

## Newsletter of the National Centre of Competence in Research (NCCR)

### Plant Survival in Natural and Agricultural Ecosystems

#### Editorial

## When streams become rivers

My recent sabbatical leave was very successful in many respects. One particularly rewarding experience I had was on a Sunday afternoon in December 2002, when I met with two colleagues in a small office at the University of Montana in Missoula, USA. Each one of us presented recent findings of his research on weed proliferation as well as preliminary ideas on how we could develop small collaborative projects. Three hours later, we had formulated two small projects. They were aimed at testing a quite novel hypothesis on plant invasions. For instance, to explain the repeatedly observed increased performance of the weed purple loosestrife (*Lythrum salicaria*) in its introduced environment in comparison with its native range. The other project concerned houndstongue (*Cynoglossum officinale*), which has become a most prominent rangeland weed in the USA. A PhD student has since started her fieldwork in Europe to assess the life history features of this weed in its native environment.



These hypotheses were the result of an intensive exchange of ideas, experience and observations, that required specific expertise in different research areas. The realisation of both projects involved PhD students doing field and laboratory work in Europe and the USA. We were all convinced of the great scientific merit of these studies. Moreover, the 'science-producing' machinery was very modest: a blackboard, mutual interest and curiosity, some spare time and a little bit of funding. It is the long-lasting, motivating effect of this process that impressed me, and it served to remind me that it is for these moments that I decided to become a scientist in the first place.

Let us make the best use of the unique opportunity offered by the NCCR programme to discuss and develop small scientific ideas. From my experience, these small ideas can end up providing a powerful fuel for the, at times, tedious daily life of a scientist engaged in large research programmes. Especially rewarding for me were meetings held on field sites with colleagues and stakeholders, mainly agricultural advisors and experts from cantonal and federal ministries and research stations, such as our 2002 NCCR workshop on "Bundbrachen, seed origin and biocontrol" at our experimental field site in Düdingen (FR). This allowed us to adjust our application goals

and to directly discuss and transfer obtained results. Another constructive meeting happened at La Sauge (VD) when I was invited to present our recent findings in a workshop organised by the *Service romand de vulgarisation agricole* (SRVA) on the topic "Jachère, une culture comme une autre". Last, but not least, let us not forget the many refreshing and stimulating discussions that we had during our exhibition at the Expo.02 site in Morat (FR).

I have also experienced similar effective discussions during the recent brainstorming among scientists from several NCCR projects that were held to establish new collaborative initiatives towards the second phase of the programme, which will begin in 2005. It is worth to keep in mind the importance of using reserve money for small grant applications, from which great new ideas will inevitably emerge.

**Heinz Müller-Schärer**

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### Contents

<b>Focus</b>	
Of genes and plants	2
<b>People</b>	
Karl Föllmi	3
<b>News from the labs</b>	4
<b>Graduate School</b>	
Biodiversity, the engine of ecosystems	6
<b>Partners</b>	
A Forum on fauna and flora	7
<b>Upcoming events</b>	8

# Focus

## Of genes and plants

**The Annual Meeting of September 17<sup>th</sup> saw a succession of no less than 13 oral presentations. The event emphasized the added value that NCCR's structure brings to the different research projects.**

The 2003 Annual Meeting was a turning point in NCCR *Plant Survival's* history. It showed, by using concrete results, that the borders between different disciplines could be crossed while at the same time leaving room for new and original discoveries. One point that was particularly striking was the presentation by Cris Kuhlemeier's group from the University of Berne: here is a team that specialised in the study of petunia genes at a purely molecular level (cf. *PS News* no.1). Today, it has completely integrated the ecological aspect in its approach, which was demonstrated by the presentations from Jeroen Stuurman and Maria Hoballah.

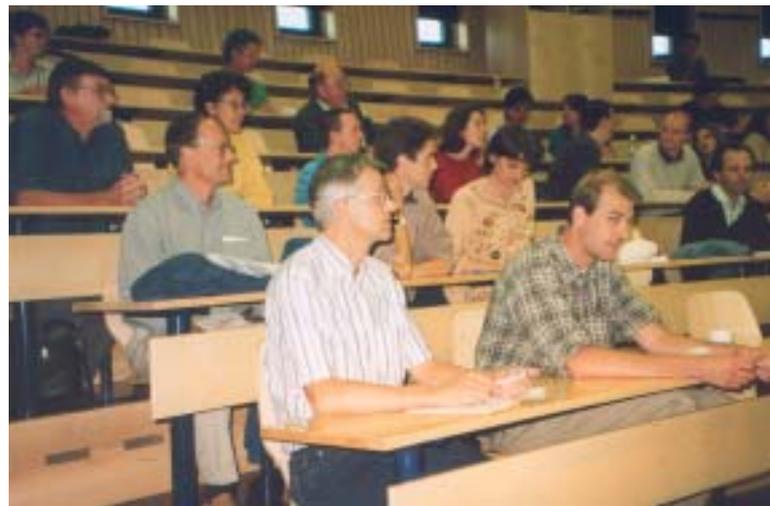
By being interested in genes that control a plant's physiological factors (such as shape, colour, odour, the secretion of nectar) that exert an influence on the attraction of specific pollinating insects, the two researchers have highlighted how molecular biology has repercussions at the ecological level. This aspect was also emphasised by an invited speaker, Cathie Martin from the John Innes Centre in Norwich (UK), of which the studies on the importance of cell shape in petunia petals for the attraction of specific pollinators prove the existence of a mutual influence between plants and insects during the course of evolution.

## Open-mindedness

"Obviously, what we are seeing is that specialists in molecular biology are opening up to other areas of research, most notably ecology. This is even more evident in young researchers who succeed rather well in inter-disciplinary dialogues", said Martine Rahier, NCCR's director. Let's take the example of chloroplast research: this area traditionally comes under molecular biology. However, we know that these organelles play an important role in the storage of starch, a phenomenon that concerns the plant in its entirety. From this came the idea of grouping together these two areas of research into one project carried out by Felix Kessler's group in Neuchâtel and Sam Zeeman's team in Berne.

Research on plant protection mechanisms against pathogenic organisms is heading in the same direction. Hence, Henk-Jan Schoonbeck, from the University of Fribourg, is looking at a bacterium's defensive properties used against the fungus responsible for grey mould, *Botrytis cinerea*. After having done trials on a

model plant (*Arabidopsis thaliana*), he is considering testing his hypothesis on grapevine. It mainly involves discovering the genes that enable the control of the protection mechanism. There we can establish a link between genetics and micro-organisms hanging around the plant's immediate neighbourhood.



## A natural chemistry

Michal Jasinski from the University of Zürich is looking at a family of proteins – the PDRs – that, at the plant cellular level, seem to serve in the transport of antifungal molecules secreted by plants. At least that's the outcome of his genetic analyses performed on *Arabidopsis* and which also offers a potential application for the control of fungal pathogens.

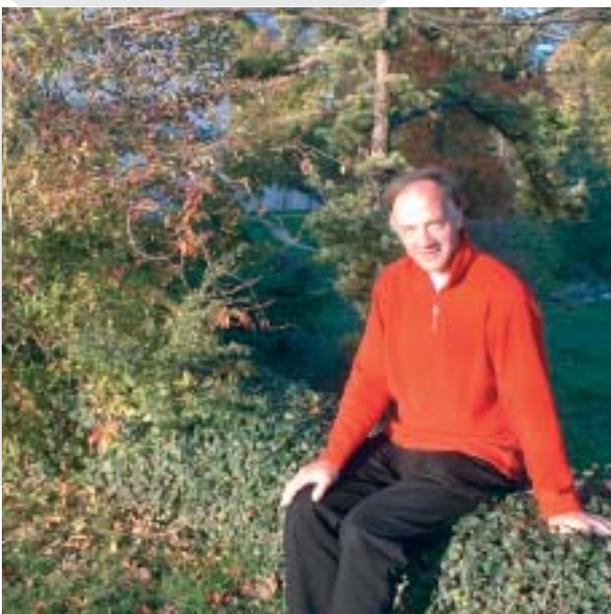
The same curiosity of dissecting grapevine's resistance mechanism against fungal diseases is found in Hannes Richter's contribution. This researcher, from the Federal Research Station in Plant Production of Changins, is interested in molecules, or more specifically stilbenes that the grapevine produces to protect itself against downy mildew, caused by the fungal pathogen *Plasmopara viticola*. Whereas Eliane Abou-Mansour and Danilo Christen, of Neuchâtel and of ETHZ respectively, are examining the mode of action of the grapevine wood diseases, Esca and Eutypa dieback, and the ways of neutralising the toxin secreted by the pathogenic agents causing the diseases. An approach that demonstrates the importance of chemistry in these types of research and that reminds us of the ongoing concern of providing results capable of being rapidly applied.

## The lifeline of rock

**Professor of geology at the University of Neuchâtel since 1996, Karl Föllmi is tracking the fine line between minerals and plants through projects that touch upon important contemporary issues such as environment and climate.**

Laid out on the table in the middle of his office is a display drawers overflowing with rock samples. How is it that some of these stones, originating from California, contain up to 30% of organic matter? This is a type of question that Karl Föllmi is asking himself and from which stems his research that traces the fine line between minerals and plants. A quest far from anecdotal, since it is based on studies of the carbon and phosphorus cycles, two fundamental elements upon which depends, no more no less, the ecological balance of the planet.

“Let’s take for example volcanic activity, explains Karl Föllmi. The eruptions release an impressive amount of carbon dioxide (CO<sub>2</sub>) and throughout earth’s history, there were periods spanning several million years during which volcanoes were very active and polluting the atmosphere with CO<sub>2</sub>”. Hence, when one talks about massive amounts of CO<sub>2</sub> released into the air, one is essentially talking about the greenhouse effect, of which the first consequence is a rise in humidity that, with the help of carbon dioxide, will, little by little, accelerate the alteration of rocks. This is where the link with the phosphorus cycle comes into play. “In fact, continues the researcher, the acids will release the phosphates trapped in the rocks that will then serve to feed plants. In addition, we know that plants, through



Karl Föllmi plays a pivotal role within NCCR *Plant Survival*

photosynthesis, have the capacity to absorb atmospheric CO<sub>2</sub>. If plant biomass increases sufficiently, the carbon dioxide released by volcanoes will be reabsorbed. This feedback phenomenon enables in the long run a return to a state of equilibrium”.

This example gives an idea of the resounding effects that Karl Föllmi and his team’s work could have, given its link to the current popular research themes, such as climatic changes, soil pollution, and agriculture. Speaking of which, the researcher reminds us that there exists rocks from which it is possible to extract usable phosphate for fertilising. It goes without saying that the line between geology and biology is very tenuous.

## Phosphates and heavy metals

It is not surprising then, that Karl Föllmi plays a pivotal role within NCCR *Plant Survival*. His team is primarily focusing on the study of two mechanisms that have direct consequences on plant development. On the one hand, there’s the process of rock alteration that enables the release of phosphates, and on the other hand, there’s the transfer of polluting elements and heavy metals from the rock to the plants.

These studies are part of a logical sequence of investigation involving three other groups of the NCCR. The first stage of the process: the phosphates and heavy metals released by the rock enter the soil, an area that Jean-Michel Gobat, Professor of Plant Ecology at Neuchâtel, knows well. Next come the interactions with plant roots, a subject that pleases Enrico Martinoia, Professor of Plant Physiology at the University of Zürich. The third: Urs Feller, Professor at the University of Berne, is studying the translocation of heavy metals in plants from the roots to the leaves.

Karl Föllmi’s research area, then, is fundamental to this chain of knowledge, which requires a multidisciplinary approach. That’s one reason why the group that he leads within the framework of the NCCR (PS 4) entrusted the task of carrying out the experiments to a biologist, Claire Le Bayon, and a chemist, Virginie Matera. This primarily involves the growing of white lupine and wheat in individual cylinders to observe plant development in function of the quantity of nutrients (phosphorus) and of pollutants (cadmium) present in the soil. More precisely, the researchers are studying the factors that favour rock acidification, a phenomenon responsible for the release of chemical elements that are subsequently absorbed by the plants. This implies using a high-precision instrument capable of analysing the chemical composition of rock, soil and plants. The contribution of Karl Föllmi and his team should end up providing valuable results for the agricultural world.

# News from the labs

## Grapes under stress in Wädenswil

**On August 21<sup>st</sup>, some thirty winegrowers and researchers participated in a meeting organised by NCCR *Plant Survival*, ETHZ, LBL (Swiss Centre for Agricultural Extension, Lindau) and the University of Applied Sciences of Wädenswil (HSW), which hosted the meeting.**

“With a yearly consumption of 45 litres of wine per person, Switzerland represents one of the most interesting markets for



*How to fight against grapevine diseases ?*

wine in Europe”. Dietrich Marbé-Sans, of the Federal Research Station in Economy and Agricultural Technology in Tänikon (ZH), opened the discussion and left some room for optimism while recalling the economic difficulties in the agricultural sector. Since, despite the difficulties of acquiring the best shelf-space in stores, the Swiss winegrowers, according to the economist, have everything to gain: the annual income per individual, in the most efficient winegrowing operations, reaches a little more than CHF 52,000, or close to double that of what is earned in dairy production. Hence, this is certainly an exploitable opportunity.

“We still have to ensure the quality of the wine that we produce”, added Wolfgang Patzwahl, head of the winegrowing section at HSW, of which the laboratory analyses the main characteristics of wine: the levels of alcohol, sugar, acidity, as well as colorants, tannins, and aroma. Besides experiments done in the greenhouse, the HSW has at their disposal an experimental vineyard on the Au peninsula where Sabrina Lanz did her diploma thesis

work, analysing different kinds of stress that grapevines encounter. Her work involved comparing the reaction of grapes to the quality of solar radiance to which they were exposed – primarily in function of the intensity of the UV-B rays.

As far as the collaboration with NCCR *Plant Survival* is concerned, it is achieved through the work of Danilo Christen, PhD student at ETHZ, who is exploring a new way to protect grapes against Esca and Eutypa dieback, two fungal diseases that attack the woody parts of the grapevine. There does exist, however, types of wine, such as *merlot*, that are naturally tolerant to these attacks due to the actions of a specific gene capable of degrading a toxin produced by the pathogen that causes Eutypa dieback. Therefore, it is possible to elaborate on a biocontrol method for this disease based on that principle. Danilo Christen also presented in Wädenswil a core sampling technique that permits an early diagnosis of Esca and Eutypa dieback without having to wait for the appearance of leaf symptoms.

Based on the article by Michael Breu, ETH-Life online, October 2003

## Academic Career and Family

**In Switzerland, 45% of the students in the faculty of sciences are female, while at the same time only 22 professorial positions (i.e. 4%) are occupied by women. Such disparities are linked to the difficulty of reconciling academic careers and family, a fact that motivated the NCCR *Plant Survival's* Equal Opportunities section to organise a day of discussion, which was held on September 24<sup>th</sup> in Neuchâtel.**

In front of an assembly of ten people (including 3 men), five academics shared their experiences: Susanne Suter, at the paediatrics polyclinic of Geneva; Henriette Herwig, Professor of Germanic languages at the Heinrich-Heine Universität of Düsseldorf, Germany and Judith Hohfeld, director of paediatric surgery at the CHUV in Lausanne. The speakers from the University of Neuchâtel were biologist Betty Benrey and geologist Philippe Renard, *maitre-assistants*.

Moderator of the meeting, Christa Binswanger, researcher at the Interdisciplinary Centre for Women's and Gender Studies at the University of Bern, brought up the fact that the average annual salary for those holding a degree in natural sciences comes to CHF 59'000 in German speaking Switzerland and

CHF 50'150 in French speaking Switzerland. However, according to a national report published in 1994, one should expect to spend on average an additional CHF 1450.- per month on the first child and CHF 700.- for the next.

Besides this economic reality, the participants evoked other preoccupying factors. Among these: the difficulty of carrying out a full time research activity while having young children, particularly concerning the question of working hours, which should accommodate family needs instead of professional obligations. One option is working part-time, but this also means fewer publications and we all know that in research one must 'publish or perish'. So how does one remain competitive under such conditions? The question remains unanswered. What also came out of the discussions was the notion of creating intermediate positions with long-term contracts for those who do not necessarily wish to become full professors, but are nevertheless interested in a university career.

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## Passing the torch (continued)

The succession to the coordinator of external affairs' throne has had another outcome than what was announced in the previous PS News issue, since Daniela Linder declined the position for family reasons. There are now two colleagues who, as of this Fall, have been sharing the position on a half-time basis. Expert in population biology, Soraya El Kadiri-Jan is in charge of the relationships with potential users (wine-growers, farmers) of the results obtained by NCCR *Plant Survival*, and she is also dealing with questions concerning equal opportunities between men and women. As for Jason Grant, a plant taxonomist who has just defended his thesis in Botany at the University of Neuchâtel, he will be dealing with collaborations with the economic sector (in large part via the agency for the promotion of innovation CTI), as well as collaborations linked to NCCR's participation in the 6<sup>th</sup> European Union Framework Programme.

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## Explaining ecology to all

Two members of NCCR *Plant Survival*, Sven Bacher and Wolfgang Nentwig, have participated in an important work on the popularisation of ecology. 'Privatdocent' and Professor of Ecology at the University of Bern respectively, the two

researchers have co-authored with three other specialists a 500-page book in German, which will be published in December 2003 by Spektrum-Verlag.

Simply entitled "Ökologie", this instructional book addresses a vast public and aims to highlight interactions that are knitted together at different levels of complexity, from the individual to populations. It explains the relationships between the different living communities, that, from the bacteria to the trees, shape the landscapes and hence gives a global vision of ecology on a planetary scale.

**Ökologie**, by Wolfgang Nentwig, Sven Bacher, Carl Beierkuhnlein, Roland Brandl and Georg Grabherr, 500 p.  
ISBN 3-8274-0172-0

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## At the Papiliorama

After a stay of six months in the greenhouses of the Neuchâtel Botanical Garden, the exhibit "When the cells go the fields" left for the tropics.... however, without leaving Switzerland. From now on, the exhibit can be visited on the premises of the Papiliorama's new location in Kerzers, in German speaking Switzerland.

Through a stroll among eight displays in German and French one will learn about some of the research going on at the NCCR *Plant Survival*. For those that missed out on this event during the summer season, the winter season will offer you a chance to see it among exotic butterflies and under the shade of palm trees.

Open daily from 10 a.m. to 5 p.m through March 2004.

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## Hand in hand

Science and economy are condemned to get along, the future of Swiss innovation depends on it. Well aware of this fact, the first *Swiss Science Forum* that was held on October 21<sup>st</sup> in Berne saw several important public figures, including the Minister of Economy Joseph Deiss, express themselves on ways of giving science in Switzerland the acknowledgement that it deserves. Martine Rahier, director of NCCR *Plant Survival* was among them. She animated a workshop that touched upon the theme of academic relief in our country.

For more information: [www.swisscienceforum.ch](http://www.swisscienceforum.ch)

# Graduate School

## Biodiversity, the engine of ecosystems

From October 15<sup>th</sup> to the 17<sup>th</sup> a course was held in Neuchâtel dealing with biodiversity and interspecific interactions, it was jointly organised with the 3<sup>ème</sup> Cycle romand *en sciences biologiques*. A central question was raised: **how can the fluctuation in the number of species disrupt the equilibrium of an ecological environment?**

Sometimes, very little is needed to disturb a whole ecosystem. Michel Loreau, Professor of Ecology at the *Ecole Normale Supérieure* (Paris, France) illustrated this by using an incident that was observed along the Russian shores: the disappearance of the sea otter. The first consequence: since this marine mammal feeds on sea urchins, its disappearance caused a sudden increase in the population of the latter. Now, the daily menu of the sea urchin is composed of kelp. Result: the brown seaweed was quickly decimated and suddenly all other organisms that depend on it are at risk. This goes even further, the disappearance of kelp leads to an increase of wave activity and hence increased erosion. One can see by this that the sea otter's disappearance was sufficient to even have geological repercussions.

Predicting these phenomena is the objective of Michel Loreau's work, by unifying two traditionally opposed approaches. "On the one hand we had specialists who were essentially interested in how ecosystems function, explains the invited speaker. They were measuring, for example, the flow of energy and the carbon, nitrogen and phosphorus cycles, elements that circulate between the different organisms making up the ecosystem. However, this point of view completely neglects the dynamics of the species present, because this factor doesn't fit in that practical view of the problem. On the other hand, we had specialists of ecological communities, who were focusing on the species diversity of ecosystems and the interactions that they form between themselves, particularly concerning food relations. In this approach, everything dealing with the flow of substances (nutrients) and energy is excluded."

Michel Loreau has, therefore, established a theory that integrates these two ways of seeing things. It enables one to predict the quantity of plant biomass produced in function of the number of

plant species present. He successfully tested his theory within the framework of the BIODEPTH project, which deals with the study of plant diversity in an ensemble of pastures in Europe.

## Nested relationships

Interactions between species are also central to another invited speaker's work, Jordi Bascompte, Associate Professor at the Ecological Station of Doñana, in Seville (Spain).

For example, he's working on describing the relationships that are established between two large families of species: pollinating insects and their target plants. "We call that mutualistic interactions, specifies the Catalan researcher, because each organism concerned receives what it needs. The plants are the first to benefit since in this case they rely on insects for their reproduction. As for the insects, the reward for their efforts is the nectar that they take from the flower."

What interests Jordi Bascompte is the way that these interactions evolve when there are several pollinator and plant communities. He has, for example, studied a system of 50 networks each composed of several mutualistic interactions. Among them, we found plant-pollinator interactions that represent various levels of specialisation: some were very 'generalist', which means that one plant or one insect could 'flirt' with any other insect or plant. In contrast, other pairs were extremely specialised and tended to lean towards a reciprocal exclusivity.

The results show that the networks made up of 'generalist' plants and insects will preferably interact among each other, forming a very dense network of interactions onto which the 'specialists' will attach themselves. While researchers were rather expecting a random distribution of the interactions, their results showed that it was not the case. The fact that these interaction webs are highly nested like Russian Dolls makes the ecosystem more resistant to disruptions, by giving the possibility of rare species to survive easier. Good news for biodiversity!

For more information:

[www.unine.ch/nccr](http://www.unine.ch/nccr)

> Education > Graduate School > Courses > Archives



## A Forum on fauna and flora

**Unique in its own right, the Swiss Biodiversity Forum has a platform dealing with raising awareness and exchanges on species diversity. Its ideas have even helped to define the activities of NCCR *Plant Survival*.**

Switzerland can boast having one of the richest fauna and flora of Europe. There are more than 20,000 vertebrates and invertebrates, close to 2700 plant and fern species, 1030 species of mosses and 2000 lichens. However, the danger of extinction is not far away. Depending on the taxonomic group considered, between 33 and 95% of the species described in Switzerland so far are considered as rare or endangered.

However, researchers are far from resting on their laurels. Between 1992 and 1999, biodiversity figured as part of an important chapter of the Swiss Priority Programme "Environment". Bernhard Schmid, professor of environmental sciences at the University of Zürich, wanted to give a continuation to this impetus, which he helped to initiate, by proposing the creation of the Biodiversity Forum, which has been up and running for the past four years under the aegis of the Swiss Academy of Natural Sciences (SANS).

Why is it so important to preserve the diversity of species and ecosystems? "The extinction of certain species directly influences, for example, the circulation of nutrients in ecosystems, responds Daniela Pauli, director of the Biodiversity Forum. In agricultural circles, it's a matter of getting the farmers to pay special attention to the preservation of the cultural heritage through the redis-



*Between nature and agriculture, a sacred balance*

covery of regional products. I'm thinking specifically of old fruit or cereal varieties that add richness to our culinary heritage. In short, biodiversity is an essential resource for humanity."

In practical terms, the Biodiversity Forum represents a showcase for research projects, collections of museums and institutions, and the characteristics of the fauna or the flora. "I see it as a unique and original tool, states Daniela Pauli. There's nothing else like it, at least not in other European countries. There are two reasons for that: for one, that fact that in this small country the scientific community is relatively limited makes it easier to establish contacts, and secondly, the strong commitment of those involved." These conditions helped to meet the first objective of the Forum: to reinforce the cooperation between principle players of the academic world by identifying themes that deserve to be further developed. A summary of that work was published in December of 2002 in a brochure entitled "Visions in Biodiversity Research".

Research conducted within NCCR *Plant Survival* answers, in fact, to those directives in which are stated the basis for its *raison d'être* namely, studying the interactions between different levels of biological organisations, from molecular genetics to the ecosystem.

The Forum's second objective is to put the emphasis on communication, or in other words, to establish a link between researchers and producers. This link comes about by directly including the partners in research – farmers, political bodies, nature conservation and protection agencies – in the identification of problems. The *Hotspot* magazine, published twice a year in German and French, bases each publication around a rallying theme (forests, agroecology, fresh water, etc.), which allows the different parties to express themselves and to thus keep the discussions open.

"It is very important to consult with those people doing the leg work before determining the direction that a research will take, insists Daniela Pauli. That is why we are in contact with advisory offices in ecology, as well as with non-governmental organisations (WWF, Greenpeace)."

This approach brings to mind the meetings that NCCR *Plant Survival* organised in April of 2002 in Neuchâtel and in August of 2003 in Wädenswil (see p.4), where producers were invited to participate in discussions on diseases that affect crops and vineyards. It defines a new way to integrate research in the economic reality of the country.

Contact: [www.biodiversity.ch](http://www.biodiversity.ch)

# Upcoming events

## Special KTT event

Annual Conference of the Swiss Society of Agronomy (SSA/SGPW)  
March 19, 2004  
University of Neuchâtel

Information: [www.unine.ch/nccr](http://www.unine.ch/nccr)  
then click on Events>Meetings>Special KTT events

## Graduate School courses

### Dynamic modelling with STELLA

Fully booked

November 12-14, 2003 in Neuchâtel  
Prof. Alexey Voinov, University of Vermont (U.S.A.)

### Peer Review and Writing Manuscript

February 5-6, 2004 in Neuchâtel  
Prof. Jeremy N. McNeil, Laval University (Canada)

### Genetics of Biodiversity and Applications

March 15-17, 2004 in Murten  
Prof. Quentin Cronk, University of British Columbia, Vancouver (Canada)  
Prof. Maarten Koornneef, Wageningen Agricultural University (The Netherlands)  
Prof. Daniel Zamir, The Hebrew University of Jerusalem (Israel)

### Multivariate Statistics in Community Ecology

March 23-26, 2004 in Neuchâtel  
Dr. Daniel Borcard, University of Montreal (Canada)

Information and registration: [www.unine.ch/nccr](http://www.unine.ch/nccr)  
then click on Education>Graduate School>Courses

## NCCR event

April 1-2, 2004  
Review Panel Site Visit  
University of Neuchâtel

### Public event

Papiliorama, Kerzers (FR)

An exhibit from the Jardin botanique de Neuchâtel and NCCR *Plant Survival*  
"Quand les cellules s'en vont aux champs, variations autour d'une plante"  
"Von der Pflanzenzelle auf die Felder: Variationen einer Pflanze"

Open daily from 10 a.m. to 5 p.m through March 2004

### New press releases

Molecules for the resistance against grapevine diseases (30.09.2003)

Réflexions sur la qualité du vin suisse à Wädenswil (ZH) - Gedanken zur Qualität des Schweizer Weines in Wädenswil (ZH) (07.08.2003)

A protein to detoxify lead and cadmium in plants (22.07.2003)

For further information:  
[www.unine.ch/nccr](http://www.unine.ch/nccr) then click on Press> Press releases

## PS News

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**The leading house of the NCCR *Plant Survival* is the University of Neuchâtel**  
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