposition rates and nutrient concentration in burned wood left over the soil 2 and 4 years after the fire, 3) Available nutrients in soil and in the microbial fraction below burned tree trunks and in bared soil areas. According to the results, the burned wood represents a great potential reservoir of nutrients for the ecosystem. Wood decomposition rates were higher at the lowest altitudes. Nutrients pools changed over the time, and in particular there was a sharp decrease in phosphorous in the burned wood. Available nutrients in soil, pH, and SOM were consistently higher below burned tree trunks than in areas without wood. The presence of burned wood also altered the content of microbial C, N and P. Therefore, we conclude that the remained burned wood after a wildfire results a useful natural element to recover fertility and soil nutrients.

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An experimental test of the impact of post-fire salvage logging on community regeneration

Jorge Castro

There is an intense debate about the ecological impact of post-fire salvage logging, but scant support is available from experimental studies. We manipulated a burnt pine forest on a Mediterranean mountain to analyze the effect of salvage logging on several aspects related to post-fire regeneration. We used a randomized block design with three plots of ca. 25 hectares each, established along an elevational gradient. Three replicates of three treatments were established per plot: Salvage logging, Non-intervention (NI), and an intermediate degree of intervention (felling and lopping most of the trees but leaving all the biomass in situ; "Partial cut plus lopping", PCL). Four variables related to community regeneration were monitored: i) regeneration of a serotinous tree (*Pinus pinaster*); ii) bird-species abundance and richness; iii) plant species diversity; and iv) natural colonization of *Quercus ilex*, a native tree with potential to establish in the area. The results show that pine seedling survival was the highest in PCL. This was associated with the amelioration of microclimatic conditions under the scattered trunks and branches. Bird species abundance and richness was reduced ca. 45% in SL. Plant diversity in SL was reduced ca. 25%. Natural colonization of *Q. ilex* was successful in the NI treatment but not in the SL, as the main acorn disperser (the European jay) used NI as a habitat for caching the acorns. The results are consistent across years and plots in all the cases. In conclusion, salvage logging has a negative effect on several key aspects related to ecosystem regeneration.

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Ecological responses to management actions: flow alteration – vegetation response relationships

María Dolores Bejarano, Christer Nilsson, Marta González del Tánago, Miguel Marchamalo

Water development has turned rivers into endangered ecosystems. Improving understanding of ecological responses to river management actions is a key issue for assuring a sustainable water management, which provides water to growing human populations and at the same time preserves freshwater ecosystems. However, very few studies have been published where ecological metrics have been quantified in response to various degrees of alteration. In this work, changes in natural riparian corridor woody species composition and distribution (as indicator of the ecological status of the fluvial ecosystem) were quantified at multiple sites along a flow alteration gradient (as indicator of impact), and based on the obtained relationships we propose a simple empirical model that predicts the riparian vegetation responses to intensity of flow regulation below a dam. For field measurements we

selected two different regulated river reaches, one Boreal and the other Mediterranean, in order to evaluate differences in response trends related to local physic-climatic factors and vegetation species. Vegetation establishment patterns appeared as objective and easy indicators of ecological responses to flow regulation. Our results show clear longitudinal recovery trends of the natural patterns of woody species distribution with distance from dam corresponding to a similar decrease of the intensity of flow regulation in the Boreal river, while altered vegetation distribution patterns remains along the Mediterranean reach corresponding to a constant degree of regulation. The existence of other overlapping pressures apart from flow regulation, the type of substrate and shape of river banks also influenced the ecological response to flow regulation. Finally, responses to flow regulation also differed for tree and shrub species.

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River and watershed restoration through the assessment of ecosystem services

Francisco A. Comín, R. Sorand, B. Mirand, L. Guara, S. Moliner, A. Calvo

Where reference sites are not available, the assessment of ecosystem services can be a useful strategy and methodology to define restoration actions. River Piedra (76 km long, watershed 1,545 km2), a Mediterranean river in the SW Ebro Basin (NE Spain), lacks typical river habitats because of intensive land-use for agriculture, many small dikes and gates, and a 80 Hm3 reservoir in the lower part of the river. Lack of riverine forests and water quality and habitat degradation are the major deficiencies of the river, after extension of agricultural areas close to the river channel, intensive use of fertilizers and multiple regulation of river flows. The assessment of ecosystem services using direct indicators (soil structure, mineral and organic contents, plant cover and habitat use for conservation, recreation, food and mineral production) and indirect estimates (gas and climate regulation, water runoff and soil erosion), applied to environmental units defined for the whole watershed (based on habitat types and land use) and the river (based on slope and riverside plant cover) identified major actions for restoration: a program for the abandonment of agricultural lands where soil erosion and water runoff is high and stimulating soil conservation and low fertilization agricultural practices; restoring degraded bush and forests with native plant communities; habitat diversification in the river bed by removing fine sediment, and providing shade through riverside forest plantation after widening the riverside through agreements with land owners. Preliminary actions developed in two river sites indicate that the ecological restoration of River Piedra and its watershed is possible through the integration of scientific/technical, social and economic aspects.

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Restauration hydroécologique de la Veyle au droit de la gravière de St-Denis-les-Bourg, département de l'Ain, France

Julien Corget, Philippe Adam

La Veyle est un affluent de la Saône, qui s'étend globalement entre l'étang Magnenet à Chalamont (est de la Dombes) et Grièges (proche de Mâcon). Dès 1972, des graviers furent exploités massivement dans le lit de la rivière à St-Denis-les-Bourg. Cette exploitation donna rapidement naissance à un plan d'eau d'une superficie actuelle de plus de 45 hectares et d'une profondeur moyenne d'environ 15 mètres. Le fait que la Veyle traversait ainsi un plan d'eau était négatif à plus d'un titre en raison du blocage des flux sédimentaires et de la rupture de la continuité écologique que cela implique, de la hausse de la température de l'eau, des risques de pollutions de la nappe, etc. Ainsi, conformément à la DCE qui milite en faveur de l'atteinte du bon état écologique en 2015, puis dans le cadre du contrat de rivière Veyle, le Syndicat Mixte Veyle Vivante envisagea comme mesure prioritaire, de "sortir" la Veyle du plan d'eau de St-Denis-les-Bourg en créant un nouveau lit pour le cours d'eau. Biotec fut mandaté pour la conception et la maîtrise d'œuvre des travaux. L'exploitant actuel de la gravière se chargea de la négociation foncière des terrains nécessaires à l'espace dévolu au nouveau cours d'eau. Le nouveau lit, d'un linéaire égal à quelques 1 800 mètres, fut créé de façon méandriforme, dont la sinuosité a été inspirée des méandres préexistants avant l'exploitation des graviers. La configuration donnée à la nouvelle rivière fut calquée sur des modèles naturels pour produire un maximum de diversité écologique avec un minimum d'interventions. La nouvelle Veyle, âgée d'aujourd'hui de quelques mois (mise en eau le 06.11.2009), présente déjà des faciès et des milieux alluviaux très intéressants, avec une alternance d'érosions, de zones de dépôts, de radiers, de mouilles de concavités, etc. La végétation rivulaire, implantée sous forme de "spots" tout au long du nouveau lit, constitue le coup de

pouce à la nature, en vue du développement à venir d'une "véritable" mosaïque de différentes formations végétales indigènes et adaptées.

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La revitalisation de l'Aire (Genève, Suisse)

François Gerber, Alexandre Wisard

Le projet de revitalisation de la rivière Aire a débuté en 1999 avec le programme de renaturation des cours d'eau initié par l'Etat de Genève sous la forme d'un mandat d'études parallèle et se poursuit encore à l'heure actuelle. Le cours d'eau se situe en périphérie de Genève et prend sa source en amont de St.-Julien-en-Genevois. Il avait été fortement corrigé dans les années 1930 avec un tracé très rectiligne et des berges artificielles en béton. Le site a subi de graves inondations en 2002 et est très fréquenté par les gens de la ville comme lieu de promenade. Le débit de la rivière varie très rapidement allant de quelques litres par seconde à plus de 100 m^3/s. Le projet, l'un des plus importants de Suisse, concerne une grande portion du territoire puisque le réaménagement est prévu sur un linéaire de 4.5 km et une largeur de 100 à 200 m. Les objectifs poursuivis par le projet intègrent aussi bien des critères environnementaux, biologiques, paysagers que des critères de loisirs et de détente mais également de protection contre les crues. C'est pourquoi, une équipe de projet multidisciplinaire a été choisie pour réaliser et suivre les travaux. Elle regroupe des hydrauliciens, des biologistes, des ingénieurs civils et des architectes (groupement Superpositions). Une première étape sur un linéaire de 800 m a été réalisée en 2002 comme tronçon pilote pour tester les divers aménagements et la seconde étape se termine actuellement. Pour cette dernière, la revitalisation de la rivière a nécessité le terrassement de 200 000 m^3 de matériaux, la plantation d'environ 20'000 arbustes, l'ensemencement de plus de 100 000 m^2 et la réalisation d'ouvrages du génie biologique sur plus de 1000 m. L'ensemble des aménagements de cette deuxième étape représente une emprise d'environ 15 ha sur la zone agricole. Les matériaux terrassés, qui ont tous été replacés sur le site, ont été nécessaires car un nouveau lit a été réalisé pour la rivière permettant ainsi de maintenir la trace historique et paysagère de l'ancien canal tout en donnant beaucoup plus d'espace et de liberté à la rivière. Pour pouvoir réaliser un projet d'une telle envergure, une importante concertation a été mise en place par le canton de Genève pour dialoguer avec tous les milieux intéressés : agriculteurs, riverains, milieux de la protection de la nature, responsables du patrimoine et de l'aménagement du territoire, communes suisses et françaises riveraines, etc. Au final, après de nombreuses discussions et négociations, c'est un projet basé sur les trois piliers du développement durable et soutenu par l'ensemble de la collectivité qui a vu le jour. Compte-tenu du succès des travaux réalisés, les travaux de la troisième étape de revitalisation débuteront déjà en 2011 et auront comme objectifs principaux la création d'un espace de liberté diversifié pour la rivière et la protection contre les crues extrêmes d'une partie de l'agglomération genevoise.

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Algal and cyanobacterial monitoring in a remediation process by salinity variations in an hypereutrophic Mediterranean pond

Julia Vergalli, Céline Bertrand, Katia Comte, Alain Maasri, Evelyne Franquet, Stéphanie Fayolle

The drainage basin of the Berre pond is highly anthropogenic, generating ecological disturbances in several aquatic systems. Among these are two hypereutrophic ponds, Bolmon and Olivier, which exhibit recurrent algal and cyanobacterial blooms bringing up important nuisances for the water use. A 10-year monitoring field data revealed a seasonal succession of phytoplankton population with a predominant cyanobacterial species microcystin-producing: *Planktothrix agardhii*. The high biomass of this harmful species and the ongoing degradation of environmental conditions have led to a remediation project resulting as a new issue in the Berre pond management. This process (begun in 2006) was based on salinities changes; inferred by the reduction of the freshwater discharges in the pond. Consequently, the management effects raised salinities in the Bolmon pond (directly linked to the Berre pond), whereas no physical modification was observed in the Olivier pond (used as the control site in this study). While month-to-month variations in several environmental parameters were reported, a total decline of *Planktothrix agardii* population from the water column was also noted and seemed to be in line with the salinities changes (as compared to the Olivier pond). The aim of the study is to carry out further the investigation in monitoring all the abiotic environmental factors

and to determine how the phytoplankton communities would respond to the salinity variation. Thus we could explore whether an inherent structural variation of salinity may have a: 1) potential application for water remediation, 2) treatment effect for a permanent decay of harmful filamentous cyanobacterial blooms.

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Conservation value and ecogeographic revisions of copper endemic flora in Katanga (D. R. Congo). What are conservation priorities?

Michel-Pierre Faucon, Arthur Meersseman, Mylor Ngoy Shutcha, Grégory Mahy, Michel Ngongo Luhembwe, François Malaisse, Pierre Meerts

The occurrence of natural plant communities on Cu-enriched substrates over significant areas of the earth's surface is exceptional. In Katanga (D.R.Congo), natural outcrops of copper-rich rocks are colonised by highly original plant communities. A number of plant species have been proposed as possibly endemic to those sites. Here we revise the taxonomic, ecogeographic and conservational status of these plants. The herbarium materials of supposed Cu-endemics have been revised and all relevant taxonomic and ecogeographic revisions have been consulted. Literature and herbarium data have been supplemented by original observations in the field. Conservational status was established using IUCN B criterion. Thirty-two taxa are identified as strict endemics of Cu-rich soil in Katanga, i.e. absolute metallophytes. Twenty-three other taxa are identified as broad endemics, i.e. with >75% of occurrence on Cu-rich soil. Fifty-seven other names formerly used for supposed endemics are rejected either for nomenclatural or phytogeographical reasons. A number of species formerly regarded as endemics have been discovered off copper-enriched substrates due to progress in the botanical exploration of Katanga. The taxonomic value of a number of proposed endemics is still uncertain and requires further research. Ten percent of strict endemics are extinct and 65% are critically endangered, due to actual or projected habitat destruction by copper mining. Endemics restricted to primary habitats may be the most difficult to conserve. Several species, mostly annuals, are able to thrive on secondary metalliferous habitats created by the mining industry and may thus be at lower risk. This study emphasizes the high conservation value of the flora of Cu-rich soil in Katanga and should help prioritise future conservation efforts.

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Contribution to the study of antioxidant enzymes in *Dodonaea viscosa* as biomarkers of diesel pollution

Tania Volke-Sepulveda, Maria del Rosario Peralta-Perez

Evaluate new plant species for phytoremediation purposes usually require a lot of time, but the use of in vitro systems to obtain a particular response could provide faster and useful information. A strategy for determining the usefulness of a plant is the use of biomarkers such as the enzyme activity of catalases (CAT), guaiacol-peroxidase (G-POX) and glutation-S-transferases (GST); these enzymes are responsible of the elimination of reactive oxygen species (ROS) produced under abiotic stress conditions by the presence of contaminants. Then, the aim of this study was to evaluate under in vitro conditions, the tolerance of *Dodonaea viscosa* to different diesel concentrations (500 - 2500 mg/L) and determine its relation to CAT, G-POX and GST activities. Antioxidative enzymes activity was measured in plants of *D. viscosa* grown during 79 days. *D. viscosa* can tolerate up to 1000 mg/L of diesel with no adverse symptoms in biomass production, biotransforming between 10 and 25% of the diesel in the medium. In general, the highest enzymatic activities were obtained in shoots at 1000-1500 mg/L of diesel. Maximum activities of GST (0.012 U/mg protein) and G-POX (570 U/mg protein) were attained at 1500 and 1000 mg/L of diesel respectively, decreasing subsequently to 50% in both cases. CAT activity increased with the diesel concentration, obtaining a maximum value (20 U/mg protein) at 2500 mg/L. The results suggest that the enzymes here tested may be related to diesel pollution; however, more studies are still needed to understand the detoxification and tolerance mechanisms in this plant species.

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Getting real: a methodology for self-evaluation of quarry restorations

Vicenç Carabassa, Marc Vizcano, Esteve Serra, Oriol Ortiz, Josep Maria Alcañiz

Many methods and criteria to evaluate and assess quarry restoration are available in the scientific literature. However, there is a lack of tools for evaluation appropriate for technicians involved in these types of activities, like quarry engineers, restoration managers and quality control supervisors in public administration. The present work attends to bridge the gap between scientific knowledge and practical needs proposing a simplified methodology, which enables the non-scientific public to evaluate restored areas. We present a preliminary version of this self-assessment procedure focused on geotechnical risk, soil erosion and other soil degradation processes, substrate quality and vegetation recovery. This has been tested in 29 opencast mines located throughout Catalonia (NE Spain), covering a wide range of Mediterranean climatic conditions and substrates. Preliminary results seem to indicate that the proposed methodology is appropriate for detecting critical parameters that can determine the success of the restorations. Geotechnical risks have been detected in 25% of the restored zones. Land erosion problems have been observed in approximately 40% of the cases, with erosion rate averages between 27 and 0.2 Mg ha-1 yr-1. These erosion problems are present in restorations where vegetation is poorly developed (vegetation cover lower than 60%) due to soil quality constraints (fine earth content), slope (upper than 30º) and grazing, among others. In order to improve this preliminary version, the addition of fauna and landscape indicators are now integrated into the evaluation procedure, without sacrificing applicability.

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Hordeum sp. a potential crop for phytoremediation and its biomass utilization

Adela Jurjescu, Smaranda Masu, Paul Pirsan, Florin Imbrea, Valeria Rus Jurjescu

The quantity of heavy metals in soils depends on: anthropogenic activity, type and duration of fertilization, athmosferic deposits, etc. The utilization of biosolids (sewage sludge) as organic fertilizer is in Romania in accordance with the UE requirements regarding the admissible limits for heavy metals concentration from soils and biosolids. Utilization of applied fertilizer over a long period can also cause significant accumulation of metals in soils and there is the possibility to be transferred in plants tissue and chain food. The aims of research are to study: the possibilities for *Hordeum* sp. utilization as a uptake tools of heavy metals from soil, bioconcentration in different parts of plants and also possibilities for a grain yield recovering withouth risks for chain food. At the same time, we study an adequate treatment for the soil base on volcanic tuff with clinoptilolit which change the biodisponibility of heavy metals in soil and their translocation in different parts of plants. *Hordeum* sp. present some caharacteristics for accumulation of heavy metals and can be used in phytoremediation process. An appropriate crop monitoring of *Hordeum* sp. can provide: 1.Utilization of *Hordeum* sp. as phytoremediation species for the soils with a low content of cadmium, lead and zinc for straw harvest. 2. Possibilities of *Hordeum* sp. grain yield utilization in chain food due to limiting heavy metals accumulation for this part of plant.

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Improvement of lead-phytoremediation by the association of *Dodonaea viscosa* and the saprophytic fungus *Lewia* sp., in a model soil

Tania Volke, Cesar Rojas-Loria, Rosario Peralta-Perez, Leticia Buendía-Gonzalez

The aim of this study was to evaluate the capability of an association between the shrub *Dodonaea viscosa*, and a saprophytic fungus of the genus *Lewia*, to accumulate and/or stabilize soluble ((PbNO3)2) and insoluble (PbS) sources of lead, using a model soil (perlite). *D. viscosa* is tolerant to drought, flooding, wind and frost, and it is recommended for erosion control and as a soil restorer. The Pb solubility had no significant effect on its accumulation by *D. viscosa*, finding Pb concentrations between 4.4 and 6.5 times higher in roots than in shoots, which indicates a low metal translocation, obtaining a translocation factor (TF) < 0.2. Pb accumulation in both roots and shoots of the plant, increased from 2.2 to 3.4 times due to the association with *Lewia* sp. regardless of the solubility of the Pb source used, reaching up to 5985 ± 559 mg Pb/kg of dry roots of *D. viscosa* in association with the fungus. The high capacity of Pb accumulation by the plant and the plant-fungus association was reflected in high values of the bioconcentration factor (BCF): ~ 9 and > 22 respectively. TF and BCF values obtained indicate that *D. viscosa* and especially in association with *Lewia* sp., could be effectively used for Pb-phytostabilization purposes

and, therefore, for revegetation of metal polluted sites. This work is one of the few studies showing that the interaction between a non mycorrhizal fungus and a potentially Pb phytostabilizer plant, significantly improves the Pb-phytostabilization by its high accumulation in the roots.

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Knowledge on symbioses of *Astragalus tragacantha* (Fabaceae), an endangered plant species, for ecological restoration purpose

Isabelle Laffont-Schwob, Pierre-Jean Dumas, Jacques Rabier, Lucie Miché, Laurence Affre, Thierry Tatoni

With a floristic richness of exception, the Mediterranean coast is however heavily threatened by urban development and pollution. This region is also one of the hotspot of demographic growth and is becoming a highly sensitive ecosystem. Thus, the Mediterranean coast engenders a paradoxical situation i.e. high endemism and rarity of the flora under environmental and human growing perturbations. In this context, there is a lack of knowledge on the ecology of one of these species, *Astragalus tragacantha*, face to various pollution sources from abandoned industrial sites and polluted sea sprays from urban effluents. Knowing that contaminated sites are generally poor in nutrients and contain a highly altered soil structure, mycorrhizal fungi and rhizobial nodulation are suspected to play an important role in vegetation establishment. For this preliminary study, field collection of roots was not conceivable for a protected plant species. Therefore, a greenhouse study was first conducted to test if seeds of this species were able to germinate and grow on a heavily polluted soil and to determine if this species was able to form arbuscular endomycorrhiza and rhizobial nodulation. Results are promising since this is the first report on the occurrence of both symbioses in this plant species. This opens new perspectives for dual inoculation with selected rhizobium and arbuscular mycorrhizal strains, in the way of ecosystem ecological restoration with this key-species.

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Phytoremediation of soils polluted with mine tailings using compost

Lixandru Benoni, Dragomir Neculai, Pricop Anca, Patroescu Viorel, Bogatu Cornel

Our research aimed: the use of compost based on sludge from a city station and studying the adaptability of some species of *Medicago* and *Festuca* to mine tailings. Experimental location was the experimental field of disciplines Fodder and Ecology of the USAMVB of Timisoara and the Grasslands Resort from Moldova Noua. The first location assured a proportion between sterile and soil, and the second, to investigate the resilience capacity of mixtures of plants. In both locations were used additions of composts and volcanic tuff. At the first harvest, the largest amount of phytomass was obtained in case of sterile soil mixed with compost and volcanic tuff, being 65% and 45% more than the control variants. In descending order, are sterile soil with compost and then with sterile soil. In the second harvest, in all cases, production of green mass is lower, 40-42% then the first harvest. In terms of quantity resulted close values between the variants, but lower on sterile soils, with or without volcanic tuff or compost. The amount of root mass and above-ground plant debris remained, have also higher values for plants grown on sterile soil mixed with compost, especially those with volcanic tuff addition. Total phytomass was of 42,800 kg *Medicago* / ha, respectively, 44,200 kg *Festuca* / ha. The analysis of the growth of sown plants, and of the surrounding flora prevailed *Sorghum halepense* and *Cirsium arvense*, on soils combined with sterile, especially those with composts, was a good development noted by the abundance of plant.

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Restoration of gravel pits disturbed by several invasive macrophytes

Jacques Haury, Michel Bozec, Julie Coudreuse

A complex site composed of 5 gravel pits (and a meadow) belonging to the City of Rennes has been surveyed since 2004. It was invaded by four invasive macrophytes: *Lemna minuta*, *Ludwigia grandiflora* ssp. *hexapetala*, *Myriophyllum aquaticum* and *Paspalum distichum* more than 10 years ago. In 2004 a complete field map has been drawn. The largest pond is used for bathing, and affected by Cyanophyta blooms maybe related to macrophyte developments. It is subject to plant control since 2006: every year the macrophyte cover and density are mapped. Effectiveness of plant removal, (time and quantity of biomass) has been evaluated and compared to experimental essays. After these 6 years of study, different patterns of plant colonisation have been observed: stabilisation (or small decrease)

in the most heavily gravel pit colonised by *L. grandiflora* and *M. aquaticum*; successful decrease due to plant control in A, unless in an oxbow where *M. aquaticum* won against *L. grandiflora* that was dominant at the beginning of the study; little colonisation in the deepest pit; and unfortunately, colonisation of the flooded meadow where control is more difficult. Connectivity between these gravel pits and the meadow appears as one key factor to explain colonisation. Relationships between macrophyte developments and water quality must be examined to explain Cyanophyta blooms. Close surveys of the area should be undertaken to improve restoration practices and avoid new extents.

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Revegetation strategies for covering fly ash dump with suitable plant species

Pricop Anca, Lixandru Benoni, Masu Smaranda, Dragomir Neculai, Morariu Florica

In the context of revegetate fly ash dumps, to chose a revegetation strategy is very important in order to obtain a vegetal layer that quickly and efficiently cover the fly ash dump ass well as to allow the wildlife development habitat. The strategy must include: adequate treatments by incorporating fertilizer and amendments, as composts and modified indigenous volcanic tuff; selecting plant species and agricultural work in accordance with geographical and whether conditions. Our experiment made in situ on a lignite fly ash dump was on the seeding period of the *Festuca arundinacea* and *Onobrychis vicifolia* plants in the autumn period that can provide the water requirement of plant and a quick and efficient development of plants with which they will start the hot and drawly times of summer. Among the seeding species, *Festuca arundinacea* adjust easier in the experimental variants. In this case, the treatment with biosolids and modified indigenous volcanic tuff can reduce the metal bioaccumulation, especially the lead with 84-94%, Fe with 53-63% and Cu, Cr and Ni between 12-53%. The other plant does not tolerate the unfertilized fly ash. The fertilizer and modified indigenous volcanic tuff assure establishing conditions for the plant by providing the nutrients. But also, due to the fact that the metal access within the aerial tissue is reduced compared to control by 29.5-59.3% in case of Cu, Cr, Ni and between 50-66% for Pb. Limiting the access of heavy metals in plant tissue is in accordance with a healthy habitat for the wildlife.

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Soil preparation approach for vegetation recovery in gypsum quarries in Granada, SE Spain

Eva Cañadas, Miguel Ballesteros, Ana Foronda, Julio Peñas, Juan Lorite

There is a close bond between gypsum outcrops and the original flora they harbour. These soils have a scattered distribution in arid and semiarid areas, and their particular chemical and physical properties have lead to the occurrence of a special flora that records an important degree of rarity and endemism. Since mining causes a serious impact on the gypsicolous flora there is a need to take action to recover these areas. This work presents a field experiment based on the soil composition that seeks to optimize the future recovery plan of the gypsum quarries in Escúzar (Granada, SE Spain). The experiment was carried out with a factorial design of two factors: core layer (plot) and surface treatment (subplot). The core layer treatments included: topsoil removal; raw gypsum; quarry gypsum waste; and organic top-layer removed prior to quarrying activities. The surface treatments were: control (neither sowing nor organic matter addition); sowing without organic matter addition; sowing plus organic substrate; and sowing plus organic blanket. A mixture of seeds consisting of gypsophytes (60%) and native scrub species (40%) was sown using 500 seeds per square meter. The number of subplots (5x5m^2) was 80 (5 replicates x 4 surface treatments x 4 core layers). All plots are periodically sampled to estimate: richness, density, cover, diversity, survival and growth. These data are accompanied by edaphic variables (pH, gypsum, organic C, SO_4^{2-}, humidity, etc.). Results will help us to select the most appropriate option to restore the gypsum vegetation in this area.

66 The growth and response of some herbaceous plant species to oil treatments

Kee Dae Kim, Tae Yup, Ha Nuel, Byeong Kyu, Jun Tae Choi

Several oil spill events have destructed the coastal areas in South Korea. We investigated into the growth and response of 16 herbaceous plant species to soil treatments for selections of adaptable species to soil pollution by oils and their applications to restore oil polluted areas. In springtime, 2009, we sampled seedlings of 16 herbaceous plant species at coastal areas, Tae-An Gun that is located on the western end of South Korea and experienced several oil spill events. Sampled seedlings were transported into the greenhouse with natural light and planted within vermiculate laden pots with 5 individuals per species. After one month with sufficient adaptations and rooting, we treated all pots with control (tap water), 7.15 ml/L (diesel/soil), 14.28 ml/L (diesel/soil), 10.70 ml/L (kerosene/soil), 21.43 ml/L (kerosene/soil). In fall, 2009, we measured the height and chlorophyll content (chlorophyll meter, SPAD-502) of all individuals. And then all plants were pulled down for cutting into stems and roots. We measured the weights of stems and roots. The study results demonstrated that the height, weight of stems and roots and chlorophyll content of all individuals treated with oils were significantly different and less than those of all individuals treated with tap waters. As a result of this study, some herbaceous plant species are recommended for restoring oil polluted areas.

67 The indigenous tuff influence for reducing the fly ash toxicity in the revegetation process

Masu Smaranda, Pricop Anca, Morariu Florica

The result of the heavy metals analysis comprised in the fly ash dump from the western part of Romania shows a high level of Fe, followed by Mn=Zn>Cr=Ni>Cu>Pb. The deposit presents an alteration of the terrestrial ecosystem that can't easily re-establish itself because of the present of toxic metals, lack of nutrients, and of moisture holding retention. Alternative for the fly ash dump and the ecosystem restoration is the utilization of them in rehabilitation of disturbed areas, as the mining areas. Choosing the plants for the phytoremediation process of the mining areas with fly ash represents a challenge because the plants can be destroyed in certain phenophases due to the high level of metals. The revegetation experimental study is made on cover lots of 20 cm fly ash, fertilized with fresh biosolids with addition of indigenous volcanic tuff. This study aim to follow the Festuca arundinacea tolerance to experimental variants: fly ash, fertilized with biosolids, and additions of tuff and the bioaccumulation level of Cr, Cu, Ni and Pb in aerial tissues. The addition of biosolids reduce only the bioavailability of 3 metals from the fly ash, respectively Cr and Ni with 25-39%, and up to 70% of Pb then control. The treatment with biosolids associated with indigenous tuff based on clinoptilolit determined the metals bioavailabily reduction in the aerial tissues of plants for all the metals, thus with 59-62% Cu, 52.7-82.2% from Cr, and 30-88% Ni and Pb, and it reduce the toxic potential of plant.

68 Toxicity of post mining soil after field and laboratory conditions

Jan Frouz, Ondrej Mufrák, Kristýna Hrčková

Field data about soil chemistry, soil fauna, soil algae and plants were compared with laboratory data about site toxicity for selected species of soil fauna, soil algae and plants in post mining sites (after coal mining in northwest part of the (Czech Republic) with various level of toxicity. Individual laboratory test ordinate sites with similar way. Relationships between lab and field data was good on the most toxic sites, but not so good in other sites. Results indicate that biological test is powerful tool in testing site toxicity but had its limitation namely in less toxic sites.

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Use of *Myriophyllum alterniflorum* (Haloragaceae) for restoration of heavy-metal-polluted freshwater environments: preliminary results.

David Delmail, Pascal Labrousse, Philippe Hourdin, Michel Botineau

Myriophyllum alterniflorum D.C., a poor-known aquatic macrophyte native to north-European freshwaters, was found even in polluted environments from the Vienne river and its tributaries which are often loaded with cadmium and copper near the Limoges metropolis (Haute-Vienne, France). This plant could cope with, to some extent, heavy-metal pollution and is used as a bioindicator since 2009. For these reasons, *M. alterniflorum* appears as a good candidate for running-freshwater restoration. In this way, the in vitro culture of this plant species was developed to allow a mass production and to study its phytoaccumulation capabilities. The in vitro culture of *M. alterniflorum* was optimized using Murashige & Skoog's medium allowing rapid growth and biomass production. Phytoaccumulation tests indicate that this species accumulate rapidly heavy metal as a 415-fold increase of cadmium and a 32-fold increase of copper were evidenced on the first 24h after contamination. Moreover, preliminary results concerning the reintroduction of *M. alterniflorum* clones in degraded and non-polluted areas are also rather encouraging, indicating that this taxon is a good candidate to freshwater restoration.

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Biological activity in soils of coal-waste heaps of the mining basin of Provence

Mélanie Clouard

The coal mining industry in Provence (Bouches-du-Rhône, France) stopped in 2003 and mining wells were closed at that time. The mining basin of Provence presents several specific aspects, which are : the nature of the coal (low grade brown coal), a Mediterranean environment (climate, vegetation and soil), its location within an expending metropolitan area and, a large set of spoil heaps with contrasting characteristics.In this area, coal-waste heaps are a mixture of various materials extracted from the mine (marno-calcareous shales, brown coal...) and fly ashes (in the most recent deposits) from the nearby thermal power plant. Some of these heaps have been left unattended since more than 50 years and some have been engineered and capped with a topsoil layer (younger heaps). Nearly all are vegetated and soils have started developing, especially on the old spoil heaps. Under different bioclimatic conditions, these young ecosystems have ever been shown to develop faster than natural ecosystems). Microbial processes are responsible for the turnover of the organic matter, but little is known on microbial activity of these newly formed soils, especially under Mediterranean climate. The purpose of this study is thus to highlight changes in microbial properties according to the age and the exposure of the heaps and to compare them with microbial properties of natural soils, especially regarding enzymatic activities that are responsible for the turnover of the organic matter. The fluoresceine diacetate activity (FDA) is known to estimate the total enzymatic activity of soil artificial samples collected at 0-5 cm and 15-30 cm in soil profiles located on the South hillside at different locations: at the top (355m NGF) and below (340m NGF). Results are compared with respirometry measurements performed with the Oxitop system, on the same samples set at various soil moistures.

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Calcareous grassland restoration in the Calestienne area (Belgium): a functional approach

Lucia Ferroni, Julien Piqueray, Gregory Mahy, Maria Speranza

Management strategies for restoration of calcareous grasslands demand in-depth understanding of vegetation processes. For this purpose the functional approach using plant functional traits could be a promising new way. In this study we focused on the analysis of some plant traits to detect general trends in trait variation in response to restoration. Two dominant species, *Brachypodium pinnatum* and *Carex flacca*, were studied in four calcareous grassland sites in Belgium. In each site two different areas were analysed: "restored grassland" (trees and shrubs cut in 2003, followed by grazing management) and "control grassland" (pastures more than 100 years old). In each area Specific Leaf Area (SLA), Leaf Dry Matter Content (LDMC) and Leaf Nitrogen Content (LNC) variations of the two dominant species were studied. For the two species, we compared traits values between sites and between restored and control areas by Anova and we analysed the relation between SLA, LDMC, LNC and the nutrient soil contents. Anova revealed no significant differences between restored and control areas. Both species showed

significant differences for SLA between sites. Moreover, *Carex flacca* showed differences for LDMC and LNC between sites. The correlation analyses between traits and soil nutrient showed significant correlations between *Carex flacca* LDMC and N, P and C soil contents. The traits are sensitive enough to reveal differences between sites but not between restored and control areas. The most sensitive species was *Carex flacca* and the most responsive traits were SLA and LDMC.

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Caractérisation des formations steppiques de la commune de Maamora (Wilaya de Saida). Proposition pour la restauration écologique de ces espaces perturbés.

Amine Habib Borsali, Hasnaoui Okacha, Raphaël Gros

L'ensemble steppique est en train de vivre une véritable catastrophe écologique et la fragilisation de son écosystème hypothèque fortement l'existence des populations. La commune de Maamora s'inscrit parmi ces zones steppiques, elle figure parmi les communes de la Wilaya de Saida, elle se caractérise par une pluviométrie inférieur à 200 m/an, un climat rude et des amplitudes thermiques importantes, ces sols sont peu profonds, elle présente une forte sensibilité aux incendies de forets et à la désertification. L'objectif principale de ce travail consiste à faire un diagnostic complet et une étude poussée pour endiguer tout échec ou perte éventuelle au cours de la restauration écologique de ces espaces dégradés et de faire également des propositions d'aménagement. De ce fait, la méthode préconisée pour entreprendre notre travail consiste en : une analyse pédologique complète, une description des différents groupements végétaux et animaux, le calcul de la fréquence et récurrence des feux de forets et de la steppe, une analyse de l'occupation du sol par type de culture et par secteur et une description des potentialités de la zone ainsi que l'action anthropique. La connaissance de ces milieux naturels et de la végétation nous a permis de travailler en accord avec cet écosystème et de présenter une restauration réfléchie et adéquate avec le milieu naturel plutôt que de chercher à le dominer ou le modifier par des aménagements absurdes en désaccord total avec les potentialités de la zone.

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Development of frequently applied grassland restoration treatments and consequences for subsequent management

Mareike Conrad, Sabine Tischew

The decrease of mesotrophic grasslands over the last centuries throughout Europe, has led to a great deal of research into techniques to restore these botanically diverse biotopes. But little is known about ecological effectiveness of grassland restoration beyond research projects. We present results of a study focused on treatments frequently applied for grasslands restoration in federal state Saxony-Anhalt (Germany). We recorded floristic composition of 56 restored plots over up to nine years and compared them to 21 reference plots. Following questions were addressed: (1) Did similarity of restored and reference plots increase over time? (2) How did floristic composition of restored plots change over time? (3) What are consequences for subsequent management? At no time of observation, either species composition or abundance order of restored plots had been similar to reference plots (measured by Soerenson´s respectively Motyka´s similarity). Both similarity indices rose significantly over years, except for plots seeded with herb-poor mixture. Because development stagnates on these plots due increasing dominance of *Festuca rubra* cultivars, extensive corrective measures are necessary to reach the restoration target (elimination of dominances, reseeding with target species, management adaptations). Species composition of other treatments analyzed has changed over years: perennial ruderals and target species replaced short-lived ruderals at natural recovered plots; sown target species spread on expense of short-lived ruderals and sown *Lolium perenne* at plots seeded with herb-enriched mixtures. Nevertheless, due to lack of target species in seed mixture and surroundings, enrichment with selected target species is necessary too to reach the restoration target.

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Ecological restoration of the Kalmykian Steppe (Lower Volga Delta, Russia) as a natural result of the discontinued soviet agronomy, detected in remote sensing data from 1962 – 2007

Sergej Bergsträsser, Torsten Prinz, Norbert Hölzel

During the Soviet period the semi-arid and arid zones in the southern part of the former USSR were strongly altered by an intense and often inappropriate agricultural land use which caused severe ecological damages to landscape: vast areas of the Kalmykian Steppe (North Caspian Region) were affected by desertification processes as a result of overgrazing, which led to pasture degradation, excessive deflation and salinization of soils. After the collapse of the USSR the intense land cover has altered to small scale farming or (predominantly) fallow land. Today, due to a continuing lack of data there is only little knowledge about the extent and the ecological consequences of this transformation process in terms of environmental changes. Remote sensing data offer a unique change to narrow this gap if used for ecological monitoring aims, especially if the data reaches back more then 45 years in the past. This study is focused on the change of land use and land cover (LULC), based upon representative test areas in the 'Hill-Lake-Region', NW of the Volga Delta, which were studied applying remote sensing techniques on recently declassified panchromatic US CORONA espionage data (1962, 1973), multispectral Landsat TM 5 data (1989, 1998), IRS 1-C LISS data (1998), Landsat TM 7 data (1999) and Quickbird data (2007). The selected test areas are typical for the different ecosystems of the Kalmykian Steppe and can be assumed as representative for other adjacent areas in that region. The multispectral analysis of the data, if compared to the few known literature and statistical sources for that particular region, made clear that in all testing areas significant changes in LULC have taken place during the last four decades. Basically this change was triggered by the first onset and the following intensification (and the later abandonment!) of intensive soviet agricultural land use policy and practices. Object orientated texture analysis and supervised classifications of remote sensing data regarding the changing LULC and its comparisons with field data collected in 1998 led to the conclusion that the studied areas underwent an ecological transformation process from an early (more or less) intact ecosystem with only minor intense farming facilities in the mid 1960'ties to a first large scale agricultural reorganization going along with an increase of pasture and irrigated areas detectable in the mid 1970'ties. This negative ecological development continued until the breakdown of the Soviet Union but changed until 1998, when the first dramatic decline of irrigated arable land becomes obvious in the remote sensing data. The former fields are successively covered by fallow communities in the dominating wormwood- communities (Artemisia lerchiana), dominated by weeds like *Ceratocarpus arenarius* and *Alhagi pseudalhagi*. Furthermore a regeneration of the desert vegetation as a result of a reduced livestock keeping in all testing areas, especially around abandoned farms, can be deduced from the 1998 and 2007 in satellite images. Field data verifies that the increasing recent vegetation cover is often caused by grasses like *Agropyron fragile*, *Stipa sareptana*, *S. capillata and S. lessingiana*. Another determinant ecological factor can be monitored from 1962 to 2007 applying remote sensing techniques: the growth of artificial ponds and lakes during the climax of the soviet irrigation measures (often lakes were used as reservoirs and channels for irrigation water), and (in the recent decade) the shrinkage of open water bodies accompanied by an increasing salinity of the remaining soils (as a direct consequence of less pumped irrigation freshwater). It is obvious that saltlakes have almost doubled in size, saline vegetation (eg. *Halocnemum strobilaceum, Salicornia europaea*) has spread considerably while as a countermove stands of reed (*Phragmites communis*) have declined significantly. Nevertheless a general positive trend in natural regeneration of the Kalmykian Steppe can be proved in current satellite data, but there are exceptions where private farming facilities have been established in naturally favoured locations, causing small scale pasture degradation and deflation due to overgrazing. Therefore it is essential to supervise livestock keeping and to introduce controlled drop irrigation techniques in order to prevent a new rise of ecological hazards for the Kalmykian Steppe in the future. In this case the analysis of multi-temporal satellite images based on modern image enhancing methods and vegetation ecological knowledge proved to be one powerful monitoring tool to evaluate the ecological stability of the Volga Delta at different scale.

75 **On the use of soil organisms to assess restoration of wet meadows on peat soil in place of sandpit**

Matthieu Chauvat, Gabriel Perez, Pierre Margerie, Estelle Langlois, Michaël Aubert, Fabrice Bureau

In recent years, in the frame of ecological research, reconstructing functional soil appears as one of the next key issues for restoration practice. In fact, many ecosystem services, from biogeochemical cycles to biodiversity conservation, depend on soil compartment healthy enough to support a complex array of soil biota. However, few studies of ecological restoration have so far focused on soil organisms albeit they supply ecosystem processes needed for a sustainable future. This is especially true in sandy or gravel pits exploitation causing severe environmental impacts by removing the vegetation cover and depleting the fauna. In Normandy (north-western part of France), former and actual sand and gravel quarries are a major component of the landscape. Restoration activities traditionally converted pits into ponds dedicating to spare-time activities. A new promising way is to re-establish terrestrial ecosystems such as meadows or grasslands. This is mainly possible through the use of filling-sediments excavated from the close-by Seine-river. In addition to its aesthetic and environmental qualities, prairie act as biodiversity sink and/or provide economical output via extensive pasturage for example. We used diversity measurements of Collembola to follow successional stages of grassland restoration in place of a former pit compared with objective pastured meadows. Preliminary findings suggest a fast colonization by springtails of the area under restoration leading after two years to mean species richness higher than in the objective grassland, even if abundance were still much lower. Furthermore, findings suggest a strong link between aboveground and belowground subsystems during restoration of soil system.

76 **Preliminary results on Orthoptera of multi-treatments steppe restoration processes in La Crau (Provence, France)**

Jean-François Alignan, Jean-François Debras, Thierry Dutoit

The La Crau area, with its xeric conditions and several millenaries of sheep herding, represents the last xeric steppe in the South of France. This unique species-rich ecosystem has lost about 80% of its original surface. A 360 ha abandoned orchard is the location of experimental restoration of this steppe ecosystems to address the question: Which processes should be used in order to restore the steppe plant community and its associated entomofauna (Orthoptera, Coleoptera)? Five treatments have been experimented for the restoration of the steppe vegetation: (i) Sheep grazing restoration which is aimed to limit competitive and unwanted species expansion, (ii) Soil excavation which is aimed to suppress ruderal species seed bank and to decrease soil trophic fertility, (iii) Nurse species seeding which are aimed to rapidly occupy spatial and trophic niches, and then to provide safe sites for steppe species once sheep grazing is reintroduced, (iv) Hay transfer which is aimed to provide local species seeds from undisturbed steppe patches and (v) Soil inoculation which is aimed to provide local species propagules with associated microorganisms and to lower soil trophic levels. The poster will briefly present preliminary results from these experiments on the Orthoptera assembly with taking into consideration the spatial distribution of the different treatments and comparison with Orthoptera assemblies of the former abandoned orchard before restoration (2008), during restoration (2009) and after one year of restoration (2010).

77 **Restoration management in wet grasslands – results from a 20 year-lasting field experiment**

Till Kleinebecker, Yvonne Oelmann, Peter Schwarze, Gabriele Broll, Kathrin Poptcheva, Verena Möllenbeck, Andreas Vogel, Norbert Hölzel

In Europe, low productive wet grasslands are of high conservation value due to their high plant species richness and their capacity as a habitat for endangered fauna. Conservation and restoration of these semi-natural ecosystems depending on low-intensity farming often suffer from poor knowledge on successional pathways of respective habitats under different management treatments. Here, we present the results of a 20-year permanent plot experiment in semi-natural wet grasslands in NW Germany including mowing with and without fertilizer addition and fallow. The studied wet grassland communities responded quite similar under equal management. Fallow resulted in the most significant changes in floristic and

functional composition facilitating highly competitive rushes and tall forbs. For all mowing treatments without fertilizer application, we still observed directed changes in the floristic composition even after 20 years. In particular mowing twice led to decreasing productivity and a shift in floristic composition towards stress-tolerant plants with low nutrient demands. Nutrient removal in non-fertilized plots significantly decreased over the study period. The changes were more pronounced the more the experimental management treatment differed from the former use. These results documented that restoration of low-yielding target communities by regular mowing is possible – even in an area with high atmospheric nitrogen inputs. Plant species richness was maintained or even slightly increased by mowing twice a year without fertilization but mainly comprised species that were already present at the study sites. This underlines the very slow immigration and spread of new species due to dispersal limitation of many target species

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SALVERE - Semi-natural grassland as a source of biodiversity improvement - a Central Europe Project

Anita Kirmer, Sandra Mann, Birgit Feucht, Albin Blaschka

SALVERE is the name of a project within the Central Europe program that started on January 1st, 2009. Until December 2011, eight project partners from six EU countries are working together to promote the use of native plant material in restoration and to create species-rich grasslands typical for the concerned region. Until today, in Central Europe, grasslands are mostly developed by sowing of commercial seed mixtures coming from the international seed market mostly comprising non-native species or ecotypes. However, in the last 15 years, the knowledge about ecological restoration increased but the implementation of new methods into practice is yet not satisfying. Additional, all over Europe, seeds of local provenance are seldom available on the market in larger quantities. To overcome those obstacles, the SALVERE partners utilized species-rich semi-natural grasslands as donor sites and used the harvested material to create new grasslands. In 2009, 11 experimental and 11 demonstration trials were established comprising different target vegetation types (e.g. *Arrhenaterion, Molinion, Mesobromion, Cnidion*) and different harvesting and restoration techniques (e.g. on-site threshing, seed-rich green hay, seed stripping). In addition, seed quality and quantity of the harvested seed mixtures are determined in greenhouse and laboratory experiments. Based on our experiences and on the results of our trials and experiments, a practical handbook for seed production and harvesting on potential donor sites as well as best practice methods for the establishment of species-rich grasslands will be published in 2011.

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Soil seed bank in successional calcareous alvar grassland in northern Estonia

Rein Kalamees, Kersti Püssa

European semi-natural dry alvar grasslands on shallow calcareous soils are eminent for very high small-scale species richness. Overgrowing succession due to cessation of grazing seriously decreases both the area and species richness of these grasslands. In order to investigate whether the seeds of grassland species stay in the seed bank during overgrowing succession, we sampled the seed bank successional alvar grasslands in northern Estonia. Four successional stages were compared: continuously grazed grassland, not grazed (still open) grassland and overgrown grassland sites for 25 and 50 yrs respectively. The overall mean seed density in the soil was 1743 m^2 (ranged from 370 in 50 yr overgrown site to 4371 in continuously grazed grassland site). A total of 63 species were detected in the seed bank, 72 taxa were recorded in the vegetation. 45 species occurred both in the seed bank and in the vegetation. *Achillea millefolium*, *Arabis hirsuta*, *Cerastium fontanum*, *Phleum phleoides*, *Potentilla crantzii*, *Sedum acre* and *Veronica spicata* were those open grassland species that were abundantly represented in the seed bank of overgrown sites. The soil seed banks beneath our grassland sites were rather large and rich in true grassland species. About 80% of species in the seed bank of open grassland sites could be classified as grassland species. This particular result runs contrary to many other studies on species rich calcareous grasslands that report about small seed banks poor in characteristic grassland species.

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Vegetation recovery in floodplain meadows in Estonia

Jaak Albert Metsoja, Silvia Pihu, Kai Vellak

Floodplain meadows are one of the most ancient community formations made by human activities. Never been numerous nowhere in North-Europe, the existence of them has become questionable nowadays while the motivation of management has disappeared together with breaking traditional land use. Floodplain meadows are rich in rare plant, bird and insect species and therefore their management for preserving their species richness has taken over by nature protection areas just recently. In 2000 a restoration experiment was started in floodplain meadows along river Suur-Emajõgi, Estonia. These meadows were left unmanaged the last 15 years and started already to overgrow by bushes. Two pairs of meadows were chosen for study, where one mowed and one left aside area was placed next to each other. The vegetation of managed and unmanaged areas was analyzed at random 1 m^2 squares. Besides of ground vegetation analysis the number of branches and crone cover of bushes as well as the percent of water and dead grass was evaluated. The repeated measurements were done in July 2004 and 2008. Regular mowing was carried out in the end of July. Our results show that mowing increases species richness on wet meadows. The number of vascular plants as well as bryophyte species has increased in mowed meadows during study period, whereas the vegetation on unmanaged meadows has became more similar. The results of vegetation monitoring and influence of soil parameters, relief and flooding on the species diversity are given.

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Adjusting restoration actions to the community's needs and preferences

Thorunn Petursdottir, Asa Aradottir

Most of today's restoration programs have multiple objectives: aiming for socio-economic as well as environmental benefits. Their monitoring and evaluation should therefore be based on measuring multidisciplinary indicators. In this study we examined the short term impacts of different restoration methods using ecological as well as visual/social measures. The study included five year old sites re-vegetated with grasses (native/non-native) and Nootka lupin (an introduced species) compared with control sites. Parameters measured included plant cover, species composition and soil C, N and pH. Furthermore, color photos were used to evaluate people's perception on the different treatments where participants were asked five questions on the visual appearance of the sites. Vegetation cover was significantly higher for all restoration treatments (36-92%) than the cover on control plots (6%). Biological soil crust and mosses were mostly absent, and only minor differences were found in measured soil parameters. Visual appearance of fertilized sites was in all cases ranked higher than the control sites except the lupin sites. Photos that participants regarded as resembling natural vegetation forms ranked higher in all cases than the ones they perceived as artificial. We conclude that ecological indicators are essential in evaluating the success of ecological restoration because restoration of ecosystem functions and structure are fundamental for the achievement of other benefits. Social factors, such as perception of the restored sites are, however, also very important since restoration programs always need the support and acknowledgment of society and should generally be designed with societies' needs and preferences in mind.

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Wetland Restoration in the Hunter River Estuary NSW Australia

Peggy Paradice

The remarkable natural productivity of the Hunter River estuary near Newcastle New South Wales Australia at European settlement is well documented. Also well documented are the degradation and loss of shorebird, fisheries and other wildlife habitat due to over 200 years of clearing, draining, filling and dredging. This paper reviews the background, current status, future prospects and collaborative nature of ecosystem restoration projects in progress at four locations covering over 3300ha in the Hunter estuary. An unusually large body of site specific natural history documentation exists which provides a solid technical basis for design of restoration activities. Historic, social and artistic value of this scientific information has resulted in members of the local community becoming involved in ecological restoration on a variety of levels linked to on-ground works. Central to the restoration effort is establishment of long term partnerships with neighbouring industries and local, state, national and international organisations involved in natural resource management. Underpinning this collaborative approach is the development of a shared

vision amongst the major stakeholders based on extensive and on-going consultation. The resulting integrated projects link wise recreational use of wetlands with habitat restoration, research and education. An essential element of effective implementation of restoration works and maintenance of restored sites in the Hunter estuary is engagement of the community – individuals and special interest groups – fostering ownership of the restoration process by showing a willingness to listen, discuss and adapt activities based on new information and long-term monitoring

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Brittany "Grand Site" rehabilitation: material and immaterial consideration

Yann Le Fur, Frédérique Chlous-Ducharme

Touristic Brittany sites which engaged Grand Site operation possess the common characteristics to be protected by the French law of 2nd May 1930 concerning "the protection of natural monuments and sites of artistic, historic, legendary or picturesque character" and be physically degraded by tourist frequentation. A documentary socio-historical analysis was realized. It emerges from it that these sites were popularized by romantic travelers of the 19th century who practiced them into the aim of meditation, a confrontation between human being and natural elements. This socially constructed freedom feeling of symbiosis with the wilderness has been spoiled by the mediatization of tourist guides and modern social attractiveness for littoral areas. In Grand Site operation projects, ecological restoration is mobilized to supply at first a technical answer to the stakeholders to rehabilitate the degraded ecosystems. From this ecological diagnosis, the landscape and aesthetic specialists try to reconcile good ecological state with good discovery conditions. Our communication wears the ambition to approach the implementing difficulties of the material and immaterial considerations, the contradictions between Grand Site operation philosophy and his application. Effectively, if notions like ecological and landscape quality or tourism management are now normalized, evaluable, it seems that technical tools take the ascendancy on coherent cultural policy. Natural site management is not the same that nature-culture site management. We indeed wonder even if ecosystems and landscape are restored, what it remains of the "sense of place" culturally and historically establish, still praised by tourist guides, when visitors are canalized on semi-artificial trails?

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Landuse as Foundation for Ecological Restoration - Development of a methodological Framework

Albin Blaschka, Thomas Guggenberger

Landuse changes in Europe, especially abandonment, pose a serious threat to the multifunctionality of the landscape, which is deeply connected with the perception of the environment as a cultural landscape. The central hypothesis is the implicit connection of landuse with landscape, being at least partly formalized in the theory of ecosystem services. The aim of the work presented is to develop and test a framework for projects combining ecological restoration with the needs of agriculture in remote, disadvantaged regions. The target is to stop unwanted processes such as encroachment of shrubs and reforestation, resulting in a degradation of the traditional cultural landscape through controlled grazing with small ruminants (sheep and goats) allowing farmers an economically viable development. During the project, the following key issues and constraints could be determined: The tool for restoration and managment is targeted pasture management, adapted to the landscape, specific site conditions and the specific flock. Handling of livestock has to be compliant with requirements of farmers and animal welfare like enough forages in adequate quality, water, protection or mitigation of harsh weather conditions. Restoration targets are reached through controlled selection of specific pasture areas and duration of stay on specific patches, which leads to tradeoffs between nutritional status and reaching the restoration targets set. A quantitative model to facilitate planning is developed. This kind of landscape management should provide the basis for interventions to influence vegetation and thus restore a traditional cultural landscape stopping or at least be able to deal with unwanted processes.

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Restoration of agricultural landscape diversity by creation of small water ponds and perennial grassland habitats

Jurate Sendzikaite, Romas Pakalnis, Dalia Aviziene, Leonas Jarasius

In the second half of the 20th century, due to tendency to drain large areas of land for agriculture, intensively reconstructed landscape in Lithuania was transformed and biodiversity impoverished. After the restoration of private land property in 1990, the initiative of farmers to maintain the landscape at their own discretion was released. The aim of the scientific society is to help land owners to select optimal variants for the maintenance of landownership plots, which would be not only economically and aesthetically profitable, but also would enable to restore landscape and biological diversity. One of the possibilities to restore hilly landscape diversity is the installation of small water ponds, surrounded by perennial grasslands, in the interhill watersheds. The concept to establish such type landscape components by relating the whole of expressive landscape components arose already in 1972 and has been implemented at Davila Experimental Field Station. Since 1997 similar experiments have been initiated at Gulbinai EFS. The dynamics of structure and productivity of perennial grasslands is an important indicator of landscape stability and economic efficiency. The research results obtained at Davila EFS enable to affirm that even in Soviet times by active efforts of Lithuanian scientists it was possible to preserve the most valuable fragments of agricultural hilly landscape complexes and use them for the establishment of initial stages of restoration of species-rich grassland ecosystems. Nowadays it is possible to observe the succession of semi-natural grassland ecosystems. This experience can be successfully used for ecological restoration of formerly reclaimed agricultural landscape.

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Promoting target plant species on former agricultural land by soil inoculations

Vanesa Carbajo Vázquez, Gerlinde B. De Deyn, Wim H. van der Putten

Restoration of plant species rich grassland communities on former agricultural land can help to counteract biodiversity decline. Plant-soil interactions are the foundation of effective and sustained restoration of terrestrial communities and ecosystems. Topsoil removal is common practice to reduce soil nutrients in former agricultural land to similar levels as those in later successional stages. However, the biotic soil conditions will not resemble those of later successional stages and this may be a major constraint for the success of late successional target plant species. Here we test the hypotheses that soil fertility reduction in former agricultural land combined with introduction of later successional living soil can enhance the development of ecological succession towards a target ecosystem. The hypothesis is being tested in a greenhouse experiment with mixtures of six target grassland species (of the target type *Gentiano Pneumonanthes-Nardetum*), growing in arable top-soil or lower layer soil (receptor soils), inoculated with small or large amounts of living soil from grasslands in different stages of secondary succession (donor soils). Soil abiotic (nutrient levels, organic matter content and texture) and biotic (nematode communities, ergosterol content and mycorrhization) properties are/will be determined and related to plant growth responses. Expected results: Soil inoculation effects on target plant species depend on the conditions of receptor and donor soil and on the amount of inoculum. Treatments with more similar abiotic conditions between donor and receptor soil will promote the development of target communities most. The results will help to develop restoration practices of species rich grassland.

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Evaluation of the hydroseeding as indoor plant restoration technique in slopes of roads in southern Bolivia

Kelly Garcete, Francisco Serrano-Bernardo, María Beltrán-Hermoso, Jose J. de la Torre-Betts, Jose L. Rósua-Campos

The processes of erosion in road slopes linear infrastructure projects, depends directly, among others, on the alterations affecting the soil layer that is exposed after clearing or boot cover. The behavior of plants used in the plant cover restoration projects, depends basically on the genetics of species and edaphoclimatic conditions in the area, such as temperature, availability of nutrients or soil moisture. This experience evaluated the behavior of the growth of two different plant species (grasses and legumes), used in the restoration of the soil cover by hydroseeding in different types of slopes in Desaguadero Corridor section - Bermejo (Bolivia). The best results were found in dark slopes, especially on embankments,

pending 2H: 1V, class of soil A1b, fine gravel and about 5% soil moisture. In all the experimental conditions, plants that were used developed according to their expansion so the species selection criteria was appropiate and the high percentage of land cover implemented indicates that the rest of experimental design parameters used in the hydroseeding were adequate.

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Twenty-eight years of vegetation monitoring in four permanent plots on the Montagne Saint-Pierre (Belgium).

Martine Lejeune, Willy Verbeke

The Montagne Saint-Pierre is situated along the river Meuse on the border between Belgium and The Netherlands. The slopes consist essentially of chalk deposits from the Cretaceous period on which *Mesobromion* vegetations have developed. Traditionnally the slopes were grazed by shepherded flocks of the local sheep breed. This type of management was abandoned after World War II. Conservation management began in 1980. At the same time vegetation studies were started using permanent plots. Four $9m^2$ permanent plots were established, which are surveyed every year. Before 1980 Tor grass (*Brachypodium pinnatum*) had become dominant due to burning and lack of management. Mowing as well as grazing readily broke this dominance. Short-lived species generally show a favourable response to the current grazing management. Although species can disappear locally from the grassland and reappear on other spots, botanical biodiversity will not be impoverished if the grassland as a whole is large enough. The disappearance of the dominance by *Brachypodium pinnatum* and the current grazing regime have locally created a "thyme heath", dominated by small shrubs of mostly *Thymus pulegioides*. Across the whole of the 28 years of observations the number of species in all plots shows a series of fluctuations which may lead to incorrect conclusions by looking only at a few years of observations. The value of longer and uninterrupted series of annual observations is motivated.

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Spontaneous vegetation succession in extracted peatlands: a multi-site study

Petra Konvalinkova

The study was conducted in 17 peatlands in the Czech Republic harvested either by the traditional hand-cutting or industrially. Questions: Is regeneration of bog vegetation and peat-forming process possible through spontaneous succession and under which circumstances? Methods: Phytosociological relevés 5 x 5 m in size were located in representative parts of the peatlands. Age, abiotic environmental characteristics (position of water table, water pH, substratum chemistry) as well as biotic characteristics (proportion of land use types in the surrounding, distance to the nearest bog vegetation) were assessed for each relevé or each locality (altitude, average annual temperature and precipitation). Results: Despite rather high vegetation variability, especially among industrially harvested sites, a general tendency for spontaneous recovery of peatland vegetation was observed. Traditionally harvested sites converged after app. 50 years towards undisturbed peatbog vegetation. Still younger industrially harvested sites, and not all of them, exhibited only a certain tendency to this. A geographical pattern was found reflecting predominantly the altitude. All investigated environmental variables exhibited at least some significant effects on the vegetation pattern, among them, especially proportion of bog vegetation in the surrounding, soil pH, water table, and successional age were most important."

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Success of peatland restoration in northern Finland

Anne Tolvanen, Marja-Leena Päätalo, Anna Laine, Mirva Leppälä, Oili Tarvainen

Almost one third, nearly 100 000 km^2, of the total land area is covered by peatlands in Finland, which is a higher relative cover than in any other country in the world. Over a half of the peatland area has been drained for forestry, and many invaluable peatland habitats are severely degraded. Peatland restoration is carried out principally in protected areas in order to repair or rebuild endangered and valuable peatlands. Restoration measures involve the blocking of ditches and removal of trees. These measures have significant ecological impacts; both on the restored habitats themselves and on their environment. The research was carried out at 24 peatlands in northern Finland, 8 of which were natural controls and 16 were drained for forestry during the 1960-1970's. Restoration measures of different types were taken place in 14 of the drained peatlands in 2007. Only two peatlands could

be left as unrestored controls, as the rest were located in protected areas and had to be restored. The first surveys were carried out one year before and the following two years after the restoration. The water table of the peatlands rose quickly to the level of the natural peatlands, whereas the change in other measured variables, such as vegetation composition, were slower. Since most forested peatlands have not completely changed into forest ecosystems after draining, it is likely that restoration improves the state of the selected peatland ecosystems in Finland. The results of the project and new research plan will be presented in the conference.

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Long-term monitoring of the structure and diversity of the vegetation of a peatbog after restoration (Québec Canada)

Francis Isselin-Nondedeu, Line Rochefort, Monique Poulin

Ecological restoration aims at recovering both the structure and the function of an ecosystem degraded by human activities. After peat exploitation, the ecosystem is deeply altered and it has lost for very numerous decades the structure and uniqueness of its vegetation (peat mosses diversity and abundance, microtopography, peatland shrubs...) and its functions (carbon sink, water filtering...). A common restoration practice is based on the complete inundation of the site, transforming it into wetland. Here we present the results of the restoration of a vacuum-mined peatland restored by a "paludification process" or "dry restoration process". Vegetation recovery was surveyed during 8 years after the restoration. The 11.5 ha of the peatland was exploited by vacuum machines then abandoned in 1980. The GRET[2] along with industrial partnerships began the restoration of an area of 8.4 ha in 1999. After the drainage ditches were blocked, plant material was spread, covered by straw mulch and the soil was lightly fertilized. We analyse the vegetation in terms of structure, species richness and functional diversity and all is compared both with the vegetation in an adjacent non-restored zone and with reference peatlands of the region. The "paludification-like" approach appears to be efficient for successfully re-establishing plant cover and diversity. In comparison to the non-restored zone, the Sphagnum carpet was 50 times thicker and richer in species, the functional diversity of the restored peatland increased progressively. We present and discuss results of the other functional groups (ericoid, graminoid) as well as the use of reference ecosystem.

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Restoration of raised bogs: don't forget the species and habitat diversity

Gert-Jan van Duinen, Hein van Kleef, Wilco Verberk

Degradation of raised bog landscapes due to drainage, peat extraction and cultivation –and more recently increased nitrogen deposition- resulted in the loss of natural gradients from the extremely nutrient poor and acid bog habitats, via transitional mires and laggs to the nutrient richer, buffered surrounding landscape. Consequently, many species characteristic for those natural transitions in bog landscapes, like the dragonfly, *Somatochlora arctica*, the damselfly *Coenagrion hastulatum* and the butterfly *Boloria aquilonaris* have become endangered in several European countries. However, comparative studies between intact Estonian bog landscapes and bog remnants in the Netherlands on aquatic invertebrates also showed that some characteristic species had been able to survive the process of degradation, persisting as relic populations in bog remnants, or even profited from the changed hydrology and the increased availability of nutrients and minerals in the formerly extremely poor central raised bog. This study also showed that many of these species are unable to cope with rapid, large scale rewetting by means of retaining rain water. Bog rewetting generally focuses on restoration of wet and acid conditions typical for central raised bogs to favour Sphagnum recovery as a first step in ecosystem restoration, but may result in loss of populations of characteristic and threatened species. Therefore, the challenge for raised bog restoration is to consider opportunities for restoration of the regional groundwater system, that may restore both nutrient poor, acid bog habitats and minerotrophic parts of bog landscapes and conserve and restore the species diversity of complete raised bog landscapes.

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Soil fauna in mine restoration: example of endemic earthworms in a New Zealand coal mine

Stephane Boyer, Stephen Wratten

Because soil is dramatically altered by opencast mining, soil fauna should be a major focus with regard to their restoration. Most restoration plans focus only on vegetation and above-ground macro-fauna, while the aim should be to restore functioning ecosystems above and below-ground. Among the potential soil species that are likely to be important early in mine restoration, earthworms are particularly good candidates. They provide ecosystem services that are likely to facilitate and accelerate the restoration of a functional ecosystem. These services include increasing topsoil fertility, providing food resource for a wide range of predators and the recycling of waste organic materials. Despite their ecological importance, earthworms have been poorly considered in mine restoration. With the aim of proposing recommendations for a better management of earthworm communities in post-mined soils, we evaluated the response of an endemic earthworm community to mining activities and rehabilitation treatments currently used in an opencast coal mine in New Zealand. The main treatments studied were vegetation direct transfer (VDT) and vegetation replanting in soil that has been stockpiled. VDT consists of removing pieces of land that include the vegetation and the topsoil and transferring them to another area where the land 'jigsaw' is reconstituted. The present work showed that this method was efficient in preserving earthworm communities. Soil that has been stored in high stockpiles, on the other hand, was mostly anaerobic and contained very few earthworms. When spread and replanted, such soil contained a depauperate earthworm community and required enhancement to restore its ecosystem functions.

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Less obvious interaction in plant succession on derelict sites – effect of soil fauna and dominant trees

Ondrej Mudrak, Jan Frouz

The understanding of the succession mechanisms can considerably improve our possibility for the restoration of ecosystems. We studied the plant succession on spoil heaps in Sokolov brown coal mining district (Czech Republic). The observatory study showed, that for the progress in plant succession, which is characterized by the shift from vegetation dominated by ruderal species to the vegetation dominated by woodland and meadow species (within 30 years of succession), is highly important mixing of the spoil substrate with the plant litter by earthworms, what results in soil formation. Positive effect of earthworms was later confirmed in manipulative experiments. However, other interactions also appeared to be important. Mainly the herbaceous species seems to be suppressed by trees like is willow *Salix caprea*, which is dominant tree in early succession stages with peak in abundance around the 25th year of succession. In manipulative experiment prevention of bellow ground competition of Salix caprea with its understory (by iron frame) led to relatively fast increase in understory cover. Prevention of above ground competition (by pruning) had lower effect. We assume that Salix capea have positive effect on plant succession in early stages of succession, because it produce considerable amount of liter, which helps to earthworms improve soil conditions and also suppress the ruderal vegetation. However, later it prevents progress in succession by bellow ground competition until it reduces its abundance. Processes ongoing bellow ground seems to be even higher importance for succession than that which are ongoing above ground.

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Molecular diet analysis of keystone snail species associated with mine rehabilitation

Stephane Boyer, Steve Wratten, Andrew Holyoake, Robert Cruickshank, Jawad Abdelkrim

As part of an opencast coalmine rehabilitation on the West Coast of New Zealand, endemic carnivorous landsnails (*Powelliphanta* spp.) living within the mine area are removed ahead of mining and relocated to an adjacent undisturbed area. The success of this relocation may depend on appropriate food availability in the release area. However, feeding is difficult to observe for these small nocturnal animals. Because Powelliphanta landsnails are endangered, it is not practicable to sacrifice individuals in order to study their diet. Therefore snails' faeces were examined. The morphological study of prey remains in snails' faeces revealed the presence of earthworms' chaetae but prey morphological identification at the species

level was not possible. Therefore, molecular techniques targeting prey DNA remaining in predators' guts and faeces appear to be good alternatives. They are potentially very precise in terms of species identification and applicable to soft-bodied prey. The main issue with faeces molecular analysis is the presence of DNA from different prey species, accidentally swallowed elements, bacteria from the predator's gut and DNA from the predator itself all occurring in the same sample. Therefore, group-specific primers were designed to extract only earthworm DNA and 454-pyrosequencing was used to sequence of all earthworm DNA present in the faeces. This study confirmed the presence of earthworm DNA in landsnails' faeces. Earthworm species identification was based on the DNA library of the species occurring in the snails' distribution area.

96 **Soil carbon storage in post mining site, the effect of vegetation and soil fauna**

Jan Frouz

Carbon storage in aboveground tree biomass and soil organic matter (fermentation and humus layer) was studied in post mining sites in northwest of the Czech Republic covered by seven various types of forests: alder, lime, oak, larch, pine and spruce plantations, and unreclaimed sites dominated by aspen, birch and willow. No topsoil was applied in these sites, so carbon accumulation is was the result of in situ soil development. Carbon storage in soil organic matter varied from 4.5±3.7 38.0±7.1 to 38.0±7.1 4.5±3.7 t ha-1 (rate of C accumulation 0.15±0.05 to 1.28±0.34 t ha-1year-1). It decreased in order: lime, alder, larch, oak, pine, spruce and unreclaimed natural regeneration sites. Soil carbon storage positively correlated positively with aboveground tree biomass, however, general linear models indicate that differences between individual tree species are more important that tree biomass per se. No correlation was found between litter input and C storage in soil. Amount of carbon in mineral layer and total soil carbon also correlated positively with earthworm abundance and amount of earthworm casts in profile. Field and laboratory manipulation experiment support the hypothesis about significant effect of soil fauna bioturbation on carbon storage. Laboratory experiment shows that incorporation of litter in soil by earthworms result in stronger carbon storage than mechanical mixing of soil or no mixing. Results indicate that soil fauna development play important role in soil formation in post mining sites.

97 **Algal forests and the replenishment of Mediterranean rocky fishes**

Adrien Cheminée, Luisa Mangialajo, Patrice Francour

Fucoids forests (e.g. the canopy-forming *Cystoseira* spp.) structure the Mediterranean rocky infralittoral habitats, providing food, shelter, and nursery habitat for many organisms including fishes. In the last decades the decline of *Cystoseira* forests has been recorded in several Mediterranean areas, due to direct and indirect effects of human activity. The loss of *Cystoseira* forests leads to a severe transformation of the habitat, which loses its tri-dimensional structure. The goal of this study is to determine what are the consequences of this habitat transformation on rocky fish assemblages, and more specifically on their replenishment through juveniles' settlement. Preliminary investigations during summer 2009 in natural habitats indicated that fish juveniles' settlement for *Symphodus* spp. was greater in *Cystoseira* forests than in less complex macroalgal assemblages (e.g. Dictyotales). Moreover, experimental habitat manipulation mimicking the alteration of a *Cystoseira* canopy (e.g. using artificial plastic algae) showed greater abundances of *Symphodus* spp. juveniles on artificially forested substratum than on bare substratum. Density-dependent effects were tested by a multifactorial experiment, showing that juveniles' densities did not differ between dense and sparse cover treatments, highlighting the importance of the presence of a canopy. Nevertheless, ongoing experiments were set up to investigate the presence of a threshold level of plant density which may determine habitat selection by fish juveniles. Our results suggested that the loss of *Cystoseira* forests may strongly affect the recruitment of littoral fishes, highlighting the need of protection and restoration of these forests.

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Marine vegetation restoration in coastal ecosystems in the Mediterranean Sea

Luisa Mangialajo, Patrice Francour, Alexandre Meinesz, Heike Molenaar, Marie-Lucie Susini, Thierry Thibaut

In the Mediterranean Sea, in the infralittoral zone, seagrasses and seaweeds (principally the *Cystoseira* genus) are the most important habitat formers, respectively on sedimentary and rocky bottoms. Most of these macrophytes are long-living organisms, endemic of the Mediterranean Sea. They are sensitive to human impacts and their distribution declined in the last decades. Large areas can now be considered completely lost due to their scarce capacity to naturally re-colonize lost areas. *Posidonia oceanica* restoration research began in the early nineties. Reliable methods have been tested, and applied in different zones. Seagrasses transplantation is often considered as compensatory measure in projects involving habitat destruction. Nevertheless their application on a large scale is still very difficult due to i) the high economic cost, ii) the limited extension of truly favorable areas and iii) the success of restoration depend on an effective protection of the area on the long term. Fucoids restoration research is much more recent: in the last years reliable methods have been tested but only at an experimental level. From a management point of view, the shallow *Cystoseira* species, forming typical belts on the swell zone, are the most threatened by the artificialisation of the coastline and by the floating pollutants (e.g. surfactants, hydrocarbons). More efforts are needed to experiment an efficient restoration of these habitats. However, satisfying the needs of mitigation for losses of habitat and biological resources demands further development of ecological theory to improve quantitative predictions of benefits of ecological restoration projects.

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BioRestore : a 3-Step process to restore marine ecosystem integrity, resilience and biodiversity

Gilles Lecaillon, Séverine Pristchepa, Eric Blin

ECOCEAN is an innovative French SME, and the world leader in sustainable post-larval capture and culture techniques for marine animals. Lyonnaise-des-Eaux is France's leading water treatment and waste management group. By combining their know-how, they are commencing work on a R&D project which seeks to accelerate the regeneration of marine coastal Biodiversity and are proposing a turnkey process entitled BioRestore. This innovation makes it possible to address both existing legislation (e.g. mandatory mitigation measures, etc.) and proposed legislation such as the biodiversity tax. It will also contribute to resolving marine resource overexploitation. The pilot project is being carried out in partnership with the Municipality of Agde and the local fishing community. Concept: Phase 1 covers capture of the post-larvae followed by Phase 2, rearing and conditioning of post-larvae in a specifically adapted aquarium, and finally Phase 3, restocking within/near micro habitats adapted to the restocked juveniles. The aims of such a process are various and mainly targeted at biodiversity restoration (To help rebuild the adult stock of local species, to support the presence of fish with commercial interest (sea bream, etc.), to enrich the ecosystem with indigenous species (lobster), to rescue declining or locally extinct endemic species (grouper) and to mitigate against possible future human impacts). Thus, BioRestore seeks to restore the marine ecosystem to its original level of integrity and diversity, in other words to boost its resilience to a self-perpetuating level. This presentation will present the steps and objectives of this ongoing R&D project.

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Marine restoration in Florida (USA): how to scoring the ecosystemic function losses and the gains from compensatory restoration?

Sylvain Pioch, Harold Levrel

Quantify the economics damage and restoration cost is a difficult task for a "right compensatory" to upset natural function losses from impacts. Since 20 years in U.S. the NOAA[1] and recently the EPA[2] developed tools to scoring the ecosystemic function based on economic and biological input inside an institutional framework. In Florida, due to the strong interest, both ecological and socio-economical, for coral reef, the compensatory project for marine underwater impact are important (more than 10 in 2010 (FDEP McLeod S. pers. Com.)). The scoring methods used to value marine ecosystemic function losses and gains given by restoration project, are habitat equivalency analysis (HEA) and more recently, specifically in Florida, the Uniform Mitigation Assessment Method (UMAM). The institutional framework is based on rules and policies from the Clean Water Act (CWA de 1977), the

National Environmental Policy Act (NEPA de 1969) and the Superfund (Oil Pollution Act de 1990). Four main organisms the NOAA, EPA, USACE[3] and the FWC[4] are involved at different scales and levels to score or permit the impact and the restoration projects. We would like to address the strengths and the weaknesses of these approaches from an ecological and an economic point of view through a concrete example: the beach renourishment in the County of Broward.

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Role of phosphorus in recolonisation processes after restoration of connectivity in Rhine side channels

Albin Meyer, Isabelle Combroux-Lazar, Michèle Trémolières

During the last century chenalization of the Rhine river floodplain lead to disconnections of side-arms, over-sedimentation of these channels, loss of the fluvial dynamics and aquatic vegetation change or disappearance. Actual restoration projects (i.e. LIFE Rhin Vivant 2003-2006) aim to the reconnection of disconnected arms to the main channel. The object of this study was to assess the nutrient dynamics in some restored channels during the vegetation colonization process. The nutrient contents (phosphorus and nitrogen) were measured within three compartments: water, sediment and plants, in six channels: two reference sites (which were always connected to the main channel) and four restored ones, during four seasons: autumn 2008, spring, summer and autumn 2009. Aquatic vegetation dynamics were also surveyed during the same period. The reference sites had a higher phosphorus concentration in water than the restored sites. However all sites have similar plants and sediment phosphorus contents. Seasonal patterns of the phosphorus contents in restored sites are also similar to those of the reference sites. Same results were observed for the nitrogen content. Phosphorus in plants is strongly linked to phosphorus in sediment, indicating that the sediment could be the main source of phosphorus, but there was no relationship between the vegetation (species richness and cover) and phosphorus content. Phosphorus seems not to play a major role in the recolonization, whereas nitrogen seems to play an role in the colonization patterns as a growth limiting factor, as suggested by the N:P ratio.

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Potential impact of dam levelling onto controlled equilibrium of nutrient availability in river

Rudy Nicolau, Bastien Doraphe, Christophe Jeannin, Yoann Brizard

According to requirement of the European Water Framework Directive taken up by the concept of blue screen in the French "Grenelle de l'environnement", the rate of staging courses water should decrease in order to achieve a good ecological status of waterbody. In this context the SABVM launched a study on the impact of cross-cutting structures and the role of sediments on ecological continuity. In addition to morphological restoration, this study aims to highlight the stock of nutrient and the potential leaching if dam is levelled or deled, on the watershed of the river Glane. Based on 33 dams, this study is expected to take into account the tracking stocks of phosphorus in addition to the requirements of the nomenclature ""water"" in order to lead to a shared management pattern of this river. A resuspension of sediment during the elimination of dam may release a large amount of P into the river and thus exacerbate a recurrent major problem posed by cyanobacteria on this watershed. As part of this restoration plan, 4 scenarios are considered depending on the particularities of each site: total or partial levelling, site development or maintenance.

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Vegetation dynamics after restoration of connectivity in Rhine side channels

Isabelle Combroux-Lazar, Albin Meyer, Corinne Grac, Michèle Trémolières

During the two past centuries, the Rhine floodplain was submitted to important engineering civil works (rectification, channelization,...) that severely damaged floodplain functionality. For several years, restoration works were carried on in order to create permanent connections between former channels and the main course. Functional recovery after those works was assessed through the recovery of aquatic vegetation. Propagule bank (PB) content (i.e. propagules lying in the sediment), relationships between above-ground vegetation and PB were studied in four restored channels and two reference channels (target, channels never disconnected from the main course). PB was estimated by the seedling emergence method completed by an estimation the amount of species resprouting from rhizomes.

Established aquatic vegetation was also surveyed during 4 years and macroinvertebrates' communities were identified during spring 2009. PB content, upstream/downstream vegetation patterns, links between each type of propagules in the soil and the established vegetation, macroinvertebrates'communities were analysed according to the date when the restoration occurred. Thanks to those results, some temporal patterns were identified: (1) Reconstruction of a PB followed started with colonization from unspecialized fragments, followed by a seed bank constitution and stabilization through rhizomes. (2) Succession of vegetation communities was also suggested: recolonization starting with algae and bryophytes followed by communities dominated by *Myriophyllum spicatum* then communities dominated by *Potamogeton pectinatus* and *P. perfoliatus*. (3) Temporal variations in macroinvertebrates' communities were also established. At least, invasibility of newly connected sites could also been noticed through the appearance of invasive species such as *Elodea nuttallii* and *Dreissena polymorpha*.

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Restoration of fluvial dynamics in ancient stream channels of the Danube floodplain in Bavaria (Germany)

Kathrin Kiehl, André Schwab

The floodplain of the Danube river between Neuburg and Ingolstadt (Bavaria, Germany) has been disconnected from natural fluvial dynamics due to river straightening and embankment in the 19th century and building of barrages for hydropower plants in the 1970s. In spring 2010, former stream channels and oxbows of the Danube will be connected to the stream again by a water course of 8 km length flowing through an ancient floodplain forest (2100 ha) with species-rich vegetation. Vegetation monitoring has already started to document pre-restoration state. Since autumn 2009, detailed seed bank analyses have been carried out to investigate the potential of the seed bank to contribute to the restoration of stream vegetation along the new watercourse in different parts of the Danube backwater system. These parts differ in the actual water regime (before restoration) from totally dry, over temporarily flooded to deep oxbow lakes. Sampling plots were distributed along 18 transects across the backwater system. Seed bank samples were concentrated (according to the Ter Heerdt method, 1996), stratified and brought to the greenhouse to germinate. First results on seed numbers and species composition indicate that only few plant species typical for dynamic floodplains are present in the system. Detailed results will be available in summer 2010. To compare the soil seed bank with the input of hydrochorous seeds transported by the inflowing Danube water seed dispersal will be studied by seed traps in summer 2010.

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Making Science happen. Linking research and practice to restore degraded drylands

Jordi Cortina Segarra

Drylands cover 41% of the Earth's land surface and sustain 38% of the global population. Their extent will probably increase in the next future following climatic change and increased human pressure, especially in developing countries. The surface area of drylands affected by desertification is estimated at 10-20% of this land, making this one of the worst environmental problems worldwide, often closely related to poverty. Numerous actions to prevent and combat desertification have been launched in recent decades. Among them, ecological restoration actions show great potential to recover landscape ability to provide goods and services, and contribute to human welfare. Recent advances in our understanding of dryland ecology have improved traditional restoration techniques and fostered the development of new technology. But scientific progress and restoration programs often run in different directions. While the former deepens our knowledge on the composition and dynamics of dryland ecosystems, the later are frequently anchored on old paradigms and driven by unsupported approaches. This is the result of failures on both sides. A compromise between researchers, practitioners and policy makers is urgently needed to fill this gap and develop integrated participative and adaptive management programs built on sound scientific grounds. Various tools may help to bridge the gap between science and practice and improve the efficiency and the social impact of ecological restoration. These include (1) new socio-ecological approaches, where cost-effectiveness of ecological restoration is evaluated considering both biophysical and social impacts; (2) networks of pilot and demonstration projects, where

technologies are tested at a management scale and the most successful implemented in representative well documented projects can be used as examples, (3) stakeholder platforms to develop collaborative management, (4) accessible data bases and ICT tools, to reciprocally exchange knowledge, and (5) the design and implementation of new funding schemes that will make these efforts sustained and worth. We will illustrate this framework by introducing PRACTICE, an EC action to try addressing these issues for a large range of desertification syndromes worldwide.

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Assessing the ecological benefits in a Mediterranean river after a physical restoration

Bernard Montuelle, Virginie Archaimbault, Evelyne Trichet, Bernard Dumont, Christian Chauvin, Alain Dutartre

In the past many watercourses were managed in agricultural or anti flooding purposes, disregarding the ecological characteristics of these water bodies. The evolution of the perceptions of rivers ecological services leads managers to implement restoration in order to obtain a better ecological status. The river Vistre is greatly modified by strong hydraulic modifications. A management plan was built in 2001 based on a physical restoration a river section to increase ecological functioning and biodiversity of the water body. In 2004, a 1.8 km length sector was restored: creating meanders, gravels reloading, management of a flooding area, riparian vegetation planting. In 2008 a study was designed to assess the environmental gains of this restoration: new hydro morphological characterization of biotopes (flow, current speeds, substrates), microbial processes in charge of organic matter mineralization and ecological status of the macrophytes and invertebrates communities. A marked diversification of substrates and current speed ranges types was obtained in the restored sector inducing increasing habitat diversity. A significant increase in the biodiversity of macrophytes was obtained and a limited improvement in the structure and the composition of the invertebrate communities. However the quality of the water remains poor with high phosphorus concentrations and only very little differences on chemical water quality between upstream and downstream was observed. Despite the physical improvement in this river part, this chemical quality stress maintains a stress on macrophytes and invertebrates: an improvement of the chemical water quality is essential so that ecological benefits associated to the physical restoration could express.

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Environmental flows in a context of ecological restoration : a case study of rivers Arga and Aragon (Navarra, Spain)

Judit Maroto, Diego García de Jalón, Marta González del Tánago

According to several authors flow regimes determine the ecological integrity of rivers through its influence in water quality, in the availability and characteristics of physical habitats, as an energy source for the geomorphologic processes or as a way to maintain material flows and organisms and for the development of biological interactions. However, Natural instream flows are increasingly being modified through impoundments such as dams and weirs, abstractions for agriculture and urban water supply, drainage return flows and structures for flood control. These interventions have caused significant alteration of flow regimes mainly by reducing the total flow and affecting the variability and seasonality of flows. In Navarra Region (Spain), flows in rivers Arga and Aragón, at their lowest reaches, have experimented strong alterations. While river Arga shows significant alterations due to abstractions for agriculture and drainage returns, river Aragón shows strong modifications due to Yesa dam (concluded in 1959) and Itoiz dam (concluded in 2003) regulations. In order to mitigate the effects of this flow alteration, Environmental Flows have been studied and proposed to the Government of Navarra Region. The methodology used is based on hydrological methods, which uses natural flow data. According to this methodology and the Spanish legislation on Hydrological Planning, the components of the proposed environmental flows will be: minimum base flow, maximum flow in the driest period of the year, timing of flows and flood flows. This last parameter will be characterized by the magnitude, frequency, duration, moment of the year and increase and decrease rate.

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How to restore riverbanks in natural ecosystems with many people using ecological services at the same time?

Pedro Joaquín Gutiérrez-Yurrita

Most of Mexico is not a territory characterized by great rivers, but rather, for temporary creeks and rivers with permanent riverbeds but with big seasonal fluctuations. The hydroperiod in these zones are very important, being outlined a rapid phase of rise, a period of stabilization of currents with big flows, a phase of water decrease that is very slow and finally, a period in which the river has very few water and slow current. These fluctuations are difficult to predict and rarely are similar in ecological spirals at a short time, for what the use of the river bank, riparian and flow resources is chaotic and disordered. Local populations composed in many cases by indigenous communities are the owners of the land and by law, of the natural resources of the land. So they are using their resources as much as they can. In addition, the rivers in better condition of conservation, including his hydrological basin, are located in places with many social problems, and where indigenous people and other communities are in extreme poverty conditions. So, the way in which they use their natural resources is closer to the philosophy "bread for today, hunger for tomorrow" than that of the sustainability. And though the efforts for preserving the ecological processes of these ecosystems, connected in network with other basins are under the paradigm of the "integral ecology", the question that is still latent is: How is it possible to restore a riverbank if there is not known thoroughly the ecological functioning of the ecosystem and its functional interaction by the ecological bordering systems, if in addition all these systems are being chaotic overexploited by people in order to satisfy their primary needs of subsistence?

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Integrated analyses for a better calibration of fluvial habitats restoration interventions

Maria Teresa Carone, Tiziana Simoniello, Anna Loy, Maria Laura Carranza

The identification of ecologically correct restoration interventions is a crucial topic, and taking into account all the critical aspects of a damaged habitat is very difficult, particularly for river ecosystems due to their strict functional links with the surrounding territory. For suggesting scientifically based strategies, a useful approach can be based on the analysis of the environmental needs of species, whose survival depends on the conservation status of the entire basin (e.g. Eurasian otter - *Lutra lutra* L.), jointly with synthetic information on different aspects affecting the primary functions of the river. We tested such an approach in the Otter Italian core area, in two sub-basins (High-Sinni River, High-Agri River) having different characteristics in term of anthropic presence: a natural structure for the first, whereas heavy hydraulic interventions for the second. To identify Otter suitable/unsuitable sites we used an Ecological Niche Factor Analysis (ENFA) by analyzing eco-geographical variables, mainly derived from satellite imagery and elevation data; the fluvial functionality levels were obtained from IFF (Italian Index of Fluvial Functionality) field survey. The IFF information revealed a good capacity for better characterizing the ENFA-based suitability map: for example, along the high-Agri River, riverbanks recolonized by vegetation can represent suitable habitats, but they are highly instable, and the characteristic low IFF levels provide the right hints for restoration needs. The results underline that a joint analysis of habitat suitability and fluvial functionality can be very helpful to locate the interventions and to evaluate the effectiveness of already implemented activities.

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Mediterranean riparian vegetation: tools to improve studies, management and restoration

Simon Dufour, Élise Buisson, Vincent Tamisier, Émilie Deschamps, Noëllie Fonvieille

Riparian biodiversity conservation and management issues are major issues in the Mediterranean biome, where (i) ecosystems are sensitive to climatic and hydrological conditions (and therefore changes) and (ii) their spatial structure remains poorly known both locally and regionally. In order to improve the scientific basis for sustainable management we propose a dual approach: 1) we conducted a field study on rivers in south-eastern France with the aim to develop and test a protocol which would be valid at different scales (local and regional) and adapted to Mediterranean riparian context integrating hydrological, geomorphological and ecological characteristics. The protocol was then tested on nine rivers and validated.

2) As some exotic species were found in the field, we completed this *in-situ* approach by an experimental approach to study the physiological response of eight tree species (four natives and four exotics) to water availability depending on the type of substrate. The results of this study show that the eight species have a wide variety of needs and responses to limited water supply and confirm the importance of limiting the spread of exotics and maintain a high diversity of habitats in the riparian vegetation.

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Morphodynamics restoration and redynamisation of the bypassed section of the Rhine downstream Kembs dam - Interreg / EDF projects

Piégay H., Aelbrecht D., Béal D., Arnaud F., Hoenen D., Johnstone K., Schmitt L., Rollet A.-J., Alonso C., Barillier A., Bouchard J.-P., Clutier A., El Kadi Abderrazzak K., Garnier A., Pinte K., Gantzer L., Vinel D., Armburster J., Spaeth V., Blanchard B., Burlet D., Pleis B., Béraud C., Camenen B., Lecoz J., Paquier A., Billard C., Dietrich L., Trautmann T., Dittrich A., Koll K., Huppmann O., Meineke J., Ostermann R., Pfarr U., Seitz B.-J, Knibiely P., Merckling L., Combroux I., Trémolières M., Piquette E., Wintz M.

Over the two last centuries, the Upper Rhine river has been heavily impacted by channelization for flood protection and navigation (19th century), and then for hydropower generation (from about 1925). In non flooding conditions, most of the flows are diverted in a canalized section whereas the regulated "old Rhine" bypassed reach runs a minimum flow. Between Huningue and Neuf-Brisach (Southern upper Rhine floodplain), engineering works induced simplification and stabilization of the channel pattern from a formerly braiding sector to a single incised channel, hydrological modifications, channel bottom armouring due to bedload decrease, and thus ecological alterations. Two complementary and interdisciplinary projects have been initiated to restore alluvial morphodynamics in this reach: - the international "INTERREG IV - Redynamisation of the old Rhine" project (2009-2012); - the left bank "controlled erosion" project launched by Electricité de France (EDF), which comes with another EDF commitment to increase minimum flows following a nature-like seasonal variation. The purpose of these projects is to evaluate the feasibility of an hydro-morphological and ecological restoration plan on a 45 km long reach, through field testing of bank erosion techniques (EDF project) and artificial sediments input from right bank excavations (Interreg project). This will help to define possible long term prospective scenarios, in order to restore sustainable sediment transport, morphodynamics variability and associated improved ecological functions. The study will involve historical analysis, hydro-morphological and hydraulic modelling, physical and ecological monitoring, and sociological aspects. Results of these complementary approaches will permit to propose innovative, international and inter-disciplinary restoration scenarios, on a large scale of one of the biggest river in Europe, for the next twenty years period.

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Special session 4: Birds & sustainable management in Mediterranean riparian areas: Bird studies in the RIPIDURABLE project

João E. Rabaça, Ana Mendes, Paula C. Dias, Carlos Godinho, Jean E. Roché, Bernard Frochot, Bruno Faivre, Eric Dincuff, Philippe Perret, Pierre-André Crochet, Inês Roque, Alexandre Vaz

RIPIDURABLE is an INTERREG IIIC European Program involving 10 partners from Portugal, Spain, France and Greece. Scientists, technicians and local/regional authorities worked together to integrate knowledge, know-how and practice, towards a rational conservation management of riparian zones. Birds can be used to characterize ecosystems, to monitor environmental changes or to assess results of restoration measures. We have conducted field surveys in order to assess breeding bird communities associated to riparian galleries in several watercourses, including issues as the relation with natural vegetation profiles, the influence of the surrounding matrix, the evolution with time or with habitat degradation, the effects of rehabilitation measures, and/or the importance of riparian galleries as ecological corridors for birds. Surveys at different space and time scales were carried out using standardised point count methods, on 8 watercourses in Portugal and France. We focussed on different aspects of riparian breeding bird community variation: along a decreasing gradient of vegetal complexity (Tagus Basin), along an upstream-downstream gradient (Allier), with different surrounding landscapes (Sado, Guadiana and Tagus Basin), with time (Alcáçovas at a 10 years interval, Allier at 16 years interval), with management status (Vidourle), with time & management status (Rhône delta at a 12 years intervals),

before & after river rehabilitation (Gandum). In addition we studied the dispersal of Barn Owls from upper Tagus Estuary along riparian corridors (TytoTagus Project), and also the importance of riparian habitats of the Guadiana basin on the autumn migration of trans-Saharan birds across the Iberian Peninsula.

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Special session 4: Restoration of the Drugeon basin

Jean-Noël Resch, Geneviève Magnon, François Degiorgi, Hervé Decourcières

Between 800 and 900m a.s.l. in the Haut-Doubs, the Drugeon valley occupies a glacial basin of approx. 170 km^2. It is famous for its wide and diverse wetlands which represent 1/7 of the territory. The Drugeon occupies the bottom of the valley over more than 35km, until its confluence with the Doubs after Pontarlier. Starting in the sixties, a dramatic adjustment of the Drugeon bed (the linear stretch is reduced from more than 40km to less than 35), as well a draining works, intensified agricultural practices, resinous plantations and various pollutions have strongly reduced the quality of the site. Between 1993 and 1998, a LIFE program «Conservation of the Drugeon Basin» allowed to start restoration actions that are still in progress: rehabilitation of the water course and streams, Natura 2000 contracts, management of a regional nature reserve, sensitive natural habitat...The main actions developed were: (1) restoration of Drugeon and its tributaries, (2) wetlands restoration and management, (3) reduction of pollutant flows of domestic or agricultural origin. A technological and methodological evaluation of the operations developed in the basin allowed to assess their incidence and adjust the actions of the local authorities towards ambitious objectives for the natural environments. In the water course, the fact that insects such as large Plecoptera can be seen again encourages the community to pursue the efforts developed for more than 10 years in favour of these remarkable ecosystems.

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Special session 4: The project RICOVER: River Recovery in the SUDOE Region

Ana Mendes, Maria Teresa Ferreira, António Albuquerque, Maria Helena Almeida, Jordi Camprodon, Paulo Cruz, Sofia Delgado, André Fabião, António Fabião, Carla Faria, Rosário Fernandes, David Gu

RICOVER project (River Recovery in the SUDOE Region http://www.ricover.eu, 2009-2011) was born from the desire to apply Ripidurable project guidelines to the recovery of natural environment to the SUDOE region, and specifically to improve the ecological quality of riparian zones and the sustainability of river ecosystems. Its general aim is to create, define or apply common strategies for the protection and restoration of SUDOE fluvial corridors. The partnership is leaded by the Technical University of Lisbon (Instituto Superior de Agronomia, PT) and includes a regional water authority (ARH Algarve, PT), a water management enterprise (Águas do Algarve, PT), a regional authority (Junta de Extremadura, ES) and a Regional Developmental Center (Centre Tecnològic Forestal da Catalunya, ES). The mainstream of activities is river restoration, in its various scales and actions, including the identification and causal quantification of river degradation, elaboration of maps for restoration planning, control of invasive alien plants and rebuilding riparian woods, woody species propagation techniques, channel cleaning guidelines, and an experimentation of best-result biophysical engineering techniques in a 5km restoration case-study in Odelouca (Algarve, PT). Demonstration projects of bioengineering techniques will occur also in Guadiana (Extremadura) and Ter (Catalunya) regions. An important effort will be dedicated to the diffusion of ecologically-sound restoration practices in SUDOE rivers, making sure these will incorporate relevant ecological concepts related to river dynamics, biotic responses and adaptative management procedures.

115 **Special session 4: The RIPIDURABLE project – sustainable management of riparian areas**

A Mendes, MH Almeida, K Arvanitis, D Arizpe, Y Chatzinikolaou, PA Crochet, PC Dias, P Dimopoulos, E Dincuff, A Fabião, B Faivre, C Faria, MR Fernandes, MT Ferreira, B Frochot, S Giakoumi, C Godinho, R Hipólito, N Koutsikos, I Loi, F Pais, C Pereira, Ph Perret, MA Prada, JE Rabaça, JE Roché, I Roque, J Viana, S Zogaris (*)
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Riparian areas are dynamic and complex ecosystems, harboring a rich mosaic of aquatic, semi-aquatic and terrestrial habitats. Their vegetation filters pollutants, stabilizes soil against erosion, and functions as a refuge for plant communities and wildlife, thus contributing to preserve biodiversity. They function as ecological corridors and also display a specific up-stream/down-stream organization. It may be difficult for management authorities to implement suitable measures for the conservation and management of riparian zones, either due to poor technical know-how, poor planning, and/or to a lack of indigenous plant species for riparian restoration. To address these problems, the scientific community became involved in an Interreg IIIC - project co-funded by the European Union. The name RIPIDURABLE, coined from "RIPI" (Latin riparius, "river bank") + "DURABLE" (French, "sustained"), conveys the idea behind this project: "sustainable river". RIPIDURABLE seeks for a rational conservation management, bringing together the economic potential of riparian areas with their functional role in the conservation of nature, water, soil and landscape. Institutes with experience in environmental evaluation, habitat restoration and propagation of forest plant species, were brought together with both national research organizations and local authorities with management competencies. Ten partners of four countries (Portugal, Spain, France, Greece) were involved. Results contributed to the development of National Policies for the sustainable management of rivers and their riparian zones. Several pilot restoration projects of Mediterranean rivers were developed. Specific publications promoted the interpretation of riparian zone ecology and conservation needs, namely one Management Guide and one Propagation Handbook (in 3 languages).

116 **The River Enningdalselva, a biological diverse watershed along the border, well suited for teaching purposes**

Marit Eriksen, Louise Buhre, Andreas Bäckstrand, Margareta Nordström, Bjørn Walseng

Enningdal watershed, on the southernmost part of the Swedish – Norwegian border, with its sources in Norway, draining northwards through Sweden and Norway,reaching the border fiord Iddefjorden. The high diversity of aquatic biota in the region was reduced because of acidification in the last century. In order to restore the water quality, liming started on a large scale in 1980. Since then the water quality in formerly acidic lakes has improved. Historical data of fish community status have been obtained, and a study including water chemistry, crustacean and test-fishing was conducted in 60 lakes in Norway and 18 lakes in Sweden. 36 more lakes have been test fished in Sweden. We also have information on bottomdwelling animals. Information have been collected on the eal (*Anguilla anguilla*), the salmon (*Salmo salar*) and the pearl mussel (*Margaritifera margaritifera*). Based on the knowledge on freshwater life in this watershed we have started an Interreg-project where the aim is to come up with a teaching guide for use in schools in both countries. The guide will focus on: The watershed and the relation to the fiord, problems due to acidification and eutrophication, abiotic factors in a restoration perspective (digital maps), stories about animals living here (including rare species and indicator species/digital maps), good localities for excursions and ideas for activities. The project will result in an open web resource, useful for teachers and students in the region and hopefully contribute to increased knowledge concerning the values of the nature in the local community.

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Conservation of *Bromus bromoideus*: feasibility study of the reintroduction of a plant extinct in the wild

Sandrine Godefroid, Julien Piqueray, Kathy Danhieux, Christine Poelaert, Benoît Delpeuch, Abigail de Martynoff, Maïté Deplechin, Florence Hecq, Marie Legast, Bernard Bodson, Louis-Marie Delescaille, Gilles Colinet, Thierry Vanderborght, Grégory Mahy

Bromus bromoideus is an endemic species from Belgium and North France. It was first discovered in 1823 and was almost exclusively restricted to spelt fields on calcareous soils. Then, in the latter part of the 19th century, the species became progressively rare and is now considered to be extinct in the wild since 1935. Fortunately, the plant still exists in ex situ collections, and seeds stored for decades at 5% moisture content and -20°C have shown a good viability (81% germination on average). Since 2006, the species is cultivated at the National Botanic Garden of Belgium and produced hundreds of thousands of seeds so far. The best case scenario for this species is to be reintroduced into the wild. As spelt fields survive as a relict crop in Europe, the future of *Bromus bromoideus* does however remain uncertain. We initiated a feasibility study to assess whether the reintroduction of the species is wise and feasible. Three types of constraints were identified. Biological constraints are related to the taxonomy of the species, the origin of the seeds, and the genetic diversity of the material available for reintroduction. Agronomic constraints have been understood by studying the competition with the crop at various densities and the influence of sowing depth on its growth. Finally, sociological constraints were examined by analyzing results from a questionnaire survey intended to farmers in order to get an idea about their willingness to participate in a reintroduction experiment and under what conditions.

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GENMEDA : Network of Mediterranean Plant Conservation Centres

Myriam Virevaire

The partners who share a common floristic region, a geographical area with a similar landscape and a common set of problems concerning natural environment disruptions, establish among themselves a network of seed banks and conservation centres of genetic resources of Mediterranean flora. Mission and objectives: The GENMEDA network has as a mission the conservation of the Mediterranean flora genetic resources and sets itself the objectives.

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Impact de* Ludwigia grandiflora *sur les micro-organismes et détermination des molécules bio-actives responsables : restauration d'écosystèmes et valorisation de la biomasse végétale.

Imen Smida, Jean Le Petit, Gérard Audran, Isabelle Giffard, Claude Charpy-Roubaud

Les hydrophytes Ludwigia sp. sont responsables de la dégradation des écosystèmes qu'elles envahissent. La perte de biodiversité des micro-organismes a été observée. Il en est de même pour le maintien de la pureté de l'eau des aquariums dans lesquels les plantes ont également été cultivées pour assurer un suivi plus contrôlé. Ces observations prêtent a priori *aux* Ludwigia *des capacités allélopathiques qui, par ailleurs, se manifesteraient en fonction du stade de développement de la plante. Les recherches développées visent à déterminer l'impact écologique de* Ludwigia grandiflora *sur les micro-organismes en fonction de son développement, à cibler les molécules bioactives responsables des effets allélopathiques et à déterminer leur nature. La méthodologie utilisée est celle des antibiogrammes, pour la microbiologie, appliquée à des souches de collection. L'étude en chimie organique en cours de réalisation a permis de déceler des structures organiques, non encore identifiées. L'objectif de l'étude est, à terme, la compréhension du fonctionnement du milieu, à des fins de restauration des écosystèmes et de perspectives de valorisation d'une biomasse polluante. Ces travaux sont développés dans le cadre d'une thèse de doctorat franco-tunisienne.*

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RESTOGEN : Restoring Habitats and Plant Genetic Diversity

Alexandre Henry, Michel Boutaud, Eric Collin, Yves Gabory, Pascal Laigle, Hervé Le Bouler, Damien Provendier, Nathalie Frascaria-Lacoste

Genetic diversity is the key to the adaptation of living, it represents a way to respond to the environmental uncertainties, particularly in the context of global climate change. Taking evolutionary genetics into account is fundamental for the design, implementation and expectation of ecological restoration. However, in practice, this is rarely considered. Nevertheless, managers are more and more wondering about the nature and origin of plant material for use in restoration. Local plants are often recommended and preferred, but the lack of a methodological framework to collect and multiply these plants inhibits these actions and gives rise to doubts about the validity of practical methods used to preserve a degree of genetic diversity: How many seeds of how many individuals? Which individuals? Should we prefer local material? The RESTOGEN program was created to answer to these questions, and to supply managers with knowledge on genetic diversity and appropriate sampling methods. A first study revealed that the ash trees in the area of Saumur (France) were hybrids between *Fraxinus excelsior* L. and *Fraxinus angustifolia* Vahl. This hybrid status does not fit in the European regulation on Forest Reproductive Material, which considers pure species only. Consequently, restoration with local ash plants obtained from trade is prohibited. A second study is being carried out with the common privet (*Ligustrum vulgare* L.) to examine whether adaptive and genetic differences exist between populations of different regions of origin.

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Rhinanthus minor as a tool for grassland restoration: establishment and effects on vegetation composition

Markus Wagner, Matt Heard, Jodey Peyton, James Bullock, Richard Pywell

Grassland restoration sites are often characterized by high residual soil fertility, resulting from intensive former land use. This tends to translate into a highly productive plant cover which, in turn, hampers establishment of specialist species from less fertile target communities. In recent years there has been a growing interest in the introduction of hemi-parasitic grassland species into restoration sites. These hemi-parasites tend to preferentially parasitize highly competitive grasses and by doing so, they can significantly reduce competition and facilitate the establishment of grassland forbs. We established a multi-factorial field experiment at three different grasslands to determine optimal sowing densities and the amount of pre-sowing disturbance required to establish three different subspecies of the hemi-parasitic *Rhinanthus minor* L. (yellow-rattle), and to investigate their effects on extant plant communities and their potential to facilitate establishment of site-specific mixtures of target forb species. Results from the first year indicate that optimal levels of pre-sowing disturbance for the establishment of *Rhinanthus* depend on the type of grassland it is sown to, and that performance at specific sites varies between the different subspecies. However, medium to high densities of *Rhinanthus* are consistently effective in suppressing dominant grasses.

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Silene portensis *L. : déplacement d'une population à partir de sa banque de semences du sol.*

Myriam Virevaire

Le déplacement d'une population sauvage, ou translocation, se place dans le contexte de l'écologie de la restauration, un domaine scientifique récent et en pleine émergence qui s'intéresse aux procédés visant à augmenter les probabilités de survie de populations menacées (réintroductions, renforcements, translocations...) ou à réhabiliter des écosystèmes dégradés. Le cas de cette population est à ce titre novateur dans la méthode employée et des résultats obtenus. Silene portensis *est une plante annuelle au port herbacé pouvant atteindre 40 cm de haut. Sa période de floraison est principalement estivale même si on peut observer des individus fleuris jusqu'en novembre. La fructification suit d'un mois la floraison. C'est une espèce fugace dont les effectifs fluctuent d'une année sur l'autre. Certaines stations peuvent disparaître plusieurs années de suite avant de réapparaître et n'être présentes pendant ce temps que par la banque de graines du sol. Il s'agit d'une espèce pionnière présente dans des milieux ouverts, chauds et ensoleillés, qui pousse sur substrat fin siliceux.*

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Boundary work in ecological restoration and conservation

Jac. A.A.Swart, Henny J. van der Windt

The concept of boundary work is often used to point to activities linking scientific and societal domains, whether this involves demarcation or integration. Restoration and conservation are examples of boundary work par excellence because they require the reconciliation of objectives, paradigms, visions and the knowledge traditions of the actors involved if they are to be successfully socially embedded. One example of boundary work is the introduction of the concept of 'natural boundaries' in relation to the Dutch part of the Wadden Sea to resolve the long-lasting conflict over gas exploitation in this natural reserve. The concept of natural boundaries demarcates and constrains human activities, guided by an a priori determination of boundary values concerning key parameters that are thought to be conditional for undisturbed ecosystem processes. In the gas exploitation case it led to the so-called 'hand on the tap' approach. However, we may also distinguish 'societal boundaries', i.e. constraints on conservation or restoration efforts set by basic socioeconomic or cultural conditions. One such example is the plan for dynamic dune management on the islands of the Wadden Sea. The dunes were established in the twentieth century for flood prevention, but are now considered to adversely affect the natural dynamics of the salt marshes. Consequently, it was suggested that passages be created through the dunes, but this led to social unrest among the local people. In this presentation we will discuss natural and social boundaries in the practice of restoration and conservation in the Wadden Sea area.

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The processes of social participation in the projects in river restoration adaptative management models (Spain)

Lara L.Rodríguez, Pérez M.A. Fernández, Mora P. Mc Ginity

The fostering of the social participation for the improvement of the basin management is one of the main objectives of the Water Framework Directive and therefore of the Spanish Strategy in River Restoration. In the search for an adaptative management model in river restoration in Spain, it has been considered necessary by the Water Administration Bodies of each basin the implementation of various participation processes and techniques involving representatives of the public organisms, and associations, such as fishers associations, local farming farmers' associations, aggregated mining associations, environmental and conservation associations as well as land owners. The participative methodology is based on the use of different tools and techniques which aim at bringing together the view of the local people and river users by the employment of working groups, formed by previously selected individuals who represent different interests and ways of understanding the river. One of the aims in the participative process is to obtain a change of mentality and a compromise of river users which might ensure the sustainability of the restoration projects. Therefore records of the commitments made by each participant in the group are kept, towards the establishment of coordination protocols and the design of long-term agreements. This work presents some of the results achieved in Extremadura (Spain). It includes techniques, methodology and reflections on the social aspects of river restoration which really have been fruitful, as might be coordination agreements with competent environmental departments, bio-invasion and inadequate environmental practices alert protocols signed with fishers associations, among others.

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Stakeholder views on restoring depleted cereal fallows in arid Tunisia: societal barriers and possible crevices

Marjolein Visser, Noémie Maughan, Azaiez Ouled Belgacem, Mohamed Neffati

All three Maghreb countries struggle with manmade dryland degradation and climate change will reinforce this trend. In arid Tunisia (100-200 mm annual rainfall), depleted cereal fallows are a prominent feature of the desertified landscape. Based on long-term agro-ecological work with promising native steppe grasses, this work explores the societal barriers to reseeding cereal fallows with these species in the Jefffara coast plain. Interviews were conducted with 23 stakeholders (researchers, development agents and land users) and 40 statements were drawn from these interviews as well as from written sources. These were sorted by 27 stakeholders (some of whom were interviewed before) following a distinct Q-sorting technique inspired by Q-methodology. Principal Components Analysis of these Q-sorts revealed three major types of barriers. (1) A widespread knowledge barrier was obvious

since opinion on several agro-ecological statements was often opposite to the scientific evidence. (2) Strong convictions about the sacrality of barley growing and cultivating land in general pointed to a cultural barrier to sowing steppe grasses on cereal fallows; in a rainy year no one considers anything else than barley. (3) Finally, especially non-scientific agropastoralists expressed a lack of trust in any state-backed project aimed at combating desertification. Without economic benefits attached to reseeding, no spontaneous takeup of reseeding can be expected. A small NGO could be set up to demonstrate the economic potential by showing that hay of these species can fetch higher prices than currently sold hay of annual weeds or fibrous grasses.

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An evaluation of restoration actions using ecosystem services in a semi-arid steppe

Mchich Derak, Jordi Cortina

Desertification is one of the major environmental problems worldwide affecting 40% of the emerged lands and 25% of the population. Ecological restoration can play a relevant role in combating desertification and contributing to human welfare. But protocols to perform an integrated evaluation of restoration actions are still lacking. We adopted a multicriteria approach based on literature review and consultation of experts and stakeholders to evaluate ecologic, socioeconomic and cultural consequences of restoration actions in a semi-arid area in southeastern Spain. Evaluation criteria were linked to biodiversity and three categories of ecosystem services: erosion control, production of goods and preservation of cultural values. Preliminary results suggest that the provision of ecosystem services is higher in areas planted with pine than in abandoned and active agricultural fields, but similar to that provided by Stipa tenacissima steppes and shrublands. Erosion control and production of goods showed the highest weight which reflects the ecological and socioeconomic dimension of restoration programs. In this study we discuss the pros and cons of our experimental approach, and recommend a protocol for the evaluation of restoration actions in semi-arid lands.

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Initiatives of Polish artists shaping respective attitude towards nature – importance of tree in ecological art

Magdalena Worlowska, Maria Marko-Worlowska

One of the most important problem in contemporary life is degradation of the environment, related to people's disrespectful attitude towards nature. Since art has a power to influence mind and spirit, many artists have created works encouraging to be active in the domain discussed in the paper- the ecology. The artists presented in the paper create so-called ecological art, the fundamental assumption of which is to motivate to ecological actions The presented works of art emphasize the role of a tree as the crucial element of the environment, as well as investigate the relations between nature and culture. First example of the similarity between natural and cultural worlds is related to architecture. Example illustrating this problem is a project of the building entitled Oxygen Towers by Jarosław Kozakiewicz. The project raises the problem of urban spaces and the role of a tree. The tree appears as well in the photo Dishes by Till Nowak, the work that is a kind of antithesis of the project by Kozakiewicz. The work depicts the absurd situation in urban city which has been flooded by media as people lose contact with nature and consequently with each other. The last work is a graphic by Jerzy Dmitruk entitled Sky Above the Forest. Here trees are symbolic representation of the possibility of continuity of life. The paper emphasizes that in order to notice and acknowledge the great importance of tree people should look at it from different perspective -the perspective that the art allows and facilitates.

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Is ecological restoration an option for Lebanese calcareous quarries rehabilitation? From legal framework to field applications

Layla Saad, Grégory Mahy, Benoit Delpeuch, Patricia Chedrawi, Antonio Francis, Carla Khater

During the last decades, Lebanon underwent an anarchical exploitation of its mineral resources, resulting in a mosaic of scars throughout the landscapes. In 1997, a decree put a stop to this environmental plague, limiting the number of exploitation permits. More than 700 quarries are now recorded in the country, most of which have been abandoned. Although, there is a national will

towards the rehabilitation of these sites, several barriers still need to be alleviated.In the present study, we considered both the legal framework and field applications for the implementation of ecological restoration as a mean of rehabilitating calcareous quarries in Lebanon. A review of the current legislation, coupled with interviews of different stakeholders allowed us to point out some gaps for the implementation of rehabilitation in general, and ecological restoration in particular. In parallel, restoration tests were performed on a pilot study site representative of the thermo-Mediterranean vegetation level. Four native species were selected and their potential for use in ecological restoration was assessed. In conclusion, some recommendations will be drawn for ecological restoration as a rehabilitation option in Lebanon.

129 **Restoration and management to conserve biodiversity at the landscape scale**

Szabolcs Lengyel, Katalin Varga, Eszter Déri, László Lontay Aggtelek, Béla Tóthmérész

Most landscapes in Europe have been influenced by centuries of intensifying use by humans. Restorations can theoretically reverse these processes, but in practice, are often limited in scope by socio-economic constraints. Here we present methods and results from a habitat restoration and management project that is exceptional in spatial scale in Europe. Grassland restoration was carried out on 760 hectares of arable lands and habitat management (grazing and fire management in grasslands and marshes; chemical-free cultivation on croplands) was implemented on 670 hectares in the Egyek-Pusztakócs marshes of Hortobágy National Park, E-Hungary since 2005. We briefly review the previous history of the 4000-ha project area and describe the targets and main methods of restoration and management. The results showed that grassland restoration was successful in starting a directed succession towards the target habitats. Grazing increased the diversity of native grasslands favourably and greatly accelerated succession on newly restored grasslands. Grazing and fire management have led to the opening up of homogeneous reedbeds and the appearance of new plant species and associations, thereby increasing the diversity of wet habitats. Finally, chemical-free cultivation, along with the other actions, decreased farming-related disturbance of the area and has led to increased populations of small mammal species that serve as prey for raptors. As a result of the project, populations of several threatened birds have recolonized or increased in the area. This project draws attention to the importance of restoring habitat complexes by combining restoration and management to increase biodiversity on the landscape scale.

130 **Restoration of species-rich grasslands on former arable land by spontaneous colonization and hay transfer and with grazing of megaherbivores**

Sandra Mann, Sabine Tischew

Since the seventies of the last century large areas with grasslands in floodplains have been meliorated, ploughed and used for intensive cropping in Germany – also in the "Wulfener Bruch" (Saxony-Anhalt). A local NGO works since 1996 successful in recovering a biotope-network of species-rich grasslands. Up to now, more than 40 ha former arable land was successively bought and immediately grazed by large herbivores (Heck-cattle and Przewalski-horses). The local farmers apply a year-round grazing regime without additional feeding and low stocking density. Scientific evaluation of the project progress and experiments with different re-vegetation variants (natural recovery, hay transfer, seeding of commercial seed mixture) revealed the following results: (1) on former arable land immediate grazing with large herbivores without additional feeding is possible and leads to a successive development of typical grassland communities with low nutrient status, (2) integration of old pastures into the grazing system enhances colonization of native grassland species alongside animal tracks, (3) seeding of a commercial seed mixture impedes the colonization of native grassland species, (4) transfer of species-rich hay accelerates the colonization rate of several grassland species, and (5) highest cover of target species was found on regularly wet sites. Therefore, we conclude that grazing with large herbivores proved to be successful in converting former arable land into species-rich grasslands. Nevertheless, rising of the groundwater table is most important for further development of species-rich wet grasslands in the Wulfener Bruch.

131 **Is large-scale, low-intensity grazing an applicable tool for promoting biodiversity in river valleys?**

Joachim Schrautzer, Veronika Breuer, Michael Breuer, Kai Jensen

This study was carried out in the valley of the River Eider (Northern Germany) which is characterized by more or less intensively drained fens in the floodplain and adjacent mineral soils on the lateral slopes. From 1999 onwards large-scale grazing systems have been set up in this valley to protect remaining species-rich grasslands and to enhance habitat quality of degraded sites. In this contribution results are presented concerning the long-term effects (1999-2009) of cattle grazing (livestock density between 1.0 and 1.5 cattle ha-1) on the vegetation structure in three pastures which differed according to their land use history. The results showed that species richness increased in all grasslands on mineral soils (*Lolio-Cynosuretum*) independent of the land use history (abandonment or high-intensity grazing) which was caused by high grazing intensities (> 65 % loss of herbage) and beginning nutrient impoverishment of the soils. Species richness on fen soils increased when the initial vegetation consisted of species-poor abandoned wet meadows (*Calthion*) or of species-poor wet pastures (*Lolio-Potentillion*) despite of relative low grazing intensities in some years. In previously moderate used fen areas with species-rich grasslands grazing intensity was low during the whole investigation period. On these sites species richness did not change in the first five years after implementation of large-scale grazing but decreased afterwards. We conclude that large-scale grazing is an appropriate alternative to more costly nature conservation measures in grasslands. However, in order to avoid abandonment in isolated species-rich wet meadows, additional management measures as e.g. mowing should be considered.

132 **Impact of soil, seasonality and consumers on biomass quality in chalk grasslands**

Till Kleinebecker, Heidi Weber, Norbert Hölzel

In chalk grasslands, low-intensive grazing is a widely-used management tool to conserve and restore the outstanding biodiversity of these ecosystems. Conservation management is cost-intensive and thus often hampered by limited financial resources. Thus, balancing necessities of nature conservation and requirements of livestock-keeping farmers is promising for sustainable and long-term conservation management. However, profound knowledge of non-intensively used grasslands with respect to biomass quality and its seasonal variation in relation to grazing is almost lacking. We analyzed the floristic composition, soil chemical characteristics and the chemical composition of the aboveground biomass in a sheep-grazed chalk grassland in NW Germany. Sampling took place in monthly intervals. To separate the impact of grazing on biomass quality an exclosure experiment was performed. Floristic composition of the studied calcareous grasslands was mainly affected by two gradients representing the trophic status and the long-term management intensity. Differences in abiotic site conditions were hardly reflected by the nutritional value of the aboveground biomass. Irrespectively of the abiotic site conditions, the chemical composition of the biomass showed a clear seasonal trend. Nutrient concentrations strongly declined from May to July but increased again in August, probably due to favourable current-year weather conditions. Grazing had a positive impact on the nutritional value of the aboveground biomass indicating that sheep grazing modifies the environment beneficially for the animals. We conclude that an early spring and a late summer grazing is an appropriate management scheme to combine both requirements of feasible livestock production and biodiversity conservation.

133 **Exclosure as restoration technique for degraded arid rangelands**

Ahmed Aidoud, Halima Slimani, Françoise Rozé

In Algeria, the arid steppic rangelands covering more than 20 million ha, suffered rapid desertification during the last few decades. Vegetation and soil reclamations were tested at local scale, mainly using planting trees and shrubs. However, the huge area affected by desertification requires techniques of low cost and assuring the acceptance of rangeland pastoralists and managers. Grazing exclosures were traditionally used for rangeland restoration and large portions of rangelands have been protected from livestock as the main measure recently taken to restore degraded steppes in Algeria. Most of the worldwide studies showed positive effects of exclosures on degraded ecosystems. However, in the case of local experiments or management, the slow process of ecosystem (re-)establishment is countered

by the faster degradation in the surrounding rangelands that are commonly grazed and far from being controlled. Here we present an exclosure dynamics between 1976 and 2006. The exclosure played, in the short term, a positive role on vegetation cover and then on soil protection in comparison with the open rangeland where overgrazing by sheep was the primary cause of degradation. In the next stages, vegetation and soil degradation was observed even inside the exclosure which suffered a severe and long dry period and especially encroachment of sand originated from immediate vicinities. The new changed environment was no longer able to support the pre-existing ecosystem. Such a result poses the questions of restoration/rehabilitation experiment design addressing control of environmental change and reference systems that can be chosen.

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Evaluating large-scale, open-ended habitat creation projects: the example of the Wicken Vision Project, Cambridgeshire, UK

Francine Hughes, Pete Stroh, William M. Adams

In the intensively farmed landscape of lowland England, a number of new wetland restoration projects have been initiated at a 'landscape-scale'. In this geographical context, the term 'landscape-scale' represents projects with more than 5 km2 of land, and encompassing whole hydrological sub-catchments. At one of these projects, the Wicken Fen Vision, an 'open-ended' restoration approach has been adopted. This approach has replaced one of strongly prescriptive land management and associated fixed targets, with one that visualises the present as part of a continuum of change over long time frames. It thus embraces a restoration paradigm in which habitat development reflects changing ambient environmental conditions and outcomes are transient along a trajectory of change. Within such restoration projects, monitoring and evaluation activities need to recognise that project goals are not defined in terms of habitat and species outcomes. At the Wicken Fen Vision, restoration goals are framed in terms of promoting natural processes, changing landscape mosaics and improved ecosystem services. Monitoring has focussed on the physical processes that underpin the development of habitat mosaics, on the way those mosaics change through time and on species that can indicate different landscape attributes of connectivity and scale. It should also include monitoring ecosystem service benefits and stakeholder response since this restoration approach is unusual in the UK and can encounter many institutional and societal constraints. Evaluation can then focus on assessing changing restoration impacts and benefits rather than on a fixed concept of ecological success.

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Relationships between age, the soil seed bank and standing vegetation across a landscape-scale wetland restoration project

Pete Stroh, Francine Hughes, Owen Mountford, Tim Sparks

Wicken Fen National Nature Reserve (NNR) in Cambridgeshire, UK, is a wetland of international importance, but is isolated in a landscape dominated by arable farming. The prospect of species extinctions within the NNR led to the creation of the Wicken Fen Vision, an ambitious project aiming to expand the reserve boundary through the purchase and restoration through natural regeneration of c.50km× of degraded land. We sampled nine fields within three distinct restoration age-categories (5, 15 and 60 years post-arable), and from three fields within the adjacent, undrained NNR, to determine (1) changes in seed bank composition across the study area, (2) relationships between restoration age, the seed bank and standing vegetation, and (3) the contribution of the seed bank to restoring wetland vegetation. Historic arable management contributed to a latent 'churned' effect in the seed bank of the youngest two age-categories, with associated and significant differences in species functional traits across the study area. Plants associated with the NNR were absent from all restoration categories. Seed bank species constant to all ages exhibited a bias for moderate to high Ellenberg F (moisture) values, persistent seed banks, and lateral vegetative spread. Relatively short (c.6 years) periods of drainage and ploughing impact heavily upon seed bank diversity and soils, resulting in an inability to restore pre-drainage vegetation, even after decades of restoration adjacent to intact, species-rich habitat. However, a seed bank of highly degraded fields can contribute towards the creation of novel wetland vegetation assemblages over time and under suitable environmental conditions.

136 **Restoration of fen grasslands by mulching – experriments on alkaline fens in Slovakia**

Dobromil Galvánek, Tomáš Dražil, Daniel Dítě Rudolf Šoltés Poprad, Anna Leskovjanská Spišská Nová Ves, Marta Mutňanová, Ján Ripka

First results of mulching experiment carried out on alkaline fen grasslands in northern Slovakia are presented. The aim of our experiment is to test mulching as a technique for restoration of fen grasslands overgrown by trees and shrubs and possible technique for their long-term management. The experiment was established in in 3 different degradation types of fen grasslands: in fen grassland overgrown by young willows (W), in fen grassland dominated by reed (R) and in relatively well-preserved fen grassland invaded by young birches (B). First year (2007), all plots were only mulched in the summer and from second year (2008) the mulch is removed from the half of the plots after mulching. Changes of species composition after mulching in 2007 were tested by RDA. Impact of mulch removal from 2008 was tested by RDA as well. Significant changes of species composition in all three parts (W, R, B) were observed after restoration mulching, the highest explained varibility by TIME factor was in part W (26,9%) and in part B (26,6%). Fen indicator species react to the treatment differently, some reactions were positive, some negative. Negative reactions may be caused by the fact, the amount of mulch from cut willlows or birches was enormous and limited the growth of some species. Mulch removal from second year of the experiment has no significant effectso far on the vegetation comparing to the unremoved parts.

137 **Cutaway bog rehabilitation and habitat creation in Ireland**

Catherine Farrell

Bord na Móna (the Irish peat company) is a significant land owner in Ireland with up to 80,000ha of peatlands and associated lands largely located in the Irish Midlands. Since the 1990s, enhancement of biodiversity has become closely linked with the cutaway bogs as re-colonisation of the bogs following cessation of industrial scale peat production leads to establishment of a mosaic of habitats and species. These habitats and landscapes are viewed as central to cutaway bog rehabilitation as former peat production areas are stabilised due to vegetation establishment while in turn sustainable wildlife habitats and rich areas of biodiversity are created. Key to planning the future landscape of the cutaway bogs is establishing a baseline ecological survey of the areas that are considered cutaway to date. The main habitats emerging are wetlands (open water, poor fen, reed-swamp, wet grassland and marsh) and woodland habitats (willow and birch scrub tending towards bog woodland habitat with margins of dry grassland). These 'new habitats' provide connectivity between existing smaller and isolated wetland and woodland areas as well as creating larger corridors between more extensive wetland sites. There are also considerable numbers of birds and other wildlife of nature conservation value using the re-colonised cutaway bogs and projects are being initiated to further enhance habitats and to increase species diversity. Apart from nature conservation management options for cutaway bogs, there are also commercial after-use options, such as wind farms. Integrated future land-use planning will be required to accommodate biodiversity and potentially 'green' commercial developments.

138 **The spontaneous re-vegetation of the milled and block-cut peatlands on the example of Rabivere and Viru bogs in northern Estonia**

Edgar Karofeld, Triin Triisberg, Jaanus Paal

The spontaneous re-vegetation of mined peatlands is a chaotic and time-consuming process because of the destroyed plant cover and diaspores and unfavorable environmental conditions. We aimed to determine the regularities in the re-vegetation of the block-cut peat extraction area, milled peat fields and milled fertilized peat fields in two bogs in N Estonia, in order to clarify the main factors influencing their re-vegetation for the restoration of abandoned extracted peatlands. The smaller area favors plants spreading from neighboring areas, and the re-vegetation of block-cut areas, mostly by typical bog species, is relatively fast and successive. In milled peat fields it is much slower (after 25 years the total coverage < 20 %) and less regular, because of the greater area and difficulties for plants to spread, fluctuating unfavorable growth conditions etc. Re-vegetation starts in the ditches and peat field edges bordering with roads, bog or forest. The main factors that influence

the re-vegetation of milled peat fields are microtopography and former treatment. The single time fertilization 25 years ago in Rabivere peatland has not had a long-lasting effect on the total number of plant species, but the mean number of species in sample squares and plant coverage increased (80 %), leading to the faster re-vegetation of the fertilized milled peat fields. The sewing of *Oxycoccus palustris* seeds or even the planting of *Rubus chamaemorus* did not have the desired effect without improving plants' growth conditions on milled peatlands. Based on the regularities in the spontaneous re-vegetation of extracted peatlands, recommendations for their better restoration can be offered.

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Planning for restoration of disturbed peatlands in Australia – a triage approach incorporating resilience assessments, peat profiling and hydrological modelling

Anita Wild

Alpine peatlands are uncommon in Australia and listed as endangered due to their limited distribution and threats from environmental factors such as fire and alterations in hydrology. Whilst most peatlands in Victoria are now protected within the conservation reserve system, many have been disturbed in the past by hydro-electricity and road infrastructure developments or diversion of catchment flows; many have been burnt by wildfires in either 2003 or 2006. Parks Victoria initiated a project to investigate options for restoration of peatlands impacted by major hydrological disturbance. The resilience of twenty-six peatlands was assessed based on the physical characteristics of the sites at a point in time. Characteristics that were investigated included the extent, pattern and state of the vegetation and the presence of 'keystone' species such as *Sphagnum* spp. Other variables that were assessed included the depth, infiltration and moisture holding capacity, and the extent, structure and current state of the peat substrate. The feasibility and reliability of rewetting disturbed peatlands was determined using surface flow measurements in autumn, and inferred ground water and catchment characteristics from a digital elevation model. These were interpolated into mass balance models approximating the water availability at the site and incorporated into predictive models of catchment yields under three future climate change scenarios: dry, medium and wet. These different hydrological scenarios showed that many of the disturbed peatlands are at risk of desiccation in the long term and that restoration efforts may not be sustainable under the medium or dry scenarios. This lack of long-term water availability, low resilience and existing impacts from fire indicates that many may already be in transition towards a dryland state. Under a triage approach, restoration efforts would be better aimed at those peatlands where restoration is more likely to be successful.

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The swamp thing; biogeochemical drivers of fen restoration

Leon P.M. Lamers, Jeroen J.M. Geurts, José M.H. van Diggelen, Esther C.H.E.T. Lucassen, Alfons J.P. Smolders, Jan G.M. Roelofs

At a global scale, wetlands including fens suffer from eutrophication, desiccation and climatic change as a result of anthropogenic influence. Their ecological rehabilitation has long been based on trial and error. We are, however, convinced that knowledge of the biogeochemical drivers of intact and biodiverse fens, and of their successful restoration is vital in order to prevent costly operations with an unpredictable outcome. The outcome of restoration can be forecasted and choices should therefore be based on the actual restoration potential of an area rather than on its historical context. This approach requires information on causal relations and therefore experiments at different scales are of pivotal importance. The present paper will show that successful restoration of fens calls for interdisciplinary experimental research in which ecology, hydrology, microbiology and geochemistry merge into a system-ecological approach.

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Biogeochemistry, decline and restoration of metallophyte vegetation in floodplain grasslands

Esther C.H.E.T. Lucassen, Jan G.M. Roelofs

On a global scale, metallophyte vegetation types are increasingly under threat of extinction. The endemic metallophyte vegetation in floodplain grasslands in the Netherlands has almost completely been replaced by grasses since the first half of the previous century. Therefore, actions towards conservation and restoration are taken nowadays. Field investigations indicated that the

remaining metallophytes only occurred on acidic floodplain soils with a relatively high Zn availability (total Zn > 40 µmol/g and Zn/Ca > 0.8) in combination with low phosphate availability (Olsen-P << 1250 µmol/kg) in the soil. Several laboratory experiments confirmed that metal and nutritional changes in the soil were driver factors for the shift in vegetation. The results indicate that high phosphate availability and alkalinity in the soil, due to intensification of agricultural practices and shut down of the Belgian metal industry, have led to the replacement of the endemic metallophyte vegetation. Based on this knowledge, small-scale restoration experiments were carried out in which the alkaline and phosphate enriched top soil layer (0-30 cm) was removed in order to restore soil conditions suitable for growth of metallophytes. Results show that re-growth of competitive grasses was nil and that metallophytes could easily establish, maintain, reproduce and expand in time during the first four years. Due to these positive results, top-soil removal has recently been applied on a large scale.

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An ecophysiological view on the importance of carbon dioxide in the re-establishment of Sphagnum: a case study

Wouter Patberg, Gert Jan Baaijens, Fons Smolders, Ab Grootjans, Theo Elzenga

In this case study the importance of carbon dioxide availability for the re-establishment of Sphagnum and bog development is demonstrated. The study area is the Dwingelerveld, a nature reserve in the Netherlands with several small damaged peat bogs scattered throughout the area. Restoration measures resulted in very large developmental differences between bogs; some bogs developed markedly well, whereas others did not. Water chemistry analysis revealed that during development the successful bogs received carbon-rich groundwater, resulting in higher carbon dioxide availability in the bogs that stimulated the re-establishment of Sphagnum mosses. Essential for successful bog restoration is the re-establishment of Sphagnum mosses. High carbon dioxide concentrations are known to stimulate the growth of (aquatic) Sphagnum mosses. Recently the physiological background of the high carbon dioxide requirement for successful Sphagnum growth has been shown. In well developed Sphagnum bogs high amounts of carbon dioxide produced by (an) aerobic decomposition processes in the peat layer has been shown to be an important carbon source for Sphagnum. In bogs that were diminished by peat cuttings this carbon source is often strongly reduced. The limited re-establishment of Sphagnum species in bog restoration projects has been suggested to be due to low carbon dioxide availability. The presented findings indicate that indeed high carbon dioxide availability is a pre-requisite for the re-establishment of Sphagnum in peat bog restoration projects. And that for the successful re-establishment of (aquatic) Sphagnum species, carbon-rich groundwater can substitute for the peat layer as a source of carbon dioxide.

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Ecological restoration of agricultural areas: experiences from the Netherlands

Alfons J.P. Smolders, Esther C.H.E.T. Lucassen, Mark van Mullekom, Hilde B.M. Tomassen, Emiel Brouwer, Jan G.M. Roelofs

In the Netherlands, more and more agricultural land is becoming available for ecological restoration projects. A low availability of nutrients, phosphorous (P) in particular, seems to be a prerequisite for long-term co-existence of plant species. However, because agricultural lands have been heavily fertilized for decades, nutrient levels in the top-soils tend to be extremely high. Calculations reveal that it may take many decades before P becomes limiting as a result of a mowing regime (harvesting of the vegetation and removal of the biomass from the site). Therefore, the restoration of a diverse and species-rich vegetation on former agricultural lands, will in most cases not be possible within a reasonable timespan without removal of the nutrient enriched topsoil. Although top soil removal, is almost always a relatively expensive measure, it may in the long term be cheaper than keeping up a mowing regime for decades. If removal of the top-soil is considered to create P-limitation, it is very important to study P availability in depth profiles in order to establish the amount of soil that has to be removed. In many cases liming can be an important additional measure to prevent acidification of the soil after topsoil removal, and to prevent mobilization of P to groundwater or surface water. Although in exceptional cases a biodiverse vegetation may develop without species being re-introduced, in most cases, re-introduction of species will deserve serious consideration. Next, hydrology and groundwater chemistry play an imminent role in the vegetation development on former agricultural lands.

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Restoration of softwater lakes based on carbon and phosphorus limitation

Jan G.M. Roelofs, Emiel Brouwer

Acidification and eutrophication have caused a strong decline of the vegetation in many, carbon limited, softwater lakes in Western Europe. Restoration measures such as sludge removal, controlled inlet of alkaline water and catchment liming proved successful on the short term; on many sites softwater vegetation returned. Twenty years after restoration, we studied the vegetation, water quality and sediment quality on a selection of restoration sites. We compared the results with a set of reference lakes. Due to a strong reduction in atmospheric deposition, the ammonium and sulphate concentrations in the water layer of all lakes were reduced by more than 50% and pH had slightly increased. In reference lakes, there was almost no recovery of the vegetation, and a thick sludge layer was present. Most restored lakes were further colonized by characteristic vegetation and almost no renewed sludge accumulation had occurred. Ortho-phosphate levels and carbon dioxide levels were still very low (on average < 0.2 and < 100 micromol l-1 respectively). In acidified lakes, long-term restoration of softwater vegetation was only observed if additional measures against acidification had been applied. However, we identified several factors causing renewed decline of softwater vegetation: the input of nutrients from agricultural land by waterfowl, insufficient water level fluctuation due to water conservation measures, and competition with exotic plant species. We will present data on water and sediment quality and vegetation, and will discuss the mechanisms behind the observed changes.

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Soil-plants relations diversity in extreme ecosystems and implications for restoration: the case of the cupriferous vegetation, in Katanga, DRC

Maxime Seleck, Julie Lebrun, Arielle Guillaume, Julien Piqueray, Grégory Mahy

Katangan copper and cobalt hills in the D. R. Congo are isolated ecosystems on highly toxics substrates (>10.000 ppm Cu, with strongly marked gradients). As a result, those outcrops host singular vegetal communities – with a diversity of specialized metallophytes species – related to soil metals content. Recent resumption of mining activities in the area threatens those ecosystems. To allow the restoration of those communities a fine understanding of the relationship maintained with the edaphic factors is required, as well as a characterization of the intra and inter sites variation. Three outcrops have been studied on the basis of a systematic grid, following the a priori trace elements gradient. In $1m^2$ quadrats, a composite soil sample (0-15 cm depth) was taken and the cover (%) of each species of vascular plants was recorded. Soils were analyzed for pH, C, N, and bioavailables Cu, Co, Zn, Mn, Fe, K, Mg, Ca and P. The cluster analysis and Canonical Correspondence Analysis show that different sites present different soil conditions and vegetation. Concentrations in Cu are an important explicative factor of the flora's variation but gradients in others edaphic parameters (pH, Mg, Mn, K, Ca) appear to be essential. However, parameters explaining the diversity of communities vary from one site to another indicating a great diversity of those ecosystems and the need to develop restoration strategies relevant for each site.

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Biodiversity conservation and mining: a study case of ecosystem reconstruction in Katanga (DRC)

Julie Lebrun, Ezana Semereab, Audrey Rensonnet, Guylain Handjila, François Malaisse, Grégory Mahy

The Katangan copper-cobalt deposits (Democratic Republic of Congo) are part of the Central African Copperbelt, one of the world's greatest metallogenic province. The ore comes to the surface in a series of hills isolated in the miombo woodland. These unique ecosystems present high metals concentration levels where a specific vegetation develops. Flora comprises more than 600 species from which 30 are endemics. Due to the recent revival of mining activities in the region, copper plant communities of Katanga and their associated flora are now critically threatened. Tenke Fungurume Mining sarl (TFM), an important mining company operating in Katanga, has developed a Biological Diversity Action Plan (BDAP) to conserve copper-cobalt flora and mitigate potential species extinction risk. One of the most original BDAP tasks is an ecosystem reconstruction experiment that should preserve plant communities representative of the diversity found on the exploited hill and to provide the plant material for further post-exploitation restoration. From December

2007 to April 2009, full vegetation blocks were translocated with their soil mat on an adequate mineral substrate of 1500m^2. Since 2008, the artificial ecosystem is monitored every year. Three communities were successfully recreated. A total of 125 species were found in the ecosystem which represents half of the original species richness. Population size decreased for only 12 out of 32 surveyed species. This first experience shows that ecosystem reconstruction is successful and may be used as a strategy to conserve copper-cobalt plant communities in their habitat.

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Restoration of nature by the post mining land use strategies, suggestions for Kure Copper Mine

Ayse Kalayci

It is an obvious fact that mining has great importance on the industrial and economical development of a country. But when the mining activities are done without considering the natural environment, it can be a threat for the ecological system of that region. To consider all the effects of the mining to the environment, and to plan the post mining land use type for that area is vital to sustain the natural resources and transfer them to the next generations. Kure Copper Mine is located in Turkey, in the city of Kastamonu. It is located very close to Kure Mountains National Park, one of the 100 hot spots adopted by WWF because of being one of the prior ecological zones in terms of nature conservation at a global level. The purpose of this study is to evaluate the possible effects of the Kure Copper Mine to the region's ecological system, and to offer land use strategies for the restoration of the area in the post mining period which could be useful to re(create) the damaged nature.

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May rare metallophytes benefit from disturbed soils following mining activity ?

Michel-Pierre Faucon, Ingrid Parmentier, Grégory Mahy, Gilles Colinet, Michel Ngongo Luhembwe, Pierre Meerts

Cuprophytes are plants that mostly occur on Cu-rich soil. In South Central Africa, these species are threatened by intensive mining exploitation destroying their habitats. *Crepidorhopalon tenuis* (Scrophulariaceae) is a tiny annual cuprophyte endemic to the Zambesian center of endemism and is particularly abundant in the Lubumbashi area. We investigate here the ecological niche of *C. tenuis* through the analyses of its abundance and distribution in relation to soil factors, plant community composition, and anthropogenic perturbations. Soil and vegetation data were collected in seven sites (five metalliferous and two nonmetalliferous). The current study shows that *C. tenuis* has its ecological optimum on copper-rich soil and can be referred to as an elective pseudometallophyte. This species is rare in primary steppic savanna on natural metalliferous soil. Its frequency and abundance peak in pioneer communities on bare soil. In particular, the species showed a surprising ecological plasticity as it was able to benefit from anthropogenic disturbance and to colonize the large areas of bare, contaminated soil left over by mining activities. Our results strongly suggest that *C. tenuis* was a very rare species in natural metalliferous communities, restricted to patchy areas of open soil in steppic savanna. Recent anthropogenic habitats may have conservation value for some rare metallophytes with colonizing traits and low competitive ability.

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Restoration of mining sites in New Caledonia: history and development of new technics.

Adrien Wulff, Laurent L'Huillier, Jacques Rabier, Bruno Fogliani

New Caledonia is a French overseas authority in the Pacific ocean; 1/3 of its emerged lands is covered by peridotite, an ultramafic rock which contains nickel, representing up to 20 to 30% of the worldwide resources of this metal. The history of mining in New Caledonia starts in 1873 by the establishment of underground galleries having nearly no impact on the environment. Actually the mining companies extract the ore in open mines and the impacts on terrestrial and marine ecosystems are quiet consequent. New Caledonia's flora (approx 3300 species, highest endemic richness of the world) is directly threatened by these activities and local stakeholders are aiming to develop methods in order to restore the original vegetation cover. The first trial of revegetation started in 1971 using exotic species. Most of these experiments didn't succeed except for 2 indigenous species, *Acacia spirorbis* and *Casuarina collina* which showed a good development but had the inconvenient to have a gregarious behavior, blocking the initiation of plant successions.

New methods lean on native ultramafic vegetation considering only these plants can survive on these soils and lead to a sustainable restoration. Actually, more than 80 pioneer species were studied, most of them are orthodox seeds (90%), some families don't present any dormancy (Myrtaceae, Proteaceae, Casuarinaceae, Cunoniaceae), some presenting physical dormancy (Rhamnaceae, Rubiaceae), morphological and/or physiological dormancy (Dilleniaceae). Studies on germination, seed ecophysiology and topsoils are one of the major advancement for the restoration of ultramafic lands in New Caledonia.

150 **Soil seed bank of calamine sites in Belgium: what could be learned for original metallophytes communities restoration?**

Jean-philippe Bizoux, Grégory Mahy

Metalliferous sites often host rare, ecologically endemic taxa adapted to high levels of heavy metals in soils. In Belgium, these sites correspond to Calamine sites. They are often considered as waste ground dangerous for human health and public authorities are inclined to promote site remediation by fertilization, ground supply or removal, building ... In the present study, we analysed the seed bank of two ancient calamine sites in order to precise strategies for restoration of calamine original communities by top soil removal and perturbation. Composite soil samples were taken in 5 facies in two sites corresponding to different association. Cores were divided in three layers: litter, 0-5 cm, 5-10 cm. The total number of taxa was 24 taxa at Theux and 15 at Schmalgraf. The most abundant species (68%) are *Agrostis capillaries* and *Viola calaminaria*. Seed bank composition appeared different between facies except for three species. The seed bank was dominated by pseudo metallophytes species in Schmalgraf and by metallophytes or other species in Theux. The majority of the species didn't present significant difference of number of seed between the three layers, except seven species (*A. capillaries, V. calaminaria, Silene vulgaris, Minuertia verna*,...) with significant lower number of seed in the layer 5-10 cm. Our result showed that soil seed bank composition reflect well vegetation communities of the two sites. In addition, because pseudo-metallophyte species as *Agrostis capillaries* dominated seed bank when they were present in the vegetation, soil removal must be used with parsimony to restore original communities.

151 **Introduction note: current situation in the French Alps and opening questions**

Francis Isselin-Nondedeu, Stéphanie Gaucherand

152 **The use of natural processes for the restoration of drastically disturbed upper elevation sites**

David Polster

Increasing disturbance of high elevation sites through resource and recreational developments dictates that effective strategies for restoration be established. Identification of the filters that limit the establishment of plants is the first step in defining restoration strategies. Common filters include lack of plant-available moisture; compaction of substrates; ravelling over-steepened slopes; low nutrients and potentially adverse chemical composition. Moisture in upper elevation sites may come in the form of brief, heavy rainfall or rapid snow melt with strong drying winds reducing the available moisture, leaving insufficient surface moisture for wind-blown seeds to establish and grow. Many human-caused disturbances result in compaction of soil materials, preventing seedlings from establishing or stunting the growth of older plants. Steep slopes are common in upper elevation areas. Human activities on these steep natural slopes may result in creation of continually ravelling slopes where vegetation establishment is difficult if not impossible. When upper elevation sites are disturbed, the delicate web nutrient cycling systems may be lost. Re-establishment of these systems can be difficult and slow. Natural solutions (reference ecosystems) to these limitations can be found in undisturbed areas. These solutions can be used as models for the design of recovery strategies. This paper presents the application of natural processes for the restoration of severely disturbed upper elevation sites.

153 **Biodiversity and erosion control: restoration of disturbed alpine sites**

Christian Rixen, Mandy Pohl

Alpine plant diversity and species identity are likely to be key parameters to stabilize soil in steep alpine terrain. Although frequently discussed, this hypothesis has rarely been tested explicitly. We tested in several experiments the effects of alpine plants on the soil aggregate stability and on surface erosion at disturbed Swiss alpine sites where it is particularly important to prevent soil erosion. 1. The number of plant species was positively correlated with soil aggregate stability, and species number was a better explanatory variable than any other variable related to soil or vegetation. Higher plant diversity was associated with a higher number of different root types. 2. Rainfall simulation experiments demonstrated that surface erosion was strongly driven by the percent of vegetation cover. At a vegetation cover of approx. 60%, an increase in plant diversity significantly reduced surface erosion. 3. Belowground traits of alpine plant species showed large differences e.g. in root length, horizontal and vertical spread and root tensile strength, illustrating that below-ground diversity of functional root types is crucial for slope stability. Our experiments demonstrate a positive relationship between species diversity or functional type diversity and soil physical properties. Not only percent vegetation cover is crucial to prevent soil erosion but also the diversity of plant growth forms. A high diversity of belowground growth forms is the most likely mechanism for the positive effect of plant diversity on soil properties.

154 **Critical ecological processes for peatland restoration in changing climate**

Alexandre Buttler, Luca Bragazza, Andy Siegenthale

Peatlands are under stress and various factors threaten their functional integrity. Many of the peatlands have been destroyed in the past and their conservation has become an important issue. Much effort has been put on restoration measurements, aiming at bringing back through adequate water management the typical vegetation (e.g. *Sphagnum* mosses) and the carbon sequestrating acrotelm/catotelm system. Nevertheless, with global changes, factors such as nitrogen deposition, increased atmospheric CO_2 concentration, increased temperature and drought, might change the outcome of traditional restoration measures. In this paper we will review some processes implying above-belowground relationship and consider alternatives for the management of these ecosystems.

155 **Towards the development of an integrative strategy for the restoration of degraded high mountain ecosystems**

Francisco A. Comín, José M. Nicolau

The restoration of high mountain ecosystems may require specific approaches and techniques as they are regulated by extreme environmental conditions. Because of intensive social changes mountain ecosystems also require a specific strategy to integrate the restoration actions in a socio-economic framework and get more success. It is necessary, first, to know if lost or degraded socio-economic structures can be restored and what is the cost/benefit for it. Second, it is necessary to know to what extent new socio-economic structures and processes contribute to a functional ecosystem which integrates the so called sustainable development. Case studies from the Spanish Pyrennees and South Iberian Range offer interesting contrasts which are analyzed under the scientific-technical, social and economic perspectives.

156 **Riparian vegetation metrics as tools for guiding ecological restoration in riverscapes**

Francisca Aguiar, Teresa Ferreira, Rosário Fernandes

Riparian ecosystems are recognized amongst the most degraded ecosystems worldwide, and the need to enhance these systems towards its natural functioning has motivated numerous restoration efforts. However, restoration decisions often lack the scientific knowledge of the ecosystems' dynamics and the prevailing cross-interactions with the riverine landscape, as well as the knowledge of the desired ultimate riparian communities. There is still a need to develop successful methodologies to identify restoration goals, to characterize previous ecological quality condition and to monitor and evaluate the success of the restoration efforts. We suggest a stepwise methodology over spatial scales, from the landscape to local

scale levels. Description and quantification of spatial patterns of riparian vegetation using high resolution imagery improves awareness of riparian structural-functional associations, inasmuch as spatial patterns can influence ecological processes affected by riparian patch configuration, connectivity, and distribution. Therefore, imagery and riparian patches will be used to identify segments to be restored. At a lower scale, field data allow the quantification of the ecological condition through riparian vegetation metrics. The degraded segments are characterized by a structured-based riparian index identifying features to be restored, as well as to evaluate the efficacy of the restoration. Such features would include for example complexity of the riparian strata, plant diversity and tree cover. Case-studies from Portuguese rivers are presented and discussed.

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River restoration of small lowland streams: evaluation of the success for macrofauna and fish

Bram Van Ballaer, Chris Van Liefferinge, Olivier Beauchard, Eric de Deckere, Patrick Meire

In Flanders (Belgium) many river restoration projects are carried out in view of the European Habitat Directive (92/43/EEC) and Water Framework Directive (2000/60/EC). Even though the river managers have high ambitions and spend a great amount of time and money on these works, the follow up is mostly very meagre. At several sites evaluation of different restoration measures was carried out, to assess their effect on the fish and macro-invertebrate communities. Results show that small measures like eco-engineered bank reinforcement, pond connections and reconnecting meanders all have an effect on the presence of the macrofauna. Both increases in target species were seen, but also shifts in invertebrate populations. When comparing several measures in streams with a different degree of "naturalness" (eg. natural banks, willow branch reinforcement and gabion baskets), a clear shift in species was found. Not only the abundance of specific macro-invertebrates changed, but also the dominant traits of the total population. In the most vulnerable streams pre-evaluation now takes place, including assessing the current population (*Lampetra planeri* Bloch, *Lota lota* L. and *Squalius cephalus* L.), to assess the current habitat suitability and create a basic habitat dataset for post-restoration analysis of changes in habitat and fish population. This is an essential step to get a fully monitored restoration project, especially where endangered species are concerned.

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Individuation of fluvial areas needing restoration through the analysis of a target species, the Eurasian otter (*Lutra lutra* L.)

Maria Teresa Carone, Tiziana Simoniello, Anna Loy, Maria Laura Carranza

Fluvial habitats are key ecosystems in maintaining landscape biodiversity for their role as corridors and filtering organisms. Since they are functionally linked to the surrounding territory, the health of riverine fauna populations depends on river/landscape equilibrium. Thus, due to the anthropic pressures that in last decades have damaged many fluvial environments, the identifying of scientifically based management strategies devoted to restore the river environmental sustainability has become urgent. Efficient restoration strategies may be valuable performed by analyzing the environmental needs of target species whose survival depends on the entire basin conservation status, e.g. the Eurasian otter (*Lutra lutra*). In this work we use a Habitat Suitability model (Ecological Niche Factor Analysis) for the Otter to evaluate the river basin functionality and to identify sectors needing restoration measures. The input data have been land covers (from LANDSAT-TM images), a DEM and a derived SLOPE map; the model was performed in the Otter core area of its Italian range, within a riparian buffer of 300 m, producing a HS final map, categorized into three levels (unsuitable, suitable, optimal). The unsuitable areas represent unbalanced sites in term of ecological equilibrium for Otter habitats and can be used to locate restoration interventions having a general character as well as to refine the analysis for specific restoration activities. In conclusion, the combined use of HS models/satellite data represents a helpful support for management policies efficiently suitable to improve the whole river functionality and to recreate balanced habitats for an endangered species as the Eurasian otter.

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Protocole d'éradication de l'écrevisse de Californie par stérilisation mécanique des mâles

Théo Duperray, Aurélien Besnard

Pacifastacus leniusculus ne cesse d'accroitre sont aire de répartition (plus ou moins naturellement) depuis son introduction il y a une quarantaine d'année en France, c'est une des plus importante menace pour nos écrevisses indigènes et notamment Austropotamobius pallipes *qu'elle concurrence et qu'elle contamine par l'aphanomycose. Devant ce constat et l'absence de solutions existantes T. DUPERRAY (puis sa société "Saules et Eaux") ont développé un protocole d'éradication par stérilisation (non chimique) des mâles pour les sites à forts enjeux. Capture d'un maximum d'individus, destruction des femelles et des petits mâles (non matures), remise à l'eau des gros mâles après stérilisation. Ceux-ci vont rechercher les femelles et s'accoupler avec elles, annulant ainsi leurs chances de reproduction pour l'année à venir. Des essais sont menés en bassins depuis 5 ans et en rivière depuis 2 ans. Les essais en cours sont très prometteurs : en bassins la probabilité de procréation pour une femelle et de 33% avec mâle témoin et 4.4% avec mâle stérilisé. Une expérimentation en milieu naturel avec le Parc National des Cévennes et encadrement scientifique du CNRS est lancée depuis 2009 sur un ruisseau ou persistent les deux espèces avec estimation (par CMR) des tailles des deux populations deux fois par an et début de la stérilisation en 2010 avec suivi des Pacifastacus par puces électroniques implantées, protocole sur 4 ans.*

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Ecologie et perspectives de restauration et de valorisation d'écosystèmes envahis par des Ludwigia sp. : Etat de l'Art

Imen Smida, Jean Le Petit, Claude Charpy-Roubaud

La colonisation des plans d'eaux par les Ludwigia *spp., hydrophytes amphibies invasives, provoque une dystrophie des écosystèmes aquatiques, un effondrement de la biodiversité des taxons indigènes et la mort des macro-invertébrés et des poissons. Leur développement exubérant entraîne donc la destruction des habitats, provoquant d'importantes nuisances écologiques, et également socio-économiques par leurs impacts sur les activités humaines, qu'elles soient touristiques ou professionnelles (pêche, chasse, agriculture, industries). L'invasion des milieux par les herbiers est très rapide et s'étend peu à peu sur tout le territoire français et les pays avoisinants. La problématique est préoccupante et divers acteurs s'investissent à résoudre les nuisances engendrées par l'envahissement des herbiers de* Ludwigia *sp. : Ministères, Administration de Région, chercheurs, diverses Associations, professionnels, touristes. Un état des lieux est dressé sur la biogéographie des* Ludwigia *spp., les connaissances sur l'écologie de cette plante, l'impact des herbiers sur la biodiversité des biotopes et, au-delà, celle des écosystèmes. Le réel impact des recherches développées et des différents moyens mis en œuvre actuellement, de même que ceux prospectés, pour limiter l'expansion de ce fléau et pour restaurer les milieux envahis sont analysés. Par ailleurs, les prospectives de valorisation biotechnologique de cette plante à des fins de développement durable sont également abordées, de même que les bénéfices socio-économiques qui en résulteraient.*

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Perspectives in restoration of biodiversity and ecosystem services in Mediterranean agricultural landscapes

José Mª Rey Benayas

Ecological restoration is widely used to reverse the environmental degradation caused by human activities. A meta-analysis of 89 restoration assessments in a wide range of ecosystem types across the globe indicates that ecological restoration increased provision of biodiversity and ecosystem services by 44% and 25%, respectively. However, values of both remained lower in restored than in intact reference ecosystems. At this global scale, increases in biodiversity and ecosystem service measures following restoration were positively correlated. Cultivation and cropping are major causes of degradation and destruction of natural ecosystems throughout the world, and farmland currently extends on more than 40% of the land's surface. 'Passive restoration', whereby abandoned agricultural land undergoes secondary succession, is often slow owing to biotic and abiotic limitations. 'Active restoration' by planting trees can be very expensive if large areas are to be restored. We suggest "woodland islets" as an alternative approach to designing ecological restoration in extensive agricultural landscapes, particularly in low productivity environments. This

approach allows conciliate farmland production, conservation of values linked to cultural landscapes, enhancement of biodiversity and provision of a range of ecosystem services. If "further research is needed", "action is desperately needed". Thus, we are implementing demonstrative restoration projects of this conciliation in Mediterranean areas. Restoration actions are accompanied by a variety of social and educational values including citizen science.

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An afforestation activity by Mediterranean shrubs in Sardinia

Giovanbattista de Dato, Paolo De Angelis, Riccardo Valentini

In order to restore degraded and abandoned soils in the arid and semi-arid regions of the Mediterranean basin, planting indigenous shrubs might be an efficient tool, contributing to combat desertification, but also to increase carbon sinks. The aims of this work were to show the results of plant survival and biomass growth three years after an afforestation activity by allochtonous shrub species, trying to explain the role of different densities, specific compositions and plant dimensions, and the role of fauna on plant establishment. The area is located in North West Sardinia, and is characterized by a Mediterranean climate. The revegetation was set up in February 2006, planting local species (*Juniperus phoenicea*, *Pistacia lentiscus* and *Rosmarinus officinalis*). Three densities and three specific compositions (monospecific plots with *P. lentiscus*, monospecific plots with *J. phoenicea* and mixed plots with the three cited species) were combined. All the area was fenced. Three plots of the total were additionally fenced. Plant growth and root taking were periodically monitored over the whole period. Plant mortality showed a high patchiness. The highest survival rates were observed in the fenced plots. Densities did not bring any effect on survival rates. Mixed plots seemed to give a better success of the plantation, because allowed the more xeric species to grow. Grazing exclusion and plant mixing would bring benefits to the success of shrubland restoration in abandoned soils in Mediterranean areas characterized by arid and semi-arid climatic conditions. These data on the initial conditions and recurrent monitorings will be basic for evaluating in the long term the potential positive effects of the plantation.

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Analysis of the Estonian forest conservation area network

Henn Korjus, Diana Laarmann, Janely Leemets

In 1997 the Estonian Forest Policy set an objective to increase the area of strictly protected forests to 4% as minimum from total forest area in order to expand the area of old-growth under protection, to improve the ecosystem coverage of conservation areas and to establish large conservation sites. Inventory of forests was carried out on existing and possible new conservation areas within the Estonian Forest Conservation Area Network project (EFCAN) in 1999-2001. In 2003 the Estonian Forestry Development Programme set more ambitious objective that area of strictly protected forests should increase at least to 10% from total forest area before 2010. EFCAN project had remarkable results. The share of strictly protected forests has increased to 7.8% of total forest area by 2009 and the network of conservation areas is quite well covering all forest ecosystems in Estonia. Several selected areas are still not protected for different reasons. These areas should still be considered for protection as the areas may lose their conservation value. Several forest types (meso-eutrophic, eutrophic boreo-nemoral and eutrophic paludifying forests) should have larger area for conservation and large disturbance areas (wind damage, forest fire) should be also included into the network. The gap between theoretical need and actual conservation is 64,200 ha. EFCAN inventory found that forests on conservation areas in Estonia have currently lower nature value than expected, they are mainly previous commercial forests including small patches of old-growth elements. These forests will turn slowly to natural forests if long-term conservation is secured. In certain cases, nature restoration measures may be adequate to speed up this process. Ecological quality of conservation areas was re-assessed on pilot area in 2009. The overall naturalness of the area was remarkably higher than expected. Spatial design of the network was analyzed with GIS methods. Area size, connectivity, patchiness, habitat mosaics were assessed. Ecosystems and habitats are complicated systems for the modeling, therefore mosaic of patches of old-growth forests was assessed visually and only possible dispersal obstacles were identified from the network perspective.

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Analysis of woodland plant and bird community richness along a rural-urban gradient - Opportunities to maintain and restore biodiversity in urban areas

Clémence Gault, Joséphine Pithon, Jeanne Vallet, Véronique Beaujouan, Hervé Daniel

The effect of urbanization on species distribution has been extensively documented, but a main challenge is to better integrate semi-natural habitats in urban planning and management. Urban woodlands are often considered as emblematic habitats for the restoration of nature in cities and for providing ecosystems services. The objective of this work is (1) to compare the richness of plant and bird communities of woodlands along an urban-rural gradient and (2) to assess the influence of dominant vegetation types and their distribution on exotic, ruderal or forest plant richness. The dominant vegetation types and their composition are related to management and characterized by the understory vegetation (dominated by brambles, grasses, ivy...). Fifty sites (of an average surface of 1.5 ha) were selected in the urban areas of Angers and Nantes. At each site, bird communities were studied using point counts, and floristic data were collected within each understory vegetation type. The rural sites showed a lower specific richness for both plant and bird communities than the urban ones. This work identified the relative contribution of each understory vegetation type to exotic, ruderal and forest plant richness. It demonstrated a large influence of the vegetation type distribution on the composition of plant communities. These vegetation types are closely related to management of these spaces, thus, results can provide important implications for the management of urban woodlands.

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Can wet heaths dominated by *Erica tetralix* be restored from a species-poor abandoned meadow?

Rainer Buchwald

In NW-Germany we studied the floristic composition of an *Erica tetralix* heath that had been restored by hay transfer after soil removal on an abandoned, species-poor wet meadow dominated by the Soft Rush (*Juncus effusus*). We combined two factors: with/without transfer of cut heath from an adjacent *Ericetum tetralicis*, and with/without removing the stands of *Juncus effusus* after insufficient soil removal; with this we were able to compare four different variants. We found the highest species diversity in the two variants with removal of the Soft Rush, while the best establishment of *Erica tetralix* (and *Calluna vulgaris*) took place in the variant with hay transfer and removal of *J. effusus*. As expected, the highest density of the Soft Rush and lowest species diversity as well as heath abundance were found in the variant without hay transfer and without sufficient soil removal. We conclude that restoration of a typical species-rich *Erica* heath can be made possible only by transfer of cut heath material on open soil without great seed amounts of non-typical plant species like *J. effusus*, *Rumex* spp. or others in the upper soil layer.

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Compensatory measurements associated with the construction of the Breña II dam: infestation level assessment of the woodborers in oak forests from the southern Iberian Peninsula

Ana M. Cárdenas, Patricia Gallardo, Lourdes Moyano, Juan M. Hidalgo

This study is part of a Research Project devoted to assess the incidence of woodborer insects in the oak forests inside the Hornachuelos Natural Park (southern Iberian Peninsula). This area is currently being subjected to the Environmental Recovery Program associated to the construction of the Breña II dam. The most prevalent woodborers in southern Iberian Peninsula are species belonging to the *Cerambyx* Group (*sensu* Soria) (Coleoptera: Cerambycidae) and the jewel beetles *Coraebus florentinus* and *C. undatus* (Coleoptera: Buprestidae). The larvae of these xylophages drill trunks and branches and cause substantial damages and even tree death. The degree of infestation by these insects depends, among other factors, of the ecological state and management type of the terrain. The density of the woody vegetation and shrubs seems to be a decisive factor for the presence of these species which show a lower tendency to colonize disturbed and cleared forest oaks. In the present work, the level and intensity of the woodborer populations was quantified by the number of injuries around the trunk and the top of the trees (holes, galleries and dry branches). Results are obtained after prospecting a total of 2.551 trees of the three species of *Quercus* prevailing in the area and provide information related to the presence and incidence of the woodborers and to the relationships between the density of these insects and the vegetal restoration state (scrub development) in the area.

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Evaluation of restoration potential using transfer of seed-containing plant material in herbaceous layer vegetation of secondary woodland

Susumu Yamada

Application of seed-containing plant material is a successful technique to transfer plant species onto restoration sites. However, this restoration method is almost confined to semi-natural open habitats. We are now planning to recreate secondary woodland with floristically diverse understory vegetation. As the first step, plant material mown from understory vegetation was taken for germination tests to assess the potential ability of propagule recruitment. The study was carried out in a suburban area of Tokyo. The study site is dominated by *Pinus thunbergii*. Herb layer vegetation is composed of shade-tolerant forest floor species, forest margin species and grassland herbs. Composition of seed bank was investigated using seedling emergence method since seed banks have been used to transfer plant species in Japan. After mown in the beginning of November 2008, harvested material was scattered onto soils, which contains no seeds. In results, 60% of the flowering species in above-ground vegetation could germinate in plant material, whereas only 30% of above-ground flora were germinated from plant material. The proportion of grassland species germinated in plant material in relation to the total number of grassland species was high, whereas few forest floor species were germinated from plant material, probably because forest floor species preferred vegetative means of spread and poor regeneration by seeds. Combination of transfer of plant material with other restoration measures, which enables transfer of vegetative organisms would be more suitable to restore herb-layer plant communities in secondary woodlands.

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Forest ecosystem restoration patterns on abandoned oil-shale mining areas in Estonia

Diana Laarmann, Henn Korjus, Allan Sims, Ahto Kangur

Many and various processes occurring in natural succession are powerful for soil development, particularly in its critical biological aspects. These processes should support restoration of ecosystem after degradation to obtain the self-sustaining natural resilience mechanisms and do not require external inputs. There are several indicators of rehabilitation success to determine sustainability of ecosystems established on abandoned mines. Landscape function analysis, vegetation dynamics and habitat complexity assessment on primary successions is often compared with a range of undisturbed, benchmark landscapes. Oil shale mining in Estonia was started in 1916. Opencast mining provides large areas for rehabilitation with primary forest succession. Planned rehabilitation of calcareous detritus for forestry purposes has been carried out on the area 11,330 ha since 1960. Most of the re-cultivated area has been planted with Scots pine. In addition, experimental sites with other species (pine, spruce, larch) and broadleaved tree species (birch, aspen, alder) has been established. In current study the data of experimental research area in Sirgala, north-east Estonia, established in 1968 was used for the growth dynamics and restoration success study on the abandoned opencast oil-shale mining areas. The mean height, diameter and volume development on different tree species and soil type were investigated in four consecutive measurements. More profound soil samplings were made in 1968 and in 2008. The species richness and the site index have shown steady improvement all over the monitoring period.

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Influence of traditional forest management on demographic structure and spatial distribution of *Caesalpinia spinosa*

Irene Cordero, Cristina Herrero-Jáuregui, María Dolores Jiménez, Juan Antonio Delgado, Luis Villegas, Percy Jiménez, Luis Balaguer

Traditional land uses affect forest development, being crucial for understanding the structure and dynamics of tree populations. Ecological restoration must take into account traditional uses in order to reconcile forest management and local development. In this work we study the tara (*Caesalpinia spinosa* (Mol.) Kuntze), a very appreciated legume species for its hydrocolloid and tannin-rich seeds and pods, that has been managed unevenly for many years. Atiquipa forest is a fog oasis surrounded by the Atacama Desert that has suffered massive deforestation. The management of the tara, predominant tree species in the area, could be the key for the restoration activities that are necessary to recover system functionality. We studied four tara populations that represent a wide latitudinal, managemental and

ecological range in Peru. In each location a 0.25 ha experimental plot was selected, where all tara individuals were measured and georreferenced. We studied the diametric structure of each population and their spatial distribution, by means of bivariate and univariate point pattern analysis, using O-ring statistics. Our data show differences in the spatial distribution of trees in the four populations, probably related to their different management regimes. While seedlings were mainly aggregated, adults showed a random distribution, showing some evidences of regular distribution in one population. Two populations showed a bias from the predominantly "J-inverted" shape of the diametric frequency histograms. Past traditional management of the forest leaves noticeable footprints in stand structure and spatial distribution of Caesalpinia spinosa populations. This can orient present management practices and their possible consequences.

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Influence silvoarable agroforestry system on diversity patterns of ground-beetles (Carabidae) and vascular plant in agricultural landscapes

Michel-Pierre Faucon, David Grandgirard, Jean-Didier Clément

Silvoarable Agroforestry Systems (SAS) are the organised cultivation of trees and arable crops on the same parcel. SAS are supposed to address a large range of agro-ecosystem threats (C sequestration, soil erosion, nitrate leaching...) so that they are actually considered as alternative systems to mitigate climate changes and preserve soil and water quality. Besides, SAS seem to have potential contribution to the conservation of biodiversity that should be of advantage to study. Our project is to explore advantages of silvoarable systems for biodiversity conservation by comparing ground-beetles (Carabidae) and vascular plants assemblages among habitats in an agricultural landscape. Objectives are to examine the distribution patterns of ground-beetles and vascular plants communities (1) spatially in relation with the composition and structure of the neighbouring agricultural landscape, (2) temporally, for a given parcel, by comparing ex-ante and ex-post communities sampled. For (1), an intensive field survey will be conducted twice a year to record all ground-beetles and vascular plant species that are present within three 25km^2 agricultural landscapes areas exhibiting a significant proportion of SAS. All records will be georeferenced and incorporated to the GIS. A species list will be compiled for each habitat (α-diversity) to allow for habitats comparison (β-diversity) and determine γ-diversity at landscape level. Besides that, for (2), annual measurement of ground-beetles and vascular plants diversity will perform in a SAS field newly established.

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Macrofauna of the soil, pine bark and topsoil as the bio-indicators of change in forest ecosystem

Maria Marko-Worlowska, Anna Chrzan, Tomasz Laciak

The impact of urban industrial agglomeration of Kraków on the biggest forest complex Niepołomice Primeval Forest situated 20km east of Kraków centre and around 10km southeast of the steelworks in Nowa Huta was analysed. Because of considerable predominance of winds blowing from west and southwest, the forest is influenced by anthropogenic pollutants related to the proximity of the city. What is more, a motorway is build directly to the south part of the forest. The Forest on account with its unique nature and beneficial role it plays for Kraków and surroundings, is designated as Natura 2000 site. Its area should be therefore constantly monitored. Bio-monitoring with physical and chemical methods give the full picture of influence of anthropogenical pollutions on the ecosystem. For the evaluation of the condition of this forest ecosystem, the topsoil and bark (*Pinus sylvestris* L.) and the groups of the pedofauna were used in two areas located in the west and south parts of the forest. The pH and concentration of chosen heavy metals in the bark and topsoil adjoining the trees were analysed. The influence of these contaminants on the density, diversity, biomass and trophic relations in the macrofauna community was examined. Our researches are the part of a comprehensive inventory of natural forest and are carried out, inter alia, also to evaluate the ecological consequences of the motorway being built nearby. As a result of our researches we wanted to gain insight into the ecological consequences of anthropogenic pollution of one of the most important for the sustainable development of Krakow city natural areas.

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Need of restoration in urban boreal forests?

Oili Tarvainen, Rauni Strömmer, Annamari Markkola

Boreal urban forests are becoming more and more fragmented and, at the same time, are exposed to low-level but long-term nitrogen and sulphur deposition. Natural mid-boreal forests are dominated by few tree and shrub species, while herbs and grasses are rare. Soils in mid-boreal forests are rich in ectomycorrhizal (ECM) fungi, forming a symbiotic relationship with forest trees, which is important for the nutrient cycle especially in nutrient-poor ecosystems. Urban forests around Oulu municipality, Northern Finland, were poor in number of fruiting ECM fungal species, but rich in herbs and grasses in the field layer, as compared to rural forests. These differences were thought to result from changes in soil properties. We attempted to improve soil conditions more suitable for fruiting of ECM fungi. However, soil manipulations may result in a risk of nutrient leakage, and a risk of invasion by non-typical plants. Main result of the study are presented and discussed.

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Reintroduction and reinforcement of endangered woody species populations in Tapia woodland, Mount Ibity, Madagascar

Swanni T. Alvarado Romero, Elise Buisson, Harison Rabarison, Charlotte Rajeriarison, Chris Birkinshaw, Porter P. Lowry II

After centuries of environmental degradation, the indigenous vegetation of Madagascar is now highly fragmented, reduced to small islands of relatively intact vegetation drowned in a sea of anthropogenic prairies. This situation has serious implications for the capacity of Madagascar ecosystems to adapt to climate change. Climate change is expected to increase fire intensity and frequency, resulting in increased anthropogenic pressure on remaining patches of indigenous vegetation. Fire is the principal factor of degradation of Tapia woodlands (= savanna type vegetation in which the dominant tree species is *Uapaca bojeri*) on the Mount Ibity, located in the Malagasy Highlands. Six woody species have been studied since March 2010: *Uapaca bojeri, Pachypodium brevicaule, P. densiflorum, Leptolaena bojeriana, Sarcolaena oblongifolia* and *Aphloia theaeformis* in an ex-situ experiment carried out at a plant nursery on 2 soil types (local soil with mycorrhizae and standard soil). Seedlings of various ages are burnt in burn-boxes (beginning July 2010 at 3, 6, 9, 12, 16, 20 and 24 months-old seedlings) to determine what fire interval is an issue for seedling survival and thus recruitment. These seedlings are burnt in 2 different densities of the *Loudetia simplex*, the principal Poaceae in the herbaceous strata. This study on the regeneration of these woody species (seed production, germination, seedling establishment) and seedling survival in response to various fire scenarios will be the basis for possible protocols for the restoration and reinforcement of populations of these endangered species. First results will be discussed.

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Restoring natural communities after pine forestry

Rachael Ord, Deanna Rokich, Shane Turner, Jason Stevens, Kingsley Dixon

This study assesses the potential of returning native Banksia woodlands to regions of Western Australia that have been occupied by *Pinus pinaster* Ait. (Maritime Pine) pine plantations for up to 50 years. It will provide crucial knowledge essential in the continuing development of restoration techniques that maximise the establishment of *Banksia* woodland species, which are increasingly threatened by clearing for urbanisation and mining. This study will extend *Banksia* woodland restoration techniques developed to date and apply them to the old field environment of pine plantations, aiming to determine if the 50 year persistence of pine plantations has affected the soil environment and its ability to sustain the former *Banksia* woodland ecosystem. This will be investigated through topsoil seedbank analyses; physical and chemical soil analyses; seedling establishment, survival, health and physiology trials; combined with an overall ecosystem health analysis utilising invertebrate and mycorrhizal activity sampling. With the State government planning to replace 23, 000 hectares of P. pinaster plantations that occur over the Gnangara Mound to native *Banksia* woodland at a rate of 1,000 hectares per year, this project will constitute the main source of recommendations for maximising restoration efforts of this ecosystem. The work will provide unique information to aid the recovery success of a historic ecosystem assemblage with special conservation concern in Western Australia.

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Restoration of a transition forest using soil and seed rain transfers near Andohahela National Park, Southeastern Madagascar

Fanambinantsoa Noromiarylanto, Ramanoelina Harijaona, Harison Rabarison, Fidisoa Ratovoson, Jimmy Randrianaivo, Porter P. Lowry II, Elise Buisson

The present study examines various ways of restoring a transition forest after cultivation and fire. The study sites are located in the transitional zone midway along a sharp precipitation/altitudinal gradient across a corridor between two large blocks of Andohahela National Park located in southeastern Madagascar: an upland parcel of humid forest and a lowland parcel with dry forest/spiny thicket. Restoration of gaps in this narrow, sinuous corridor may be essential to retain connectivity as the impacts of climate change are likely to be particularly severe in this region. In November 2009, soil and seed rain samples were transferred to 3 replicate plots left fallow. Preliminary results will be discussed.

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Sequence of facilitation, allelopathy and competition within a single growth season between an aridland shrub and its understory grass

Mohammad Jankju, Parvaneh Abrishamchi, Azam Maghamnia, Asieh Behdad

Research on plant-plant interactions provide the basic information for restoration of degraded ecosystems. Measuring the physiological ecology parameters helps us to understand the mechanisms underlying shrifts in the type and intensity of plant interactions across the gradients of environmental severity. We compared the interactions between an aridland nurse shrub *Artemisia* Khorasania krasch, and a perennial forage grass *Bromus kopetdaghensis* podle, in a semiarid rangeland, Quchan, Iran. Microclimate conditions and physiological parameters were simultaneously measured under the canopy of the shrub and in the adjacent open areas. Effects of shrub's allolepathic compound were assessed on the grass germination and seedling growth. Available soil water were measured in three soil depths; at the vegetative, flowering and seed ripening growth stages of the grass. At the early growth season, higher soil moisture, and possibly favorable light and temperature conditions, facilitated grass establishment under the canopy of shrub. By the end of season, competition for soil water led to the high grass mortality. The water soluble root and shoot extracts of shrub negatively affected the grass seedlings, especially at the early growth stage. Physiological measurements also confirmed the late season environmental stress; i.e. leaf proline and malondealdehids increased and those of chlorophyll a and chlorophyll b decreased from the beginning towards the end of growth season. Accordingly there was a sequence of interaction types between the two plants within a single growth season; it began as facilitation and continued as allelopathic and competitive effects of shrub on the grass.

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The effect of a restoration program on the Orthopteran diversity from a protected area in the southern Iberian Peninsula

Ana M. Cárdenas, Juan M. Hidalgo, Lourdes Moyano, Patricia Gallardo

The Directive 92/43/EEC of the European Council on the Conservation of natural habitats and of wild fauna and flora establishes that member States must take all compensatory measures necessary to ensure that the overall coherence of Natura 2000. In consequence, the Project of the Breña II, a new dam constructed in the Guadiato basin (southern Iberian Peninsula), implies the implementation of a package of compensatory measures to offset the environmental disturbance that flooding of territory belonging to a Nature Reserve and the dam infrastructure represents. Between these actions, a re-vegetation Program was included. The predominant vegetation in the area consists of open oak meadowlands alternating several *Quercus* species (*Q. suber, Q.ilex* and *Q. faginea*) as well as shrubs and scrubland. Patches of the clearest forest areas ha been restocked with autochthonous scrub vegetation, mostly with species of *Cistus*, *Rubus ulmifolius*, *Pistacia lentiscus*, *Arbutus unedo*, *Rosmarinus officinalis*, *Phillyrea angustifolia* and *Olea europaea*. This paper provides preliminary data on the comparative study of the Orthoptera fauna that colonizes the reforested areas and the surrounding territories. In order to characterise the Orthopteran community, the indices most commonly-used in the study of insect populations were applied: Richness, Diversity and Evenness. The results suggest that the improved areas act as refuges, especially when the adjacent environment is subjected to traditional management such as land-clearing and intensive grazing.

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Restoring the web of life – Ecological networks for more biodiversity in the Alps

Yann Kohler

In response to decreasing biodiversity and phenomena such as climate change, a transnational approach aimed at creating a pan-alpine ecological network has been developed during the last few years in the Alps. It is promoted in particular by three initiatives: Ecological Continuum Initiative, ECONNECT project and Platform Ecological Network of the Alpine Convention. This pan-alpine approach underlines the importance of both an international framework and the need to extend connectivity activities to other sectors than nature protection. Unlike the national approaches, the cross-border approach developed by these initiatives is based on a new vision of protecting the natural environment of the Alpine massif as a whole, from France to Slovenia. In several pilot regions distributed over the Alps, work is carried out to show how ecological connectivity can be improved between existing protected areas at the regional level. The place and role of protected areas within their regions are being redefined. The areas are situated in a wider territorial context and new cooperative arrangements are encouraged with local actors. To promote cross-border working in the development of ecological networks, the Platform Ecological Network was established in the framework of the Alpine Convention bringing together policy makers, practitioners and scientists. It encourages a political dialogue with the objective of generating political support for networking initiatives in the Alps.

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Surveys and evaluation of restoration operations

Sébastien Gallet, Jérôme Sawtschuk, Frédéric Bioret

The success of ecological restoration operations depends largely on the knowledge of the ecosystem, of local conditions as well as weff defined management objectives and appropriates tools. Nevertheless, this success can't be guaranteed and it is fundamental to envisage a procedure of surveys and evaluation. If various authors advanced for a long time the interest of long-term surveys, these are in fact rarely made, or only for a short period. This can be explained by various parameters. First, some devices of financing do not give the possibility of financing long term surveys. Moreover, collaborations between managers and scientists are not often enough developed. An important point is also the choice of the modalities of surveys. Indeed, scientists have a rather wide palette of tools which can be used. A complete and precise evaluation of the state of an ecosystem requires the implementation of all these tools and is quite often heavy and expensive. If these studies are fundamental for a better knowledge of the ecological processes, they are certainly not generalizable. Thus a balance has to be found between the needs of the site managers, the scientific rigor and the given means. Various examples will demonstrate the interests and limits of various methods based on the observation of the vegetation and how they could be twinned with approaches from other disciplines in order to give a global evaluation of ecological restoration operations.

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Certification for ecological restoration practitioners

Sasha Alexander, John Stanley, Andre Clewell

The Society for Ecological Restoration International (SER) is creating a certification program for practitioners of ecological restoration. A new corporation named the SER International Practitioners Institute (SERIPI) will administer the SER Practitioners Certification Program (PCP). SER PCP goals are to: 1) Provide practitioners of ecological restoration with the credentials needed to improve consumer confidence in the profession; 2) Improve the quality of ecological restoration projects worldwide; 3) Foster the incorporation of the principles of ecological restoration, as embodied in SER foundation documents, into the decision-making process of ecological restoration practitioners; 4) Develop a community of practitioners who are actively engaged in the continued improvement of their individual abilities and of their profession; 5) Create standards for practitioners of ecological restoration; and 6) Stimulate growth of the profession of ecological restoration. The results of a "Standards of Practice Survey" conducted in the spring of 2009 are being used to guide the design of the certification program. The SER PCP will certify practitioners based on their overall professional competence taking into consideration their education, training, experience, and professional involvement. Three levels of certification that will be offered: Certified Ecological Restoration Practitioner In-Training (CERPIT), Certified Ecological Restoration Practitioner (CERP), and Certified Senior Ecological Restoration

Practitioner (CSERP). Specific requirements for certification vary depending on the level of certification. SERIPI will begin accepting applications for certification in 2011. This presentation will discuss specific elements of the program. We will welcome input from the conference attendees regarding the program.

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Implementing the Habitats Directive: Management Planning in Germany

Anne Böhnke-Henrichs, Torsten Lipp

(1) Introduction. The Habitats Directive (Council Directive 92/43/EEC) is part of the European nature conservation policy. To implement the Habitats Directive and reach its conservation objectives management of designated special areas of conservation is one essential key point. On the example of Germany the management of special areas of conservation is investigated. Therefor 29 management plans of 12 federal states are examined whether they are complete in form and content and their planning quality is analysed. Moreover, it is proved whether the suggested management measures suit to the particular habitat types. (2) Analysis of Management Plans: Results and Conclusion. While planning of concrete management measures was realised adequately for the investigated habitat types in most of the plans examined, the investigation of content and form as well as planning quality identified deficits in two thirds of the plans. For instance the monitoring and the evaluation and the detailed consultation process are missing or insufficient as well as a periodic updating or the integration of impacts from outside. As an example, without a monitoring concept the effects of management cannot be understood, aberration identified and measures adjusted to site specific needs. Thus, the formal and planning deficits may finally undermine the good measure-oriented quality of the plans.

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Limitations of large-scale nature restoration practices for species typical for the protected Natura 2000 habitats - the Dutch perspective

Agata Klimkowska, Han van Dobben

An assessment of the quality of the Natura 2000 habitats in the Netherlands is, among others, based on the presence of so-called typical species. These are selected species of vascular plants, invertebrates, mosses, lichens, birds, or representatives of other groups of organisms. However some of these species became extremely rare in the Netherlands and there is a serious threat that if no measures will be taken, they will disappear completely within coming 5 to 10 years. Survival of these species, likely depends on adapting the management measures or an additional restoration measures to be incorporated in the standard practices. Several problems were identified: (1) the lack of the heterogeneity of the habitat, (2) too high or too low intensity of management or restoration activities, (3) irreversible hydrological changes, (4) a high nitrogen deposition, (5) poor dispersal opportunities. Several cases of typical species will be demonstrated. Based on practical experiences and research we proposed restoration strategies for some of these typical species and indicate the factors that may play a key role for their survival.

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Extinction debt and colonization credit? When both phenomena are mingled

Julien Piqueray, Sara Cristofoli, Emmanuelle Bisteau, Rodolphe Palm, Grégory Mahy

Calcareous grasslands are among the most species-rich ecosystems in temperate countries. These ecosystems suffered a high fragmentation process during the last century. Fragmentation can lead to the creation of an extinction debt in remaining habitat patches. In our study site, it was shown in a previous study that Fragmented habitat patches (area loss since 1965 >80%) exhibited an extinction debt in comparison to Stable habitat patches (area loss since 1965 <80%). However, human activities also created new habitat patches in the landscape and provided therefore opportunities for calcareous grassland plant species to colonize new sites. They also provide opportunities for studying species colonization abilities in the context of habitat restoration. We analyzed species richness in these new patches in comparison to old patches in order to detect colonization credit. When taking as reference Fragmented patches (that exhibit an extinction debt) or all old patches (Fragmented and Stable), we concluded to the occurrence of a colonization credit in New patches. However, when the reference is Stable patches (the less likely to exhibit an extinction debt) alone, no colonization credit could be detected. Moreover, correspondence analysis revealed that New patches were similar to old patches in term of species composition. These results are encouraging for restoration programs. They

also showed that the presence of an extinction debt in reference habitats can lead to mistaken conclusion in restoration monitoring. Extinction debt occurrence should be taken into account in the choice of reference habitats for evaluation of restoration success.

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Restoration of calcareous grassland on ex-arable land: the importance of establishment microsites and longer-term management

Markus Wagner, Jodey Peyton, Lucy Hulmes, Sarah Hulmes, Ben Woodcock, Matt Heard James Bullock, Richard Pywell

Restored grasslands often fail to achieve the high species richness of their target communities. It is usually the habitat specialists from such target communities that tend to fail in restorations, whereas habitat generalists characterised by wide ecological amplitudes perform much better. The poor performance of specialist species in restoration projects may often be due to failure to create suitable microsites for their establishment during the initial phase of a project or failure to maintain such microsites in the longer term, thus effectively preventing the continued regeneration of habitat specialists. We established a large-scale experiment in species-poor grassland on ex-arable land to investigate a range of techniques and management options for creating and maintaining microsites. Results from the first two years of the project indicate that the specific establishment requirements of individual species strongly depend on whether they were introduced as seed or as small plants that were nursery-grown. Successful establishment from seed tends to require more open microsites, e.g. created by strong mechanical disturbance, whereas successful establishment from nursery-grown plants requires more sheltered microsites, e.g. created by the band-spraying of herbicides. Results from the second year indicate that initial survivorship may not necessarily be a good indicator of longer-term performance.

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Preliminary results of multi-treatments steppe restoration processes in La Crau (Provence, France)

Renaud Jaunatre, Elise Buisson, Thierry Dutoit

The La Crau area, with its xeric conditions and several millenaries of sheep herding, represents the last xeric steppe in the South of France. This unique species-rich ecosystem has lost about 80% of its original surface. A 360 ha abandoned orchard is the location of experimental restoration of steppe plant community to address the question: Which processes should be used in order to restore the steppe plant community? Objectives are first to limit the colonization of unwanted plant species and to improve characteristic species establishment, then to replace plant community on the desired plant successionnal trajectory and eventually to restore steppe plant community richness, composition and structure. Two main barriers to the spontaneous recolonisation of steppe plants which have been recognized as thresholds of irreversibility for the restoration of the steppe are the low dispersal potential of characteristic species and the high dispersal and establishment potential of unwanted species particular due to an increase of soil fertility. Five treatments are experimented : (i) Sheep grazing restoration which is aimed to limit competitive and unwanted species expansion, (ii) Soil excavation which is aimed to suppress ruderal species seed bank and to decrease soil trophic fertility, (iii) Nurse species seeding which are aimed to rapidly occupy spatial and trophic niches, and then to provide safe sites for steppe species once sheep grazing is reintroduced, (iv) Hay transfer which is aimed to provide local species seeds from undisturbed steppe patches and (v) Soil inoculation which is aimed to provide local species propagules with associated microorganisms and to lower soil trophic levels. The talk will briefly present preliminary results from these experiments.

186 The fate of herbaceous seeds during topsoil stockpiling: germination rate and viability

Desirée Rivera, Berta Jáuregui, Gabriel De la Rosa, Begoña Peco

Topsoil removed during linear infrastructure construction is one of the most valuable resources for the ecological restoration of roadslopes, as it contains the highest concentration of micro-organisms, nutrients and seeds in the soil. During construction work, topsoil is stockpiled in a way that can harm seed germination and survival capacity. In order to assess the effects of topsoil storage time and seed burial depth on germination rates and viability, an experiment with three replicas was conducted using two factors: time (1 to 6 months) and burial depth (0, 5, 30 and 50 cm). At each depth of the stockpile we sowed 25 seeds from 10 natural grassland species -belonged to 5 families- in permeable nylon sachets. Germination rate and viability were analyzed using binomial GLM, with family as random factor and three covariates –time, depth of burial and seed weight. Germination rate and viability were analyzed using binomial GLM, with family as random factor and three covariates –time, depth of burial and seed weight. Germination rate increased with time (X^2=550.82; p<0.001) and seed weight (X^2=5.68; p<0.05), but decreased with burial depth (X^2=1071.62; p<0.001). Family was also significant (X^2=529.12; p<0.001), higher in Poaceae and lower in Caryophyllaceae. Viability decreased significantly with storage time (X^2=888.88; p<0.001) and depth (X^2=70.55; p<0.001), while it increased significantly with seed weight (X^2=49.25; p<0.001). Family also had a significant influence (X^2=529.12; p<0.001) on viability. It was lower in Compositae than in the rest of the families. The results show that there may be a loss of viable seeds in topsoil stockpiles, particularly in the case of large seeds. This study is part of the CENIT-OASIS project.

187 Restoration of rupestrian fields, physiognomy of Cerrado threatened by land use changes

Soizig Le Stradic, Elise Buisson, Geraldo Wilson Fernandes

Rupestrian fields or campos rupestres, located in eastern Brazil, are a more or less continuous herbaceous stratum with sclerophyllous evergreen small shrubs between rocky outcrops which occurs between 800m and 2000m. It is the largest vegetation formation of the Espinhaço Range and the harsher physiognomy of the biome Cerrado. While their soils are shallow, sandy, highly acidic and poor in nutrients, they are very diversified with one of the highest level of endemism in Brazil. Interactions between the substrate, local topography and microclimate create a huge variety of micro-habitats generating a mosaic of communities. Currently, the Cerrado is one of the most endangered biome of South America and rupestrian fields remain poorly documented. Because of intense anthropic pressures, ecological restoration studies are urgently needed to rehabilitate this ecosystem and services they provide. This study tests the transfer of herbaceous native species from rupestrian fields to restore three kinds of degraded areas (with stony substrate, sandy substrate or ferruginous substrate) using hay collected on two types of rupestrian fields (sandy and stony). We manipulated 2 or 3 levels of 3 treatments in a multifactorial experiment: weeding/plant interactions, nutrient addition/no fertilization, hay from stony site/from sandy sites/no hay. Experimentations were carried out in three replicate sites for each kind of degraded areas (n=9) and each treatment was replicated 4 times at each site in blocks. Controls were also set up in the field and in greenhouse. Preliminary results will be discussed.

188 Transfer of one population of a rare orchid in Corsica

Richard Franck, Michaël Kaczmar, Hugot Laetitia, Bertrand Schatz

Orchids are often emblematic species, which are protected at different level. Fine interactions with pollinators for their reproduction, with mycorrhizal fungi for their nutrition and with their habitat for their life history are important constraints for restoration operations. Here, we reported a case in which a population of a rare and protected species, *Ophrys eleonorae*, was directly threatened by a planned road extension. This population was then displaced in three population in similar and nearest habitat. All individuals flowered the year after transfer, but they are only 10% to do it 10 years after in spite of a good level of pollination. A 10 year survey shows that we also observed variations among populations in the individual survival. Since few studies reported cases of transfer for orchid populations, this operation allowed us to evaluate conditions of success of such population transfer.

189 **The importance of restoring dynamic coastal sand dunes for fauna**

Bart Wouters

The original highly heterogeneous landscape of dry coastal dunes once inhabited a tremendous biodiversity due to a patchwork of different habitat types. These were shaped by windblown sand, rabbit grazing and land-use, causing a continuous habitat rejuvenation. However, since the mid-1950s many characteristic animal species decreased profoundly or even have disappeared totally from Dutch coastal dunes. High depositions of atmospheric nitrogen and a decreased intensity of rabbit grazing stimulate tall competitive grasses and shrubs to spread, homogenizing the original patchwork of habitats. Ultimately, changes in vegetation cause this dynamic landscape to stabilize, by blocking sand-dynamics as one of the main drivers of the ecosystem. In the authors' point of view, the use of redynamisation of sand-dynamics as a measurement tool is the most promising measure since it functionally restarts one of the main drivers of dune ecosystems. We hypothesize that a frequent burial with fresh dune sand restores soil properties and microclimate conditions, beside plant quantity and quality. Together, these processes establish a prime habitat for dune fauna. The authors illustrate the positive effects of redynamisation of sand-dynamics on development and reproduction of characteristic dune fauna species in various examples. Sandy dune grasslands have for instance a 10-20ºC higher temperature just below soil surface opposite to grass encroached sites. These open sandy places are of major importance for reproduction of grasshoppers resulting in big differences for the development speed of grasshopper eggs.

190 **Evaluation of Dutch coastal wetlands restoration: effects of weather conditions**

Bikila Warkineh Dullo, Ab Grootjans

Successful restoration of coastal wet lands and their corresponding plant communities is a complex process that requires a comprehensive approach based on a thorough knowledge of dune systems. This paper investigates the effect of weather fluctuation i.e. an increase or a decrease of precipitation on basiphilous dune slack species. We hypothesized that the observed meteorological change has caused an accelerated succession toward more productive but species poor stages that have become much more common all along the Dutch coast. We investigated the relationship between measured environmental variables such as pH, organic matter, different management regimes, groundwater levels and precipitation regimes by using a multivariate analysis (CANOCO 4.5). Our result shows a rapid acidification process owing to intense spring or summer rainfall, high rate of organic matter accumulation within few years and a rapid establishment of competitive tall grass species and scrubs. Therefore, an increase in precipitation could lead to a feedback mechanism by raising the water level, reducing soil pH and facilitating organic matter acculturation and thus facilitating the establishment of competitive species. We conclude that restoration projects should take into account the unpredictability of weather conditions and should aim to more dynamic approaches.

191 **Rate of soil organic matter accumulation: a key factor in succesfull restoration of dune slacks on the Dutch Wadden Sea Islands**

Rohani Shahrudin, Bikila Warkineh Dullo, Ab Grootjans

One of the main objectives in coastal wetland management is to preserve pioneer plant communities since they have a high conservation value. Interdunal wetlands or dune slacks harbour a large number of plant and animal species that elsewhere in Europe have become extremely rare. Theoretically, soil organic matter (SOM) will increased with increasing ecosystem age. In dune slacks, however, a rapid increase in soil organic matter usually leads to a drop in soil pH, which leads to the decline of basiphilous plant species. On the Dutch Wadden Sea Islands sod cutting is a common management practise to start the succession anew. In the present research we used long term monitoring data (16-60 years) of soil and vegetation to evaluate the success of restoration projects. We compared both sod cut and not sod cut sites. We found large differences in the rate of organic matter accumulation and also in the rate of pH decline. A general trend was that pioneer stages persisted longer when SOM rates were low. Basiphilous species such as Epipactis palustris and Schoenus nigricans could persist however quite a long time (ca. 30 years) when SOM rates were high, but only under the conditions of regular supply of calcareous groundwater. Our results suggest that sod cut practice alone is not always an efficient way

to restore dune slacks. Therefore, nature managers should have knowledge about the hydrology system that plays a key role in successful restoration.

192 **Elucidating the beneficial and toxic endpoints of a soil conditioning agent (commercial humic acid) in coastal plant restoration**

Jonathan Willis, Michael Dupuis, Mark Hester

Commercial humic acid is a soil conditioning agent that has shown promise in improving the quality of marginal soils in agricultural and horticultural environments by increasing nutrient availability and soil organic matter, among other mechanisms. Preliminary investigations of the benefits of humic acid amendment to the establishment and growth of dune and swale, as well as back barrier marsh vegetation in soils typical of barrier island restorations have been initiated. However, further refinement of this technology is needed to better incorporate this methodology into coastal plant community restoration efforts. The effect of nutritive elements and compounds on organisms can generally be described as a dose-response relationship, with no effect, beneficial, and toxic responses occurring as the concentration of the nutritive element or compound increases. Thus, a key step towards the effective employment of emerging restoration technologies that use novel amendments is determining the range of doses at which the optimal effects occur for critical species. In this study, several plant species that are frequently employed in coastal restoration efforts in the southeastern United States were assessed in regard to their response to humic acid application in a greenhouse setting. A general trend of no effects below 100 ml m-2, beneficial effects from 100 ml m-2 to 900 ml m-2, and deleterious effects at 2,700 ml m-2and above was elucidated for most species plant examined. Assays are currently underway to determine the impacts of humic acid amendments on soil respiration and direct microbial toxicity.

193 **Evaluation of humic acid amendment in facilitating plant establishment in coastal environments**

Mark Hester, Mike Dupuis, Christine Pickens, Jonathan Willis

The restoration and protection of barrier islands and other sandy coastal habitats requires that plant communities are rapidly and effectively established. The rapid establishment and expansion of vegetative cover is crucial in dune, swale, and back-barrier marsh habitats where vegetation serves to trap and bind sand and sediment, thereby providing increased stability to storm and overwash events. Although humic acid has been reported to minimize the impacts of environmental stressors associated with growing crops in marginal soils, its reported use in the peer-reviewed literature of restoration science is very limited. We conducted a series of controlled experiments in which we investigated potential benefits of humic acid amendment on the growth responses of key dune species (sea oats, *Uniola paniculata*; bitter panicum, *Panicum amarum*; seashore paspalum, *Paspalum vaginatum*), swale/high marsh species (marshhay cordgrass, Spartina patens; groundsel bush, *Baccharis halimifolia*; saltgrass, *Distichlis spicata*) and salt marsh species (smooth cordgrass, *Spartina alterniflora*; black mangrove, *Avicennia germinans*). Results to date indicate significant differences among species in their growth responses to humic acid amendments. In general, woody species (groundsel bush, black mangrove) and species with slower establishment times (sea oats) have not displayed the level of growth enhancement observed in faster growing species. Field trials at barrier island restoration sites in Louisiana, USA, are currently in progress across a suite of habitats. In these large-scale field experiments, we are further elucidating the potential benefits of humic acid in enhancing the establishment of key barrier island and coastal plant species.

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Suitable site selection for sustainable coastal tourism based on ecological criteria (with GIS and Delphi method). Case study: Caspian Sea Coast of southern Iran

Mahsa Hakimi Abed, Masood Monavari, Abdolreza Karbasi

In this survey and for appropriate site location in regard to coastal tourism and sustainable development and restoration, required environmental and natural criteria as well as limiting factors such as climate, topography, soil texture, types of flora and fauna and slope have been identified and categorized. Then, using G.I.S. information (data) layers as well as appropriate sites for coastal tourism have been identified and provided. Next, considering social and economic criteria and by means of Delphi method via design, assessment and analysis of questionnaire results sites have been prefered and categorized. The basis for appropriate site selection for coastal tourism and sustainable development is in accordance with environmental, ecological and bio-geographical criteria. These important criteria are listed as follows: (1) Climate: Considering humidity, temperature, and rainfall. (2) Topography: Slope and direction. (3) Water Resources: Surface and groundwater. (4) Geology: Bedrock and distance from Fault. (5) Soil: Types, texture. (6) Flora: Uniqueness and distance from sensitive environments. (7) Fauna: Diversity and vital habitats. (8) Being natural and virgin.

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Assessment of forest stand history using pedoanthracology: a precious tool to definite a forest system "reference", at the local scale

Vincent Robin, Oliver Nelle, Brigitte Talon

Restoration projects need to definite an aim towards which to restore the target system. To do that it is important to observe the target system in its spatial-temporal context. Indeed, the current state of ecological systems (i.e. resilience and stability potentialities) is the result of processes occurring at different and complementary spatial and temporal scales. This is why the assessment of ecological systems should be done through their various scales. In restoration context it is especially important to determine what is natural (i.e. which processes, dynamics, disturbances regimes, etc., are natural?). Several palaeoecological approaches allow investigating forest dynamics along time and space, but these approaches are relevant in different ways on different spatial-temporal resolution. But, the possibility to use one of those is highly dependent on the presence of archives which record environmental change by conserving relevant palaeo-indicators, e.g. lakes for pollen analysis. This limits essentially the usage of palaeoecological investigations connected to restoration projects. However, the pedoanthracological approach (analysis of charcoals from soils) is a relevant and useful tool is this context, due notably to its spatial and temporal resolution. In this communication we present pedoantharcological investigations on three different study sites in Western Europe. On these three woodland sites soil sampling has been done. From them wood charcoal pieces have extracted and quantitatively and qualitatively analyzed to investigate fire and vegetation history. With these case studies we intend to highlight the pedoanthracological contribution to the assessment of vegetation history and the degree of naturalness of forest stands.

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Characteristics of reference ecosystems in defining restoration targets: static vs. dynamic approach

Ekaterina Shorohova, I. Vanha-Majamaa

We study the impact of variable retention felling on ground vegetation dynamics and natural regeneration and assess sources of variation - weather, within-stand site diversity, stand age, structure and successional stage, natural disturbance and management history - in boreal Norway spruce dominated forest stands used as 'controls'. The results are based on two case studies: MONTA - complex forest management and restoration experiment in Finland started in 1995 and "Vepssky Forest" - permanent sample plots in pristine forests in Russia inventoried since 1973 as well as on the literature review. The successional changes in control can and should be studied if the restoration aims to mimic natural disturbance patterns. The true variation vs. sampling error, criteria for choosing 'control', their relative importance in basic research and restoration as well as limitations in using controls are discussed.

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Conservation and restoration models of non-homogenous forest habitats

David Hladnik, Lado Kutnar

In the last decades, several efforts in sustainable management of forests and in environmental conservation stimulated changes in forest policy and legislation and in forest management practices throughout the world. The general aim of new management and ecological restoration systems in forestry, influenced strongly by Central European developments in forest management based on natural processes, was the encouragement of structural diversity and uneven-aged structure on a fine spatial scale. Despite the political declarations and actions, which have established a solid ground for growth and diversity in today's forests, the criteria and indicators for maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems and cultural landscapes have been primarily undertaken on the national scale. The processes in historical development of today's fine-grained, open, semi-natural and cultural landscapes in Mediterranean and Central European countries have hidden or have made impossible the implementation of quantitative descriptors to be used in restoration efforts or for the conservation of habitats that are in ecosystem functions or species composition comparable to existing reference sites. The intent of the study was to present the spatial model based on landscape ecological reference points for an assessment of disturbances in agricultural and forested landscapes induced by human land use in Slovenia. As it is not possible to design a general model that could be used as a basis for assessing the natural processes of a cultural landscape, the researchers determine the condition of forest habitat types and restoration efforts in cultural landscape indirectly. Based on characteristics of 34 forest plant communities, the ecological and diversity array of three most extended forest habitat types in Slovenia have been tested. By combining both conceptual models, the site-specific restoration goals can be nested to the spatial planning aimed at preserving and restoring natural processes in cultural landscapes.

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Can we restore natural habitats after plant invasion? Lessons from years of management

Gwenn Frisson, Mathieu Halford, Emmanuel Delbart, Grégory Mahy

Negative impacts of invasive plants on natural habitats have been widely demonstrated. Hence, the management of invasive plants, aiming at eradicating, or at least controlling their spread, is being more and more developed. For this purpose, we need to identify the most efficient management techniques which could lead to the restoration of invaded ecosystems. Up to now, management methods mentioned in literature were pragmatic tools and often lacked scientific assessment. For several years, we have tested similar mechanical and chemical management techniques in the field on highly invasive plant species, representative of different life forms and invaded habitats: herbaceous rhizomatous perennial Fallopia japonica, ligneous rhizomatous *Spiraea* spp., ligneous root suckering Acer rufinerve and ligneous stoloniferous *Cotoneaster horizontalis*. We investigated the efficiency, cost and feasibility of these techniques, and their effects on the restoration of invaded ecosystems. The best performing management technique was found to be highly species specific and was also influenced by the invaded habitat type. For these perennial species, long-term management must be considered, to reduce their competitive capacities with repeated mechanical or chemical techniques (cutting or pulling out several times a year, injection combined with mechanical methods, etc.). For species with sexual reproduction, like *Acer rufinerve* and *Cotoneaster horizontalis*, seed bank and seed dispersal must also be taken into account to avoid dissemination when managing. We can conclude invasion plant management is usually expensive and hard to implement but some results are encouraging and show the importance to carry on research on invasive plant management methods.

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Restoration of plant populations and communities – does arbuscular mycorrhiza matter?

Martin Zobel, Mari Moora, Maarja Öpik, Kadri Koorem

Performance of natural plant species in experiments depends on symbiotic arbuscular mycorrhizal fungi (AMF) living in their roots. However, the understanding the role of AMF in structuring plant communities is limited because we know very little about their natural distribution. We first summarise global distribution data of AM fungi, based on published information of fungal SSU rRNA gene sequences and show that highly disturbed ecosystems are characterised by low diversity of AMF. Second we show that association between host plant species and AMF may be more specific than thought earlier. We then present data about AMF diversity in boreonemoral forest, obtained with novel pyrosequencing technique. We found that specialised forest plants had diverse AM fungal communities with many locally distributed fungal taxa in their roots. In contrast, the roots of generalist plant species were colonised by a low number of widely distributed fungal species. We conclude that the occurrence of plant species characteristic to undisturbed natural communities might be critically dependent on the presence of particular symbiotic fungi. The restoration of populations of narrowly distributed plant species, as well as of biodiverse plant communities might thus require the presence of specific AM fungi, which should be introduced to the site. Finally we present the preliminary results of a field experiment where we established old forest species into disturbed sites with and without associated AMF. We conclude that the role of AMF in determining the success of restoring plant populations and communities might be more significant than earlier recognized.

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Ecosystem effects of introducing non-local plants: genetic introgression into local populations and interactions with other organisms

Lisèle Crémieux, Armin Bischoff, Heinz Müller-Schärer, Thomas Steinger

In ecological restoration schemes, concerns associated with the introduction of foreign plant populations have often focused on their potential maladaptation to the local site conditions. Interactions of introduced genotypes with other ecosystem members, such as plant antagonists or neighbouring populations of native conspecifics, have received less attention. In a reciprocal transplant experiment at three sites across Europe, we examined the patterns of population differentiation in resistance to local antagonists for two common grassland species, Plantago lanceolata and Holcus lanatus. Moreover, for Plantago, we studied the consequences of gene flow from foreign provenances on the fitness of local population by producing three generations of interpopulation hybrids and comparing their performance to that of within-population crosses in a field experiment. In both experiments, we included both geographically distant populations and close-by populations from distinct habitats. We found strong genetic differentiation among provenances in the amount of damage by their main above-ground antagonists in both species. Local provenances of Holcus had higher amounts of rust infection while those of Plantago were less damaged by their specialist beetle than the foreign provenances. This opposite pattern suggests that it will be difficult to predict the consequences of plant translocations for interactions with organisms of higher trophic levels. Most fitness-related traits of the interpopulation hybrids were close to the average of their parents, leading to reduced fitness of the hybrids compared to local plants, and dilution of local adaptation, when foreign parents performed poorly. The introduction of maladapted populations from distant or ecologically distinct environments might, at least temporarily, decrease the fitness of neighboring local plants.

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Local versus non local: managing in the face of uncertainty

Nathalie Frascaria-Lacoste

The emerging discipline of restoration ecology provides a powerful suite of tools for speeding the recovery of degraded lands. In the fields, restoration projects vary in size and degree of disturbance. In the past, restoration programs have been done with few species that were often "exotic" to the disturbed site. Recently, studies have shown that the restoration of ecosystem functions and diversity needs the establishment of native species with the argument that local genotypes are more adapted to the local environment. Opinions differ on the correct strategy for choosing plant material restoration. Can we favour the local species or not? What is the advantage to introduce new genotypes on a specific site? In general, literature cannot recommend a single strategy for any specific situation but presents conceptual frameworks for assessing the value of the different strategies. Climate variability, as well as land use practises and stressors, create novel environment conditions never experienced by ecosystems before. Species will differ in their response to climate change depending on their environmental niche properties and physiological characteristics. Some will adapt to the changes, some will move, and some will go extinct. Accepting that the future will be different from both the past and the present, managing in the face of uncertainty will force managers to create ecosystems with short and long term strategies. In my talk, I will review various strategies across a wide array of situations in a context of change.

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Plant introduction in restoration projects: implications for dependent insect populations

Barbara Smith

A practical study indicated a tendency for the growth rate of common blue caterpillars to differ when raised on limestone grassland plants of different origin, suggesting that plant origin may influence the reproduction of dependent insect populations. This leads us to hypothesise that plant origin could influence the successful invertebrate colonisation of newly restored sites. However, to determine this, a single study is insufficient, we need to synthesise existing work. The information that we need is not plentiful in studies focussing on restoration ecology, but is scattered through the botanical / entomological literature. In this paper, the results of our own study will be presented and a range of sources investigating plant / insect interactions will be drawn together in an attempt to identify key knowledge gaps for research. In particular we will investigate whether there is sufficient information available to answer the following questions: Is there any evidence that plant origin determines the reproductive success of dependent invertebrates? What is the strength of that evidence? Can we draw any conclusions about the role of plant origin in restoring invertebrate communities in the field? Are we in a position to draw up guidelines based on existing work?

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Native seed production and use for restoration of Pyrenean habitats: implications and limitations

Sandra Malaval

In the French Pyrenees, commercial herbaceous seed mixtures commonly used in alpine and subalpine revegetation were, until recently, always allochthonous. At these altitudes, they often failed to give durable results; moreover, their systematic use might modify and treathen native flora and habitats. Species sourced locally are well adapted to ensure the technical success of revegetation, especially at high altitude, and that is why we initiated a program of native seed collection and production experiments. Seed users (ski resorts and local authorities) and seed producers were involved in a participative approach that aimed at defining rules for seed collection, production and use, with a special emphasis (focus) on promoting genetic diversity throughout the entire process. We wrote together a code of good practices for the production and use of Pyrenean native flora and are preparing now the registration of a collective trademark. Genetic analysis (based on RAPD) of the plants under study allowed us to define two seed transfer zones within the French Pyrenees. Finally, we are designing a web site that will trace native seed geographic origins from their collection in the field to their sowing. Nevertheless agricultural grasses and legumes are still being used for high elevation revegetation, because the seeds are reliably produced in large quantities and at low prices. Will the

constraints of the code of practices (eg limitation of 4 generations of multiplication, collection sites above 1000 m, minimum of 3 different collection sites for each species, etc.) be accepted in the long run?

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Social acceptability of population restoration of endangered species: the question of species autochthony and nature artificialization.

Anne-Claire Maurice

Only few publications in social sciences deal with population restoration of endangered species. If some anthropological studies on animal restoration plans are existing, researches on plant restoration programs are very rare. However, projects about vegetal species have also a social dimension, putting in interaction several protagonists: scientists, naturalists (local associations...) and institutional people (Office National des Forêts, local authorities...). All of them have specific uses and representations of nature which directly influence the way they perceive population restoration. This aspect cannot be ignored to approach feasibility and social acceptability of plant restoration programs. Our research, based on an ethnoecological approach, deals with two projects: 1) population restoration of Arenaria grandiflora L. in Fontainebleau forest, realized with exogenous seedlings (from Loire Valley); 2) introduction-reinforcement of Centaurea corymbosa Pourr. population in its endemism's area (Massif de La Clape). To which extent the autochthonous (or indigenous) character of those plants is considered by the different protagonists involved in restoration projects? The analysis of their discourses and their practices reveals that beyond the plant, the social value of the place is also very important. In order to evaluate the human impact on the plant and on the place, and the way their conservation is affected, we must also consider the restoration methods and their results: is it regarded as natural by the different protagonists, or is it an artificialization of a natural object?

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The importance of Interregional cooperation on river restoration: Ripidurable and Ricover case studies

Ana Mendes

Riparian zones are responsible for many ecological functions considered crucial to the preservation of river ecological conditions. In the Mediterranean landscape, riparian corridors emerge from surrounding landscapes as "linear oasis" with particular structural and compositional features. They are, however, severely altered by adjacent human activities and land uses in the drainage basins, which pollute, impose barriers, extract or transfer water, straighten and constrain river channels, alter banks or cut vegetation to gain space. There is an urgent need to support actions to protect river systems and to restore their original ecological integrity and functions, as the Water Framework Directive imposes to all member states. Moreover, according to the "European Spatial Development Perspective", biodiversity cannot be preserved with only a network of protected areas, but also needs the development of ecological corridors. Cooperation among different actors at regional levels arises as the best practice to really achieve twofold objectives, that is, river and water restoration activities and contributing to the development of a network of ecological corridors across regions. This work presents the experience achieved during the development of two interregional cooperation projects dedicated to river restoration. RIPIDURABLE project (www.ripidurable.eu) was dedicated to the conservation of riparian ecosystems; four projects of habitat restoration using bioengineering techniques were developed. RICOVER project (www.ricover.eu) was born from the desire to apply Ripidurable project guidelines to the recovery of natural environment to the SUDOE region; three river habitat restoration projects are under development in Odelouca (Algarve, PT), Guadiana (Extremadura, PT/SP) and Ter (Catalonia, SP) regions.

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River restoration approaches in SUDOE Europe: problems and pitfalls. Experience in the Ter River, Catalonia, north-east of Iberian Peninsula

Jordi Camprodon, Marc Ordeix, David Guixé, Francesc Llach, Laia Jiménez, Núria Sellarès

In our study areas we observed that riparian forests were relatively well conserved, but that they had not attained their potential due to three problems:1) width loss, especially in the second line of the forest; 2) introduction of exotic species; 3) water volume. Our project included preliminary studies of biological indicators and producing plans for fluvial management in private and public forest land - pilot. In the management plans, forestry tools are used for fluvial restoration. Four forest land - pilots were chosen to carry out restoration projects in riparian forests. To coordinate goals and development work, custody agreements between landowners, town councils, CERM and CTFC were signed. Some of the restoration tasks involved the application of forestry methods for sustainable management, pasture management and plantation of autochthonous species. The first results led us to the following recommendations: 1 Improvement of the structure of the riparian forest by means of the application of forestry methods applied to the restoration of the natural vegetation. 2) Establishment of some protocols in forestry treatments. 3) Monitoring of the results of the restoration by bioindicators. 4) Study of the biological variables associated with the level of conservation and degradation of the riparian forest. 5) Publication of a guide about the project in technical and informative format. The experience in the Ter River is part of the project SUDOE Ricover.

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Birds as bio-indicators and as tools to evaluate restoration measures

Jean Roché, Carlos Godinho, João E. Rabaça, Bernard Frochot, Bruno Faivre, Ana Mendes, Paula C. Dias

Rivers and streams are in many countries the only aquatic habitats with natural origin, where species have evolved adaptations. Riparian habitats provide food and shelter for many species, they also act as biological corridors, and they are of crucial interest for biodiversity at different scales. They suffer from human activities through changes in land use, habitat fragmentation, erosion, channelization, or decrease in water quality... Methods are needed to assess quality and ecological integrity of streams and riparian habitats. Indicators can summarize or cluster complex environmental data, providing overall pictures of biodiversity and its threats. Invertebrates, plants or fishes are commonly used, but they focus on the stream itself, neglecting the riparian ecosystems. Bird communities can be good models to assess quality, relevant perturbations and efficiency of restoration processes. Within RIPIDURABLE (www.ripidurable.eu) project several rivers stretches (in Portugal, Greece, France) were selected for restoration actions. Bird surveys were conducted to: a) explore how and at which scales of space and time bird communities provide information about riparian ecosystem quality; b) assess restoration results. We defined a procedure for assessments of riparian bird communities: (1) Describing initial state, (2) Choosing bird assemblages, (3) Defining control areas, (4) Survey method and sampling sites, (5) Result interpretation, (6) Replicability. We show that bird communities: 1) are particularly relevant to assess large scale and long terms changes in hydrosystem characteristics and functioning; 2) because they quickly react to perturbation, are also useful to assess more local features and detect habitat alterations. The RIPIDURABLE project offered the opportunity for further research currently included in national programs such as Plan Loire Grandeur Nature which allows long term studies on riparian birds.

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The importance of Interreg Initiative as a financial instrument for promoting ecological restorations projects

Fernando Nogueira, Ana Mendes

Interreg aims to stimulate interregional cooperation in the European Union. It started in 1989, and is financed under the European Regional Development Fund (ERDF). The amount of co-funding required differs by region, ranging from 50% down to 0% in the poorest regions. The final beneficiaries of Interreg funds are usually public authorities, interest associations and non-profit organisations. Interreg IV has a budget of almost 7,8 billion euro, up from 4,9 billion euro in Interreg III. Interreg is made up of three strands: Strand A : cross-border cooperation between adjacent regions. Strand B: non-contiguous regions from several different countries cooperate because they experience joint or comparable problems. Strand

C: interregional cooperation across Europe in order to improve development policies and instruments through large-scale information exchange and sharing of experience. Habitat fragmentation through Europe is a common problem and the application of Habitats, Birds and Water directives impose habitat protection and restoration to all member states. Moreover the "European Spatial Development Perspective" recognizes that biodiversity cannot be preserved with just a network of protected areas, and that the development of ecological corridors is just as important. In fact, cooperation is the only effective ways to strive against habitat and biodiversity loss since living organism do not recognize borders. Under previous Interreg Initiatives ecological restoration projects have been funded: Strand C over 32 million euro (ME); SUDOE program on Strand B over 2 ME and Strand A 64 ME. Activities funded vary between monitoring, evaluation and restoration activities all achieved through cooperation.

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Assessing the role of riparian vegetation and land use on river ecological status using remote sensing and spatial modelling

Pascal Kosuth, Thierry Tormos, Flavie Cernesson, Nathalie Lalande

Preserving or restoring the ecological quality of aquatic ecosystems is a major objective of Water Framework Directive. A pending question deals with the gain in river ecological status indicators that could be allowed by restoring riparian tree vegetation. In order to quantify in a statistically relevant way the role of riparian vegetation on river ecosystems, a regional approach is required that mobilizes three complementary fields of research : (1) the use of very high spatial resolution satellite imagery to map river corridor land use and riparian vegetation along large river networks; (2) the design and quantification of synthetic spatialized indicators of river corridor land use; (3) the development of pressures/state spatialized models that quantify the relation between river corridor land use indicators and river water bodies ecological status indicators. The corresponding methods were developed and implemented on various river basins, particularly over lower Normandy river networks (6000 km long; 157 ecological stations). Results show for instance that in this region, changing the local land use along a river from agriculture to forest (over a buffer 1km long and 30m large on both sides of the river) allows in average to increase by 0.3 points the river ecological status indicators (EQR-IBGN between 0 and 1). Such results are of high interest for decision-makers that can estimate the interest of investing in restoration strategies by anticipating their effect in terms of Water Framework Directive standards.

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Restoration of degraded Mediterranean rangelands

Vasilios P. Papanastasis

Rangelands amount to 52% of the Mediterranean basin countries thus making the largest land use type of the region. They are characterized by a large variety of plant communities and a high biodiversity. At the same time, they are considered as the most degraded natural resources as a result of misuse by human activities, particularly livestock husbandry. Their degradation is mainly attributed to overgrazing which leads to elimination of plant cover and soil erosion. For restoration of degraded rangelands total banning of livestock grazing is generally proposed so that they are converted to woodlands though natural succession or reforestation is practised so that animals are excluded from their use. Research findings over the last few decades however suggest that Mediterranean ecosystems and rangelands in particular have been evolved with the presence of livestock and grazing exclusion may result in more serious degradation than overgrazing. As a matter of fact, undergrazing and land abandonment may also result in rangeland degradation due to fuel accumulation and the subsequent devastated wildfires. Restoration of degraded grazing lands can be achieved by adjusting the grazing management rather than by totally excluding livestock, in case that only the biotic function of rangelands has been damaged. However, if the abiotic function has been also affected then additional measures besides adjusted grazing management is needed. In any case, grazing management should be an essential part of the restoration plan. The various options of restoration of degraded rangelands are analyzed and discussed and case studies from several parts of the Mediterranean region are provided.

211 **Intervention ecology: managing and restoring ecosystems in the 21st century**

Richard Hobbs

The world is changing more rapidly and more comprehensively than ever before in human history. Abiotic conditions are changing with changing climates, land use and human inputs and extractions from ecosystems, and biotic compositions are changing through range shifts, invasions and local extinctions. These changes are leading to a reconsideration of what the goals for management, conservation and restoration can and should be. In addition, there is increased recognition that active intervention in ecosystem dynamics will be required to ensure the continuation of ecosystem service provision and biodiversity conservation. Such intervention will increasingly have to take multiple factors into account in a more meaningful way. On-ground management and restoration programs are currently wrestling with these issues and can provide useful test-beds for new ideas and approaches. There is a strong need for the development of a more effective ecology that facilitates the analysis and management of ecosystems in a rapidly changing world. I suggest that restoration ecology needs to extend its reach to become a more comprehensive "intervention ecology" which couples conceptual and empirical studies with on ground application. When, how and where should intervention be implemented, and what types of intervention are likely to be most effective? I provide examples of this type of approach from Western Australia, where we are working with groups conducting broad-scale restoration aimed at restoring ecological function and maintaining biodiversity within highly degraded agricultural, urban and mining landscapes.

212 **Determining environmental investment priorities – a new framework**

Melanie Strang, David J. Pannell, Anna M. Roberts, Geoff Park, Jennifer Alexander

Environmental problems are much larger than the budgets allocated for addressing them, and programs are often not achieving cost-effective outcomes for public investment. Certainly this is the case in Australia and likely to be the case in Europe also. A new asset-based tool that enables transparent, effective and informed decision making regarding investment in environmental projects has been developed and is now used extensively in Australia. Called INFFER (Investment Framework for Environmental Resources), this tool is a seven-step process that assists users to identify the most valued environmental assets (for example rivers, wetlands, endangered species, highly valued agricultural land) in their regions, and determine which ones are the most cost-effective to protect. INFFER uses available science and gives priority to highly valued natural assets that are highly threatened or degraded, upon which actions with high technical feasibility of avoiding or repairing that damage can be undertaken, and where the likelihood of adoption of the required works by relevant land managers is high. INFFER has been used throughout Australia in nineteen of the fifty six natural resource management regions and in several state government agencies. The first northern hemisphere trial is currently being undertaken with the University of Florence and there is strong interest in North America. Other partnership opportunities are being investigated through Europe and the United Kingdom. This paper will outline the lead author's experiences in using INFFER by presenting a case study application from Western Australia and discuss the strengths it offers over more conventional environmental approaches.

213 **Wild design: principles to guide ecological restoration in protected natural areas**

Eric Higgs, Richard Hobbs

In an era of rapid environmental and ecological change restorationists are asked to make timely judgments about interventions that stray far from experience and from the comfort zone of traditional ethical practice. For instance, should species near the limits of their present range be assisted in moving to new locations? How much intervention is justified, and on what basis? What is the risk of doing harm in attempting to correct a problem? I apply a version of design practice, wild design, to ecological restoration, and outline a framework based on seven principles (clarity, fidelity, resilience, restraint, respect, responsibility, and engagement). Design is the intention and planning behind any action. Wild design refers to intentions and plans that recognize and support free-flowing ecological processes. Thus, there is a critical tension between unrestrained processes (wild) and human intervention (design) in wild design. Protected areas are an exquisite test for wild design. Managers are willing to go more slowly, attend more carefully to the qualities

of the thing or ecosystem, invest greater energy in finding durable approaches, and recognize all the while that posterity is at stake. Therefore, protected areas provide the greatest challenge for working out how to restore appropriately, if in fact restoration is ultimately appropriate. They are also places where there are the greatest restrictions on and resistance to resolute ecological restoration.

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Ecological restoration in Belgium, a practical approach by an NGO

Willem Laermans, Tom Andries

Civil society plays an important role when it comes to actions related to ecological restoration. Different stakeholders are interested in the scarce open space that's still available. Hunters, nature organisations, farmers, local residents, tourists, they all use the landscape. How can we overcome the usual problems and unite our powers on this issue? Natuurpunt is a Belgian NGO (Flemish region) involved with nature conservation which gives volunteers the ability to engage themselves for a better environment. A key factor is to give these volunteers responsibility in local management of sites. These people are organised in local management teams and are supported by professional employees. This volunteer based management gives the local people the responsibility to acquire land and start up the management of the site. Because these people are embedded in the local social network they are the best "voluntary employees" you can have. For decades they managed to establish strong coalitions with farmers. This creates as win-win situation: the nature management is done and the farmers can use the NGO's land for grazing en mowing. Agreements with local entrepreneurs are made to produce local products for example the biol-labelled meat of special nature management cows. Working with these volunteers is at first time consuming but in the long term it pays back (surveillance, local network building, raising public awareness,..). A part of the solution to tackle the loss of biodiversity can be found on the local level and an important base for strong coalitions with stakeholders can be made.

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Comparative examination of potential biotic and abiotic influences on the dynamic of dry grasslands in Brandenburg, Germany

Kristin Meier, Torsten Lipp, Volker Otte

In Brandenburg as well as in Central Europe dry grasslands belong to the highly endangered habitats. The federal state of Brandenburg is home to extensive and diverse occurrences. Within the group of dry grasslands, calcareous grasslands only make up a small percentage due to the regional natural conditions. A huge variety of endangered species can be found there. Many of them reach their westernmost distribution in Brandenburg (i.e. *Campanula sibirica*, *Silene chlorantha*). Not only natural conditions made the existence of calcareous grasslands possible but the very important factor of land use, especially grazing. Changes in land use in the last century have led to a decline and qualitative change in species diversity and vegetation structure. The decline of species is well documented in the Red Lists. The documentation of the reduction of habitats and the changes in quality of vegetation structure within certain areas is lacking, although it would be important to know for nature conservation and restoration.Therefore basic methods for determining the extensive change of calcareous grasslands in Brandenburg have been tried out. For the examined areas no relation between receding area and loss of species diversity could be found. Qualitative changes were more important. Species were surveyed concerning their main distribution. More species than expected outlasted in edges and woody areas. Exposition did not matter. The examined plants were classified by their distribution types to establish whether for instance continental types would suffer from decline more than others. Additionally a valuation of the recent quality took place.

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Subordinate plant species and mycorrhizal fungi: preferential symbiosis association?

Pierre Mariotte, Claire Meugnier, Charlotte Vandenberghe, Edward Mitchell, Alexandre Buttler

Plant communities are composed of dominant and subordinate species with a well-established hierarchy for which soil organisms and particularly Arbuscular Mycorrhizal Fungi (AMF) could have an important role. In pasture communities, 80% of plant species are colonized by this kind of fungi (10 to 30 species in meadows). Recent studies show that subordinate species could be more mycorrhizal dependant and have specific or symbiotic interactions with fungi. This relationship between plant species and soil organisms could contribute importantly to ecosystem functioning. The aim of our study is to test the role of AMF in growth of subordinate and dominant species and bring to light a preferential symbiosis between subordinates and AMF. Two dominant species and two subordinates, determined by relative cover in the field (Swiss Jura, 1400 m a.s.l), were assembled in all possible intra and inter-specific combinations of two plants per pot containing sterilized substrate. These combinations were reproduced two times, with and without AMF inoculation. Above- and belowground plant biomass, rate of AMF root infection and fungal biomass will be measured for each species and each pot. Results of this experiment will show whether AMF are important for growth and competition success of dominant and subordinate species and whether they form specific interactions with subordinates. On a broader scale, our study will help to understand the role of Arbuscular Mycorrhizal Fungi in plant community structure, particularly in the hierarchy of dominant and subordinate species, and in ecosystem functioning.

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Preliminary results of monitoring the changes in field layer of restored wooded meadow

Elle Roosaluste

Fennoscandian wooded meadows are one type of seminatural grasslands that have been considered to be extremely rich-in-species plant communities. During last decades their area has dramatically decreased due to changed agricultural activities and nowadys wooded meadows belong into the list of seriously threatened ecosystems. The restoration and following management of wooded meadows is subsidized by European Union and local governments but by many reasons this process has not been very successful. Restoration and management of seminatural communities is more continuous on protected areas but usually some difficulties are met there too. The present study has been proceeded on small island that belongs to the Hiiumaa Islets Landscape Reserve. The island was settled for hundred years and managed by traditional way (grazing animals, mowing, cultivating land) but now abandoned already for 40 years. The administration of reserve started with restoration of wooded meadows on this island in 2005. During 5 years the tree and shrub layer has been gradually removed and partly the aim – plant community with sparse oak stand –has been achieved. For long-term monitoring of changes in the field layer in summer 2005 20 permanent sample plots (1 x 1 m) have been marked and described and it has been continued for 5 years. For analysing the preliminary results of restoration process the data collected on sample plots was set into tables, the frequency of species was calculated and the course of adding of new species was found out. The differences between mean numbers of plant species found during different years on sample plots were compared by analysis of variance (one-way ANOVA). The preliminary results are the next: the mean number of species on sample plots has been significantly increased (in 2005 – 10,80±0,75, in 2009 14,45±0,96); the main reason of positive change is the increasing number of herbaceous species; comparing with the first year altogether 11 new species were found on the sample plots; the most frequent persistant species were seedlings of *Acer platanoides*, *Fraxinus excelsior* and rhizomatous forest herbs like *Convallaria majalis*, *Hepatica nobilis*; the most frequent new species were annuals (for example *Alliaria petiolata*, Cardamine impatiens); the initial vegetation consisted mainly from shadow-tolerant plant species but after thinning the tree and shrub layer light-demanding species started to invade on sample plots; the restoration process of typical vegetation of wooded meadow is very slow but remarkable changes took place even during very short observation period.

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Pioneer conditions are steering for river grassland restoration

Kris Van Looy

Major challenge in restoration projects is increasing the diversity and abundance of indigenous species. For the restoration of a specific plant community with its diversity and composition, the question is whether and to what extent the initial floristic composition is determining the success of the final recovery. Over an extensive set of newly created restoration sites for dry river grasslands along the River Meuse, a multilevel experiment design was drawn. Different restoration techniques were compared for the realised diversity at different scale levels. The spatially nested sampling design allowed to distinguish between spatial and local factors determining the developments. Based on our results, we conclude that the regional species pool and aspects of dispersal limitation and river influence are much stronger reflected in the pioneer vegetation than the local topography and soil conditions. The applied restoration practices proved successful in the recovery of target species. They showed significant effect for species richness yet did not affect vegetation cover nor richness or abundance of non-native species. As the enhanced restoration practices of sowing and topsoil translocation might hamper the expression of the local species pool and the river influence, uncertainty remains for the effectiveness of these practices with respect to the development of the target communities.

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The role of drought years in forecasting restoration success – case studies from Hungary

Katalin Török, Rebeka Szabó, Katalin Szitár, Balint Czúcz, Tibor Szili-Kovács

The area and habitat diversity of Pannonic inland dune habitats and sand steppes have considerably decreased in the past century in Hungary due to intensive agricultural production and the dropping level of groundwater. The socio-economic transition in the 1990s together with the water shortage induced broad scale landuse changes: abandonment of cultivation on nutrient-poor soils, further expansion of alien tree plantations and spread of invasive species on degraded areas. Open sandy grassland and other sandy steppe habitats were particularly affected by these changes. Therefore different restoration methods had to be applied in order to regain some of the former area of these Natura 2000 priority habitat types. Effect of restoration treatments was analyzed by comparing trajectories of vegetation development in control and treated plots. A general influence of summer drought was detected for each treatment. Drought response of species life history types was different, resulting in altering succession trajectories during restoration trials. Vegetation composition was altered according to the severity of drought. As climate change models predict higher temperatures and less precipitation in summer for the lowland of Hungary, the probability of drought years increase. This implies an increased uncertainty of restoration success that should be taken into consideration during planning and hypothesis development.

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Restoration of the tidal lagoon of the Zwin

Jean-Louis Herrier, Marc Leten

The tidal floodplain of the Zwin between Knokke (Belgium, Flanders) and Cadzand (Netherlands) is a border-crossing relic of the sound that once connected the medieval ports of Damme and Sluis with the North Sea and gave Bruges its golden age. Historic land reclaim, that only ended in 1872, reduced the Zwin to a tidal lagoon with a superficies of only 200 hectares, comprising salt mashes, mudflats, tidal gullies and coastal dunes. Once an important sanctuary for coastal bird-species, the Zwin is in both concerned European Union member states included in the European Natura 2000-network. Since the years 1980, accelerated silting up of the lagoon and gullies and encroachment of the salt marshes with Elymus athericus have resulted into a significant loss of biodiversity. The accelerated silting up is caused by the lack of dynamics in relation to the too small scale of the remaining sea-inlet. After the necessary hydrodynamic modelling and an Environmental Impact Assessment were carried out, it was decided that the floodplain of the Zwin should be enlarged with 120 hectares by moving the sea-retaining dike inland. The Agency for Nature and Forest (Flanders) has, together with the Province of Zeeland (Netherlands), also elaborated an arrangement-plan for the presently existing tidal site. This arrangement-plan prescribes rejuvenation of the salt marshes by cutting off sods and grazing

by cattle and livestock as well as restoration of a tidal lagoon and expansion of the main sea-inlet by excavations.

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A long term ecological restoration project for the dune habitats in northern Tuscany

Antonio Perfetti, Leonardo Lombardi, Francesca Logli, Luca Puglisi, Linda Colligiani, Andrea Porchera, Olga Mastroianni, Mariaceleste Labriola

A four-year project was realized in an ecologically complex area, with 8 dune habitats and 7 hygrophyl habitats included in the Natura 2000 network. The project involved about 80 ha of dune habitats and 8 km of coastline in a protected area of northern Tuscany that is actually an ecological island surrounded by artificial areas. The area is subjected to overtrampling because of tourism pressure (bathing and sexual) and the invasion of *Yucca gloriosa*. These pressures caused direct and indirect degradation of dune ecosystems in the last 70 years with the trivialization of biodiversity and the simplification of the dune morphology. Since 2006 a series of direct and indirect actions led to the closure of over 100 main pathways, the concentration of people flow on the remaining 20% through special panels and wooden structures, the quickly rebuilt of dune morphology by fascines and the elimination of Yucca cenosis. The monitoring of botanical and zoological variables evidences the gradual recovery of the habitats where human disturbance is reduced or ceased. Examples of measured variables are the cover and density of psammophilic vegetation and invasive plant species and the number of reproductive territories of *Calandrella brachydactyla* and *Charadrius alexandrinus*. Besides the difficulties, techniques and results are analyzed in relation to the ecological processes restored to achieve the improvement in the vitality of habitats and species included in Habitats (e.g. Coastal dunes with Juniperus spp.) and Birds Directives and the recover of processes and services of previously damaged ecosystems in a landscape perspective.

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Environmental filters effects in spontaneous succession. What implications for restoration of maritime cliff-top vegetation?

Jérôme Sawtschuk, Fréderic Bioret, Sébastien Gallet

As in many touristical regions, in Brittany impacts of human activities have resulted in the destruction of coastal cliff-top heathland and grassland vegetations in touristic sites. The awareness of loss of these natural habitats has led land-managers to reduce human pressure. In many degraded sites, access to the area has been restricted for vegetation restoration by spontaneous succession. A description of such passive restorations process allows assessing the key factors limiting system development in aims to develop a minimum intervention restoration approach. In coastal cliff-top degraded vegetation, these key factors are based on the nature and intensity of the degradation, but are also linked to the high-stress environmental conditions linked to the sea proximity. Succession rates are subject to the influence of factors that affects recruitment and growth and tend to be slower in unfavorable environments where new species must pass environmental filters. Environmental filters effects were studied in touristic sites of Belle-Île and Groix islands, where restoration operations have just started. Vegetation surveys were located on transects starting next to the cliff top where stress exposure is maximum and going inland to compare spontaneous succession according to stress exposure. Various degradation levels were surveyed to describe initial degradation effect, with compaction and seed bank measurement. Significant correlations exist between vegetation changes and distance to the sea and initial degradation level. These results contribute to explain observed differences in passive restoration operations. It also stressed on that a slow restoration of cliff top vegetation must not be systematically seen as a failure, especially in stress-exposed site.

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Chemical and biochemical properties of the soil as potential tools for monitoring woodland restoration in south western Western Australia

Katarzyna Bialkowski, Robert Archibald, Giles Hardy, Treena Burgess

Forest certification is encouraging Australian plantation companies to manage biodiversity within their estates, especially within native woodland remnants which serve as important habitat for fauna and flora. However, many remnants have been degraded by soil nutrient enrichment and weed invasion, and so support less native biodiversity. We investigated the suitability of a range of chemical and biological measures to monitor the condition of the soil in degraded woodland remnants so that the effectiveness of restoration treatments can be accurately assessed. Remnants were within Eucalyptus globulus plantations from south western Western Australia. Small-scale restoration trials conducted over one year were performed with herbicides (glyphosate and simazine) and mulching with plantation harvest residue. Soil potassium content, basal respiration, - glucosidase and fluorescein diacetate hydrolysis activities have shown the potential to detect changes in soils caused by these treatments. Glyphosate, but not mulching, significantly improved the condition of the soil, as judged from a comparison with the reference sites (intact native woodland and pasture). The assessment of the remnants condition using these same soil measures concurred with the classification of site type. We concluded that a combination of chemical and biological soil properties can be a sensitive monitoring tool for tracking the progress of restoration in the native woodland remnants.

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Resilience of the transition forest following slash-and-burn cultivation near Andohahela National Park, Southeastern Madagascar

Melissa De Wilde, Elise Buisson, Fidisoa Ratovoson, Richard Randrianaivo, Jimmy Andrianirina, Stéphanie M. Carrière, Pete P. Lowry II

Prior to implementing a restoration project, the need for restoration must first be identified. Gathering baseline ecological information on the reference ecosystem and studying its resilience are thus priority tasks in restoration planning. Resilience is defined as the time period or the process through which an ecosystem (or community) returns to its reference trajectory after a disturbance. The current study investigates the influence of now-abandoned rice or manioc/corn slash-and-burn cultivation on resilience of a transition forest. The study sites are located in the transitional zone midway along a precipitation/altitudinal gradient across a corridor between two large parcels of Andohahela National Park: an upland parcel of humid forest and a lowland one with dry forest/spiny thicket. Restoration of gaps in this narrow, sinuous corridor may be essential to retain connectivity as the impacts of climate change are likely to be particularly severe in this region. Vegetation surveys were carried out in February & March 2009 on 23 plots abandoned and left fallow for two to more than 30 years; adjacent transition forest was sampled as controls. Soil analyses were also carried out. Plots are not colonized by forest species but by *Mimosa delicatula*. Succession thus leads to a dense thorny thicket of Mimosa and restoration possibilities will be discussed.

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Post logging ban timber tree planting in Southeast Asia: Cases of Philippines and Thailand

Yonariza

Two decades ago, Thailand adopted total logging ban policy in natural forest and the Philippines applied logging moratorium in most provinces. These restrictions of logging in natural forest caused a serious domestic timber supply in both countries, but at the same time opening new market opportunities for planted timber. Nevertheless, the process of timber tree domestication in both countries take different paths where Thailand promote local tree species, the Philippines adopted exotic species. Yet the bureaucracy of planted timber, i.e; planting registration, harvesting and transporting permit follow the same path. This finding has far reaching implication on the future of small holder forestry in the tropic. This paper aims at 1) discussing post logging ban tree planting policies and practices in Thailand and Philippines, 2) examining the small holders response, 3) discussing the future of tree planting from the point of economic and environmental values of the planted trees. Based on recent field work in Thailand and Philippines, this paper argues that the future of small holder forestry would depend on incentive availability.

These include market incentive, government subsidy, environmental service payment, and other locally available incentive.

226 **National native plant materials development program: ensuring options in a changing climate**

Peggy Olwell

Following record breaking wildfire seasons of 1999 and 2000, Congress directed the Bureau of Land Management (BLM) to develop and implement a program for site appropriate native plant materials. The Native Plant Materials Development Program (NPMDP) is coordinating organizations around the country to collect, curate and conserve plant diversity. With the assistance of more than 500 partners, BLM is leading the Interagency NPMDP to ensure the quality and quantity of genetically appropriate native plant materials are available commercially for restoring native plant communities across the American landscape. Developing a crop from native wild species begins with seed collection. Seeds of Success (SOS) is the native seed collection phase of the NPMDP. SOS makes the primary collections needed for restoration following disturbances and for use in climate adaptation strategies. Nearly 100 teams working nation-wide have contributed to the more than 9,500 collections in the SOS National Collection. Climate change is altering native plant communities at a greater rate than previously anticipated and effects on native plant communities could be extensive. To avoid the threat of habitats dominated by monocultures of invasive species, we may need to move and establish native plant materials to more northern latitutdes if plant communities cannot adapt to climate change. Developing native plant materials and having native seed stored in long-term storage and available commercially for restoration will provide federal agencies with important tools to help address threats to natural systems posed by destructive events such as wildfires, invasive species, and climate change.

227 **Building bridges between researchers, farmers and NGOs to develop a collaborative native seed program**

Nancy Shaw, Berta Youtie

The Great Basin Native Plant Selection and Increase Project (GBNPSIP) was initiated by the USDI Bureau of Land Management's National Native Plant Development Program and Great Basin Restoration Initiative in 2001. Project objectives are to increase the availability of native plant materials, particularly wildflowers, delineate seed zones, develop seed technology and cultural practices for agricultural seed production, formulate guidelines for establishing multispecies seedings, and provide demonstration areas and science delivery. Because of the varied disciplines required to accomplish project goals and the large number of species involved, objectives and challenges must be prioritized and cooperators sought. Species were selected by surveying land managers and resource specialists across the Great Basin. Research cooperators are recruited from botany (seed biology, plant geography), forestry (seed zone delineation, climate change impacts on vegetation), plant materials development, agronomy (seed production practices), and entomology (pollination biology, seed predators). Commercial seed increase requires collaboration with private sector seed growers willing to accept the challenge of producing species new to the native seed market and the accompanying seed production and marketing challenges. Also essential is collaboration with seed regulatory agencies to solve problems related to seed certification and testing of wildland species. Developing effective technologies for repairing rangelands damaged by human activities, invasive exotics, and changing wildfire regimes, entails research in the areas of species biology, interactions of native and exotic species, seeding technology, equipment development and improved wildland monitoring systems. Results are improving the ability of public land managers and private land owners to restore diverse, functional native communities.

228 **Seed certification tracks the natives from wildlands to restoration**

Stanford Young

Native species plant materials utilized for restoration are often chosen on the basis of price, convenience, or desperation. Such materials may be mislabeled as to species, or have a provenance that is not a good match with species genetic variability structures and/or physical and climatic environmental conditions of the planting site. A preferable choice would be to obtain seed that has been increased from remnant wildland populations or formal stock seed banks of a desired species, thus establishing genetic identity. Genetic purity can then be tracked through field or nursery production, marketing, distribution, and planting. This procedure is expedited by the Pre-Variety Germplasm (PVG) seed certification program, a third-party inspection and labeling protocol developed by the Association of Official Seed Certifying Agencies (AOSCA). Native seed procurement for large fire rehabilitation plantings in the Great Basin (Western U.S.) has been greatly facilitated by the AOSCA PVG and associated stock seed maintenance programs. The certification process for wildland seed collection and cultivated production includes filing applications, proper permitting for wildland collection, wildland site and/or field or nursery inspections, monitored harvesting, seed conditioning, and seed sampling procedures, seed purity and viability analysis, and tagging of seed lots to signify completion of certification. The process is efficient and economical and easily recognizable in the marketplace. It provides accurate provenance and production documentation for those seeking site appropriate native plant materials.

229 **The complex business of farming native seed**

Jerry Benson

Growing plants for Nature's purposes, as well as our own, causes us to change our focus from agronomic paradigm to an ecological one. The shift in purpose and genetics between the two ideas is large. A transition in cultural method and decision-making must take place in a partnership between producers and end-users. Where ecology is ascendant, disengaging project outcomes from the production process will not work. The complex work of restoration now becomes more so, as those stakeholders must learn to be a new kind of farmer.

230 **Restoration and enhancement of Atlantic salmon populations: what we have learned from North Iberian rivers**

José Luis Horreo, Gonzalo Machado-Schiaffino, Ivan Gonzalez Pola, Eva Garcia-Vazquez

North Iberian Atlantic salmon populations are extremely vulnerable, as corresponding to the southernmost edge of the species' natural distribution. They are experiencing a sharp decline the last decades, associated with global indicators of climate change. Efforts have been made for restoring those populations and stopping their decline, principally based on stocking, supportive breeding and habitat restoration (enabling accessibility to upstream spawning sites). The efficacy of the different measures has been different. In this study, focused on the central part of the region that contains the largest Spanish populations, we demonstrate that accessibility and habitat improvement has been the most efficient for increasing population censuses. Supportive breeding accounts for some level of census increase up to 10%. Finally, stocking should be discarded as a restoration method because it encompasses threats to natural variation of Atlantic salmon and also its sympatric species brown trout.

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Ecological restoration of Atlantic salmon according in the Adour catchment with special references to biogeographical structure

Jérôme Le Gentil, David Barracou, Jean-Claude Salavado

In a context of ecological engineering studies, genetic tools and biogeographical approach can be useful to evaluate the right and pertinent scale approach and the success of the population restoration. Ecological monitoring is essential to evaluate the effects of river restoration projects. Localised in the western Pyrenees, the Adour catchment has suffered until the 1970s from impassable dams, pollution, and habitat degradation, which have provoked fish population declines. Recently, many fitting up actions have occurred in order to increase upstream accessibility. Atlantic salmon, a migratory fish often considered as an umbrella species, has been chosen as a global indicator of Adour river restoration. This species has also a special social-economic interest (e.g. anglers and river managers). Reproductive success was monitored among the river, while 920 salmons were genotyped at 12 microsatellites loci to determine the population geographical structure, to define the migration fidelity and to participate to the restoration evaluation. The accessibility restoration has favourably profited to the wild populations, who re-colonised several areas of the tributaries and rivers upstream parts, with isolation by distance pattern. According to assignment tests, several rivers and tributaries among Adour-Nivelle catchment showed particular populations and genetic fingerprints. Both at local and at regional scale, Atlantic Salmon had a well defined structure, thanks to an important, but non-strict, spawning site fidelity. Upstream areas showed higher salmon productivity, which confirm the interest to restore connectivity at various landscape scales and to consider ecological restoration at the whole catchment.

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Multidimensional ecological modeling applied to the management of *Loendro Laurisilva* habitat in northern Portugal

Paulo Miguel Pereira

The Rhododendron ponticum ssp baeticum *LoendroLaurisilva* habitat is characteristic from river gallery in three different locations, many kilometers apart from each other. The disjunt distribution of *Loendro* is first explained through a regional model applied to the Iberia Peninsula; this distribution in northern Portugal (Caramulo mountain), southern Portugal (Monchique mountain) and southern Spain (Ajibe Mountain) responds to a climatic envelop very specific: low values of continentality (difference of august maxim temperature and January minimum temperature) and precipitation above 1000 mm, in acidic soils are the main variables found to be common to the three locations where the Loendro is found. In Caramulo, a local ecological model was applied within this climatic envelop. At local scale, *Loendro* is found in river galleries of Alfusqueiro and Alcofra, always with sharp margins, with a altitudinal range between 300 m and 1000 m. From the 120 prospection points predicted by the model, 80% resulted in positive for this species. This knowledge was applied to the prospection of new populations of *Loendro*, allowing to enlarge the former botanical reserve from 23 ha to more than 1000 ha. The ecological model at local scale will be also the base to an action plan to the *Loendro* Habitat, to develop within AARC project (Interreg IVB) and also will give a future candidature to Life & funds.

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Consideration of population genetic structure and local adaptation for increasing the chances of success in Atlantic salmon population restoration programmes

Philip McGinnity, Jamie Coughlan, Tom Cross

Some of the most productive Atlantic rivers in the Northeast Atlantic area have been harnessed for hydro-electric power generation. Consequently large areas of productive habitat upstream are compromised. In compensation, salmon mitigation programmes using hatcheries were established in order to make up for the loss of this productivity, to maintain natural runs and to preserve biodiversity. Despite best efforts of these hatchery programmes many of the salmon populations above these facilities are effectively extinct. The large hatchery programmes continue to exist but are increasingly coming under the spotlight from cost benefit analyses and their success in maintaining fisheries, supporting natural production through stocking and protecting biodiversity. Most of these mitigation schemes were developed many decades ago before much of the contemporary information about sub species population structuring was developed. It would seem timely

now to reassess and redirect mitigation programmes with respect to the large body of evolutionary, population and quantitative genetic knowledge that now exists particularly with respect to meta-population theory, landscape genetics and new knowledge about the biology of the salmon (effective population size etc.). A stock restoration strategy that reproduces natural re-colonisation processes by combining knowledge of ecological and evolutionary biological principles could increase the chances of success. In this poster we describe initial stages of a new project funded under the Atlantic Area Inter-reg Programme, to be undertaken in the Shannon River system, which will attempt to test the potential effectiveness of this approach.

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Change and recovery of plant after flooding events, Upo Wetland

Gu Yeon Kim, Hyun Hee Son, Gee Jae Joo

An evaluation of the effects of flooding on the limnology of a riverine wetland ecosystem, the Upo Wetland, was carried out. The physico-chemical and biological characteristics were monitored biweekly. The annual water level changes in the Upo Wetland were small (<1m) except for the flooding period in summer (Jun. ~Sept.). During the study period, flooding events occurred two or three times a year. Water levels rose to 2 ~2.5 m due to precipitation in the catchment and inflow from the main channel of the Nakdong River. Most of physico-chemical parameters and plankton dynamics in the wetland during the summer were greatly influenced by flooding events and the growth of free-floating plants (*Spirodela polyrhiza*, *Salvinia natans*). Significantly lower dissolved oxygen (Jun. ~Sept, 4.8±2.4 mg/l; Oct. ~May, 9.7±3.6 mg/l) was observed due to the active growth of free-floating plants. Overall lower conductivity (Jun. ~Sept, 250±149; Oct. ~May, 416±89) levels were observed during rainy summer. Flooding was found to be an overriding impact on free-floating plant species abundance and total surface cover. In each year, the decrease in *Spirodela polyrhiza* density was observed during the flooding season. Surface covered by *Salvinia natans* increased after the flooding. Flooding event is considered to be one of the most important physical characteristics of the wetland.

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Changes in landscape ecological structure and diversity of plant associations 15 years after the restoration process of Lake Piskory

Chmielewski T. J., Sender J., Chmielewski Sz., Kolejko M.

Lake Piskory is situated in CE Poland, in the south-eastern part of the Vistula River spillway about 7,5 km from the mouth of the Wieprz River to the Vistula River. At the beginning of the 70's years of the XX ct. Lake Piskory was shallow (max depth 2m) and covered with rush communities of a total surface area of 126 ha. Nevertheless, drainages of surrounding grasslands after the 70's and 80's diminished water supply to the lake. Further improper management of water resources caused progressive disappearance of the lake to its total drainage in 1990. The restoration project was elaborated in 1993. According to a stability over damming the outflow and rebuilding of the supply system, water mirror has been completely reconstructed. In 2010, 15 years after the project was finished, a trial to evaluate the ecological effect of Lake Piskory restoration was undertaken. The realization of Lake Piskory restoration project brought very important ecological effects. Those results were stable during the decade. But the last five years of investigations showed that plant associations overgrowing all the lake surface. The elevation of water damming level and the steps to increase the habitat diversity and create conditions for general improvement of biological diversity of Lake Piskory were taken according to the researches made at the of the 80's and in 1973. Water mirror range and the surface area of particular plant communities showed fluctuations depended on climatic conditions in the following years. During dry years the surface area of reed rushes visibly grew, while the extent of valuable submerged charophyte meadows decreased. That's why a maximal retention of spring malt waters and summer rain waters is crucial to maintain the stable biological diversity of Lake Piskory. The diversity of avifauna has been strongly increased together with the rush communities development.

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Development of a tool for restoring and managing wetlands within a ski area – example of the ski resort of Val-Thorens

Stéphanie Gaucherand, Alain Bédécarrats, Francis Isselin-Nondedeu

After the construction of a water catchment for artificial snow, the ski resort of Val-Thorens and the SETAM (Société des Téléphériques de Tarentaise Maurienne; Tarentaise and Maurienne' cable-car society) must propose remedial and compensatories measures for the environmental impact on the protected plant Silene sudetica (red list of protected species). The Vanoise National Park has initiated a project, financed by the SETAM, to improve the management of the wetlands. Indeed, many wetlands have been destroyed or deeply disturbed since the creation of the ski area. The main part of the watershed is located between 1900m and 2400m and is formed by a network of wet peat meadows, mesotrophic ponds, streams and meadow brooks. The study has begun in 2008 and is leaded by the Cemagref of Grenoble. We present the two firsts phases of the restoration project: the knowledge of the reference ecosystem and the planning of the restoration. For the first phase of the project, we used aerial photography, soil and water measurements and floristic dataset to know how was the structure of the wetlands and of the watershed before the construction of the ski area. This method allows to specify the impacts that the different types of construction (ski slopes, cable-car building, roads...) have had on the wetlands. In the second phase we show how we reached a compromise between the managers of the ski resort, the scientists and the feasibility of the restoration techniques and procedures. We discuss the relevance of the compensatories measures.

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Ecological Restoration and rehabilitation needs of Bolkar moutains lakes, Turkey

Gulsun Omeroglu

Bolkar Mountains extend 560 km parallel to the Mediterranean coast of Asia Minor in Turkey; form the southern border of the Anatolian Plateau. Species richness of these mountains is high. Taurus frog, *Rana holtzi*, WERNER, 1898 is one of the local endemic species to Karagol and Cinili Lakes as core areas in Bolkar Mountains. It has been on the IUCN Red List, Threatened Species List. Twenty years ago *Cyprinus carpio* and *Salmo trutto* were put into Karagol Lake. Although the Ministry of Environment and Dokuz Eylul University carried out some projects with local people to rehabilitate Karagol Lake, *Cyprius carpio* is still a big threat to *Rana holtzi* and its natural habitat. Recently, landscape management tries to minimize adverse effects of human development. Latest scientific data show that ecological restoration is a popular subject restoring the damaged ecological value of fragile ecosystems. Thus, ecological restoration emerges as one of the most important drivers of landscape ecology. Some concepts such as ecological corridor, core area, buffer zone entered our lexicon representing a critical step in landscape management in conservation of biodiversity. Protecting of core areas needs to be integrated into various ideas such as restoration issues. This new approach might help us to find the sustainable solutions about natural habitat of *Rana holtzi*. The aim of this presentation is to point out that Taurus frog's habitat needs to be rehabilitated by ecological restoration with the new approaches in Bolkar Mountains.

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Ecological restoration of the Lower Prut Floodplain Natural Park – through the project LIFE 05 NAT/RO/000155

Gina Alina, Anastasia Lescai, Viorica Capatin

The Lower Prut Floodplain Natural Park (8247ha) placed alongside of the lower floodplain Prut, eastern border of Romania with Republic of Moldavia, covers a vast range of natural and habitats with a stunning diversity of flora, fauna and avifauna, not only national, but also European, interest. It is the route of three major corridors for migratory birds on the Eurasian territory (East Elba route, Carpathian route and Pontic route), included in the European ecological network Natura2000 as SCI - ROSCI0105, Lower Prut Floodplain (5656 ha), and as SPA - ROSPA0071, Prut Floodplain - Vlădești – Frumușița (7657 ha), also.Restoration of the specific habitats for aquatic birds (Pochina Vlăscuța and Mața-Rădeanu Lakes), through the activities provided by the project LIFE Nature LIFE05NAT/RO/000155 "Ecological Restoration of Lower Prut Floodplain Natural Park" consisted of rehabilitation works so that to ensure the water balance of the wetlands, securing the future of this special areas of conservation.The results of the restoration activities of the project mentioned above, focused on the improvement of the conservation status of the most important

aquatic bird species (especially from Annex I of Birds Directive), its were disseminated through permanent release of information in order to raise the awareness of local and regional stakeholders, to ensure the straight way of recognising the management plan and conservation efforts as the most important and useful step in protecting the natural habitats (please see site: www.luncaprut.ro).

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Ecology and conservation genetics of the endangered banded newt *Triturus vittatus vittatus* in northern Israel

Oren Pearlson

In order to establish ways to protect and restore the damaged habitats of the endangered amphibian species, the banded newt, more information is needed concerning their life history, genetic profile, ecological and biological parameters in the breeding sites they inhabit, as well as the anthropogenic and agricultural effects on their presence and absence from different ponds. Findings and records from the last 50 years provide evidence that populations of the banded newt were found in Israel from the cool humid areas in the north to the south, along the Mediterranean coastal plains, where conditions are dry and hot. Today we find that newt populations In Israel are disappearing from many habitats. Biotic and abiotic factors together with genetic analysis of populations from different sites in Israel were studied for four years. Water temperature, pH, dissolved oxygen, electrical conductivity, ammonia and nitrite concentration together with turbidity were measured in the different ponds. Larval growth periods extend between April and July (longest), in ponds located at the highest elevation, while the shorter periods were found in ponds at altitudes in which water temperature is high and the hydroperiod is shorter. Nucleotide sequences of two mitochondrial fragments revealed some variations. Specimens from the pond located at the lowest altitude, most distant from the other sites, with the least annual precipitation, were most divergent due to accumulation of anagenetic sequence changes. This basic data that was gathered will enable us to design the appropriate way for the ecological niche protection and restoration.

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Effect of Phosphorus and Nitrogen on the Growth of Two Forms of *Warnstorfia fluitans* (Hedw.) Loeske

Kairi Sepp, Mati Ilomets

We investigated *Warnstorfia fluitans* in laboratory experiment as a potential nursery-plant species for disturbed peatlands. We distinguished two forms of the species. Stems of the form 1 grow vertically up to 5 cm above the water table and form 2 grows commonly in the water. Main aims of our study were to investigate the effect of N and P addition on the growth of *W. fluitans* and to assess the indication of chlorophyll fluorescence in stress situation. Solutions with different concentrations of NaH_2PO_4 and NO_3NH_4 plus control with no addition of nutrients were added. The two forms of the species responded to the nutrients additions differently. Fertilization affected the concentration of N and P in dry mass, but not directly the growth and production of the species. The value of F_v/F_m for vascular plants approaches under optimum conditions the level of about 0.83. As a rule, bryophytes show lower values. At the beginning of our experiment the difference between the two forms was significant (F_v/F_m 0.73 and 0.50, respectively), but not at the end of the experiment (F_v/F_m 0.70 and 0.72, respectively). PCA analysis showed that growth of one form is limited by N and another by P. As a response to the addition of limiting nutrient the dry weight of the individual shoot increases because of formation of new adjacent shoots. It seems that fertilization may enhance the growth of the two forms of *W.fluitans* and contribute to more rapid formation of the moss carpet on abandoned peat field.

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Evaluation of large scale bog restoration in northwestern Germany – lessons from 30 years of practice

Birgit Sieg, Norbert Hölzel, Till Kleinebecker

In northwestern Germany more than 2000 km² of raised bogs were destroyed or strongly altered by peat harvesting or cultivation. To enhance protection of rare species and to contribute to the reduction of green house gas emissions, in several thousand ha of these bogs rewetting measures have been carried out in the last 30 years. However, in many cases information about restoration success and its most relevant constraints are not available. As rewetting will continue over the next 20 years and will be applied to more than 10000 ha in the area, a better understanding of the development of such sites is needed. Therefore a new project aims at an evaluation of restoration success in rewetted peat extraction areas in northwestern Germany. The study will mainly focus on the temporal and especially the long-term development of cut-over peatlands following restoration measures. To accomplish this, several spatially dispersed sites of different restoration age will be compared concerning vegetation, ground-water table, water chemistry and peat characteristics as well as landscape features. Hindering and favorable factors for the recovery of peatland functions as well as easily applicable indicators for a successful restoration will be identified. The results are meant to enhance the actual restoration practice in harvested bogs. They will also be the basis for the elaboration of an appropriate monitoring program for northwestern Germany

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Influence of lowbush blueberry plantation age on natural biodiversity on abandoned peat production area

Marge Starast, Tea Tasa, Katrin Jõgar

The objectives of this study were to compare the diversity and abundance of arthropods, mosses and lichens on different age lowbush blueberry (*Vaccinium angustifolium* Ait.) plantation on abandoned peat field. Experimental area located in abandoned milled peat field, Tartu County (58°20' N and 26°13'E), South Estonia. The soil type in the experimental area was the Fibric Histosol (Dystric, Drainic), peat layer more than 1m thick. Peat production was finished there in 1986. In 2009 observations were made from 4, 6 and 13 years old lowbush blueberry plantations. No cultivated, pure abandoned peat area was monitored also. In four years old plantation lowbush blueberry plants covered 41% of all plantation area. Same parameter was 99% in 13 years old plantation. Several mosses and lichens occurred in four and six years old plantations. Mostly *Ceratodon purpureus* (Hedw.) Brid., *Polytrichum strictum* Brid. *Cladonia fimbriata* (L.) Fr., and *Cladonia cornuta* (L.) Hoffm. were found. During the study the large number of arthropods was found in pitfall traps of 6 years old and 13 years old blueberry plantation. Considerably lower was the abundance of arthropods in younger experimental variants, including no cultivated variant. Dominating arthropods groups were Collembola, Thomisidae, Lycosidae, Araneidae and Formicidae. The cultivation of lowbush blueberry is successful on abandoned peat field and it helps to diversify natural flora and fauna populations on this area. Our results showed that growing lowbush blueberry may become one alternative to restore abandoned peatlands.

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Is aquatic vegetation removal as management technique a bless or a curse?

Annelies Boerema, Kris Bal, Hans Backx, Kerst Buis, Eric de Deckere, Ilse Loots, Patrick Meire, Jonas Schoelynck

Current land-use and changing climate conditions force lowland rivers to drain larger water quantities during ever shortening time periods. Drainage, however, is hampered by human artefacts such as weirs and bridges as well as by natural occurring aquatic vegetation. To avoid flooding and water related problems, river managers opt to remove aquatic vegetation. This action has ecological and economical consequences for local stakeholder living, working, farming or recreating in and around the river. With this research we tried to gain insight in the ecological, economical and social consequences of vegetation removal in the Nete Catchment (Belgium). The ecosystem goods and services of the catchment were therefore implemented in a socio-economic model. To reach this model, river managers, farmers and local stakeholders were asked to monetize goods and services of a natural river system and to list up costs related to management or damage. These enquiries merged with scientific knowledge of river ecology and -biology show if restoration and management

are bridge builders between nature conservation and sustainable local economic development or generally rather negative for all life in and around the river. By combining science with socio-economic know-how, we addressed the question whether aquatic vegetation removal is a bless or a curse for our society, broadly supported by various stakeholders.

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Macroinvertebrate community in restored salt marshes with *Spartina maritima*

Guillermo Curado, Enrique Figueroa, Jesús M. Castillo

The use of the native European cordgrass *Spartina maritima* (Curtis) Fernald in salt marsh restoration projects is innovative and a few works have monitored its effects on the invertebrate community. This work analyzes the benthic macroinvertebrate community along the intertidal gradient in low marshes 2 years after *S. maritima* plantations in southwestern Iberian Peninsula. These restored marshes were compared with a non-restored salt marsh invaded by South American neophyte *Spartina densiflora* Brongn. and a well-conservated salt marsh colonized by natural population of *Spartina maritima*. The well-conservated marsh and restored marsh showed a higher biodiversity than the other marsh. The benthic macroinvertebrate community of the non-restored marsh presented a lower ecological diversity and a lower density of individual for samples, but there were no significant differences in dominance or evenness with the others marshes. We can conclude that salt marsh restoration with *S. maritima* plantations influences the macroinvertebrate community.

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Monitoring and assessment of a coastal dune restoration, Canet-en-Roussillon France

Stéphanie Grosset, Philippe Richard, Hugues Heurtefeux

South of France Mediterranean coasts are highly coveted places. They are submitted to strong anthropic pressures: urbanization, mass tourism frequentation. The Golfe du Lion that stretches from Spain to Marseille is dominated by sandy coasts. Specific sand dunes can be found on this coast, evolving from west to the east with their own characteristics. Despite their quite strong artificialization these coasts show a range of valuable natural habitats. These ecosystems are valuable for their patrimonial interest as well as for their functional interest for coastal protection. Restoration actions have been led around the French Mediterranean basin for 25 years, but lots of places are not yet protected from human impact and are suffering from destruction and fragmentation. In this context the Canet-en-Roussillon lido (sand strip between the Mediterranean Sea and a lagoon) has been strongly disrupted for 50 years, since tourism is very busy during the summer season. A restoration program was planned on this site in order to restore the system: the action plan was set in 2006, the works were led in 2006 and the monitoring carried out from 2006 to 2010. The site study is based on diachronic analysis of aerial photographs, topographic survey, natural habitats cartography and vegetation monitoring from 2006 to 2010. Dune restoration is based on a double process: restoration of the natural morphology and biological recovery. Successive stages that led to the ecosystem recovery after protection works are described and analysed, and indicators of restoration efficiency were used for its assessment.

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Natural propagule sources for wetland restoration on Rhine's Island (Upper Rhine Floodplain)

Isabelle Combroux-Lazar, Marlène Biessy, Michèle Trémolières

During the two past centuries, the Upper Rhine river has been heavily channelized (flood protection and navigation) and then dammed for hydropower generation. Nowadays, for the 50 km downstream Basel, most of the flows are diverted in a canalized section whereas the regulated "old Rhine" bypassed reach runs a minimum flow. This induced simplification and stabilization of the flood plain from a formerly braiding sector to an actual situation where those two channels are thus fixed and separated by the single island, the so-called Rhine's Island. Within the Kembs hydroelectric station relicensing process some restoration projects were launched by Electricité de France (EDF). One of these projects deals with the re-creation in 2011-2012 of a former braided channel on the Rhine's island. The purpose of these projects is to evaluate, the potential recovery of some aquatic and wetland vegetations after the restoration works. We will thus evaluate the amount of each of the existing propagule sources. Soil seed-bank density is estimated by the seedling

emergence method over the 2 upper meters concerned by the future works within the 100 ha of the restored zone. The drift source of propagules is assessed through net-samplings within the canalized section over a growing season. At least, potential colonization through wind dispersal from surrounding wetlands will be assessed by the analysis of vegetation inventories and cartography of the whole sector.

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Overcoming seed limitation in degraded inland sand ecosystems by epizoochorous dispersal: a five-year restoration project

Linda Freund, Saskia Wessels, Iris Retta, Carsten Eichberg, Christian Storm, Angelika Schwabe

To test the contribution of roaming sheep flocks to the colonisation of seed-limited restoration sites by means of epizoochorous seed dispersal, a field experiment was carried out (2005-2009) on three newly established nutrient-poor deep-sand plots. At the beginning of the experiment, seeds of 14 species typical for FFH-inland sand vegetation were experimentally attached to the fur of sheep. For most of these species, natural epizoochorous dispersal had been documented (Wessels et al. 2008). The sheep were present for 24 hours on the plots (Wessels-de-Wit & Schwabe 2010). Yearly sheep grazing as management was implemented. Within the investigation period 13 target species (e. g. the threatened species *Koeleria glauca*, *Stipa capillata*, *Alyssum montanum* subsp. *gmelinii*) became established. In the course of succession, however, ruderal species were introduced by aerial seed rain. Seed trap investigations showed high proportions of *Conyza canadensis* and *Sisymbrium altissimum*. Ruderalization processes were diminished by grazing. In 2009, target species ratios (target species number/total species number) were about 0.4 (target areas: 0.5-0.8). DCA showed that the plots developed in the direction of target areas. The experiment proves a contribution of sheep epizoochory to the restoration of endangered sand grassland by connecting target areas and isolated restoration sites.

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Recovery of anuran community diversity following habitat replacement

Alain Pagano, Lesbarrères D., Fowler M., Lodé T.

The success of many pond restorations is often poorly documented. Following construction of a highway in western France, a restoration project was initiated in 1999, allowing the assessment of restoration efforts and changes through time. The amphibian communities of eight ponds in the area were surveyed before they were destroyed. Replacement ponds were created according to precise pedological criteria, consistent with the old pond characteristics and taking into account the amphibian species present in each. Data are presented on species richness and ecological factors of the replacement ponds and compared to the original levels. Presence of amphibian species was recorded every year during the breeding period. Species richness declined during the two years following construction of the replacement ponds but increased thereafter, generally returning to initial levels. Species diversity followed the same pattern but only returned to the original diversity in 2003. Pond surface area and depth, along with sun exposure were the most significant habitat characteristics explaining both amphibian species richness and diversity. Similarly, an increase in the number of vegetation strata was positively correlated with anuran species richness supporting the need of maintaining a heterogeneous landscape containing relatively large open wetland areas. Our findings offer initial insight to the maintenance of species richness in disturbed aquatic environments.

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Restoration of species-rich wetland by topsoil removal and seed transfer

Marcus Fritsch, Juliane Drobnik, Christian Storm, Angelika Schwabe

We studied wetland restoration in the model landscape of the Hessian reed, Germany. Before the experiments, the vegetation at the study site was species-poor mown grassland on an ex-arable field. The soil consists of 20-30 cm mineralized former peat above calcareous loam. A target plant community (Cirsio-Molinietum) still exists 30 km away. Obstacles to restoration are eutrophication and seed limitation. We asked whether topsoil removal and seed transfer can override these constraints. Experiment 1: On a gradient with various soil removal depths, seeds of each of four target species (*Carex tomentosa, Cirsium tuberosum, Galium wirtgenii, Linum catharticum*) were sown on 18 plots. Their establishment was studied by assessing abundance und vegetation composition for four years. All four species could

establish themselves, optimally at a soil removal depth of 25-40 cm. Three species were able to colonize their surroundings with less soil removal. Experiment 2: In 2008, 20-30 cm topsoil was removed from 1400 m×. Seeds were transferred by either raked (a) or mown material (b) from the target plant community, in each case applied on 100 m× containing 12 plots. Vegetation was assessed in 2009. Transfer of seeds and establishment of target species were successful, tending to result in (a) higher species diversity, (b) higher cover of target species. Actually, a mean number of 3.8 (a) or 1.4 (b) "red list" species emerged. Conclusion: The experiments give evidence that restoration of a species-rich wetland is possible if abiotic constraints and seed limitation are overcome by appropriate techniques.

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Restoration of the habitat 'humid dune slacks' in 'Hannecart-wood' at Oostduinkerke

Jean-Louis Herrier, Marc Leten, Hannah Van Nieuwenhuyse

At Oostduinkerke, a former tidal channel of the medieval Yzer - estuary that for at least five centuries has been cut off from the sea, still forms an elongated hollow in between two higher ranges of dunes. The lime-rich groundwater of the surrounding dunes seeps to the surface of the hollow, that constitutes a calcareous marshland. Through the centuries the wet hollow was mainly used as hayfields. During the Interbellum and after the second World War, the area was afforested with alders and poplars by its private owners, the Hannecart-family, so that the afforested site was from then on called 'Hannecart-wood'. The site, with a superficies of 31 hectares, was purchased by the Flemish region and soon designated as a nature reserve in 1989. In 1999 a management-plan was approved by ministerial decree. Inspired by historical accounts from botanist Louis Magnel of the very special and rare types of vegetation that flourished in the area at the beginning of the 20th Century, the management-plan imposed the restoration of the habitat '2190 humid dune slacks' by the removal of 6 hectares of withering alder-plantations and bramble bush. Although facing scepticism about the chances of its success, the partial deforestation of 'Hannecart-wood' was carried out in the frame of the LIFE Nature – project 'FEYDRA' (2002 – 2005). The conclusion of the scientific monitoring of the site following the deforestation is that the success of the habitat-restoration is above all expectations.

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Soft shoreline engineering: We built it, have they come?

Michael Zarull, John Hartig, Anna Cook, Mary Bohling

Historically, many urban shorelines were stabilized and hardened to protect developments from flooding and erosion, or to accommodate industry (i.e., hard shoreline engineering). Today, there is growing interest in developing shorelines using ecological principles to reduce erosion and achieve stabilization/safety, while enhancing habitat, improving aesthetics, and even saving money (soft shoreline engineering). In 2008–2009, a survey of 36 soft shoreline engineering projects in the Detroit River-western Lake Erie watershed was conducted. In total, $16.5 million was spent on these projects. Of the 36 projects implemented, only six (17%) had any quantitative assessment of ecological effectiveness. The remaining 30 had no post-project monitoring or only a qualitative assessment. Key lessons include: involve habitat experts up front in waterfront planning; establish multiple objectives; ensure multidisciplinary project support; start with demonstration projects and attract partners; involve citizen scientists, volunteers, university students, and/or researchers in monitoring, and obtain commitments for post-project monitoring of effectiveness up front in project planning; measure benefits and communicate successes; and promote education and outreach, including public events that showcase results and communicate benefits.

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Vegetation development in the restored tidal estuarine wetland

Gu Yeon Kim, Gee Jae Joo, Hee Sun Park, Hyun Hee Son, Ji Yoon Kim

Phragmites australis (common reed) and Scirpus planiculmis is in the Nakdong estuary generally regarded as an ecologically beneficial plant providing habitat and food for endangered wildlife. The artificial wetlands (Eulsukdo, Daemadeung and Shinho-dong) were constructed in the mid 1990s in order to compensate for the loss of wetlands caused by the reclamation of industrial complexes and residential areas. *Phragmites australis* were planted at the artificial wetlands. However, monitoring and evaluation of these newly created habitats at these wetlands after the construction has not been made since the construction in 1996. We investigated the actual vegetation, basic geographical study and water quality at the artificial wetland in Eulsukdo. A total of 73 species of the plants were found in this study. *Phragmites australis* community dominated in this area (about 60% of the vegetation). Density, height and diameter of the reed community were 137±16.9/m2 (n=4), 148±36cm (n=100) and 4.9±1.2 mm (n=100) respectively. We analyzed cross-sectional distribution of vegetation to understand habitat structure and development. The plants found from the cross-section study were *Ruppia rostellata, Scirpus planiculmis, Phragmites australis, Salix* spp., mixed community. Average depth of water channel was 2.0±1.8 (n=20), length was 86.3±7.4 (n=20). From this study, we conclude vegetation development at this site is still poor. Furthermore, a detailed evaluation on the ecology of this habitat is strongly needed.

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Restoring sponges in the Belgian Ardennes

Martine Lejeune

This project deals with natural water retention. It is part of the Interreg IVB project AMICE (Adapatation of the Meuse to the Impact of Climate Evolutions). Floods and droughts are two aspects of just one problem. The idea is that sources areas and floodplains in the upper parts of the catchment basin can play an important role for the whole of the Meuse basin. Condition is they function in a natural way. When the bog, moor and fen vegetation is well developed it acts as a sponge for the sky-water. This presents a double benefit. First, in case of high water the flood is slowed down because the water will saturate the natural sponges first. Only when the sponge is full will the extra water flow into the brooks and the rivers. Second, as the water is kept in the sponges it also has enough time to infiltrate the soil. The water thus kept in the system presents a welcome reserve in times of drought. In the Ardennes a number of small tributaries of the Meuse are being restored to their natural situation by cutting spruce plantations and filling drainage ditches combined with appropriate management. The result is that the natural vegetations of sources and brooks redevelop. This can already be seen in the Emmels and Holzwarche valleys. Moreover research indicates that ecosystems that function in a natural way could very well be more resilient to the impacts of climate change.

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Factors controlling the vegetation dynamic at the roadside: application to new restoration protocols

Enrique García, Ignacio Mola, Maria Dolores Jiménez, Miguel Angel Casado, Luis Balaguer

The increasing global rate of road construction is leading to a parallel increase of areas of degraded environmental conditions. One of the main impacts of road construction is the creation of two contrasted scenarios: the high productivity – low stress embankments versus the low productivity – high stress roadcuts. The main of the present study is to identify what confluence of environmental factors determines the successful establishment and dynamic of the vegetation on this emerging ecosystem. We believe that this knowledge will provide insights that will aid the design of restoration protocols. The experimental study was comprised in two highways, the M-12 and M-13 (Madrid, Central Spain). We selected nine roadcuts and six embankments with similar slope angles. On each road slope three experimental plots were considered: one was hydroseeded with a standard seed mixture, as planned in the construction project, a second was hydroseeded with an alternative seed mixture of autochthonous species, and a third one remained untreated. Annual samples were carried out during three years from 2007 to 2009 for all plots considered. We sampled species cover in quadrat plots (50 x 50 cm) at three different levels, according to a nested factorial design (2 samples x 3 positions x 3 plot x 15 roadslopes). We have

observed that these highly antagonistic environments (enmbankments vs roadcuts) show a convergence in the time regarding some ecological parameters like diversity. This convergence is discussed in the light of the influence of different factors resulting from biotic and abiotic interaction.

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Ground cover estimation on roadslopes: a method using digital photographs analysis

Luis Eduardo SanJoaquin, María Dolores Jiménez, Miguel Ángel Casado, Ignacio Mola, Rocío Torre, Ana Vázquez, Luis Balaguer

Roadslopes have a high risk of erosion and their sediments delivery to the roads drainage systems. After road construction, these new surfaces are commonly hydroseeded to provide plant cover and improve surface stabilization. Total vegetation cover are commonly estimated visually, as this constitutes a standard method for assessing hydroseeding success in infrastructure engineering, but this approach may be prone to observer bias. The aim of this study is to evaluate an alternative method using digital photographs analysis to quantify the ground cover more accurately and efficiently. Study area was located in two south oriented roadcuts on the M-12 highway (Madrid, Central Spain). A total of 20 photographs, 10 per roadcut, were taken on quadrats (50 x 50 cm) to a distance of 90 cm from the surface and vertically downward, using a Canon EOS400D 10.1-megapixel digital camera and a monopod. We used eCognition Developer (an object-based image analysis software) to segment photographs into relatively homogeneous objects, which were further classified using fuzzy logic rule sets into three categories (vegetation, litter and bare soil). Percent ground cover for each category was then estimated. We used a manually cover measurement method (digital grid overlay using SamplePoint software) to evaluate the accuracy of software predictions. We conclude that ground cover estimation on roadcuts by photographic method is a better choice because it: reduces human bias by limiting the influence of human judgment, is more accurate, facilitates extensive data collection and provides a permanent file of images that can be maintained for future examination.

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Habitat suitability models for species selection in ecological restoration: an application to legume shrubs selection for roadside revegetation

Gastón A., García-Viñas J.I., Maroto J., Herrero B., Ropero C.

Shrub planting is a common practice in ecological restoration and is commonly used for roadside management for controlling soli erosion, for reducing headlight glare and for absorbing the energy of errant vehicles. As in any planting activity, an adequate species selection is required to avoid high mortality rates in ecological restorations. Habitat suitability models predict species presence likelihood as a function of environmental variables and may support species selection pointing the species more suitable for the habitat to be restored. Habitat distribution models for legume shrub species in Spain were fitted and validated using presence/absence data from the Spanish Forest Map. A logistic regression strategy was used to predict species presence based on climatic and lithologic variables. Model outputs were used to develop a shrub planting plan for the roadsides of a set of highways in Spain

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Roadslopes soil restoration: the role of decomposer edaphic fauna and soil physic and chemical parameters

Mónica Gutiérrez-López, Dolores Trigo, Mónica Otero, Miguel Berdugo, Ignacio Mola

Soil degradation in artificial roadslopes areas shows severe erosion causing the loss of natural soil fertility. Understanding the factors that regulate the decomposition of residues and their contributions to fertility of soil systems is an important area of research. Descomposer biota ensures the decomposition of organic matter in soil, depending on properties of soil like the quantity and quality of plant litter and a range of physical, chemical and microclimatic factors. Microarthropods (usually used as indicators for soil quality evaluation) influence on decomposition through changes in the primary decomposer community and through the increasing of the surface area of plant detritus and faecal deposition for microbial attack. The aim of this study was to evaluate the impact of soil restoration of roadslopes (embankments) near Barajas Airport (Madrid, Spain) on the structure of decomposer arthropods community and their importance maintaining the properties

of soils. Epigeic and endogeic arthropods were sampled from roadslopes areas with different grade of vegetation restoration. Physical-chemical analyses of the soil were performed and weight and cover of vegetation families were estimated. With these data we described (1) the taxonomic and functional diversity of decomposer arthropods, (2) the physic-chemical properties of soils and (3) the effects of different grades of vegetation restoration on the structure of decomposer communities and on the soil parameters. Oribatida mites, Acaridida mites and Collembola were the most important major groups defining areas associated to different levels of restoration. Carbon content, moisture and silts and clays were the principal soil parameters influencing communities.

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Role of plant-plant and plant-animal interaction in roadside reclamation

Rocio Torre, Álvaro Ramírez, María Dolores Jiménez, Ignacio Mola, Ana Vázquez, Miguel Ángel Casado, Silvia Murillo, Luis Balaguer

Infrastructure construction has given rise to novel scenarios. Little is know, however, about the ecological processes driving the state and cycle of these novel ecosystems. Plantations are a usual practice in land reclamation for aesthetic purposes, besides they may play an important role on ecosystem functioning. The main goals are: first, to analyse the effect of plantations (clusters of trees and shrubs) to attract bird dispersers, which introduce propagules increasing the interactions between roadslopes and the surrounding landscape; second, to determine whether clusters may catalyze nucleation processes and species interaction at the roadside. The experimental design was setup in the A-1 highway; El Molar (Madrid, Central Spain).We selected six embankments: three with plantations and three without them. Bird census were carried out during autumn and winter to estimate species richness and density. Avian faeces were collected in traps located in treatment embankments to study the role of birds as seed dispersers. Flora surveys were performed in plots with three types of treatments (plantation with watering, outside plantation with watering and outside plantation without watering). After the study of bird communities, we have observed that main of them were more conditioned by human historical uses of local area than the common protocol activities of landscape restoration. Nevertheless, some bird species appeared to be linked to the clusters influence zones, where the number of faeces was higher than outside them. In sight of these results, we propose that a previous analysis of regional species composition is needed before applying general restoration measures.

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Role of adjacent surrounding vegetation during succession in sites disturbed by mining: additional potential for restoration?

Klára Řehounková, Romana Trnková, Petra Karešová, Helena Dvořáková, Karel Prach

Species composition of (semi-)natural vegetation in close surroundings of disturbed sites is expected to influence the course of succession. However, the exact evaluation of similarity between particular successional stages and surrounding vegetation has only rarely analysed. We present results of several case studies in which surrounding vegetation was considered influencing succession in disused gravel-sand pits, spoil heaps from coal mining and quarries. The mining sites represented stages from 1 to 100 years since abandonment. Nearly 100 mining sites were surveyed and for each of them species composition of surrounding semi-natural vegetation up to 100 m distance from a disturbed site were recorded. The analyses showed: Similarity between species composition in sites disturbed by mining and surrounding vegetation mostly increased during succession and gradually reached nearly 100% in several cases. A similarity to surrounding vegetation was lower if wetlands, including shallow water bodies, occurred in disturbed sites. It can be concluded that in restoration projects it is highly reasonable to preserve all remnants of (semi-) natural vegetation in the surroundings of a disturbed site during the mining or similar activities. The long-distance dispersal (farther than 100 m distance) should be taken into consideration for the establishment of especially wetland species. The findings should be considered in practical restoration projects within mining and post-mining operations.

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Reed margins along drainage dikes in an intensive agricultural landscape: valuable or negligible ecological structures for marshland invertebrates?

Kris Decleer, Johan Baetens, Patrick Grootaert, Didier Drugmand, Leon Baert, Wouter Deconinck, Marc Pollet, Rudy Van Diggelen, Dries Bonte

On 16 locations we sampled the invertebrate fauna of reed vegetations along drainage dikes in an area dominated by intensively used arable land on clay soil. The average width of the reed fringes was 2.5 ± 0.8m. Sampling was done with 3 pitfalls and 3 white water traps on each location. The results were compared with the invertebrate fauna of 6 medium-sized and 6 larger reed marsh habitats along old creeks or remnants of creeks in the same area ("Meetjeslandse kreken", Belgium). The study focussed on Spiders (Araneae), Ground beetles (Carabidae), Rove beetles (Staphylinidae), Long-legged flies (Dolichopodidae), Dance flies (Empididae) and Hoverflies (Syrphidae). Numerous typical wetland species and even several red list species of each taxonomic group were found in the narrow reed margins. Some wetland species were even confined to the latter, as compared to the larger reed marsh habitats. This was most possibly due to the presence of micro-habitats (more bare soil) along the drainage dikes. Our results indicate that narrow reed margins in an intensive agricultural landscape can function as (at least temporary) habitat for marshland invertebrates. It is recommended to preserve, enlarge or create such 'green veins' in agricultural landscapes with fragmented reed marsh habitat in order to improve the local ecological connectivity.

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Mapping, avoidance, mitigation and restoration in environmental impact assessments

Annebeth Hoffmann, Anne Eiby, Jan Rasmussen

Restoration of the ecological functionality in an area impacted by a project, is an important aspect of Environmental Impact Assessments (EIA). In order to find out what is impacted and how this is avoided or mitigated, it is necessary to make detailed mapping of occurences of animals and plants in the given area. This mapping is used in analysis of population structures and ecological connectivity in the area. The analysis forms the basis of the assessment of impacts and the incorporation of relevant mitigation measures in the project. The mapping also forms the basis of a possible monitoring program, a programme which is not required for EIA, and therefore rarely carried out. The work is presented using a case study from a Danish EIA for a road project that has a potential severe impact on locally rare plants and amphibians.

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Biological and technical variables associated with successful plant reintroduction programmes

Sandrine Godefroid, Thierry Vanderborght

Reintroduction of native species has become increasingly important in conservation worldwide. However, few studies have reported the outcome of reintroduction efforts in plant species. Using data from the literature combined with a questionnaire survey, we analysed 249 plant reintroductions worldwide (involving 172 taxa belonging to 62 families) by assessing the methods used and the results obtained from these reintroductions. The objectives were: (1) to examine how successful plant reintroductions have been so far in establishing or significantly augmenting viable, self-sustaining populations in nature; (2) to determine the conditions under which we might expect plant reintroductions to be most successful; (3) to make the results of this survey available for future plant reintroduction trials. Results indicate that survival, flowering and fruiting rates of reintroduced plants are generally quite low. Furthermore, our results show a downward trend with time. We identified various parameters influencing plant reintroduction outcomes, e.g., material type, number of individuals introduced, provenance of material introduced, demographic status of source population, introduction method and management of the out-planting site. The detection of the effects of these variables on reintroduction success is of considerable importance for conservation management. This study also revealed shortcomings of common experimental designs that greatly limit the interpretation of plant reintroduction studies. We therefore conclude by suggesting improvements for the design of future experiments.

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Ranking of plant species: from dominant to subordinate, what's effect of root competition?

Pierre Mariotte, Charlotte Vandenberghe, Alexandre Buttler

Plant community are composed out of dominant and subordinate species which participate to biodiversity and ecosystem functioning but which factors are playing an important role in explaining the relative abundance of plant species in grassland communities? Dominance may be the result of traits for competitive dominance and/or traits for tolerating environment and it is important to disantangle these two situations. In our study, we explore the importance of root competition in dominance and show how it can play a role in the hierarchy of dominant to subordinate species. Five dominant and three subordinate species, determined on the field (Swiss Jura, 1400 m), were assembled in all possible intra and inter-specific combinations with interactions of two species in each pot. Combinations was reproduced two times, the first with toot competition and the second without root competition applied with a PVC barrier. We estimated overall competitive hierarchy from relative yield per plant (above and belowground biomass) and determined species ranking with or without root competition. We showed that competition clearly plays a role in the plant species abundances observed in the field as we obtained similar species ranking from dominant to subordinate species. When we suppress root competition, dominant species maintain or decrease their relative performance (suppression of facilitation) whereas subordinates species do better (suppression of competition). Root competition, which is not very studied on community structure, seems to play an important role in hierarchy of dominant and subordinate species and could be one of essential factors in colonization or invasion processes.

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Restoration of Mediterranean dry grasslands by sowing structuring species

Clémentine Coiffait-Gombault, Elise Buisson, Thierry Dutoit

When an ecosystem is damaged, one of the key factors slowing down natural restoration is weeds recolonizing the disturbed area as they prevent the establishment of characteristics species by covering soils. To restore such ecosystem the best solution is to eliminate weed plant species and change the trajectory by seed introduction. The Nature Reserve "des Coussouls de Crau" is a French Mediterranean dry grassland created by the combination of a dry climate, particular soil properties and 6,000 years of extensive sheep grazing. During this last century, this ecosystem has been submitted to a lot of damages reducing its area to 9,500 hectares. A seed mixture composed of three structuring indigenous steppe species was tested for the first time for the restoration of this dry grassland. The species chosen are two perennials which are the structuring species of the reference steppe ecosystem (*Brachypodium retusum* and *Thymus vulgaris*) and one annual (*Trifolium subterraneum*) which is well known for its ability to quickly cover bare soils. Restoration success was evaluated by surveying sown species establishment, germination and seedlings establishment of four target steppe species sown one year after structuring species and by carrying out floristic inventories. Sowing of the selected native seed mixture can be considered as a success. Sowing 1) reintroduces typical structuring steppe species and 2) has a positive effect on the desired plant community: it decreased weed species and increased steppe species by improving their establishment.

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Physical and biological structure of woody patches determine establishment success of a Mediterranean key species

Beatriz Amat, Jordi Cortina

Woody patches are key components of semi-arid ecosystems. In Stipa tenacissima steppes, patches of sprouting species as *Quercus coccifera, Pistacia lentiscus, Rhamnus lycioides, Ephedra fragilis* and *Juniperus oxycedrus* have been positively related to ecosystem functioning and community composition; but *S. tenacissima* steppes may be impoverished in woody patches as a result of past land use and species failure to establish under current environmental conditions. Restoration practices aimed at increasing the cover of patch-forming species have been promoted in recent years. However, information on patch dynamics and their ability to incorporate new individuals is scarce. Here, we evaluate the effect of woody patches on the establishment of a key patch-forming species, *Pistacia lentiscus*, and explore the relationship between patch physical and biological traits and seedlings establishment. We planted *P. lentiscus* seedlings in four microsites: underneath woody patches, on

the northern and southern edges of these patches, and in open areas and measured seedling survival and growth for one year. First-year survival was two-fold higher in seedlings planted under patches than in those planted elsewhere. Survival underneath patches was mainly explained by slope, patch height and projected area (63% of the variability explained). Survival was also associated with dominant species: most seedlings planted near *Ephedra fragilis* survived, whereas those planted near *Rhamnus lycioides* died. Our study highlights the influence of microsite on establishment success, and provides new insights on population dynamics of patch-forming species. This information will enhance the efficiency of restoration practices in degraded *S. tenacissima* steppes.

266 **Role of rangeland shrubs as safe sites for the restoration projects**

Mohammad Jankju, Hamid Ejtehadi

Nurse shrubs may increase the establishment and survival of their understory plants, by providing a favorable microclimate or by protecting them against herbivores. However, there are suspicions about their capabilities as safe sites. Series of field studies were conducted from 2003-2010 in the extensively grazed rangelands of Iran. The objective was to compare the most common type of shrubs' facilitation in the arid or semiarid rangeland, normal or dry years, north or south facing aspects, and between different nurse shrubs. Results generally indicated higher soil moisture, soil fertility and protection against herbivores but lower sun irradiation and evapo-transpiration, under the canopy of shrubs than in open areas. Canopy facilitation generally increased the species diversity and richness of naturally growing plants. Protection against herbivores was a common facilitation under the all environmental conditions; only being dependent on the canopy structure of the nurse shrubs. On the other hand, shrubs' facilitation for soil moisture was reduced from the beginning towards the end of growth season; it was higher under the medium than the sever drought conditions; besides being higher in the semiarid than the arid rangelands. In conclusion, the most common and persistent facilitation effect of rangeland shrubs was due to protection against herbivory. Therefore, part of the controversies, on the capability of shrubs for being used as safe sites, might be because of paying much attention on the soil moisture and fertility, while neglecting their role for protecting other plants against the livestock grazing.

267 **From buds to seeds: bees are key**

James Cane

Government land managers oversee 40 million ha in the Great Basin of the western U.S.A. Its shrub steppe plant communities include diverse perennial wildflowers, but are widely degraded. Annual demand for 250 tons of affordable wildflower seed to restore Great Basin landscapes can only be satisfied by farming for seed. Sixteen wildflower species native to the region were chosen because they are widespread, common, broadly adapted, and practical for farming. We are studying each species' breeding biology, pollination needs and pollinators; these are often unknown for entire genera or even tribes. None are wind-pollinated. Only Crepis can be autogamous, the rest requiring a pollinator. All but two species sets more seed with outcrossing; some require it. Native bees are the dominant, often only visitors in each floral guild in the wild. We find that these steppe bee communities are surviving wildfire because most species nest in the ground. Where healthy wildflower communities follow burning, wild bees remain diverse and abundant. Most of the candidate plant genera host one or more potentially manageable bee species. Osmia bees abound at 7 of the wildflowers, especially Astragalus, Hedysarum and Lupinus. These legumes in particular share bee species, including cavity-nesting species with management potential. One or more of the 3 agricultural field pollination strategies – hived honeybees, nesting management of native non-social bees, and bee community stewardship – is being developed and prescribed for farming each flowering species.

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Farming native seeds for site specific mixtures and the importance of quality-standards in the wild seed market in Europe

Birgit Feucht

I. Farming wild-seeds of regional origin by indigenous cultivation : After collecting the wild-seeds in their natural habitats they are cultivated as singular species. This suits the purpose to preserve the natural populations and to enlarge the amount of seeds for trade in the next generation. The single species are then recomposed in mixtures for different site-related conditions and the needs of the client. The compositions of the mixtures are created according to the natural plant societies and the region of the future receptor site. The aim is to stay in the same region.

II. Use of seed mixtures : Wild seed-mixtures can be used for example in : bioengineering or renaturalization, species rich borders, greening up of industrial sites, the establishment of vegetation on roofs

III. Quality aspects of wild seeds: Guarantee of the indigenous origin of the basic seed, preservation of a high genetic spectrum, Cultivation of the basic seed in the same region, Preservation of a high germination rate, High purity of the seeds, Control of the flow of goods, All these aspects should be assured by an independent certificate. European seed market for indigenous wild seeds. Because of the influence of the European legal framework on national and regional seedmarkets we sustain the efforts of a European network and the development of European quality standards.

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Seed multiplication: making the most of natural assets – By their fruits we shall know them!

Richard Scott

Landlife has been involved with creative conservation and the delivery of high quality ecological landscapes for over 35 years. In the nineteen seventies and eighties it was almost impossible to purchase native seed of any description, so groups and individuals interested in pioneering these subject areas had to find their own sources, and become adept at locating sites for collection as well as advocating the best possible use of a very precious resource. This presentation addresses the importance of combining the good practice of establishing and producing reliable sources of seed; as well as demonstrating the use of native wildflower seed, and promoting the advantages of these actions, rather than doing projects furtively with little social connection. By showcasing good practice and demonstrating the use seed mixtures in a whole set of challenging scenarios, we can engage diverse groups of people in the process, and deliver principles of environmental justice. In parallel to Landlife's wildflower farming operation, Landlife established the UK's National Wildflower Centre in 2000, and is engaged in a range of initiatives that are as much socially driven as ecologically based. These social bridges are critical if native wildflowers are to be adopted in the kind of large scale landscape scale solutions demanded to address the environmental crisis of our age.

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The EU-Salvere Project: producing native seeds using threshing material and species-rich hay from grasslands

Anita Kirmer, Sabine Tischew

Extensively managed semi-natural grasslands are known for their extremely high biodiversity. This biodiversity can be protected by specific conservation measures but also by using the available seed potential in restoration. Seeds can be harvested with different techniques such as mowing, on-site threshing, or seed-stripping. The use of harvested seed-rich materials in restoration leads to a species composition typical for the concerned region, consequently contributing to the preservation of regional biodiversity. The established ecotypes are optimally adapted to local climatic and edaphic conditions. "Semi-natural grassland as a source for biodiversity improvement (SALVERE)" is a project within the Central Europe program. Until December 2011, eight project partners from six EU-countries are working together to promote the use of native plant material in restoration. Among harvesting techniques, a key issue is quality and quantity of seed mixtures harvested under different conditions. In 2009, 17 pilot projects were implemented and seed mixtures are analysed in laboratory and greenhouse experiments. Together with five old demonstration trials, restoration success was documented on former arable land, species-poor grasslands, and mined sites. The trials comprise different vegetation types (*Arrhenatherion*,

Bromion, Molinion, Deschampsion) and restoration methods (seed-rich green hay and hay, seed-rich material from on-site threshing and seed-stripping). First results show a fast vegetation development and a good establishing rate of introduced species. In 2011, a practical handbook for seed harvest on suitable donor sites and ecological restoration of species-rich grasslands with best practise methods will be published to enhance exchange of knowledge about ecological restoration all over Europe.

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"Native seed production" Seed production of native grasses and herbs in Austria

Bernhard Krautzer, Albin Blaschka

In Austria, many thousands of hectares are restored each year following such infrastructural intervention as road building, flood protection, construction of torrent- and avalanche barriers or as a part of compensation measures. But also other areas like roughs on golf courses, sporting fields, railway reserves, industrial sites, flat roofs and public areas are interesting open space that should be used to provide biodiversity preservation. In the last 20 years the Federal Research and Education Centre for Agriculture (AREC) Raumberg-Gumpenstein, Austria, established systematically a scientific basis for the exploitation, propagation and practical use of site specific grasses and herbs. At the same time the commercial propagation of species for restoration in high altitudes and for landscape construction was set up. Thus, for innovative farmers and seed producers, new possibilities for a profitable, not regulated production emerged. The propagation of site specific species is riskier than conventional seed propagation and bears a much higher complexity. For a viable seed production are costs, yield and revenue essential. Preconditions are above average care, high willingness to take risks and a learning process of several years. At present, about 65 site specific grasses and herbs are propagated in Austria on more than 120 hectares. In addition, a seal for local, site specific seed and plant material as well as a land register of potential donor sites for the collection of native plant material are under development.

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Some novel ideas on payments for ecosystem services to fund restoration of areas targeted through whole catchment surveys and modelling

Dylan Bright

Conservation and resource protection over the years has evolved. By and large, conservation initially took the form of 'fortress conservation' and this is still the most prevalent form in the UK. This approach requires regulation and publicly funded monitoring and maintenance and excludes communities and ignores wider socio-economic costs. The public has become disenfranchised from the subject and the objects of conservation and there is little support and some antipathy for this approach, nicknamed 'fence it and forget it' conservation. What followed was referred to as Community Conservation. Westcountry Rivers Trust was at the forefront of this movement in the UK. Community Conservation depended on the establishment of win-win scenarios for resource managers, in our case farmers. For example the Trust developed an extensive suite of farm advisory information sheets which described how to subtly change management, limiting costs of inputs and preventing losses. Importantly, the recommendations had an economic benefit for the farmer and ancillary benefits for the environment. These integrated conservation and social development projects were the great hope for sustainable development. Their decline in popularity stemmed from the fact that the approach only indirectly linked social development initiatives to conservation. As such, the outputs of community conservation initiatives were often a rise in social welfare, but an increase in the level of conservation could not be ensured. The great hope for the future of conservation is Paid Ecosystem Service provision (PES). PES is a market-based system whereby those who benefit from ecosystem conservation transfer money to those who provide the Ecosystem Services (ES), thus creating a market where none previously existed and incentivising ecosystem protection. Currently, for example, farmers in the Westcountry represent less than 1% of society and yet mange nearly 80% of the land. Farmers manage (for better or worse) the large proportion of many ecosystem services for society including flood defence, water supply, biodiversity, amenity, landscape value, green house gas flux and food production yet they only get paid for the food production. Given this disparity, through PES we would create a direct economic link between those who benefit from flood defence, water supply etc. etc. to encourage them to pay a hypothecated sum to the provider (the farmer) to deliver these services instead of

producing food in critical areas of a catchment. The whole process will be privately funded, decentralised and strategically targeted and we feel it will quickly dwarf the sum of all the 'fortress conservation areas' in the region. PES represents an improvement over other conservation strategies because payments are conditional on conservation, can be more easily targeted to critical areas or ecosystems, and create a direct link between conservation and the welfare of the provider. WRT have developed a PES project in the UK and we will present an outline of this project at the conference.

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Headwater stream riparian restoration: landscape structure importance on the success of ecological restoration of salmon rivers in Normandy, France

Ivan Bernez, Maryline Kneveler, Amandine Merlin, Yannick Delettre, Didier Le Coeur

In a typical bocage landscape in Normandy, France, a research project in ecological restoration is applied to the maintenance of salmon's rivers in an agricultural context. The technical methodology of the restoration consisted of the exclosure of cattle: by the installation of fences and feeding troughs, river managers limit the access of the cattle to the brook to prevent from the erosion. Then, instead of planting trees, as done classically for maintaining the banks, the in situ experimentation, was to test the effect of passive restoration: a "*laissez-faire*" methodology and the ecological consequences was the main objective. Ecological surveys recorded the modification of the riparian vegetation (herbaceous and ligneous species were considered) and some non-target species influenced by the vegetation changes, as butterflies. A method of multivariate analysis treated, on a hierarchical basis, the factors which determine the composition of the riparian vegetation. The principal factors which differentiate the riparian vegetation seemed to be related to the recent anthropic impacts (pasture, with the trampling of banks by animals) and old ones (bocage structure: woodlands and hedges). The secondary factors are related to aspects of hydromorphology and the longitudinal river gradient. In term of richness, comparison between two brooks showed great differences according to island-like system functioning. These riparian changes will strongly contribute to create a connectivity of the woody elements on the brook which did not exist: from 21% of disconnected hedges, one passes to 3 %. On 29 taxa of butterflies, 12 taxa represented less than 10% of the 1864 butterflies observed. Perspectives of evaluation of best restoration practices have to be relevant at landscape scales: that is to consider taxa known as indicators of a landscape quality structure, selection of plants and animals could be proposed and validated. These results are helpful to communicate on the importance on non-target species in a ecological restoration project and on the importance on more communication between managers and scientists with different professional backgrounds, as hydrobiology, landscape ecology, agronomy, etc.

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Building a collection of river hydromorphology restoration examples in France

Josée Peress

Since 2000, the European Water Framework Directive (WFD) has set ambitious environmental objectives for the ecological status of rivers and has put an emphasis on river continuity. However the WFD risk assessments showed that hydromorphological pressures and impacts are one of the most important risks of failing to achieve WFD objectives. Restoring the river's hydromorphology is therefore an important catalyst that needs to be amplified across the French territory in order to improve to the aquatic ecosystems. One way towards multiplying and implementing new restoration projects is the dissemination of past and on going examples and their promotion amongst others who could take on similar actions (associations, local authorities, landowners, ...). This is what the tool "collection of examples" aims to do. The French agency for water and ecosystem (ONEMA) and the six French water agencies (*Agences de l'eau*) have together selected a number of restoration projects that have taken place over the last 20 years on French rivers. Mainly ones that aim to re-establish natural hydromorphological processes such as weir or bank removal, re-meandering. For each of these restoration projects (about 70 of them) are reported not just the type of works carried out but also the context in which the project emerged, the decision making leading to it, the monitoring carried out if there was any, the outcome of the restoration and its valorisation. The collection of examples ("*le recueil d'expériences*") will be available in paper format and can be found at the website http://www.zones-humides.eaufrance.fr

275 **Biogeochemical constraints and restoration perspectives after degradation by atmospheric nitrogen deposition**

Roland Bobbink

Atmospheric nitrogen deposition, from both oxidised (NOy) and reduced (NHx) compounds, is nowadays one of the main threats for biodiversity in European (semi-) natural ecosystems of high conservational value. Long-term nitrogen input from the atmosphere may cause eutrophication, soil acidification and/or ammonium toxicity. The severity of these impacts depends on the biogeochemistry of the particular ecosystem, but is especially severe under oligo- to mesotrophic, weakly buffered soil conditions. Long-term field trials have been set up in deteriorated dry grassland and heathland sites since the early 1990s to counteract the severe impacts of N pollutants. The first aim was to restore former soil conditions, as we feel that rehabilitation of ecosystems should start with recreating appropriate abiotic conditions. Removal of the vegetation and top soil ('sod cutting'), liming or a combination of measures was used depending on the actual biogeochemical constraint after the degradation. The effectiveness was evaluated by following the soil chemistry and plant composition during a 10-12 years period. In this presentation an overview of the experimental restoration measures and the main factors of success or failure are presented. Several (combination of) measures proved to be successful in restoring appropriate soil conditions and a low productive sward. A full recovery of plant diversity was, however, seriously limited when the characteristic species had already disappeared, especially in dry conditions or when it was impossible to increase the soil buffer capacity after acidification. Additional measures to counteract the dispersal limitation of many endangered species may be needed.

276 **A national monitoring scheme for restoration of traditional rural biotopes in Finland**

Carina Järvinen, Katja Raatikainen

The amount of managed semi-natural meadows and pastures in Finland is less than 30 000 hectares, and they form the most threatened habitat type group. Totally, circa 4 400 hectares are situated in protected areas, where the managed area is 3 100 hectares. Generally, clearing of overgrown areas and grazing are the most common management methods, but also mowing, and rarer methods, such as slash and burn or tree pollarding, are used in protected areas. EU agri-environment scheme and support for management of traditional rural biotopes is the most important financing for management. Considerable amount of work is also done in different projects and by voluntaries. Because of limited resources and low amount of valuable areas, the management actions should be powerful enough to maintain the diversity of species and habitat types. In order to evaluate the effectiveness of restoration and proper management actions in protected areas, a monitoring scheme is being compiled. The monitoring scheme includes three levels. First, yearly management actions are stored in Metsähallitus' GIS system. Second, the quality of management in every site is checked every 3-5 years by field observations filled in on a standardised form. Third, a network for monitoring the effects on species and species communities will be established during 2009 - 2012. Focal species group is vascular plants, but also insects and birds are included. Monitoring in protected areas will be a part of larger scale monitoring of traditional rural biotopes in Finland.

277 **A simulation model for the restoration of the vegetation on ski trails under various scenarios of restoration procedures and management**

Francis Isselin-Nondedeu, Alain Bédécarrats

Ecological restoration of high-altitude meadows degraded by ski trails construction or excavation works has two main objectives: 1- to stabilize rapidly the soil, 2- to promote the return of the vegetation with a structure and functioning satisfactory. However, this is a very long process with results difficult to predict because they are linked to the initial conditions of the restoration works and of the management that follows. We present a model which was developed for predicting vegetation changes under various scenarios of restoration and management. It is a mechanistic model based on rules of functional ecology and of ecophysiology rules of alpine plant species. The model is set up as a cellular automaton and simulates the community composition by taking into account (1) the nitrogen content and C/N of the soil, (2) the daily amount of temperature, (3) the local species pool, (4) the

composition of the seed mixtures used for the revegetation, (5) a set of plant functional traits. Results make possible to visualize the trajectories in which the restored ecosystem is engaged. Simulations over 30 years allow to predict the abundance of particular functional groups and species coming either from the seed mixture or from the natural populations surrounding the site. Soil fertilization during the restoration process and thereafter is a key element. For instance, moderate levels of fertilization lead to highest levels of functional and species diversity. The model is useful for planning both restoration and management procedures of the vegetation on ski trails.

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Application of Terrestrial Laser Scanner for monitoring geomorphic evolution of roadslopes under different restoration strategies

Estela Barroso, Fernando Barbero, José Francisco Martín Duque, Saturnino De Alba

Road construction has given rise to extensive degraded areas that require to be reclaimed. Commonly these new areas are hydroseeded to improve slope stabilization against hydric erosion. However, little attention is put on monitoring and understanding the geomorphic factors, which have a main role on ecosystem functioning. In this study we propose the use of Terrestrial Laser Scanner with this purpose. The main aims are: (i) to establish a protocol that enable a rapid and accurate data processing; (ii) to analyze and quantify roadcut surface variations as a consequence of different erosive and sedimentation geomorphic processes. The experimental design was setup on a roadcut located in Torres de la Alameda (Madrid, Central Spain). A total of twelve plots of 10-16x8.5m were selected along the roadcut, where four different reclamation techniques were applied, one per plot and with three replies each one. We used Leica ScanStation2 scanner, with 2mm of resolution, for surveying of the road roadcut before and after the treatments. The point clouds obtained were initially processed by Cyclone 6.03 software. Digital Elevation Models were generated and compared using Polyworks 10.0 software, from which surface variations for each plot were quantified. We conclude that Terrestrial Laser Scanner is a superior choice to assess surface variations because it: facilitates extensive data collection, provides a better approach to studying the evolution of the geomorphologic factors by offering a significant precision, and is a useful tool to determine the more adequate reclamation techniques to achieve the success of the reclamation process.

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Applying Australian-developed monitoring procedure to investigate soil disturbance level in boreal zone

Oili Tarvainen, Anne Tolvanen

An Australian-developed monitoring procedure, Landscape Function Analysis (LFA), shows how well an ecosystem works as a biogeochemical system. The LFA procedure consists of 1) measuring soil surface features in different type of habitat zones and 2) calculating stability, infiltration/runoff and nutrient cycling indices by scoring the measured features. The method is developed by Mr. David Tongway from CSIRO, Australian National University and used widely in rehabilitated former rangeland and mining areas around Australia, but LFA is also used e.g. South African mining areas. Our aim is to calibrate the procedure to boreal conditions and use it in the monitoring of regenerating ecosystems, such as reforested roads. More than 120,000 km of gravel roads have been built to facilitate the transfer of timber and to excavate soil for construction purposes in Finland. Some of these roads are located in recently established nature protection areas. Reclamation of less used gravel roads improves habitat connectivity and facilitates ecosystem processes in protected areas where forest and peatland restoration is also carried out. We have established an experimental study comparing impacts of different road reforestation methods on soil processes and the regeneration of vegetation in eastern Finland. In autumn 2007 we reforested three roads (0.8 to 2.1 km in length), each in a different protected forest area. First surveys were carried out in 2008. Along with our standard monitoring methods we applied LFA method in this context. The current state of the research and newest results from 2009 will be presented in the conference.

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Error analysis and calibration of data collected with a Terrestrial Laser Scanner (TLS). Implications for monitoring surfaces evolution of roadslopes

Estela Barroso, Fernando Barbero, José Francisco Martín Duque, Saturnino De Alba

Terrestrial laser scanning (TLS) is an innovative surveying technology allowing the user to capture large amounts of 3D (x,y,z coordinates) data directly, rapidly and with high accuracy. As an example the equipment used in this work, a Leica ScanStation II, collects data at a rate of 50,000 points per second with a spatial resolution of 2 mm. In addition, TLS systems are of easy operation and enable non-specialist users to efficiently generate detailed Digital Elevation Models (DEM) and other derivate results (maps of elevation change, erosion...). Nevertheless, of all the survey techniques available, TLS has the least standardized control practices and error assessments. This is due to both the relative novelty of TLS as a survey tool, the ease of its operation and the apparently complete and satisfactory outputs it provides. In this work the main interest was to analyze the systematic instrumental errors and those derived from the field work survey protocols and data processing. In order to identify and quantify the different error components an outdoor experimental setup was performed, simulating as much as possible the real survey conditions in roadslope scenarios. Results indicate some error values that could be used as values of reference for similar studies, as well as criteria and practical recommendations for minimizing these errors. Finally, we discuss about the appropriateness of the use of TLS for studying different surface geomorphic processes (water erosion, mass movements, etc.) regarding the spatial scale at which commonly they take place on roadslope systems.

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Near-Infrared Spectroscopy (NIRS) as a time- and cost-saving tool in restoration ecology

Valentin H. Klaus, Till Kleinebecker, Norbert Hölzel

The nutrient supply of herbaceous communities is negatively related to phytodiversity and data on the trophic status are thus crucial for implementation and evaluation of restoration measures, e.g. impoverishment of nutrient enriched grasslands. The chemical composition of the biomass, e.g. nitrogen and phosphorous contents, is a good and practicable proxy to determine the nutritional status. However, wet chemical analyses are very costly and time consuming, especially for a large number of samples and different entities of interest such as fibre fractions and primary nutrients. The application of the NIRS technology can reduce time and money expenses of lab analyses significantly. In this study, we sampled biomass of 150 grassland plots belonging to the biodiversity exploratories (www.biodiversity-exploratories.de), recorded NIR-spectra and determined concentrations of C, N, P, K, Ca, Mg and contents of fibre fractions (NDF, ADF, ADL) by reference methods. We developed calibration using partial least-squares regressions and tested the model quality by a cross-validation procedure as well as by external validation. We obtained good and useful models for all chemical components with prediction errors being in the range of the respective errors of the reference methods. The developed NIRS calibrations can be used to generate large data sets on nutrient contents in grassland biomass in a quick and cheap way, what is very useful to optimize planning and evaluation of restoration measures. We can also give some special recommendations on samples size to develop robust calibrations and for standardized sample preparation. Finally, we give ideas of applications of NIRS-technology.

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Vegetation mapping methodology for monitoring and assessing success of ecological restoration operations.

Frédéric Bioret, Sébastien Gallet

At the scale of a restored site, vegetation mapping is one of the most appropriate tools for both spatializing and assessing the state of conservation of the whole studied area. The presented methodology and which has been built and tested on a selection of sites along the Atlantic coast, encompasses two complementary tools that can be used at the scale of a restored site. Mapping of vegetation units: each polygon is characterised by both physical and biological attributes rather easily observable on the field: soil structure and depth, structuring species, percentage of vegetation cover, indices of erosion. Assessment of the overall degeneration index of the vegetation, based on the Landscape degeneration index method: for each well conserved and degenerated vegetation unit, spatial extension of the degeneration is calculated. At the scale of the entire site, an overall index of

landscape degeneration is evaluated. This methodology can be used for long term monitoring: it allows to define precisely the initial state of the vegetation and to assess successfulness of ecological restoration operations. Combined to a GIS database, the tool also provides synthetic maps that could be used to discuss with managers and policymakers for defining restoration objectives and principles, as well as ecological engineering methods.

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Are functional groups and dispersal modes an option to predict vegetation dynamics on reclaimed mines?

Josu Gonzalez Alday, Yesica Pallavicini, Rob H. Marrs, Carolina Martinez-Ruiz

The vegetation dynamics on reclaimed sites are commonly described using richness and plant cover patterns through time. We expand this approach by considering functional groups and dispersal strategies, as important components of ecosystem function and key traits for colonization. Our objective was to analyze if the species richness and cover of these traits change during succession in 26 reclaimed coal mines, and if these changes improved the description of vegetation dynamics. The vascular plant species number and cover were monitored in 26 coal mines of different age, from 1-32 years since reclamation started. Functional groups richness showed a clear tendency in the order of species dominance starting from annuals, perennials and woody, whereas cover dominance was not similar to richness since perennials was the most important group covering the mines along the sequence. Dispersal modes showed that zoochorus and anemochorus species were the most influential on richness and cover. Our results suggest that the use of functional groups and dispersal strategies patterns improves the description and prediction of vegetation dynamics and allowed us to identify succesional stages. Our results also highlight that species response to disturbance are controlled in some part by species functional groups.

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Is chronosequence correct approach for the prediction of succession?

Ondrej Mudrak

For many restoration studies the prediction of successional changes is essential. One of the most common approaches used for prediction substitute space for time (chronosequence). Sites of different age are explored and it is assumed that biota of the younger sites will be replaced by the biota of older sites. However, succession at each site is affected by many random factors, which are variable in time. Consequently, there is a discussion if such approach is correct or not. We sampled annually the vegetation (since 2002 to 2009 with gap in 2005 and 2006) on five sites at spoil heaps of Sokolov coal mining district (Czech Republic). The sites were dumped in the year 2003, 1994, 1991, 1985, and 1959). To describe the course of annual changes in vegetation we calculated index percentage dissimilarity among the pairs of younger and older sites. We found that species composition of the vegetation at the three youngest sites (where trees are rare) had increasing similarity to the older sites. The second oldest site overgrown by trees did not increased the similarity to the oldest site during observed period, but composition of the tree seedlings enables estimation, that at least overstory will probably change as expected by chronosequence. We conclude that chronosequence can be used for the prediction of the course of the succession.

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Prediction of vegetation succession in a sand-pit: a basis for restoration

Věra Zemanová, Klára Řehounková, Karel Prach

Supporting spontaneous successional processes represents a progressive approach to restoration of sites disturbed by mining activities in various European countries. However, there are not many studies focused on quantitative and detailed prediction of vegetation succession in mining sites. We attempted to predict establishment of habitats and dominant vegetation types in a model sand pit after 25 years since the site abandonment. This age corresponds to a stage with already fully established vegetation using GIS models The prediction is based on a study of vegetation succession in many pits at a country scale and investigations in the given study site. In the site, mapping of dominant vegetation types in already revegetated parts of the pit (used as reference sites) and in the surrounding landscape up to 1 km from the pit were provided. The ecological restoration led to a higher landscape mosaic compared with traditional reclamation methods. The minimum intervention

strategy is especially effective in the case of favourable site conditions, especially if the site is surrounded by (semi-)natural vegetation. Diverse vegetation is able to establish in a reasonable time of approximately 25 years. Therefore, the spontaneous succession should be considered as a regular rehabilitation method for post-mining landscape and incorporated into practical restoration projects.

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The use of waste water for agro-forestry multipurpose systems in desert Oases

Paolo De Angelis, Cristina Monteverdi, Sara Da Canal, Hocine Larbi, Federico Chiani, Riccardo Valentini

The Sahara oases are facing several environmental challenges related to human development and climate change. The increase of population and the overexploitation of natural resources are gradually destroying the fragile ecosystem equilibrium and the traditional social organization of the local community. In the oasis of Brezina in the wilaya of El Bayadh in Algeria, the increasing amount of waste water produced from the nearby community is becoming a public health hazard competing with fresh water needs. The main purpose of this study is to set up a new oasis management strategy based on recovery and treatment of wastewater effluents gathered from the nearby human community of Brezina. The non-conventional water resource becomes a win-win solution for reducing risks of water table contamination and for promoting new agro-forestry activities. The small scale pilot project, under construction in Brezina, intends optimise the process of wastewater treatment trough two parallel systems. Treated water is used to irrigate the agro-forestry plantation. The experimental plot tests and optimises several "environmental services" like desert restoration, carbon sequestration, conservation and improvement of biodiversity and finally support the sustainable development of small chain economies. We present the institutional framework, the concept design and the first steps of the implementation.

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Landscape-scale spatial variability in dryland restoration success. The combined role of site conditions and technological effort

Haroun Kribeche, Esteban Chirino, Alberto Vilagrosa, Susana Bautista

Southeast Spain is considered one of the most desertification threatened areas in the Mediterranean Europe. In 2003, the Valencia Regional Forest Service implemented a restoration demonstration project in this area. The site is a small catchment (25 ha) located in the Albatera range. The catchment is highly heterogeneous, with terraced slopes, south-facing slopes and north-facing slopes being the three main landscape unit types in the area. The restoration strategy was based on planting evergreen trees and shrubs that can recover quickly after disturbances, and on field treatments aimed at maximizing water harvesting (microcatchments) and conservation (tree shelters, mulching). On south-facing slopes, the whole set of field treatments were applied, while north-facing slopes were treated only with tree shelters and terraced-slopes were treated only with microcatchments. Survival and growth of planted seedlings were used as metrics of restoration success. To assess the impacts of the actions applied on soil conservation, soil loss rates (from 2005 to 2009) were evaluated using the erosion pin method. Despite the more limiting conditions prevailing on the south-facing slopes, this landscape unit showed the lowest mortality rates and highest growth rates in the area. Soil loss rates were higher on south-facing slopes than on the other landscape units, though these rates decreased with time. North-facing slopes and terraced slopes showed a net soil mass gain, probably reflecting the trapping of sediments produced by the plantation works. The best seedling performances on south-facing slopes were probably due to the highest technological effort applied to this landscape unit.

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Climate change and changes in spatial nature structures in Flanders: adaptation strategies

Frederic Stragier

Abstraction of the success of mitigating short term measures, climate change will anyhow influence the way in which Flemish society organises its use of land and space. Instead of closing our eyes, it is time to develop strategies to anticipate to possible effects of climate change, or – put in other words – to assess new investments in spatial development and to investigate how to make them climate-proof so they can withstand the effects of climate change. Therefore a project (CcASPAR: Climate change And changes in SPAtial structures in Flanders: Research project) is set up with several scientific partners in the Low Countries. The project is divided in six packages with first of all a general focus on qualitative exploration through research by design of possible planning concepts for a more adaptive approach of changes in spatial structures as a result of climate change and secondly, a scientific evaluation and appreciation of existing planning policy instruments and public governance mechanisms in relation to the implementation of spatial adaptation strategies in relation to climate change. One of the packages, which will be investigated at the University of Antwerp, will assess the geographically differentiated impact of the climate change effects on spatial nature structures. A relevant typology of elements of these spatial structures will be defined in relation to climate change, followed by an assessment/analysis of the sensitivity of these elements for climate change, and finally there will be a development of adaptation strategies with a focus on ecosystem based land-use planning.

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Collaboration among scientists, landscape planners and practitioners to solve problems of "industrialized" urban mini plot viticulture

Thomas Siegmar

Actual changes of historic cultural landscapes include: loss of land form- and bio-diversity and naturalness; elimination of older more diversified agricultural landscapes. Examples will be discussed from a small and most northern wine region of Germany, the right side slopes of river Elbe valley, south and west exposed, around Dresden, Meißen (50 km). It is said, viticulture is an "exclusive character" (?) for the Upper Elbe conurbation, Saxony. 4000 hobby-mini-winegrowers with only some hundreds square-meters each are managing the slope wine parcels. For gaining a maximum yield: They use the largest machines as possible. Environmental risks are: soil wind erosion on bare ground, high water erosion potential, species-poor ground vegetation; air pollution: soil emission ("desert storm"-like), and motorized long-range spraying pesticides with drift into residential areas. The modern "industrialized" viticulture destroys sometimes land form- and bio-diversity, and historic cultural landscape. The aims of regional landscape and urban planning are to reverse the decrease in landscape and urban diversity towards sustainable development. We should protect remaining forests and hedges near upper slope shoulders and within small erosion valleys/depressions. They have ecological functions like leading cold air from upper plains and strong winds from wine areas to the Elbe valley. Protect these forest remains and hedges for town planning/settlement subdividing functions! Never reduce land form diversity by filling up natural erosion valleys (with old worthy bio-diversity)! Hobby mini plot vineyards in the vicinity of living houses only with protective distance zones / broad shelter belt tree hedges!

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Effectiveness of restoration measures for WFD and Natura 2000

Wendy Liefveld, Bart Reeze Arcadis, Marieke Ohm

The European Water Framework Directive and the Habitat- and Birds Directive (Natura 2000) both demand ecological restoration measures in order to achieve management goals in the Netherlands. Nearly two-hundred restoration measures are defined to increase the ecological quality of large water bodies in the coming five years. But can we be sure? Do we have sufficient knowledge of the effects of these measures in terms that are relevant for WFD and Natura 2000? The measures planned are not new: many have been carried out in the past, in the framework of former policies and restoration goals. Evaluation of these measures, based on monitoring data, permits a comparison with current WFD and Natura 2000 goals. Analysis of these data reveals that some types of measures are well studied and can be easily translated to nowadays management goals. Per type of measure

we estimate the effects on WFD and Natura 2000 goals and give hints for lay-out and realisation of these measures to optimise ecological benefits. We also summarise ten recommendations on a larger scale that apply to the whole of measures to be taken. Some measures, carried out in the past and planned for the future, have never been monitored on biological aspects relevant for nowadays water management. These types of measures are candidate for a specific monitoring strategy in the forthcoming years, carried out by the Dutch administration, Rijkswaterstaat. Knowledge derived from these evaluations, permits planning and finetuning of measures in the next river basin management plans.

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Impact mitigation of the Chiaiano's dump on the environment of the Park of Naples hills (South Italy)

Maria F. Caliendo, Lucilla Fusco, Valerio Mele

The Park of Naples hills (Italy) was instituted by the regional law 17/2003 with the aim of the green area's safeguard of the town hills. But, in consequence of the waste emergency of the Campanian region, the Italian government decided the opening of a dump in the Park, in Chiaiano. Utilizing the birds as bioindicator, we studied the environmental quality of the whole area before and after the opening of the dump, correlating the avifaunal indices to some landscape indices. Before the opening, generally we note that the various areas of the park were constituted from a fragmented landscape and not many mature faunal communities. The dump site, called Chiaiano wood, is not so different from other areas of the park because of a similar landscape, formed from old chestnut coppices alternated to farmland and buildings. Here is important the nesting of some SPEC species, as the predators *Falco peregrinus* and *Falco tinnunculus* and some Chiroptera. The dump might cause the lost of rocky habitats in the Chiaiano wood with a remarkable impact on the ecosystem. The data collected in the first year of the dump's activity showed some differences, increasing with the time, as the presence of the Herring gulls (*Larus michahellis*), eating urban waste and the increase of synanthropic species, as Columba livia, vector of micro-organisms. For that we list some intervention to mitigate the increasing impact of the dump.

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Indication of archaeological features by soil chemical properties and by plant species composition in ancient medieval village in the Czech republic

Jiri Ondráček

The study site is an abandoned medieval village, located in central part of the Czech Republic near Labe (Elbe) river on sandy soil in a 100 year-old mixed deciduous forest. Dominant trees are *Betula pubescens*, *Tillia cordata* and *Quercus robur*. Relevés and soil samples were collected from destructions of buildings, former courts, village square and gardens. Plant available (Mehlich III) P, Zn, Ca, Pb, As and Cd found in soil were higher on sites where buildings were destroyed than on other locations. Moreover, P, K, Mg and Cu nutrients and heavy metal content were higher on courts than on village square and gardens. The sites where buildings werer destroyed were characterized by plant species, such as *Primula veris* and *Anemone ranunculoides*.

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Summer schools on restoration ecology – Bringing together young scientists and practitioners throughout Europe

Verena Möllenbeck, Norbert Hölzel

Summer Schools on restoration ecology for PhD students have become a tradition within SER Europe. After events in Bremen/Germany (2003), Sokolov/Czech Republic (2004) and Nijmegen/The Netherlands (2007), a Summer School took place in Münster/Germany in 2009. Summer schools are a promising instrument to enhance exchange of knowledge across frontiers by training young academics from Europe and neighbouring regions in restoration ecology. Participants get both the opportunity to broaden their scientific and practical background and to work intensely on a specific topic, together with academic specialists and practitioners in the particular field and with other young colleagues. Here, we discuss the outcomes of the past Summer Schools and the opportunities for future events. The aim of the course in 2009, primarily intended for PhD students, was to provide theoretical background by lectures of specialists and to train practical research skills and learn about restoration projects on-site by field work and excursions. Short

presentations of the participants on their own research and intensive exchange between participants and lecturers were further important parts of the programme. The evaluation by the participants pointed out that both the theoretical and the practical part led to a high to very high gain in knowledge. The constantly increasing number of applications and the evaluation results of the past Summer Schools confirm the high interest in similar events and in restoration ecology as a field of applied science. For future courses, opportunities regarding the group of participants (MSc/PhD/PostDocs/ Practitioners), topics (e.g. regional topics) and funding are outlined.

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Cumulative effects of nitrogen deposition on dry inland dune ecosystems

Marijn Nijssen

High levels of nitrogen deposition is one of the major threats to dry, nutrient poor ecosystems. Effects on soil chemistry and development or structure and composition of the vegetation are often described but effects on fauna are mostly unclear. In an interdisciplinary research project on inland dunes or 'drift sands' in The Netherlands effects of nitrogen deposition on aeolian dynamics, soil, vegetation and fauna were analysed. It turned out that fauna was affected by high nitrogen deposition via several indirect ways. Nitrogen increased stabilisation of aeolian dynamics and subsequent vegetation succession. This changed vegetation composition on landscape level and thereby altered soil fauna composition. Moreover, nitrogen deposition also affected soil fauna within identical vegetation types and had a negative effect on food quality of Grey Hairgrass *Corynephorus canescens*, the main herbivore food source. Cumulative effects of all these pathways resulted in low prey availability for the insectivorous bird species Northern Wheatear *Oenanthe oenanthe*. Restoration of aeolian dynamics can counteract these negative effects partly and can therefore be an important ecological tool for restoration of dry dune ecosystems.

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Early indicators of atmospheric nitrogen deposition impact on lichen-rich, coastal dune grasslands

Eva Remke, Emiel Brouwer, Jan G.M. Roelofs, Irmgard Blindow, Annemieke Kooijman

Despite reductions in atmospheric depositions during the last three decades, depositions still form a permanent threat to oligotrophic and weakly buffered ecosystems. An example is lichen-rich coastal dune grasslands, a priority habitat under the European Habitats Directive. At moderate loads of nitrogen deposition, dry coastal dunes become dominated by a dense sward of only *Carex arenaria*, especially lichen species richness decreases. Thus, critical loads for these acid dunes have to be adjusted to 5-10 kg N ha-1 yr-1, half as high as previously thought. Early signs of an impact of atmospheric N-depositions are not easy to detect. Only once a system has experienced longer periods of elevated N-loads and has already swapped to more nutrient-rich conditions, a dense vegetation has established, the impact is obvious. An early indicator of the influence of low to medium N-loads on acid to slightly calcareous dune ecosystems may be the total organic matter content (LOI). If the LOI in the upper mineral soil horizon of lichen-rich, short grasslands is above 1-1.5% and the pH is below 4.0-4.5, the system is about to change to nutrient-richer, less extreme soil conditions and metals become freely available, e.g. Al/Ca-ratios >1 occur. Furthermore, occurrence of certain lichen and forb species can give a valid indication of site conditions. But one has to bear in mind that not only one singular feature standing alone can give a proper indication of an elevated atmospheric nitrogen deposition influence. Only a certain array and combination of features will give a sound judgement.

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Ecological restoration in Grey dunes: the role of N-deposition in different soils

Kooijman A.M., Noordijk H., Hinsberg A. Van, Cusell C., Til M. Van

Grey dunes (H2130) have lost many species due to grass-encroachment. Increased atmospheric N-deposition is a major cause, and obstacle to ecological restoration. In 75% of the Dutch dunes N-deposition has supposedly decreased below critical levels. However, actual values may have been seriously underestimated. Measured concentrations of ammonia were 2-4 times higher than modeled ones, and critical loads may be lower than assumed, or overestimated for particular areas, because sensitive dune grasslands were combined with less sensitive Buckthorn. In calcareous dunes, high atmospheric deposition has also led to increased acidification and P-availability. Decalcification by atmospheric deposition was estimated as 4-11 mm in 20 years, which is only slightly lower than natural decalcification

of 12-18 mm. Furthermore, increased acidification leads to increased dissolution of calcium phosphate, with values of 60 mg P m^{-2} per mm acidified soil. Atmospheric deposition has thus increased availability of both N and P, and stimulated grass-encroachment. Responses to N-deposition are modified by soil conditions related to lime and iron. In calcareous dunes, grass-encroachment has been relatively low, because P is fixated in calcium phosphate, and N may primarily be taken up by microbes and stored in the soil. Restoration of grass-encroached sites has been relatively easy. In more acid dunes, however, grass-encroachment is generally high. P-availability is high, except for iron-rich soils with low organic matter content. N-availability is high because microbial communities have changed, microbial N-demand has decreased and efficiency of N-mineralization and N-availability to the vegetation increased. To counteract grass-encroachment, more intensive management is required.

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Butterfly population response to reduced nitrogen deposition and site restoration

Alan Feest

The theoretical basis behind the dynamics of population recovery and restoration following an environmental impact is explored showing that impact on populations and their recovery are not mirror images. Nitrogen deposition in Northern Europe in particular has been asserted to have been a powerful cause of biodiversity decline and we are now in a recovery phase. Butterflies are a SEBI 2010 indicator group and are hypothesised to be strongly influenced by nitrogen deposition. The evidence is presented that this biodiversity decline has indeed occurred in monitored Dutch butterfly populations but detecting these changes requires more than a simple species richness assessment and a range of simple indicators show the modus of population biodiversity change. Therefore in attempting the restoration of the original nitrophobic biodiversity of oligotrophic sites from the effects of excess nitrogen deposition there needs to be allowance made for both a) complex colonisation processes b) the measurement of biodiversity and c) the historic and ongoing nitrogen deposition.

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Restoring South African mediterranean-type ecosystems following alien plant invasion

Karen Esler

Following global trends, invasive alien plants are an increasingly large problem in South Africa where growing evidence links invasive alien plant transformation to declines in ecosystem integrity and services. Invasion ecology is a thriving field of plant science research in South Africa. While the primary focus has been on basic issues such as the production of conceptual frameworks and understanding the mode of introduction, distribution, abundance and impacts, there is an increasing awareness of the need to understand the link between invasion and management actions, particularly those linked to restoration of key ecosystems. Working for Water (WfW), with its combined aims to enhance ecological integrity, water security and social development, has been in operation since 1995. WfW has worked under the assumption that its focus ecosystems would "self repair" once the main stressor (dense stands of invasive alien trees) was removed. This assumption is explored using two case studies in alien plant-invaded landscapes in the Fynbos Biome. The first describes the integrated control of the invasive shrub Hakea sericea over four decades in South Africa, where landscape-level restoration of mountain Fynbos has been achieved. The second focuses on Fynbos riparian ecosystems, where restoration of indigenous riparian vegetation structure, diversity and function requires a move beyond the assumption of "self repair" to one that includes active restoration actions. In exploring these case studies, the aim is to identify best-practice techniques to ensure ecosystem recovery after alien clearing.

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Effects of light and exogenous plant growth regulators on seedling establishment of four autochthonous shrubby plants from high Mediterranean mountain, Sierra Nevada (S Spain)

Francisco Serrano-Bernardo, Kelly Garcete, María Beltrán-Hermoso, José Juan de la Torre-Betts, José Luis Rosúa-Campos

The Sierra Nevada (S Spain) constitutes a unique mountain system among Mediterranean high mountains for its richness in endemic species. The ski station on the mountain has gravely altered the landscape, making recovery measures necessary for the vegetation cover. Several experiments were made under controlled conditions using seeds from four autochthonous shrubby plants of Sierra Nevada and Betic Sierras. The seeds were pretreated with different concentrations of known hormonal growth regulators. In the first experiment, were studied the combined effects of light and plant hormones on germination of these species. Afterwards, in a second test these plants were sown in vermiculite, a substrate used for the implementation of the vegetal cover. Germination, rooting, and seedling growth was monitored in all plants. In the first case the results proved that the exogenous application hormonal growth regulators combined with light affect germination in all the species studied but not ever in a positive manner. However, in the second experiment the results justified the application of the growth hormones tested, which in all cases improved the growth of the shoot, the root, or both, confirming its suitability in restoring plant covers. Also, the use of vermiculite it seems to be a useful substrate in laboratory in the first stages of seedling development, as well as for testing the action of phytoregulators on these processes. This raises the expectation that, when transferred to the field, these treatments will be an effective aid to plant recruitment in recovery programs

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Multi-criteria evaluation of forest restoration projects in the northern Mediterranean

Anahi Ocampo-Melgar, Susana Bautista, Jose Antonio Alloza, Barron Joseph Orr, Ramon Vallejo

There is a consensus on the need for the evaluation of restoration actions, and there is a growing demand for standardized methods to evaluate restoration efforts. Approaches that integrate biophysical and socio-economic indicators are particularly requested. Since the real outcome of a forest restoration project can most effectively be evaluated comprehensively over the longer term, the reforestation projects implemented during the last century in the northern Mediterranean offer a unique opportunity to assess the potential of reforestation initiatives for restoring Mediterranean forests. We assessed 38 reforestation projects that were implemented from 1860 to 1989. Data were obtained from the REACTION Database (www.ceam.es/reaction), an open-access database that compiles evaluation data from forest restoration projects implemented in the northern Mediterranean region. The wide variety of biophysical and socio-economic indicators used were organized in categories that represent the structural and functional quality of the restored system and relate to the main categories of ecosystem services recommended by the Millennium Ecosystem Assessment. We applied a multi-criteria approach to analyse the available data from the selected projects. Although most projects succeeded in terms of achievement of original goals, the current quality of the restored ecosystems varies significantly between sites. To some extent, all the evaluated projects enhanced ecosystem services as compared with previous conditions, though very few of them had a sustained impact on the well-being and stability of rural populations. However, in most cases, the restoration actions produced certain indirect socio-economic benefits, such as the enhancement of tourism in the project sites.

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Environmental drivers of seedling performance in *Quercus ilex* plantations

Jaume Tormo, Jorge Monerris, Jordi Cortina

Despite increasing efforts to improve the success of forest plantations in Mediterranean areas, uncertainties are still large. Very often, the effects of nursery practices and planting techniques on seedling performance are small compared to the effects of site conditions. The identification of local drivers of seedling establishment and suitable indicators of these drivers should be a priority to increase plantation success and improve the efficiency of restoration programs. We explored the drivers of the establishment of a common Mediterranean tree species, *Quercus ilex*, in a karstic landscape in N Alicante (SE Spain) by relating seedling survival and growth with site features. *Quercus ilex* seedlings were planted in 16 experimental plots with contrasted soil and vegetation properties. We measured environmental variables related to physiography, soil fertility, vegetation cover and composition, and determined seedling nutritional status and planting technique. Then, we used principal components analysis and regression analysis to assess the influence of site features on seedling performance. Vegetation cover was the main driver of seedling growth. But other factors related to soil properties (as soil nitrogen content and stoniness) also affected seedling performance. Seedling survival was related to the dimensions of the planting hole and soil fertility (particularly soil available phosphorous and organic mater content). The magnitude of these effects was small. We will present results of an ongoing Structural Equation Model analysis based on these data, and discuss the implications of our findings for the management of Mediterranean forest plantations in karstic environments.

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Fine-scale genetic structure in two micro-catchments from southeastern of Spain

Karen Disante, Beatriz Amat, Jordi Cortina

Patches of woody vegetation are key components of semi-arid ecosystems worldwide, as they strongly affect community composition and ecosystem processes. In semi-arid *Stipa tenacissima* (alfa grass) steppes of the western Mediterranean, woody patches affect water, carbon and nutrient fluxes and the richness of vascular plants, soil fauna and biological soil crusts. Thus, patch-forming species as *Quercus coccifera* and *Pistacia lentiscus* have been extensively used to restore degraded *S. tenacissima* steppes. However, little is known on the long-term dynamics of patch forming species in these areas and their ability to cope with future climatic conditions. We performed a fine-scale spatial genetic structure study of P. lentiscus and *Q. coccifera* populations by using polymorphic microsatellite loci in two small catchments in southeastern Spain. Our objectives were (i) to examine the relationship between genetic and geographic distance and (ii) to identify foundation individuals/areas and dispersal paths. Our results will provide new insights on the ability of keystone species to colonize degraded *S. tenacissima* steppes and contribute to the efficiency of future restoration programs.

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Ecological strategy of species involved and water availability modulate the outcome of grass-shrub interactions in degraded semi-arid systems

Santiago Soliveres, Pablo García-Palacios, Fernando T. Maestre, Jorge Monerris, Jordi Cortina, Adrián Escudero, Fernando Valladares

Equilibrium between the establishment of an herbaceous cover for soil protection and the establishment of woody species to foster succession is crucial for restoration success in semi-arid degraded slopes. We studied the effect of the ecological strategy of species involved and different water availability levels on the outcome of these interactions in two different experiments. We report the response of six different woody species to herbs presence under two different levels of water availability (experiment 1), and the effects of the changes in water amount and frequency, predicted with climate change, on the final outcome of a particular grass-shrub combination (experiment 2). Our results show that the grass-shrub interactions response to different water availabilities are species-specific. While increase in the amount of water compensated herbs competition for the more competitive species, the contrary happened with the stress-tolerant species, where increase in herbs competition had stronger effects than the benefits of increasing water availability per se. Increases in the abundance, but not the frequency, of water availability turned the interaction from negative to neutral in the second experiment. The combination of both experiments suggests neutral interactions between these two groups at mid stress

levels, but competitive in both sides of the water availability gradient when stress-tolerator woody species are involved. A monotonical increase of competition with water stress is expected when seedlings follow competitor strategies. The use of herbs as nurse plants is only recommended under very high water availability scenarios, which are unlikely to occur in semi-arid Mediterranean environments.

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Aménagement écologique de l'Alzette au Dumontshaff

Micha Bunusevac, Jean-Claude Kirpach

(1) Introduction, Situé dans la « Zone de protection spéciale pour les oiseaux sauvages », le projet de revalorisation écologique de l'Alzette au Grand-Duché de Luxembourg, issu du partenariat entre 5 communes et les ministères étatiques compétents, est soutenu par la Commission européenne par le fonds LIFE-Nature. (2) Propos : Renaturation de l'Alzette (revalorisation écologique : restauration des habitats humides, amélioration hydraulique et hydrologique, revalorisation paysagère, amélioration de la qualité de l'eau). Gestion d'une réserve naturelle au moyen d'exploitation agricole extensive (pâturage permanent – races rustiques de bovins) en vue de la conservation des habitats du milieu ouvert (empêchement du recouvrement par une forêt alluviale). Valorisation touristique et didactique par les centres d'accueils, sentiers pédestres, stations didactiques et brochure. Solutions économiques par production de viande et distribution dans les restaurants locaux avec sensibilisation du public. (3) Méthodologie. Utilisation des références historiques et actuelles pour la recherche de « l'état de référence du cours d'eau ». Interventions (Déplacement de l'Azlette dans le fond de vallée, Aménagement d'un bras secondaire, Réaménagement du ruisseau Kiemelbach. Solutions économiques par les contrats agro-environnementaux (biodiversité). (4) Résultats (254 espèces végétales différentes, 37 espèces rares, Augmentation des effectifs d'oiseaux de pâturage, Partenariat avec les communes et associations locales). (5) Conclusions (génération de bénéfices économiques, favoriser l'acceptation de la protection de la nature, Modèle de développement durable pour les plaines alluviales, Pollution héritée des sites en amont (friches industrielles)

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Ecological restoration of coastal wetlands in the central Mediterranean area

Antonio Perfetti, Stefano Cavalli, Leonardo Lombardi, Pietro Gattai, Pasquale Vernina, Mariaceleste Labriola, Olga Mastroianni, Alessio Favilla, Luca Puglisi

The Regional Park of Migliarino-San Rossore-Massaciuccoli has about 31 km, of which 16 km of natural coastline, where there is a rich mosaic with many wetlands linked to a series of fossil dunes and inter-dunes (over 5 km), a plain with a low slope towards the sea and a surface groundwater emerging. Before the land reclamation and then the urban development, the coastal erosion and the invasion of exotic species led to a decrease of areas and phenomena of degradation. In the last five years direct and indirect actions locally led to a reversal of trends with the creation of 20 wetland islets for more than 13 ha. A significant part of these zones were in an advanced successional stage due to the diffusion of the exotic *Amorpha fruticosa*; the majority of the remaining 7.5 ha had been largely reclaimed during the last century. Hydrological, botanical and zoological variables measured in tens of sample plots evidence the gradual recovery of freshwater habitats also at few hundreds meters from the sea coast, by measuring variables such as the surface water level, the electrical conductivity, the cover of aquatic vegetation and invasive plant species, the number of aquatic birds species in reproduction and wintering. Therefore techniques, results and difficulties encountered are analyzed in a broader context of the maintenance of ecological diversity in oligo-mesotrophic water ecosystems such as flooded wet meadows, Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* and Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.

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Restoration of an old agricultural estate in Doñana National Park (SW Spain): a six year vegetation study of a transformed marsh

Alberto Vélez-Martín, Carlos J. Luque, Manuel Coca, Anthony J. Davy, Eloy M. Castellanos

For a period of 6 years, since the beginning of the restoration actions of 'Los Caracoles Estate', the vegetation changes ocurred in their previous farmland have been recorded. The study site is an area of more than 2600 hectares of non-tidal marsh in Doñana National Park (SW Spain) which was dried in the seventies for agricultural purposes, through the construction of perimeter levees and drainage channels along the estate, both eliminated at present. The monitoring programme has consisted in a grid of permanent sampling points based on a nested model. A total of 441 points are sampled: 270 within the estate and 171 on areas of reference around 'Los Caracoles' where Arthrocnemum macrostachyum is the dominant species. In our preliminary results, a gradual trend toward complexity of the different communities has been observed, with increases in both richness and diversity. Furthermore, the current absence of salt marsh species in many sites of the restored area probably reveals a slow recovery of the natural vegetation. This study serves to (i) evaluate the success of the restoration actions executed (e.g. removal of perimeter levees and burial of drainage channels), (ii) assess the changes in early stages of ecological succession in both dried and cultivated marsh and (iii) predict the rate and degree of recovery plant community from medium to long term.

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Long term effects of liming on biogeochemistry of Norwegian softwater lakes: restoration of the vegetation by introducing an eco-engineer

Esther C.H.E.T. Lucassen, Alfons J.P., Jan G.M. Roelofs

Softwater lakes are generally nutrient-poor and contain very low amounts of dissolved inorganic carbon in the water column. As a result, the submerged vegetation is often dominated by isoetids that posses several morphological and physiological adaptations to these circumstances. Many southern Scandinavian lakes became acidified in the 1970s as a result of increased atmospheric sulphuric acid deposition. Surprisingly hardly any negative impact on the submerged vegetation was found. To protect fishes from aluminum toxicity, thousands of Scandinavian acidified lakes and streams were limed yearly since the 1970s. This resulted in a massive explosion of *Juncus bulbosus* and a decline of the isoetid vegetation. J. bulbosus is capable of profiting from the higher nutrient concentration in the limed sediment in combination with the temporal higher carbon dioxide concentration in the surface water following re-acidification. Dense mats of *J. bulbosus* eventually died back and are still deposited on the sediments. Several elodeid species established in the limed lakes under which *Sparganium angustifolium* that can use benthic CO2. Recovery of the original isoetid vegetation hardly took place as germination is inhibited in anaerobic sediment. However, re-introduction of *Litorella uniflora* mats turned out to be successful as this plant species can reproduce vegetatively. *L. uniflora* may act as an eco-engineer by having high radial oxygen losses so improving sediment chemistry and stimulating germination of other isoetid species. This may ultimately result in a recovery of the original vegetation in limed lakes.

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Recovery of anuran community diversity following habitat replacement II: A long term survey allows.

Alain Pagano, F. Foussard, D. Lesbarrères

The success of many pond restorations is often poorly documented. Following construction of a highway in western France, a restoration project was initiated in 1999, allowing the assessment of restoration efforts and changes through time. The amphibian communities of eight ponds in the area were surveyed before they were destroyed. Replacement ponds were created according to precise pedological criteria, consistent with the old pond characteristics and taking into account the amphibian species present in each. Eight year survey data are presented on species richness of the replacement ponds and compared to the original levels. Presence of amphibian species was recorded every year during the breeding period. Species richness declined during the two years following construction of the replacement ponds but increased thereafter, generally returning to (or increasing) initial levels. Reggarding biodiversity, it appears as a success but regarding species specifically, there are some problems to solve in order to improve mitigation measures.

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Measuring the restoration process: the mean species trait approach

Isabelle Le Viol, Christian Kerbiriou

Although biases and pitfalls of biodiversity indicators are recurrently debated, their ecological meaning and their relevance for restoration evaluation are often not clearly established. In this context, a new type of biodiversity indicators, reflecting variations in explicit species-specific traits in species assemblages has been proposed (Mean Species Traits, MST). Here, we highlight the strengths and weaknesses of MST indicators both from practical and ecological perspectives. We use the vegetation dynamics after extraction of littoral turfs in a community specialisation index as a case-study. This turf was used as fuel for traditional cooking in a Biosphere Reserve and the recent increase of this practice resulting from tourism demand has been identified as a threat for biodiversity conservation. Through the comparison of vegetation communities of different successionnal stages after perturbation (109 stations, 0-23 years), we show that this metric is relevant in restoration survey, both sensitive to duration after perturbation and to different environmental factors. We further compare this metric with more classical indices (richness, diversity, rarity index, composition similarity index). Our results show the relevance of such mean species trait indicator in restoration evaluation. Overall, our results show that such metric, based on the ecological niche theory, highlight biological processes.

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Near-natural restoration of mining sites. A multi-site comparison

Karel Prach

Possibilities and limitations in using spontaneous succession, either manipulated or not, in restoration projects are analyzed. Sites disturbed by mining were surveyed in the Czech Republic, central Europe and included spoil heaps from coal mining, sand and gravel pits, extracted peatlands, and stone quarries. The following main conclusions emerged: (i) Potential for spontaneous succession to be used in restoration projects is between 95 and 100% of the total area disturbed. (ii) Mining sites often act as refugia for endangered and retreating organisms, and may contribute substantially to local biodiversity. (iii) To sustain populations of these organisms, advanced succession may be locally returned back (rejuvenation) by technical measures. (iv) Using allochtonous nutrient-rich material should be avoided because it supports synanthropic organisms with broad ecological amplitudes. (v) Eradication of locally occurring invasive aliens may be useful in and around (up to 100m) of a mining site. In general, prescribed spontaneous succession should be included into restoration programs much more then at present.

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Restoration of target communities in the course of spontaneous succession in old fields: a multi - site study from central Europe

Alena Jírová

After three decades, a repeated sampling in the old fields was made in two regions in the Czech Republic. The cover of vascular plant species was estimated in the percentage, in the first case in 58 fields (sampled size of 16 m2) in the Bohemian Karst Protected Landscape Area, and in the second case in 13 fields (sampled size of 225 m2) in a military training area. The fields were grouped into five categories delimited by the time since abandonment: (less than 6 years; 7-16; 17-29; 30-50 and more than 50 years old), and into two categories according to cover of shrubs and trees: with the total cover of woody species below and over (E3<10%, E2≤60% and opposite). The average Ellenberg indicator values and number of target species (*Festuco-Brometea, Querco-fagetea*) were calculated for each relevé. The data were analysed using multivariate methods (ordination). The spontaneous succession in old fields proceeds towards target rare and valuable shrubby grassland communities under certain environmental conditions, i.e. in fields occurring on dry sites mostly on southern slopes. About half of the old fields in both regions developed after approximately 30 years to the shrubby grassland resembling natural steppe-like communities, being typical for the regions, which are valuable from the restoration point of view.

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Secondary succession in roadside slopes: the role of plant-soil interactions to improve ecosystem restoration

Pablo García-Palacios, Fernando T. Maestre, Santiago Soliveres, Fernando Valladares, Adrián Escudero

Ecosystem succession is a suitable framework to guide restoration efforts aiming to recover plant communities and soil processes because it incorporates the temporal dynamics of the ecosystems, and the barriers to their development. Plant-soil interactions are of major importance to understand the role of biodiversity in controlling ecosystem processes and properties. Therefore, to understand the temporal dynamics of plant-soil interactions is crucial to improve restoration projects aiming to recover the ecosystem functioning in the long term. We discuss the results of several studies conducted in the herbaceous communities characterizing roadside slopes in center (semiarid climate) and south Spain (sub-humid climate). Secondary succession was responsible of the changes observed in the vegetation, soil biota and surrogates of ecosystem functioning. Plant-soil interactions played a key role to determine the evolution of these degraded ecosystems towards the reference site.

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Investigation of communities in mining areas at different scales: the organisms' potential as bio-indicators and for accelerating the secondary succession

Virgil Iordache, Marilena Onete, Mihaela Pauca, Ioana Gomoiu, Dorina Purice, Ioana Cobzaru, Liliana Oromulu, Viorica Honciuc, Aurora Neagoe

We investigated the structure of biological communities at ecosystem and landscape scale in four small catchments including in their structure contaminated areas resulted from mining and processing of heavy metals ores. The contaminated hot spots (ecosystems) were mining dumps, tailing dams and areas polluted by atmospheric deposition around a smelter. The groups of organisms have been selected such as to reflect information about the properties of the biotope from small scale (soil microorganisms, oribatid mites), to average scale (plants, thysanopthera, carabid beetles), and large scale (birds). The objectives of the research have been to characterize the secondary succession in heavy metals contaminated ecosystems of different types and ages, to characterize the potential of each group of organisms as bio-indicator of the ecosystem state, and to identify the native plant species appropriate for phyto-remediation (acceleration of secondary succession) in the contaminated ecosystems. The overall structure of the community was a result of sub-ecosystem, ecosystem and landscape scale structural characteristics. Soil microorganisms and oribatid mites were useful indicators of the heterogeneity of the abiotic conditions within the investigated ecosystems, but less for comparison with surrounding reference systems. Plants, thysanopthera, carabid beetles were good indicators of the ecosystem state as compared to the reference ecosystems from the surrounding landscape. Birds were not sensitive to the state of the contaminated ecosystems, but rather to the structure of the integrating landscape. A set of native plants have the potential to be used for accelerating the secondary succession in combination with soil microorganisms (especially mycorrhizal fungi).

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Soil bioengineering treatments for degraded riparian ecosystems

David Polster

Soil bioengineering is the use of living plant materials to perform some engineering function. Treatments have been developed to solve a variety of riparian problems. Soil bioengineering treatments are modelled on the natural processes that provide solutions to degraded riparian areas. Plant species that will root readily from dormant stem cuttings are used. Willows (*Salix* spp.), some poplars (*Populus* spp.) and red-osier dogwood (*Cornus stolonifera*) are commonly used in western North America. Live gravel bar staking can be used to stabilize excess sediment in streams and therefore speeds the process of pioneering vegetation establishing on gravel bars and starting the successional processes that eventually lead to productive riparian forests. Live bank protection provides an erosion-resistant face for eroding stream banks. As the plant materials used in the construction of live bank protection grows, the shoots from the new growth serve to slow near shore water velocities thus further reducing erosive forces and providing an opportunity for sediment in the water to be deposited. Live silt fences can be used in small ditches and drainages to slow flow velocities allowing sediment to drop out. As the plant materials used in the live silt fences sprout and grow, a wooded wetland is created that serves to capture

sediment and address some pollutants that may be present. Wattle fences can be used to stabilize steep streambank slopes by creating small terraces on the slope. In addition to the growth of the cuttings used to construct the wattle fences, by stopping the constant movement of surface materials on over-steepened slopes, the wattle fences provide an opportunity for pioneering species to establish. Live pole drains can be used to address seepage areas on disturbed slopes, initiating the successional recovery of these unstable areas. Soil bioengineering methods can also be used to manage invasive species by providing successional advancement past the stagnant weedy stage. Creation of an instant canopy of woody species can suppress the growth of problem weeds such as reed canary grass (*Phalaris arundinacea*) and blackberry (*Rubus discolor*). Examples are drawn from over 30 years of experience by the author.

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Eco-engineering: initial plant diversity and soil stability

Frank Graf

Plant diversity is a key issue in eco-engineering. Different investigations have been pointing to its importance in view of slope stabilisation and, consequently, it is conventionally recommended to rely on species-rich measures. The persisting and heavy rainstorms from 20th to 22nd August in 2005 resulted in loss of human lives and tremendous damage on infrastructure all over Switzerland. Many of the measures taken hitherto to protect against such natural hazards were stressed to their limits or even beyond. This extreme and exceptional configuration offered the possibility to investigate the reliability of eco-engineering measures within the scope of slope stabilisation, torrent and gully control and, in particular, the importance of the composition of the initial planting. For that purpose, three slopes affected by superficial sliding and subsequently re-stabilised with eco-engineering measures were investigated related to the development of species diversity and soil stability. The sites (Wirzweli, Klosters, Arieschbach) are situated in different areas of beech-fir-spruce forest associations of the higher montane zone of Switzerland and share similar climatic conditions and soil properties. Concerning eco-engineering measures, however, evident differences are noticed in the number of shrub and tree species used for the initial planting (1 to 15 species) as well as in the available time for development (10 to 25 years). Investigations in 2005/2006 revealed neither obvious differences in current plant diversity nor the corresponding soil stability. The soil aggregate stability increased by 30 to 39%; accompanied by a decrease in dry unit weight (1.1 - 3.1 kN/m3). A distinct shift in the grain size distribution was noticed from well sorted gravel with clay and sand (GW-GC) to silty gravel with sand (GM) in Wirzweli and a silty to clayey gravel with sand (GC-GM) in Klosters and Arieschbach. The number of shrub and tree species recorded in 2005/2006 varied between 12 and 16 and the cumulative vegetation cover ranged from 110 to 150%. According to the recommendations for silvicultural maintenance of protective forests, the shrub- and tree layer consisted of 75 to 100% of the required plant species in view of the potential target association. Although current slope angles exceed the soil mechanically accepted one by 6-7°, the areas have been stable since 10 and 25 years. The corresponding soil mechanical instability is bridged by biological effects, integrally expressed by the substantial increase in aggregate stability. Related to that, the species diversity is of course an important requirement, particularly regarding rooting depth. However, it seems not necessary to anthropogenically introduce diversity along with initial planting. Natural re-colonisation and succession processes combined with appropriate maintenance may equally lead to success.

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Anthropogenic alterations of solid transport in rivers: how can they be resolved?

Jean-René Malavoi, Norbert Landon

Since the spectacular collapse of the Wilson Bridge in Tours (1978), which revealed the hydromorphological impacts of aggregate extraction from the river, many studies have evaluated the direct and indirect effects on streams, from the substantial reduction of bedloads since the end of the 19th century and the resulting widespread incision of riverbeds. The reduction in solid bedload and incision result mainly from extraction of aggregates in low-water channels, but many other factors, both natural (global warming since the end of the Little Ice Age) and anthropogenic (stabilisation of watersheds, flushing and dredging, dams and sills), have also contributed, with variable intensities depending on the region and the type of stream. The best-known impacts of these incision processes related to alterations of solid bedload transport are: (1) lowering of alluvial groundwater and its indirect effects

such as drying of river ecosystems and the reduction of low-cost and high-quality drinking-water, le scouring bridges, levees, river bank protections, etc.; (2) increased erosion of unprotected riverbanks by streams seeking to compensate for the deficiency in solid bedload by lateral sediment reloading and a reduction of slope by increased sinuosity; (3) modification of the nature of the riverbeds or denuding of the rocky substratum, with repercussions on aquatic and riparian biocenosis (developing on mobile alluvial riverbanks), whose alluvial substratum makes up a special habitat. Hereafter we present a few points on the impacts of diverse anthropogenic interventions on bedload transport and the leads that could be explored in an attempt to resolve them. First, however, an introduction on the natural modification of the climate in the middle of the 19th century will add to a better understanding of the climate context in which these interventions take place.

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Bedload deficit alters river floodplains: consequences of river incision on functioning and biodiversity of riverine wetlands

Gudrun Bornette

The increase of human activities during the last Century led to deep modifications of river functioning, through the very strong decrease of their spatial and temporal heterogeneity. Many parameters have been altered, as hydrology, bedload grain size and channel mobility. A major consequence of such anthropogenic constraints is the sometimes huge incision of most large European rivers. Riverine wetlands contribute for a dominant part to the aquatic biodiversity in river floodplains, and provide many functions and services to human societies. The aim of this presentation is to analyse the short and long-term consequences of river incision on the functioning and biodiversity of such wetlands. At the wetland scale, two main processes are described: first, the consequences of the decrease of lateral mobility of the river, which alter the disturbance regime in remaining wetlands, i.e. their dynamics and biodiversity, but also the potentiality of creation of new wetlands; second, the consequences of river channel deepening on the perenniality and the hydro geological functioning of wetlands. At the larger scale of the river, the short and long terms consequences of such processes on functional heterogeneity of wetlands are then briefly described.

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A global approach to ecological restoration in protected areas

Karen Keenleyside

The establishment and effective management of well-connected networks of protected areas are seen as a major part of the solution to global conservation challenges such as biodiversity loss, land use conversion, overexploitation of resources, and climate change. However protected areas rarely contain complete unaltered ecosystem, particularly in densely populated regions. Despite growing international attention to the values and practice of ecological restoration and its scientific and policy context, the global protected area community lacks clear, consistent decision-making guidance for ecological restoration. In recognition of this gap, the IUCN's World Commission on Protected Areas is developing best practice guidance for ecological restoration in protected areas. This guidance will be based on the Canadian approach, which builds upon the foundation work of the Society for Ecological Restoration International and is described in Principles and Guidelines for Ecological Restoration in Protected Natural Areas. IUCN members have agreed that the global guidance should support ecological restoration activities in protected areas that ensure ecological success (i.e., are effective), are practical and affordable (i.e., efficient), enable and encourage meaningful participation, support and commitment of indigenous and local communities, and recognize and embrace interrelationships between people, culture and nature (i.e., are engaging). This presentation highlights challenges and issues being addressed through this work, and invites conference participants to offer suggestions to further its objectives.

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TUESDAY AUGUST 24TH

LUNCH
Warm Dish
Sauted lamb like a tagine, Saffron Semolina with small vegetables.

For Vegetarians
Casserole of fennel and fig with baby vegetables

Dessert
Iced nougatine, ganache sauce

DÉJEUNER
Plat chaud
Le sauté d'agneau façon tajine, Semoule safranée aux petits légumes

Pour les végétariens
La cocotte de fenouil aux figues et petits légumes

Dessert
La nougatine glacée, Sauce ganache

WEDNESDAY AUGUST 25TH

BOX LUNCH FOR FIELD EXCURSIONS
1 Swedish bread sandwich with raw food and goat cheese with basil
1 Club Sandwich with chicken, curry and young sprouts
1 Fennel salad with baby vegetables and fresh peppermint
1 Madeleine cake, lavender tasted
1 Fruit compote

PIQUE-NIQUE POUR LES SORTIES SUR LE TERRAIN
1 sandwich pain polaire crudités et brousse au basilic
1 sandwich club au poulet, curry et jeunes pousses
1 salade de fenouil aux petits légumes et menthe fraiche
1 madeleine à la lavande
1 compote de fruits

THURSDAY AUGUST 26TH

LUNCH
Warm Dish
Grilled Duckling Filet, Raspberry vinegar gravy, Provencal Ratatouille.

For Vegetarians
Cold plate: Eggplan Caviar, grilled eggplant, Vegetables stuffed with multicoloured peppers, artichokes barigoule

Dessert
Season fruits tartlet, Lavender sorbet

DÉJEUNER
Plat chaud
Le filet de canette grillé, jus au vinaigre de framboise, Ratatouille Provençale

Pour les végétariens
Assiette froide : caviar d'aubergine, aubergine grillée, petit farci aux poivrons multicolores, barigoule d'artichaut

Dessert
La tartelette aux fruits de saison, Sorbet à la lavande

FRIDAY AUGUST 27TH

LUNCH

Warm Dish
Served in its glass bowl: Small vegetables risotto, Chopped young rabbit in mustard seeds

For Vegetarians
Risotto "from our vineyard", roasted & raw lettuce.

Dessert
Strawberry soup with peppery mint, Thin Almonds biscuit.

DÉJEUNER

Plat chaud
Servi dans son bocal : La poutine de risotto aux petits légumes, Emincée de lapereau en graine de moutarde

Pour les végétariens
Risotto « retour des vignes », laitue crue et braisée

Dessert
La Soupe de Fraises à la Menthe Poivrée, Tuile aux amandes

THURSDAY 26 AUGUST

GALA DINNER (75 EUROS)

Starter
Sea bream tartar, Vichyssoise (cream) with asparagus tip

For Vegetarians
Served in its glass bowl:
Iced tomato & melon soup flavored with marrow seed oil and balsamic vinegar

Warm dish
Lamb cooked 12 hours with glazed eggplants in a rosemary honey, herbs "panisse" and tomato stuffed with pepper

For Vegetarians
Mash potatoes with oil flavored with truffles, Zucchini flowers stuffed with vegetables, Provencal Tomato, "Panisse" Chip

Dessert
Served in its glass : Almond milk Blancmange, panned red fruits with basil, Choco-coffee thin biscuit

DÎNER DE GALA (75 EUROS)

Entrée
Le tartare de Daurade, Vichyssoise aux pointes d'asperges

Pour les végétariens
Servie dans son bocal en verre :
La soupe glacée de tomate et melon à l'huile de pépins de courge et balsamique

Plat chaud
L'effeuillée d'agneau "12 heures" aux aubergines confites dans leur miel de romarin, frites de Panisse aux herbes, tomate en pimentade

Pour les végétariens
Purée à l'huile aromatisée aux truffes, fleur de courgette farcie aux légumes, tomate à la Provençale, frite de panisse

Dessert
Servi dans son verre: Blanc manger au lait d'amandes, Poêlée de fruits rouges au basilic, Arlette choco-café

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