Eawag
Swiss Federal Institute of Aquatic
Science and Technology

Annual Report 2022

eawag
aquatic research

Contents

Cover photo and opposite page In close exchange with various universities in Switzerland and abroad, Eawag is committed to the education of undergraduate and doctoral students in natural, engineering and social sciences. In 2022, Eawag employees supervised 149 doctoral theses – such as that of Dorothee Kurz. In collaboration with ETH Zurich, the engineer in Joaquin Jimenez-Martinez's research group is investigating how bacteria form biofilms in soils and groundwater aquifers. To do this, she works with simplified models that simulate the natural environment. Read more about academic training at Eawag on page 27.

Aldo Todaro, Eawag

Eawag

Eawag's research activities focus on how to ensure a balance between humanity's use of water resources and the preservation of resilient aquatic ecosystems. Eawag offers 39 professors and lecturers and over 300 scientists a unique environment for pursuing research to generate new scientific findings and develop solutions to fundamental societal challenges. Here, an important role is played by an interdisciplinary approach and knowledge transfer with the authorities and stakeholders from business and society. The 5,700 teaching hours at Swiss higher education institutions and the supervision of over 180 bachelor and master theses and 149 doctoral theses per year are an important contribution to the education of young professionals for the Swiss water sector.

Photo opposite Forum Chriesbach, constructed by Eawag in 2006, is a highly energy-efficient building, noted for its pioneering approach to water management and sustainability. It is set in largely natural surroundings, with the Chriesbach river forming an integral part of the campus.

Water is at the heart of the most important environmental issues.

Eawag

Due to a combination of low precipitation and high evaporation, 2022 was one of the driest years in Switzerland since measurements began over 150 years ago. The lack of water presents us with difficult decisions: how much water can be used in agriculture, how much water can be retained in reservoirs for energy production and how much must remain in streams and rivers to protect aquatic life habitats? Such dry periods will become more frequent and the competition for water will become even greater. Climate change is changing the water cycle in Switzerland. More rainfall and greater water runoff from the mountains are expected in winter, resulting in low water reserves and increasing drought in summer.

Water is also central to other environmental issues. Biodiversity loss is progressing and is particularly severe in freshwater habitats. The contamination of natural habitats with nutrients and pollutants is increasing and many of these substances end up in rivers and lakes. The production of food for a growing population in a changing climate raises the demand for water and puts greater stress on water bodies. Increasing urbanisation calls for new approaches to decentralised and circular water management. In all these areas, basic research and impact-oriented science can provide important insights and innovations.

Eawag is well-equipped to play an important role here. Professor Janet Hering has led Eawag for 16 years, developing it into one of the world's leading aquatic research institutes. On page 39, she explains how strong research goes hand in hand with close exchange with practitioners. Dialogue with authorities, politics and industry ensures that scientific findings and innovation have an impact. As Janet Hering's successor, I look forward to building on this strong foundation.

We also need strong research partners to tackle the major challenges of our time. Climate change, changes in land utilisation, urbanisation and biodiversity loss affect not only the environment, but also all areas of our lives. Our incorporation in the ETH Domain offers unique opportunities to meet the complexity of these challenges.

Close collaboration with the institutions of the ETH Domain allows us to bring together relevant scientific perspectives, use modern methods including data-driven and computational approaches, and become more involved in the innovation process for environmental solutions. Eawag is involved in seven of the ten joint research initiatives of the ETH Domain and is actively engaged in establishing further research collaborations.

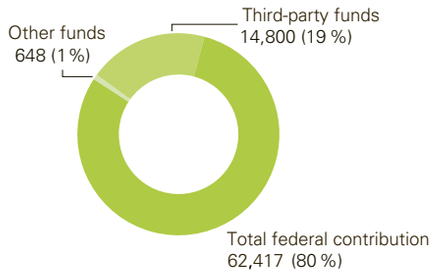
Martin Ackermann
Eawag Director

Eawag in figures

Finances

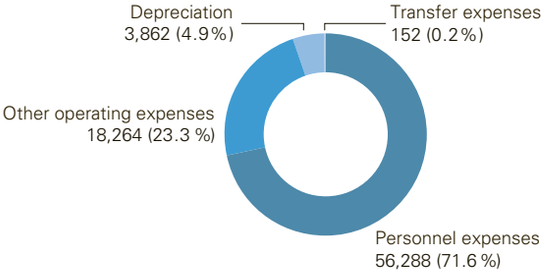
Operating revenue (in CHF thousands)

77,866



Operating expenses (in CHF thousands)

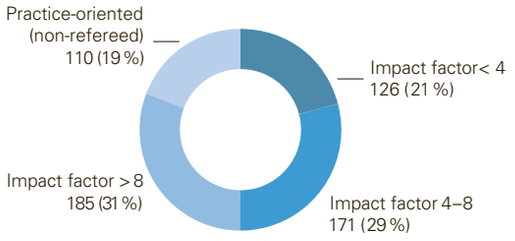
78,566



Research

Publications

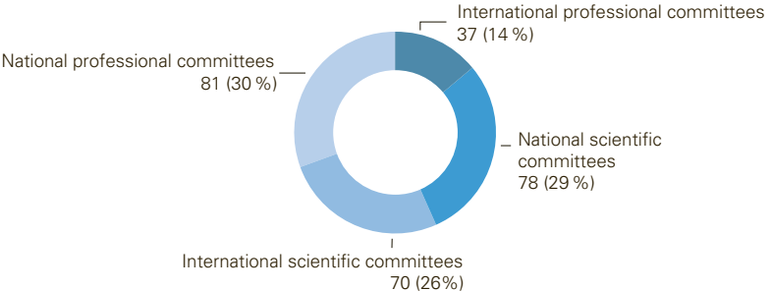
592



The higher the impact factor of a scientific journal, the greater its impact.

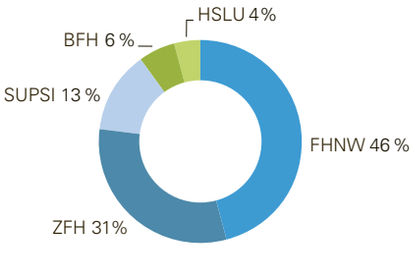
Committee memberships

266



Joint activities with universities of applied sciences

48

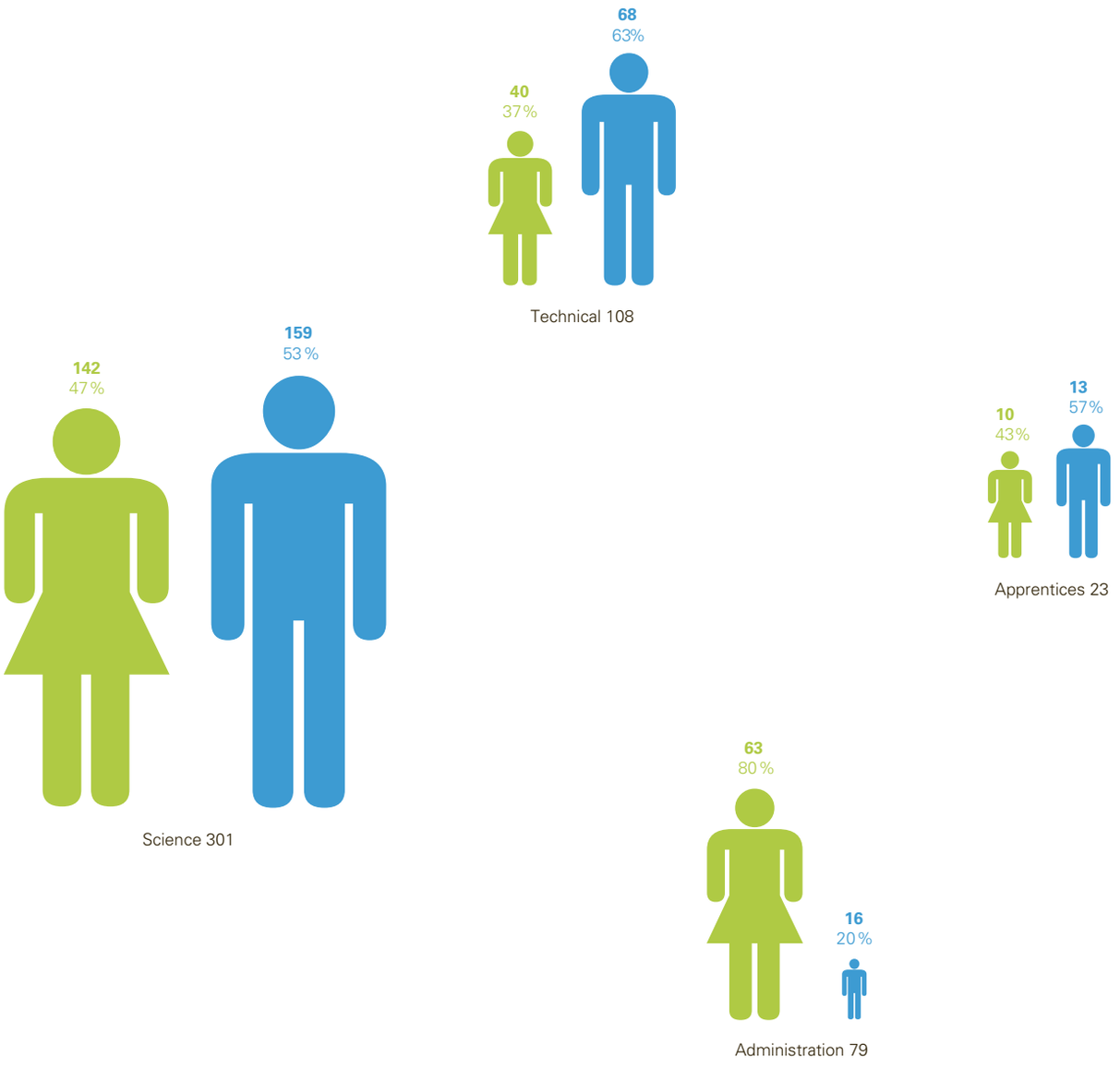


Due to rounding, individual figures may not sum to the totals shown.

Personnel

Employees by function

511 50 % 50 %



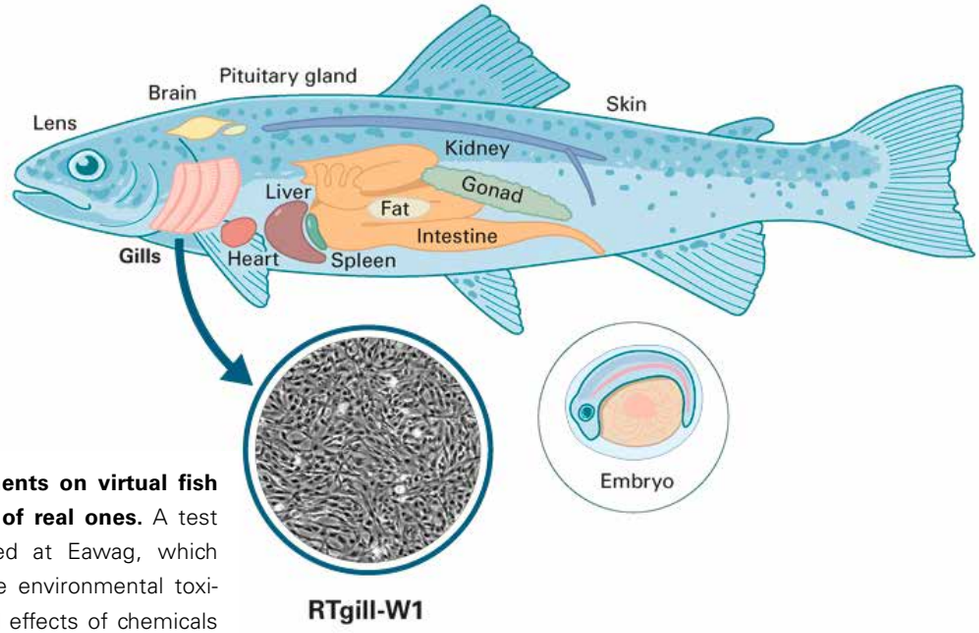
Annual financial statements
View online

Spotlight

Samuel Mühlemann

Monitoring antibiotic resistance in wastewater. Antibiotic-resistant bacteria enter wastewater treatment plants with the wastewater. As part of the new National Research Programme NRP 72, Eawag researchers have found that although wastewater treatment plants remove a large part of these bacteria, they can still enter rivers, especially when it rains. The researchers recommend setting up a monitoring system for antibiotic resistance in Swiss wastewater treatment plants.

Roland Ryser, Eawag

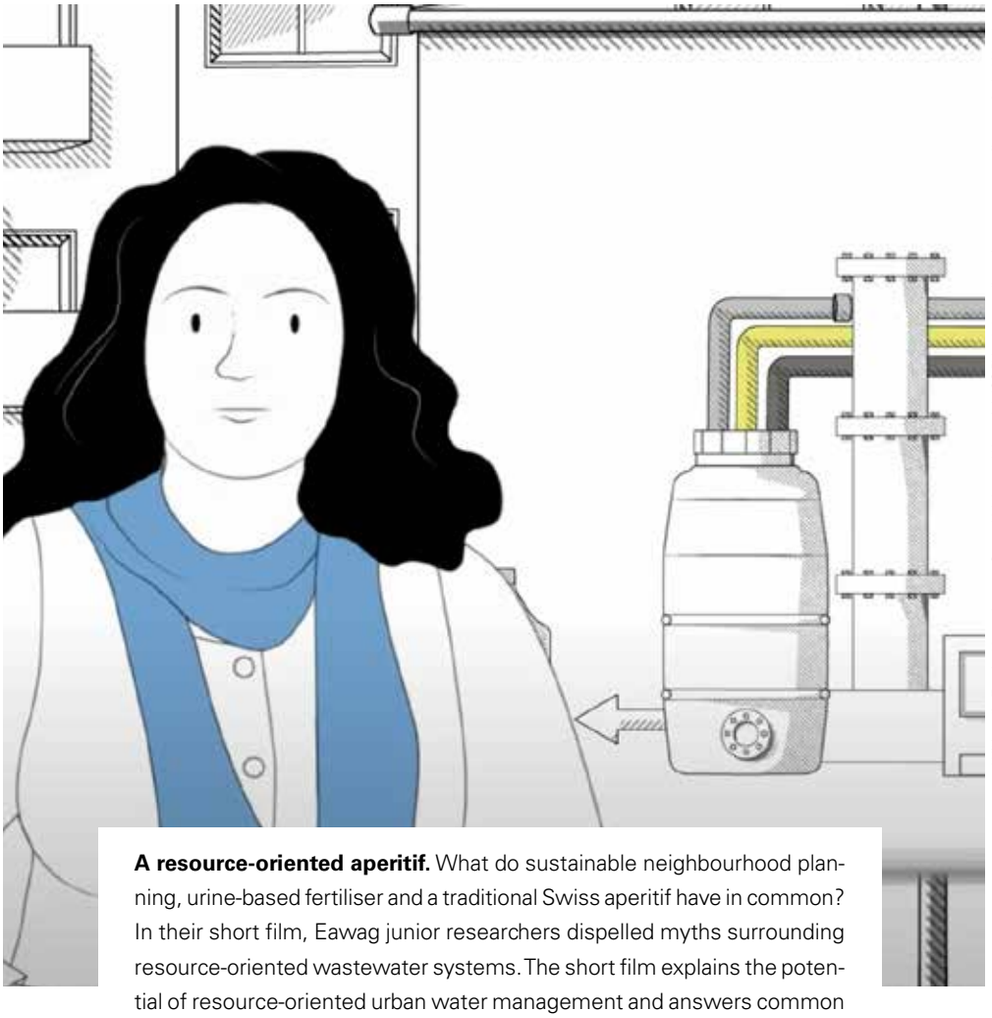


Experiments on virtual fish instead of real ones. A test developed at Eawag, which tests the environmental toxicological effects of chemicals only on gill cells instead of live fish, was released as a guideline by the OECD in 2021. As part of a new National Research Programme, the researchers are experimenting with further tests based on cultured intestine or nerve cells from the fish. This data is to be fed into a single computer model – the virtual fish – to replace further animal testing.

Urine separation on track for success. Vuna GmbH, which was established six years ago as an Eawag spin-off, is now fully independent – and has even founded a sister company, Vuna Nexus AG, to further develop the reactor, which can be used to process urine into certified fertiliser. To celebrate these successes, the team held a party at the Chriesbach site in Dübendorf and also inaugurated the world's first urinoduct, which transports urine from two Eawag buildings across the Chriesbach stream (in the picture) to the central processing facility.

Unicef/Pierre Hotz

Where are fluoride levels elevated in groundwater? As an additive in toothpaste, fluoride protects our teeth from decay. But, if it accumulates too much in groundwater, it becomes a hazard to our health. With a detailed map of global fluoride contamination in groundwater, Eawag researchers have for the first time shown which regions of the world are particularly affected. Read more on page 18.



Wikimedia, Tasnim News Agency, Seyyed Mahmoud Hosseini, (CC BY 4.0, https://creativecommons.org/licenses/by/4.0/deed.en)

A resource-oriented aperitif. What do sustainable neighbourhood planning, urine-based fertiliser and a traditional Swiss aperitif have in common? In their short film, Eawag junior researchers dispelled myths surrounding resource-oriented wastewater systems. The short film explains the potential of resource-oriented urban water management and answers common questions and concerns of key stakeholders. The researchers also took part in the Global Science Film Festival with their short film.

Explanatory video
Watch now

Peter Penicka, Eawag

Esther Michel, Eawag

Research

Practical issues and societal challenges are central to Eawag's research, which focuses on water for human welfare and ecosystem function, as well as strategies for resolving water-related conflicts. Eawag researchers pursue a systems approach, seeking a holistic understanding of processes and relationships. These efforts are supported by transdisciplinary collaborations in national and international research networks, as well as contacts with water professionals and the authorities.

Photo opposite Doctoral student Linda Haltiner is researching in Piet Spaak's research group how the invasive quagga mussel is conquering Switzerland. Read more on page 12.

The quagga mussel conquers Switzerland

Since 2014, the invasive mussel species has been spreading into more and more lakes in Switzerland. Where the quagga mussel settles, it multiplies en masse. Now, researchers at Eawag are showing that this could unbalance lake ecosystems, decimate fish stocks and increase the cost of maintaining and cleaning water pipes.

Esther Michel, Eawag

In the picture Since its first detection in Switzerland in 2014 in the Rhine near Basel, the quagga mussel has been spreading rapidly in Switzerland.

The quagga mussel *(Dreissena bugensis)* originates from the Black Sea region. But now it is widespread in Europe and North America, where it is an aggressive invasive species that contributes to the loss of biodiversity. It was first detected in this country in Lake Constance in 2014. Since then, it has been found in more and more lakes, as a team led by Linda Haltiner from Eawag's Aquatic Ecology department and Hui Zhang from the University of Konstanz has proven.

New habitats

Quagga mussels spread naturally by floating in the current in the larva stage. However, the larvae are also carried away unintentionally in the ballast or engine cooling water of ships and recreational boats. In addition, the adult mussels stick to objects in the water: If these are not cleaned or dried thoroughly before they are released into other water bodies, the mussels can also enter new habitats in this way.

Where the quagga mussel settles, it multiplies en masse. This is because it finds enough to eat even when food is scarce, reproduces almost all year round and also colonises soft substrate in the deep zone of a lake that is inaccessible to other mussels. It is thus capable of completely displacing other species. In North America, at least, it has succeeded in doing so.

It is still too early to make a final assessment of the consequences of the quagga mussel invasion in Switzerland, says Eawag researcher Piet Spaak. But he fears that the invasive mussel species could also affect how we humans use the lakes: because quagga mussels efficiently filter food out of the water, less is left for the plankton. And the fish stocks that feed on plankton are becoming smaller. In addition, the tiny larvae easily find their way into pipes, which increases the effort required for the maintenance and cleaning of drinking water supply systems.

Quagga mussel
Fact sheet (PDF)

Consequences of pesticide use in the tropics

While the use of pesticides in industrial countries is being questioned more and more critically, less is known about their consequences on human health and the environment in tropical countries. The interdisciplinary project "Pestrop" is now changing this and also shows where the necessary measures need to be taken.

In the picture Spraying equipment and pesticides in a shed in the Zarcero region of Costa Rica.

Samuel Fuhrimann, Swiss TPH

When it comes to water in the Global South, the focus is usually on microbiological quality. Small wonder, given that diseases, such as cholera or typhoid, spread through contaminated drinking water. Pesticides, on the other hand, are a little-researched topic in tropical regions. However, a team of experts from the fields of environmental chemistry, human toxicology and political science has now investigated which pesticides were used in two test regions in the period from 2017 to 2020 in Costa Rica and Uganda, and which active substances were found in streams and drinking water production. At the same time, research was conducted on how farmers handle pesticides and how well-informed they are about the risks. The team found clear evidence of long-term negative effects of pesticide use on farmers' health. The project also uncovered deficits in environmental data, inadequate advice to farmers and outdated statutory requirements on pesticide use.

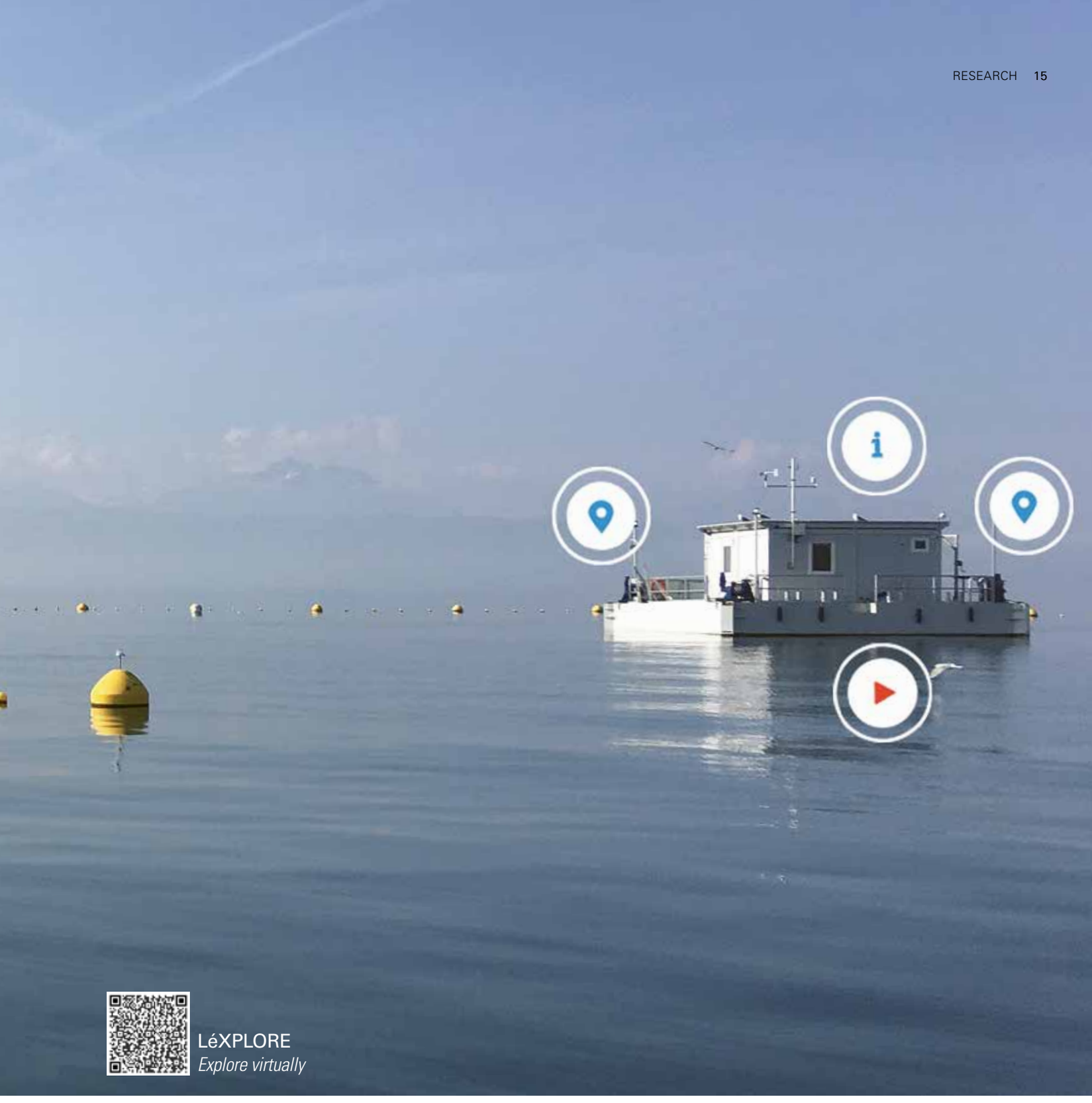
Surprising insecticide findings

The project focused on "modern", often polar active substances, such as fungicides and insecticides. In Africa as well as in Central America, there are still hardly any regulations on these. However, it is evident that they are widely used. In individual samples from streams, the researchers found active substances in concentrations that were significantly above the threshold limits as recognised in Switzerland. And problematic concentrations were also found in boreholes and ponds from which the population draws its drinking water. In addition – and this was surprising – the team found substances in the water that are hardly ever sprayed on the fields, including the insecticide chlorpyrifos, which has since been banned in Switzerland. The researchers suspect that the agent is used to control mosquitoes and mites in stables and enters the environment with farmyard manure, for example. The "Pestrop" project was jointly led by Eawag and the Swiss Tropical and Public Health Institute.

Video on the project
View now

Cary Troy, EPFL / Grafik: Eawag

In the picture Up to 16 scientists can work at the same time at laboratory work stations on the approximately 100 square metre platform – and drive forward a total of around 40 projects that deal with carbon dioxide fluxes or microplastics in the lake, for example. LéXPLORE is a joint project of Eawag and the EPFL, the Universities of Lausanne and Geneva and CARRTEL.



LéXPLORE
Explore virtually

Research station LéXPLORE opens its door in virtual form

A globally unique research facility called LéXPLORE has been floating on Lake Geneva since 2019. The platform is equipped with high-tech sensors that collect physical, chemical and biological measurements around the clock – and down to a depth of 110 metres. Now the research station is opening its doors in virtual form: those who wish can also visit the cabin on the platform. And learn more about the instruments, the data collected, the research projects and the objectives of LéXPLORE.

Information on flooding via social media

Thanks to an automatic image processing method, mobile phone videos posted on the Internet can be used as an important source of data during a flood. This should allow rescue workers to take targeted protective measures – and warn the population at an early stage.

Chaudhary, P. et al.: Flood-Water Level Estimation from Social Media Images

In the picture Using the size of known objects, mobile phone videos estimate how high the water is above the ground.

Heavy rainfall leads to flooding in urban areas: because the mass of water cannot seep away on the asphalted surfaces, it seeks its way through rows of houses. Within a very short time, streets become raging torrents. Not only does it cause huge damage, but human lives are also endangered.

How fast does the water flow?

In order to be able to take protective measures in good time, the rescue services need to know, among other things, how fast the water is flowing. In very few places are sensors installed that reliably provide this information in the event of a flood. But now a research team at Eawag has tapped into a new data source.

"When a flood happens somewhere, it usually doesn't take very long for mobile phone videos to appear on social media," says environmental engineer João P. Leitão from the Urban Water Management Department. Together with his team, the research group has developed an algorithm that automatically evaluates these images to determine the flow velocity, for example, based on the wave structures on the water surface.

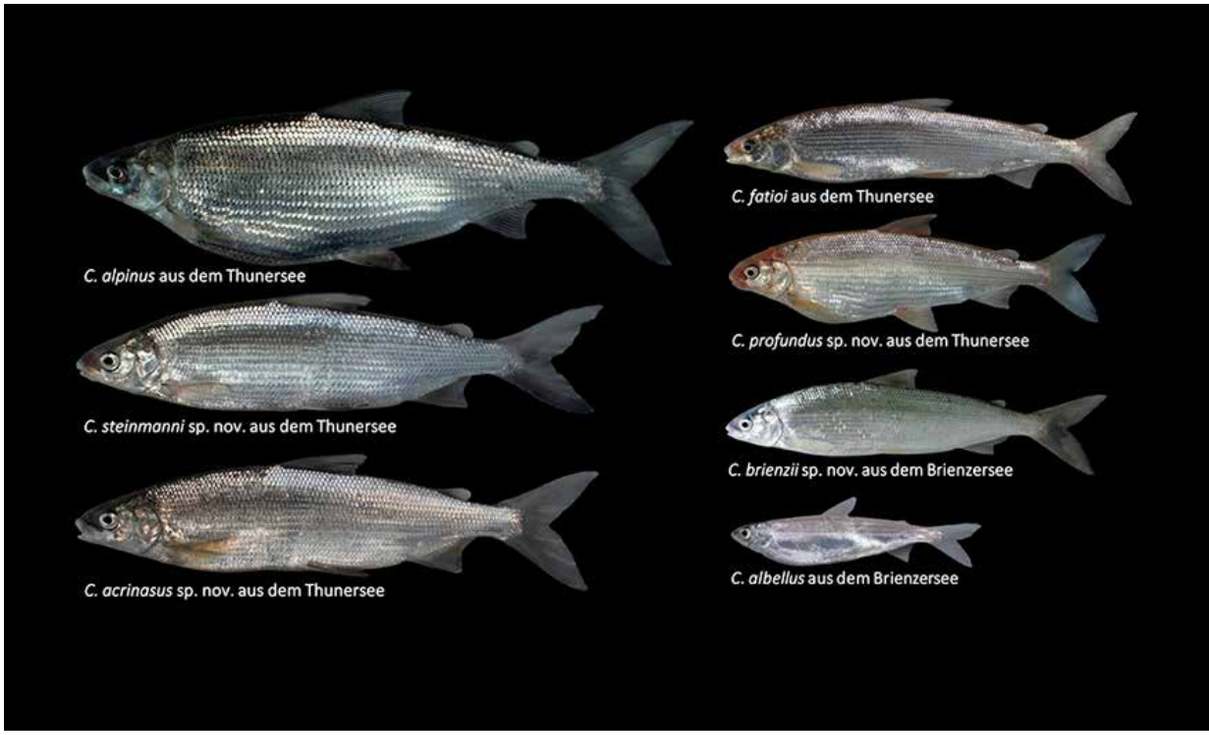
Experiments in the army's training facility

However, the researchers first had to calibrate the algorithm. To do this, they flooded the streets and cellars of a flood training facility where the army and fire brigade normally practice for emergencies. While conventional surveillance cameras filmed what was happening, a radar device recorded how high and fast the floods were. Now it was only a matter of aligning the radar measurements and the image evaluation with each other. "With our fully automated image processing, mobile phone videos can be used practically in real time to warn the affected population at an early stage", says Leitão.

What the diversity of the whitefish reveals about its origins

Why is there a whole spectrum of whitefish species in Switzerland, some of which differ greatly in appearance? With comprehensive genetic analyses, researchers have now found answers to these and other questions.

In the picture Seven different whitefish species are found in the Lakes of Brienz and Thun alone.



Oliver Selz, Eawag

Led by Philine Feulner, research group leader in the Fish Ecology & Evolution Department, a team of researchers from Eawag and the Universities of Bern and Edinburgh has studied the complete genomes of 99 fish belonging to 22 different whitefish species. Their analyses show that, surprisingly, the many whitefish species in the large Swiss pre-alpine lakes only developed after the last ice age – i.e. not in millions of years, but in only around 10,000 years.

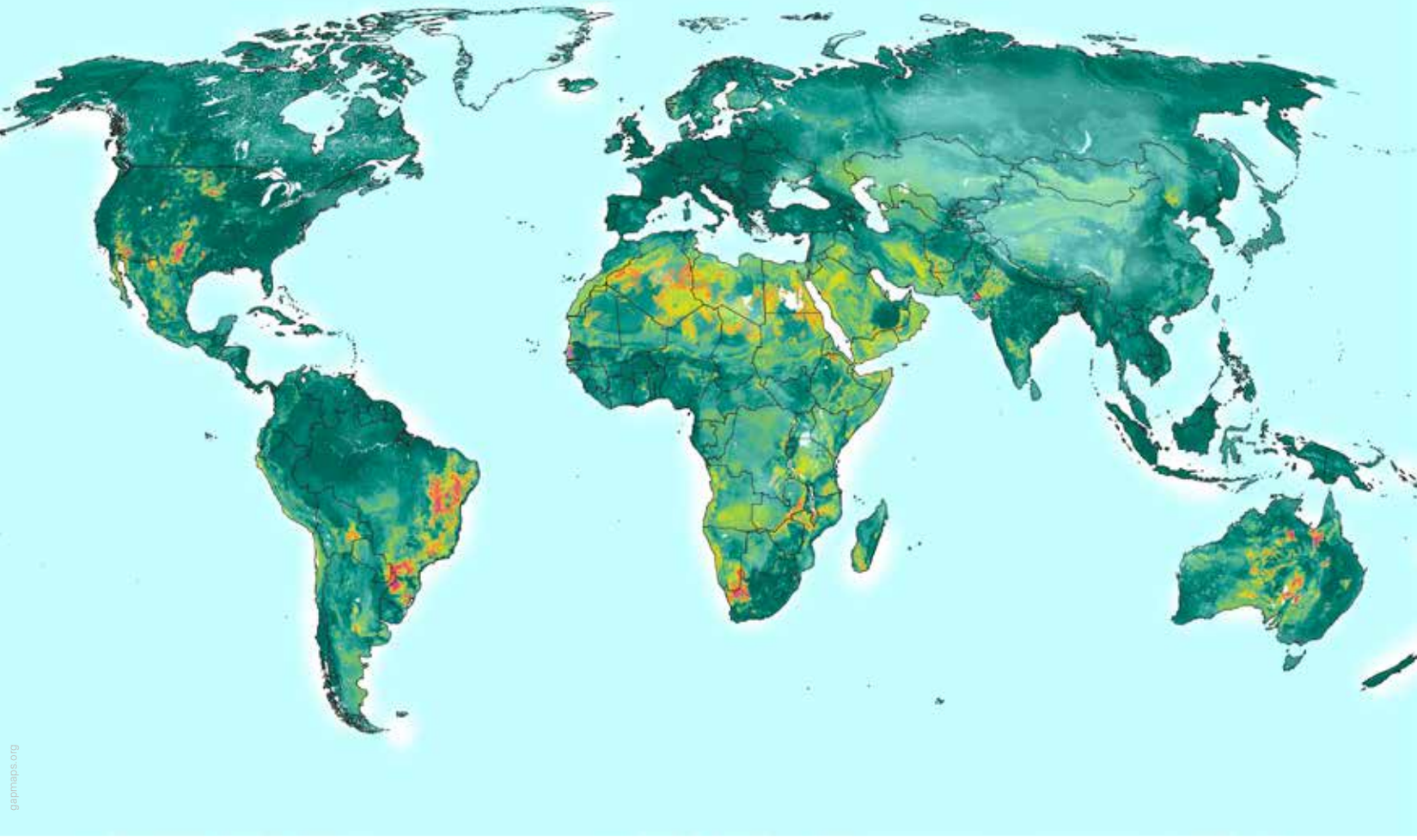
Diversity developed separately in each lake region

The fish differ in appearance and size, but also in their prey pattern and the preferred depth in which they mate and reproduce. Large whitefish live near the shore and feed mainly on soil organisms. In the open water are the small Albeli whitefish, which eat mainly plankton. Between these two extreme forms lie the medium-sized whitefish. They draw on both sources of food to satiate themselves.

The new genetic analyses confirm earlier assumptions that the diversity of whitefish evolved separately and independently in each lake group. This is because whitefish species from the same lake are closely related genetically, even if they are very different externally. And fish from different lakes, which at first glance look very similar, have more strongly deviating genetic sequences.

Hybrid forms and endemic species

Genetic exchange within a lake, but also between the large lakes, has led to the formation of hybrid forms. In very deep lakes, such as Lake Thun, Lake Lucerne and Lake Constance, this has favoured the emergence of unusual species that live and spawn at depths of over a hundred metres. Many of these species are endemic, i.e. they are found exclusively in the Swiss pre-alpine lakes.



When fluoride threatens to accumulate in groundwater

In the picture The map shows the probability of the fluoride concentration in groundwater being above the threshold limits set by the WHO. Virtually all of Africa and large parts of Asia have potentially hazardous fluoride exposure.

Eawag researchers have evaluated a huge global dataset of fluoride measurements in groundwater using an artificial intelligence-based model. They conclude: fluoride pollution endangers the health of around 180 million people, most of whom live in Africa and Asia.

As an additive in toothpaste, fluoride protects our teeth from decay. But ingested in larger quantities, it can cause bones and joints to degenerate. The risk is increased especially in hot and dry regions. There, more fluoride dissolves from the rock because the rocks weather faster due to the increased temperatures. And the fluoride remains in the groundwater for a long time because due to the infrequent rainfall, the groundwater is only renewed slowly.

To make matters worse, fluoride often goes undetected because it is odourless and invisible. Only water analyses provide information about excessive concentrations. But in many countries of the Global South, groundwater is hardly tested at all. "The risk areas are not known comprehensively, and there are many gaps," says Joel Podgorski. Together with Michael Berg, Head of the Water Resources and Drinking Water Department, he developed a model that evaluated 400,000 fluoride measurements in groundwater and calculated – based on topographical, geological and climatic factors – where in the world the threshold limits of 1.5 milligrams per litre will in all probability be exceeded. The work was supported by the Swiss Agency for Cooperation and Development (SDC).

Fluoride concentrations are too high in southern Africa, Central Asia, China and Mongolia, for example. This is relevant to health in that many people in these regions are not connected to a network where the drinking water comes out of a tap. Those who draw their water directly from a groundwater pump are exposed to increased fluoride contamination. According to the model, around 180 million people worldwide are affected.

Gapmaps
Interactive map

News in brief

Stephanie Merbt, Eawag

Nanoplastics in the aquatic food web. Plastic is chemically stable – and therefore more durable than many of us realise. Over time, it breaks down into smaller and smaller pieces, which in the end measure only a few nanometres. Because such nanoplastics can only be detected in the environment with great effort, the tiny plastic particles have remained largely unexplored until now. But now researchers at Eawag have shown in laboratory experiments for the first time: nanoplastics remain affixed to the biofilm (in the picture) that forms on stones in flowing water, for example, and thus affect freshwater snails that feed on this biofilm.

Verena Lubini

Unchanged biodiversity of aquatic insects. While the diversity of insects on land has sharply declined in recent years, Swiss watercourses still sheltered the same number of species of aquatic insects in 2019 as they did in 2010. This is shown by data from the biodiversity monitoring that WSL and Eawag have analysed. In bodies of water at medium altitude, the biodiversity of aquatic insects has even increased because heat-loving insects such as the mayfly *Baetis rhodani* (in the picture) spread further upstream in the watercourses – and join the species already present there without displacing them.

BGB
More about the project

Teaching

Eawag's teaching activities extend beyond the ETH Domain and are based on the institute's own research. They cover specialised fields, considering the effects of various types of water use on ecosystems. In addition to supervising undergraduates and doctoral students, Eawag scientists make a valuable contribution to practice-oriented training at higher education institutions. Eawag is also committed to providing continuing education for water professionals, as well as vocational education and training.

Photo opposite With 39 professors and lecturers and 5,700 teaching hours in the year 2022, Eawag was involved in academic education at the ETH Zurich, at the EPFL and at national and international universities.

Valentin Flauraud, Eawag / Keystone

In the picture Benoît Ferrari, Head of the Ecotox Centre, gave a presentation on sediment quality assessment.

Discussion of the new tools for lake research

Around 140 participants from public administration, private engineering firms and research took advantage of the Eawag Info Day in Lausanne to learn about and exchange information on new possibilities for collecting and using water data.

After a three-year break due to the pandemic, it was finally time again on 15 September for the Eawag Info Day 2022 on the topic "Dynamic Water Bodies: New tools, new opportunities". Experts and researchers were able to meet each other directly and cultivate the important exchange with practice – especially in French-speaking Switzerland. The Info Day was held for the second time at the Swiss Tech Convention Center on the EPFL Campus. A clearly visible sign of the "close and long-standing relationship between EPFL and Eawag", as both Prof. Martin Vetterli, President of EPFL, and also Prof. Claudia Binder, Dean of the University's Faculty of Architecture, Civil and Environmental Engineering emphasised in their welcoming address.

Measurements in high temporal resolution

Lausanne has a long tradition of monitoring surface waters. For it was here on Lake Geneva that François-Alphonse Forel founded the science of limnology 125 years ago. Since then. a lot has happened both scientifically and in the development of research methods. On the one hand, this involves measurements that take place in high temporal resolution – and depicts the dynamic events in great detail. For example, EPFL environmental scientist Prof. Tamar Kohn presented how she and her team are not only able to trace the course of the pandemic from wastewater samples, but also track the spread of different virus variants and estimate the reproduction number of the pathogen.

Dam burst at the diamond mine

In addition to these on-site and often continuously measured data, remote sensing also provides new possibilities for the collection of water body parameters. Daniel Odermatt, remote sensing expert and research group leader in the Surface Waters Department, reported on how his team used freely available satellite data to determine the extent of an environmental disaster that occurred in Angola in September 2021. Due to a

dam burst in the country's largest diamond mine, toxic metals entered the Kasai River. This led downstream in the Congo to several thousand people being poisoned and twelve dead. Odermatt's team determined the concentrations of suspended particles: it was 60 to 80 times higher than the national threshold limits. "Such concentrations are lethal to fish, regardless of composition," Odermatt said.

Complex and dynamic environmental systems

Other examples were also presented at the Info Day, such as how drone images or videos distributed via social media can be used for remote sensing. This wide variety of research methods serves a single purpose, said water physicist Damien Bouffard, research group leader in the Surface Waters Department and associate professor at the University of Lausanne. "We want to better understand water bodies as complex and dynamic environmental systems – and develop sustainable solutions to problems." Bouffard and his team have developed the "Datalakes" platform, which can host and bring together a wealth of data from a wide range of sources. The data is publicly accessible on the platform. The data can be combined, visualised and extracted in any way. But communication between all the parties involved is needed so that exactly the data is collected that is actually needed, and so that potential users are even aware of the existence of the data and can also interpret it. The lively exchange between representatives from research, practice and authorities at the Eawag Info Day made an important contribution to this.

Valentin Flauraud, Eawag / Keystone

In addition to the lecture programme, participants had the opportunity to experience some of the tools on site, for example, drones for monitoring rivers, presented by the University of Lausanne.

Valentin Flauraud, Eawag / Keystone

The Eawag Info Day 2022 provided an overview of recently developed methods for monitoring surface waters.

Alessandro Della Bella, Eawag

In the picture Simon Bloem (Eawag; on the right) and Michael Arnold (Water Protection Association of the Zug Region) carry out a comparative measurement with a newly developed conductivity sensor in the feed line of a rain overflow basin. Modern measurement networks in urban water management will also be the focus of a PEAK in-depth course in 2023.

PEAK
Course programme

Finally on-site training courses again

After pandemic-related cancellations and restrictions, most of the practice-oriented Eawag courses (PEAK) were able to take place again. Two courses took place online, another one was hybrid. “All nine courses were very well attended,” says Marianne Leuzinger, who is responsible for PEAK. The PEAK courses cover a wide variety of topics. In 2022, for example, they addressed methods for monitoring plankton diversity in water bodies or antibiotic resistance in the environment. The courses were in German, French or English and some were even bilingual. They serve to impart knowledge and at the same time are an important forum for dialogue between research and practice.

Our apprentices: tomorrow's skilled workers

Eawag has been involved in basic vocational training for many years. In 2022, eight young people successfully completed their apprenticeships and another nine began their training. In its programme for trainee laboratory technicians, Eawag collaborates closely with the external training partners Bachema, Biotronik, Coca-Cola, Niutec and the Veritas Laboratory. *Paula Heiss, a commercial apprentice in her 2nd apprenticeship year, wrote the following portraits.*

Peter Penicka, Eawag

Max Hofland, EFZ Laboratory Technician, specialising in biology, third-year trainee

"I looked for apprenticeships as a laboratory technician specialising in biology, was allowed to take a closer look at Eawag and was on Lake Greifen with a department," says Max Hofland. Because of the variety of work and the favourable first impressions, he then applied to Eawag. As a laboratory technician, he has to follow procedures and work precisely. Working in a team is also important. "At Eawag, I like the employees and the good atmosphere." That's why he would like to continue working at Eawag after his apprenticeship.

Peter Penicka, Eawag

Paula Heiss, EFZ Commercial Assistant, second-year trainee

Already in her first apprenticeship year, Paula Heiss gained many insights into Eawag. She likes the varied work and the changes between the different departments. "What I like about Eawag is that even as a trainee, I was allowed to do a lot of things right from the start. For example, participate at meetings, helping out on Info Day and conducting interviews. I am also happy with the working atmosphere," she explains. She has no plans for the future yet. The first thing to do is to complete her apprenticeship.

Peter Penicka, Eawag

Annina Gsell, EFZ Laboratory Technician, specialising in chemistry, third-year trainee

Annina Gsell analyses water samples in the AuA (training and analytics laboratory). "For the most part, we do photometry," she explains. What is important to her in her job? She says: "You have to do your work accurately and question it at the same time." She likes the variety at Eawag. "You are always getting to know new people, different analyses and companies. This is also the way to look for a path in the future." In the near future, she plans to complete the vocational baccalaureate and then perhaps study.

Peter Penicka, Eawag

Noel Läderach, EFZ ICT Specialist, first-year trainee

"It was through the career information morning that I first came into contact with Eawag," says Noel Läderach. He works for the support of various departments and sets up workstations. At a later stage, he will be responsible for certain departments. "Being friendly and understanding" is what he says you have to be as an ICT professional. He likes the work at Eawag. Among other things, the employees and the working atmosphere contribute to this. He doesn't have any plans for the future yet.

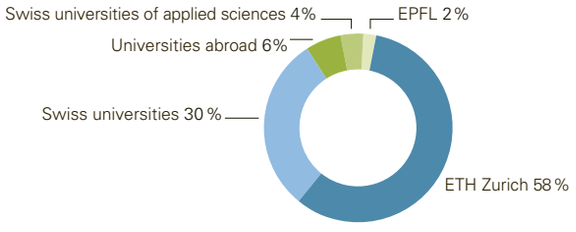
Master students at the cutting edge of research

Every year, around 180 bachelor and master students are supervised at Eawag. They often participate directly in research projects. This integration, the flat hierarchies and Eawag's interdisciplinary culture repeatedly lead to master theses receiving awards.

At Eawag, master theses are usually integrated into research projects. For the students, this has the advantage that they can work within a predefined framework and still have the flexibility to bring in their own perspectives. For example, the work of Frank (Zhao Rui) Zhang was awarded: under the supervision of Barbara Jožef and Kristin Schirmer, the environmental toxicologist from Canada contributed greatly to the development of a protocol for non-animal tests on chemicals. For this, he received the ETH Medal, which is awarded every year for outstanding master and doctoral theses. "I am glad that I met many great people at Eawag and was able to work together with them," says Frank Zhang. "I greatly appreciated working in a supportive environment where I was given a lot of freedom. So I could actually implement the ideas I had for the project." His two supervisors also look back very positively on their time together. "Working together with Frank was a real pleasure. He brought a lot of enthusiasm and dedication," says Barbara Jožef. The results of his master thesis not only brought light to some astonishing, observations of hitherto unknown processes in fish cells, but also "contributed significantly to advancing our current project with serum-free fish cell cultures", adds Schirmer, whose research group has for years repeatedly set new standards when it comes to alternatives to animal experiments in the field of environmental toxicity. After graduating, Frank Zhang returned to Canada. He is happy about the award, but for him the medal means something else: "It will always remind me of the wonderful times I had at Eawag." In order to pass on knowledge to students, Eawag holds various joint professorships with the ETH Zurich and EPFL, as well as with national and international universities.

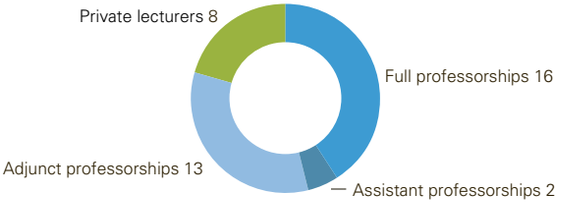
Tertiary-level teaching

5,697 h



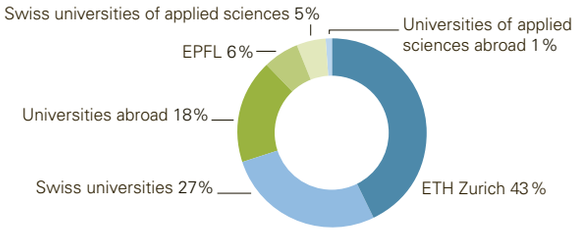
Professors and lecturers

39



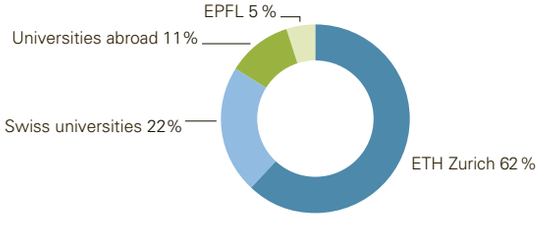
Bachelor and master theses supervised

188



Doctoral theses supervised

149



Alessandro Della Bella, Epwag

Consulting

Eawag scientists collaborate with water professionals on numerous projects and provide their technical input to a wide variety of national and international bodies. In addition, they serve on expert committees and take on consulting contracts. Eawag also operates various competence centres, which promote exchange between research disciplines and practice. Eawag disseminates the latest research findings in application-oriented publications, thus ensuring knowledge transfer to practitioners.

Photo opposite A new detection method makes it possible to detect new variants of the SARS-Cov-2 virus in wastewater at an early stage. Eawag research group leader Tim Julian (right) played a key role in this development, together with colleagues from various Swiss research institutions – including Prof. Niko Beerenwinkel (left) from the ETH Zurich. More about this on pages 32 and 33.

In the picture As part of the Blue-Green Biodiversity research initiative, blue and green biodiversity are being researched together.

New theory helps to protect ecosystems

Ecosystems sometimes react very differently to human influences. However, the causes for this are still poorly understood. A new integrative approach now shows how ecosystems on land and in the water can be better protected if fundamental ecological processes are taken into account.

Some ecosystems are very sensitive to climate warming, others are less affected. Where does this difference come from? This question was investigated by a group of scientists from the WSL and Eawag research institutes as part of the Blue-Green Biodiversity (BGB) research initiative. They have developed an integrative approach with which the different reactions can be explained. This theory links human impacts to four fundamental processes that shape species diversity at a site – species dispersal, species formation, species level selection and ecological drift – and analyses whether the relative importance of the processes differs in terrestrial and freshwater ecosystems

A path into the future

The research team hopes that the proposed approach will provide nature conservation practitioners and authorities with new instruments to protect biodiversity. Because if it is known which processes are most influential at a specific time, measures can be applied in a more targeted manner. This means: for example, if ecosystems are strongly affected by ecological drift, i.e. populations are declining rapidly, the primary objective could be to protect population sizes and conserve large-scale habitats. If human activities primarily limit species dispersal, measures should be taken to better connect the remaining habitats. And if warming is the main problem, the objective could be to create shady, cool habitats that provide refuge for animals and plants.

BGB
More about the project

Fritz Brugger

In the picture One of the local "citizen scientists" measures the pH value in a wastewater channel of a Zimbabwean mine.

Supporting the fight for clean water

Because environmental laws in many countries of the Global South are usually only implemented in a fragmented way, the impact of mining is often serious for both people and nature. For a study in Zimbabwe, Eawag researchers worked together with the local population to generate knowledge that is now being used locally as a weapon against water pollution from coal mines.

In Hwange in west Zimbabwe, coal mines have been discharging their acidic and metal-containing effluents into the Deka River for many years. In doing so, they endanger the health of the people who fish in the river or drink the river's water. The local population has complained several times about the pollution. However, they had no evidence in their hands and were rebuffed by the operators.

Active participation of the local residents

But in 2018, Eawag researchers teamed up with 13 women and men from four different villages on the riverbank to measure water quality in the river and mine drainage channels over a period of one and a half years. Researchers from Switzerland are usually only on site for a few weeks for measurement campaigns. "But this only gives us a very limited time frame", says geologist Désirée Ruppen from the Surface Waters Department. "The local residents therefore regularly took samples for us over a longer period of time, so that we could map the entire hydrological year with rainy and dry seasons and all its fluctuations."

Far too much manganese

The study was able to prove what had already been suspected due to the frequent dying of fish: the Deka River is heavily contaminated. Its water contains too much nickel and arsenic and far too much manganese. For the local population, this study is of great importance. Not only because of the local citizen scientists – the youngest is 16, the oldest is 70 – have contributed significantly to the study. But also because the local residents can now confront the responsible companies with the collected data.

More about the project
Watch the video

We found the Delta variant in wastewater 118 days before the first clinical detection.

Tim Julian joined Eawag in 2014 after completing his education at the University of Stanford in the USA and the John Hopkins Bloomberg School of Public Health in Baltimore. Here, he established a new research group in the Environmental Microbiology Department, which he has headed ever since. Julian's team is working on various human pathogens and has the objective of understanding the transmission of pathogens at the interface between humans and the environment.


Raoul Schaffner, Eawag

Many people who become infected with the SARS-CoV-2 virus also excrete genetic material of the pathogen during defecation. This material can be purified from wastewater samples and then examined. The approach has also proven successful in the early detection of new virus mutations, says Tim Julian, who developed an analytical method for new variants together with colleagues from various Swiss research institutions.

Together with your colleagues, you have shown that new variants of the Covid pathogen can be detected in wastewater even before they lead to an outbreak.
Yes, we detected the Alpha variant in our wastewater samples 13 days before the first cases. And we even found the Delta variant 118 days before the first clinical detection in Lausanne's wastewater. Omicron, on the other hand, appeared for the first time in wastewater from the city of Basel. Overall, these results mean that we have an effective wastewater monitoring system throughout Switzerland. I am therefore confident that new, as yet unknown variants will also be detectable in wastewater at an early stage. However: even though the analysis of wastewater is fast, unbiased and inexpensive, it can only support clinical monitoring, but by no means replace it.

What experiences have you had in cooperating with the authorities?
We had a good staring position in that we were already in regular contact with cantonal laboratories and federal offices before the pandemic. Our study is exemplary proof of the effectiveness of strong networks within the ETH Domain: networking enables fast and uncomplicated cooperation. And it also facilitates direct exchange with the authorities. Our results provided early indications of the emergence and increase of these variants in Switzerland – and met with great interest. But to what extent this has influenced politics I cannot say.

Are you personally worried that new variants of the SARS-CoV-2 virus will soon emerge that may cause more severe courses of the disease or be even more contagious than the previous ones?
We cannot rule out this possibility in the future. However, we know much more about the pathogens today than we did at the beginning of the pandemic. For example, we have learned a lot about how the coronavirus is transmitted – and how to reduce the risk of transmission. Today, we also know much better how to treat infections in hospitals. Furthermore, we now have effective vaccines. Nevertheless, I believe that we need to continue reliable monitoring in order to detect new variants and understand their characteristics as early as possible.

Wastewater monitoring
Current figures

Faeces as a valuable resource

In Uganda and Senegal, human faeces are used for fuel in brick kilns. During the decades of development of this technology, Eawag researchers have acquired knowledge that they now want to make usable in Switzerland. There are numerous ideas waiting to be explored. And just as many problems that still need to be solved.

Michael Vogel, Eawag

Linda Strande, Eawag

In the picture On the left: The beaker is used to investigate which flocculants are best for dewatering blackwater.
On the right: Optical sensor test for the determination of the amount of solid matter in blackwater samples.

Three billion people worldwide, mainly in low-income countries, have no connection to a sewage system. With studies and pilot tests in several African countries, researchers at Eawag have been developing technologies for the production of faecal fuels for decades, which are used, for example, to operate brick kilns in Uganda and Senegal.

Conversion into insect biomass

In Switzerland, considerations regarding the use of human faeces contained in the flushing water – known as blackwater – are even less concrete. The reason: 97 % of households are connected to a central wastewater treatment plant. But now researchers like Michael Vogel from the Department of "Sanitation, Water and Solid Waste for Development" want to make the knowledge they have acquired in Africa usable in Switzerland, too. There are numerous ideas waiting to be explored: our faeces could be used to produce protein-rich animal feed, because it is eaten by the black soldier fly larvae – and thus converted into insect biomass.

Moisture content of the faecal sludge

The use of faeces as fuel is also being discussed. However, there is a big problem here: the variability of blackwater. Every trip to the toilet provides different source material that needs to be dried. Vogel and his colleagues are therefore looking, among other things, into the question of both the type and quantities of flocculants required that are best suited to accelerate the dewatering of blackwater. The faecal sludge must be pressed into pellets, which must be further dried in an additional step before they become combustible.

However, there are still more than just technical problems to solve before wastewater can be used as a resource on a broad basis in Switzerland. So far, only the use of sewage sludge from wastewater treatment plants is regulated by law. It may not be spread on the fields as a fertiliser but must be dried and then incinerated in waste incineration plants or cement works. But Vogel believes in the future utilisation of blackwater: "Our job as researchers is to show industry that solutions are feasible and that there is a market for them."

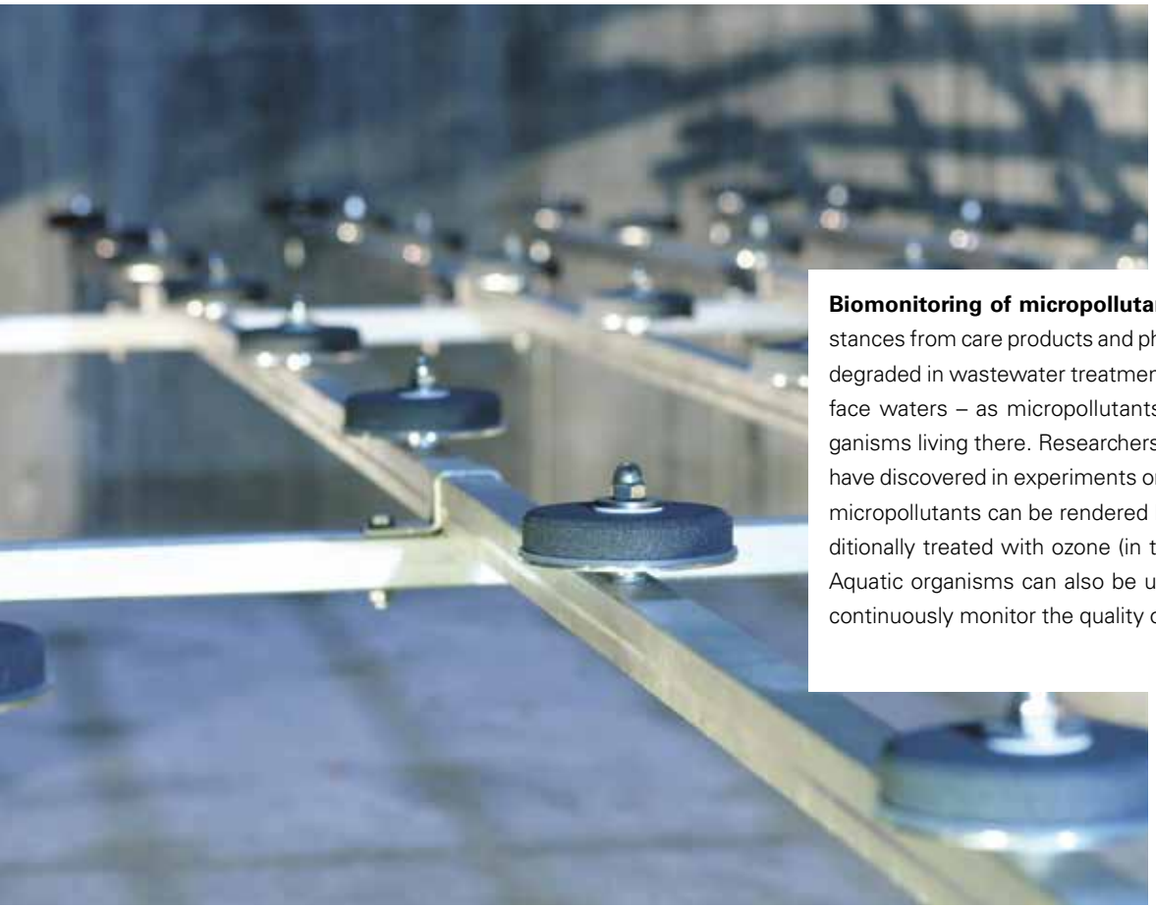
Research with faeces
Comic report

News in brief

Fridolin Haag (Eawag) und cottonbro

An app for making difficult decisions. In principle, the Value Decisions app developed at Eawag works like a cost-benefit analysis. However, it is not only a matter of keeping costs as low as possible, but also of achieving a wide range of often contradictory objectives. The app makes the results of the analysis visible. This shows at first glance which options are best for which players. The app has already proven itself in practice: in the canton of Solothurn, for example, it helped to compare the advantages and disadvantages of a conventional wastewater treatment plant with those of a decentralised wastewater infrastructure such as dry toilets.

Value Decisions
See the app



Aldo Todaro, Eawag

Biomonitoring of micropollutants in wastewater. Various substances from care products and pharmaceuticals are not completely degraded in wastewater treatment plants. They therefore enter surface waters – as micropollutants – where they can harm the organisms living there. Researchers at Eawag and the Ecotox Centre have discovered in experiments on green algae and water fleas that micropollutants can be rendered harmless if the wastewater is additionally treated with ozone (in the picture) and activated carbon. Aquatic organisms can also be used in biomonitoring systems to continuously monitor the quality of the treated wastewater.

Alessandro Della Bella, Eawag

Institution

Eawag is committed not only to excellence in research, teaching and consulting, but also to creating a motivating and supportive working environment. Contributing to this are the various support departments, which ensure smooth operations, as well as the outstanding infrastructure available at the two sites in Dübendorf and Kastanienbaum. Eawag attaches great importance to work-life balance, equal opportunities and respect.

Photo opposite Prof. Janet G. Hering has headed Eawag as director since 2007. She has left a lasting mark on the aquatic research institute. She retired at the end of 2022. In the interview on page 38, she explains what the “virtuous cycle” is, why she considers networking to be enormously important and what continues to challenge water research today.

The key point to keep in mind is that you are not alone.

Prof. Janet Hering was Director of Eawag and Full Professor of Environmental Biogeochemistry at ETH Zurich and of Environmental Chemistry at EPFL from 2007 to 2022. Janet Hering made a significant contribution to developing Eawag into a globally recognised research institute. In particular, she strengthened the scientific output of specialist publications and the mentoring of young researchers. She paid great attention to the exchange between science and the public and authorities. Janet Hering researches the treatment of contaminated water to produce drinking water, the biochemical behaviour of trace metals and the exchange of knowledge between research, society and politics. She received her PhD in oceanography from the Massachusetts Institute of Technology (MIT) in 1988 and was a professor of Environmental Science and Technology at the California Institute of Technology and the University of California from 1991 to 1996 and again from 1996.

Eawag

Prof. Janet Hering has headed Eawag as director since 2007. She has left a lasting mark on the aquatic research institute. She retired at the end of 2022. In this interview, she explains what the "virtuous cycle" is, why she considers networking to be enormously important and what continues to challenge water research today.

What has inspired you over the years and what makes Eawag special in your eyes?
I have always been very impressed by the extent to which Eawag's research and expert consulting has been put into practice to improve human welfare and protect the water environment. I have found this to be a strong motivation for us all at Eawag. Eawag profits from a "virtuous cycle" in which the excellent reputation attracts outstanding staff, who then contribute to Eawag's exceptional performance.

What were the most formative developments for you during your time at Eawag?
In my postdoctoral time at Eawag, I experienced the importance of building professional networks across the international scientific community. When I returned as director, I saw how effectively my predecessor, Alexander Zehnder, had continued this networking, increasing the focus on Europe. A strong national network emphasising inter- and transdisciplinary research with stakeholders was promoted by Ulrich Bundi, who served as interim director before my arrival. All these efforts illustrate the importance of Eawag's engagement in the international scientific community as well as with national stakeholders.

What were the most significant challenges for an aquatic research institute then? What are they today?
The overarching challenge remains the same – that is, to meet direct human needs for water while preserving the capacity of the water environment to provide ecosystem services. Within this overarching challenge, aspects may emerge as particularly salient over time. For example, the impacts of climate change on aquatic ecosystems and biodiversity in Switzerland are more obvious today. This has motivated research not only on the impacts of climate change but also on adaptation and mitigation. Even in 2007, the indirect carbon dioxide emissions of wastewater treatment plants, associated with energy consumption, were being addressed at Eawag through research on reducing the oxygen demand of nitrogen removal. Subsequently, nitrous oxide emissions have been identified as an important contributor to the greenhouse gas emissions of wastewater treatment plants. Eawag's research provides the basis to understand and reduce these emissions.

You were the first female director of Eawag. What advice do you have for women in research today?
The key point to keep in mind is that you are not alone. There are increasing numbers of women in research who can share their experiences and support each other. Working together to find collective solutions is, in my view, the path to sustainable success.

Awards

Otto-Jaag Water Protection Prize for Wenzel Gruber and Urs Schönenberger

The two environmental engineers Wenzel Gruber and Urs Schönenberger win this year's Otto-Jaag Water Protection Prize of the ETH Zurich for their dissertations. Gruber explored the question of how emissions of climate-changing nitrous oxide from wastewater treatment plants can be reduced, while Schönenberger showed how "short circuits", for example inlet shafts, in agricultural drainage systems lead to pesticides unintentionally entering water bodies.

Raoul Schaffner, Eawag

Wenzel Gruber and Urs Schönenberger

Peter Penicka, Eawag

Lenny Winkel

Lenny Winkel receives two awards from the European Association for Geochemistry (EAG)

The EAG awarded Prof. Lenny Winkel the "Science Innovation Award" for her contribution to the understanding of selenium occurrence in soils and arsenic occurrence in groundwater. In addition, the EAG also awarded the geochemist and research group leader the honorary title of "Geochemistry Fellow".

IWW Zentrum Wasser

Michel Riechmann (in the middle) accepts the Mülheim Water Award.

Award for the "Water Wall"

The "Water Wall", developed by Eawag researchers, recycles handwashing and toilet flushing water in a closed loop and can therefore also be used in regions with scarce water resources or those without water and wastewater networks. The project was awarded the Mülheim Water Award in 2022. This international water prize, which is awarded every two years in the German city of Mülheim an der Ruhr, rewards practice-oriented research and development projects as well as innovative concepts in the field of drinking water supply systems and water analysis.

Appointment as honorary members of the Swiss Water Pollution Control Association (VSA)
Prof. Janet Hering, Prof. Rik Eggen, Prof. Alfred Johny Wüest

Award as "Highly Cited Researcher" by Clarivate Analytics
Prof. Bernhard Truffer

Rifcon Early Career Scientist Award of the Society for Environmental Toxicology and Environmental Chemistry (SETAC)
Sarah Könemann

ETH Zurich medal for outstanding master thesis
Frank (Zhao Rui) Zhang

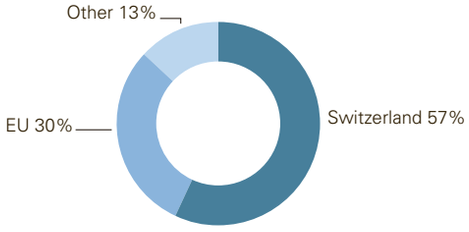
Headcount and personnel structure

As of 31 December 2022, Eawag's headcount (excluding interns, visiting academics and temporary staff) was 511 people (453 full-time equivalents/FTEs), distributed among the following functions: scientific, technical and administrative staff, and apprentices. Women account for 50% of the total (including apprentices). Eawag continues to provide training for 23 apprentices – chemical and biological laboratory technicians, business administrators and ICT specialists.

Eawag's international character as a world-leading aquatic research institute is reflected by the diverse origins of its employees, who come from 42 different countries.

Origin of employees

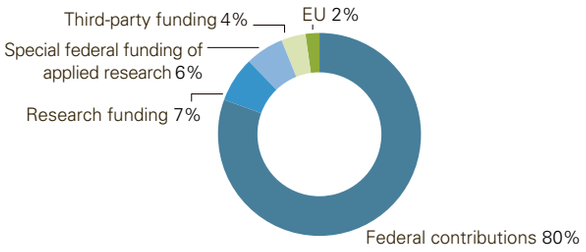
511



Financing for staff derives not only from federal contributions, but also from research funding obtained on a competitive basis. As of 31 December 2022, the financing of the FTEs (excluding apprentices) breaks down as follows:

Sources of funding for personnel (in CHF thousands)

56,288



Personnel policy and career development

Eawag is a socially responsible employer, deploying modern personnel policy instruments, which make it possible to maintain high levels of performance and motivation. In addition, Eawag promotes equal opportunities for men and women. For this purpose, it offers flexible working time models, integrated health management and training opportunities so as to ensure the retention of first-class employees, and to enhance employability, both in research and in the technical and administrative areas.

Internal training focuses in particular on the areas of management development, workplace health management and occupational safety. For many years, Eawag has also invested in language courses, reflecting the institute's international ethos. Training measures are reviewed and fine-tuned each year. Financial support is also provided for individual external courses, so that employees' qualifications are maintained at a high level.

For its 78 doctoral students, Eawag provides excellent infrastructure, specific training options and tailored information platforms. For scientists with fixed-term project appointments, Eawag organises career planning workshops and offers academic transition grants to develop their qualifications for the labour market.

The Eawag Partnership Programme for Developing Countries (EPP) offers students from these countries the opportunity to carry out research at Eawag, establish contacts and transfer the expertise acquired to their home countries. The Eawag Postdoctoral Fellowship for outstanding young scientists is also an established part of Eawag's efforts to foster talent and expand research networks.

Throughout the year, Eawag's Covid-19 Task Force monitored the situation, adapting the strategy and measures in a forward-looking manner.

Personnel news

Martin Ackermann elected to head Eawag and appointed as EPFL professor

At the end of June 2022, the Federal Council elected Martin Ackermann as the new director of Eawag to succeed Janet Hering. The 51-year-old biologist is Professor of Ecology of Microbial Systems at the ETH Zurich and heads a research group at Eawag. He will take up his new post on 1 January 2023. As part of his new position, Ackermann has also been appointed Professor of Microbial Systems Ecology at the EPFL. "Water is at the heart of many of the most important environmental issues of our time", says Ackermann. "That's why I'm exceptionally excited about the opportunity to work together with my colleagues on solutions for the sustainable use of water as a resource."

Alessandro Della Bella, Eawag

Martin Ackermann

Christoph Ort takes over the Urban Water Management Department

After almost 14 years in office, Prof. Max Maurer stepped down as head of department at the end of June 2022. He has passed on the baton to cultural engineer Christoph Ort, who has been heavily involved in tracking the Covid viral load in wastewater for the past two years. Ort has already made a name for himself by coordinating the measurement of drug residues in wastewater across Europe.

Esther Michel, Eawag

Christoph Ort

Manuel Fischer is new head of the Department of Environmental Social Sciences

Prof. Manuel Fischer, political scientist and head of the research group, took over from Bernhard Truffer at the beginning of July 2022. "I am very pleased to be able to take over a successful, varied and well-connected department," says Fischer. In his previous work, he looked closely at political networks. But with his new function, Fischer is now becoming a networker himself, because integrating the department into Eawag – as well as in the national and international research community – is an important concern for him.

Peter Penicka, Eawag

Manuel Fischer

Frederik Hammes leads the Environmental Microbiology Department

Frederik Hammes studied microbiology in South Africa, then did his doctorate in Belgium – and joined Eawag as a postdoctoral researcher in 2003, where he has headed the Drinking Water Microbiology research group since 2012. Since the beginning of 2022, Hammes has also been leading the department, which he has headed ad interim since March 2020. What Hammes particularly values at Eawag and wants to continue promoting, is the intensive cooperation with other experts. "Cooperation instead of competition, I think that's fantastic," says Hammes.

Peter Penicka, Eawag

Frederik Hammes

Nathalie Dubois appointed titular professor

The palaeolimnologist Nathalie Dubois has headed the Eawag sedimentology research group since 2013. With her team, she analyses the sediments in lakes layer by layer and thereby reconstructs past environmental conditions – with the objective of relating these to current and future climate changes. Dubois has also been giving internship lectures at ETH Zurich since 2014. From 2016 to 2021, Dubois received a professorship from the Swiss National Science Foundation This year, she was finally appointed titular professor by the ETH Board on 1 June 2022.

Peter Penicka, Eawag

Nathalie Dubois

Damien Bouffard becomes professor at the University of Lausanne

The University of Lausanne has appointed Damien Bouffard as associate professor ad personam. The specialist in aquatic physics has headed the Aquatic Physics research group since January 2017. He focuses on the characterisation of physical processes that determine transport and mixing in natural bodies of water. Together with his team, he combines a wide range of instruments for this purpose, from in-situ observations, such as on the LéXPLORE research platform floating on Lake Geneva, to various types of hydrodynamic models such as Meteolakes.

Raoul Schaffner, Eawag

Damien Bouffard

New head of the Fisheries Advisory Service

The office of the Fisheries Advisory Service has been headed by Andrin Krähenbühl since May 2022. The biologist studied at the University of Bern and specialised in aquatic ecology and evolution. Then he worked at Eawag on crustaceans, molluscs and insects in freshwater. In addition, he had been working at the Swiss Competence Centre for Fisheries (SKF) since 2021. Krähenbühl has been a passionate angler ever since he was a young child. He regularly visits a wide variety of watercourses and lakes in Switzerland, and his favourite way of getting around is by boat in the Three Lakes Region.

Raoul Schaffner, Eawag

Andrin Krähenbühl

Karin Ingold is president of Proclim

The political scientist Karin Ingold, professor at the University of Bern and research group leader at Eawag, has been chairing the Forum for Climate and Global Change of the Swiss Academy of Natural Sciences since 2022. "I am looking forward to continuing the dialogue between science, society and politics," says Ingold. In Switzerland's political system, it is difficult to bring about rapid change. On the other hand: "With our experience in participatory processes and dialogues across many levels, we have, however, excellent instruments to strengthen exchange."

Raoul Schaffner, Eawag

Karin Ingold

Broad dialogue

Eawag points out the importance of groundwater

World Water Day, which the United Nations holds once a year, is an annual reminder of the special nature of water as the most essential resource of all life. In 2022, the guiding principle was "Our groundwater, the invisible treasure". A fitting motto, because large parts of society are not aware of how important a resource groundwater is. "It supplies most of our drinking water," says hydrologist Christian Moeck in the World Water Day interview, which can be found on the Eawag website.

> Interview: Read now
eawag.ch/worldwaterday

Pavel Klimenko, iStock

Our groundwater: the invisible treasure

Research insights as part of the WEF

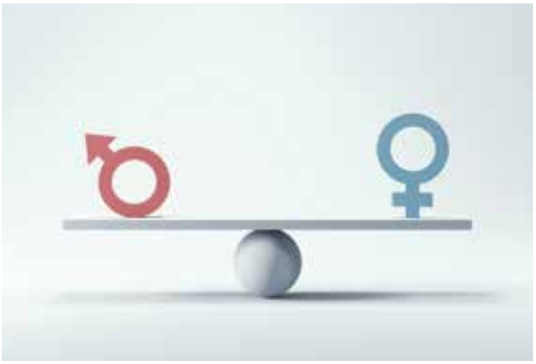
"Innovations from the ETH Domain: Insights into research in the service of Switzerland": This is how the universities and research institutes of the ETH Domain presented themselves to Federal Councillor Guy Parmelin and around sixty other guests from politics, research and business at the World Economic Forum. For Eawag, Christine Weber took the audience on a journey through time: she explained that watercourses are among the most severely impacted habitats. And she showed how Eawag supports the revitalisation efforts of the federal government and the cantons with applied research projects.

Luzia Schär

Christine Weber undertook a journey through time

Audited wage equality

The ETH Board had an extended audit carried out and used a legally recognised method to check whether women and men receive the same pay for the same work at the six institutions of the ETH Domain. The analysis came to the conclusion in the affirmative. It has only identified small wage differences of a maximum of 2 %, which are significantly below the 5 % tolerance threshold defined by the federal government. In contrast to all other five institutions of the ETH Domain, women at Eawag even earn 1.4 % more than men.



oatawa, iStock

Equal pay for women and men at Eawag

Greater sustainability at Eawag

Dominik Scheibler has been Eawag's environmental officer since the beginning of 2021. In this function, he is committed to sustainability and also conducts performance reviews. Scheibler is supported in his work by the Ecology Team at Eawag. In terms of power supply, Eawag is already in a pretty good position: it only draws on renewable green electricity and also produces electricity from its own photovoltaic installations. "This proportion is only around five per cent at the moment, but it is to be further expanded in the future," says Scheibler in an interview published on the Eawag website on the occasion of the Environment Day.

> Interview: Read now
eawag.ch/energy

Peter Penicka, Eawag

In the interview: Dominik Scheibler

Advocating respectful behaviour

With the respect campaign, Eawag has made its employees aware that respectful behaviour promotes cooperation. In addition to posters and flyers, three short videos also showed in a playful way that you can do something if you come across sexist or racist acts in your everyday working life, for example. At the closing event at the end of September, a performance was given by an improvisation theatre group. "We wanted to make people think and trigger discussions," says campaign manager Annette Ryser. "I think we succeeded in that."

Katja Schubert, Eawag

Respect campaign: encouraging employee reflection

Water research on the boat trip on Lake Greifen

An interested public was able to experience how researchers at Eawag monitor the lake on an evening boat trip in summer and another trip in autumn on Lake Greifen. For example, with an automatic underwater camera whose images allow conclusions to be drawn about impending potentially toxic algal blooms. Later, the participants also took a look underground. Sediment cores are the history books of our environment, other researchers explained. They depicted both the great flood of 1813 and the over-fertilisation that began in the 1930s.

Claudia Carle, Eawag

Eawag researchers explain why they study plankton.

Women and girls in science

With the International Day of Women and Girls in Science, the UNO wants to promote careers of female researchers – and introduce young generations to female role models in the field of science. That is why Eawag published a short video on 11 February 2022 in which female scientists tell what motivates them. "I became a researcher because it allows me to pursue my curiosity," says PhD student Marie-Sophie Maier. She and many other women at Eawag have access to numerous further education opportunities as well as networking and mentoring activities.

> Women at Eawag: Watch the video
eawag.ch/women

Eawag

Women scientists tell us what motivates them.

Well-attended exhibition in Gersau

The small cargo ships on Lake Lucerne are called "Nauen". 13 such ships could be seen at the Nauen meeting at the beginning of July. This attracted a large number of visitors, who were able to learn about Eawag's research in an exhibition on the Naue "Unterwalden". Young and old learned about previous tsunamis on Lake Lucerne. The visitors were able to explore the amazing diversity of plankton and algae under the microscope. And marvel at how fish migration can be tracked with microchips.

Helmut Bürgmann, Eawag

Numerous visitors learned about Eawag's research on the Naue "Unterwalden".

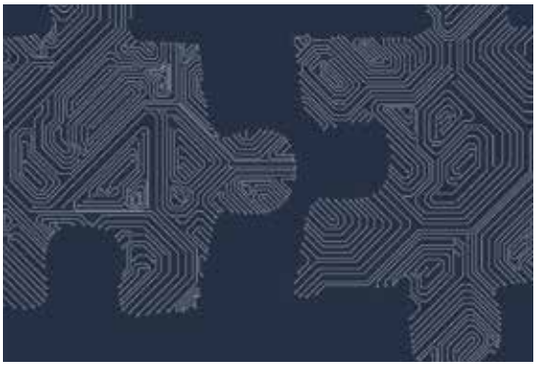
Joint initiatives within the ETH Domain

With a total of 37 million Swiss francs, the ETH Board is supporting ten initiatives to strengthen cooperation and teamwork within the ETH Domain. The focus is on the strategic research priorities of "Energy, Climate and Ecological Sustainability", as well as "Involvement and Dialogue with Society".

Eawag is involved in seven of these ten initiatives, such as the "Speed2Zero" initiative, which is about developing tools, action plans and technologies to enable a sustainable transformation to a greenhouse gas-free and biodiversity-friendly Switzerland. Eawag is also involved in the "Translational Centre for Biodiversity", whose objective is to provide stakeholders and researchers with the relevant information and knowledge they need to solve urgent environmental problems.

In the "Engage" project, whose objective is to establish a national dialogue platform, Eawag is in charge with Christian Stamm. Players from both science and society are to be involved here. Questions such as the spread of the coronavirus or pesticides in groundwater show that the idea of "science provides the data, politics decides" falls short – the problems are too complex. What is needed is an improved dialogue between science, society and politics.

GuirongHao, iStock



The ETH Board supports ten initiatives for increased cooperation and teamwork.

Equal opportunities

The Equal Opportunities Committee (EOC) consists of representatives of all employee groups and is committed to ensuring equal opportunities at Eawag and in the ETH Domain. In addition to its long-standing involvement in the ETH Domain's "Fix the leaky pipeline" programme, Eawag also participated in the next round of the "CONNECT" programme in 2022, which networks female academics with the private sector. The EOC also continued work on the Gender Strategy in the ETH Domain 2021 – 2024.

Together with the EOC and Melina Spycher, expert for diversity and inclusion, Eawag refined gender-appropriate communication. Terms in job publications and addressing in recruitment procedures were elaborated further. Eawag focuses specifically on gender-neutral employment in recruitment and relies on a proven gender balance in management positions, which has been demonstrated both in recruitment and in internal changes and promotions. Offers such as working from home, flexible working hours and part-time work have been further extended and help to reconcile family life and career.

Eawag again conducted a respect campaign in which employees participated in seminars and improvised theatre on topics such as hierarchy or microaggression in racism. Targeted creative initiatives with video messages and posters raised and consolidated awareness of the issues of diversity and inclusion.

Reconciling family life and work remains an essential issue. The Tailwind programme makes financial resources available to mothers to ease their burden during the first months of motherhood. Female scientists on the tenure track receive an automatic extension of their appointment when they start a family. Fathers can apply for a temporary reduction in their employment level. In addition to its continued commitment to crèche solutions, Eawag also supports lower-income parents by contributing to the cost of childcare.

At 36 per cent, the proportion of women in management positions at Eawag is once again at a high level.

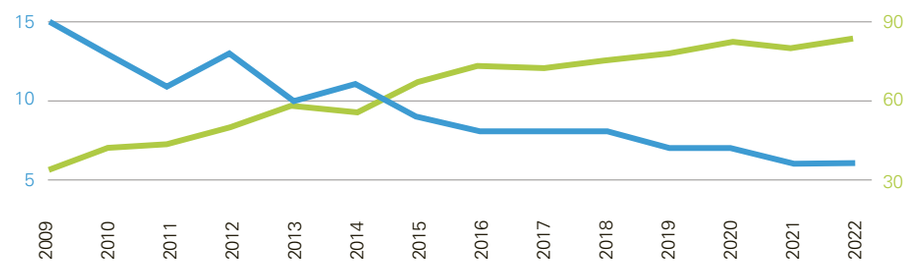
Environment

Due to the coronavirus crisis, it was difficult to estimate how Eawag's energy balance had developed in 2020 and 2021. Now it is clear that we have been able to improve. The total primary energy used in the building sector in 2022 was again at about the same level as in 2006 (approximately 3,600 MWh) – although the number of employees increased and the energy reference area grew from about 28,000 to 34,345 m^2. The CO_2 emissions fell from 1,640 to 256 tCO_2e in the same period. Net zero has not yet been achieved and more efforts are required to reach this objective. Likewise, the positive figures should not hide the fact that mobility (especially flying), procurement and catering cause considerable CO_2 emissions, which have only been partially recorded so far. Another piece of the puzzle towards low CO_2 mobility was laid in 2022 with the introduction of a PubliBike station on the Dübendorf campus.

Energy consumption per capita

Energy consumption
MWh/FTE

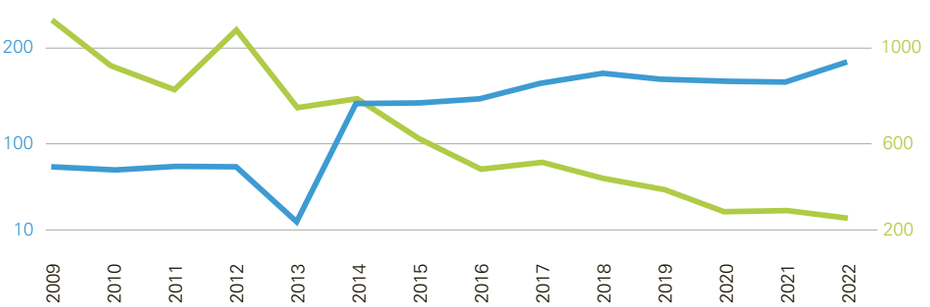
Renewable energy share
in per cent



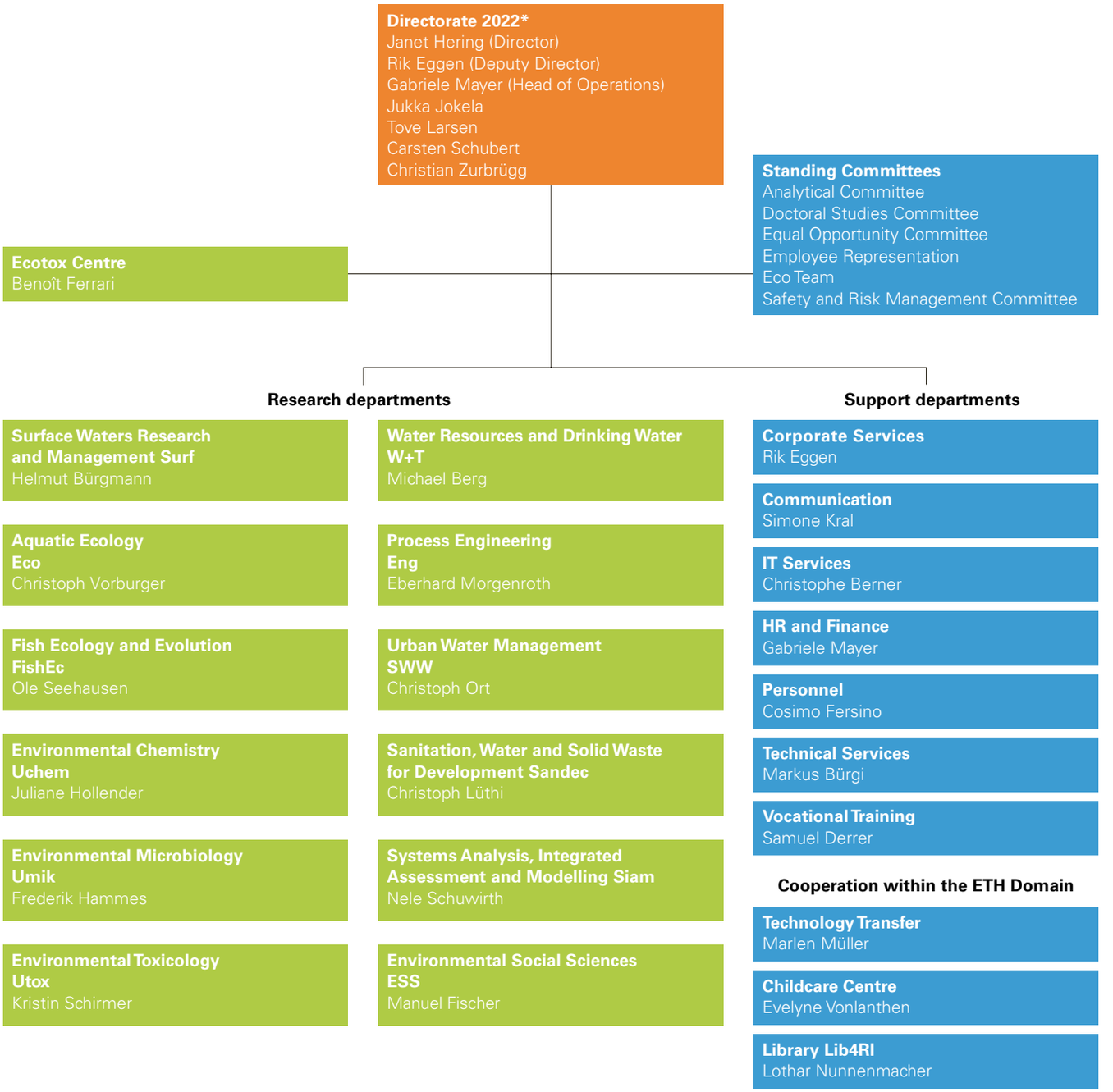
Electricity generation and greenhouse gas emissions

Solar power
MWh

Greenhouse gas emissions
in tCO_2e



Organisation



***New in the Directorate since 2023**

- Prof. Martin Ackermann, Director (since January)
- Dr. Christian Stamm, Deputy Director (since March)
- Prof. Florian Altermatt (since March)
- Prof. Lenny Winkel (since March)

As of 31 December 2022

Directorate 2022*

Janet Hering Director
Janet Hering, a chemist, is an expert in processes for the treatment of contaminated water and in the biogeochemical behaviour of trace metals. She is Professor of Environmental Biogeochemistry at ETH Zurich and Professor of Environmental Chemistry at EPFL. She is also a member of various national and international bodies. In 2015, she was inducted into the US National Academy of Engineering.

Rik Eggen Deputy Director
Rik Eggen, a biologist, is particularly interested in the effects of aquatic chemical pollution on environmental and human health, the underlying mechanisms and the development of mitigation strategies. He is Adjunct Professor of Environmental Toxicology at ETH Zurich.

Gabriele Mayer Head of Operations
Gabriele Mayer, a business manager, has considerable experience in the fields of internal control systems and international accounting. She has held executive positions with US and Swiss corporations. At Eawag, she is responsible for the support departments and cross-institutional infrastructure. This includes the operation and further development of the SAP system used by the four research institutes within the ETH Domain, as well as projects such as the changeover to International Public Sector Accounting Standards (IPSASs).

Jukka Jokela Group Leader Eco
Jukka Jokela is an internationally renowned expert on the evolution of aquatic organisms and on coevolutionary host-parasite interactions. In his applied research, he develops management methods to control the spread of invasive species and pathogens. He is Professor of Aquatic Ecology at ETH Zurich and a member of the Directorate and the Advisory Board of the ETH Zurich Genetic Diversity Centre.

Tove Larsen Group Leader SWW
Tove Larsen, a chemical engineer, works on sustainable urban water management. Her research focuses on technologies for source separation and on-site wastewater treatment. For example, she led the award-winning Blue Diversion project (development of a grid-free urine-diverting toilet). She is Adjunct Professor at the Technical University of Denmark and a member of the Advisory Boards of the FHNW School of Life Sciences and the ZHAW School of Life Sciences and Facility Management.

Carsten Schubert Group Leader Surf
Carsten Schubert, a geologist, conducts research on organic geochemistry and isotope geochemistry in lakes and marine systems. He is particularly interested in the global methane cycle, methane formation in relation to the origin of the organic material and methane oxidation processes. As a member of the Directorate, he represents Eawag's Kastanienbaum site. In addition, he has been a lecturer at ETH Zurich since 2004 and Adjunct Professor since 2019.

Christian Zurbrügg Group Leader Sandec
Christian Zurbrügg, an expert in water supplies, sanitation and waste management, studies concepts and technologies for upgrading infrastructure and services in urban areas of low- and middle-income countries. He has led several international programmes and projects in this field. Christian Zurbrügg teaches at ETH Zurich and EPFL and is an Adjunct Professor at the Swedish University of Agricultural Sciences.

Risk management at Eawag

Background

Requirements for the management of risks are specified in the ETH Board's directives of 4 July 2006 (revised version: 16 May 2018) on risk management at ETH and its research institutes. These directives regulate the essential aspects of risk management and define the goals of the risk policy pursued by the ETH Board. They regulate in particular:

- the goals of risk policy and responsibilities
- risk identification
- risk assessment
- risk minimisation and financing
- risk controlling

The goal of Eawag's risk policy is, in a prudent and timely manner, to identify, assess and draw attention to any material risks threatening Eawag's operations and activities, and to take appropriate measures – adapted to the institute's cultural diversity and organisation – to absorb or mitigate such risks.

Responsibility and risk management processes

In accordance with the autonomy granted to ETH's six institutions under the Federal Act on the Federal Institutes of Technology, which is fundamental to their work in the fields of teaching, research and knowledge/technology transfer, each institution is responsible for managing the risks existing in its own sphere of operations. The presidents of the Federal Institutes of Technology and the directors of the research institutes thus have overall responsibility for risk management within their respective institutions.

The two Federal Institutes of Technology and the four research institutes have each introduced their own risk management processes, based on the requirements specified by the ETH Board. These include the identification and assessment of individual risks, risk minimisation strategies and risk controlling. Eawag has a risk manager, who coordinates and controls the risk management processes. The risk manager is supported by the other individuals responsible within Eawag's risk organisation. The implementation of risk management is periodically reviewed by the Directorate and by the ETH Board's internal audit, which reports to the ETH Board's Audit Committee.

Risk situation

Risks

Eawag's individual profile is reflected in its risk catalogue; its core risks and the assessment thereof are influenced by the fact that Eawag is relatively small compared to the other institutions within the ETH Domain.

The risks identified, and the potential consequences thereof, are described in detail in the risk catalogue and assessed in terms of likelihood of occurrence and financial impact. In addition, particular attention is paid to the potential impact of risks on Eawag's reputation.

Eawag updates its risk catalogue at least once a year, taking account of new developments and changes in the risk situation. The catalogue comprises the following risk categories:

- financial and economic risks
- legal risks
- property, infrastructure and natural hazard risks
- personnel and organisational risks
- technological and scientific risks
- social and political risks
- environmental and ecological risks
- specific real estate risks

Classified as core risks are those with a potentially high financial impact and an above-average likelihood of occurrence, which may pose a direct threat to the fulfilment of the institute's legal duties. The risk organisation (internal risk committee) meets at least once a year to discuss the risk situation at Eawag and, under the leadership of the risk manager, prepares a risk report. In 2022, as in previous years, the risk report was submitted to the Eawag Directorate for consideration and approval. As part of its annual reporting, Eawag informs those responsible within the ETH Board as to its core risks, and in particular the current extent and potential impacts thereof. In the event of any exceptional changes to the risk profile or exceptional loss events, the ETH Board, as the supervisory body of the ETH Domain, is directly informed in a timely manner.

Eawag's core risks have been identified in the following areas:

- quality of teaching, research and services
- scientific misconduct
- damage to or loss of test systems/samples
- accidents suffered by employees or visitors
- IT risks (data loss, unauthorised access, etc.)

Risk management instruments and measures
As a fundamental element of risk management, subsidiary to other measures, Eawag is required to obtain insurance covering possible losses, with the institute's individual risk situation being taken into account.
With regard to insurance policies, an appropriate cost-benefit ratio must be aimed for and the relevant provisions concerning federal public procurement must be complied with. These policies must meet the usual standards of the Swiss insurance market and must be issued by an insurance company licensed in Switzerland.

Eawag is responsible for taking out its own insurance policies and managing its own insurance portfolio. In its directives, the ETH Board merely specifies that, in addition to the insurance required by law, the two Federal Institutes of Technology and the four research institutes must obtain basic coverage by taking out the following types of insurance:

- property and business interruption insurance
- general liability insurance
- insurance policies required to provide the broadest possible coverage of core risks

It should, however, be borne in mind that not all core risks can be insured, or that such insurance may not be affordable. Eawag has taken out property and liability insurance policies covering losses or damage. Eawag also has smaller policies covering specific business risks, as required by the directives.

Disclosure of risks

In the preparation of the annual accounts, it is ensured that risks are fully recognised within the existing reporting. Based on the estimation of the likelihood of occurrence, risks are reported either under "Provisions" (more than 50-per-cent likelihood of occurrence) or in the Notes under "Contingent liabilities."

Internal control system

In accordance with the requirements specified by the ETH Board, Eawag operates an internal control system (ICS) that promptly identifies and assesses the relevant financial processes and risks related to bookkeeping and the rendering of accounts and incorporates appropriate key controls to cover those processes and risks. The ICS encompasses those procedures and measures that ensure proper bookkeeping and rendering of accounts and accordingly form the basis of all financial reporting. It thereby ensures that financial reporting is of a high quality. Eawag sees the ICS as an activity aimed at the continuous improvement of processes.

Annual financial statements
View online

Eawag
Überlandstrasse 133
8600 Dübendorf
+41 58 765 55 11
info@eawag.ch
eawag.ch

Alessandro Della Bella, Eawag

Science that matters