



UFZ-Special

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

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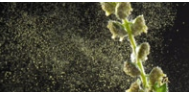






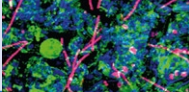


BIODIVERSITY

The diversity of plants and animals around us is often taken very much for granted and yet biodiversity is threatened; the changing climate is affecting flora and fauna just as much as the invasion of alien plants and animals in new habitats. Exactly what is happening, the effects that it is having and the instruments that can be used to counteract it, is being investigated at the Helmholtz Centre for Environmental Research.



HELMHOLTZ
CENTRE FOR
ENVIRONMENTAL
RESEARCH – UFZ

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Helmholtz-Zentrum für Umweltforschung GmbH – UFZ
Public Relations
Permoserstrasse 15
04318 Leipzig/Germany

phone: +49 (0) 341/235-1269 e-mail: info@ufz.de
fax: +49 (0) 341/235-1468 web: www.ufz.de

Editorial Office

Doris Böhme (chief editor), Jörg Aberger (p. 4-5, 9, 19, 23),
Tilo Arnhold (p. 13, 16, 21, 22), Sandra Hasse (p. 8, 14, 15, 20),
Gundula Lasch (p. 6, 10-12,)

Photography

André Künzelmann

Picture Editing

André Künzelmann (responsible), Tilo Arnhold, Doris Böhme

English Translation

Sarah Gwilym, www.der-fachuebersetzer.com

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USING AND CONSERVING BIODIVERSITY



The environment is back on the agenda. The general debate about climate change has made sure that people working in economics, politics, the media, science and the general public not only think more about just how sensitive and finite our resources are, but also about biodiversity. These days biodiversity is no longer a unfamiliar term and yet just how many people think about what is really meant by it? Does one actually think beyond the extinction of plant and animal species? Does one make the connection that biodiversity has something to do with the structure and complexity of ecosystems, with primary production, that is dependent on the range and diversity of resources; that an ecosystem is apparently more stable and able to adapt to changes, the more complex it is and that genetic diversity is invaluable to ensure the provision of ecological functions and services for mankind.

Lets take a look at the facts as they were rather impressively collated by the Millennium Ecosystem Assessment in 2005: over the last 50 years mankind has benefited significantly by using, changing and even destroying biodiversity through intervening with nature. The provision of natural goods, above all food and water has hereby constantly increased. Indeed nowadays it is assumed that the excessive use of biodiversity is now already and over the coming decades more likely to increase than decrease and that has already led to significant damage of ecosystems. We therefore have to ask ourselves just what kind of a world and with how much biodiversity we envisage for the future. Now more than ever we are faced with the challenge of developing solutions that encompass goals to conserve and yet at the same time use bio-

diversity for development goals in the community and to make such goals compatible where possible. This is where modern biodiversity research can and must contribute – not lastly as a mediator of knowledge, facts and options for decision-making.

It is about closing the gaps in our knowledge and explaining fundamental associations – for example between species diversity and the stability of ecosystems, between biodiversity and ecological services of ecosystems, between various ways of utilisation of land and the survival of species or between patterns of climate change and species distribution. This requires various approaches of systematic research, for example explaining associations and processes using finely adjusted experiments and models and understanding these so well that developments can be forecast both sufficiently and reliably. Ecosystems are dynamic; they change through natural and anthropogenic influences. Recording and forecasting the state and development of biodiversity is by far a more demanding and more labour-intensive task compared to collecting other data on the environment. Research is a crucial partner in this respect, also in terms of promoting the efforts towards international networking – for example by recording changes to biodiversity and ecological functions, as well as by standardising international political guidelines. Only with such basic principles will the development of sustainable utilisation and conservation strategies be possible.

Not lastly it is the task of research to devise numerous solutions that are suitable for practical realisation and decision-making based on the facts. Nature conservation for example is often considered as an obstacle

for economic development, although it provides on the other hand the foundations for it. It is therefore necessary to identify the various socio-economic, cultural and ecological demands and goals of various interest groups from a local to a global scale and to present on this base substantiated scientific approaches for solutions. Only then can conflicts be recognised in time and resolved effectively.

More than 100 scientists at the UFZ are committed to the spectrum of issues in biodiversity research. It is only the close integration of the natural and social science disciplines at the UFZ that makes it possible to find answers and suggestions for solutions.

In this special edition of the UFZ Newsletter we would like to give you an insight into the biodiversity research at the UFZ and illustrate to you just how much responsibility, diversity and fascination are involved in researching our living environment, that we endeavour to conserve and use sustainably.

We wish the 9th Meeting of the Conference of the Parties to the Convention of Biological Diversity (COP9) in Bonn a great deal of and above all sustainable success.

A handwritten signature in black ink, appearing to read 'G. Teutsch', written in a cursive style.

Prof. Georg Teutsch
Scientific Managing Director,
Helmholtz-Centre for
Environmental Research – UFZ



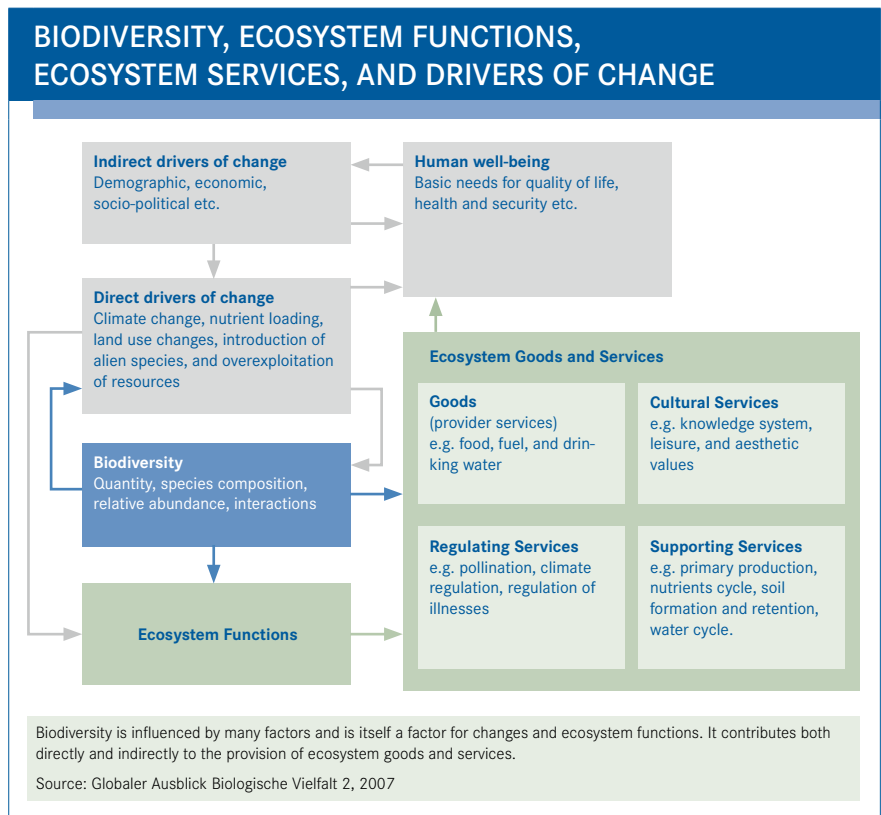
BIODIVERSITY ASSURES ‘JOIE DE VIVRE’ AND QUALITY OF LIFE

“What would happen if ...” the scientists of the Helmholtz Centre for Environmental Research (UFZ) ask themselves constantly, and many of their answers illustrate: if there was a bit less biodiversity, then human life would not be acutely threatened, however our ‘joie de vivre’ and quality of life would be considerably limited. “Nutrition is a very simple example of this”, says Klaus Henle, Head of the Department of Conservation Biology at the UFZ. The diversity of fruit and vegetables available to us ensures a welcome variety and various kinds of meat and fish form part of a varied diet for those who eat them. Looking at it from another aspect: many dishes would be tasteless or bland if we weren’t able to add spices to them. Indeed, the availability but also the lack of biodiversity has direct consequences on our daily lives. “We are all dependent on fully functioning ecosystems”, emphasises Henle. To ensure that these are in place, biodiversity is an essential although often not sufficiently perceived foundation. More than 70 percent of the world’s population depends on pharmaceuticals made from natural resources; for over 3.5 billion people, oceans are the most important source of nutrition; ocean fisheries have a current market value of 80 billion dollars and worldwide half of the population works in agriculture.

The very existence of agriculture is not lastly a consequence of biodiversity: micro-organisms prepare the ground for plants; humans

harvest corn and process it to flour and then bread; as pollinators, insects are responsible

for pollinating flowers; humans harvest cherries, apples or plums. In many different ways,



Biodiversity: According to the Convention on Biological Diversity (CBD) the term biodiversity means the variability among living organisms on Earth, including the genetic diversity within species, the diversity between species and of ecosystems.



mankind benefits from biodiversity. Nature provides free services such as the decomposition of waste products; scenic countryside with numerous animal and plant species provides mankind with a place to live. It serves not only as a place of relaxation but also as a source of income. "And yet conflicts between man and nature still prevail", states Henle explicitly. As an example he refers to the cormorants, seals or otters that end up in conflict with fisheries. Conflicts also arise in areas where larger wildlife comes into contact with humans and their livestock, for example brown bears in the South of Germany or wolves in the Lausitz. "At the UFZ we try to demonstrate in such instances the options available for mitigating human-wildlife conflicts and living in harmony with nature."

As the scientist points out, the relationship between mankind and nature fundamentally changed in the 20th Century. Mankind is now influencing life on this planet more than ever before. The rapid development of the world population, the vast anthropogenic use of land, the increasing per capita consumption of natural resources and technologies that are not environmentally-friendly have all triggered this off. Several small examples can be mentioned here: woodlands have been adapted to the needs of the timber industry with vast monocultures being formed that are extremely susceptible to pests and hardly able to withstand storms. Where salmon pop-

ulations in Saxony used to be so large that it was decreed by law to serve employees this fish no more than three times per week, these days the salmonid is a valued fish bred in aqua-farms after waterbodies were polluted with industrial waste.

"A lot of this encroachment on the environment has long term effects, that only become apparent years later", states Henle. Moreover, it is often overlooked with the implementation of new technologies, especially in the case where they are apparently particularly environmentally friendly. In this context Henle refers to the example of energy produced from biomass: for such energy production, sweet corn for example is cultivated over vast areas of land. However in the areas where this has taken place, the White Stork (*Ciconia ciconia*) has vanished. Its food supply disappeared when meadows were drained for cultivation. A piece of biodiversity also vanished together with the White Stork. Revealing such developments, identifying potential dangers and developing instruments to avoid them is part of the daily activities of the scientists at the UFZ.

In doing so, different specialist divisions work together in an interdisciplinary manner: take the issue of biological invasions for example, the Department of Community Ecology is just as involved with the issue as research scientists from the Departments of Environmental Law, Conservation Biology and River Ecology.

Likewise, the climate change issue is not only of concern for the UFZ ecologists, but its economists also want to establish which financial effects are to be expected or which costs must be incurred to mitigate or adapt to climate change.

"It is our task to make know-how and tools available that will help to conserve biodiversity", summarises Henle. The knowledge that we acquire is made available to policy makers so that accountable decisions can be made. Policy makers however also approach scientists with questions that the UFZ can help to answer. "This dialogue is imperative, because it shouldn't be a one-way process." According to Henle's point of view, these processes need to be fortified through politics, science and society.

UFZ contact persons:

■ **PD Dr. Klaus Henle**

phone: +49 (0) 341/235-1270

e-mail: klaus.henle@ufz.de

■ **Dr. Stefan Klotz**

phone: +49 (0) 345/558-5302

e-mail: stefan.klotz@ufz.de

Further information:

www.ufz.de/biodiversitaet



NATURE – SHOULD IT BE NATURAL?

Natural resource management – a task for governance research

Dead tree stumps as far as the eye can see; deserted piles of dead wood – is this really what a National Park should look like? In the mid-90's discussions about an extension of the Bavarian Forest National Park led to an outpour of emotions. What had happened? In 1983 a storm had uprooted vast areas of trees in the area and several years later the Bark Beetle continued this work. Taking the Park's motto "Let nature be nature" quite literally, the National Park administration decided in both cases not to interfere but to allow the forest to regenerate on its own. This strategy however infringed quite obviously upon prevalent expectations about what a forest should look like, i.e. not like "natural chaos", but a "tidy cultivated landscape". The economic concerns from residents, tourist companies and private forest owners played an important role, too.

Solving conflicts through participatory approaches

A lack of acceptance from the local population towards environmental and conservation measures or a rejection of these by certain interest groups are not unusual. The example of the Bavarian Forest National Park emphasizes that it is not sufficient to simply have a scientifically sound concept. One also has to plan carefully how to realize such a concept. In order to achieve this, communication with the local population is crucial. It is not enough "to be right", one also has to take into account societal realities, i.e. in our example, cultural perception patterns and socio-economic

interests, that might possibly be affected. Indeed it is perfectly justified not to give the last word to unquestioned images of nature and particular interests ranging from the customs of residents to the interests of walkers, cyclists, rangers and the forest management. While implementing a conservation strategy, it is by all means more effective yet, to resolve conflicts in advance as opposed to stirring up a dispute. In our case, however, the cultural expectations on how an intact forest should look were battled against in an ideological and legal manner as opposed to taking the problems of the residents or concerns regarding the negative effects on tourism or forest management seriously. Even the National Park administration itself admitted with hindsight that they had made a mistake in this respect.

Action can be taken to address potential conflicts through participatory approaches and corresponding implementation strategies. The interaction and co-operation of decision-makers at different levels though, make the problem increasingly more complicated. Growing participatory demands of the local population

sometimes conflict with the provisions of international agreements or the resolutions of the European Community. What is necessary from an expert point of view, for example the establishment of a European system of protected areas that improves adaptation to altered climatic conditions in the face of climate change, that must be urgently discussed and adjusted with the local population to avoid making the same old mistakes.

The GoverNat project (see box) investigates possibilities for resolving similar conflicts such as the one in the Bavarian Forest more easily in the future. The Bark Beetle in any case hasn't had any long-term negative effects on tourism in the region and in the meantime the local population has also learnt to value the evolving natural forest.

UFZ contact person:

■ **Prof. Christoph Görg**

phone: +49 (0) 341/235-1628

e-mail: christoph.goerg@ufz.de

GOVERNAT

The Marie-Curie research and training network GoverNat coordinated by the UFZ focuses on ways to reconcile conservation, socio-economic interests and cultural perception patterns. Nine PhD students and four PostDocs are conducting research at ten different partner institutes throughout Europe. The focus is on the interaction of European, national, regional and local levels in the context of the EC Habitats Directive and the EC Water Framework Directive and how the implementation of these can be improved by participatory measures.

www.governat.eu

POINT OF VIEW: THE GERMAN STRATEGY TO BIODIVERSITY



Dr. Carsten Neßhöver is a scientist in the Department of Conservation Biology at the UFZ. A geo-ecologist by training, he works to improve the interface between research and policy. In the framework of the CBD he is currently a member of the Advisory Board for the Third Global Biodiversity Outlook that will be published in 2010.

phone: +49 (0) 341/235-1649
e-mail: carsten.nesshoever@ufz.de
www.ufz.de/index.php?de=4973

On 7.11.2007 the German Federal government adopted the National Biodiversity Strategy (NBS), 13 years after it had entered into a commitment to do so with the ratification of the Convention on Biodiversity (CBD). An earlier development of such a strategy had failed several times. Over this period, both goals and approaches towards the implementation of the CBD developed quite considerably, for example with the development of the ecosystem approach. In Europe too, in addition to the biodiversity strategy of 2001, there has been a clear identification of goals with the communication of the EU-Commission from 2006 (COM 2006/216 final). How is the German strategy to be evaluated in this context?

Cross-sectoral approach

The cross-sectoral approach of the NBS is covering the problem areas well. In this respect, for all fields of politics concerning issues of biodiversity, definite targets for acting including target years have been set that are partially very ambitious. The fields for action are supposed to substantiate measures to achieve goals and to address various stakeholder groups in society. Admittedly however, there is the inherent danger that implementation in this respect is limited to individual actions and to what is feasible with simple means (and in any case planned).

Involving key stakeholders

At the national level a clear signal has been given for biodiversity with the strategy. However, just how are key stakeholders going to deal with the goals of the NBS?

A look at the development in the German federal states augurs badly. According to the German Advisory Council on the Environment, the capacity in many German federal states in official environmental management and conservation has been continuously reduced. The awareness and knowledge for integrative conservation approaches, as encouraged by the NBS, are not very prevalent. From an economic perspective, it is also imperative to involve the private sector of industry a lot more as a stakeholder in the implementation process. It must be made clear in terms of sustainable development, that keeping nature intact should be of central importance. The initiative "Business & Biodiversity" set up by the

Federal Environment Ministry is in this respect a very pleasing step.

Establishing a meaningful reporting system

Are the measures being undertaken really suitable and effective in order to achieve the targets that have been stipulated?

This is supposed to be investigated through reporting and the use of indicators and monitoring measures in the strategy, with most of them already in place or developed at the national and international level. If one regards the amount of individual goals and measures of the NBS against this set of reporting measures, the limits of this kind of approach become apparent. In many cases there is little clarity about how the actions and their potential effects should be measured by the indicators. Moreover, experience with using indicators in other fields, like for example the National Sustainability Strategy, shows that their publication only generates limited pressure for taking action. Therefore it is necessary to think about an amendment to the indicators that demonstrates the loss of performance of ecosystems and emphasizes the true loss of natural assets, thus contributing to the awareness-raising process in society and policy.

Strengthening the role of science

The concept of biodiversity was originally brought about by science to increase awareness about the loss of species and ecosystems. In Germany however, biodiversity science has difficulties with getting involved in political discussions. Now as in the past, there is still a large divide between research for biodiversity on the one hand and the implementation of conservation measures on the other. Issues that would be relevant for applied conservation do not very often correspond with "scientifically interesting" ones; at the same time however the urgency for action is increasing and with it the need for scientific expertise. The implementation of the national strategy should therefore also be used to improve communication between the fields of policy, conservation in practice and science, for even when we have to live with some knowledge gaps or uncertainties, research with its long tradition in Germany should contribute more towards the conservation of biodiversity and its sustainable use.

SCIENTIFIC POLICY ADVICE AT THE UFZ

The UFZ offers its wide range of expertise in the natural and social sciences on biodiversity at different levels in policy and society. Research projects are being orientated more and more to political requirements and enquiries answered through discussions with specialists, workshops and professional reports. Examples of this are a study on the relevance of the Millennium Ecosystem Assessment for Germany (www.ufz.de/millenniumassessment) and support for the IMoSEB-process. (See page 17)



TAKE A LOOK – BUT LOOK CLOSELY!

Around 150 plant and animal species disappear from our planet every day. Together, the EU member states aspire to stem this loss and to conserve species in the wild. In order to do so they have established a convention and among other things apportioned 20 percent of European land as protected areas. But just how does one test whether or not these steps are actually working and stabilising biodiversity?

This is where the role of monitoring comes in. Various plants and animals are observed in different habitats over a long-term period – counted, listed on inventories and the resulting data finally analysed and extrapolated. Tree frogs for example are identified and counted in the evening hours during their “choruses”. Such work is not only conducted by professional observers but also in most projects by amateurs, often to save costs. The season and weather conditions in which and for how long and how often the amateurs are able to observe an area can equally vary, as can the extent of the areas surveyed and the method of analysing data. The recording methods for species can also differ. In Europe for example there are a total of over 600 monitoring schemes, resulting in a complicated accumulation of methods and results and impeding reliable statements that are compatible between countries on the current endangered status of the observed species.

EuMon sorts out the chaos

It was high time to unify systems, to identify those that were most effective and to establish some guidelines, as monitoring gains more and more importance. Increasingly more laws and international agreements call for monitoring and status reports as a control mechanism for the effect of conservation measures. Scientists from eleven European

countries therefore got together to procure a desperately needed vision and outline. Within the project EuMon – EU wide Monitoring Methods, coordinated by the Helmholtz Centre for Environmental Research, they have been recording the countless monitoring systems that were available and have been doing so since 2004. They have compiled recommendations on how data from different monitoring systems can be standardised and made comparable and have identified which techniques in particular are economical, exact and

meaningful. Indeed a downright tricky and time-consuming task and yet it has been tremendously successful. From the heap of data both a database and an interactive tool have emerged, both of which can now be used worldwide and free of charge.

UFZ contact person:

■ **PD Dr. Klaus Henle**

phone: +49 (0) 341 / 235-1270

e-mail: klaus.henle@ufz.de

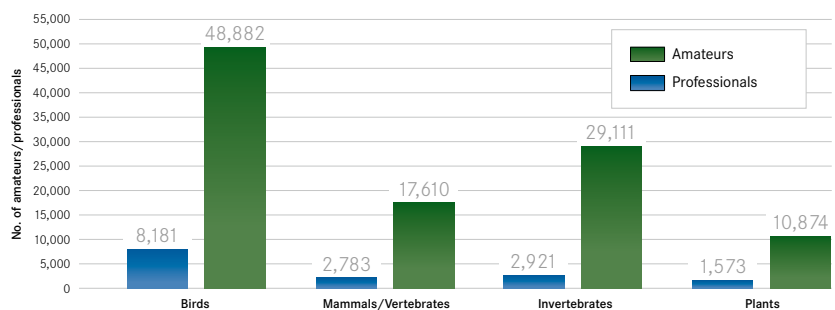
NEW TOOLS FOR PLANNING AND ANALYSIS

The online database **DaEuMon** offers detailed information and illustrations on the various monitoring procedures in Europe. Everyone can learn which species are recorded in which country at which costs and how this is done. Furthermore, information is also provided on advantages and disadvantages. Scientists were able to discover for example that monitoring data is more accurate the more observers there are involved in a project. Whether these observers are amateurs or professionals is, however, against all expectations, unim-


portant – a positive insight, especially from an expenditure point of view.

The **interactive tool BioMAT** provides tips and tricks for those who are planning a new monitoring project, who want to optimise an established project, or already have data and are looking for the right way to analyse it. The system retrieves all important parameters and redirects the user in an uncomplicated manner to the appropriate procedure.

<http://eumon.ckff.si>



The proportion of amateurs and professionals in monitoring of various groups of organisms
Source: <http://eumon.ckff.si>



Common ragweed originates from North America and has already spread to large parts of Europe. Its pollen counts as one of the most primary causes of allergies. Image: Agroscope ACW

BIOLOGICAL INVASIONS: A CURSE OR BLESSING?

Meaning well doesn't always equate to acting well! Time and time again in the history of mankind, discoverers have brought back plants and animals with them from distant countries to Europe. What they didn't realize however was that in their new home these "souvenirs" were sometimes able to spread as invasive alien species, not only pressurising but sometimes even extirpating indigenous species. How this has happened and is still happening now, the consequences of biological invasions on biodiversity and whether certain trends can be deduced from all of this, are just some of the issues being researched by scientists from the UFZ Department of Community Ecology.

"We are collecting data not only from one species at one site, but from many different species on numerous sites", Ingolf Kühn describes the work of the biologists in the department. The data recorded are analysed and are supposed to provide answers to questions such as which plant traits constitute invasiveness and their distribution pattern. "It's about establishing whether one can deduce certain displacement mechanisms", explains Kühn. Furthermore, the researchers want to establish how long it will take before alien plant species are able to harbour a similar level of insect diversity as native plant species and which factors this will depend on.

Data based on observational studies are firstly analysed statistically and "then we come into play", states Harald Auge. He and his colleagues undertake research on individual plant species and investigate among other things whether exotic species in Europe are subject to less herbivory. Auge cites the

example of *Buddleia*, otherwise known as the Butterfly bush; introduced to Europe in the 19th Century as an ornamental shrub from China, nowadays it can be found growing wild, mostly on floodplains, along roadsides, or in particular along railway embankments.

"After examining specimens of the species in China and those that grow here, we were able to establish that those distributed in Europe are not only larger but also produce more seeds", Auge summarizes.

Furthermore, the Chinese specimens of the species displayed considerably more herbivory. "We assume that there is a causal relationship between the lack of herbivores, e.g. insects and the vigorous growth of the species in Europe", states Auge. This could be an important cause of the successful invasion of *Buddleia* in Europe and also consequently why the species has become a risk to safety along railway embankments. In Switzerland, Spain and France for example the species already appears on the "black list" of particularly dangerous invasive species, but even outside of Europe it is categorised under "high risk" and battled against. Just how much has been spent there on combating the invasive species *Buddleia* is not known exactly. What is clear however is that biological invasions can cost a lot of money. According to a study conducted by the Federal Environment Agency, the economic costs of 20 investigated alien species in the year 2002 were approx. 167 million Euros in Germany alone. Unfortunately, more recent figures are not yet available. In the near future, health care costs caused by the highly allergenic Ragweed are to be investigated by the UFZ.

The *Buddleia* (or Butterfly bush) is a representative of the spread of alien species and how even today they are still being unintentionally introduced or consciously imported. With his example it becomes clear that there is no simple judgement about whether a biological invasion is more of a curse or blessing. The garden owner who regards the species as a welcome enrichment to his land will answer this question very differently to the person responsible for the safety of railway tracks. Indeed, sometimes it is only a very fine line that determines good from evil.

DAISIE

Within the framework of the EU project DAISIE (Delivering Alien Invasive Species Inventories for Europe) all known invasive species were recorded for the first time for all European countries. Information was collected on the ecology and the distribution of invasive plants and animals and made accessible to all those interested in the topic via an online database. Research centres and organisations from 15 nations are represented within the project. For further information see: www.europe-aliens.org

UFZ contact person:

■ Dr. Harald Auge

phone: +49 (0) 345/558-5309

e-mail: harald.auge@ufz.de



ALARM FOR BIODIVERSITY

Biodiversity is disappearing, entire ecosystems are changing, regions are becoming unbalanced – the causes due to the considerable intervention of mankind with nature. In ALARM, one of the largest European research projects in the field of biodiversity, over 250 scientists from 35 countries research the risks for biodiversity and develop strategies to redress the balance.

A chemical researcher and a bee researcher engrossed in conversation... until now this kind of dialogue would have been regarded as relatively unlikely, not lastly because communication between scientists of different disciplines is not that easy. “This kind of conversation is imperative however to get an idea of the whole picture”, as Josef Settele knows. The 47 year-old agronomist is the coordinator of the European project ALARM. The research within the framework of ALARM is primarily concerned with four significant drivers of global change: climate change, environmental chemicals, biological invasions and loss of pollinators.

The effects of these driving forces are evaluated in the context of future development

scenarios (e.g. altered land use patterns) and methods are developed to identify the causes of risks to biodiversity. This knowledge acts as an indispensable basis for implementing the respective countermeasures.

Scientific support to policy

In order to derive sound conservation measures for conserving biodiversity, new strategies must be developed. According to Settele “the negative trend for biodiversity results above all from current politics in the fields of agriculture, energy, transportation, commerce, the chemical industry and biotechnologies, but also in the field of the environment”. In the ALARM project these influences are analysed and sound political recommendations developed to minimise any negative

impacts on biodiversity. In this way, databases are linked with geographical modelling in the ALARM project, in order to provide information on a European scale. Standardised methods are developed for long term investigations, the updating of databases and the scenarios based on these. Finally, protocols will be available for analysing the environmental risks to ecosystems based on tested methods. The biodiversity affected by this can be observed at different levels – from genetics to populations and even to the level of species or entire ecosystems. To quantify the impacts of the drivers beyond the project, a combined scale is used from risk-probability to risk-impacts. With this scale, low, medium and high risks can be recognised for various predicted scenarios.



The foundations for decision-making in the future

The final year of the project has started, causing a silent woefulness among not just a few fellow colleagues in the “ALARM family”. There is no reason for this however: “At the end of the project, international cooperation will not drop off”, Settele ascertains. Out of the ALARM-Project a number of smaller interdisciplinary projects have been set up within which the scientists will continue their research. Concrete results can already be seen from these projects; they are creating a knowledge base on what mankind will have to do in the future in order to stop the loss of biodiversity.

UFZ contact person:

■ **PD Dr. Josef Settele**

phone: +49 (0) 345/558-5320

e-mail: josef.settele@ufz.de

Further information:

www.alarmproject.net

THE ALARM PROJECT

ALARM stands for **A**ssessing **L**arge scale environmental **R**isks for biodiversity with tested **M**ethods. The project has been running since February 2004 and will run until January 2009 with 68 scientific institutions from 35 countries involved. The project focuses on the development of methods to assess the risks for biodiversity and the development of strategies to redress the balance. The assessment and forecast of changes in biodiversity and in structure, function, and dynamics of ecosystems relates to ecosystem services and includes the relationship between society, economy and biodiversity.

www.alarmproject.net

► **Biodiversity Atlas:** At the end of 2008 the “Biodiversity Atlas of Europe” will appear as one of the results of the ALARM project. The atlas with approx. 250 pages will contain many concrete examples and clear explanations – an important tool for decision-makers on a political and economic level. A part of this atlas is already available on the internet:

www.biochange-lab.eu/resources/data

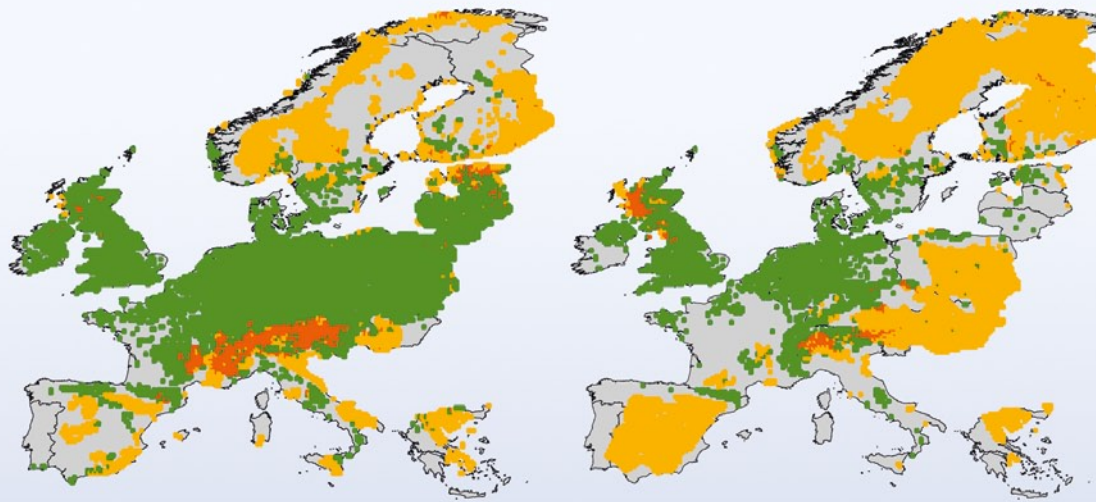
► **Butterfly Monitoring:** In 2005 from the ALARM-Project the Butterfly Monitoring project in Germany started as an initiative of the UFZ and several NGOs. Around 500 registered volunteers regularly record butterfly species throughout Germany. This data collected on butterfly populations is merged with data from approx. 20 other European countries under auspice of “Butterfly Conservation Europe” to document the development of butterflies as indicators for the state of the environment.

www.tagfalter-monitoring.de · www.bc-europe.org

Niche overlap (in red) of Titania's Fritillary (*Boloria titania*, in yellow) and its only food plant, the Common Bistort (*Polygonum bistorta*, in green). The figure on the left shows the current niche overlap, the model simulation on the right shows the projected overlap for 2080 under the assumption that the plant does not have any dispersal possibility. The changes are accordingly severe, particularly in the Alps.

Modeling: Dr. Oliver Schweiger/UFZ

■ Common Bistort
■ Titania's Fritillary
■ Niche overlap



CLIMATE CHANGE MAKES PLANTS GET A MOVE ON

Climate change is on everyone's lips; discussions about the impacts it will have and the policy on climate change are in the media almost every week. Indeed, natural systems have been regularly influenced over the geological era through a changing climate. However, the rapid global climate warming trend of 2 to 4° C that is to be expected by 2100 could significantly influence not only the adaptability but consequently also the distribution of plant species (and the animals that depend on them – see the model simulation of Titania's Fritillary above). In Europe alone, models have projected that with an extreme temperature increase of more than 4°C, almost a quarter of species could lose more than 80 percent of their current distribution range. Indeed, migration to new habitats is potentially possible, but whether or not this will be able to bear up against the speed of climate change remains to be seen. To some

extent, the plants would have to migrate ten times faster than they did after the last ice-age. Against such a background, what can be expected for German flora in particular? As a result of research, the reactions of plant species could already be established, both in temporal as well as spatial dimensions.

New challenges for nature conservation

It is therefore a new task for nature conservation to be able to evaluate the inherent risks for conservation areas or individual species and to develop appropriate action plans adapted to climate change. For this it is necessary to answer the following questions:

- ▶ How have the spatial ranges of plant species already changed and are likely to change in the future due to climate change?
- ▶ Which species will experience a particularly high loss in terms of their spatial distribution or will shift to new areas and where will these be?
- ▶ How will biodiversity in Germany alter due to this generally?
- ▶ How do the reactions of species differ under various climate scenarios?

The research project "Modelling the impact of climate change on plant distributions in Germany" coordinated by the UFZ is looking for possible answers. The first results are available; for three possible climate scenarios until 2080, the impact of the climate and land use changes on distribution ranges was analysed using 550 species as an example and conclusions drawn on the potential developments and dangers for flora and fauna.

"As we cannot predict the future we have to rely on support from models for the analy-

sis of potential future distribution ranges of plant species, just as much as we do for climate projections", coordinator Ingolf Kühn from the UFZ explains. By analysing species-environment relationships it is possible to determine a statistical correlation between distribution and climate factors. "We analyse the spatial distribution patterns of species in Germany i.e. where which species are present and the environmental conditions that are found there. From this we can then derive where species might disappear or where they might find suitable climate analogous regions elsewhere in the future", states Kühn.

Man as the main influence

The probability with which plant species will lose their habitats and find new ones will significantly depend on the direction of future economic and societal developments. These will influence CO₂ emissions and other greenhouse gases, that will have an effect on the temperature and other climatic elements and consequently species distribution ranges. The existing results underline the timeliness of potential climate-induced changes for our environment at the national level (see: www.ufz.de/klimawandel-flora). Nature conservation must be prepared for such changes and ready to adapt its strategies.

ASSISTANCE FROM VOLUNTEERS

Distribution data on native flora, freely accessible at www.floraweb.de generated among other things the starting point for investigations within the project "Modelling the impact of climate change on plant distributions in Germany". This database is based on the work from numerous volunteers mapping vegetation and provides an optimal tool for investigating the spatial patterns of German flora. European distribution data for plants were used in addition.

UFZ contact person:

■ Dr. Ingolf Kühn

phone: +49 (0) 345/558-5311

e-mail: ingolf.kuehn@ufz.de

Further information:

www.ufz.de/klimawandel-flora

Jochen Flasbarth is head of the directorate for nature conservation and sustainable use of nature at the Federal Environment Ministry. The economist and political scientist was the chairman of the German Nature Conservation Association (NABU) from 1994 to 2003.
Photo: Agroscope ACW



WE REQUIRE INTERNATIONAL STANDARDS FOR BIOMASS PRODUCTS

The German Advisory Council on the Environment has strongly criticised the goal of adding 20 percent bio-fuels to conventional fuels. Should this goal be revised?

I think that it is right to have targets as guidelines so that research and development as well as industry can adapt to them. We are just at the beginning of a technological development and as long as we keep within the guidelines of sustainability, as long as we ensure that no further nature is destroyed to achieve this, as long as we ensure that agricultural production methods are sustainable and in earnest a positive greenhouse gas balance emerges, then I don't see why this should be seen as such a bad thing. These targets must adhere to aspects of sustainability and be measured by these. It cannot be in the interest of a comprehensive sustainability policy that one allegedly solves a problem in the field of climate protection, if at the same time this creates a huge problem in the field of biodiversity.

How can one ensure that biomass is not only cultivated sustainably here in Germany, but also in those countries from which we will be increasingly importing bio-energy in the future?

What we have just now got off the ground with the German Biomass Sustainability Ordinance is a requirement: For us only those bio-fuels that fulfil these criteria will be approved and this must be proven by certification, not only in Germany, but all over the world. We have already cast this first stone. I will not conceal the fact that even superficially speaking, it cannot be regarded as truly optimal that one country, even if it is a large

Interview with Jochen Flasbarth, Federal Ministry for the Environment

and strong economy with very ambitious biomass goals, introduces such an obligation to produce supporting documents, when in the rest of the world nothing is happening. This would be a crucial step for us because at an international level we are not making headway quickly enough. We do hope however that the EU will soon move forward with an EU-wide regulation, so that in this respect we can also enact the respective import regulations, which is something that Germany cannot do at the moment within the framework of the single European market. Ultimately, it would make sense to regulate this at an international level and as chair of the forthcoming Conference of the Parties to the Convention of Biological Diversity, Germany has already intensively called for formulating criteria in the pre-negotiations. This also concerns issues on the destruction of ecosystems through an increase in biomass cultivation. The CBD cannot of course regulate standards on the climate balance as these have to come from the climate regime. Based on these two pillars, an international system of minimum requirements for the production of biomass can then be established.

What are you expecting from the Conference of the Parties to the Convention of Biological Diversity in May?

It's not going to be a walk in the park! Large agricultural producers like Brazil have already signalled tremendous resistance in the pre-negotiations. They do not want a vote on these regulations internationally. Similarly, the United States who is not a member party

to the CBD has already made clear that they do not agree with this kind of approach under the CBD. The Europeans however deem this to be correct as do others. The negotiations are going to be very difficult. It is not comprehensible to us that those who also want to sell bio-energy on the international market in the future and whom we also don't want to keep away from our markets through foreclosure, are not prepared to open up to such minimum standards.

We have got a number of problems that need resolving at the Conference of the Parties to the Convention of Biological Diversity but two of them really stand out from the rest. In Bonn we have to succeed firstly in getting the issue of biopiracy under control. The developing countries expect with every due right that we will get an internationally-binding regime off the ground that rules out biopiracy. Secondly, we need to pursue the right direction to fill existing gaps in the worldwide system of protected areas. The loss of biodiversity is still, as it was before, immense and therefore protected areas in which their sustainable use is largely possible, must be of central importance.

(Translation: Sarah Gwilym)

Further information:

www.bmu.de · www.naturalallianz.de



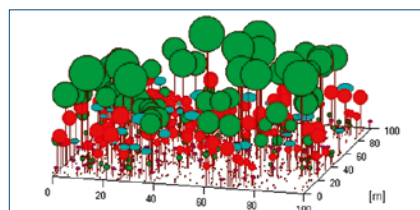
LOOK OUT..., TREE FALLING! THE IMPACTS OF FOREST USE

Wood is irreplaceable. We rely on it whether it is for paper, furniture, and complete houses or even indirectly for electricity and heating. The worldwide demand for wood has been on the increase for decades. Wood for processing or wood as a fuel? The most varied of sectors are in strong competition for this good as it becomes in shorter supply worldwide, resulting in the daily sacrifice of countless native and tropical forests. Thousands of times the world over, you will hear them call: look out - tree falling... and in the proverbial sense it literally does fall at our feet, should things continue in this way without any form of restraint. Indeed, in the tropical rainforests in particular mankind's husbandry resembles that of a blind rampage. He intersects the forest with logging roads and logging trails thereby destroying species-rich ecosystems that would otherwise absorb vast quantities of the dangerous greenhouse gas CO₂ and replaces it with global warming and a loss of biodiversity. Working to stop this are networks of partners from science, forestry and the timber industry, united by one thing – the vision of sustainable forestry worldwide. This should not only be economically efficient and ecologically effective but also socially responsible, emphasize Andreas Werntze and Andreas Huth, who work in various ways on the issue of forest use and conservation at the UFZ.

Global Forest Use

Huth and his colleagues are developing concepts for a more promising way of managing rainforests in the future. "We are looking for key processes, that can ensure the conservation of biodiversity", says Huth. "Computer models are helping us to analyse how well and quickly forests are regenerating after being managed and harvested in different ways." Results have already shown for

example that for the rainforests of Southeast Asia, considerably larger time periods would have to be left between harvests in order to allow sufficient time for forest regeneration. Furthermore, logging roads should be planned in such a way that they don't cause any further damage to the forest. Projects following these guidelines have already been carried out in numerous countries. How a forest is to be managed in detail will of course depend on a number of individual factors and will vary from forest to forest. Therefore UFZ scientists are consulting various authorities accordingly.



Simulation of a logged-over tropical forest using a forest computer model. Source: Andreas Huth, FORMIX3

Forest Use in Germany

In contrast, the funding priority by the BMBF "Sustainable forest and timber management in Germany" covers investigations on timber resources for the entire of Germany and is chaired and accompanied by Andreas Werntze from the UFZ. Since 2005, 25 individual projects belonging to this funding priority have been committed to finding solutions to the following and many other significant questions: which kinds of tree species do we need to plant and how do we need to manage forests so that they can still be used as a resource later? How do climate changes affect the forests and how do changes to the forest affect the climate? How can the forestry and timber industry sectors be kept competitive and secured in light of increasing globalisa-

tion and decreasing biodiversity? We already have preliminary answers to these questions that are now being practically tested. One of these is the combined crop growing of both woods and agricultural crops like corn on a field, a so-called agro-forestry system. On test sites in Baden-Württemberg for example valuable tree species like Walnut or Cherry are being cultivated, and sometimes in addition particularly fast-growing species like Willow, Robinia or Poplar, explains Andreas Werntze: "With this system, the increased demand for a variety of valuable tree species can be met quickly." At the same time the pressure is taken off the well-established forest ecology of the native forests, because less intensive intervention is required there as a result. Furthermore, there is another positive effect: "The agricultural crop lands are ecologically enriched with stands of trees and with this kind of structure might provide new habitat for other animals."

It is now to be tested whether or not trees and corn can be viably cultivated in coexistence and whether both growth and harvest are possible without any difficulties. It must also be calculated what this means for the landscapes and above all for the farmers who require practical and affordable solutions if they are to implement the whole thing.

UFZ contact persons:

■ Dr. Andreas Huth

phone: +49 (0) 345/235-1719

e-mail: andreas.huth@ufz.de

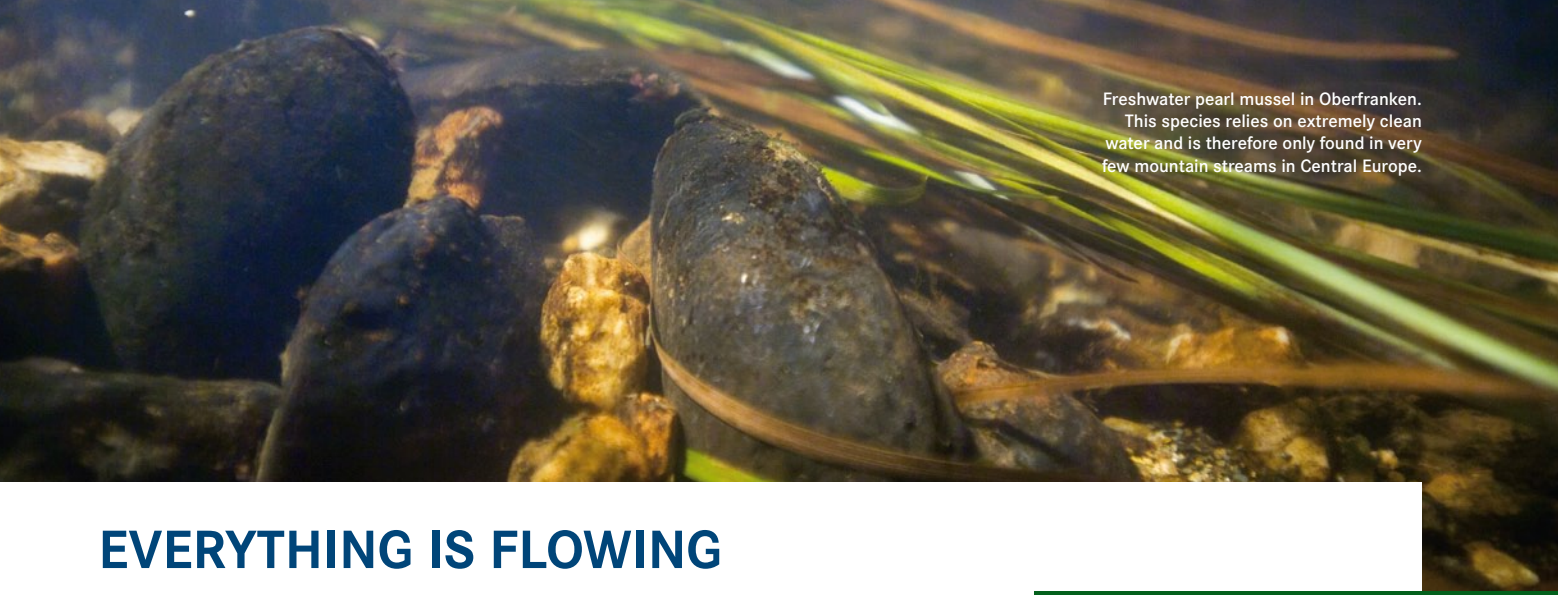
■ Andreas Werntze, MSc.

phone: +49 (0) 341/235-1816

e-mail: andreas.werntze@ufz.de

Further information:

www.nachhaltige-waldwirtschaft.de



Freshwater pearl mussel in Oberfranken. This species relies on extremely clean water and is therefore only found in very few mountain streams in Central Europe.

EVERYTHING IS FLOWING

It is the species that every ecologist would like to find in a watercourse – the freshwater pearl mussel. This particularly treasure is only found in rivers and streams that are ecologically intact and where the water quality is particularly good. However, scientists have to look for a long time these days before they find one, although if lucky they might still find specimens in Germany in the Lüneburger Heide, Saxony and Bavaria. The reasons why this mussel has become rare are evident; overexploitation due to the greed for pearls has played just as significant a role as have decades of water pollution and continuous habitat destruction. Hence two thirds of all European rivers are in a critical ecological condition, according to what was established in water resources inventories from the year 2005. In any case, too heavily influenced and damaged by mankind to provide suitable habitat and living conditions for the sensitive mussel.

How is that possible, given that there have been decades of building sewage plants and providing technical solutions for wastewater problems? “Physical-chemical and biological purification alone is not sufficient,” emphasizes Dietrich Borchardt from the Department

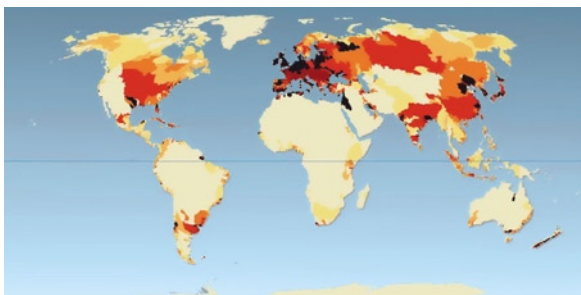
of Aquatic Ecosystems Analysis at the UFZ. “The ecological status of a watercourse depends considerably on its structure, aquatic biodiversity and the functioning interactions between its biota. Numerous organisms are functionally associated with each other, they regulate the cycle of matter and with it the water quality.” For example, organic material such as leaves and branches fall into the river acting as nutrients for microorganisms like bacteria, protozoa and invertebrates. In turn these are fed on by trout that require not only cool, oligotrophic, unpolluted water but also fine gravel for spawning grounds. Furthermore, the trout is a requirement for the existence of the freshwater pearl mussel; the parasitic larvae of which encyst on the gills of the juvenile brown trout, developing there until they drop off and settle in sediments of the river bed, burying into the coarse sand there. “Watercourses with such complex biodiversity are more robust to external influences, have a greater potential for self-purification and are even able to break down pollutants”, according to Borchardt, “but only when they are not overstressed or degraded to the status of drainage channels. Unfortunately the opposite is mostly the case”. This is supposed to

and must change by 2015 according to legally binding European environmental objectives.

The EU Water Framework Directive envisions a ‘good ecological status’ for all surface waters in the EU. Investigations are therefore taking place at the UFZ to establish which approach would make the most sense. Among the key concepts are: reducing the influx of pollutants from waste waters and agriculture, allowing rivers that have been straightened out to find their natural course again, enabling watercourses to reclaim their floodplains and allowing for more river bank vegetation. “To achieve this however, more detailed investigations must be conducted to understand how complex interactions in watercourse ecosystems behave and allow themselves to be controlled”, explains Borchardt. “To do this we are planning laboratories directly on the watercourses, where we want to investigate and manipulate water currents. Among other things we will be removing and introducing individual species of organisms and artificially polluting or purifying the water to find out what happens.”

Even climate change will influence streams and rivers. Just how exactly is also being investigated in order to find effective action plans to deal with the consequences. These are then supposed to provide guidance for environmental authorities and the public decision makers. Indeed, decisions that will have to make sure that our watercourses don’t literally drain away.

POLLUTION FROM NITRATES IN RIVERS



Increase of nitrate in rivers and estuaries. Dark colours show very high loads.

- less than 1%
- 1% to 50%
- 50% to 100%
- 100% to 200%
- 200% to 400%
- 400% to 500%
- more than 500%

Source: Millennium Ecosystem Assessment

UFZ contact person:

■ **Prof. Dietrich Borchardt**

phone: +49 (0) 391/810-9757

e-mail: dietrich.borchardt@ufz.de

Further information:

www.ufz.de/index.php?de=13995

Klaus Töpfer was Federal Minister for the Environment, Nature Conservation and Nuclear Safety from 1987 to 1994 and from 1994 to 1998 Federal Minister for Building and Regional planning. From 1998 to 2006 he was the Executive Director of the United Nations Environment Program (UNEP). Since 2001 Töpfer has been a member on the Council for Sustainable Development.



“WE NEED TO DO OUR HOMEWORK”

In May the 9th Conference of the Parties to the Convention of Biological Diversity will take place in Bonn. What are you expecting from this large international conference?

Firstly it is really exciting, that it is going to take place here in Germany. The conference will be a very important instrument of this UN Convention for the Parties. I hope that many people including those here in Germany will come to understand that biodiversity is by no means a luxury good discovered by prosperous nations but that it embodies an extraordinarily essential function for our well-being. Biodiversity is genetic diversity and therefore also a treasure of knowledge in nature which we should preserve with all due diligence and use very wisely. It is crucial to the survival of mankind!

As General Secretary of the United Nations Environment Program you lived in Kenya for a long time. What impression do the developing countries have of the biodiversity resource?

We have got the intellectual property rights and we know that these property rights are very important so that research can be conducted and the ones who have conducted it

Biodiversity is not a hobby for rich people interested in nature but a fight for survival – An interview with Klaus Töpfer

can benefit from what they have researched. We have absolutely no regulation in this respect for genetic property rights. Developing countries like the mega biodiversity countries ask: how do we manage this? This is going to be one of the large central issues at the Conference in Bonn. We will be able to much better support the active conservation of biodiversity if we can make the associated services connected with it, subservient for the people living there. It is a fact that genetic diversity is a common property, whereas resources and services are privatized. This must be overcome, otherwise we will have to wait a long time for a genuine interest in the conservation of nature and ecosystems.

Over recent years a strong awareness has developed that climate change presents a problem for mankind. Can the loss of biodiversity equally get into our heads like climate change has done?

In the field of species conservation and biodiversity we are lacking something similar to what the UN Intergovernmental Panel on

Climate Change (IPCC) is, which has now won the Nobel Peace Prize. This is a brilliant instrument that connects government and science. It is the Intergovernmental Panel on Climate Change. Both scientists and governments are represented here, enabling options for acting to materialize much quicker. I advocate that a comparable instrument is established in the field of biodiversity and I believe that one should have something like a “Stern Review” for biodiversity. It must be calculated in just the same way i.e. what are we losing? Of course one could say that nature is worth a lot more than one can express in Dollars or Euros! This is right of course, but one also has to see that this was done for climate change and it was only with this that one finally saw and apprehended – there are endless significant economic costs, if we don’t take action. It is precisely this that can and must also be calculated for biodiversity. Using these instruments are good prerequisites for making mankind a lot more aware that biodiversity is not just some kind of enthusiasm, but a very important investment in survival.

What can research contribute to solving conflict?

On the one hand, research must generate knowledge. What are the causes, effects and correlations? Which conditions must be created for the existence of flora and fauna? What are the minimum sizes? How can one restore nature without jeopardizing economic stability? Take a look at the story behind land consolidation and then you will know what

science can do: in the early days, land consolidation was literally just clear-felling and what resulted from it were horrific problems with soil stability. Hence, we alone created floodwaters in the rivers from clearing the landscape. It then became very clear that clearing the landscape could also result in an economic catastrophe. Therefore preserving the landscape so that it still has some natural landscape elements also results in economic

advantages. Science has to make that clear.

Can Germany be a role model?

We have to do our homework. It really is that easy. It is clear that other countries have completely different prerequisites because they are not as densely populated as us or are on the outer perimeters of Europe. The situation in Scandinavia is a completely different one to the densely populated Netherlands. I therefore like to use the expression "role model" with caution. It also sounds a little bit authoritarian and those associated with this label are not exactly considered to be particularly popular. No, we definitely have to do our homework. We have to make it clear to ourselves that we can't preach to others about conserving biodiversity as if we were the world champions at it, when we don't do anything about it in our own country. We need to conserve biodiversity both here and in other countries. I consider this to be both feasible and necessary and we should argue this in Bonn in May.

(Translation: Sarah Gwilym)

IMOSEB – A WORLD COUNCIL FOR BIODIVERSITY

To bring representatives from science, politics and NGOs together, a consultation process was brought into being three years ago, which was supposed to lead to the founding of a new committee ("International Mechanism of Scientific Expertise on Biodiversity" - IMOSEB). In October 2006 experts from all over the world met for this at the UFZ in Leipzig. It still remains their goal to create an international committee for biodiversity in the near future, as was already achieved for the Intergovernmental Panel on Climate Change.

www.ufz.de/index.php?de=10436 · www.imoseb.net

The value of biodiversity

Animated by the "Stern Review" on the economics of climate change, the G8 + 5 states have decided to compile a review on the costs of not taking action on the conservation of biodiversity. The first results of the work, in which the UFZ is also participating, will be presented at the 9th Conference of the Parties to the Convention of Biological Diversity (COP9) in Bonn.

POINT OF VIEW: LAND CONSUMPTION MUST BE STOPPED!



Prof. Dr. Wolfgang Köck has been a lecturer in the Department of Law at the University of Leipzig since 2001. Since 2004 he has been the Head of Department "Environment and Planning Law" at the UFZ.

phone: +49 (0) 341/235-1232
e-mail: wolfgang.koeck@ufz.de
www.ufz.de/index.php?de=1777

The reduction of "land consumption" for settlement and transport is listed as an action field of the German Federal Government's National Strategy on Biodiversity. Up until 2020 the current amount of land converted for roads and settlements of more than 100 hectares per day, mainly in connection with agricultural land use, is to be reduced to 30 ha per day. This is to be achieved by regulating and stocking the amount of construction activity, by improving the urban residential environment and by pooling areas used for infrastructure.

The main drivers of the current land consumption trend are towns and municipalities. New land set aside for settlements from local authority planning accounts for 80%, and the access roads required for such settlements equally authorised by local authority planning bodies account for a further 10%. Interregional highways, rail networks or airports account for just 4% in comparison. In the future it will be a matter of enforcing that road planning will have to comply with the legal requirements of the National Association of Biotopes and not vice-versa.

The urban land development for settlements is driven by:

- ▶ macro-economic factors (e.g. economic growth and higher operational demands for land as commercial premises due to globalisation),
- ▶ micro-economic factors (e.g. the price of land and competition between local authorities for investors and residents),
- ▶ demographic factors (e.g. a change in the size of households),
- ▶ residential preferences (the predominant family model of "country living"),
- ▶ increased automobilisation, that first enabled the suburban sprawl and
- ▶ a generally weak land use planning at the regional or national level, that has until now hardly placed any limitations on the land use planning of municipalities.

Implementing economic global control instruments.

If we are to achieve the 30 ha goal, then as far as I am concerned the state information and funding instruments are insufficient.

In realising the "National Strategy" it is just as important to implement economic incentives, like the concentration of housing grants for the renovation and restoration of existing buildings or the "greening" of the revenue sharing system at the state level, as it is to implement regulatory instruments. The spatially-oriented planning law of improved efficiency is awaiting with regulatory instruments.

In our recently published study for the Federal Environment Agency (Umweltbundesamt - UBA) we identified a number of improvement options for using the planning law more effectively to save land (Activating spatial planning law. Options for the reduction of land consumption, UBA-reports 1/07). Particularly with the law on local land use planning ("Bauleitplanung") that makes stipulations for the municipalities and with the law on regional land use planning ("Raumordnungsplanung"), the opportunities for saving land have still not been fully exploited.

Improving instruments for town planning

Making regulatory instruments more effective does not only comprise a limitation of the scope for municipal planning. The town planning instruments that are available to the municipalities for reallocating existing structures must also be improved. Currently municipal options are very limited with town conversion areas, building restrictions or obligations to remove buildings, to initiate a competent local policy for the development of the core city to protect the natural landscape.

If a real breakthrough is to be achieved, then not only these inter-ventory instruments, but also the compensation regulations will have to be examined. In fact, the law does not fully exploit what is allowed by the Constitution. Only then will the municipalities really be in a position to make use of the instruments available within town planning laws, to create the spatial prerequisites for a reuse of derelict land within the core city ("land recycling").

TRADABLE PERMITS FOR CONSERVING BIODIVERSITY?

Economic development should not be limited unnecessarily. Therefore it is worth considering the authorisation of a loss of habitat in one place when a tradable land use permit is used to show that an equally valuable habitat has been created elsewhere.

If permits for designating building land can be freely traded, then a market for tradable permits can be developed that contributes to the cost-effective and flexible conservation of biodiversity. The conditions under which this can be successful are being investigated within the framework of the EcoTRADE project. EcoTRADE is financed by the European Science Foundation and is a joint project run by ALTERRA (in the Netherlands) and the UFZ.

www.ecotrade.ufz.de



INTEGRATING CONSERVATION INTO INTERGOVERNMENTAL FISCAL TRANSFERS

One doesn't speak of money one has got money! With its chronic lack of financial resources, nature conservation in Germany would love to subscribe to this point of view. In this field however, money matters have to be discussed and clarified. It has to be considered where funds should come from and for which projects and how conservation measures can be financed.

Irene Ring, Deputy Head of the Department of Economics at the UFZ has a possible answer to this dilemma: "from intergovernmental fiscal transfers."

"In Germany for example large protected areas are frequently seen as barriers to development", says the scientist. This is particularly true for the municipalities, for when the use of land is limited, this is often considered to be a threat locally. As the municipalities procure a large part of their revenue from intergovernmental fiscal transfers, incentives could be created here to take conservation more into account. By means of intergovernmental fiscal transfers to the local level, as carried out in 2002 in Saxony she calculated how fiscal transfers to municipalities that are more committed to nature conservation could be raised.

Firstly, she investigated the designated protected areas within municipal borders and in doing so she took into account the stringency of protection using a grading system: For the highest level of protection, the National Park, she gave it a factor of 1, whereas the landscape protection area with the lowest protection level was valued with a factor of 0.3. Ring then equated one hectare protected area as a unit with one inhabitant, due to the fact that with intergovernmental fiscal transfers one

of the main indicators for general lump-sum transfers is the number of inhabitants. "It could be seen from the results (see map), that only very few municipalities would have actually had to accept restrictions, while a whole row of them would have benefited considerably", the economist summarises the results.

Ring uses the example of Brazil to demonstrate how this kind of financing really works. There, in the State of Paraná protected areas were already introduced in 1992 as indicators for intergovernmental fiscal transfers to municipalities with great success. Not only did the overall number of protected areas increase but the quality of these also improved. This can be explained by the fact that quality indicators were recorded that take into account for example which conservation goals have been achieved. In the meantime 12 of the 27 Brazilian states have developed similar models, with others currently considering implementation. In Europe, Portugal is the

forerunner with the idea of intergovernmental fiscal transfers to municipalities for Natura 2000 areas that correspond to the EU Habitats and Birds Directives.

Through increased efforts for nature conservation, various municipalities in Germany could make up for what they are lacking in economic power compared to other municipalities. At the same time they could also strengthen their own economic position, in that they develop sustainable tourism for example building on the discovery of extensive protected areas. Not lastly, they would also have an instrument available in order to stop the migration of labour and brain drain.

UFZ contact person:

■ **Dr. Irene Ring**

phone: +49 (0) 341/235-1741

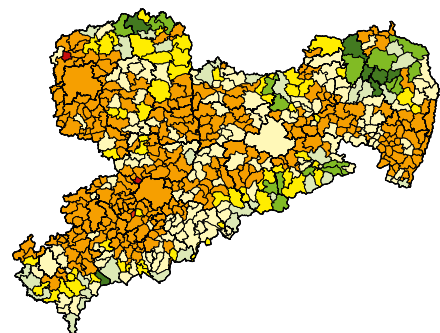
e-mail: irene.ring@ufz.de

FISCAL TRANSFERS FOR NATURE CONSERVATION IN SAXONY, GERMANY

Changes in lump-sum transfers:

Red	- 100 to < - 50%
Dark Red	- 50 to < - 25%
Orange	- 25 to < 0%
Light Orange	0 to < 25%
Yellow	25 to < 50%
Light Green	50 to < 100%
Green	100 to < 200%
Dark Green	200 to < 500%

The map shows changes in general lump-sum transfers to municipalities in Saxony if protected areas were taken into account for the intergovernmental fiscal transfers of 2002.





SLY AS A FOX WITH VIRTUAL EXPERIMENTS

BTV-serotype 8 is an aggressive virus, that spreads extremely quickly. First discovered in Germany in 2006 and transmitted by midges, it causes the bluetongue disease and with it significant damage to sheep and cow populations. Its victims limp around, suffer from fever and weight loss and many even die. One assumes that accelerated climate change, leading to shifts in species compositions has caused it to spread to Germany. Nowadays, its vector midges finds the ideal conditions to thrive in Germany. Consequently, the exotic virus, which previously only occurred in countries south of the Mediterranean, can now spread here. A vaccine against the blue-

tongue disease is supposedly available. However, when, where and how often vaccinations must be carried out to stop the epidemic is currently being discussed. To support this debate, a virtual experimental field would be ideal to run through possible scenarios as often as one likes.

Revealing mechanisms and forecasting consequences

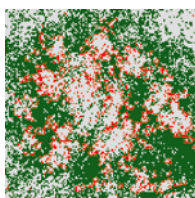
The scientists in the Department of Ecological Modelling are developing the corresponding simulation tools: they are "modelling". With their computer models for example, they are able to re-enact how a classical swine fever

epidemic spreads in virtual wild boar populations or fathom out which rules drive the life cycle of the fox tapeworm. Furthermore, they are able to test how different intervention strategies interfere with nature; for example when rabies (that is not only a danger to the fox but also to humans) is tackled using a large-scale oral vaccination of foxes in the field.

Current decision support for policies

Scientists have just found out how rabies can be stopped more cost effectively. It is indeed sufficient to vaccinate only 60 percent of all model foxes. This result has questioned an EU-regulation that stipulates that the co-financing of a vaccination program will only be supported if at least 70 percent of all foxes are vaccinated. With the small correction, about a third of the vaccine doses could be saved and consequently the associated costs reduced. This would be particularly important for the new EU member states from Eastern Europe where rabies is, now as before, still rampant and who cannot afford the expensive vaccination campaigns. Similarly, with the bluetongue disease, scientists are in agreement that virtual experiments can help to find optimal and practical solutions.

DISEASE CONTROL ON THE COMPUTER



Modelling – how does this work?

Scientists feed their computer with elementary rules and large quantities of data, for example rabies cases that have actually been recorded in the past. A virtual picture of the rabies epidemic then arises from numerous lines of programming language. On applying the model, various scenarios for combating rabies are compared by simulating the vaccination protocols thousands of times. In the results it can then be forecast how probable it is for a certain control strategy to be effective or fail and how the number of baits, time of vaccination and extent of the vaccination area must be combined to optimally eliminate the pathogen. Recommended action plans are derived from this and incorporated into the regulations of the responsible authorities.



Combating rabies – how is that possible?

Oral mass vaccination programs control rabies in foxes by distributing vaccine-filled baits by aircraft, on average 20 baits per square kilometre twice a year. For the foxes they are both a treat and a vaccination at the same time. This year will see the final eradication of the virus in Germany, making Western Europe free of rabies. Now it is important to maintain what has been achieved and prevent a possible reintroduction of the virus.

UFZ contact person:

■ **Dr. Hans-Hermann Thulke**

phone: +49 (0) 341 /235-1712

e-mail: hans.thulke@ufz.de

Further information:

www.ufz.de/index.php?de=6365



The joint project EVENT between the University of Bayreuth and the UFZ is conducting research on the effects of extreme weather events on vegetation. Image: Jürgen Kreyling/UFZ

EXPERIMENTS TO UNDERSTAND PROCESSES

It's harvest time twice a year: just like on a real montane meadow, the grass is mown, only that the researchers here are not leaving anything to chance. On twenty sites in the Slate mountains of Thuringia and Frankenwald they have painstakingly conducted inventories of the number and species of grasses and herbs. Following this, the plant diversity was deliberately manipulated by sowing seeds from additional mountain meadow species on all sites. The result was surprising: not only the biodiversity of meadows increased after sowing the seeds, but also the hay harvest. "The explanation is simple", explains Harald Auge. "Different species occupy different niches. The resources are used more effectively and consequently the yield increases. In the future we might even say: it's better to sow seeds than fertilize." Indeed, the classical form of fertilising does not only pollute watercourses with nitrates, but also suppresses less competitive species. The meadow ecosystem therefore becomes more unstable and for instance more susceptible to invasive species. The influence of insects has a positive effect by comparison. These normally weaken the strong plant species therefore giving less competitive plants a chance and resulting in an increase in biodiversity. With the DIVA-project, the Helmholtz-researchers want to establish together with their colleagues from the University of Jena, which local and regional processes influence biodiversity.

On the research sites it is also about the influence of even smaller life forms, namely soil microorganisms. Topsoil and soil microorganisms (one can count up to 130 tonnes of bacteria in the soil of a one-hectare meadow) represent the largest carbon sink on the planet. If there is less plant diversity then

carbon will escape into the atmosphere in the form of the greenhouse gas carbon dioxide and the climate will get warmer. Hence, the small soil dwellers react to changes in the vegetation cover. What is special here is mycorrhiza – the symbiotic association between fungus and the roots of a plant. This complex symbiotic association was investigated by soil scientists using the example of the common oak in climate chambers and is now being confirmed in field experiments.

Experiments in biodiversity research are still rare. "Modern biodiversity research will not get around conducting experiments", Stefan Klotz feels certain. Without experiments there is no data to be revised and consequently no reliable modelling. "Observations alone are insufficient. We have to confirm our observations with experiments, in order to understand processes" emphasizes François Buscot.

The researchers want to test one hypothesis that is important for the global climate in Kreinitz near to Riesa in Sachsen. Can ecosystems with lots of species produce more biomass and therefore absorb more carbon dioxide and consequently have a positive effect on the climate?

Researchers are experimenting on this with the number of tree species. They want to examine carefully up to six different species over 10 years in order to get new insights into the growth of mixed forests. Worldwide, there are only seven such tree experiments, with Kreinitz being the only one investigating the first stage of growth. In 2008 the UFZ researchers are starting another experiment. On study sites in China, the diversity of forest trees and shrubs is being manipulated to find out how soil erosion can best be prevented. In

the West of China in particular, the encroachment of the Gobi desert is proving to be an elementary problem.

Experiments in biodiversity research are therefore not just to gain basic insights and understand the functions of various species. They are also the key to managing ecosystems better and therefore using them more effectively and sustainably.

LTER – LONG TERM ECOLOGICAL RESEARCH

Without long-term observations many effects cannot be recognised. For this reason, a network for long-term ecological research was established that conducts research on various sites from the Wadden Sea to the Bavarian Forest. LTER-Germany, coordinated by Stefan Klotz (see page 5), is integrated in both the European as well as the global LTER-Network. There are also new Biodiversity Exploratories for functional biodiversity research of the German Research Foundation (DFG) in Schorfheide, Hainich and the Swabian Alps. The UFZ is part of this network with 5 projects.

www.lter-d.ufz.de

UFZ contact persons:

■ **Prof. François Buscot**

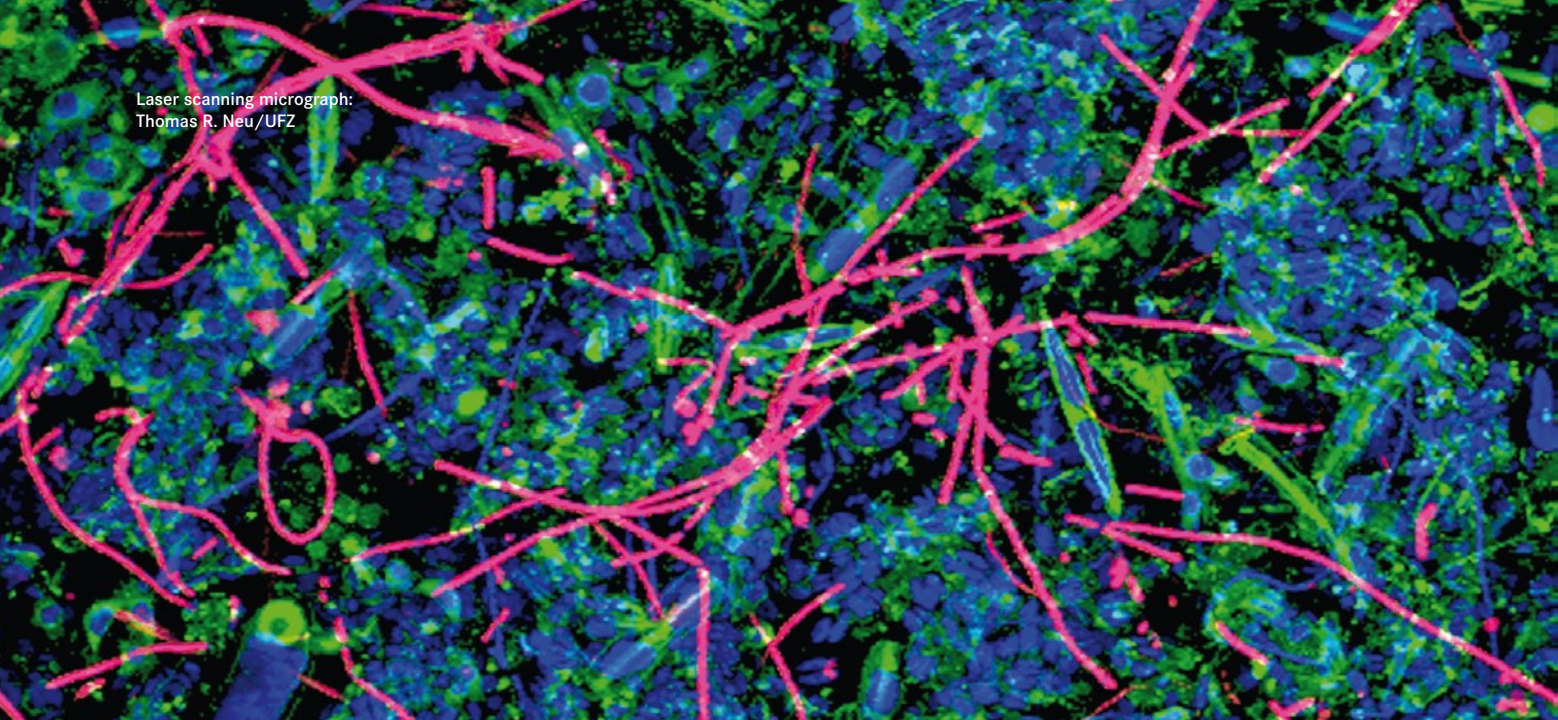
phone: +49 (0) 345/558-5221

e-mail: francois.buscot@ufz.de

■ **Dr. Harald Auge**

phone: +49 (0) 345/558-5309

e-mail: harald.auge@ufz.de



MICROBIOLOGY – THE OVERLOOKED MAJORITY

There are only estimates of just how many different species our planet actually harbours. What is certain however is that a large proportion of these escape our attention because they cannot be seen with the naked eye. Indeed, microorganisms could account for about one third of the estimated 100 million species. In accordance with many estimates, a single spoon of soil contains more kinds of microorganisms than there are plants on the entire planet. Does a genetic difference however automatically equate to two different species? This concept is difficult in microbiology, where the rule that applies to plants and animals i.e. those that are able to reproduce together represent a species, does not apply. Experts therefore consider microbiology to be in the position now that the “greater” biology was in a century ago. Above all this applies to registering species and the investigation of interactions between plant and animal communities. “A site with a certain level of plant diversity is manageable, something which is not possible with a microbial system because there are simply too many players in the game”, explains UFZ-microbiologist Hauke Harms. That is why these processes have to be simulated.

In spite of such methodical problems, one thing is clear – microorganisms represent a significant factor; they keep all ecosystems running and nothing functions without them. The biomass of bacteria, archaea and viruses corresponds to roughly the amount of plant

biomass on the earth. That means that just as much as is seen above the ground, also exists in the oceans and even more so in the ground. Even in the deeper soil layers one can still find up to one million microorganisms per gram of material. There are bacteria in tiny slate pores that were obviously trapped there, when the stone was formed 200 million years ago. “Since then they have been sitting in their little ‘chambers’, simply preserving themselves. Their metabolism is probably so low that even the tiniest quantities of hydrogen from radioactive decomposition or geological reactions would be sufficient to prevent a chemical decomposition of the cell components.” This is obviously an extreme example and yet their omnipresence ensures that they steer numerous processes so that climate researchers, atmospheric chemists or botanists alike are increasingly interested in them.

Unlocking the code for microorganisms

“Microorganisms make the entire biochemical cycles turn”, explains Harms. “Take for example the nitrogen cycle. If one factors out the microbial reactions there, then there is almost nothing left.” For microbiologists, the smallest life forms contain a code that tells us what the soil can do and which perspectives it has. For this very reason, researchers are working to decipher this information. Their goal is a sort of early-warning system, that enables statements about what is there and how much is required in order to be able

to keep these ecosystems stable. “At the moment we still have soil that still functions well in relation to the emissions from greenhouse gases (in other words, giving off relatively small quantities of methane and nitrogen oxide). Whether or not this will still be the case, with rainfall and temperatures changing is not so certain.”

Understanding microbiology as a part of ecology

Plants offer shelter for microorganisms, according to preliminary investigations in the constructed wetlands for wastewater treatment at the UFZ in Leuna. So far one can only speculate about the service in return from microorganisms. Diverse interactions show that ecology is an integrative discipline that cannot be broken up into animal, plant and microecology. It is high time that microbial ecology made headway and developed into a theory-driven experimental science that is accepted and supported by general ecology. For at the end of the day, all disciplines will have to work more closely together for the conservation of biodiversity, just as plants and bacteria do when decomposing pollutants.

UFZ contact person:

■ Prof. Hauke Harms

phone: +49 (0) 341/235-1260

e-mail: hauke.harms@ufz.de

On the Island of Navarino in Chile, the beaver is being combated as an alien species, while some families there keep it as a pet.



NATURE CONSERVATION ALWAYS HAS AN ETHICAL COMPONENT

It builds dams across rivers, floods meadows, changes the face of entire areas and certainly doesn't belong on the Island of Navarino in the Chilean part of Tierra del Fuego – the Canadian Beaver.

Without any natural enemies on the island, the beaver, initially introduced to the main island of Tierra del Fuego in the forties, was able to spread without any restrictions. From just a few individuals that arrived at Navarino Island at that time its numbers grew to reach almost 20,000 today. In some parts, the beaver even became a regular plague due to its "craftsmanship". Should species that are alien and able to spread rapidly in certain areas, count as part of the biodiversity of that respective region or do they count as an "unnatural" form of biodiversity, as an alien that should be combated and eliminated?

"Such issues can only be dealt with by a combination of natural sciences, social sciences and ethical research", explains Kurt Jax from the Department of Conservation Biology at the UFZ. Scientific arguments alone cannot justify nature conservation just as little as they can determine the correct form of biodiversity management. Whether consciously or unconsciously, value assessments are always made, from which action plans are then derived. "In the case of the beaver or even the mink, which has also invaded Navarino, it is clear to see that one is always faced with alternatives: one can either simply do nothing, one can encourage further spread, one can attempt to eliminate the animals or one can

limit their distribution locally", outlines Jax.

The decision to opt for one solution or the other is far too often made "from a gut feeling". Instead, it must be weighed up beforehand, in which framework of values one is operating i.e.: "which values are considered, what is considered as valuable, and what as less valuable?" With any kind of consideration it would be necessary to judge both the positive and negative effects resulting from the spread of plants and animals in countries and areas that are not their native habitat. Value assessments however, do not replace the assessment of empirical data. In fact, a lot more comprehensive data must be collected in order to allow considerations with sensible and comprehensible arguments. However, the

ethics of nature conservation and the assessment of local value systems help to structure this process.

With their studies on Navarino, researchers have established that the local inhabitants there have an extremely ambivalent attitude towards the beaver: on the one hand it is combated and on the other even kept as a pet by many families, and it is also to be seen waving as a mascot on official signs. Impressions of the mink were considerably more critical in comparison: "It is mainly seen in a negative light, as predators are generally always seen to be more problematic", reports Jax.

In his opinion, the ethics of nature conservation significantly contributes to reinforcing and stimulating the discussion on nature conservation and biodiversity management. Jax is of course aware that an ideal solution will never be found, no matter what one does or doesn't do. "Ethical arguments for nature conservation offer no simple solutions, cannot replace data and cannot provide any simple answers", he summarises, adding "they do however allow conflicts to be discussed rationally at a more distinguished level."

BIOKONCHIL

The German-Chilean research project **BIOKONCHIL** (a project within the BMBF program BioTEAM) investigated the evaluation of biodiversity and its relevance for the local inhabitants there using an example region in the south of Chile. With the aid of the project, a biosphere reserve was set up on the Island of Navarino in the Cape Horn Archipelago. Information materials compiled by the UFZ are now successfully being implemented for environmental education in Chile. www.ufz.de/index.php?de=1894

UFZ contact person:

■ Prof. Dr. Kurt Jax

phone: +49 (0) 341/235-1648

e-mail: kurt.jax@ufz.de

RESEARCH FOR THE ENVIRONMENT

Our environment is changing, whether as a result of natural processes or through anthropogenic activity. Biodiversity is decreasing; the climate is changing; water, soil and air are becoming polluted and increasingly more land consumed, sealed or contaminated. The ecological, economic and social implications are difficult to estimate, partly because the true causes are still unknown and partly because many of these changes are creeping and extremely complex processes.

At the **Helmholtz-Centre for Environmental Research – UFZ** scientists are investigating the causes and consequences of far-reaching changes to the environment. Their work is to provide knowledge about complex environmental systems and human-environment interactions within a limited time period. Based on this, instruments and concepts are developed for taking action in political, economic and societal spheres in order to support making well-founded decisions and contributing to solving more tangible environmental issues. The Helmholtz scientists develop remediation strategies for contaminated ground and surface waters, soils and sediments. They try to get to the bottom of biodiversity issues, investigate associations between pollutants and human health. They work on models to predict environmental changes and on adaptation strategies to climate change. In general, environmental research at the UFZ is characterised by a close collaboration between natural and social scientists.

The UFZ is a member of the Helmholtz Association of German Research Centres (www.helmholtz.de) and founder of the PEER-network, to which seven large European Environmental Research Centres belong (www.peer-initiative.org). The UFZ employs approximately 900 employees at its offices in Leipzig, Halle and Magdeburg. It is financed by the (BMBF) Federal Ministry of Education and Research as well as by the State of Saxony and Saxony-Anhalt.

Helmholtz-Centre for Environmental Research GmbH – UFZ
Permoserstraße 15 · 04318 Leipzig
phone: +49 (0) 341/235-0 · e-mail: info@ufz.de
www.ufz.de

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The Helmholtz Association contributes to finding solutions for large and pressing issues in society, science and economy through excellence in the following 6 areas of research: earth and the environment, energy, health, key technologies, structure of matter, transport and aerospace. With its 26,500 employees at 15 research centres and an annual budget of approx. 2.3 billion Euros, it is the largest scientific organisation in Germany. Work is conducted in the tradition of the great biologist Hermann von Helmholtz (1821-1894).



UFZ's main office in Leipzig,
Permoserstraße 15



UFZ offices in Halle,
Theodor-Lieser-Straße 4



UFZ offices in Magdeburg,
in der Brückstraße 3a