IGB

Leibniz-Institute of
Freshwater Ecology
and Inland Fisheries

Freshwater Research 2016

IGB Annual Report

Environmental Change
Who is benefitting from climate change? How lakes are changing.

Use & Management
Bringing nature into cities: How much is feasible and fair?

Behavioural Ecology
Do fish have a personality? What to learn from mollies.

Angling

Aquaculture & Aquaponics

Biodiversity

Dialogue & Transfer

Freshwater Ecosystems

Use & Management

Multiple Stressors & Pollutants

Environmental Change

Behavioural Ecology & Swarm Intelligence

Water & Matter Cycles

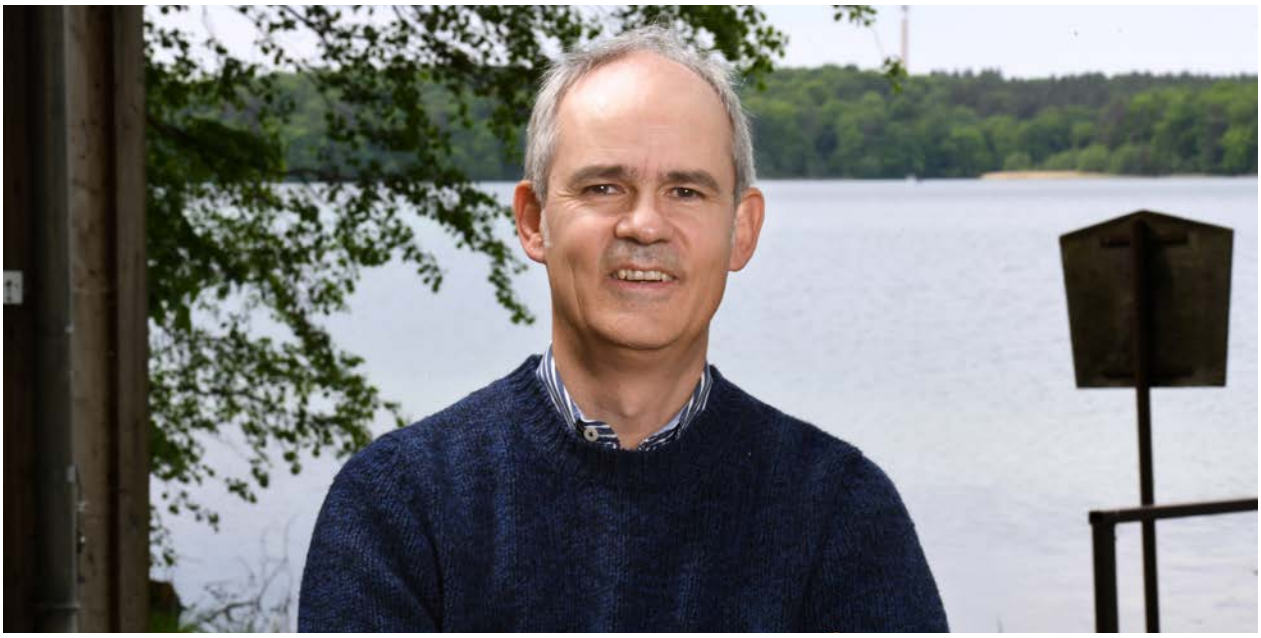
Research for the Future of our Freshwaters

IGB is Germany's largest research centre for freshwaters. At IGB, scientists from a whole range of disciplines work under one roof. They are working together to investigate the fundamental processes governing rivers, lakes and wetlands, and join forces to develop measures conductive to sustainable water management.

On the following pages we present selected research results, projects and events from 2016. The content is categorised in ten topics in which we bundle the results of our research work that could be of interest to you. For each topic, you will find further information, materials, experts as well as background information and current news on our website.

www.igb-berlin.de

A Changing World



"IGB is deeply committed to the basic principle of valuing established facts over opinions and carefully weighed rational considerations over gut instinct and ill-founded views."

Dear Reader,

'Post-truth' is the Word of the Year 2016, a term that gives the chills not only to the scientific community. The pseudo-reality experienced last year for the first time so directly in our immediate political environment not only undermines the very foundations of science. It also erodes our democratic society, whose functioning relies on public discourse. An essential ingredient of this discourse is that society accepts the value of scientific insights derived from documented facts. Acceptance of evidence is a major virtue and a crucial prerequisite to ensuring that balancing the pros and cons of options for action leads to rational decisions in the political arena. IGB is deeply committed to the basic principle of valuing established facts over opinion and carefully weighed rational considerations over gut instinct and ill-founded views. As a research institute of the Leibniz Association, IGB's remit is not only to generate and communicate knowledge for its peers, but also to share new findings with the general public. This task is taken very seriously at IGB.

In 2016, a range of new instruments were established at the institute to promote the exchange of knowledge with political and other stakeholders as well as the public at large. The IGB Outlines series seeks to contribute to laying the foundation needed for any sensible political and social debate of new or controversial issues. There are three types of Outlines: IGB Fact Sheets, IGB Dossiers and IGB Policy Briefs. These instruments are presented on page 33 of this Annual Report. The first IGB Dossier addresses the problem of sulphate contamination of the River Spree. It met with an overwhelming response that far exceeded our expectations. This is encouraging, particularly in the post-truth year 2016, because it shows that the public has a keen interest in receiving reliable information on environmental issues.

In addition to the IGB Outlines and the newly designed IGB website (www.igb-berlin.de), the IGB Academy was launched in 2016 – a new series of events on practice-oriented topics directed at water experts. 'Aquaponics for Practitioners' was the title of the first Academy in 2016 (page 32), an important subject in the sustainability debate that has been investigated at IGB for many years. We also continued working with established formats such as the Müggelsee Dialogue, which took place in October and was dedicated to fish stocking. As shown on page 32, this controversial topic resonates with anglers and

Photo: David Ausserhofer

nature conservationists alike. I consider it a great success that the Müggelsee Dialogue has been instrumental in making the debate of divergent positions objective.

Fish and fish management are key research topics at IGB, as illustrated, for instance, by the articles presented on pages 10, 14 and 25. As much as 40 per cent of all fish species worldwide are dependent on freshwaters, even though freshwater ecosystems cover less than 1 per cent of the earth's surface. But it is not only fishes that contribute to the remarkable biodiversity of inland waters. Consequently, freshwater science is expected to assume responsibility to explore freshwater biodiversity in its whole breadth and to develop effective concepts for preserving it in a world of rapid change. A prime example of IGB's biodiversity research is the large collaborative research project Bridging in Biodiversity Science (BIBS), which was launched in 2016 within the virtual Berlin-Brandenburg Institute of Advanced Biodiversity Research (BBIB), where IGB seeks to understand the ecological dynamics of coupled aquatic and terrestrial ecosystems. Similar issues are also addressed by a newly established European doctoral training network, MANTEL (page 16), and the Berlin Center for Genomics in Biodiversity Research (page 30).

The impact of global environmental change on rivers and lakes is another research focus at IGB. For instance, we explore how water bodies respond to environmental changes such as rising temperatures, elevated concentrations of nutrients and the increased supply of humic substances to surface waters. For example, a global synthesis led by IGB and published in 2016 shows that, contrary to commonly held views, there are no reliable early warning signals to predict abrupt shifts of lakes from one state to another (page 28). This makes it impossible to anticipate such regime shifts and take targeted countermeasures early enough to avoid them. Other current topics explored at IGB relate to questions such as how invasive species affect aquatic ecosystems (page 21) and what consequences of microplastic pollution in freshwaters are to be expected (page 24). The departure of Klement Tockner, director of the institute since 2007, marked a turning point at IGB in September 2016, when he took on a new challenge as President of the Austrian Science Fund (FWF), Austria's national research foundation. During the years under his direction, the Institute has flourished, resulting in strengthened governance structures and greatly increased visibility in both the international scientific community and the broader public in Germany. Klement Tockner was strongly committed to pursuing these objectives – relying on his rich imagination and tenacity, a solid knowledge of the national and international research environment, and his trust in the IGB staff. I am convinced that the foundations he has laid are sufficiently robust to carry IGB into the future, not only during the current transition phase but also under the leadership of the new director, who we currently seek to appoint.

'Future' is also the keyword when it comes to young researchers, for which IGB is dedicated to provide crucial support. Education and training are offered in structured programmes within several research training groups (UWI, Interfaces, SMART, HypoTRAIN and MANTEL) as well as in IGB's specific doctoral programme. In 2016, more doctoral students than ever before in the history of IGB successfully completed their dissertations. In addition, various prizes and awards were conferred on young IGB researchers last year in recognition of their ideas and work (page 48). I would like to highlight particularly the European Research Council (ERC) Starting Grant awarded to Gabriel Singer in 2016 to examine mechanisms controlling carbon fluxes in fluvial networks (page 50). These achievements and recognitions demonstrate that the range of issues related to freshwater ecology and inland fisheries will continue to be represented in the future by competent, creative researchers.

Last but not least I would like to take the opportunity to thank IGB's national and international partners, notably the universities in Berlin and Brandenburg, for our close and confidential collaboration. I am also grateful to our Scientific Advisory Board, which has a key role to play especially during the current transition phase, the Forschungsverbund Berlin (FVB) and the Leibniz Association, the Senate of Berlin and the German Federal Ministry of Education and Research (BMBF). I cannot overstate the importance of the trust and goodwill that I was fortunate to experience over the last few months. Without this intellectual and administrative support as well as solid base funding, IGB as a central institute of freshwater ecology in Germany would be unable to conduct its forward-looking research to the same extent and especially at the same high quality. This potential can only be unleashed thanks to our committed staff members. Therefore, I would like to express my great appreciation and gratitude to my colleagues at IGB and FVB who have devoted their motivation and efforts to freshwater science.

I am delighted to present on the following pages the IGB Annual Report 2016. It provides insights into the wide range of developments and activities at the institute last year. Your interest in the report testifies to the continued demand for scientifically sound information on inland waters and their biodiversity, even in today's post-truth era. This encourages us at IGB to continue embracing our mission: Research for the future of our freshwaters.

Yours sincerely,

Mark Gessner
Acting Director

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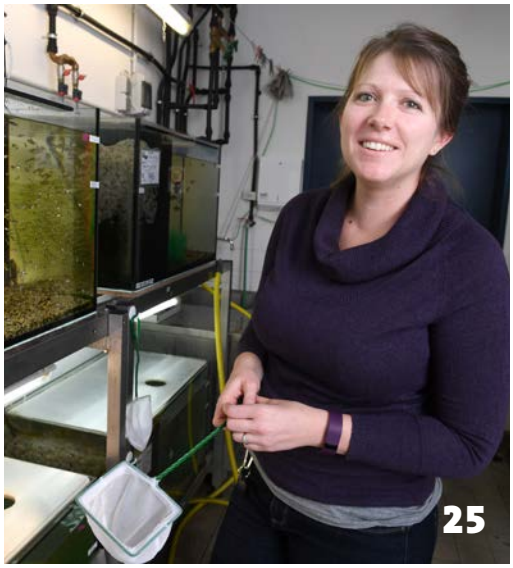

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New Projects and Initiatives

“Berlin’s Citizens Want More from their Urban Waters than Foul Water in Clogged Canals”

The interdisciplinary “Ecological Potential of Urban Waters” research network, which is being funded for three years by Berlin Senate Department for Economics, Technology and Research, was launched at the end of 2016. The objective is to bring together national and international stakeholders involved in measures for revitalising urban waters. The network, initiated by IGB and currently including 15 members, is in the process of identifying research issues and funding opportunities for improving waters in urban spaces. Jörg Freyhof, Network Coordinator, talks about the opportunities and stumbling blocks involved in improving the waters of Berlin.

The declared goal of the new research network is to improve lakes and canals in urban spaces. Why have urban waters hit the agenda of biologists?

Jörg Freyhof: Urban waters are usually heavily modified waters that, according to the specifications of the European Water Framework Directive, are to achieve “good ecological potential”. This means an improvement of the waters without impairing their use by humans. However, the Water Framework Directive is being implemented very slowly, and questions of social justice have been neglected. We seek to involve citizens in the improvement of water bodies. We want more nature in the city and to take into account people’s wishes, which is why we seek ways in which the Water Framework Directive can help improve citizens’ quality of life. In cities, water bodies are particularly important as recreation areas – and yet only a certain section of the population

Photo: David Ausserhofer

is able to benefit from them. Many people living in socially disadvantaged areas have no access to water bodies in the vicinity. For this reason, the aspect of environmental justice plays an important role in the network's work.

What is the situation of Berlin's waters?

All of the city's water bodies have been heavily modified by anthropogenic influences. Most of the stakeholders concerned with water in Berlin concentrate on the quality of water. There is indeed a lot of work to be done in that area, and a lot of money is being invested accordingly. For example, the rainwater and wastewater systems within Berlin's S-Bahn ring converge with each other, and the system then overflows following heavy rainfall, meaning that faeces are discharged into water bodies untreated. This happens around 30 times a year. Now, however, millions are being invested in the construction of new underground storage facilities, which will considerably reduce the amount of spillage and improve the water quality. Major achievements are being accomplished in this area, and improved water quality is an important interim goal to make a city such as Berlin viable for the future. However, it also goes without saying that we do not want a city with great water quality, but where it is virtually impossible to get to the water because everything is built up and out of bounds. We want more nature in Berlin, so that one day people can swim in the River Spree again – at cool spots and in an urban setting.

That's the aim of your partner, Flussbad Berlin, which wants to create bathing opportunities on the Spree at the Kupfergraben. Is it a realistic goal?

Absolutely! Berlin's style is to take up new and innovative ideas and to present itself as a functional city. Which is why the river swimming project has been included in the new coalition agreement. It will become a test case for whether we are capable of overcoming administrative obstacles for the benefit of citizens. Nowadays, swimming is prohibited in most federal waterways; this is the case with the Spree and all of Berlin's canals. However, the "Blue Ribbon Germany" (Blaues Band Deutschland) programme, a joint initiative of the federal ministries of transport and environment, is intended to develop subsidiary waterways in environmental terms as well as improving them for leisure and recreation. This is a great opportunity for many of Berlin's water bodies.

What other aspects are currently being addressed?

There are, of course, many areas that call for freshwater research. For example, the state of small water bodies and small lakes is deteriorating significantly. In Berlin, most of the rainwater is discharged into the sewage system and is unable to seep away. Many small water bodies dried up after the summer of 2016, when little rain fell. This is where we want to examine possibilities for enabling rainwater to seep away better throughout the city, which can then be stored for use.

How much nature can be brought into the city?

Much more than is currently the case! In Berlin, people have become used to being surrounded by water bodies that have more or less been destroyed and being unable to reach the water at many sites. But the city is home to a strong civil society that is open to visionary ideas. Science can expand on this strength!

The interview was conducted by Wiebke Peters.

More information and reports on this subject can be found on our "Use & Management" topic page at www.igb-berlin.de/en/use-management

Dr. Jörg Freyhof | j.freyhof@igb-berlin.de

Project: Interdisciplinary research network "Ecological Potential of Urban Waters", **Duration:** 10/2016 – 10/2019, **Funded by**: Berlin Senate Department for Economics, Technology and Research, **Direction:** Professor Gunnar Nützmann, nuetzmann@igb-berlin.de, Dr. Christian Wolter, wolter@igb-berlin.de, **Involving:** Department 1, Research Domain 3

Photo: Thomas Wolter/pixabay

A Robot Shows Guppy Shoals the Way

Usually only a few leaders decide the direction in which a group of fish should swim. And yet how do they convince the other individuals to follow them? Researchers have developed a robotic fish that is accepted as a conspecific by live guppies. In a new project funded by the German Research Foundation (DFG), researchers manipulate the leadership behaviour of these robots and analyse which is the most effective behaviour.

Collective motion is no easy matter. Leaders must decide which direction to take, and all individuals must follow to ensure the group remains intact. As with humans, it is usually only a few leaders that decide the direction to be taken by a group of animals. It is then up to all other individual to keep up with them. "We know from theoretical models that leaders must not overstep the mark by changing directions too sharply, for example – else the others will fail to follow, and they will find themselves alone," explains David Bierbach. That would be a bad thing, because even leaders are less well protected from predators when they stray outside the group. The leader must therefore be able to gauge the extent to which it can get its own way, whereas the other individuals must decide how far each wants to follow the leader. Both aspects require a high degree of social responsiveness.

A Robotic Fish, Accepted as a Conspecific by Live Guppies

It is difficult to study such group interaction. Not only are the objectives pursued by leaders often unclear, they are also virtually impossible to influence. "To get around this difficulty, we teamed up with Tim Landgraf from the Freie Universität Berlin to construct a robotic fish," says David Bierbach. "It is modelled on the guppy, and is accepted as a conspecific by live guppies."

The guppy is one of the most common model organisms in behavioural research. The robot now enables them to "smuggle" a leader into a group of guppies and to control it as they wish. Thanks to globally unique double-system video recording, they are always able to locate the robot in the group. In addition to being controlled via the keyboard, the robot also uses information about the position of the live fish to automatically adapt the direction in which it swims – i.e. it behaves interactively, just like a live guppy.

The robot can either follow its neighbour in the group or, if desired, can assume leadership. How "authoritarian" can it be in its leadership style before all of the live guppies stop following it? Does it have to adopt a stronger or "more authoritarian" style as the group gets bigger? These are just some of the questions to be addressed in a new DFG project. "Our objective is not only to gain deeper insight into animal group behaviour, but also to identify general mechanisms that play a role in organisational psychology in humans, for instance," summarises David Bierbach.

Project: Exploring the Consequences of Social Responsiveness on Leadership using an Interactive Biomimetic Robotic Fish, **Duration:** 06/2016 – 08/2019, **Funded by:** DFG, **Direction:** Dr. David Bierbach, bierbach@igb-berlin.de, **Involving:** Department 4

Landgraf, T, Bierbach D, Nguyen H, Muggelberg N, Romanczuk P, Krause J (2016) RoboFish: increased acceptance of interactive robotic fish with realistic eyes and natural motion patterns by live Trinidadian guppies. Bioinspiration & Biomimetics 11(1): 015001

"Our objective is not only to gain deeper insight into animal group behaviour, but also to identify general mechanisms that play a role in organisational psychology in humans, for instance."
David Bierbach

Photo: Melanie Hauber

International Network Connects Large Marine and Freshwater Experimental Research Infrastructures

Lakes, rivers, estuaries and oceans are closely connected, and ecosystem processes act at many levels, including at the global level. And yet aquatic research is often divided into the separate disciplines of marine and freshwater sciences. As a result, there is insufficient cooperation between projects at the international level, experimental research is often conducted on a too local scale, and potential sources of funding are left untapped.

The aim of the AQUACOSM project, launched in January 2017, is to rectify this fragmentation by establishing an integrated, international network of experimental infrastructures for freshwater and marine research. This network should significantly improve the quality of data for all types of water. "In the future, we want to better coordinate research projects, develop common best practices, and open up both mesocosms of freshwater and marine research institutes for international, interdisciplinary collaboration," explains IGB researcher Jens Nejstgaard, who heads the EU project.

Mesocosms are filled with large volumes (1-1,000 cubic metres) of natural water for experimental manipulation. In this way, the separate and combined effects of multiple stress factors on entire ecosystems can be measured over periods of weeks to years. This approach is currently the most realistic method of studying the effects of future environmental changes on aquatic ecosystems. The results obtained are compared with predictions from long-time data series and models. Conclusions can then be drawn from the combination of different approaches, resulting in the effective future management of our waters.

"The effects of stressors can vary widely depending on the ecosystem and the season," emphasises Jens Nejstgaard. For this reason, they must be investigated in comparable mesocosm experiments using uniform methods, but in different climatic and geographic regions. AQUACOSM creates the necessary prerequisites for this approach and gives researchers the opportunity to conduct experiments in different climatic and geographic zones of Europe, ranging from the Arctic to the Mediterranean Sea, from alpine mountains to flat coastal areas.

The experimental infrastructures of the 21 partner institutions involved in the AQUACOSM project are diverse, ranging from tank systems and gutters such as in Lunz am See (Austria) to large free-floating open-ocean facilities such as the Kiel Offshore Mesocosms (KOSMOS). Featuring unique dimensions (24 mesocosms with 1,270 cubic metres each), IGB's LakeLab at Lake Stechlin sets a new benchmark in experimental freshwater research.

"In the future, we want to better coordinate research projects, develop common best practices, and open up the mesocosms of freshwater and marine research institutes for international, interdisciplinary collaboration".
Jens Nejstgaard

Project: EU H2020-INFRAIA project No 731065 "AQUACOSM: Network of Leading European AQUAtic MesoCOSM Facilities Connecting Mountains to Oceans from the Arctic to the Mediterranean", **Duration:** 01/2017 – 12/2020, **Funded by:** European Union's Horizon 2020 Programme (EU H2020-INFRAIA), **Direction:** Dr. Jens C. Nejstgaard, nejstgaard@igb-berlin.de, **Transnational access leader:** Dr. Stella A. Berger, berger@igb-berlin.de, **Involving:** Department 3

www.aquacosm.eu
www.mesocosm.eu

Photo: David Ausserhofer

A Limnological Journey through Time

Climate change has already brought changes to Lake Iseo, northern Italy, that lakes in northern Germany are only expected to undergo at the end of the 21st century. In the ISEO project, scientists explore how these changes affect the quality of water and derive preventive measures from these findings as climate change proceeds.

Lake Iseo is located at the southern foot of the Alps. With an area of 65 square kilometres, it is the fourth largest lake in northern Italy. With a depth of 251 metres, the deepest basin of the lake could almost accommodate the Eiffel Tower.

Separated Hypolimnion:
Water in Lake Iseo No Longer Circulates

Limnological records from the 1960s show that large quantities of oxygen were once present in water at these depths. Since then, however, the chemical-ecological state of Lake Iseo has increasingly been the subject of change: it now has a hypolimnion that is permanently separated from the seasonally circulating water mass, a monimolimnion. Since summers are now longer due to climate change, there is no longer a sufficient number of winter days to reduce temperatures in the entire water column to the same temperature level necessary for circulation. This process of separating the monimolimnion from the upper layer of water stabilises itself because the density of the hypolimnic water increases as stagnation persists: dissolved and particulate substances accumulate there.

Industrial and Agricultural Wastewater "stresses" the Lake

"Lake Iseo's monimolimnion has not been involved in the autumn circulation for ten years now; it is getting closer to the surface from year to year," reports IGB junior researcher Maximilian Lau, who is involved in the project. "At the same time, considerable external nutrient loads cause the lake problems." These are mainly caused by runoff from the local

In 2016, the artist Christo presented his "Floating Piers" on the shores of Lake Iseo.

industry and the intensively farmed agricultural areas around Lake Iseo. Although municipalities at the shores of the lake discharge only treated wastewater, sewage overflow is discharged straight into the lake in the event of heavy rainfall.

In the depths of the lake, these nutrients accumulate in the monimolimnion. As a result, it acts as a temporary trap for the nutrient phosphorus, which limits production. If, however, intermixing occurs, as was last the case in the winter 2005-06 storms, the resulting shock load of phosphorus triggers an explosion of planktonic algae in the surface water. "Already, the degradation of falling algae has now exhausted the monimolimnion's entire oxygen supply," explains the young researcher. The oxygen-free dead zone in the water column is becoming increasingly long and high. "Anaerobic processes lead to the development of other degradation products such as methane and hydrogen sulphide, causing deposited nutrients to find their way from the sediments back into the water – a well-studied yet problematic vicious circle."

The Aim: To Restore Lake Iseo to a Nutrient-Poor State

The project was initiated by Italian hydroengineer Marco Pilotti from Brescia University. In 2016, he assembled an interdisciplinary team of scientists to tackle the problem of Lake Iseo – including colleagues from IGB. The research group led by Michael Hupfer is involved in taking stock of the situation and in developing solution strategies. Equipped with many hands and modern instruments, they are getting to the bottom of Lake Iseo's nutrient fluxes: researchers will only know where to start tackling the lake so as to restore its nutrient-poor or "oligotrophic" state by recording exactly how nutrients are distributed and converted and with a clear understanding of the lake's flow and mixing processes. This is also the express goal of the ISEO project, funded by the Italian Fondazione Cariplo.

The findings have been compiled and discussed in the context of annual workshops. Pilotti hopes that the accumulated knowledge will enable them to restore the lake to the healthy condition it enjoyed 50 years ago. Hupfer and his team are using the knowledge they have gained to look to the future. "In the process, we gain valuable information on the problems facing our freshwaters over the next 50 years and how we should tackle them," he states.

"Anaerobic processes lead to the development of other degradation products such as methane and hydrogen sulphide, causing deposited nutrients to find their way from the sediments back into the water – a well-studied yet problematic vicious circle."
Maximilian Lau

"In the process, we gain valuable information on the problems facing our freshwaters over the next 50 years and how we should tackle them."
Michael Hupfer

Project: ISEO (Improving the lake Status from Eutrophy towards Oligotrophy), **Duration:** 03/2016 – 03/2019, **Funded by:** Fondazione Cariplo, **Direction:** Dr. Michael Hupfer, hupfer@igb-berlin.de, **Involving:** Department 6, Research Domain 2

Photos: Maximilian Lau; David Ausserhofer (2)

The sturgeon is a great subject of fascination, whether as cute juveniles or impressive adults. These fish, with their distinct mouth and bony armour that protected them against predators back in the time of the dinosaurs, grow up to a length of five metres.

Out to Sea and Back: Migrating with Fish such as Sturgeon and Salmon

It is a great moment for both children and researchers when a small sturgeon is released into a river and sets off on its journey to the ocean. Such stock enhancement measures are an important element of the programme for reintroducing the sturgeon. These measures are now being integrated into a comprehensive education programme: the Wanderfisch (migratory fish) project takes children and young people on a journey between the river and the ocean. These measures are accompanied by teaching materials as well as ideas for class trips and projects. The project, part of the "Science Year 2016*17 – Seas and Oceans", is supported by the German Federal Ministry of Education and Research.

Migratory fish, such as sturgeon, salmon, allis shad, houting and eels, link oceans to flowing water in a unique way. While a single brook, river or lake suffices as a habitat for most fish, migratory fish are more demanding: they require a suitable environment for every stage of their lives. The sturgeon, for example, spends much of its 150-year life in the ocean, and yet migrates to rivers for spawning. These fish migrate all the way back to their natal waters to reproduce.

"We want to exploit this fascination to explain to children and young people, using the example of this migratory fish, the complexity of the interplay between aquatic habitats and human use and how they interact."
Jörn Geßner

Photos: Solvin Zankl / GeoTag der Artenvielfalt; David Ausserhofer

"We are developing practice-related materials with our partner, BildungsCent e.V., which can be used in the classroom as well as outside school."
Angelina Tittmann

There was once a time when the sturgeon populated almost all large European rivers and upstream coastal waters. Sadly, however, weirs, pollution and river engineering have prevented them from reaching their spawning grounds, reducing their survival rate and depriving fish larvae and juveniles of the resources needed to live and feed. In conjunction with unsustainable fishing, stocks declined dramatically towards the end of the 19th century. Our native sturgeons are now among the most endangered species of fish worldwide. They are currently extinct in Germany and, with just one stock, in France, in all the rest of Europe.

Discovering and Protecting Waters with the Sturgeon

The sturgeon's age, size and way of life make it an extraordinary species of fish. "We want to exploit this fascination to explain to children and young people, using the example of this migratory fish, the complexity of the interplay between aquatic habitats and human use and how they interact," explains Jörn Geßner. The IGB researcher has devoted himself to the reintroduction of this special fish species for over 20 years.

This species enables topics such as species protection, river engineering, water pollution and the river-ocean connection to be relayed in a practical, appealing way. "We use specific examples to show that different stakeholders from the realms of science, politics, authorities and nature conservation must join forces if sturgeons and other migratory fish are to return to our waters again," states Geßner. He is certain that "measures to protect the sturgeon, such as habitat enhancement, will also benefit other species, and hence the entire ecosystem."

In the Migratory Fish project, the sturgeon acts as a charismatic patron species, taking children and young people on a journey between the river and the ocean. There are plans to develop activities with schools along Germany's rivers. "To achieve this, we are developing practice-related materials with our partner, BildungsCent e.V., which can be used in the classroom as well as outside school," explains Angelina Tittmann, initiator of the collaborative project. "We would like children and young people to get to know the sturgeon during stock enhancement procedures, enabling them to explore and discover their local water bodies using our Migratory-Fish-Backpack. To achieve this, we are preparing materials such as flashcards, exhibitions and project ideas that encourage them to join in, learn and develop projects together."

All of the relevant materials as well as information about migratory fish and water bodies and contact details of visitor centres and partners are available on the project website. Schools can also use the website to apply to participate in the programme.

Project: Wanderfisch, **Duration:** 09/2016 – 10/2017, **Funded by:** Federal Ministry of Education and Research (BMBF), **Direction:** Dr. Jörn Geßner, sturgeon@igb-berlin.de,
Involving: Department 4, PR

www.wanderfisch.info

Children and young people release small sturgeons into rivers such as the Mulde, Middle Elbe, Havel, Stör, Oste and Oder, the starting point for their migration to the ocean.

Photos: David Ausserhofer; Philipp Freudenberg

News

MANTEL, an Innovative Training Network

Extreme weather events, such as storms and heat waves, will become more frequent as a result of climate change. In MANTEL, scientists investigate how freshwaters respond to such episodic events, whether critical threshold values are exceeded, and the significance this will have for ecosystem functioning. In order to explore the environmental impacts from the local to the global scale, the researchers use high-resolution in situ measurements taken from lakes using automatic probes. Doctoral candidates based at two universities are trained in this project. Partnerships exist between the Freie Universität Berlin and the University of Geneva (Switzerland) and between the University of Potsdam and Dublin City University (Ireland).

Project: Management of Climatic Extreme Events in Lakes & Reservoirs for the Protection of Ecosystem Services (MANTEL), **Duration:** 01/2017 – 12/2021, **Funded by:** Marie Skłodowska-Curie Actions; Innovative Training Networks (ITN), H2020-MSCA-ITN-2016, **Direction at IGB:** Professor Rita Adrian, adrian@igb-berlin.de, Professor Hans-Peter Grossart, hgrossart@igb-berlin.de. **Involving:** Departments 2 and 3

www.dkit.ie/mantel

LakeBase

Continuous long-term data on aquatic organisms (plankton, benthos, macrophytes and fish) and key abiotic drivers (temperature and nutrients) from recent decades exists for many lakes in Germany. Its high taxonomic and temporal resolution makes it unique in the world. The aim of LakeBase (Database Infrastructure for Long-Term Data of German Lakes) is to save this data in an accessible database system and to connect it to international data portals (GLEON, FIP, NetLake, LTER NT Lakes). In addition, a detailed metadata description will make it easier for researchers to use the data in the future. LakeBase is therefore an important basis for facilitating international research, the development of management strategies and policy consultation.

Project: Database Infrastructure for Long-Term Data of German Lakes (LakeBase), **Duration:** 09/2015 – 08/2018, **Funded by:** DFG, Scientific Library Services and Information Systems (LIS), **Direction:** Professor Rita Adrian, adrian@igb-berlin.de, **Involving:** Department 2

curious

Current Studies and Research Results

“Species Decline in Freshwater Systems is Alarming”

In a working paper published at the end of 2016, IGB researcher Dr. Gregor Kalinkat and his colleagues called for more to be done to protect biodiversity in freshwater systems. In an interview, the biologist explains why species in lakes, rivers, etc. are particularly at risk – and reveals which creature would be a good flagship species for Berlin’s waters.

The loss of biodiversity on our planet has been a hotly debated topic in biology for years, one that is also being researched at IGB. What does the decline in biodiversity mean to humankind?

Dr. Gregor Kalinkat: This question is being debated intensely in academic circles. First, there is the utilitarian dimension, i.e. the extent to which species diversity is specifically beneficial to humankind in the form of ecosystem services. Second, there are moral aspects, i.e. our obligation to acknowledge nature as a value that needs to be preserved per se. The main utilitarian argument is the so-called portfolio effect, which states that species diversity reduces the risk of unexpected events having a dramatic impact on humankind, such as in food production.

Can you give me an example?

Scientists have demonstrated that salmon yields on the Pacific Coast of North America remain constant even if a population may weaken occasionally. The fact that many different populations

Photo: David Ausserhofer

exist there has a stabilising effect. But biodiversity does not only mean the diversity of species, it also means genetic diversity within a species. This is equally important, such as when a disease outbreak occurs within a population: if the individuals have a high level of genetic diversity, it is more likely that several of the specimens will cope better with the disease, enabling the population to survive its outbreak unscathed.

The loss of biodiversity in freshwater systems is more severe than in marine or terrestrial systems: according to figures published in WWF's Living Planet Index in October 2016, 81 per cent of biodiversity in freshwater systems was lost between 1970 and 2012, compared to 38 per cent in terrestrial systems and 36 per cent in marine systems. Why are freshwater systems affected so badly by species decline?

There are two main reasons for this: humans have a very high demand for freshwater; we use it for drinking water, as well as for agriculture and industry. The second central aspect is the island situation, which characterises many freshwaters. Most habitats containing freshwater species are isolated from each other; the species that live there are bound to their "island" and are unable to get to another island if theirs is destroyed. Although the figures given in the Living Planet Index refer only to vertebrates, they are a clear indication of the alarming extent to which the diversity of species is declining in freshwater systems.

Why has the topic of species decline in freshwater systems received so little public attention?

Terrestrial systems are home to lions and elephants; marine systems feature whales and sharks – freshwater systems are lacking in large-bodied species that move people emotionally. The habitats, too, differ in their 'sex appeal' – it's much more exciting to go on safari or to scuba dive in coral reefs than it is to drag a net through a forest pool or to explore domestic lakes underwater. This imbalance is also reflected in research: fewer studies are undertaken on freshwater organisms because there is less likelihood of receiving funding for such projects.

In an article published in 2016, you called for the identification of "freshwater pandas" to help raise people's awareness of freshwater biodiversity. How can this concept help protect species?

The idea is to identify species that have the potential to represent the loss of biodiversity and to raise awareness of this decline among the public, as well as in academic and political circles. River dolphins, for example, would be the ideal global "freshwater panda". For Berlin and Brandenburg's waters, it could be the banded darter, an endangered dragonfly that prefers near-natural flowing waters with flooded areas.

The concept of the freshwater panda was developed during an international workshop on freshwater biodiversity at IGB. What happens next?

We are currently developing an initiative that seeks to achieve the better pooling and coordination of research on biodiversity in freshwater systems – there's a lot to catching up to do compared to research on terrestrial biodiversity.

The interview was conducted by Wiebke Peters.
The interview is available in full length on www.igb-berlin.de

More information and reports on this subject can be found on our
"Biodiversity" topic page at
www.igb-berlin.de/en/biodiversity

Dr. Gregor Kalinkat | kalinkat@igb-berlin.de

Kalinkat G et al. (2017) Flagship umbrella species needed for the conservation of overlooked aquatic biodiversity. Conservation Biology 31 (2): 481-485

The banded darter (Sympetrum pedemontanum) is one of the protected species, which could be a flagship for freshwater biodiversity in the Berlin area. The drawing of its wings creates when flying the visual effect of a glimmer.

Photo: L. B. Tettenborn

The Mixture is the Essence: Predicting Temperature in Lakes Using the "Universal Lake Formula"

The temperature in lakes varies depending on the depth of the water. Such thermal stratifications may be mixed if the surface water cools down or strong wind cause turbulence. In the LakeShift project, a "universal lake formula" was developed that now enables researchers to predict whether lakes mix regularly or stratify seasonally.

Sun rays heat up the surface water of lakes much more strongly than the underlying deep water, especially in summer. Physical laws lead to temperature stratification in the lake: since warmer water is lighter, the density of the water increases with depth, isolating the bulk of lake water from direct contact with the atmosphere. This fundamental process determines the entire ecology of lakes and how they are likely to respond to climate change or pollution.

One key issue in lake research is therefore whether or not mixing of the lake surface is capable of destroying the density stratification of the water. Until now, lakes were classified as either polymictic (regularly mixed) or predominantly stratified based on rough depth estimates or on regional-specific experience of the ratio of lake depth to area. More accurate estimates could only be made using complex numerical models applied to one particular lake. "We have now developed a rating scale that can be used to predict whether lakes mix regularly or stratify seasonally, based solely on information about shape and geographic location," explains Georgiy Kirillin.

Basic Processes Combined into One Simple Formula

The valuation standard is derived from fundamental physical relationships that govern the formation and destruction of stratification. Stratification occurs whenever surface water heats up, for example, by exposure to sunlight or by heating from the air. Layering can be destroyed by either cooling of the surface water or by strong wind, resulting in turbulence and mixing. In addition, the extensions of lakes play an important role: large-scale horizontal stretches of lake influence the degradation of stratification by a process known as upwelling. Upwelling occurs when the wind pushes the warm surface water to one end of the lake. The deeper, cold water then rises to the surface on the opposite side of the lake. Upwelling therefore increases mixing and can induce complete water circulation in large lakes. "Our scaling criterion combines all these fundamental processes, averaged over seasonal scales, into one simple formula," emphasises the IGB scientist.

The scaling formula has already been tested with great success in several hundred lakes around the world. For a large number of lakes, it is very easy to make accurate predictions about the mixing regime. The "universal lake formula" can be used to estimate greenhouse gas emissions from lakes using remote sensing or in global climate models, which require efficient algorithms for lakes.

"We have now developed a rating scale that can be used to predict whether lakes mix regularly or stratify seasonally, based solely on information about shape and geographic location."
Georgiy Kirillin

Project: LakeShift, **Duration:** 02/2014 – 01/2017, **Funded by:** German Research Foundation (DFG KI 853/7-1), **Direction:** Dr. Georgiy Kirillin, kirillin@igb-berlin.de, **Involving:** Departments 1 and 2, Research Domain 2

Kirillin G, Shatwell T (2016) Generalized scaling of seasonal thermal stratification in lakes. Earth-Science Reviews 161: 179-190

Photo: David Ausserhofer

“We Do Not Know the Exact Impact of Most Invasive Species”

In 2016, the European Commission published a list containing 37 “invasive alien species of Union concern” (the Union list) that are to be controlled. As a result, biological invasions have received increasing attention and interest – including in the media. In an interview, Jonathan Jeschke, Head of the IGB and FU “Ecological Novelty” research group, explains what invasive species are and why they are so difficult to control.

Mr. Jeschke, what exactly is an alien or invasive species?

Jonathan Jeschke: Different definitions of these terms exist, but an alien species is frequently defined as a species that, due to human influence, now occurs in an area where it did not occur prior to 1492. Since Columbus’ arrival on the American continent, human transport vectors such as ships and, later, planes have changed the world enormously. Invasive species are a subset of alien species, those that have managed to become established and spread in their new environment. Another definition of invasive species, often found in the media or in popular science texts, is limited to alien species that additionally have a negative impact.

The coypu (Myocaster coypus) *and the spiny-cheek crayfish* (Orconectes limosus, *right) are just two of the 37 species on the list of invasive alien species of Union concern, which entered into force under Regulation (EU) No 1143/2014 in August 2016.*

The aim of the Union list is to prevent invasive alien species from having a negative impact on native fauna and flora. How do such species get here?

We generally distinguish between two major groups: intentional and unintentional import routes. The first group are species that have been introduced on purpose by humans, such as many vertebrates. These species are either released or they manage to escape, for instance from an aquarium or an enclosure. Examples of unintentional transport routes are water contaminated with microorganisms and introduction via a host animal, such as the crayfish plague, which came to Europe with the introduction of North American crayfish. Then there are "stowaways", such as mosquitoes, that find their way into aircrafts. Other key import routes, particularly in the aquatic area, are manmade corridors such as the Suez Canal. However, we still know too little about such routes of entry. This knowledge is incomplete in the case of most invasive species, or routes of entry are not known at all. We also know that some "traditional" assumptions concerning biological invasions are simply not true.

Can you give me an example?

The "tens rule", according to which ten out of 100 imported species become established, and one becomes invasive. Currently available data suggest that the real percentage is in fact considerably higher: in the case of vertebrates, for example, we have calculated that it is more like 50 per cent for each stage, i.e. that 25 out of 100 species become invasive. This is problematic because this rule is often used to parameterise economic models, such as in risk assessment. In such models, measures targeting invaders then appear to be less beneficial than they actually are.

Your group is currently conducting research on crustaceans that originally came from North America and have now become established in Europe. These crustaceans are also included on the Union list. What threat do they cause?

We are comparing the spiny-cheek crayfish with the marbled crayfish and the impact they have, or can have, on ecosystems such as the lake Müggelsee. Both species are capable of introducing the aforementioned crayfish plague to a lake, and although these species are resistant to this disease, native crayfish become infected and are decimated. At present, we are mainly concentrating on the effects that these crustaceans have on food webs in lakes. Little is known about this as yet.

What makes some invasive species more successful than others?

The key factor appears to be propagule pressure. The more frequently species are introduced and the larger the number of individuals that are introduced each time, the likelier it is that a species will become established. This is compounded by the fact that alien species that cope well in an anthropogenically influenced environment are also more likely to become established and spread there. Another important factor, at least in the case of mammals, is the variance of their traits, as we were able to demonstrate in a study conducted in 2015: the more diverse a species' characteristics, the more capable it is of becoming established.

Is it possible to assess the impact of invasive species?

We do not know the exact impact of most invasive species. In a study published in 2016, we investigated which invasive species posed a particular threat to vertebrates throughout the world. At the top of the list is the chytrid fungus *Batrachochytrium dendrobatidis*, which affects and poses a threat to many amphibian species. Next on the list of high-impact invaders in our study are mammals: rats and domestic cats take second and third place. Cats are predators that pose a threat to many bird species, e.g. in

Photo: Jonathan Jeschke

Australia. Together with the International Union for Conservation of Nature (IUCN), we are in the process of developing impact classifications. The system, which resembles the Red List and is set to go online in 2017, illustrates different effects on biodiversity on a global scale. Effects on economics, health and culture will be added at a later date.

Are there "good" and "bad" immigrant species?

Those are judgements that need to be made by society. However, the whole of society is in agreement concerning the impact of some species: no one wants to have human pathogens. One species that we would assess positively, on the other hand, is the potato, which was introduced to Europe in the 16th century. And then there are "conflict species", species that have a negative effect on biodiversity, for example, but which are assessed positively by some stakeholders. This is the case with a number of invasive fish, for instance, which are appreciated by some anglers. Nevertheless, conflict even exists in the case of many species that are clearly harmful, particularly concerning their control. For example, the Asian long-horned beetle, introduced via wooden packages, is a plague in Bavaria. It is being controlled by felling all broad-leaved trees within a certain area, in the hope of eradicating the entire population. It goes without saying that this is a drastic measure. The main problem with this particular beetle is that the perpetrators, who could prevent its introduction by treating the wood, have no economic interest to do so. The problem could be tackled at this point by ordering the perpetrators to bear the cost of the damage. It would then be easier to prevent the introduction of such harmful invasive species.

Photo: Bernd Wolfram

The interview was conducted by Wiebke Peters.

More information and reports on this subject can be found on our "Biodiversity" topic page at www.igb-berlin.de/en/biodiversity

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Projects:

Forecasting Future Invasions and their Impacts (FFII), **Duration:** 12/2013 – 12/2017, **Funded by:** German Research Foundation (DFG) in the context of BiodivERsA, **Direction:** Professor Jonathan Jeschke, jeschke@igb-berlin.de, Dr. Wolf-Christian Saul, saul@igb-berlin.de, **Involving:** Department 2, Research Domain 1

EU Regulation on Invasive Species: Listing Propositions and Prioritisation of Introduction Pathways for Invasive Species of Union Concern in Germany, **Duration:** 07/2015 – 10/2017, **Funded by:** Federal Agency for Nature Conservation (BfN), **Direction:** Professor Jonathan Jeschke, jeschke@igb-berlin.de, Dr. Wolf-Christian Saul, saul@igb-berlin.de, **Involving:** Department 2, Research Domain 1

Long-Term Effects of Invasive Species in Novel Communities, **Duration:** 01/2015 – 12/2017, **Funded by:** DFG, **Direction:** Professor Jonathan Jeschke, jeschke@igb-berlin.de, Florian Ruland, ruland@igb-berlin.de, **Involving:** Department 2, Research Domain 1
http://indynet.de

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Immobility due to Microplastics

Plastics now occur virtually everywhere: hundreds of thousands of small plastic particles can be found floating on every square kilometre of the sea's surface; they also accumulate on the coast, and even in deep sea sediments. Researchers estimate that, by 2050, our oceans may contain more plastic than fish. Only recently have they turned their attention to rivers and lakes. And yet most of the plastic that enters the sea originates from these water bodies.

Studies have long suggested that microplastics are ubiquitous in aquatic ecosystems. Small plastic particles measuring less than five millimetres originate from cosmetic products, for example, or are washed out of synthetic materials. It is difficult to estimate how many such particles enter our seas and freshwaters. "At this point, we have little idea of the actual concentration of microplastics in aquatic ecosystems," states Saskia Rehse, who is writing her PhD thesis on the topic at IGB. Methods for precisely determining the composition and concentration of microplastics have not yet been established and standardised.

Tiny particles, often measuring only a few micrometres, in particular create problems. These tiny particles cannot be filtered out completely by sewage treatment plants, and are therefore very widespread. Some of the potential effects, such as inflammation of the gastrointestinal tract through ingestion of the particles or their accumulation in the food chain, have already been investigated in several studies, particularly for marine organisms. Science has established that plastic particles are now being found in fish, seabirds, seals and whales. However, scientists still know nothing about how microplastics may affect freshwater.

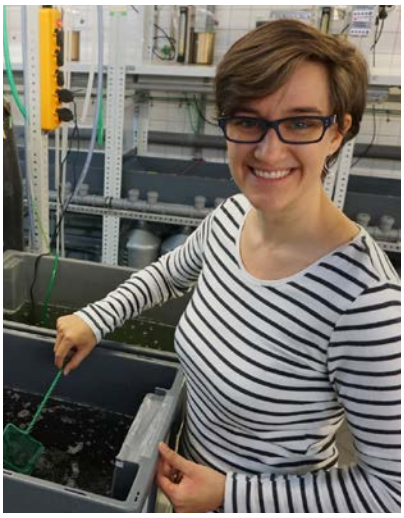
Microplastics Paralyse Water Fleas

In her experiments, Saskia Rehse exposes water fleas *(Daphnia magna)*, typical residents of inland waters, to extremely high concentrations of polyethylene particles. Polyethylene, the most widely used plastic in the world, is primarily used as packaging. The young scientist uses different sized particles in her experiments. Her objective is to determine potential threshold values which, when exceeded, can be expected to have an adverse impact on organisms.

"Small particles measuring only one micrometre in diameter float in the water column, are swallowed by water fleas, and immobilise them after just a few days," reports Rehse. Larger particles, on the other hand, accumulate on the water surface like a carpet. In some cases, they remain attached to water fleas, but can be shaken off by them. "We focus on water fleas because they play a key role in lake ecosystems," she explains. "They feed on algae and bacteria. If they become immobile, they cannot ingest as much food." This in turn can lead to increased algae growth and algal blooms. At the same time, water fleas are an important source of food for fish and other organisms. For this reason, further research must be conducted to determine whether microplastic particles accumulate in the food chain in rivers and lakes, and if so, how this occurs.

Project: DBU doctoral scholarship, **Duration:** 01/2014 – 12/2016, **Funded by:** German Federal Environmental Foundation (DBU), **Contact:** Saskia Rehse, rehse@igb-berlin.de, **Involving:** Department 5

Rehse S, Kloas W, Zarfl C (2016) Short-term exposure with high concentrations of pristine microplastic particles leads to immobilisation of *Daphnia magna*. Chemosphere 153: 91-99



"At this point, we have little idea of the actual concentration of microplastics in aquatic ecosystems."
Saskia Rehse

Photo: privat

“It is an Important Evolutionary Mechanism for Fish to Have a Personality”

IGB researcher Kate L. Laskowski has been investigating the personality of fish for ten years. In an interview, the behavioural ecologist explains what we can learn from fish – and reveals why she is particularly fond of a certain fish species.

Dr. Laskowski, what constitutes a fish personality?

Kate Laskowski: By the term ‘fish personality’, I mean their predictability: if, based on their past behaviour, I can predict how they will behave in a similar situation, they have a personality. Fish, for example, exhibit different degrees of activity or aggressiveness, and react differently to new environments or risky situations.

How can you test personality in fish?

We observe fish in standardised assays. One way of finding out more about different types of fish is to place them in a new arena with other vegetation or fish, i.e. in a new environment, and to observe their behaviour over several days or weeks: does a fish tend to be more active or passive? What happens in the face of danger?

Such as?

We simulate a predatory attack by hitting the surface of the water with a bird skull. Almost all fish exhibit a strong anti-predator behavioural response to this where they either freeze or hide. We look to see how long it takes each fish to recover and to resume its normal swimming behaviour.

Photo: David Ausserhofer

Why do fish have different personalities?

It is an important evolutionary mechanism to have a personality, i.e. to behave differently. This way, individuals might be able to reduce competition within their group, thus increasing their own individual success in terms of survival or reproduction. From a more proximate perspective, the behaviour of an individual fish is very much dependent on its development. For example, in experiments we conducted with clonal mollies, i.e. fish that have an identical genetic make-up, we determined that their differences in behaviour can be a result of their early social experience. We paired up this fish at birth in such a way that we could control which fish would win a dominance fight. Some of the fish were paired in such a way that they always won a fight, other fish were paired in such a way that they always lost and still others paired so that sometimes they won and sometimes they lost.

... and what did you find out?

As expected, the mollies that always won at a young age continued to dominate over their adversaries later in life – they were strong, dominant individuals. And this effect of early experience lasted much, much longer than previously thought – until well after sexual maturity. We then expected that the mollies that sometimes lost and sometimes won would, then, be expected to continue winning and losing later in life, too. On the contrary, however, they turned out to be the real losers.

Why was that?

These fish have come to realise that they can sometimes win, so they boldly attack the 'natural winners' – and lose. This is where the 'loser fish' come in. They challenge the vanquished fish, and finish them off, enhancing their position in the group.

Can these results be transferred to humans?

Maybe! Repeated failed attempts to perform a risky task may be something that is hard to cope with. But it also highlights the importance of being opportunistic – despite negative experiences early in life, some individuals can overcome this if they just wait for the right moment to make their move.

How do fish personalities influence their environment?

This issue is addressed in our latest project, which tested how the composition of personalities in perch groups influenced whole food web dynamics. Perch have quite strong personalities; some individuals are relatively shy and inactive, whereas other individuals are relatively bold and active. We divided the perch into three groups: one containing exclusively shy individuals; one containing bold individuals only; and one with a mixture of both types. We then placed these fish into ponds and measured how these groups of perch affected the whole ecosystem. We measured changes in the composition of invertebrates – which the perch eat – and changes in algal growth and rates of leaf litter decomposition. The data is now being analysed; I expect that the ponds containing only active or inactive fish will differ the most: active individuals are likely to consume lots more invertebrates, leading to more prolific algae growth and less leaf degradation than with the inactive bass.

Are you particularly fond of a certain fish species?

I am very fond of sticklebacks. They seem more intelligent than other fish. You can almost see them thinking: "Is it okay for me to swim out now?" Mollies, on the other hand, are forever just thinking about food.

The interview was conducted by Wiebke Peters.

More information and reports on this subject can be found on our "Behavioural Ecology & Swarm Intelligence" topic page at www.igb-berlin.de/en/behavioural-ecology-swarm-intelligence

Dr. Kate L. Laskowski | laskowski@igb-berlin.de

Project: How individual behavioural variation during predator-prey interactions determines invasion success, **Duration:** 10/2015 – 10/2018, **Funded by:** German Research Foundation (DFG), **Direction:** Dr. Kate L. Laskowski, laskowski@igb-berlin.de, **Involving:** Department 4

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Photo: David Ausserhofer

A Focus on Amphibians: From Basic Research to Environmental Impact Research

Studies on the evolution of amphibian sex chromosomes provide insight into the development of species. The findings also enable researchers to determine the impact of hormone-like substances in freshwaters on wild amphibian species. In the context of a Heisenberg project funded by the German Research Foundation (DFG), IGB researcher Matthias Stöck investigates the genetic evolution of frog and toad species.

Two evolutionarily young tree frog species meet in the Vistula region: the European Tree Frog *(Hyla arborea)* and the Oriental Tree Frog *(Hyla orientalis)*. Although there is barely any difference between them as far as appearances go and though these two species originate from a single species of origin, they lived apart for around five million years. They only regained contact after the last Ice Age, less than 14,000 years ago.

Using their sex chromosomes as a basis, it is possible to draw conclusions on the evolution of amphibian species. "We want to find out how long it takes a new frog or toad species to develop following geographical isolation, and what makes them genetically independent," explains Dr. Matthias Stöck. If populations remain separated for a long time, genetic adaptations to the environment and random mutations become frequent. It is known from other animals that such differences accumulate on the sex chromosomes from a molecular perspective. It was not known until now whether this is also the case for the indistinguishable sex chromosomes of frogs, which cannot be differentiated microscopically.

Mating between the two tree frog species in the lowlands of Poland produces hybrid frogs that carry the sex chromosomes of both species. "Using population-genetic methods, we were able to demonstrate that the hybrid frogs successfully reproduce more rarely than their two ancestor species," explains Stöck. "Molecular markers on the sex chromosomes entered the gene pool of the other tree frog species much more rarely than those on the other chromosomes." This suggests that sex chromosomes play a greater role in the evolution of new species than other chromosomes, including in the case of frogs. The two species will no longer be able to merge together completely.

Sex Reversal from Oestrogen in the Pill

Stöck also utilises the findings generated from basic research in applied research on environmental impact: "Amphibians are particularly vulnerable to adverse effects in the environment because they depend on both water bodies and terrestrial habitat," he states. If hormone-like substances find their way into water, they affect the hormonal system of the animals that live there. One of these substances is 17α-ethinylestradiol (EE2), a synthetic oestrogen. This substance, which frequently originates from oral contraceptives, is only partially degraded in wastewater treatment plants.

"If amphibian populations are exposed to hormonal effects, it may lead to their global extinction, as well as causing other risks."
Matthias Stöck

In collaboration with colleagues from IGB and the University of Wrocław (Poland), Stöck compared the effects of EE2 on the sexual development of three amphibian species. The results show that oestrogen from the pill can lead to the complete feminisation of genetic males. Using molecular markers, this proof was furnished for the first time in Europe for wild tree frogs and green toads. The team compared the genetic and the phenotypic sex of specimens, enabling them to record the exact quantitative effect of EE2 for the first time. Although sex reversal occurred in all three amphibian species, they responded with differing degrees of sensitivity. This also has consequences for biodiversity: "If amphibian populations are exposed to hormonal effects, it may lead to their global extinction, as well as causing other risks," Stöck warns.

Project: Heisenberg scholarship "Evolution of Sex Chromosomes, Sex Determination Systems and Recombination and Significance for the Speciation and Protection of Amphibians", **Duration:** 10/2012 – 11/2017, **Funded by:** DFG, **Direction:** PD Dr. Matthias Stöck, matthias.stoeck@igb-berlin.de, **Involving:** Department 5

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Photo: David Ausserhofer

“Cyanobacteria are among the Beneficiaries of Climate Change and will Continue to Grow in Importance in Productive Lakes”

Global climate change affects all ecosystems, including lakes – and is therefore the focus of long-term research conducted by Rita Adrian, Head of the Ecosystem Research department at IGB. In an interview, the IGB researcher explains how climatic changes have already had an impact on lakes and what we can expect in the future.

Ms. Adrian, what environmental changes are lakes already exposed to?

Rita Adrian: Lakes are influenced to a great extent by global warming and the input of substances from their respective catchment area. Both effects act in parallel, increasing the risk of the eutrophication of lakes – the excessive enrichment with nutrients disturbing the lake’s ecological balance.

How?

Increases in air temperature result in an increase in water temperatures. Since 1985, the global average of the temperature increase of the surface water of lakes in summer has increased by 0.32°C per decade. The warming trend of Berlin’s shallow Müggelsee since 1976 has in fact been 0.54°C per decade. Consequently, the upper limit of increases in air temperature adopted in the Paris Agreement in 2015 has already been exceeded in lakes.

What effect does the temperature rise have on lakes, how do they react to it?

Their thermal structure changes. We have observed an increase in the duration of the thermal stratification of lakes in summer. In productive lakes such as Berlin's Müggelsee, the extension of the duration of thermal stratification leads to an increase in oxygen-free conditions in hypolimnic water, and subsequently to the release of nutrients such as phosphorus that were previously bound in sediment. This climate-induced lake-internal fertilisation promotes the eutrophication of lakes and consequently the development of Cyanophyceae blooms. Cyanophyceae are perfectly adapted to high temperatures, stable thermal stratification and high nutrient concentrations – under climate change, all three variables change to the advantage of these microorganisms. Other prominent changes in ecosystems in the context of global climate change are changes in phenology – the timing of distinct seasonal events. We are seeing drastic changes in this area: the ice starts breaking up earlier, which improves the light conditions in lakes. As a result, algae start to develop earlier in spring: on average, almost one month earlier in lakes of the northern temperate zone.

And what is your prediction for our lakes in the future?

It appears to be the case that lakes are becoming warmer and more oxygen-deficient in the wake of climate change, and that thermal structures will change in the long term. In addition, lake ecosystems are likely to undergo abrupt change once critical boundaries – referred to as tipping points – are exceeded.

Is it possible to predict such abrupt changes?

No, unfortunately not. We have investigated known occurrences of abrupt changes in European and American lakes for early warning signals. These are generic statistical changes in a time series that theoretically predict rapid changes. The mechanisms underlying the abrupt changes in the tested lakes are very well known, thanks to empirical time series spanning 30 to 40 years. We have tested four such signals and ascertained that they were not early warning signals that are able to predict abrupt changes with certainty.

Which topics will your group address in the future?

We will continue to conduct our climate impact research. Biodiversity, the metabolism of lakes, the role of temporal scales, and the effects of extreme events will be our key areas. To be more specific, we are exploring the following questions: How is biodiversity created and how can it be preserved? What time scale do we need to look at in order to understand the dynamics of lakes? Will we fail to identify central mechanisms if we only take measurements at monthly or weekly intervals? Global networks such as GLEON and NetLake, in which data of a high temporal resolution is measured in lakes around the world, now offer us a global perspective of the situation. Intense data exchange and close cooperation take place within such networks. Data management and the development of global data portals will increase in importance in our bid to improve the visibility and accessibility of data. It also remains important for our group to ensure that our findings are incorporated into policy. For example, our work has been incorporated into IPCC (Intergovernmental Panel on Climate Change) reports. IGB has a voice in global climate research, which we want to continue raising.

”

The interview was conducted by Wiebke Peters.

More information and reports on this subject can be found on our "Environmental Change" topic page at www.igb-berlin.de/en/environmental-change

Prof. Rita Adrian | adrian@igb-berlin.de

Numerous staff members were – are – involved in these studies, currently in the "Long-term Development and Climate Impact Research" working group: Silke Schmidt, Ulrike Scharfenberger, Torsten Seltmann, Benjamin Kraemer, Thomas Hintze, Ursula Newen, Katrin Preuss, Barbara Stein, Jürgen Schreiber, Daniel Langenhaun and Simone Frenzel.

Projects:
LakeBase, **Duration:** 09/2015 – 08/2018, **Funded by:** DFG, **Direction:** Professor Rita Adrian, adrian@igb-berlin.de, **Involving:** Department 2

GEISHA, **Duration:** 01/2016 – 01/2019, **Funded by:** CESAB (France) and USGS (USA), **Direction at IGB:** Professor Rita Adrian, adrian@igb-berlin.de, **Involving:** Department 2

MANTEL, **Duration:** 01/2017 – 12/2021, **Funded by:** EU, **Direction at IGB:** Professor Rita Adrian, adrian@igb-berlin.de, Professor Hans-Peter Grossart, hgrossart@igb-berlin.de, **Involving:** Departments 2 and 3

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Photo: David Ausserhofer

News

A Global Database on Biological Field Stations

Thanks to the use of Biological Field Stations (BFS), scientists are able to monitor and explore global change *in situ*, from species extinction, to land use change, to climate change. Biological field stations also play an important role in training young researchers and providing information to the public. Scientists from IGB and the Cary Institute of Ecosystem Studies (USA) have undertaken a global inventory of these individual stations for the first time and compiled the information from them in a publicly accessible database. Most of the just under 1,300 stations are located in near-natural, species-rich ecosystems, representing all biomes and covering marine, terrestrial and freshwater systems.

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Progress at the BeGenDiv

The talents of six institutes and universities come together at the Berlin Center for Genomics in Biodiversity Research. In addition to IGB, the consortium members include the Botanic Garden and Botanical Museum Berlin (BGBM), the Freie Universität Berlin, the Leibniz Institute for Zoo and Wildlife Research (IZW), the Museum für Naturkunde – Leibniz Institute for Evolution and Biodiversity Science, and the University of Potsdam. In 2016 alone, the Center published 26 articles in international peer-reviewed journals. The Center also held its 4th Annual Genomics Symposium in November. Since its foundation in 2012, the Berlin Center for Genomics in Biodiversity Research has subsequently become an important platform for genomics and bioinformatics researchers. Here, scientists join forces to develop innovative methods of modern biodiversity research and to explore which ecological and evolutionary processes influence biodiversity.

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http://begendiv.de

The 2016 Genomics Symposium at the Museum für Naturkunde in Berlin.

Photo: Hwaja Götz @ MfN

Periphyton: The Underrated Control Parameter of Submerged Vegetation

Submerged macrophytes play a key role in stabilising the clear water regime in lakes. However, the eutrophication of many lakes often results in a loss of submerged vegetation, causing the water to become turbid. One of the main causes is the shading of submerged macrophytes by periphyton, which is present in all water bodies. If sufficient light is available, it covers all surfaces, including submerged macrophytes. A team led by Sabine Hilt is exploring which biotic and abiotic factors influence periphyton development and how it interacts with submerged macrophytes. In their studies, the researchers combine field investigations with mesocosm experiments and theoretical modelling. Initial results show, for example, that periphyton causes submerged macrophytes to become more susceptible to animal predation.

Project: Periphyton, **Duration:** 03/2013 – 12/2018, **Funded by:** IGB Fellowship Programme (2013), Leibniz Competition AQUALINK (03/2013 – 03/2016), German Research Foundation (DFG) (01/2016 – 12/2018), Chinese Scholarship Council (12/2016 – 11/2017), **Direction:** PD Dr. Sabine Hilt, hilt@igb-berlin.de, **Involving:** Department 2, Research Domain 2

Hidding B, Bakker ES, Hootsmans MJM, Hilt S (2016) Synergy between shading and herbivory triggers plant loss and regime shifts in aquatic systems. Oikos 125 (10): 1489-1495

Périllon C, Hilt S (2016) Groundwater influx differentially affects benthic primary producers in lakes. Hydrobiologia 778: 91-103

sought-after

Dialogue and Knowledge Transfer

IGB Establishes New Dialogue Formats

IGB Academy: Launch of New Workshop Series

IGB has further expanded its commitment to knowledge transfer by launching a new series of workshops called the IGB Academy. The aim of this format is to convey application-related research knowledge to practitioners. The first event was devoted to combined fish and vegetable farming (aquaponics). Numerous applications were received – those from people with the most interesting ideas and projects were selected for the workshop.

Some 30 practitioners and specialists from the fields of horticulture, fish farming and facility construction gathered at IGB on 28 November 2016 to familiarise themselves with aquaponics and the latest findings in the field. As a public research institute, IGB has adopted a role of providing objective advice to those directly working in the field. In keeping with this mission, IGB researchers highlighted the potential offered by the technology, as well as the obstacles and risks involved in practical aquaponics endeavours. The participants also had the opportunity to exchange information about their own initial experiences and to network with each other. Other practice-oriented IGB topics will be addressed at later events of the IGB Academy series.

The Müggelsee Dialogue: Fish Stocking in a Delicate Balance between the Fisheries Sector and Nature Protection

Fish stocking is a hotly debated wildlife preservation measure in the fisheries sector and in the protection of fish species. For this reason, around 50 experts from the areas of science, the fisheries sector, environmental protection and nature conservation as-

Photo: Juliane Lutze

sociations, authorities and administration gathered for the 6th Müggelsee Dialogue at IGB on 4 October 2016.

The participants used the latest research and practical experience to identify and hotly debate potential options for action and unresolved issues.

The aspects discussed included success factors as well as the environmental and genetic risks involved in fish stocking. Participants also shed light on practical examples from eel and carp stocking, the reintroduction of migratory salmonids, and how the protection of fish species is perceived by the public. The attendees agreed that professional stocking must be reconciled with the requirements of the fisheries sector and nature and water protection, but that this necessitates considerable changes to current stocking practices.

IGB Outlines: The Launch of a New Publication Series at the Institute

The objective of a new series of publications called IGB Outlines is to present socially relevant research knowledge in a manner comprehensible to policymakers, authorities, business, associations and the public.

"Water and freshwaters are the central foundation of human existence. And yet there is rapidly growing pressure on the use of these ecosystems around the world. The scientific community can and should make objective bases for decisions available for society concerning the protection and use of aquatic ecosystems," explains Mark Gessner, Interim Director of IGB.

The publication series consists of three different formats: the IGB Fact Sheet provides a brief, neutral overview of the key facts and findings in addition to the general state of research on a current issue of social relevance. Each IGB Policy Brief presents scenarios or options for action relating to a current policy-relevant issue, aimed at decision-makers and other political actors. Finally, the IGB Dossier is a longer version of the IGB Fact Sheet, for more complex thematic areas in which a research topic is addressed at greater depth, but nevertheless in an easily comprehensible manner.

The first publication in the IGB Outlines series was the IGB Dossier "Sulphate contamination of the Spree" in 2016. The background: sulphates increasingly enter the Spree via its tributaries and groundwater. This may have an impact on ecosystems as well as on drinking water supplies. The topic is the subject of intense public debate, where scientifically grounded arguments are occasionally lacking. In the IGB Dossier, the Institute provides

The first IGB Dossier met with a great response: over 1,500 downloads and broad media exposure reflected the great public interest in the topic of sulphate contamination in the Spree.

the public with a clear compilation of the causes, effects and current findings relating to sulphate contamination, as well as drawing attention to previous knowledge gaps. It was extremely well received by the public: the dossier was downloaded from the IGB website over 1,500 times and also distributed on the websites of other organisations and media. Various political groups, environmental associations and the major media cited the IGB Dossier, created links to it, and commented on it.

The IGB Dossier was created as a follow-up to the 5th Müggelsee Dialogue in November 2015, where IGB researchers had exchanged information and ideas with representatives from science, politics, authorities, administration, environmental associations and industry on the impacts, possible courses of action and the current state of research. In the future, IGB will step up its efforts to directly link such dialogue-oriented formats to the new stakeholder publications. The next manuscripts for IGB Outlines are currently in preparation.

More information and reports on this subject can be found on our "Dialogue & Transfer" topic page at www.igb-berlin.de/en/dialogue-transfer

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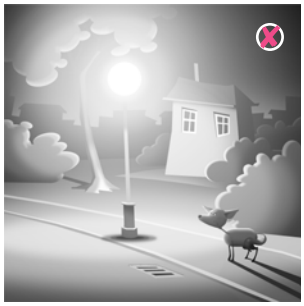
How to Illuminate Correctly: Researchers Publish Recommendations for Exterior Lighting

Street lanterns, facade lighting and commercial displays: virtually nowhere is free from night illumination. It is a known fact that light pollution can have a negative impact on humans and nature. An international research team, which has collaborated for four years within the European "Loss of the Night Network", has published practical guidelines for outdoor lighting. The aim of these guidelines is to contribute to the sustainable use of light in our cities – for the benefit of residents and the environment.

"Light has an effect on plants and animals as well as on us humans," states IGB scientist Sibylle Schroer, coordinator of the network. Even small quantities of artificial light at the wrong time can upset our inner clock, create a hormonal imbalance and confuse predator-prey relationships. "The rapid worldwide increase in night light in recent decades and the global trend towards whiter light has fundamentally changed many night landscapes – with a number of serious consequences for ecosystems and biodiversity," says project leader Franz Hölker.

How this situation can be improved is outlined in practical recommendations for action, which the researchers have now published:

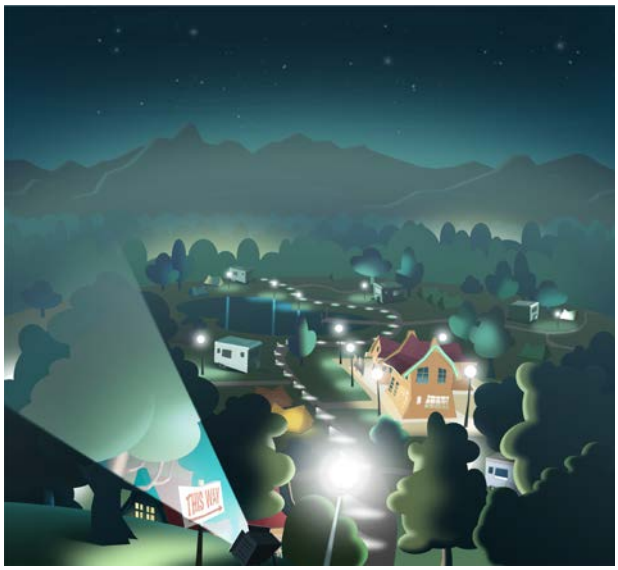
1) Avoid cold white light with wavelengths below 500 nanometres as far as possible: The high proportion of short-wave blue light disturbs the circadian rhythms of higher vertebrates as well as humans. Chronic shifts can interfere with sleep, metabolism and immune defence, leading to serious health problems. Possible consequences are suppressed fat catabolism, diabetes or depression. Outdoor lighting should therefore have a colour temperature of 3000 Kelvin or lower.



2) Use lampshades to direct light where it is needed: Suitable lampshades do not allow light to be seen directly. Properly directed light does not shine into the eyes of pedestrians, into windows or into the sky, where it spreads quickly and illuminates entire landscapes. "Light – including facade lighting – should always shine downwards," advises Sibylle Schroer. For example, ground-recessed spotlights that radiate light upwards should be avoided.

3) Illuminate streets with the lowest possible intensity: Rural roads should only be illuminated with an average luminance of 0.3 candelas per square metre, which corresponds to an illuminance of 4 lux. This complies with the lowest class of the EU standard for street lighting (EN13201). "EU standards recommend much brighter values than are currently implemented in most municipalities," reports Sibylle Schroer. Compliance with standards across Europe could therefore lead to drastically higher energy consumption levels and CO_2 emissions in road lighting. Since lower lighting values do not necessarily jeopardise safety, values should be reviewed and reduced.

4) Adapt exterior lighting to times of use: Much less light is needed after 10 pm or midnight, enabling street lights to be dimmed. A 50-80% reduction of illumination levels is possible.



A poor example of exterior lightning: the light shines into the sky, where it spreads quickly and illuminates entire landscapes.

Proper outdoor lighting directs light to where it is needed and adjusts intensity according to use.

"Private lighting should be turned off completely if there is no immediate need," recommends Sibylle Schroer.

The guidelines are the result of four years of interdisciplinary cooperation within the "Loss of the Night Network", involving 67 active members from 16 different disciplines and 18 countries.

The network is supported by the European Cooperation for Science and Technology (EU-COST Action ES1204, 2012-2016). It will continue to operate as an external team within the EU collective awareness platform for sustainable and social innovation STARS4ALL.

"Light – including facade lighting – should always shine downwards."
Sibylle Schroer

These and other recommendations are available on the IGB-Website as an illustrated flyer for citizens and recommendations for outdoor lighting in nature parks.

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Project: COST Action ES1204 LoNNe (Loss of the Night Network), **Duration:** 01/2012 – 12/2016, **Funded by:** European Cooperation in Science and Technology (COST), supported by the EU Framework Programme Horizon 2020, **Direction:** PD Dr. Franz Hölker, hoelker@igb-berlin.de, **Involving:** Department 1, Research Domain 3
www.cost-lonne.eu

Taxonomy Workshop at IGB

New Findings on the Taxonomy of Phytoplankton and its Relevance for Assessment Methods according to the European Water Framework

Free-floating algae (phytoplankton) are one of four biological components that must be investigated and assessed in large rivers and lakes in accordance with the European Water Framework Directive (WFD) and the Ordinance on the Protection of Surface Waters (OGewV). There may be more than 5,000 of these autotrophic species and clans from a variety of levels of classification (taxa) occurring in Germany's freshwaters. In light of this, a workshop held at IGB in November 2016 was devoted to coding the names of species.

Why is it so important to name species correctly? "In order to be able to assess the ecological status of freshwaters, laboratories and authorities analyse between 1,500 and 2,500 samples taken from Germany's lakes and rivers each year to determine the species composition of phytoplankton," explains Ute Mischke. "The biological findings are assessed using the Phyto Lake Index and the PhytoFluss Index. The relevant assessment software programs (PhytoSee and PhytoFluss) that are used to calculate the assessment indexes contain an annotated list of taxa."

"In order to be able to assess the ecological status of freshwaters, laboratories and authorities analyse between 1,500 and 2,500 samples taken from Germany's lakes and rivers each year to determine the species composition of phytoplankton."
Ute Mischke

Any renaming or changes to the taxonomic position of species in this list may thus have an impact on indicator species and ecological assessment. In order to ensure that assessments do not have to change with every new scientific publication, the coding of taxa names in Germany is only adapted every five or six years. The last update for phytoplankton species in the comprehensive Federal Taxon List of Aquatic Organisms took place in 2011. The annotated list of taxa was last updated in May 2009.

Some 18 to 20 volumes are needed to determine phytoplankton. Although they describe hundreds of taxa, they are not always in line with the latest scientific findings. For this reason, 70 additional individual publications have been listed (as of 2009) to ensure consideration of the latest findings and for rare taxa of freshwater flora. "At least 400 phytoplankton taxa have since been renamed following extensive taxonomic revisions," the IGB researcher pointed out. Sometimes it takes years or even decades for these individual scientific publications to be collected in updated identification guides.

For this reason, Mischke invited experts to a Taxonomy Workshop involving the coding of names of phytoplankton species in November 2016. At IGB, 39 participants from regional authorities and laboratories discussed the significance of the latest findings from modern taxonomy (for example, by molecular genetic analysis) for taxon lists in surface water monitoring, which tend to be more practice-oriented. "Incorporating the knowledge of practitioners and specialists, we have compiled the updating requirements for the nomenclature," she explains. The participants also took the opportunity to exchange information about minimum determination limits, which are based on distinguishing features detectable by light microscopy. Problems encountered with this method for a number of indicator species were therefore also discussed.

The results of the workshop have been summarised in a concept for updating taxon lists, described in the project report (LAWA O2.16). This concept will be implemented in a subsequent project in 2017 in consultation with sections of the German Working Group on Water Issues of the Federal States and the Federal Government.

www.laenderfinanzierungsprogramm.de

Dr. Ute Mischke | mischke@igb-berlin.de

Photo: David Ausserhofer

interconnected

Collaborations and Scientific Events

Conferences and Workshops

European Hyporheic Forum

The first meeting of the European Hyporheic Forum (EHF) took place at IGB in June 2016. Emphasis was placed on the importance of the hyporheic zone (stream beds) for river ecosystems and the self-purification capacities of rivers. As an international platform, the EHF facilitates quick and direct knowledge transfer between different disciplines, as well as between science and practice. The meeting was initiated by HypoTRAIN, an EU-funded project coordinated by IGB. Featuring three internationally renowned keynote speakers, the programme attracted participants from all over the world. More than 20 doctoral students presented their research on posters, initiating interesting discussions. The next EHF meeting will take place in summer 2018.

Project: HypoTRAIN, Duration: 01/2015 – 02/2018, **Funded by:** Horizon 2020, research and innovation programme of the European Union under grant agreement No 641939, **Coordination:** PD Dr. Jörg Lewandowski, lewe@igb-berlin.de, Karin Meinikmann, meinikmann@igb-berlin. de, **Involving:** Department 1, Research Domain 2

www.HypoTRAIN.eu

SWS Conference: Linking Science and Practice

Meeting of the Society of Wetland Scientists (SWS) in Potsdam

Wetlands across Europe are severely threatened. It is therefore important not only to protect existing wetlands and to use them wisely, but also to restore these valuable biotopes on a large scale. Under the leadership of IGB, almost one hundred experts gathered in Potsdam in May 2016. The key topics addressed at the 11th SWS Conference – knowledge transfer, conservation conflicts and management – were discussed in numerous lectures as well as on excursions. The purpose of the three-day event was to find a consensus between natural wetland functions and economic interests. The results of the conference provide information and recommendations for the future management of wetlands, including the mitigation of water pollution, the reduction of greenhouse gas emissions and the promotion of biodiversity.

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Artificial Light at Night

International Conference in Transylvania

The Fourth Artificial Light at Night (ALAN) Conference was held in Cluj-Napoca (Romania) in August 2016. It was the final conference of the "Loss of the Night Network", a COST event that has been coordinated by IGB since 2012. Findings from 18 different disciplines were presented in the lecture programme. The results will be published in two special issues of the recently launched International Journal of Sustainable Lighting. Research results on the issue of light pollution have increased significantly since the ALAN series of conferences was initiated in Berlin in 2013. The next ALAN conference will take place in Utah (USA) in November 2018.

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artificiallightatnight.org
www.cost-lonne.eu

Photo: private

Participants at the Second InDyNet Workshop in Berlin, late November 2016.

The Second InDyNet Workshop

InDyNet (Invasion Dynamics Network) is a group of scientists investigating the temporal dynamics of biological invasions and their impacts. Following the Kick-Off Workshop in 2015, the group came together again in November 2016. Not all of the about 40 participants were present at the first workshop, which meant a mixture of old and new faces. Many participants were from the Berlin region, who were joined by colleagues from other parts of Germany, Europe and from North America. In addition to showcasing the results of previous InDyNet activities, new ideas were presented at the workshop. A number of working groups discussed the most promising of these ideas and developed them further. Work will continue beyond the meeting for publications and presentations at the Third InDyNet Workshop in early 2018.

Project: Long-Term Effects of Invasive Species in Novel Communities, **Duration:** 01/2015 – 12/2018, **Funded by:** German Research Foundation (DFG), **Direction:** Professor Jonathan Jeschke, jeschke@igb-berlin.de, Florian Ruland, ruland@igb-berlin.de, **Involving:** Department 2, Research Domain 1

indynet.de

The Launch of the Human Frontiers Science Program Project

Participants of the international Human Frontiers Science Program (HFSP)'s "Bacteria-Phytoplankton Interactions" project gathered at the kick-off meeting in Neuglobsow from 21 to 23 November 2016. Together, they have planned to conduct a high-throughput screening of all possible combinations of interactions of around 100 different genome sequenced heterotrophic bacteria as well as four autotrophic phytoplankton model systems (diatoms and cyanobacteria). The project focuses on gene expression and metabolite production. Researchers hope that the results will help them to create dynamic flux-based models (FBA), which should enable them to gain a better understanding of all kinds of microbial interactions. By combining knowledge from molecular biology, physiology and biochemistry, the project is venturing a step further, seeking to predict how microbial systems will develop in a drastically changing world.

Project: Interactions among Marine Microbes as they Grow and Die: Linking Experiments and Genome-Scale Models, **Duration:** 11/2016 – 11/2019, **Funded by:** Human Frontiers Science Program (HFSP), **Direction:** Professor Hans-Peter Grossart, hgrossart@igb-berlin.de, **Involving:** Department 3, **Project partners:** University of Haifa (Israel), Boston University (USA), IOW

www.hfsp.org

International Conference on the Conservation of Sturgeons

With the support of IGB and the World Sturgeon Conservation Society (WSCS), an international conference on sturgeon conservation was held in Krasnodar (Russia) from 31 May to 4 June 2016. It was organised locally by the "Kubanbioresursi" State Regional Centre for Sturgeon Gene Pool Conservation, the Russian Ministry of Natural Resources, and the Kuban Sturgeon Farming Institute. More than 200 people from 14 countries participated in the conference. The aim of the meeting was to facilitate the constructive exchange of information between Russian and Western European colleagues on the latest developments in commercial aquaculture, caviar production and breeding for stocking programmes. The conference ended with a visit to production facilities for commercial sturgeon aquaculture and stocked fish as well as a visit to the fish passage facilities at Kuban.

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Photo: Pavel Pipek

Knowledge in the Dark

How much of what we could potentially know do we actually know?

Digital networking means that we can retrieve more information and data than ever before. Scientific datasets now have dimensions that were previously unthinkable ("Big Data"). And yet this development is more or less decoupled from the knowledge and understanding that actually exists in our society: there is a gap between potential and actually existing public knowledge. We call this gap "knowledge in the dark" or simply "dark knowledge". This topic has been the subject of exploration by a discussion group consisting of members of IGB, the Freie Universität Berlin (FU), the Haus der Kulturen der Welt (HKW) and other partners since September 2016.

"Post-truth" and the German equivalent "postfaktisch" were voted the German and international Word of the Year in 2016. The Gesellschaft für deutsche Sprache justified its decision by stating that success in the "post-truth era" is not achieved by the aspiration to truth, but by expressing "perceived truth". However, this is not a new phenomenon: a distinct field of research focusing on ignorance has emerged in recent years. This research field is called agnotology.

"Ignorance has different aspects and causes. For example, certain areas of science tend to be investigated intensively, whereas little or no research is conducted in other areas," explains Jonathan Jeschke, who leads the group. There are several reasons for this Matthew effect, such as a stronger emphasis on priority areas by certain funding lines. Another cause of dark knowledge is the ever-increasing specialization and level of disciplinarity in science, combined with the development of an increasing number of technical and professional languages (jargons) that are scarcely understood outside the relevant discipline, acting as a barrier to knowledge transfer.

Furthermore, large amounts of existing data and information are not publicly accessible: "In recent years, industry and science have stepped up their cooperative activities," states Jeschke. "This kind of research promoted by industry leads to results at public research institutions that are sometimes not made publicly accessible, or only in part." This is particularly widespread in medical research where research results are frequently only selectively published.

The "Dark Knowledge" discussion group was initiated by IGB's Research Domain 1 and has been exploring the topic collaboratively since September 2016. "In the process, biodiversity research is the key area of emphasis," explains Sophie Lokatis, who coordinates the work of the group. In addition to colleagues from IGB, the group has members from diverse fields, e.g. political science, sociology, cultural sciences and history. They are affiliated with the Freie Universität Berlin (FU), the Humboldt-Universität zu Berlin (HU), the Haus der Kulturen der Welt (HKW) and the Max Planck Institute for the History of Science. Members of the Art Science Node, a transdisciplinary project at the juncture between art, science and technology, also joined the group at the beginning of 2017.

"Our Dark Knowledge project attaches great importance to promoting and advancing this kind of transdisciplinary cooperation with other institutions in the Berlin-Brandenburg region," stresses Jonathan Jeschke. The members join forces to develop novel approaches that allow narrowing the gap between potential and actual knowledge, particularly on aquatic biodiversity. Two manuscripts on the topic have been completed, and there will be a Dark Knowledge session in Alpbach, Austria, in August 2017.

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Involving: Research Domain 1, Departments 2, 3 and 4, PR and Knowledge Transfer

committed

Career Development
and Public Engagement

News

Unchartered Waters: IGB Continues its Internal Series of Workshops

Producers of knowledge may well benefit from discussing the potential and outcomes of their research with actors from politics, business and the media, but it can also be very challenging. Sometimes the actors' logics of action, interests and "languages" appear to differ too greatly. In a bid to help researchers engage in exchange with target groups in society, IGB launched an internal series of workshops called "Unchartered Waters" in 2015. During training sessions with external contributors, researchers find out how to communicate and exchange knowledge efficiently with different stakeholders. This also includes practical exercises, enabling participants to look at a situation from the viewpoint of their dialogue or cooperation partners. In addition to media and camera training sessions, workshops on the topic of political consultation and a crash course in business were also held in 2016. The series of workshops is part of the Science Society Interface at IGB, which seeks to enhance the transfer of research knowledge to society as a whole.

Johannes Graupner and Angelina Tittmann | ssi@igb-berlin.de

In training sessions such as, in this case, a crash course in business, researchers assume a new role and work on case studies, which are then presented to the group and assessed.

A Fresh Impetus and a New Record in the Doctoral Degrees of Young Researchers

New "Rules for Doctoral Research at IGB" were introduced in May 2016. As a result of an extensive internal evaluation and discussion, these rules provide a new foundation for the supervision of doctoral candidates at IGB. "The new rules offer a better structure for supervision in the future," states Kirsten Pohlmann, Coordinator of the Doctoral Programme. Besides tried-and-tested courses, the doctoral programme also offered new courses that have received a great deal of praise from participants. These new courses included an introduction to QGIS, efficient reading, and an introduction to analysing stable isotopes.

The career development of postdocs, launched in 2015, was stepped up considerably in 2016: the IGB Postdoc Society hosted its first PostDoc Retreat as well as a series of mentoring sessions on the topics of group leadership, time management and applying for group leader positions. In light of the popularity of these activities, they will be continued next year.

2016 also saw the completion of the most doctoral degrees since the establishment of IGB: 20 doctoral candidates successfully defended their doctoral theses. Moreover, another 27 successfully completed Master's theses, one Diplom thesis and seven Bachelor theses offer further testimony to the quality of young researchers at IGB. Kirsten Pohlmann and the entire IGB wish these graduates all the best for their future careers!

The new Rules for Doctoral Research at IGB can be downloaded from the IGB website.

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Photo: Angelina Tittmann

Events

Wild Rivers on the Silver Screen

Berlin's first "FlussFilmFest" took place between 22 and 24 January 2016. Over 30 films were screened, showing rivers in Germany and the rest of the world as fascinating yet endangered habitats. Introductions and rounds of discussions drew the audience's attention to the ongoing destruction of these habitats due to dams, pollution and overuse. The FlussFilmFest was organised by GRÜNE LIGA e.V. as part of the "Wild & Scenic Film Festival," originating from North America. IGB was responsible for providing the festival with scientific support. Impetus came from former IGB Director Klement Tockner on the first evening: "It is important for us to retain our last wild rivers – not only for future generations, but also as natural reference systems for future restoration," he stated. At the same time, he warned of a rapid decline in biological diversity. This diversity of life represents information that has accumulated over several billion years of evolution. This unique information is lost forever every time a species or a population disappears.

During the FlussForscherMatinee (RiverScientistMatinee) on Saturday morning, IGB researchers Simone Langhans, Jörn Geßner and Gabriel Singer discussed issues such as usage conflicts, restoration and species reintroduction with the cinema audience. The matinée opened with a cinema premiere of the "Flussfisch" music clip. For the video, the Swiss band "Knuts Koffer" set the scientific work of Simone Langhans to music at the Havel and Spree rivers. The aim of the event was to further expand the dialogue between IGB researchers and different target groups of society.

https://youtu.be/6MJkQOao_dw

Angelina Tittmann and Johannes Graupner | ssi@igb-berlin.de

Photo: Thilo Arnhold

Water Protection at Environment Week

Federal President Joachim Gauck hosted the "Fifth Environment Week" in the park of Schloss Bellevue, his official residence, on 7 and 8 June 2016, which was enjoyed by 12,000 visitors. Participants praised the "great atmosphere, almost resembling an enormous garden party." From the 600+ entries received, the jury selected 190 exhibitors from the fields of business, science, civil society, politics and the media, who were given the opportunity to present their innovative projects for the environment and sustainability. IGB was also present, showcasing its projects LakeLab and Moneris, which have been financed in part by the German Federal Ministry of Education and Research. The LakeLab, a large on-site experimental facility, is used to explore the impact of global environmental change on lakes; Moneris focuses on flowing waters and their nutrient loads. In addition, Klement Tockner was also available to answer questions from the audience as a member of a panel of experts during a forum on the topic of citizen science, which was also attended by Federal President Joachim Gauck.

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An Impetus for Sustainable Wildlife Preservation

The Besatzfisch (fish stocking) project is social-ecologically engaged in exploring the scientific foundations of sustainable fish stocking and alternatives to this method of fisheries management. The project team presented their findings during a series of seminars in six cities throughout Germany during autumn 2016. About 600 river keepers, anglers and representatives from associations and authorities took the opportunity to attend the free advanced training on modern principles of angling management. During the seminars, the project team presented the basics of fish population dynamics and yield development, principles of sustainable fish stocking, planning fundamentals for sustainable wildlife preservation, and a new wildlife preservation planning software program developed by the IGB team led by Andreas Mühlbradt and Fiona Johnston. Project cartoons and explanatory films served as valuable sources of entertainment. All of the materials and videos presented, as well as lecture notes, are available online.

Project: Besatzfisch 2.0, **Duration:** 01/2016 - 12/2016, **Funded by:** Federal Ministry of Education and Research (BMBF), **Direction:** Professor Robert Arlinghaus, arlinghaus@igb-berlin.de, **Involving:** Department 4, Research Domain 3

www.besatz-fisch.de

Arlinghaus R, Alós J, Beardmore B, Díaz Á, Eschbach E, Hagemann R, Hühn D, Johnston F, Klefoth T, Lübke K, Matsumura S (2016) Hechtbestandsmanagement in der Angelfischerei - Möglichkeiten und Grenzen der Hege über Besatz, Habitatmanagement und veränderte Fang- und Entnahmebestimmungen. Deutscher Angelfischerverband, Fisch des Jahres 2016 - Der Hecht *(Esox lucius)*, 19-53

All Besatzfisch cartoons are available on the playlist of the IGB YouTube channel (in German only):

Guests and Events

Laughing is good for you. Which is why IGB's Besatzfisch research project provided special training for the laughter muscles at the **48th Science Slam** in Berlin-Kreuzberg on 3 March. Under the title "Cool pike seeks partner – an insight into the chronicles of a stocked fish", the ten-minute slam entry presented a few of the key project results to all science aficionados, fish fanciers and humour lovers in a stunning stage programme.

1 Eleven girls took the opportunity to look over the shoulders of researchers and technical staff during **Girls' Day** on 28 April. Emphasis was placed on bogs as important habitats and rivers in the landscape.

2 ARTE and the Science Department of the French Embassy invited visitors to an **advance premiere of the science documentary "Verlust der Nacht, die globale Lichtverschmutzung" (Loss of the Night, Global Light Pollution)** on 29 April. Following a screening of the film, a lively panel discussion took place between IGB researcher Franz Hölker and Bruno Lafitte (ADEME, France).

3 **"Elbe – find' ich gut!" (I find the Elbe good)** was the slogan of a BildungsCent workshop at the Fritz Reuter Grammar School Centre in Dömitz. During the workshop on 14 June, 42 students from two ninth grade classes and eleven experts discussed whether it is possible to return the Elbe to a more natural state in spite of its economic exploitation. IGB's Jörn Geßner and Angelina Tittmann were also involved in responding to these key issues.

4 Around 350 people attended **IGB's open day at Lake Stechlin** on 4 June. "I could have listened to them for hours, it was just like being at university!" was the enthusiastic response of one visitor who left the event some time late in the afternoon. Visitors often remained for several hours to make the most of the varied and entertaining information. And if any of their questions had yet to be answered, visitors were happy to return to IGB's LakeLab.

5 IGB researchers turned night into day at the **Long Night of the Sciences** on 11 June, showcasing their scientific work together with six other institutes at the Leibniz Association headquarters. Around 1,000 visitors took the opportunity to find out about some of IGB's research topics, such as microplastics, aquaculture and biological field stations. They were also involved in a blind tasting session, where tomatoes grown using the INAPRO aquaponics system were compared with conventionally produced tomatoes.

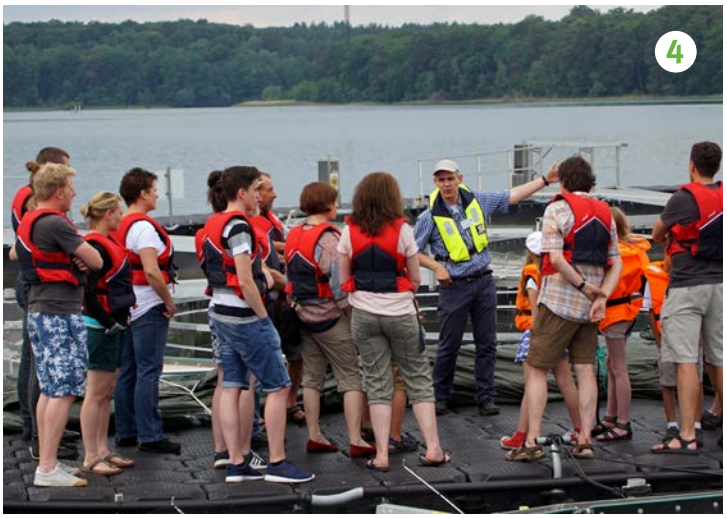
6 Biodiversity protection as a global challenge was showcased at an **open-air salon** for the whole family and an expert symposium in Berlin on 1 and 2 July. Adopting the motto "The best of all worlds is species-rich", professional researchers and volunteer species experts at the Hausvogteiplatz in Berlin shared their knowledge about biodiversity and how it is at risk in Germany. Jonathan Jeschke and Hans-Peter Grossart and their teams presented animals that had been introduced to the country as well as different species of plankton.

7 On 10 August, a **delegation of Chinese researchers** from China Agricultural University (CAU) and the Inner Mongolia Agricultural University visited IGB's aquaponics system. A floating pilot plant proved particularly popular.

8 Following nine years in the capacity of IGB Director, Klement Tockner joined the Austrian Science Fund in Vienna. He said farewell to IGB as well as partners from the fields of science and politics during a **celebration in the IGB garden** on 2 September. Among the guests were Matthias Kleiner, President of the Leibniz Association, and Jutta Koch-Unterseher, Secretary of the Berlin Senate Department for Economics, Technology and Research.

9 **Steffi Lemke, Member of the Bundestag** (B'90/Die Grünen), visited IGB on 27 October. IGB researchers presented their findings on issues such as the nutrient contamination of freshwaters, the effects of hydropower utilisation, microplastics and the reintroduction of the sturgeon. Another topic of discussion was the relationship between research and professional politics: "I realised that much of the research work discussed is also significant to my parliamentary work in the Bundestag. My visit to IGB has once again demonstrated where junctures can develop between science and politics," stated Lemke.


3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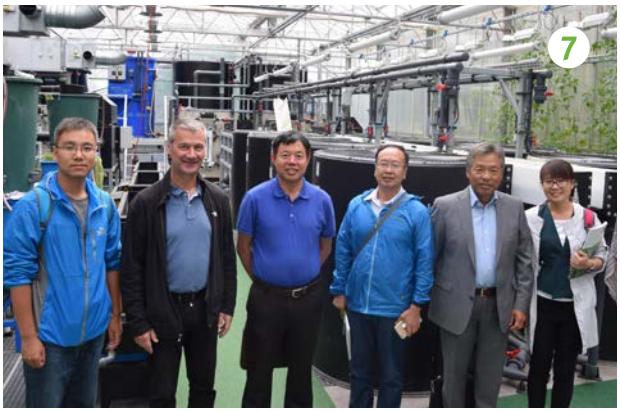
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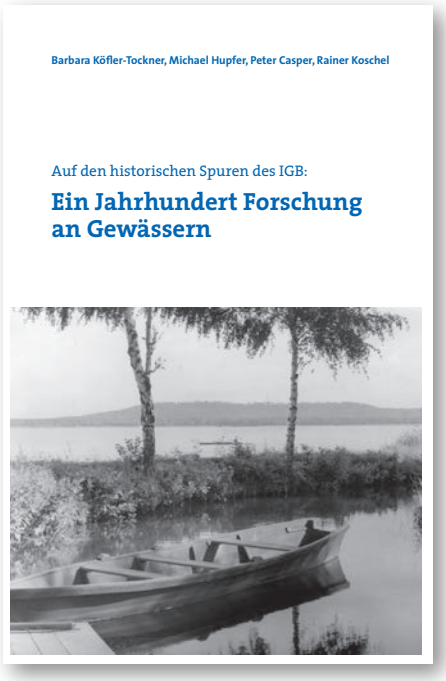
Photos: Nadja Neumann, Jarek Godlewski, Marc Kupetz, Christoph Herbort-von Loeper, Angelina Tittmann (3), Hendrik Monsees, Juliane Lutze

A century of research on waters

Book on the historical roots of IGB

IGB was founded in January 1992. However, its long history dates back much further into the past, since the institute evolved from three different institutions. To mark the 25th anniversary of IGB, a book has been published about the institute's history. Rather than focusing on the 25 years of IGB, the book explores IGB's predecessor institutions, including the turbulent transitional phase between the political changes in the GDR in 1989 to the establishment of IGB in 1992.

"The roots of the institute date back to the year 1893, when the Biological and Fisheries Experimental Station was established as one of the first freshwater research facilities in the world at Müggelsee in Berlin-Friedrichshagen," says Barbara Köfler-Tockner. "The Royal Institute for Inland Fisheries emerged from this institution in 1906." In addition, two renowned Academy Institutes of the GDR became part of the IGB in 1992: the Hydrology Department of the Institute of Geography and Geoecology (IGG) and the Department of Experimental Limnology in Neuglobsow at Lake Stechlin as part of the Ecology division of the ZIMET Jena.



The book can be ordered from Lydia Koglin or Michael Hupfer at the IGB library for a nominal fee of € 10.

Together with her co-authors, the graduate historian portrays a detailed history of the three institutions. Besides reproducing numerous historical photos, she also gives brief portraits of key researchers and provides a selection of the most important publications. "The 120-page book opens up further research possibilities for readers, offering a comprehensive collection of source material," she explains.

Barbara Köfler-Tockner's research and documentation efforts involved undertaking long journeys to visit contemporary witnesses. The chronology and background to the turbulent period more than 25 years ago that led to the current structure and orientation of IGB are therefore superbly accurate. Readers are taken back in time: "It becomes apparent that the GDR's scientific system was adapted under great time pressure. This adjustment process often led to the destruction of research potential, disappointments and upheaval in the lives of affected employees," says Barbara Köfler-Tockner. However, the founding of IGB could be seen as a positive example of successful restructuring, or rather as a "rebirth", as Harald Rosenthal puts it in his preface.

The recollections of limnologist Arnold Nauwerck highlight the dilemma that most commissioners from the old federal states found themselves in. In retrospect, talking about the need to rehire scientists at his own institute, he felt it strange to "sit here and to make decisions about colleagues who are scientifically as good as you are – or even better."

Co-authors Michael Hupfer, Peter Casper and Rainer Koschel are long-standing members of IGB, and more or less part of the story themselves. When asked why such a book is needed today, they agree: "The answer may vary according to one's age and relationship to IGB. To us, however, it is clear that many of the foundations for the current position of IGB as one of the most renowned sites of water research in Germany were laid in the past." Delving into the past helps us determine locations and identify with IGB, which is connected to the work of many outstanding personalities in water research.

Lydia Koglin | koglin@igb-berlin.de
Dr. Michael Hupfer | hupfer@igb-berlin.de

Köfler-Tockner B, Hupfer M, Casper P, Koschel R (2016) Auf den historischen Spuren des IGB: Ein Jahrhundert Forschung an Gewässern. Berichte des IGB Heft 29, 120 S

outstanding

Awards and Honours

Awards and Honours

Robert Arlinghaus was awarded the 2016 CULTURA Prize by the Alfred Toepfer Stiftung F.V.S. for his cross-disciplinary research work. CULTURA, the European Award for Sustainable Land Use, was launched in 2008 to recognise and honour innovative and exemplary scientific achievements in the areas of nature conservation, agriculture and forestry, and related sciences. The prize, worth € 25,000, is awarded annually. 1

Prof. Robert Arlinghaus | arlinghaus@igb-berlin.de

Tobias Goldhammer won the 2016 Hans Cloos Prize, awarded by the German Geological Society (DGGV). He received the prize for his scientific achievements in the field of global biogeochemical cycles. His work was considered to be an outstanding contribution to research of the sedimentary phosphorus cycle. The prize is awarded to young geoscientists. 2

Dr. Tobias Goldhammer | goldhammer@igb-berlin.de

IGB scientists **Hans-Peter Grossart** 3 and **Thomas Mehner** 4 have been made Fellows of the Association for the Sciences of Limnology and Oceanography (ASLO). ASLO is the leading international scientific society in the field of limnology and oceanography. Every year, honours are awarded to members who have made an outstanding contribution to the progress of aquatic research and whose findings have benefited society.

Prof. Hans-Peter Grossart | hgrossart@igb-berlin.de
PD Dr. Thomas Mehner | mehner@igb-berlin.de

The idea of IGB's doctoral candidate **Hendrik Monsees** to host a citizens' workshop on sustainable aquaculture won an award within the Science Year 2016*17. The € 10,000 prize money from the "Zeigt eure Forschung!" (Show your Research!) competition is being used by Monsees and his team to set up an exciting dialogue format, also involving the joint production of a film with the participants.

Hendrik Monsees | h.monsees@igb-berlin.de

Fiona Johnston was awarded the Advancement Award of the Verband Deutscher Fischereiverwaltungsbeamter und Fischereiwissenschaftler (VDFF) for her work on analysing interactions between the development of fish stocks and the satisfaction of anglers as the basis for models for optimising the management of target species for anglers. The prize, which comes with € 2,000, is awarded annually for outstanding work in the German fisheries sector. 5

Dr. Fiona Johnston | johnston@igb-berlin.de

Kate Laskowski was nominated as Referee of the Year by the journal Behavioral Ecology. Chief Editor Leigh Simmons acknowledged in particular the number and quality of the reviews that she wrote for the journal's articles as well as the excellent feedback she gave to authors and referees. 6

Dr. Kate Laskowski | laskowski@igb-berlin.de

During his one-year sabbatical, **Michael T. Monaghan** served as visiting professor at the Department of Engineering and Environmental Technology of Ehime University in Matsuyama (Japan) as well as on the "Emerging Infectious Diseases Programme" at Duke-NUS Medical School in Singapore. His stay was facilitated by a research fellowship from the Japan Society for the Promotion of Science (JSPS). 7

Dr. Michael T. Monaghan | monaghan@igb-berlin.de

Photos: David Ausserhofer (5), privat, Andy Küchenmeister

ERC Starting Grant: Unravelling Fluvial Carbon Fluxes

River ecosystems are an important part of the global carbon cycle, converting large quantities of terrestrial organic matter (TOM) from surrounding terrestrial ecosystems. The resulting carbon dioxide flows released into the atmosphere are constantly being reassessed by researchers – not least because of their importance for the carbon cycle and climate change. In contrast to this global significance, research into underlying ecosystem processes generally focuses on the local level of individual isolated ecosystems. This gap restricts our understanding of processes between different scales, limits the precision of projections, and reduces our scope of strategies for dealing with climate change. IGB scientist Gabriel Singer, seeking to close this scale gap in our understanding of ecological correlations, has been awarded an ERC Starting Grant for his interdisciplinary approach spanning biogeochemistry and ecology.

"This basic research will focus mainly on ecological processes at the regional scale of river ecosystems, enabling us to gain a deeper, mechanistic understanding of biogeochemically relevant carbon fluxes," explains Singer. His innovative approach is based on three basic assumptions: (1) The molecular diversity of organic matter is extremely high. To ensure an efficient conversion of matter, there must therefore be a high level of biodiversity among its "consumers", such as microbes, fungi and insects. (2) This biodiversity depends on a dynamic exchange of species between partially isolated ecosystems which together, at the regional level of an entire fluvial network, form a meta-ecosystem with a meta-community. (3) The rules relating to how the branched structure of a fluvial network creates a meta-community are radically different from those that determine regional diversity patterns of organic matter. It is therefore not easy to predict which biodiversity of consumers will encounter which molecular diversity of important resources for a complex fluvial network.

Singer believes that carbon respiration in "fluvial meta-ecosystems" is the interactive product of spatially structured resource and consumer diversity at the regional level: "I suspect that this coupling of the meta-community structure with meta-ecosystem functioning is influenced by the spatial structure of the fluvial network as well as by anthropogenic fragmentation (e.g. due to sections that have fallen dry or dams), and by the scale of spatial variation of the surrounding area (e.g. due to land use patterns)."

His project combines experiments in innovative laboratory meta-ecosystems with spatially explicit modelling on the basis of computer models and field studies in real-life fluvial networks.

"The aim of this interdisciplinary work is to help develop an innovative, mechanistic understanding of the processes behind carbon fluxes in flowing water networks at the decisive landscape level," he hopes.

Singer has been conducting research at IGB since 2013. Before that, he worked at the University of Vienna and the WasserCluster Lunz am See in Austria, where he explored the functioning of biofilms in brooks with Tom Battin, gaining initial experience in flowing water networks. His current key research areas include ecosystem functions and biodiversity in aquatic systems, particularly in brooks and rivers at the local and regional level. He is particularly keen to describe chemical properties and the conversion of organic carbon compounds.

Project: ERC Starting Grant 2016, Fluvial Meta-Ecosystem Functioning: Unraveling Regional Ecological Controls Behind Fluvial Carbon Fluxes (Grant No. 716196), **Duration:** 04/2017 – 03/2022, **Funded by:** European Research Council (funding amount € 1,487,000), **Direction:** Dr. Gabriel Singer, gabriel.singer@igb-berlin.de, **Involving:** Department 1

"The aim of this interdisciplinary work is to help develop an innovative, mechanistic understanding of the processes behind carbon fluxes in flowing water networks at the decisive landscape level."
Gabriel Singer

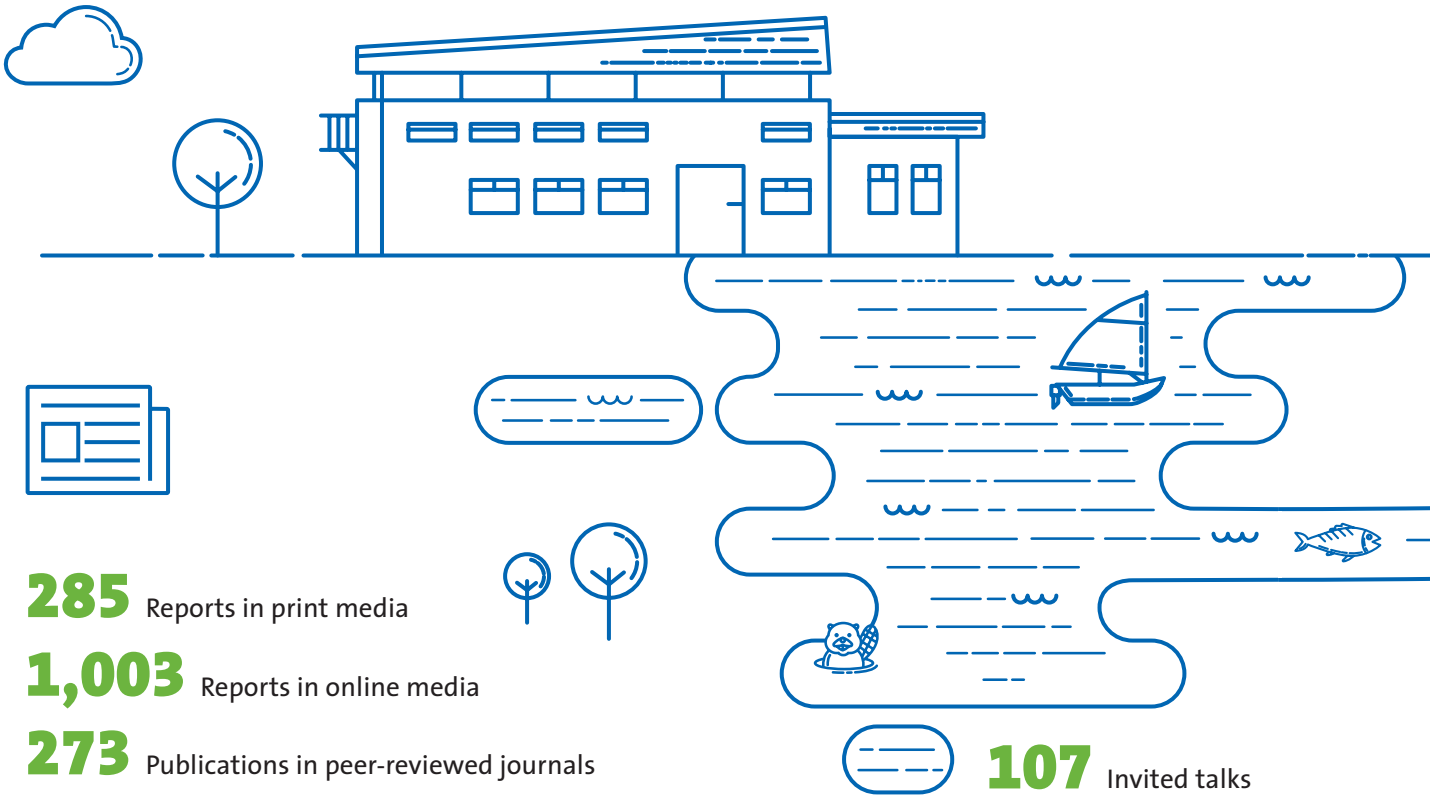
Photo: David Ausserhofer

annex

Key Figures at a Glance

229 Employees
(including **141** scientists)

20 Employees active in committees
and expert associations



285 Reports in print media

1,003 Reports in online media

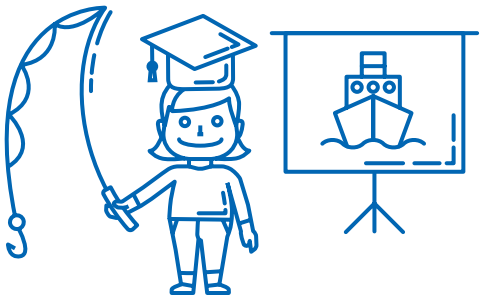
273 Publications in peer-reviewed journals

107 Invited talks

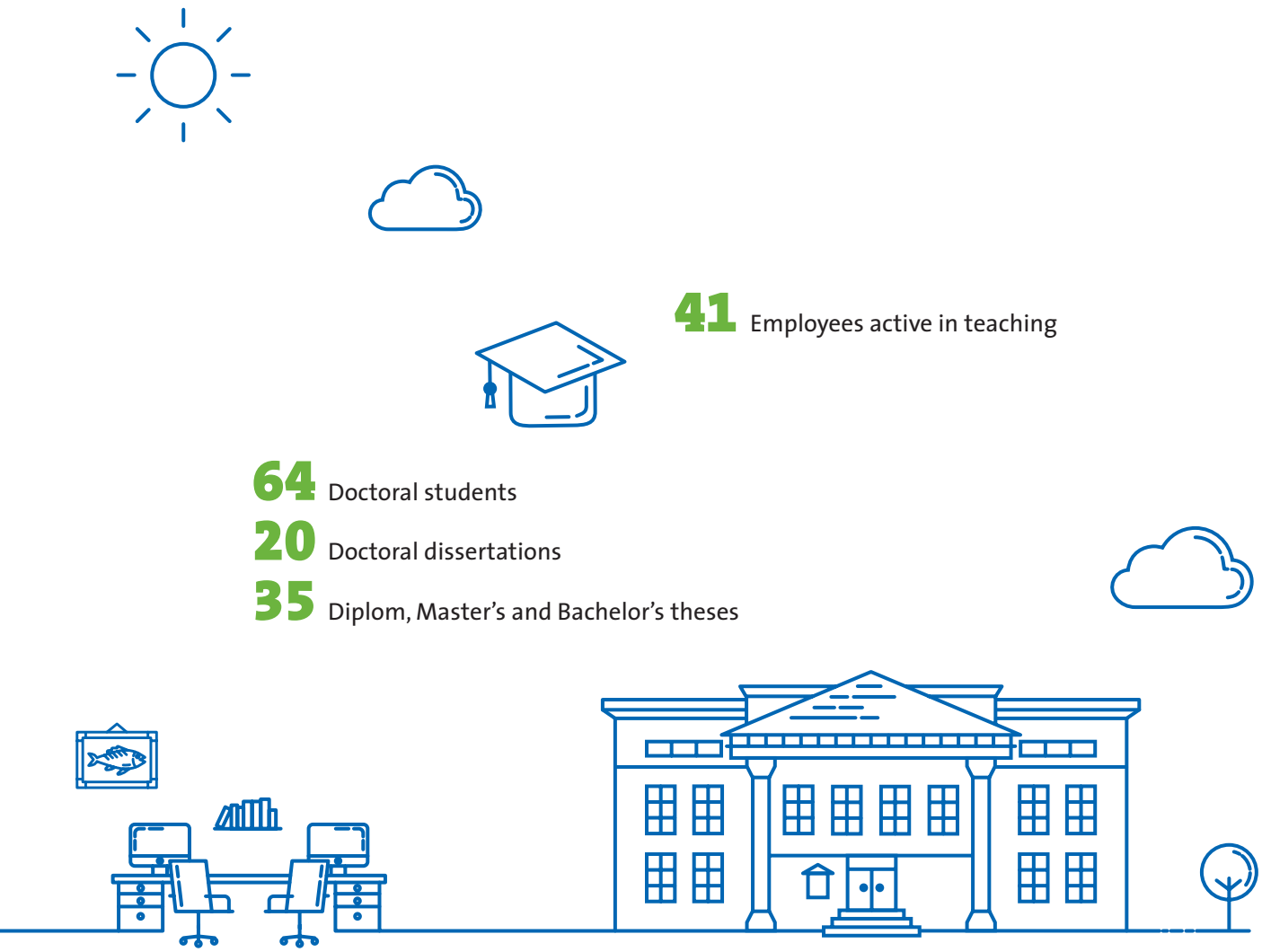
including **32** plenary talks and
keynote lectures
at international congresses

28 Scientific events and workshops
including **16** with international
participation

with in total
1,600 participants



Status as of 31 December 2016



41 Employees active in teaching

64 Doctoral students

20 Doctoral dissertations

35 Diplom, Master's and Bachelor's theses

11 Joint professorships with universities

29 IGB colloquia

External grants: **6,445,193.45 €**
including **1,270,401.10 €** EU grants

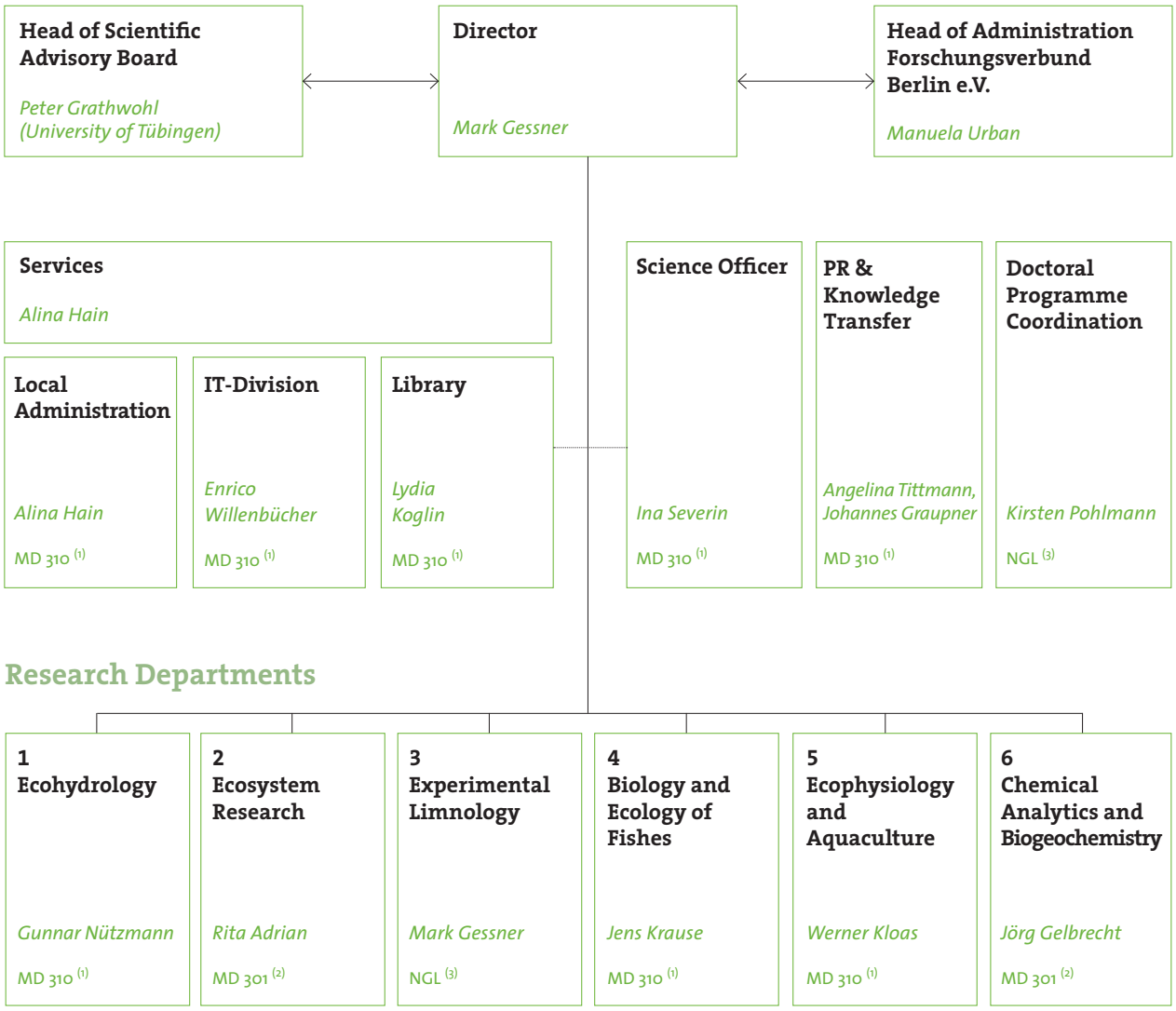
Internal budget: **13,170,397.01 €**

Overall budget: **19,615,590.46 €**

Proportion of external funding: **33 %**

Structure

Leibniz-Institute of Freshwater Ecology and Inland Fisheries
Forschungsverbund Berlin e.V.



Research Departments

Cross-cutting Research Domains

1 – Aquatic Biodiversity

Hans-Peter Grossart & Jonathan Jeschke
NGL (3) & FU Berlin

2 – Aquatic Boundaries and Linkages

Michael Hupfer
MD 301 (2)

3 – Human-Aquatic Ecosystem Interactions

Christian Wolter
MD 310 (1)

(1) MD 310: Müggelseedamm 310, Berlin (2) MD 301: Müggelseedamm 301, Berlin (3) NGL: Neuglobsow

Status as of 31 December 2016

Departments

Disciplinary research is pooled in our six research departments.

Department 1 – Ecohydrology

The overarching objective of research conducted in Department 1 is to identify fundamental physical and biogeochemical mechanisms occurring in flowing waters and lakes. We focus in particular on processes in/at aquatic interfaces and on transport and turnover between water and land. Such interfaces, or transitional zones, are particularly reactive or ecologically sensitive zones, e.g. between surface and ground water, between rivers and their riverbeds, between aquatic plants and the surrounding water, between lakes and their sediment, and even within water bodies such as in the stratification of lakes separating the epilimnion from the hypolimnion. We seek to gain a better understanding of aquatic ecosystems and to find innovative ways to manage inland waters.

Contact:
Professor Gunnar Nützmann
nuetzmann@igb-berlin.de

Research Groups

- Dr. Franz Hölker: Light Pollution and Ecophysiology
- Dr. Jörg Lewandowski and Professor Gunnar Nützmann: Groundwater-Surface Water Interactions
- Dr. Gabriel Singer: Ecology of Stream Ecosystems
- Dr. Alexander Sukhodolov: Ecohydraulics
- Dr. Markus Venohr: Nutrient Balances in River Basins
- Dr. Georgiy Kirillin: Lake Physics

Department 2 – Ecosystem Research

In Department 2, we investigate the effects of the trophic level, hydromorphology and climate on lake and river ecosystems, as well as their stability and long-term development. We study interactions between biotic ecosystem components (microorganisms, plankton, macrophytes, macroinvertebrates and parasites) and their physical and chemical environment as well as the key processes of physical limnology, primary production, evolution, and carbon flux. We employ techniques used in molecular biology and genomics, laboratory and field research; we exploit long-term databases and apply statistical and deterministic models. Our research, integrated into global research on the effects of climate change and biodiversity, provides the basis for developing theoretical concepts.

Contact:
Professor Rita Adrian
adrian@igb-berlin.de

Research Groups

- Professor Rita Adrian: Long-term Development of Lakes and Climate Impact Research
- Dr. Sabine Hilt: Ecology of Macrophytes – Aquatic-Terrestrial Coupling
- Dr. Sonja Jähnig: Global Change Effects on River Ecosystems
- Professor Jonathan Jeschke: Ecological Novelty and Theoretical Ecology
- Dr. Jan Köhler: Photosynthesis and Growth of Phytoplankton and Macrophytes
- Dr. Michael T. Monaghan: Molecular Ecology – Evolution and Biodiversity in Freshwater
- Dr. Martin T. Pusch: Functional Ecology and Management of Rivers and Lakeshores
- Professor Justyna Wolinska: Disease Evolutionary Ecology

Department 3 – Experimental Limnology

Department 3 is located north of Berlin on the shores of Lake Stechlin. We focus on assessing the consequences of global environmental change on the biodiversity and functions of aquatic ecosystems. Much of our efforts is devoted to microorganisms and processes mediated by microbial activities. In addition to investigating bacteria suspended in water and associated with sediments and organisms, we study the dynamics of algae, zooplankton, fungi and viruses. Ecological models, the analysis of long-term data and field experiments, especially in a large facility, the LakeLab in Lake Stechlin, are essential elements of the research conducted in our department. We use the knowledge gained in our research to devise concepts and methods that foster the sustainable management of lakes in the light of rapidly proceeding environmental change.

Contact:
Professor Mark Gessner
stechlin@igb-berlin.de

Research Groups

- Dr. Peter Casper: Microbial Ecology of Sediments
- Professor Mark Gessner: Ecosystem Processes
- Professor Hans-Peter Grossart: Biodiversity and Aquatic Microbial Ecology
- Dr. Peter Kasprzak: Water Management and Zooplankton Ecology
- Dr. Jens Nejstgaard and Dr. Stella Berger: Experimental Phyto- and Zooplankton Ecology
- Dr. Sabine Wollrab: Ecological Modelling

Photos: David Ausserhofer (2), Andy Küchenmeister

Department 4 – Biology and Ecology of Fishes

In Department 4, we seek to understand the ecological and evolutionary processes that structure populations and communities of freshwater fishes and affect their functions. We use this knowledge to improve the management and conservation of wild fish populations. Our work focuses on interactions between natural and anthropogenic ecological factors and their effects on the dynamics of fish populations. The methodological approaches include hypothesis-driven laboratory research, mesocosm experimentation, lake manipulation, comparative field studies and theoretical modelling.

Contact:
Professor Jens Krause
j.krause@igb-berlin.de

Research Groups

- Professor Robert Arlinghaus: Recreational Fisheries, Fish Ecology, Human Dimensions
- Dr. Jörn Geßner: Reintroduction of the European Sturgeon to Germany
- Professor Jens Krause: Collective Behaviour and Social Networks
- Dr. Thomas Mehner: Evolutionary Ecology of Fish
- Dr. Georg Staaks: Experimental Fish Biology
- Dr. Max Wolf: Causes and Consequences of Behavioural Types
- Dr. Christian Wolter: River Revitalization

Department 5 – Ecophysiology and Aquaculture

In Department 5, we investigate the ecophysiological impacts of multiple environmental factors on aquatic vertebrates, in particular fishes and amphibians. Our goal is to create the scientific foundations for sustainable aquaculture. We seek to shed light on how biotic and abiotic factors stress or influence the various physiological functions of individual vertebrates with regard to reproduction, stress, development, growth and behaviour.

Contact:
Professor Werner Kloas
werner.kloas@igb-berlin.de

Research Groups

- Dr. Jörn Geßner: Reintroduction of the European Sturgeon to Germany
- Professor Werner Kloas: Environmental Effects of Endocrine Disruptors; Aquaponics
- Dr. Klaus Knopf: Parasitology and the Immune System of Fish
- Dr. Klaus Kohlmann: Genetics and Phylogeography of Fish
- Dr. Ilka Lutz: Environmental Effects of Endocrine Disruptors
- Dr. Thomas Meinelt: Ecotoxicology in Fish – Disinfection in Aquaculture
- Dr. Sven Würtz: Fish Reproduction and Nutrition; Aquaponics
- Dr. Matthias Stöck: Evolutionary Biology and Effects of Endocrine Disruptors on Amphibians

Department 6 – Analytical Chemistry and Biogeochemistry

Our research focuses on fundamental and applied research questions regarding the biogeochemical transformation of substances in aquatic interfaces (freshwater and wetlands) and of the carbon flux between terrestrial and aquatic ecosystems. This includes investigating greenhouse gas emissions from inland waters as well as developing and introducing in situ techniques for measuring matter flow in high temporal and/or spatial resolution. We also provide services for important parts of chemical analysis; implement measuring programmes for long-term experiments; and accompany PhD students in the analytical research involved in laboratory and field experiments.

Contact:
Dr. Jörg Gelbrecht
gelbr@igb-berlin.de

Research Groups

- Dr. Michael Hupfer: Biogeochemical Processes in Lake Sediments
- Dr. Jörg Gelbrecht: Biogeochemistry and Restoration of Peatlands
- Dr. Tobias Goldhammer: Nutrient Cycles and Chemical Analytics
- Dr. Katrin Premke: Carbon Fluxes in the Landscape

Photos: David Ausserhofer (1), Andy Küchenmeister (2)

Research Domains

Our three research domains are cross-disciplinary in nature and focus on very different thematic priorities. Within the research domains, our scientists perform cross-departmental work to explore issues with high scientific and/or societal relevance:

Research Domain 1 – Aquatic Biodiversity

Research Domain 1 acts as a platform that enables us to systematically tackle the broad field of 'Aquatic Biodiversity' and develop new overarching concepts. In particular, we seek to: 1) explore genetic and species diversity on various spatial and temporal scales; 2) investigate the environmental factors that determine the structure and functions of aquatic communities; 3) improve our understanding of the structure and ecological functions of aquatic communities (biocoenosis); and 4) further develop methods and research concepts. The research domain is subdivided into the thematic areas 'Functional Biodiversity', 'Genomics and Evolution' and 'Stress and Resilience of Ecosystems'. The aim of the research domain is to understand the mechanisms of dynamics and patterns of aquatic biodiversity on various spatial and temporal scales.

Contact:
Professor Hans-Peter Grossart
hgrossart@igb-berlin.de

Professor Jonathan Jeschke
jeschke@igb-berlin.de

Research Domain 2 – Aquatic Boundaries and Linkages

In Research Domain 2, scientists from four departments explore the mechanisms that control the state of aquatic ecosystems and their role in matter fluxes in the landscape. In particular, our research focuses on highly reactive interfaces such as wetlands and ponds; transition zones between ground and surface water; the littoral zones of lakes; and the sediment-water interface. One important aspect of this research domain is the interdisciplinary training of young scholars achieved by initiating and managing post-graduate schools such as the International Graduate School Aqualink; the Innovative Training Network (ITN) HypoTRAIN; and the 'Urban Water Interfaces' Research Training Group funded by the German Research Foundation (DFG).

Contact:
Dr. Michael Hupfer
hupfer@igb-berlin.de

Research Domain 3 – Human-Aquatic Ecosystem Interactions

Waters are indispensable for meeting basic socio-economic human needs such as drinking water supply, flood protection, irrigation, inland navigation, fisheries and recreation. However, human uses often affect ecosystem functions whose importance is insufficiently known or economically underestimated in many cases. For this reason, in Research Domain 3 we investigate the (socio)ecological consequences of different human uses. Our studies on human-aquatic interactions provide an important scientific basis and recommendations for the sustainable management of rivers and lakes.

Contact:
Dr. Christian Wolter
wolter@igb-berlin.de

Photos: David Ausserhofer (3), Andy Küchenmeister (1)

Scientific Advisory Board

Prof. Peter Grathwohl
Head of the scientific advisory board
Hydrogeochemistry, University of Tübingen, Germany

Prof. Joseph Holden
School of Geography, University of Leeds, Great Britain

Prof. Wolfgang Cramer
Mediterranean Institute of Marine and Terrestrial Biodiversity and Ecology (IMBE), France

Prof. Otomar Linhart
Department of Fish Genetics and Breeding, Research Institute of Fish Culture and Hydrobiology, University of South Bohemia, Czech Republic

Prof. Karen Wiltshire
Biological Institute Helgoland & Wadden Sea Station Sylt, Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI), Germany

Prof. Gunilla Rosenqvist
Department of Biology, Norwegian University of Science and Technology, Norway

Prof. Ken Irvine
UNESCO-IHE Institute for Water Education, The Netherlands

Prof. Bernhard Wehrli
Department Surface Waters, Eawag, Switzerland

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Marén Lentz (Vice-Chair)
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Stefanie Burkert

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Postdoc Representatives
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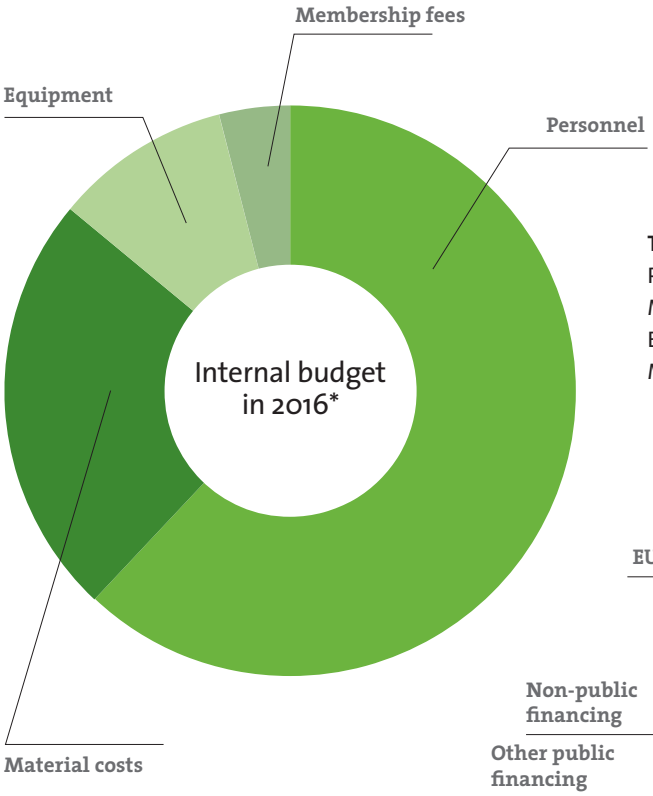
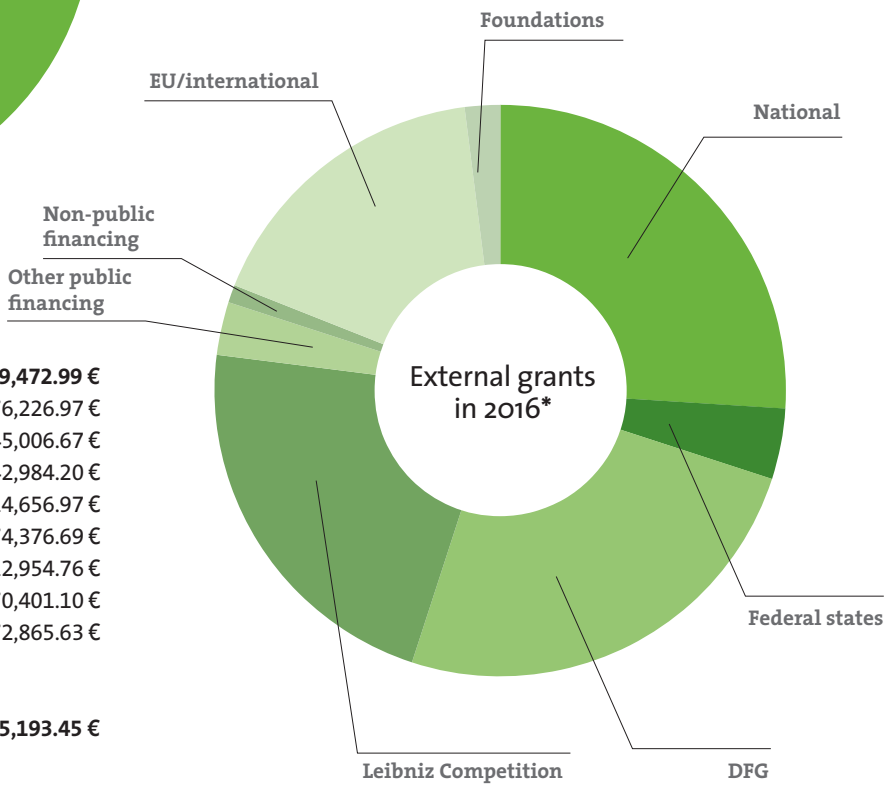
Status as of 31 December 2016

Finances

Status as of 31 December 2016



Total	**13,170,397.01 €**
Personnel	8,511,335.42 €
Material costs	3,102,865.13 €
Equipment	986,617.13 €
Membership fees	569,579.33 €



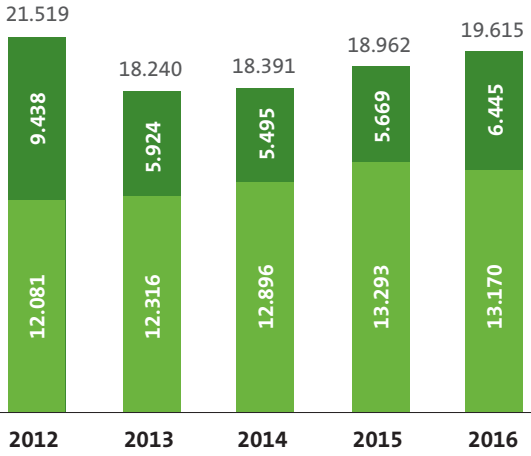
Total	**6,009,472.99 €**
National	1,976,226.97 €
Federal states	245,006.67 €
DFG	1,442,984.20 €
Leibniz Competition	814,656.97 €
Other public financing	174,376.69 €
Non-public financing	12,954.76 €
EU/international	1,270,401.10 €
Foundations	72,865.63 €

External grants (including externally managed funds)..... 6,445,193.45 €

* on expenditure basis

Budget Development 2012-2016

(Million €)



Publications

Journal contributions

Peer-reviewed publications with impact factor

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We look forward to your visit!

Imprint

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Urban waters like the river Spree in Berlin are often heavily modified by anthropogenic influences. Since 2016 a new interdisciplinary research network – initiated and lead by IGB – is working on how to facilitate more nature in the city. *(► Page 8).*

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