

DIAGONAL

FOCUS

Learning from each other: Research and practice in dialogue

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EDITORIAL

As our name makes clear, we are here to do research. But not as an end in itself: according to the ETH Act, we must take “Switzerland’s needs” into account. This is why we make our findings available to industry and the public sector in Switzerland. We want to help them work better and more efficiently.

This issue of *Diagonal* focuses on cooperation and knowledge transfer. Even fundamental research involves both. While such research is not required to be directly applicable, it does help us understand the systems and processes underlying particular societal problems better. It provides a basis for applied research and for finding solutions to problems.

Knowledge transfer into practice takes place finally through publications in the Swiss national languages, software, websites, courses and consultations.

The wording of the ETH Act may seem simple and clear, but meeting these requirements is all the more challenging! Doing justice to all aspects of the mandate involves a balancing act. We hope and believe that we are succeeding. But read and judge for yourself!



Christoph Hegg
Deputy Director WSL



Research and practice



TRAINING COURSES

Every year, practitioners in the field of snow and avalanches are trained at SLF.

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IDENTIFYING NEEDS

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TOGETHER IN THE FIELD

A fungus is threatening valuable old chestnut groves. To control it, researchers are collaborating with experts from the field and trying out new treatment methods.

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SHARING EXPERIENCES

When it's a matter of providing protection against natural hazards, professionals from research and practice work closely together. Both sides benefit from the exchange of experience.

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KEY TOPICS

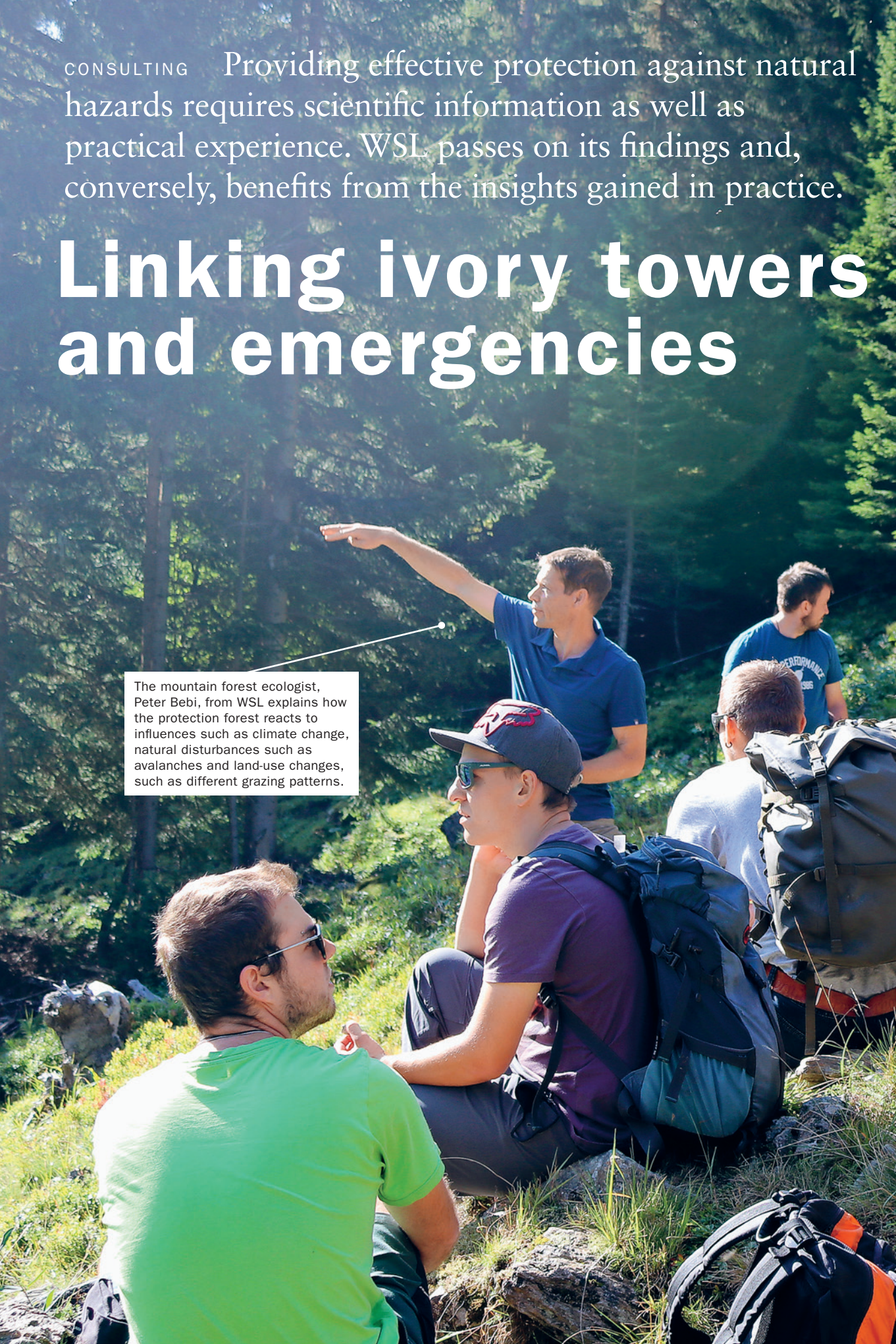
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CONSULTING Providing effective protection against natural hazards requires scientific information as well as practical experience. WSL passes on its findings and, conversely, benefits from the insights gained in practice.

Linking ivory towers and emergencies

A group of people are gathered in a forest setting. One person in a blue shirt is pointing towards the trees. In the foreground, a person in a purple shirt and a person in a green shirt are sitting on rocks, looking towards the speaker. There are large backpacks and gear around them.

The mountain forest ecologist, Peter Bebi, from WSL explains how the protection forest reacts to influences such as climate change, natural disturbances such as avalanches and land-use changes, such as different grazing patterns.



Trainee foresters from the forestry schools in Maienfeld and Lyss on a field trip to learn about the forest structure of an avalanche course and the forestry measures being taken to maintain the long-term protection function of the forest.

Dischmatal near Davos (Canton Grisons)

Photo: Herbert Schnyder

The storm ‘Vaia’ swept through Switzerland for barely two hours in the night from 29 to 30 October 2018. Afterwards the Albula Valley, the Upper Engadine and Puschlav were a sad sight: trees had been bent like toothpicks and large areas looked as if they had been mown down. The storm, with wind peaks of up to 210 km/h, quickly destroyed over a hundred hectares of protection forest in Canton Grisons, i.e. of forest managed to protect settlements from avalanches, landslides and rockfall. The notorious storm ‘Burglind’ had destroyed a similar area of protection forest not long previously on 3 January 2018.

The foresters were faced with urgent questions. Should they clear the storm timber, which is very dangerous work, or leave it lying on the ground? Is the area still protected against natural hazards? Is a bark beetle infestation imminent? The regional forest engineer, Claudia Bieler, from the Grisons Office for Forests and Natural Hazards was confident WSL could provide answers to these questions. She therefore asked for on-site advice. “I wanted to ensure that all foresters involved were up to date and had the latest information,” Claudia explains.

When nature strikes with full force and flattens forests or sends entire mountainsides thundering down to the valley, the practical knowhow of the practitioners reaches its limits. Researchers’ specialist knowledge is especially in demand after extreme events such as storms, floods like those in 2005, or landslides such as in Bondo in 2017. “We have a complete overview of the topic, as well as more time and opportunities for comparisons with other countries and regions,” says Peter Bebi, a

protection forest expert at SLF. Researchers can draw on international experience with, for example, uncleared storm areas.

Creating concrete scientific information bases for practical use has been one of WSL's core missions since it was founded in 1885, when it was called the 'Central Station for Experimental Forestry'. At that time, the focus was on, among other things, how forest experts could make the heavily overused forests fit enough again to provide protection against natural hazards. Experts from WSL and SLF today still carry out workshops and training courses for government authorities and engineering offices on request, provide expert opinions or support safety officers on site with risk analyses. They make their research findings available for practical use through guidelines, leaflets and reports. In particular, their event analyses, i.e. the comprehensive retrospective evaluation of what happened during a natural disaster, provide local authorities with valuable information to prepare for similar events in future.

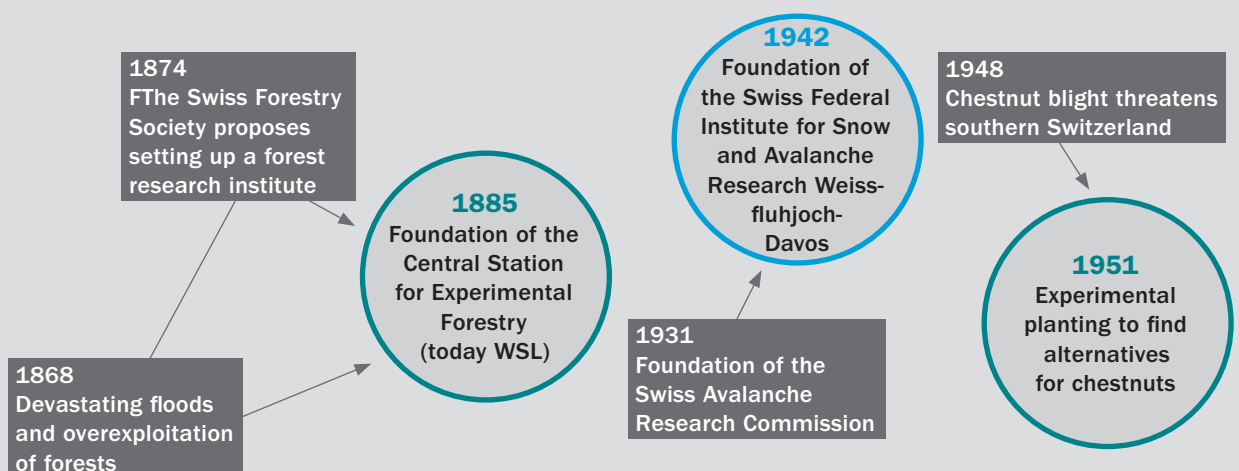
For further information on protection forests, see: www.slf.ch/protectionforest

Sharing experiences

In the case of the storm 'Vaia', Peter Bebi, together with other WSL researchers, tramped through windthrow areas with the foresters several times during the winter 2018/19. "We were able to tell the foresters directly about our experiences with the storms Vivian in 1990 and Lothar in 1999," he says. "From a scientific point of view, there are many reasons for leaving storm wood lying." The uprooted root plates and tree stems frequently provide sufficient protection against avalanches and rockfall. This natural protection can therefore be relied on more often in places where the risks of bark beetle outbreaks are clearly within acceptable limits. Published material on this is available, but "during inspections together, foresters can ask questions directly and receive the latest information first-hand," says Claudia, the forest engineer, who used to work at SLF herself and therefore has good contacts with researchers.

Peter Bebi, head of the Mountain Ecosystems Group at SLF since 2006, has already led dozens of excursions and inspections like this in mountain forests. He is not only an experienced mountain forest ecologist, but also a member of the Mountain Forest Conservation Group (GWG/GSM). In this group, forest experts and scientists have been working together since 1986 to ensure the best management of protection forests. There is also a corresponding

How WSL and SLF have responded to developments in society and the environment





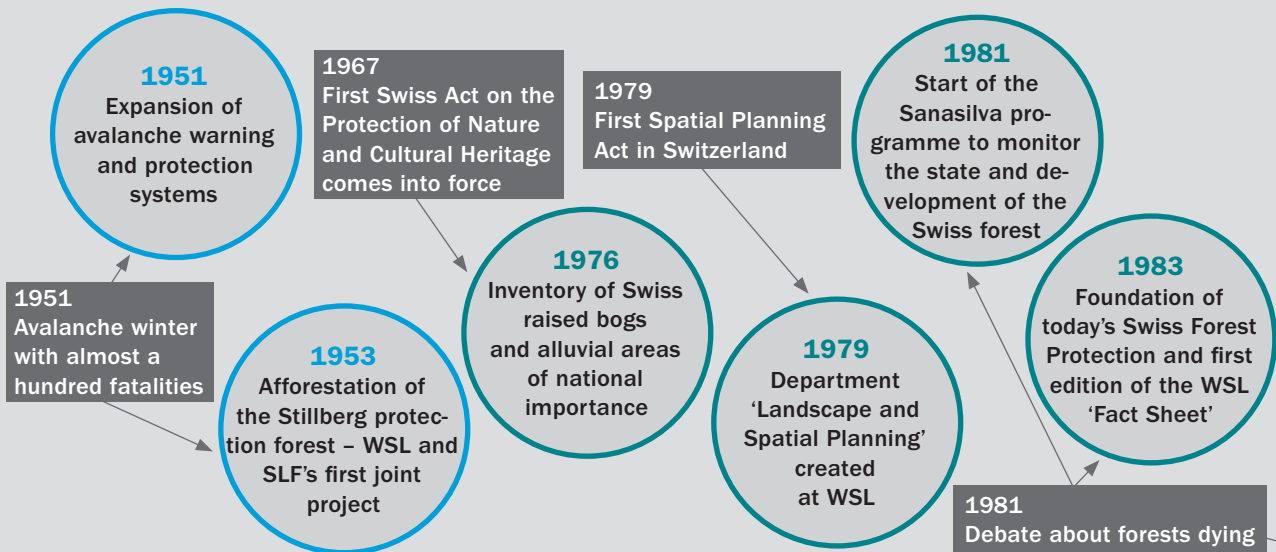
After the storm 'Vaia' in 2018 severely damaged the protection forest in Canton Grisons, WSL researchers advised foresters on how to treat the storm-damaged areas.

group for natural hazards in general, Natural Hazards Experts Switzerland (FAN), in which the federal government, cantons, private individuals, researchers and insurance companies are represented. The president is the WSL geomorphologist Christoph Graf. Both groups offer their members regular further training and promote lively dialogues between research and practice.

Dealing with extreme events

Practitioners usually come to WSL when a specific event, such as the storm 'Vaia', occurs or if they have unsolved problems. Canton Grisons, for example, wanted to have clearer procedures for recording on hazard maps areas where sliding snow avalanches could be a risk. "In such cases, we write directly to a scientist with a lot of experience in the area," says Christian Wilhelm, Head of

Photo: Office for Forest and Natural Hazards, Canton Grisons



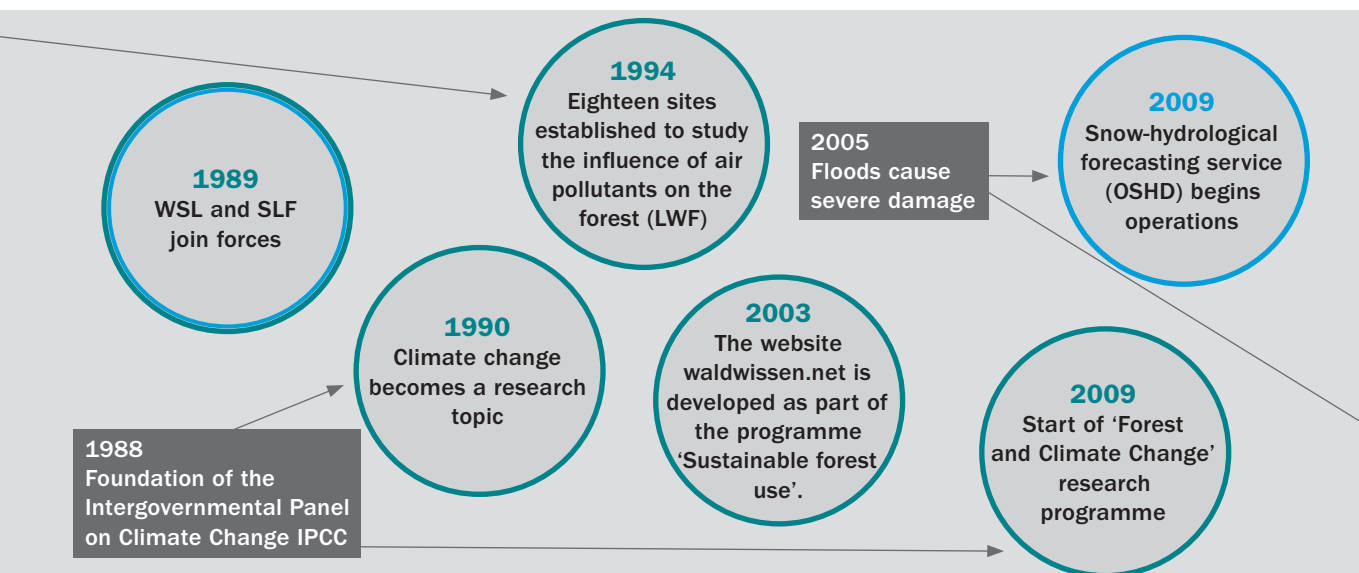
Natural Hazards and Protection Structures at the Grisons Office for Forest and Natural Hazards. One of the by-products of the assignment was a WSL report with guidelines for practical use.

Private engineering firms are also keen to cooperate with the scientific community. “We deliberately maintain close relations with researchers,” says Daniel Tobler from Geotest, a company in the field of environmental and geo-engineering, who is also a member of FAN. For example, they were able to learn from the researchers how to use the latest techniques and equipment, such as monitoring rock movements with radar or lasers. “When dealing with large, complex projects or natural hazard events, support from research is essential.” Keeping up to date with state-of-the-art methods and the latest findings is beyond the capacities of private individuals. Conversely, WSL employees frequently contact his company, for example when they are looking for a suitable site for a particular project.

Suggestions for research projects

The SLF researcher, Peter Bebi, also emphasises that both sides benefit from close contact: “We learn a lot from practitioners.” Many questions from experts ‘in the front line’ lead to smaller or larger research projects. An uncleared ‘Vaia’ area in Val Tuors near Bergün is today still a research area, so that Bebi and his colleagues can study the extent to which the remaining stands after the storm can hold back avalanches. A question posed by a forester in the Engadine has also been addressed directly in a master’s thesis at WSL, namely when would interventions in single-layer, dense spruce stands be beneficial?

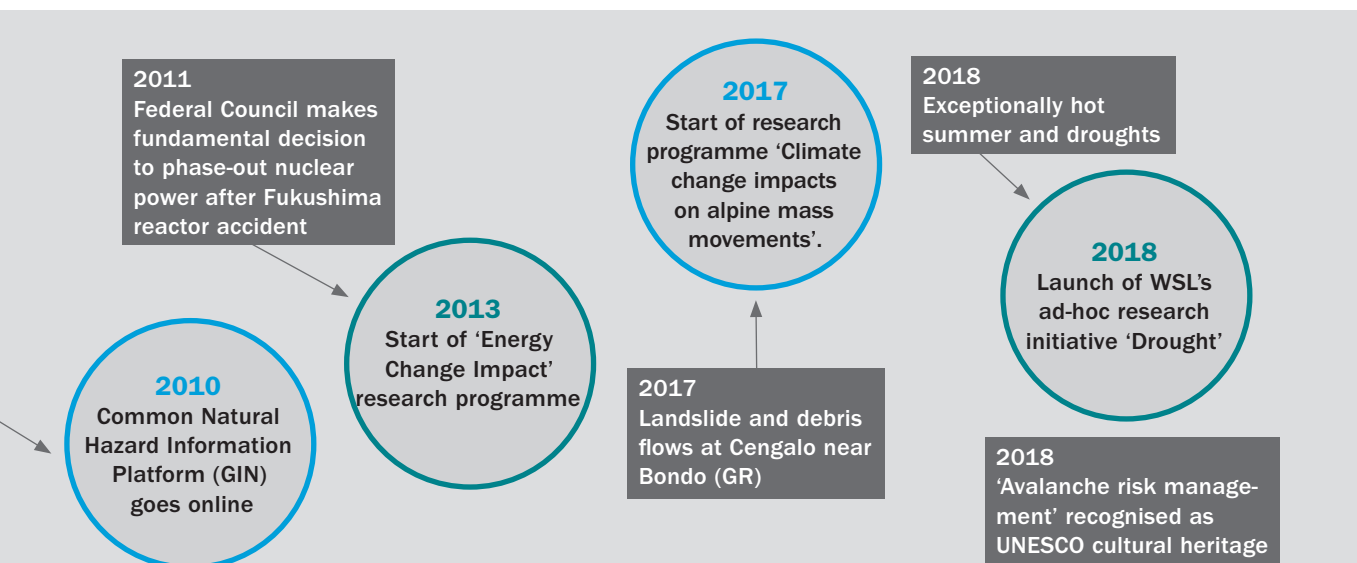
In addition to these ‘bottom-up’ suggestions, WSL also receives commissions from ‘the very top’, i.e. from cantons and the federal government. These include four legally mandated tasks: maintaining an avalanche warning service, long-term forest monitoring (National Forest Inventory, Sanasilva, LWF, natural forest reserves), monitoring forest health and supervising scientific and technical measures against forest pests and diseases. External inputs often lead to long-term cooperations, such as Zurich city’s early warning system for Sihl floods, which was urgently needed when the new underground station was under construction, and is still in use today. Even the Federal Assembly sometimes provides suggestions for new research.




Parliament's call for more research into Switzerland's energy future led to eight research competence centres (SCCERs) being set up, as part of which WSL launched various energy projects.

In principle, the exchange of ideas between research and practice works very well. But WSL is in a field of tension between practice and research because it must also hold its own in top scientific research. According to recent findings, however, such research provides the foundation for practical applications. But new research results are usually first published as scientific articles in scientific journals, mostly in English, rather than primarily as reports for foresters and geo-engineers. Some researchers complain that the time they spend on implementing the results is time they cannot spend on writing papers. Moreover, researchers receive little recognition from the scientific community for implementing their findings.


The pressure to publish is also making itself felt in practice: “New findings from research today tend to be delivered as small appetizers more than previously,” says Christian Wilhelm. “It is sometimes difficult for us to estimate which innovations we should adapt our practice to.” In general, however, new research findings are “very, very important” for practice. “Constantly improved models and methods provide the basis for effective protection against natural hazards.” *(bki)*





Large old trees are important for forest biodiversity as they provide a habitat for many animal and plant species, as well as lichens and fungi. Researchers from WSL exchange ideas on how to promote diversity in the forest with, for example, practitioners in the Swiss Working Group on Forest Biodiversity.

Forests also provide a place for recreation: this is one of their most important functions on around ten percent of the Swiss forest area. WSL studies have shown that people want to find good air and experience nature amidst the trees, where they can leave the stress of everyday life behind them.



Around 36 percent of all forests in Switzerland provide protection against natural hazards such as rockfall. WSL experts are, together with practising foresters, promoting the sustainable management of mountain forests to ensure they can provide long-term protection against natural hazards.

Forest path in the Alps.



Field trip during a course: a snow profile provides information about the snow cover, which is important for assessing the avalanche danger.

TRAINING COURSES **Better decisions thanks to solid knowhow.** Every year, SLF gives courses on snow and avalanches to professionals and other people.

Should a road be closed or a settlement evacuated because the avalanche danger is high? The avalanche services in mountain regions are often confronted with such questions. They are responsible for the safety of the local population and tourists. One of them is Franz Baumgartner, a mountain guide and member of the Avalanche Commission in Frutigen. For him to be able to identify dangerous situations and take the right measures, he needs experience and reliable knowhow.

SLF runs courses on snow and avalanches for avalanche service staff and their advisors, as well as for SLF observers. They are the ‘eyes’ of the avalanche warning service in the field and provide up-to-date information. The courses focus primarily on observation and assessment, addressing questions such as: What influence does the weather have on the avalanche danger? How does the danger develop? Are roads or buildings at risk?

In addition, SLF cooperates with external experts, such as media trainers or lawyers. Franz Baumgartner is convinced that: “The courses help me review and build up my knowhow, learn about new findings from avalanche research and improve my decision-making skills, especially in unclear avalanche situations”. In addition, the courses offer field experts the opportunity to discuss their work and experiences.

But it is not only the participants who benefit. Lukas Dürr, avalanche forecaster and course instructor, says: “Through personal contacts, we get more feedback from people familiar with local conditions about avalanches and the snow situation.” Such information is essential input in avalanche warning for producing a reliable avalanche bulletin.

For Lukas, however, it is also important to find out what problems course participants consider crucial and which situations are particularly difficult for them to assess. Not only can such topics then be taken up in subsequent courses, but they may also be relevant for research and for developing new tools for the avalanche warning service. *(sni)*

For further information about the courses, see: www.slf.ch/courses

KNOWLEDGE SHARING **Giving the local population a voice.**
How can the use of wood as fuel contribute to making the supply of energy more secure in the Ukrainian Carpathians? Researchers at WSL are exploring this question – and relying on unusual methods.

The Ukraine suffers from regular bottlenecks in its energy supply, especially when gas supplies from Russia are interrupted. The country is therefore looking for ways to increase its self-sufficiency. One of these involves renewable energy. “A sensible way to supplement other renewable energy sources could be to use wood more,” says the WSL researcher, Astrid Bjørnsen, head of the project ‘Identifying Green Energy Options’ at WSL. Also involved in this project are: the Centre for Development and Environment of the University of Bern and the National Ukrainian Forestry University in Lviv (formerly Lemberg), among others.

In the project, the potential of energy wood in the Ukrainian Carpathians is being assessed. Huge areas of forest cover the mountainous area in the west of the country. One fifth of the timber harvested is already used as fuel wood. The researchers are investigating, on the basis of ecological, economic and social criteria, whether more could be used. “It is very important for us to involve local people so that our research does not overlook their needs,” says Astrid.

That’s why the researchers launched a Best Practices Contest in the study region. Among other things, the researchers were looking for suggestions on how fuel wood could be used more efficiently. The first prize went to a school in the town of Boryslaw with 38,000 inhabitants. Their suggestion was to build a shelter so that the firewood for heating the school building could be kept dry

For further information, see:
www.wsl.ch/energy-wood-ukraine



Local people in the small Ukrainian town of Boryslaw were asked to share their knowhow and experiences and to develop visions for a sustainable energy future.

Photos: Astrid Bjørnsen, WSL



Stronger sense of community: Boryslaw residents produced a video together on the energy supply in their city.

and no longer had to be stored in the rain. As Astrid points out: “The proposal may seem banal, but it makes it clear what fundamental problems people are struggling with.”

Video as mouthpiece

After the Best Practices Contest was won in Boryslaw, further project measures were carried out there. The researchers adopted an unusual approach and invited six residents to shoot, under guidance, a so-called ‘participative video’ on the energy situation in their city. “The method enables us to bring the members of a community together and give them a voice,” Astrid says. The video was presented at a public event in Boryslaw in 2018 and at an international conference. “In addition to yielding relevant information about people’s energy use, valuable contacts between researchers and residents of the small town ensued.”

The project has already led to positive changes. The University of Lviv wants to ensure its courses have more practical relevance. Master students will therefore carry out case studies in Boryslaw and draft applications for municipal funding projects in the field of renewable energy. WSL is also committed to building up research capacities at the Ukrainian partner university and has invited Ukrainian researchers to Switzerland as guests.

As the project runs until 2020, no conclusive results on the potential of energy wood in the Ukrainian Carpathians are yet available. However, according to Astrid, it seems likely that more wastewood from wood processing could be used. Efficiency also plays a role: a lot of wood could be saved if it were dried sufficiently before burning, which is what the school in Boryslaw intends to do.

(cho)

FIELD TRIALS **Saving the sweet chestnut.** A fungus threatens valuable old chestnut groves. To control it, research and practice have joined forces and are testing new methods of treatment.

Chestnut trees are widespread in Canton Ticino, but they also grow on the north side of the Alps. Until the 1950s, the chestnut served as the ‘bread tree of the poor’, but was later forgotten. Today, however, it is experiencing a revival. For example, over the past twelve years, an association promoting chestnuts in Central Switzerland (‘IG Pro Kastanie Zentralschweiz’) has restored many previously abandoned chestnut groves around Lake Lucerne, such as that in Chestenenweid near Weggis (Canton Lucerne). The trees, which are up to 150 years old, were pruned, new trees planted and the area cleared of bushes.

But the chestnuts on the north side of the Alps are threatened by chestnut blight, which is a lethal disease. It is caused by the fungus *Cryphonectria parasitica*, which infects the bark and kills branches or even entire trees. “Even in Chestenenweid, 40 percent of the chestnuts are already infected,” estimates Emanuel Helfenstein, a forest scientist and the project manager of the local chestnut association. There is currently only one effective method to save the trees: biological control of the fungus. This involves using a virus that naturally infects the fungus and weakens it. As a result, the diseased bark areas – the so-called cankers – heal and the trees survive. While on the south side of the Alps the virus has spread on its own, north of the Alps it requires help.

“The biological control works well,” says Simone Prospero, a researcher in the phytopathology group at WSL. Together with his colleague Francesca Dennert, he carries out treatments on behalf of various cantons. For the researchers this involves first isolating the respective fungal strain from the bark of an infected chestnut tree, and then introducing the virus into the fungus in several steps in WSL’s Plant Protection Lab. The next step is to produce a virus-infected fungal paste, before applying it as follows: small holes are made around the infected area on the stem or branches of the original chestnut tree and filled with the fungal paste. The virus is transmitted to the fungus in the tree, and the bark canker should then heal within months or years.

Costly and time-consuming treatment

“Applying the paste is not difficult, but it is very time-consuming,” says Emanuel, who himself carries out treatments in the field. He often needs more than an hour to treat a tree. To make it easier and quicker to apply, WSL is testing new methods, including a fungal spray. In addition, a research project initiated by the association Pro Kastanie is currently underway in Chestenenweid. The WSL researchers, in cooperation with Emanuel, are investigating how effective it is simply tying pieces of wood on which virus-infected fungal spores are present to the branches or the stem of a chestnut tree. “The idea behind this is that the rain washes out the spores, which then get into the bark and transmit the beneficial virus,” Simone explains.

Project page at WSL:
www.wsl.ch/chestnutblight



Website of the local
association IG
Pro Kastanie
Zentralschweiz:
[https://kastanien.
application-lab.ch](https://kastanien.application-lab.ch)

To test a new treatment method, the forest scientist, Emanuel Helfenstein, attaches a piece of wood with virus-infected fungal spores to a diseased chestnut tree.

The tests so far have been very promising. “But only the experiments in the Chestenenweid site will show whether the method really works,” says Simone. Both sides benefit from these tests: WSL, because it depends on suitable test sites for its research, and the association Pro Kastanie because the research results are useful for combating chestnut blight and can thus contribute to the rescue of the chestnut trees on the north side of the Alps. *(cho)*

ONE-TWO **Cultivating personal contacts.** A WSL survey has shown that, for nature conservation professionals, their own experience counts more than scientific facts. WSL researcher Rolf Holderegger and nature conservation practitioner Stefan Birrer discuss how the dialogue between research and practice can be improved.

Mr. Birrer, do you, as a practitioner, read scientific publications in scientific journals?

SB: I mainly read publications that have something to do with Switzerland and Central Europe. American journals are of little use to me. But there is not just one kind of practice and one practitioner. If you are responsible for a small protected area, you will have less need for contact with researchers than people involved in conceptual nature conservation.

How could research have a greater impact in practice?

RH: You must study something that is relevant to practice. The most important thing, however, is for you to be motivated to engage in dialogue with practitioners and spend time discussing ideas with them. If two or three people from practice know you personally and can ask you questions on the phone, you will probably have more effect than if you publish a lot.

SB: I think it's very important that both sides are interested in dialogue. We had several practical questions that could have been suitable for master's theses. Unfortunately, we couldn't find anyone in research prepared to address these questions for us. Maybe the

researchers themselves are not interested in the problems, or they can't find any students keen to do a more practical thesis.

So would it be better to combine research and practice earlier in university education?

RH: Yes. At university, the students receive a lot of theoretical input. However, the majority of graduates later work in a practical area, and only very few will have the opportunity to stay in research for longer. This means universities are teaching the professionals who will later work for government authorities, environmental consulting offices and companies. More attention should be paid to this fact in university courses. It would be particularly desirable for students to know more about species identification or the legal environment, as well as for them to develop soft skills such as communication and negotiation skills.

SB: We have to ask ourselves whether training people only in theory and not in practice is not a waste of resources.

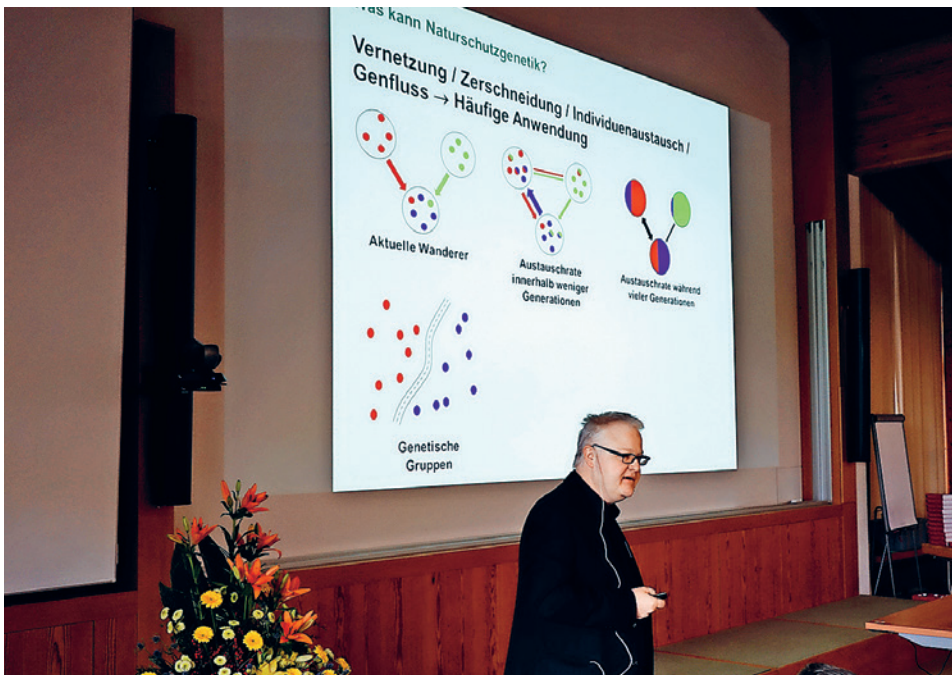
RH: In addition to basic research, we also need applied research at Swiss universities and research institutes. Such research is not only important for practice,



The biologist, Stefan Birrer, has worked for the environmental consulting company, Hintermann & Weber in Reinach for 20 years.



The biologist, Rolf Holderegger, is head of the Research Unit 'Biodiversity and Conservation Biology' at WSL



Conferences on topics relevant for practitioners promote dialogue and personal contact.

but also for politics and society, which expect research to contribute to solving current problems and not only focus on having an excellent scientific reputation. Basic and applied research often go hand in hand and can be mutually beneficial.

But does basic research contribute anything at all to practice?

RH: Often only indirectly and to a limited extent. Take the term ‘trickle down effect’. It implies that, even though the focus of basic research is not on obtaining applicable results, its findings will, at some point, seep through into practice anyway. In reality, this approach does not work, or if it does, it takes a very long time.

SB: But it worked in genetics. In the beginning, this was basic research, but now genetic methods are used widely in nature conservation. I think the assumption that research findings will eventually be

of practical use is basically correct. There are probably only a few practitioners who see basic research as a problem. However, there must also be sufficient room available for practice-relevant research to take place, as well as corresponding funding.

How useful is applied research in practice?

SB: Very useful. But I have become a little bit more critical of science in recent years. I frequently come across studies that don’t convince me, even if the statistical evaluations are correct. All too often there are methodological errors that could have been avoided if an expert from practice had been involved. Research also often places too little weight on relevance. How important is it if five percent more or less of a particular insect species are found when a certain mowing technique is used? Perhaps other factors are more relevant? However, I don’t

like, as a practitioner, to accuse researchers of making mistakes in a study. It is always easy to criticise.

Turning the question around, what does research want from practice?

RH: Many research questions relevant to practice could be answered with data from practice, especially from the cantons. But we cannot access this treasure trove of data because it has not been processed sufficiently. I would like to see greater openness here, also with regard to what research has to offer. You hear people coming out with preconceptions like: “Researchers only want to publish. When you talk to them, you can’t understand them. They tell us how to interpret their results, but in the end you don’t have a conclusion that is applicable in practice.” This cliché is true to a certain extent, but there are many researchers who are accessible and would love to discuss their work with people in practice.

SB: This negative attitude actually exists among practitioners. Above all, species specialists are sometimes incredibly intolerant here. They believe that you will not be able to get good results if you have only studied for a few years, have no experience in fieldwork, and first need to become familiar with a particular species group.

How can these prejudices be overcome?

RH: We have organised several conferences specifically for practical purposes, for example on over-

passes and conservation genetics. Here it is important for the topics to have a practical focus and for practitioners to also have a say in organising and contributing to the programme. And there must be plenty of time for discussion so that people can talk and get to know each other.

SB: I find such meetings very valuable. There could be more of them. In Basel there is the conference “Nature conservation in and around Basel”, where all conservationists from the region come together with researchers and scientific findings are presented.

RH: From my point of view, personal contact is the most effective way of exchanging information between research and practice. (*lbo*)

“The most important thing is for you to be motivated to engage in dialogue with practitioners and spend time discussing ideas with them.”

Anna Hersperger, Birmensdorf

Award Winner

SNSF Consolidator Grant



SPATIAL PLANNING IN URBAN AGGLOMERATIONS

What is the best way to plan development in large urban regions? Or is it like in a jungle and completely uncontrollable? Landscape researcher Anna Hersperger compared spatial planning in 21 European cities and is now analysing the most important processes involved in detail for Bucharest, Zurich and Austin (Texas). “We are beginning to understand much better the role that strategic visions, land-use plans and actors play in the development of urban agglomerations.”

FOREST Seeds and the introduction of harmful organisms: the risk is greater than thought

Tree seedlings and seeds are today traded widely across Europe and the world. Seed is imported not only when it is cheaper to buy abroad, but also as part of a lively trade in the seeds of exotic ornamental plants to liven up parks and green areas. Whether the seed and plant material are free from harmful organisms,



The seeds may look healthy but are high risk: the germinating pine seeds will, within a few days, become covered with microbial organisms transported in or on the seeds.

such as insects and fungi, is a question that arises at the latest at the Swiss border. Alien organisms may be introduced into a country with the imported seeds. The organisms could then, depending on the circumstances, reproduce and spread uncontrollably in their new environment.

When importing wood and living plants, official documents are required that confirm the plant material is healthy. But no such docu-

ments are necessary for importing seed because it is considered less dangerous. The seed trade is therefore not regulated for most tree species.

Carry out test planting prior to export

But the risk could be greater than previously thought. The biologist Iva Franić checked seeds from North America, Europe and Asia for insects and fungi for her doctoral thesis at WSL and the Centre for Agriculture and Bioscience International (CABI) in Delémont. It turned out that the seed samples of some tree species from China and North America are far more infected with fungi than previously assumed. The fungi included species that are already known as pathogens. Simone Prospero, who is supervising Iva's doctoral thesis at WSL, says: "The high infection rate of some tree species' seeds is worrying."

It is not yet clear whether all insect and fungal species found are dangerous and how great their damage potential is. To find out, researchers from WSL and CABI Delémont will perform infection tests with plant material and genetic analyses at WSL's Plant Protection Lab in Birmensdorf.

Another method for identifying potential pests is so-called 'sentinel planting', which is already carried out in the seeds' country of origin. This involves planting the seeds of frequently exported tree species and then examining the plants for harmful organisms. The final decision about exporting the seed and plant material is based on a risk analysis to

assess whether these organisms could become invasive in one of the importing countries. One such plantation was established in WSL's experimental tree nursery in Birmensdorf in 2018. Here, five tree species native to Central Europe that are regularly exported to Asia are being checked for fungi and insects.

Seed testing required

From the results so far, the researchers conclude that it is essential to reconsider phytosanitary measures in trading tree seed. "The risk of unintentionally introducing harmful organisms can only be minimised if seed samples are tested for fungal and insect infestation in their country of origin, and each sample then receives a corresponding certificate," explains Simone. The earlier and more accurately invasive pests are identified, the easier it is to prevent their introduction into countries that were previously free of infestations.

"The new plant health regulations of the EU and Switzerland are a step in the right direction," Simone maintains. These regulate the import requirements for plant material from third countries such as China more strictly. Once pests have spread across continents, the financial and ecological consequences can be immense. (lbo)

www.wsl.ch/plantprotectionlab



WSL's diagnostic lab regularly checks imported pine seeds.



Acorn of an American oak species (*Quercus garryana*) infested with fungi and damaged by insect larvae feeding on it.

FOREST Experts handle conflicts between economic and ecological interests differently in forestry and nature conservation



A marteloscope is a training plot where each tree is numbered and where different forest management tasks can be 'virtually' explored.

How can you harvest wood and at the same time promote biodiversity in the forest? A team led by the political scientist Tobias Schulz and forest scientist Frank Krumm compared, together with researchers from Germany, how experts in forestry and experts in nature conservation deal with this conflict. On two days, twelve participants from each group were invited to visit a Marteloscope in an oak forest. This is a training area where all the trees and their characteristics are recorded and mapped. The participants had to weigh up economic and ecological considerations, and select not only a certain amount of valuable timber for harvesting but also ten habitat trees. Habitat trees are trees that should be preserved because they have special structures, such as hollows and cracks, that provide habitats for many animal species.

Nature conservation experts mostly selected only large old oaks as habitat trees, while foresters also selected younger hornbeams with a lower ecological value. Large oaks are economically valuable and were marked for harvesting by the foresters, but by hardly any conservationists. The foresters behaved more uniformly when weighing up economic and ecological aspects than the conservationists as all they chose trees without much economic value as habitat trees.

Essential factors such as occupational safety or time pressure were not surveyed in this study. Further Marteloscope exercises will show the influence of these factors on how experts weigh up economic and ecological priorities. *(lbo)*

LANDSCAPE Computers are sometimes better at mapping plant species than humans

Numerous vehicles travel on Swiss motorways every day. These main traffic routes are used not only by people but also by alien plant species, which can spread along these corridors. Some of these so-called invasive neophytes reproduce rapidly, and may be toxic, cause allergies or lead to increased road maintenance costs. It is often unclear where and how quickly they spread as mapping them on motorways is dangerous work, which is why such maps are lacking.

The WSL ecologist, Michael Nobis, and his team are now testing, in collaboration with the Computer Vision Lab at ETH Zurich, a new method to map plant species quickly and automatically. It involves researchers driving along a motorway, such as the A1 between Geneva and St. Margrethen, with two cameras to film the side and central strips. Travelling at 90 km/h and recording 24 frames per second resulted in a data set with several million individual images of the vegetation along the roads.

This data set is then evaluated with the help of 'Deep Learning', i.e. with artificial neural networks that are trained to recognize certain patterns in data. On a comparatively small number of the pictures, the occurrence of tree-of-heaven and narrow-leaved ragwort plants are recorded by hand. With this training data set, the computer learns to identify the species. Michael is convinced: "the new technology could simplify time-consuming routine tasks such as mapping in the field." An earlier project involving drones on SBB railway

lines has shown that the machine sometimes identified the species better than a botanist.

The aim of the current project is to test the new method and produce detailed distribution maps of the tree of heaven and the narrow-leaved ragwort along motorways. The Federal Roads Office (FEDRO), which commissioned the project, and the Federal Office for the Environment



Cameras in the car film the vegetation on the left and right. The image of the tree of heaven (right), taken at a speed of 90 km/h, is astonishingly clear.

(FOEN) are very interested in the results. These will show the current distribution of invasive species along Swiss motorways and provide help in deciding how best to deal with these species. (lbo)

LANDSCAPE Survey on the energy transition: the public wants to play a greater role in planning power plants

The Swiss public clearly said “yes” to the government’s Energy Strategy 2050. However, many people are sceptical when it comes to selecting potential locations, for example for wind farms. In twelve municipalities north-east of Bern, WSL researchers have investigated how local people envisage implementing the energy transition in the immediate area around where they live.

The geographer Stefanie Müller conducted a survey to find out from the people living in the region how satisfied they are with their involvement in the planning of renewable energy plants. In addition, Stefanie wanted to find out how the public imagine the installation of plants for producing renewable energy would change the area where they live. She

took a new approach and asked those affected to use a so-called Geographical Information System (GIS) and to mark on sections of digital maps where wind turbines could potentially be located. They also had to explain why they thought wind energy should not be generated in particular places.

A total of 530 people took part in the survey. A large majority said they could imagine, for example, finding sites for wind turbines in their local area, but thought it essential to allow those affected to play a more active role than previously in the local planning process. For example, they should be involved in the selection of the type of renewable energy source, the production site and the concrete design of the plants.

If public opinion were to be taken into account more in the implementation of the new Energy Strategy locally, this would call into question existing processes in politics and the administration. Involving local citizens to a greater extent and earlier, however, would increase the chances that renewable energy sources will not be perceived in the future as an unwanted intrusion in the immediate area around where they live, but rather as part of it.*(rlä)*

www.wsl.ch/wind-energy-survey



Wind turbine near Haldenstein in the Rhine Valley by Chur.

LANDSCAPE Water could become scarce – does Switzerland have sufficient storage capacity?



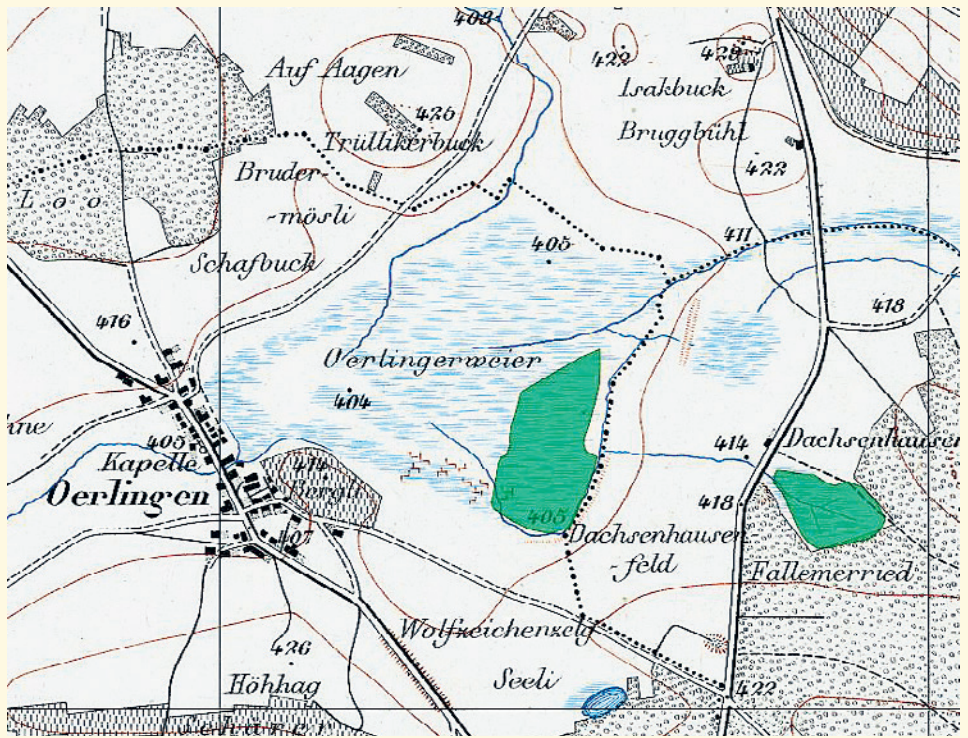
The water in artificial reservoirs, such as this one in Val de Bagnes (Canton Valais), is mostly reserved for producing electricity.

More very hot days, dry summers and winters with little snow: according to the Swiss Climate Scenarios CH2018, this is what Switzerland can expect if climate change progresses unchecked. Water could therefore become scarce, especially in summer. Will it be possible to cope with such shortages by replacing precipitation and discharge with water from existing reservoirs? On behalf of FOEN, the hydrologist Manuela Brunner investigated this question together with researchers from the University of Applied Sciences Rapperswil. In 307 catchment areas in Switzerland, they estimated how scarce water in summer is today and is likely to be in future, and compared their estimates with the storage volume of natural lakes and artificial reservoirs.

Their findings: throughout Switzerland, the volume stored is suffi-

cient to cope with a water shortage. However, current regulations mean that only a small proportion of the water volume in the lakes can actually be used, while the water in reservoirs is mainly reserved for hydro-power production. In order to exploit the potential of reservoirs, concessions for use would have to be renegotiated. In addition, the reservoirs are often not located on the Central Plateau, which is where water is mainly needed. A follow-up project will investigate how the framework should be changed to ensure the existing storage facilities can be used for more than one purpose. *(lbo)*

BIODIVERSITY Zürich's wetlands: Without countermeasures, more plant species will disappear



The wetland indications on the map (in blue) show the extent of the Oerlinger wetland around 1850. Today it is much smaller (green patches). This is typical for wetlands in Canton Zurich.

Wetlands cover less than one percent of Canton Zurich – around 1850 the area was ten times as large. The reason for this decrease is that many wetlands have since been drained. They are now used for agricultural purposes or have been built over. When this happens, it is clear that the plant species adapted to wetlands disappear. Several wetland-specialised species in the Canton have already become extinct, and numerous other species have become much rarer.

In her master's thesis, the environmental scientist Anine Jamin investigated whether more plant species can be expected to disappear. She compared the number of species in wetlands that have lost less than half their area since 1850 with those in wetlands that have greatly shrunk. She found that there are currently

more plant species in severely shrunken wetlands than you would expect on the basis of their small size. However, this is only seemingly a good sign: the observed surplus of these species indicates an 'extinction debt'. The biologist, Ariel Bergamini, who supervised the master's thesis, explains: "When the habitat shrinks and becomes fragmented, many plants survive for a while. But the populations in the remaining isolated patches are small. Over time, such species are lost because they can no longer, for example, reproduce successfully."

Opportunity for nature conservation

The consequence for the Zurich wetlands is that, even if the wetland area no longer decreases further, more

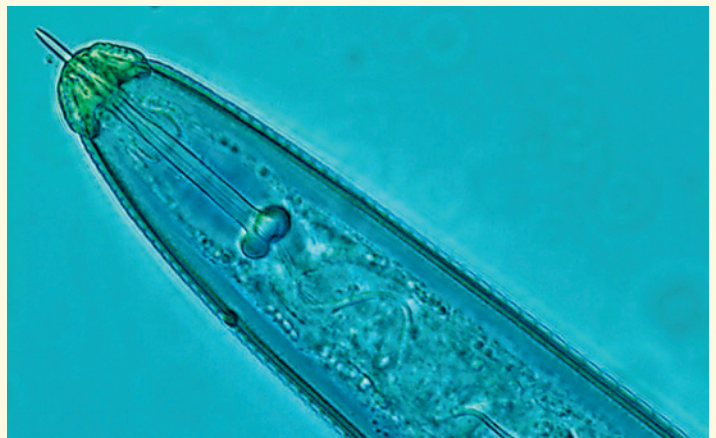
plants will die out until the number of species is in line with the size of the area. To ensure these plants can be preserved, Ariel and Anine call for urgent measures to promote the wetlands and their flora: the existing network of wetlands should be supplemented and expanded by rewetting parts of wetlands that have been drained. To improve the quality of the remaining wetlands, existing drainage ditches must be closed and sufficient buffer zones set up. As par-

adoxical as this may sound, Ariel also sees extinction debt as an opportunity for nature conservation: “The species are still present locally and can be saved.” (bio)

BIODIVERSITY The soil recovers after intervention

Extensively managed grasslands are nutrient-poor and therefore home to very diverse species communities. In Switzerland, however, fertilization and frequent mowing have transformed many former species-rich grasslands into highly productive, but species-poor, agricultural ‘deserts’. Nature conservationists want to restore them in, for example, protected areas. One controversial but efficient intervention for this purpose is topsoil removal, where some of the nutrient-rich topsoil layer is removed with a digger. Fresh hay and seeds from target plants are then added. Soil experts, however, have criticised this, maintaining it permanently disturbs the soil.

Carol Resch, an environmental scientist at WSL, was able to counter this objection with the help of nematodes, which are belowground indicators of soil conditions. Thus the more complex the network of herbivorous, bacterivorous, fungivorous, and omni-carnivorous nematodes, the healthier the soil is. Carol has studied eleven restored grasslands in the Eigental nature reserve (ZH), where 22 years ago nutrients



Nematodes are indicators of soil conditions. The herbivorous species *Rotylenchus robustus* punctures plant cells with its stylet at the front end to suck out the juice.

were removed in various ways. She found that topsoil removal with and without seed addition was able to restore the targeted plant community, while repeated mowing alone was not enough. In addition, the soil nematodes successfully recovered from the digging. “Topsoil removal alone would be sufficient in the long term to restore species-rich grasslands,” Carol concludes. “But if this is to be achieved more quickly, seed will have to be added.” (bki)

Why researchers fish stones from mountain torrents with nets



Researchers collect bedload with a net in the mountain torrent Avançon de Nant in Canton Vaud.

A catch net approximately 50 centimetres wide runs along a rail in the burbling mountain torrent Avançon de Nant in Canton Vaud. It is not, however, there to catch fish, but rather to trap bedload, i.e. sediment transported by the water. In addition, measuring plates equipped with geophones are installed on the streambed to measure the vibrations of the rumbling stones – this makes it possible to estimate the amount of bedload. But which geophone signal indicates a particular quantity of sediment?

This is what Tobias Nicollier, a PhD student at WSL, wants to find out. He is developing a computing method that will, in future, link each

geophone signal automatically to a certain amount of bedload. For this, he needs comparative data, which he can obtain either with the help of such catch nets, or with permanently installed bedload trap baskets. “It is only with these two methods that we have been able to determine the amount of bedload at high discharges,” says Tobias. To obtain the necessary data, he carried out various net measurements in the summer of 2019 in the torrents Avançon de Nant, Albula (Grisons) and the Erlenbach (Schwyz).

If bedload is deposited in the wrong place, it can contribute to the damage caused by flooding. It is also important for hydropower plants to know how quickly reservoirs fill up with sediment. Eighty years have, however, passed since the bedload in Swiss rivers was last extensively measured.

In parallel, Tobias is carrying out experiments in artificial streambeds in order to obtain an even more accurate picture of the movements of the transported stones. He reconstructs the soil structure there and the flow behaviour of the torrents as accurately as possible and films the rock particles through plexiglass walls. “The aim is to understand the natural sediment budget better.” This is also important for successful river revitalisation, which also requires natural bedload transport, for example for forming gravel banks. In Switzerland, around 4000 kilometres of river courses have still to be revitalised. *(bki)*

www.wsl.ch/bedload

NATURAL HAZARDS Rock slope failure and avalanche on the Flüela Wisshorn: a chain of processes

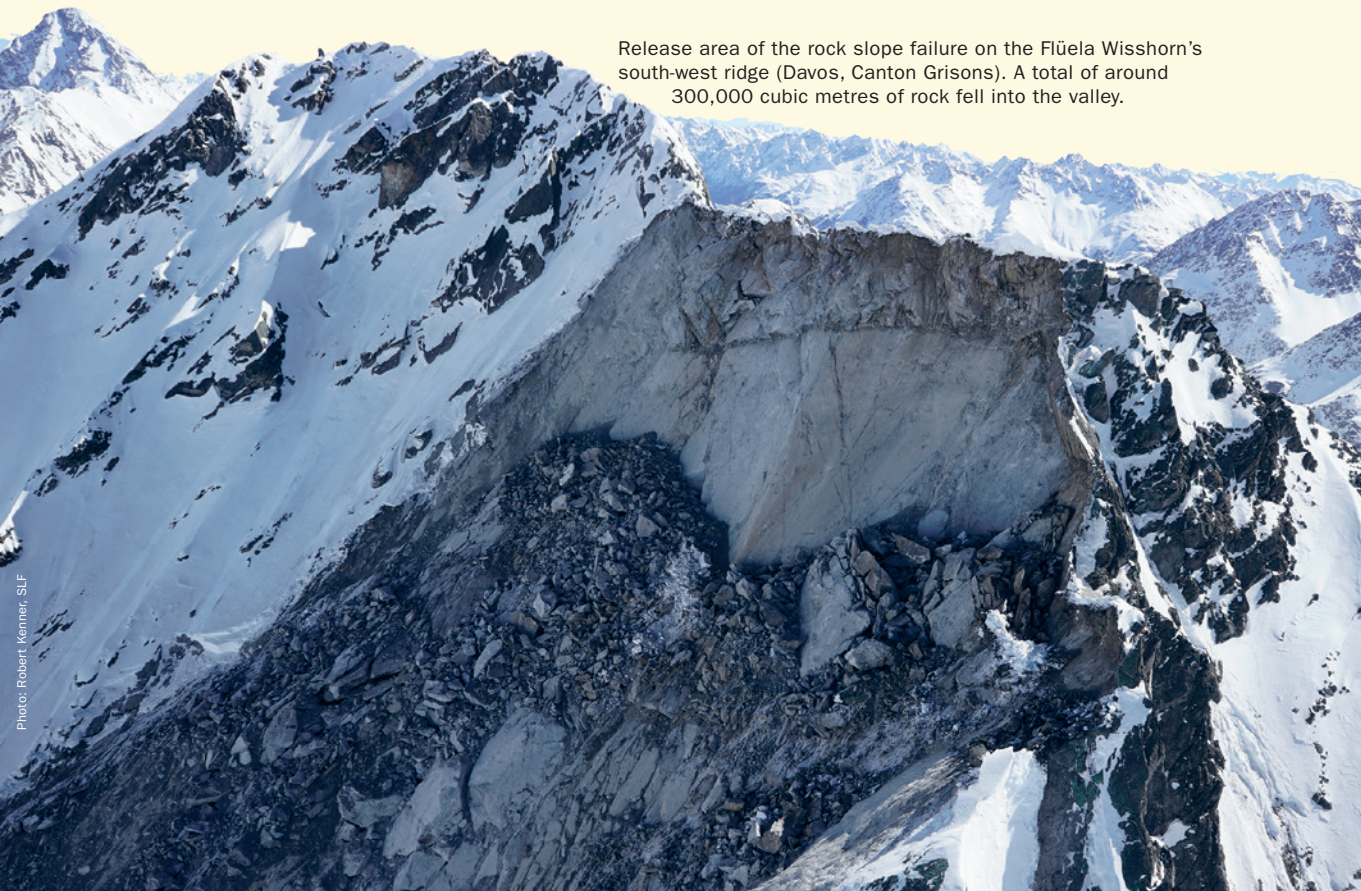
On the night of 19 March 2019, almost a third of a million cubic metres of rock crashed down from the Flüela Wisshorn near Davos. As a result, a very large snow avalanche broke loose that almost flowed onto the closed Flüela Pass road. Little is yet known about such chains of natural hazard events – in this case, slope failure followed by an avalanche. This is why researchers at SLF are intensively studying such linked processes as part of the “Climate Change and Alpine Mass Movements” programme. The aim is to understand the processes in more detail and then simulate them on the computer so that protective measures can be adapted accordingly. The Flüela Wisshorn incident provided an interesting case study for the researchers to analyse in detail using seismic measurements and drone images.

Robert Kenner, a permafrost researcher at SLF, sums up the results of the analysis: “The release area of the rock slope failure is located in permafrost. However, the slope failure was probably mainly due to the geological structure of the rock and the erosion of the slope foot through glaciation during the last Ice Age.” The mixture of falling snow and rock landed on an existing rock glacier. The researchers are now curious to see whether the movement of the rock glacier will change in coming years due to this additional mass.

The Flüela Wisshorn event and some comparable rock slope failures in past winters show that such slope failures of this size are not only possible in summer, but at any time of the year. *(mhe)*

www.slf.ch/rockslope-failures-permafrost

Release area of the rock slope failure on the Flüela Wisshorn's south-west ridge (Davos, Canton Grisons). A total of around 300,000 cubic metres of rock fell into the valley.



Where is there (no) snow? Satellites record the snow cover on hiking trails

Active recreation in natural surroundings, like hiking or mountain biking, is widely advertised by tourist offices in mountain regions and outdoor platforms on the Internet. But these activities are very dependent on the weather and terrain conditions. Hiking trails in the moun-



You don't always know whether your planned hike will be snow-free.

tains are often snow-covered, even in summer. However, it is not always easy to get information about where exactly there is snow and how deep it is as the paths in alpine terrain are often difficult to reach. Checking on the conditions there on foot or by helicopter is very costly. Therefore, only selected routes are checked from time to time. For example, those responsible for tourism often lack the information they need to assess the condition of hiking trails and advertise them accordingly.

The start-up company, WeGaw, together with SLF, plans to fill this niche with the support of the European Space Agency ESA. For its

“DeFrost” demonstration project, the young company is using various optical satellites to obtain up-to-date information about the snow cover on mountain trails and to display it on a map. The latest SLF Avalanche Bulletin and the snow depths recorded by measuring stations in the Swiss Alps provide additional information.

The SLF researchers are using automatic cameras to check whether the new method works. The cameras are installed at several sites in the Dischma valley near Davos. They record, at a high spatial and temporal resolution, where the ground is really still covered with snow. A comparison of the images with the map shows how well it represents reality.

In DeFrost, it is planned to develop a ‘snow cover index’ for the paths in alpine terrain. The entire system is expected to be in operation by spring 2020. It should help tourist organisations to assess the walkability of hiking trails better. (sni)

Francesca Pellicciotti, Birmensdorf

Award winner
ERC Consolidator Grant



RESEARCH ON THE ROOF OF THE WORLD

The glaciers in the high-mountain areas of Asia form the third largest ice mass in the world. Millions of people depend on their water. The glaciologist Francesca Pellicciotti is investigating the water resources available to humans and

nature under climate change. With her team, she is collecting data in countries such as Nepal, Tibet, India and Pakistan, as well as in Chile and Peru. She is also developing simulation models that can predict future water shortages.

SNOW AND ICE When soil in the tundra thaws: Arctic microorganisms heat up climate change



Measurements on Svalbard show that dry tundra soil (photo) releases hardly any methane and nitrous oxide, but wet soil releases a lot.

Plants in the arctic tundra have only a few weeks a year when they can grow. Soil microorganisms also spend many months in a kind of cold sleep and are only active for a short time when the top layer of the soil thaws. They then break down organic material – but less than what the plants grow during the same time. This is how thick peat soils have been formed over thousands of years. They store about twice as much carbon worldwide as the entire atmosphere. But climate change is turning tundra soils from carbon sinks into carbon sources: as temperatures rise, the soil remains frozen less long and thaws into deeper layers in the summer. This is particularly advantageous for microorganisms, which can as a result break down more organic material than the plants form. The carbon dioxide released further intensi-

fies the greenhouse effect and thus climate change. And it could get even worse, as the microbiologist Beat Frey explains: “The climate models predict that the Arctic will become more humid. In a water-saturated soil, different microorganisms from those found in dry soil could become active and release more potent greenhouse gases.”

Nitrous oxide and methane instead of carbon dioxide

Beat’s colleague Aline Frossard, who is also a microbiologist, is therefore taking a close look at microorganisms in both dry and wet tundra soil. Her measurements on Svalbard show that, as suspected, the microorganisms active in wet soil differ from those in dry soil. As a result, much more methane and nitrous oxide are released from the wet soil. These

gases amplify the greenhouse effect from roughly twenty-five to three hundred times more than carbon dioxide. Aline: “Global climate models should take this into account so that forecasts can be made more reliable.”

Aline and Beat study microorganisms in tundra and permafrost soils in all seasons – in winter with its perpetual night and icy cold, in spring during the snow melt and in summer with the midnight sun. Genetic investigations of their soil samples are providing insights into a

largely unknown treasure trove of species. As hostile as the tundra may seem to life, it is the natural habitat for many microorganisms. *(bio)*

SNOW AND ICE Microplastics in snow probably come from the atmosphere

Microplastics can now be detected in the most remote regions, such as in Arctic sea ice or deep-sea sediments. The tiny particles get there with the help of ocean currents. But this may not be the only way: tyre tread abrasion, paint particles, synthetic clothing fibres and other materials could also be transported through the atmosphere by wind. There, snow catches some of the particles and brings them down to the earth. At least, this is what is known to occur with other types of air pollution.

Recently researchers have, for the first time, detected microplastics in snow samples. The study, under the direction of the German Alfred Wegener Institute, also included scientists from SLF. In winter 2017/18, they collected new snow in the Flüela Valley near Davos. The samples and others from Bavaria and the North Sea island of Helgoland were compared with Arctic snow from Svalbard and various ice floes north-east of Greenland.

The samples with the largest quantities of microplastics were those from Bavaria, which were collected directly next to a country road: up to 150,000 particles per litre of melted snow. But even the Arctic samples contained up to 14,000 particles – an astonishing amount for such remote regions. The concentrations in the alpine Flüela Valley were similarly high.

The results indicate that microplastics probably reach the Arctic with the global wind systems. Further studies are, however, needed to find out how the particles enter the atmosphere in the first place. *(cho)*

Catherine Graham, Birmensdorf

Award winner

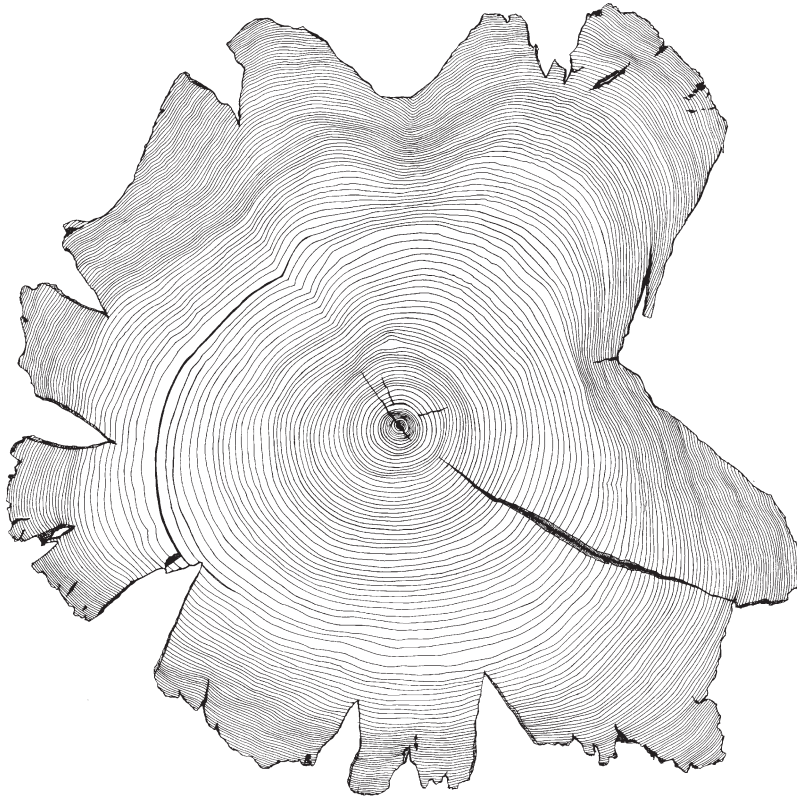
ERC Advanced Grant



PREDICTING THE DIVERSITY OF THE FUTURE

How does biodiversity change over time and space? And what does this mean for the interactions between plants and animals? To examine these questions, the ecologist Catherine Graham is studying, as an example, hummingbirds and

the plants they feed on in mountain regions of Central and South America. Her findings will be incorporated into a model for predicting the interactions of various plant and animal species – an important tool for protecting biodiversity.



Wood can be used in many ways: as a fuel or building material, or for the production of paper. WSL is researching how to make the use of this renewable raw material sustainable, as well as working on basic principles for forestry. Wood also serves WSL researchers as a natural archive: in the tree-ring lab, they analyse the tree rings on, among other things, tree stumps that have been preserved in the soil for thousands of years, to draw conclusions about the former climate of our planet.

Diagonal can be ordered free of charge: www.wsl.ch/diagonal

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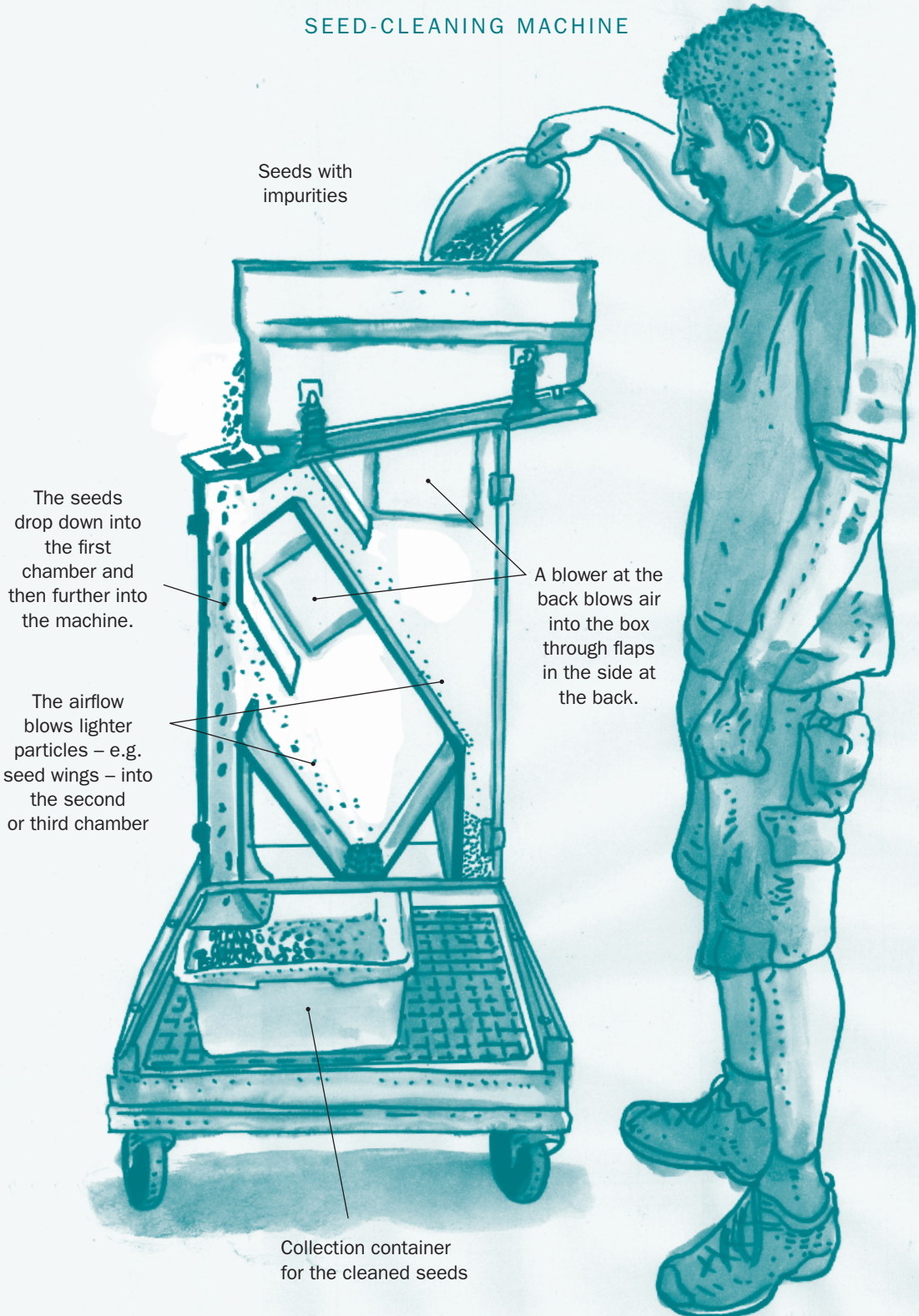
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PEOPLE



The WSL editorial team, from left to right, top row: Sandra Gurzeler, Birgit Ottmer, Beate Kittl, Claudia Hoffmann; bottom row: Reinhard Lässig, Sara Niedermann, Lisa Bose

SEED-CLEANING MACHINE



At WSL, seeds from about ninety different tree species are harvested, cleaned and stored. These seeds are then used for in-house experiments or made available to forest enterprises. To remove impurities, various seed-cleaning machines can be used. These machines separate the raw material according to weight, separating, for example, heavier spruce seeds from lighter impurities. The cleaned seeds are collected in a container for further use.

Video at:
www.wsl.ch/object





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RESEARCH FOR PEOPLE AND THE ENVIRONMENT

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