Austrian Academy of Sciences

Annual Report 2010

Institute for Limnology

REPORTING PERIOD:	1.1.2010 – 31.12.2010
DIRECTOR OF THE REPORTING	Thomas WEISSE
RESEARCH INSTITUTION:	
ADDRESS:	Herzog-Odilostr. 101 5310 Mondsee

Content

1. Mission Statement

Our mission is to investigate and advance scientific understanding of freshwater ecosystems, and to disseminate this knowledge through scholarly publication and education. As an ecological discipline, limnology is the comprehensive science of the biological properties of inland waters in their physical-chemical environment. We use aquatic model organisms, reaching from bacteria to fish species, to investigate patterns and processes of general ecological and evolutionary relevance. We are especially interested in understanding the proximate and ultimate factors responsible for the distribution, interactions, and specific adaptations of freshwater organisms. Our emphasis is on process oriented basic research, but our research results are also used for consulting and in the search for solutions in the management and protection of inland waters. Our present research provides the basis for the sustainable use and protection of the water quality of our fresh waters. We provide training for national and international graduate students and post-doctoral fellows within various research projects and the International Post-Graduate training programmes in Limnology. Our current research focuses on investigating the origin and maintenance of diversity of aquatic organisms and communities at various levels, ranging from molecules (genes and proteins) over organisms and populations to communities.

2. Scientific Activity 2010

2.1. Zusammenfassung des wissenschaftlichen Berichts 2010

Der Berichtszeitraum umfasst das dritte Jahr, in dem die Aktivitäten des Instituts für Limnologie (ILIM) der Österreichischen Akademie der Wissenschaften (ÖAW) durch die Unterbringung der Einrichtung auf fünf verstreute Standorte empfindlich behindert waren. Die provisorischen Laboratorien, die im TechnoZ Mondsee angemietet wurden, erfüllen nicht die Mindestvoraussetzungen eines international konkurrenzfähigen Labores. Der Umbau des urprünglichen Institutsgebäudes am Seeufer ging sehr langsam voran, und die Fertigstellung ist immer noch nicht absehbar. Trotz dieser Widrigkeiten setzte das Institut seine Untersuchungen erfolgreich innerhalb des gegenwärtigen Schwerpunktes fort, der *Erforschung des Ausmaßes, der Entstehung und der ökologischen Bedeutung der intra-spezifischen Diversität aquatischer Mikro- und Makroorganismen*. Der gemeinsame Nenner aller Arbeitsgruppen von ILIM besteht darin, mikroevolutionäre (d.h., unterhalb der Artebene) Anpassungen an die gegebenen und sich ändernde Umweltbedingungen anhand von ausgesuchten Modellorganismen, die von Bakterien bis zu Fischen reichen, zu untersuchen.

Innerhalb des Berichtszeitraumes lag der Schwerpunt der Untersuchungen auf den beiden neuen, integrativen Forschungsprojekten RADICAL (Risk Analysis of Direct and Indirect Climate effects on deep Austrian Lake Ecosystems) und DETECTIVE (Decadal Detection of biodiversity in alpine lakes). Vier DissertantInnen begannen ihre Arbeit innerhalb dieser beiden Projekte. Die Langzeit-Arbeitsgruppe (AG) Paläolimnologie unter der Leitung von Roland Schmidt wurde mit seiner Pensionierung Ende März 2010 beendet. Diese Position wurde mit Liisa Nevalainen von der Universität Helsinki nachbesetzt. Frau Nevalainen etablierte gemeinsam mit ihrem Ehemann Tomi Luoto die neue AG Evolutionäre Paläolimnologie. Der Arbeitsschwerpunkt der neuen AG liegt auf der Untersuchung der evolutionären Reaktion der Cladoceren auf die Klimavariabiliät der Vergangenheit und der Gegenwart mittels paläolimnologischer, ökologischer, statistischer, experimenteller und genetischer Methoden. Dabei werden Chydoriden (LN) bzw. Chironomiden (TL) als die primären Modellorganismen eingesetzt.

Eine weitere sehr erfolgreiche AG, Diversität und Ökologie der Flagellaten und Mikroalgen, wurde mit der Ernennung des Gruppenleiters, Jens Boenigk, zum Ordinarius für Allgemeine Botanik an der Universität Duisburg-Essen (Deutschland) Anfang Oktober 2010 beendet. Das Verfahren zur Nachbesetzung dieser Stelle läuft derzeit. Eine Dissertation (S. Jost) wurde innerhalb dieser AG 2010 erfolgreich beendet.

Das neue, von der ESF finanzierte Projekt FREDI (Functional Role and Ecotype DIvergence in freshwater ultramicrobacteria) integriert fünf Forschergruppen aus unterschiedlichen Ländern. Der von ILIM in der AG Umweltmikrobiologie untersuchte Teil analysiert die ökologische Diversifizierung innerhalb der Unterart *Polynucleobacter necessarius* ssp. *asymbioticus*.

Die Arbeiten, die innerhalb mehrerer vom österreichischen Wissenschaftsfond (FWF) finanzierter Projekte im Berichtszeitraum geleistet wurden, konzentrierten sich auf die molekulare Ökologie der Cyanobakterien, die Diversität und Ökologie mehrerer Gruppen des Mikroplanktons (heterotrophe Flagellaten, Ciliaten, Mikroalgen und Rotatorien) , die experimentelle evolutionäre Ökologie von Rotatorien und die Populationsgenetik von österreichischen Coregonen.

Ein erheblicher Zeitaufwand der administrativen Arbeit war der Vorbereitung des Treffens des Wissenschaftlichen Beirats (12.-13. Oktober 2010) sowie der zweistufigen, externen Evaluierung gewidmet. Der erste Schritt umfasste einen schriftlichen Evaluierungsbericht , der von fünf anonymen internationalen Experten auf der Basis diverser schriftlicher Dokumente, die von ILIM nach Vorgaben der ÖAW eingereicht worden waren, verfasst wurde. Die zweite Stufe, der Besuch des Instituts durch ein weiteres internationales Evaluierungsteam unter der Leitung von Assaf Sukenik (Kinneret Limnological Laboratory, Israel) fand in Mondsee vom 29. November bis 1. December 2010 statt. Der Evaluierungsbericht, der Ende des Jahres an die ÖAW übermittelt wurde, bestätigt das hohe Niveau des wissenschaftlichen Ertrages, der Koordination und Zusammenarbeit unter den WissenschaftlerInnen von ILIM und stuft das Institut als ein Exzellenzzentrum innerhalb der aquatischen Wissenschaften ein. Das Institut sieht den Bericht als Ermutigung und Unterstützung an, um die in der im Oktober 2009 an die ÖAW übermittelte ‚Zukunftsvision 2020' genannten Ziele konsequent zu verfolgen. Der Zeitaufwand und die Bemühungen, die jedes Mitglied des Wissenschaftlichen Beirats und der Evaluierungsgruppe auf die kritische Evaluierung und weitere Verbesserung der Forschung von ILIM aufwandte, werden mit großem Dank anerkannt.

2.2. Wissenschaftliche Höhepunkte 2010

Der Genpool der ursprünglichen Reinankenpopulationen in den Alpenseen hielt dem Jahrzehnte-langen Einfluss durch Besatz mit standortfremden Coregonen weitgehend stand, d.h. die befürchtete, völlige Vermischung von autochtonen Fischen mit Besatzfischen kann aufgrund neuer populations-genetischer Studien zurückgewiesen werden (Winkler et al. 2010). Lokal angepasste Formen zeigen Überlebensvorteile durch reproduktive Nischendifferenzierungen. Die Ergebnisse ermöglichen gezielte Naturschutzaktivitäten zum Erhalt der heimischen Biodiversität.

5 selected publications

Adolfsson, S., Michalakis Y., Paczesniak, D., Bode, S.N.S., Butlin, R.K., Lamatsch, D.K., Martins, M.J.F., Schmit, O., Vandekerkhove, J., Jokela, J. (2010). Evaluation of elevated ploidy and asexual reproduction as alternative explanations for geographic parthenogenesis in *Eucypris virens* ostracods. Evolution 64: 986-997 (Impact Factor 5.429).

Jezberová, J., Jezbera, J., Brandt, U., Lindström, E.S., Langenheder, S., and Hahn, M.W. (2010). Ubiquity of *Polynucleobacter necessarius* ssp. *asymbioticus* in lentic freshwater habitats of a heterogeneous 2000 km^2 area. Environ. Microbiol. 12: 658-669 (IF= 4.909).

Medinger, R., Nolte, V., Pandey, R.V., Jost, S., Ottenwälder, B., Schlötterer, C., Boenigk, J. (2010). Diversity in a hidden world: potential and limitation of next generation sequencing for surveys of molecular diversity of Eukaryotic microorganisms. Mol. Ecol. 19: 32-40 (IF= 5.960).

Stelzer, C.P., Schmidt, J., Wiedlroither, A., Riss, S. (2010). Loss of Sexual Reproduction and Dwarfing in a Small Metazoan. PLoS ONE 5(9): e12854. doi:10.1371/journal.pone.0012854 (IF= 4.351).

Winkler, K., Pamminger-Lahnsteiner, B., Wanzenböck, J., Weiss, S. (2010). Hybridization and restricted gene flow between native and introduced stocks of Alpine whitefish (Coregonus sp.) across multiple environments. Mol. Ecol., doi: 10.1111/j.1365-294X.2010.04961 (IF= 5.960).

2.3. Summary of the scientific report 2010

The reporting period covers the third year in which the activity of the Institute for Limnology (ILIM) of the Austrian Academy of Sciences (AAS) was significantly hindered due to the relocation of its facilities to five dispersed locations. The interim laboratories rented at the TechnoZ Mondsee do not fulfill the minimum requirements of an internationally competitive laboratory. Reconstruction of the original institute building at the lake shore proceeded only very slowly; it is still not clear when the reconstruction will be completed. In spite of these obstacles, the Institute for Limnology continued its successful research within the current focus, i.e. investigating the *extent, origin and ecological significance of intraspecific diversity of aquatic micro- and macroorganisms*. The common denominator of all working groups at ILIM is to investigate microevolutionary (i.e., at the subspecies level) response to particular and changing environmental conditions, using selected model organisms ranging from bacteria to fish.

Within the reporting period, particular emphasis was placed on the two new integrative projects RADICAL (Risk Analysis of Direct and Indirect Climate effects on deep Austrian Lake Ecosystems) and DETECTIVE (Decadal Detection of biodiversity in alpine lakes). Four PhD students started their work within these two projects. The long-term working group (WG) Paleolimnology headed by Roland Schmidt was finished with his retirement at the end of March 2010. This position could be filled with Liisa Nevalainen from the University of Helsinki, who started the new WG Evolutionary Paleolimnology together with her husband Tomi Luoto. The focus of this new WG is on evolutionary responses of freshwater organisms to past climate variability and the present climate change by the means of paleolimnological, ecological, statistical, experimental and genetic methods, using chydorids (LN) and chironomids (TL) as primary model organisms.

Another highly successful WG, Diversity and ecology of Flagellates and Microalgae, was finished with the appointment of its head (Jens Boenigk) to full professor of General Botany at the University of Duisburg-Essen (Germany) in early October 2010. Recruitment of a successor is currently under way. A PhD thesis (S. Jost) was successfully finished within this WG in 2010.

The new ESF funded project FREDI (Functional Role and Ecotype Divergence in freshwater ultramicrobacteria) integrates five research groups from different European countries. ILIM's part conducted by the WG Environmental Microbiology analyses the ecological diversification within the subspecies *Polynucleobacter necessarius* ssp. *asymbioticus*.

The research conducted within several projects funded by the Austrian Science Fund (FWF) focused on molecular ecology of cyanobacteria, diversity and ecology of various groups of

microplankton (heterotrophic flagellates, ciliates, microalgae and rotifers), experimental evolutionary ecology with rotifers, and the population genetics of Austrian whitefish.

A significant time of administrative work was devoted to the preparation of the Scientific Advisory Board (SAB) meeting (12-13 October 2010) and the two-step, external evaluation. The first step consisted of an evaluation report by five anonymous international experts based upon written documents provided by ILIM on request of the AAS. The second step, the meeting of another international evaluation team headed by Assaf Sukenik (Kinneret Limnological Laboratory, Israel) was held at Mondsee from 29 November to 1 December 2010. The evaluation report submitted to the AAS at the end of the year confirmed a high level of research output, coordination and cooperation amongst the scientist in ILIM and defined the institute as a center of excellence in the field of aquatic sciences. The institute views this report as encouragement and support for its future goals outlined in the 'Vision 2020' scenario submitted to the AAS in October 2009. The time and effort that each member of the SAB and the evaluation panel invested to critically evaluate and further improve ILIM's research is gratefully acknowledged.

2.4. Highlights 2010

The gene pool of indigenous whitefish populations was largely preserved, in spite of stocking with allochthonous coregonids for decades. The suspected complete mixing of the autochthonous fish stock with introduced fish can be ruled out, according to new population genetic studies (Winkler et al. 2010). Locally adapted forms gained superior fitness resulting from reproductive niche differentiation. The results enable targeted conservation efforts to preserve the indigenous biodiversity.

5 selected publications

Adolfsson, S., Michalakis Y., Paczesniak, D., Bode, S.N.S., Butlin, R.K., Lamatsch, D.K., Martins, M.J.F., Schmit, O., Vandekerkhove, J., Jokela, J. (2010). Evaluation of elevated ploidy and asexual reproduction as alternative explanations for geographic parthenogenesis in *Eucypris virens* ostracods. Evolution 64: 986-997 (Impact Factor 5.429).

Jezberová, J., Jezbera, J., Brandt, U., Lindström, E.S., Langenheder, S., and Hahn, M.W. (2010). Ubiquity of *Polynucleobacter necessarius* ssp. *asymbioticus* in lentic freshwater habitats of a heterogeneous 2000 km^2 area. Environ. Microbiol. 12: 658-669 (IF= 4.909).

Medinger, R., Nolte, V., Pandey, R.V., Jost, S., Ottenwälder, B., Schlötterer, C., Boenigk, J. (2010). Diversity in a hidden world: potential and limitation of next generation sequencing for surveys of molecular diversity of Eukaryotic microorganisms. Mol. Ecol. 19: 32-40 (IF= 5.960).

Stelzer, C.P., Schmidt, J., Wiedlroither, A., Riss, S. (2010). Loss of Sexual Reproduction and Dwarfing in a Small Metazoan. PLoS ONE 5(9): e12854. doi:10.1371/journal.pone.0012854 (IF= 4.351).

Winkler, K., Pamminger-Lahnsteiner, B., Wanzenböck, J., Weiss, S. (2010). Hybridization and restricted gene flow between native and introduced stocks of Alpine whitefish (*Coregonus* sp.) across multiple environments. Mol. Ecol., doi: 10.1111/j.1365-294X.2010.04961 (IF= 5.960).

2.5. Report on the scientific activity during 2010 *(max. 10 pages)*

Molecular ecology and physiology of cyanobacteria

(**Rainer Kurmayer**[1], Guntram Christiansen, Stephan Blank, Veronika Ostermaier, Philipp Trummer, Josef Knoblechner, Maria Reischauer)

Our research was performed in the course of the FWF project P20231 (Genotype determined toxin content in cyanobacteria), one Doc-fFORTE PhD fellowship (Time in microevolution of toxin synthesis), and the two integrative ILIM projects RADICAL (Risk Analysis of Direct and Indirect Climate effects on deep Austrian Lake Ecosystems) and DETECTIVE (Decadal Detection of biodiversity in alpine lakes).

Within the FWF project the work on genome annotation as well as closing the genome has been finished. Finally the genome of *Planktothrix agardhii* (5 MB) could be assembled into two chromosomes by constructing a fosmid library and sequencing the ends of > 500 of fosmids. In total five plasmids (5, 7, 50, 79, 115 kb) were identified. The growth experiments to analyze the transcription rate of genes involved in cyanotoxin production have been completed.

The aim of the Doc-fFORTE project was to investigate the toxin gene composition in populations of the planktonic cyanobacterium *Planktothrix sp.* over several decades. This unique approach was possible by the analysis of DNA extracted from preserved phytoplankton samples that date back to 1980. Since Lake Zürich underwent significant changes in the trophic state due to human induced eutrophication the toxin gene proportion as estimated by quantitative real-time PCR gives essential information in order to predict the toxin gene composition of harmful blooms favoured by global warming in the future.

Within the project RADICAL the change in phytoplankton composition and abundance of toxic filamentous cyanobacteria (*Planktothrix* sp.) was monitored and related to lake physical characteristics including vertical mixing and light availability. For this purpose thermistors were installed across the whole water column at the deepest part of Lake Mondsee (in cooperation with the Federal Institute at Scharfling) and cyanobacteria were counted weekly from May-October and bi-weekly from November – April using semi – automated counting by image analysis.

Within the DETECTIVE project protocols for DNA extraction, PCR amplification, ultra-deep sequencing as well as bioinformatical exploration of the sequences have been set up in order to analyze the microbial community composition by the most sensitive ultra-deep sequencing technique. For the first time results on bacterial diversity estimates were compared between laboratories (Limnology and Blutzentrale Linz) in order to control for potential biases in diversity estimates by contamination. Both laboratories produced very similar profiles of the microbial diversity for two samples of different microbial size fractions (> 1.2 µm and 0.2-1.2 µm) collected from Lake Mondsee.

[1] The principal investigators are listed in bold face

Environmental Microbiology – Heterotrophic bacteria

(**Martin Hahn**, Ulrike Koll)

We further intensified our aims to integrate research on ecological function, diversity and taxonomy, and biogeography of planktonic freshwater bacteria. In 2010, we started two new projects with international cooperation partners emphasizing on revealing the diversity of freshwater bacteria at the genomic level. Furthermore, we described one novel genus and five new species of freshwater bacteria (Table 1).

Table 1. New taxa of planktonic freshwater bacteria

Taxon	Family	Reference
Polynucleobacter cosmopolitanus **sp. nov.**	**Burkholderiaceae**	**Hahn et al., 2010a**
Limnohabitans **gen. nov.**	**Comamonadaceae**	**Hahn et al., 2010b**
Limnohabitans curvus **sp. nov.**	**Comamonadaceae**	**Hahn et al., 2010b**
Limnohabitans planktonicus **sp. nov.**	**Comamonadaceae**	**Kasalický et al., 2010**
Limnohabitans parvus **sp. nov.**	**Comamonadaceae**	**Kasalický et al., 2010**
Limnohabitans australis **sp. nov.**	**Comamonadaceae**	**Hahn et al., 2010c**

Rhodoluna genome project

In the reporting period, we started together with Ford Doolittle (Dalhousie University, Canada) and Adrian Sharma (Massachusetts Institute of Technology, USA) a project aiming on analysis of the genome of the freshwater bacterium *Rhodoluna lacicola* MWH-Ta8. This strain represents one of the few freshwater *Actinobacteria* cultivated in pure culture. Genome sequencing, assembly, gap closure and genome annotation (Fig. 1) could be finished within the first year of the project. The genome of the strain consists of 1.43 Mbp and encodes only 1376 genes. This is the third smallest genome of all so far sequenced *Actinobacteria*, and the smallest genome of a free-living actinobacterial strain. The genome shares many characteristics with the genome of *Pelagibacter ubique*, an abundant marine bacterium, indicating convergent genome evolution of planktonic marine and freshwater bacteria.

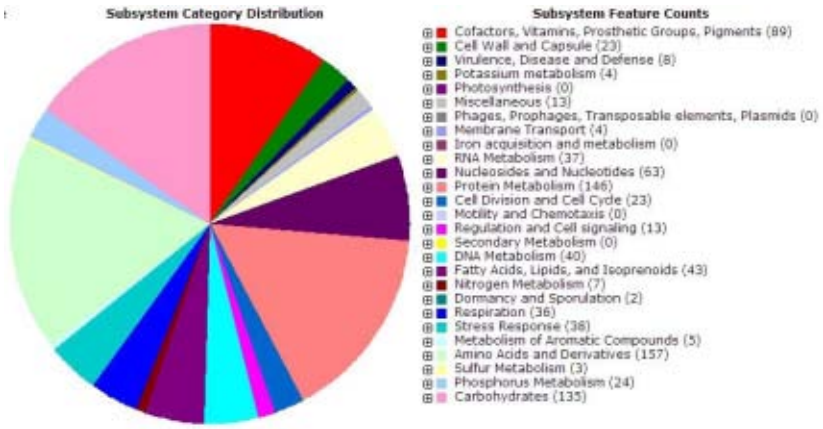


Fig. 1. Functional annotation of the *Rhodoluna lacicola* genome

European Science Foundation (ESF) project FREDI

The project FREDI integrates research of five groups from different European countries (Switzerland, Germany, Czech Republic, Sweden, and Austria) on freshwater bacteria. The part of the project conducted by the Environmental Microbiology group aims on analysis of the ecological diversification within the subspecies *Polynucleobacter necessarius* ssp. *asymbioticus*. This will be mainly based on the comparative analysis of the genomes of eleven strains adapted to contrasting limnological conditions. Genome sequencing is currently ongoing.

(**Jens Boenigk**, Liselotte Eisl, Anneliese Wiedlroither, Barbara Findenig, Steffen Jost, Ralph Medinger)

The research of this working group focused on key aspects of diversity, evolution and ecology of eukaryotic microorganisms with emphasis on chrysophytes. The analysis of distribution patterns concentrated on an Alpine lake gradient ranging from the German border north of Salzburg to the central Alps, comprising 40 lakes. This successful working group was finished with the appointment of its head, Jens Boenigk, to full professor and department head at the University of Duisburg-Essen, Germany on 1st October 2010. Major achievement in the reporting period were

- publishing the newly developed single cell multiplex PCR method and applying this method to analyze protist species distributions in Alpine lakes (Jost et al. 2010)

- describing the taxonomy and ecology of several that far undescribed chrysophyte cysts (Findenig et al. 2010)

- exploring and publishing the potential and limitation of next-generation sequencing for surveys of molecular diversity of eukaryotic microorganisms and establishing a workflow for high-throughput sequencing of environmental samples (Medinger et al. 2010)

- summing up the 'Everything is everywhere' debate with respect to protists (Bass & Boenigk, in press)

(**Thomas Weisse**, Peter Stadler, Ulrike Scheffel, Michael Moser, Nicole Laufenstein)

Habitat selection and local adaptation in acid mining lakes

We continued and largely finished our investigations on the adaptation of planktonic species (flagellates, ciliates, and rotifers) to and their microevolution in acidic mining lakes (AML) within FWF project P20118-B17. AML are extreme aquatic habitats with strongly reduced biodiversity, providing a rare case of suitable ecosystem models to test for the significance of strong habitat selection. The rationale of this project and the main hypotheses to be tested were described in detail in last year's Annual Report. A master's thesis was finished (Laufenstein 2010), a Ph.D. thesis (Moser 2011) nearly completed during the reporting period. We demonstrated that

- acidotolerant species may benefit from competitive release under conditions of acid stress (Moser & Weisse 2011a)
- combined stress effect of pH and temperature narrows the niche width of flagellates (Moser & Weisse 2011b) and rotifers (Laufenstein 2010) in acid mining lakes
- species richness in Lake Langau is remarkably low, even in comparison to other AML with pH <3 (Weithoff et al. 2010, Moser & Weisse 2011c)

Ecology of endemic ciliates from bromeliads (FWF project P20360-B17, in cooperation with the project leader W. Foissner, Univ. Salzburg)

Stable cultures of several ciliate species endemic to the reservoirs of bromeliads from Jamaica were established in our laboratory. Some of these cultures are difficult to rear because of unexpected interactions between culture media, pH, and the food and target organisms. In spite of these obstacles, the first ecophysiological laboratory experiments with *Bromeliothrix metopoides*, probably the most common and wide spread bromeliad-specific ciliate (Foissner 2010), revealed that

- this species thrives when fed with flagellates of the genus *Polytomella*
- if bacteria are the sole food, high levels (>10^8 cells ml^{-1}) are needed to maintain the ciliate population
- flagellates, but not bacteria or starvation, induce the formation of macrostomes of *B. metopoides*
- in the presence of *Polytomella* flagellates, macrostomes are always present but rarely exceed 10% of the total ciliate population
- *B. metopoides* prefers moderately acidic to alkaline conditions (pH 5.0 to >9.0), but does not tolerate pH of 4.0 that has been occasionally recorded in the tanks of bromeliads (pers. comm. by W. Foissner, Univ. Salzburg)

Evolutionary Paleolimnology

(**Liisa Nevalainen**, Tomi Luoto, Hans Knoll)

The work of the research group started in July 2010 with the sediment core sampling of five ultra-sensitive Alpine lakes in the Niedere Tauern region. This sampling related to the DETECTIVE project targeted long-term faunal (Cladocera and Chironomidae) changes in these sensitive ecosystems. A further focus was on long-term reproductive patterns in chydorid cladocerans (Chydoridae). During the year 2010 a high-resolution sediment core from Oberer Landschitzsee was analyzed for its fossil invertebrate remains and the sediment samples were sent to Poland (Quaternary Geochronology Laboratory, Institute of Geological Sciences, Polish Academy of Sciences) for age determination (210Pb dating method) to provide a chronology. Though the chronology is not yet determined, the results from Oberer Landschitzsee showed dramatic changes in both Cladocera and Chironomidae assemblages between 8-6 cm, approximately during ~1800 AD (calculated using an average sedimentation rate over the past 2000 yrs). Chironomid assemblages were further used to infer quantitatively changes in late-winter hypolimnetic dissolved oxygen concentrations, applying a previously available inference model. The oxygen inferences suggested that the lake exhibited severe oxygen depletion from ~1800 AD onwards (Fig. 2) that was possibly related to extended ice-cover periods during the climate deterioration of the Little Ice Age. Simultaneously with the decreasing oxygen levels, the reproduction patterns of the two most common chydorid species, *Alona affinis* and *A. quadrangularis* exhibited clear and gradual shifts from the dominance of asexual to sexual reproduction (Fig. 2) suggesting that chydorids may respond directly (oxygen depletion) or indirectly (shortened open-water period) to environmental perturbations by increasing sexual reproduction.

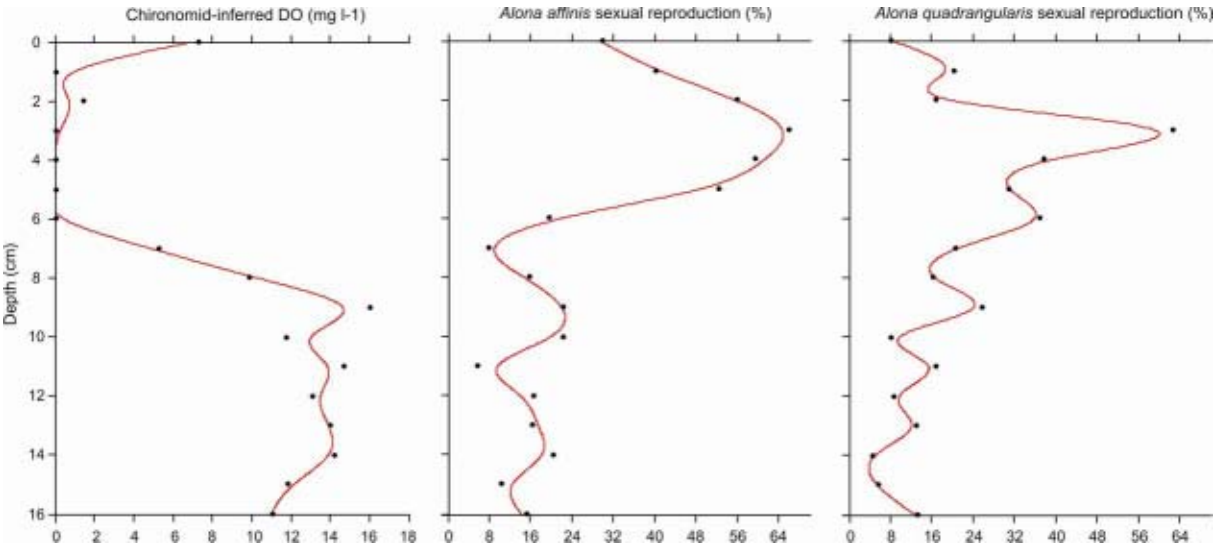
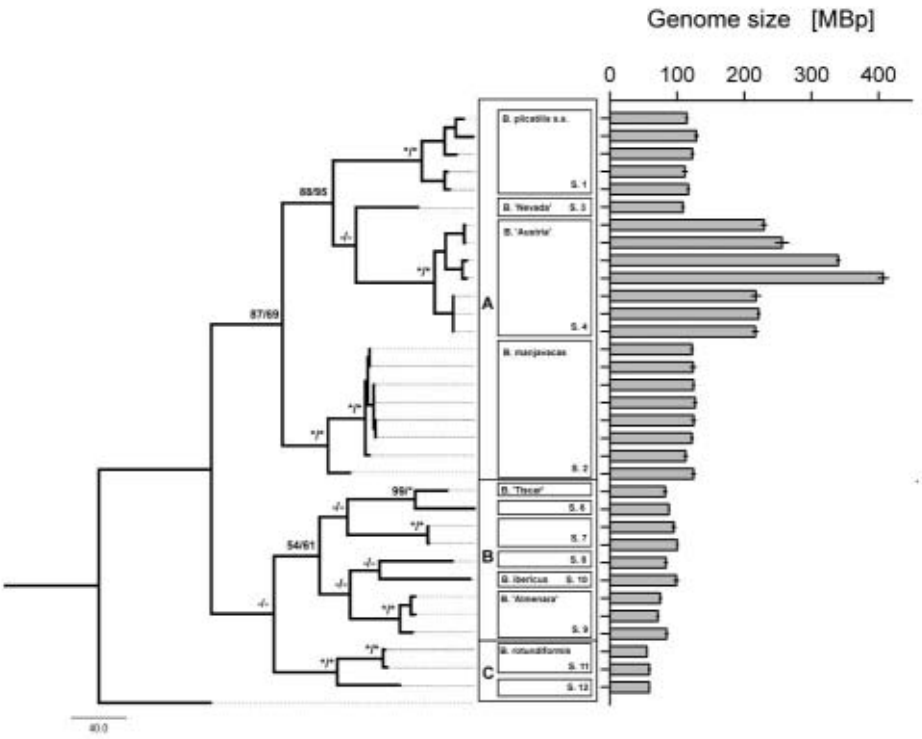


Fig. 2. Chironomid-inferred oxygen concentrations and sexual reproduction of common chydorids in the sediment core from Lake Oberer Landschitzsee.

(**Claus-Peter Stelzer**, Simone Riss, Thomas Scheuerl, Sabine Ullrich)

Our scientific activity in 2010 encompassed the following research projects:

- Genome size evolution in *Brachionus plicatilis*. We measured genome size variation in relation to the phylogeny of *B. plicatilis*, a cryptic species complex consisting of approximately 14 closely related species of worldwide distribution. We found substantial genome size variation above and below the species level, indicating rapid changes in genome size during speciation. In addition we found evidence for, at least, one major genome duplication during the evolution of this species complex (Fig. 3).
- Obligate parthenogenesis in *Brachionus calyciflorus*. Building on the results of an earlier study (Stelzer et al. 2010), we analyzed in more detail the genotypic effects of the op-allele, a mutation which causes obligate parthenogenesis in the rotifer *B. calyciflorus*. In a comprehensive study involving measurements of many different life history traits and population parameters we established that the op-Allele is completely recessive, that is, heterozygotes are virtually indistinguishable from wild-type individuals (Scheuerl et al. submitted). This finding has important implications on the potential for asexual transitions in natural rotifer populations.
- Population biology of asexual reproduction. We initiated a long-term experiment on population dynamics (population stability, oscillations) in cyclical vs. obligate parthenogenetic *B. calyciflorus*. We expect differences between these two reproductive types because cyclical parthenogens possess an additional density-dependent mechanism for population regulation (sex induction). This mechanism is lacking in obligate parthenogens.



Molecular and Cytogenetic Evolution of Asexual Aquatic Organisms

(**Dunja Lamatsch**, Maria Pichler, Michaela Zopf)

The paradox of sex remains the queen of problems in evolutionary biology. Sexual reproduction is widespread throughout the animal and plant kingdoms, but under certain conditions remains costly compared to asexual reproduction. Sex creates a wide variety of genotypes on which natural selection can act, but it also breaks up favourable gene combinations. Asexuals have the ability to preserve their genome and to propagate genotypes that have a previous history of success. In addition, asexuals can reproduce twice as fast as sexuals, because all, rather than half, of their offspring are themselves capable of reproduction (=females). Although asexual reproduction offers several clear short-term advantages, ruling evolutionary theory dictates that the absence of a mechanism for rapid genetic change will direct clones persisting over long time frames into evolutionary dead ends. Several animal and plant groups nevertheless show a large incidence of asexual reproduction and some lineages might have been fully asexual for many millions of years.

The research of this WG concentrates on sperm-dependent parthenogenetic fishes, mainly the invasive Prussian carp in collaboration with Jukka Jokela (EAWAG, Zürich) and Jouni Taskinen (Jyväskylä, Finland). The second focus is investigating the genetic variability in the freshwater ostracod *Eucypris viren*. In 2010, the PI of this WG was on maternal leave from 10 January onwards. The two laboratory technicians listed above took care of the live stock (conditioned fish) of this WG and continued parts of the genetic and experimental work. As in the previous years, the interim space needed for the aquarium during the reconstruction works of the institute was generously provided by HR Dr. Albert Jagsch of the Bundesamt für Wasserwirtschaft, Scharfling.

In spite of her absence from office, the PI finished one publication on the sperm-dependent Amazon molly, *Poecilia formosa*. Another 5 articles were already in press and were published in 2010.

Ecology of Freshwater Fish

(**Josef Wanzenböck**, Harald Ficker, Stefan Mayr)

The analysis of population genetics in Austrian whitefish within the FWF project L229 were largely finished and published. A PhD thesis has been submitted (B. Pamminger-Lahnsteiner, Univ. of Salzburg) and the PhD project will be finalised with the formal defence in Feb. 2011. Analysis of experimental crossing experiments undertaken within that project continued in 2010 and was supplemented by additional experiments on egg development of additional populations. Embryonic traits, e.g. embryonic development time and mortality, were specifically studied to quantify the effects of temperature, egg size and population differences. In contrast to the literature we found strong differences in embryonic traits between populations which were more important than egg size effects.

Within the project RADICAL this WG focused on the development of different population models for native and introduced whitefish species (*Coregonus* ssp.) in pre-alpine lakes of the Austrian Salzkammergut Lake district. Demographic population trends were modelled by the use of matrix calculations which have already been used for different whitefish populations. Age- and length-classified matrix models (Leslie-Lewis and Usher-Lefkovitch Matrix) are two different model approaches and

require length- and age- frequency distributions of the population, respectively. Furthermore, survival and reproduction probabilities (S and F in Fig. 4) are necessary.

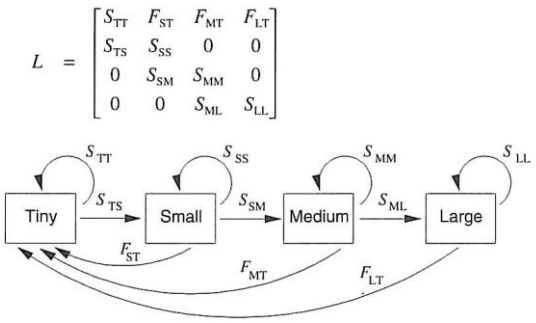


Fig. 4. Length-classified projection matrix model

For the pre-alpine whitefish populations, these parameters are estimated through datasets from fisheries, echo sounding and mark-recapture studies. Different projection matrix models of the Lake Irrsee population were compared, to obtain an optimal model approach for coregonid species. The data set used in this first study was provided by Dr. Hubert Gassner of the Federal Agency for Water Management, Institute for Freshwater Ecology, Fisheries Biology and Lake Research in Scharfling. Net samples were taken annually in October between the years 2000 and 2010. As a first step, the samples were calibrated to CPUE-values (catch per unit effort = catch/12h). Then an average length- and age distribution over the last decade was calculated, due to strong fluctuations between the yearly catches. These fluctuations are probably the result of different annual reproduction success and fish activity per sampling date.

Gillnets are selective for fish size, which depends on the mesh sizes used. Therefore, the age- and length frequency distribution of the catch does not reflect the demographic distribution in the population. The correction of the catch by the gillnet selectivity results in an estimation of the populations length- and age distribution, respectively. The maximum-likelihood based SELECT-method was used to fit different selection curve models on the set of used mesh sizes. The overall length- and age frequency distribution was refitted by the calculated correction factor for each fish length and mean length per age (Fig. 5).

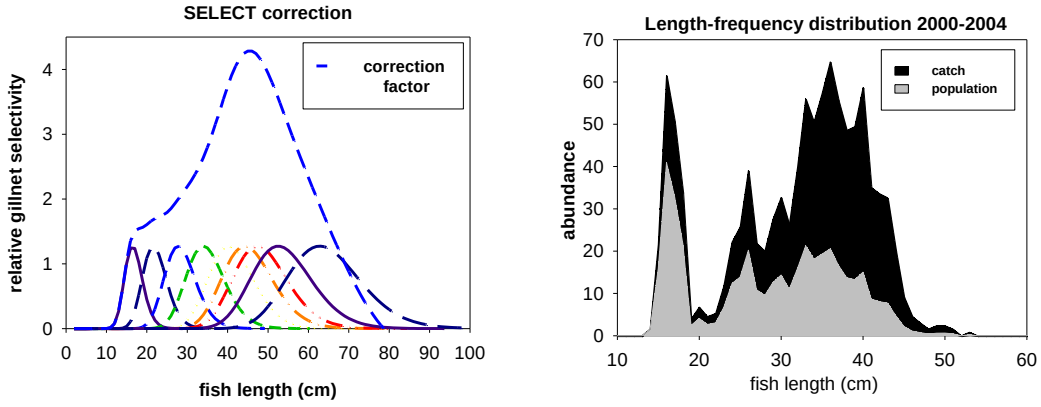


Fig. 5. Gillnet selectivity correction

Stream Ecology

(**Maria Leichtfried**, Anneliese Wiedlroither/Johann Knoll, Hiranthi Walpola and external cooperation partners)

As extension of the project "Initiative in River Ecology in Sri Lanka: from Science to Application" (IRESA) ecological experiments on leaf decomposition processes were continued and the second PhD thesis within IRESA was finished in July 2010 (H. Walpola, Univ. of Innsbruck).

To investigate longitudinal patterns of macroinvertebrate abundances and diversity in natural leaf packs and their relationship to abiotic parameters, environmental variables were recorded and 25 natural leaf packs (in total 500 leaves) were analyzed from five stream sites, longitudinally distributed from headwaters down to the mouth of the Eswathu Oya. The total abundances of invertebrates increased steadily in a longitudinal pattern. The compositions of the functional feeding groups in the leaf packs were dominated by gathering collectors (GC) slightly decreasing with the stream. Predators (PR) and scrapers (SC) increased with the stream, the pierce-herbivores (PH) and filtering collectors stayed in the similar range (Fig. 6)

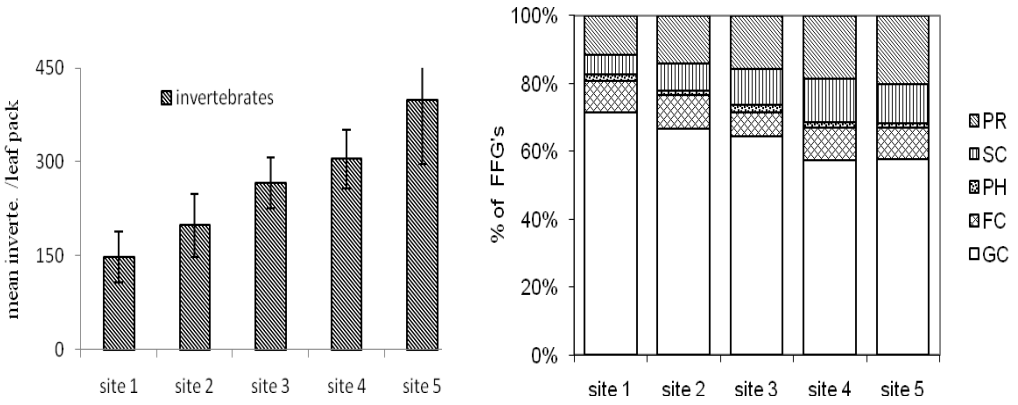


Fig. 6. Abundance of macroinvertebrates (left) and compositions of the functional feeding groups in the leaf packs along a longitudinal investigation in the tropical stream Eswathu Oya

These findings confirm the results of the detailed decomposition experiment in upper area of the stream, done before (Walpola 2010).

One article on leaf litter decomposition in Eswathu Oya was recently published (Walpola et al. 2011); others have been submitted or are in preparation. The results of the IRESA project were further presented at two international meetings and congresses (NABS in Santa Fe, New Mexico; IAD Dresden, Germany).

Activities within the joint DETECTIVE project of ILIM mainly encompassed supervision of students working on the benthic fauna in the area of the Giglach lakes.

International Post-Graduate Training Programmes in Limnology (IPGL)

(**Gerold Winkler**, Regina Brandstaetter, plus several national and international partners)

22 young professionals in aquatic ecology and water resource management attended academic training courses organized and implemented by IPGL. Nine programme participants finished their M.Sc. theses successfully in April 2010 and five participants started theirs M.Sc. projects in October 2010. The results of two IPGL M.Sc. theses (Ms G.A. Ssanyu; Mr. D. Mushi) were published in peer reviewed journals. The significantly restructured M.Sc. programme "Environmental Sciences, specialization Limnology & Wetland Ecosystems" was implemented successfully in 2010. The M.Sc. curriculum included three trimesters of 4-months each, held in The Netherlands (UNESCO-IHE), Kenya (Egerton University) and Austria (IPGL/AAS), and followed by a 6-months research period in Eastern Africa. Teaching and research equipment/infrastructure was updated and a "Water Resource Centre" was established at Egerton University. Training programmes/workshops were organized on project management, academic quality assurance and teaching methods for institutions implementing the international M.Sc. programme. A workshop was implemented on harmonizing the curricula of international and Eastern African M.Sc. programmes to increase student mobility and to expand international joint programmes. IPGL became a member in the UNESCO-IHE Global Partnership for Water Education and Research.

Molecular ecology and physiology of cyanobacteria

- Relation of genetic variation (mutations/recombinations) to the transcriptional rates of the genes involved in toxin production (FWF P20231)
- Quantifying the growth rates of naturally occurring toxic and non-toxic genotypes of *Planktothrix* in competitive growth experiments (PhD thesis Veronika Ostermaier)
- Integration of phytoplankton growth and environmental data into conceptual models to model population growth and toxin (microcystin) production in dependence on the environmental parameters (PhD thesis Philipp Trummer)
- Ultra-deep sequencing of planktonic prokaryotic and eukaryotic communities in alpine lakes (PhD thesis Stephan Blank)

Research of the WG **Environmental Microbiology** will focus on comparative analyses of the *Polynucleobacter* genomes, as well as of the *Rhodoluna* genome.

Plankton ecology and ecophysiology

Within FWF project P20118-B17

- finishing and publishing the remaining ecophysiological laboratory experiments with protists and rotifers (3 peer-reviewed publications)
- finishing the species description of the newly found taxa (2 peer-reviewed publications)
- presenting the major results of the project at the ASLO meeting in Puerto Rico

Within FWF project P20360-B17

- continuing the ecophysiological laboratory experiments with selected ciliate species from bromeliads
- presenting the first experimental results at the VI European Congress of Protistology

Evolutionary Paleolimnology

- Analyses on recent shifts in faunal assemblages and chydorid reproduction in additional four ultra-sensitive lakes
- Climate reconstructions based on previously available inference models from the Alpine regions
- First tests on ancient DNA extraction and PCR amplification of fossil chydorid resting eggs

Experimental evolutionary ecology

In 2011 the goal of this WG is to expand our understanding of the long-term evolutionary consequences of obligate parthenogenesis. We will address this issue by

- studying experimental populations subjected to "local adaptation" (i.e., experimental populations that have been adapted to contrasting sets of environmental conditions). In such populations, we examine the effects of sexual vs. asexual reproduction, both under stabilizing selection or under directional selection (i.e., following an environmental change).

Molecular & Cytogenetic Evolution of Asexual Aquatic Organisms

- From March 2011 onwards, the PI will follow up her research on the invasive sperm-dependent parthenogenetic Prussian carp in collaboration with Prof. Jukka Jokela (EAWAG, Zürich) and Dr. Jouni Taskinen (Jyväskylä, Finland). We collected morphometric, genetic and flow cytometric data on 2 Finnish, 1 German and 3 Austrian populations. In collaboration with Dr. Josef Wanzenböck (ILIM) we will apply for further funding.
- The data collected on the genetic variability in the freshwater ostracod *Eucypris virens* will be analysed and published.
- In collaborations with colleagues from ILIM (Dr. Josef Wanzenböck, Dr. Martin Hahn) we will investigate the risks of the fish and human pathogenic *Mycobacterium marinum* mediated by climate change.

Ecology of Freshwater Fish

- Final analysis and publication of results regarding experimental crossing experiments and studies on embryonic development.
- Further development of whitefish population models.
- Ecotoxicological experiments on whitefish juvenile growth studying the effects of cyanobacteria.
- Other activities: Organization of the 11th International Symposium on the Biology and Management of Coregonid Fishes (September 2011, Mondsee).
- A cooperation project on whitefish density assessment using pair trawling conducted in 2009 led to a new project application in 2010 (Austrian Academic Exchange Service) awaiting decision in early 2011. Approval of this travel grant project will determine further developments within this collaborative effort.

2.7. Publications/talks/poster presentations 2010

Peer reviewed journal articles and book chapters (ILIM scientists and collaborators in **bold** face)

Adolfsson, S., Michalakis Y., Paczesniak, D., Bode, S.N.S., Butlin, R.K**., Lamatsch, D.K.**, Martins, M.J.F., Schmit, O., Vandekerkhove, J., Jokela, J. (2010) Evaluation of elevated ploidy and asexual reproduction as alternative explanations for geographic parthenogenesis in *Eucypris virens* ostracods. Evolution 64, 986-997.

Ajith Kumara, P.A.D., Amarasinghe, U.S., Schiemer, F., **Winkler, G.**, Schabuss, M. (2010) Gillnet selectivity of small cyprinids in three Sri Lankan Reservoirs. Asian Fisheries Science 22, 885-900.

Bode, S.N.S., Adolfsson, S., **Lamatsch, D.K.**, Martins, M.J.F., Schmit, O. et al. [..] (2010) Exceptional cryptic diversity and multiple origins of parthenogenesis in a freshwater ostracod. Molecular Phylogenetics and Evolution 54, 542–552.

Hahn, M.W., Kasalický, V., Jezbera, J., **Brandt, U.,** and Šimek, K. (2010) *Limnohabitans australis* sp. nov., isolated from a freshwater pond, and emended description of the genus *Limnohabitans*. Int. J. Syst. Evol. Microbiol. 60, 2946-2950.

Hahn, M.W., Kasalický, V., Jezbera, J., **Brandt, U.,** Jezberová, J., and Šimek, K. (2010) *Limnohabitans curvus* gen. nov., sp. nov., a planktonic bacterium isolated from a freshwater lake. Int. J. Syst. Evol. Microbiol. 60, 1358-1365.

Hahn, M.W., Lang, E., **Brandt, U.,** Lünsdorf, H., Wu, Q.L., and Stackebrandt, E.. (2010) *Polynucleobacter cosmopolitanus* sp. nov., free-living planktonic bacteria inhabiting freshwater lakes and rivers. Int. J. Syst. Evol. Microbiol. 60, 166-173.

Huber, K., Weckström, K., Drescher-Schneider, R., **Knoll, J., Schmidt, J., Schmidt, R.** (2010) Climate changes during the last glacial termination inferred from diatom-based temperatures and pollen in a sediment core from Längsee (Austria). J. Paleolimnol 43, 131-147.

Jezberová, J., Jezbera, J., Brandt, U., Lindström, E.S., Langenheder, S., and **Hahn, M.W.** (2010) Ubiquity of *Polynucleobacter necessarius* ssp. *asymbioticus* in lentic freshwater habitats of a heterogeneous 2000 km^2 area. Environ. Microbiol. 12, 658-669.

Jost, S., Medinger, R., **Boenigk, J.** (2010) Cultivation independent species identification of *Dinobryon* sp. (Chrysophyceae) by means of multiplex single cell PCR (MSC-PCR). J. Phycol. 46, 901-906.

Kasalický, V, Jezbera, J., Šimek, K., and **Hahn, M.W.** (2010) *Limnohabitans planktonicus* sp. nov., and *Limnohabitans parvus* sp. nov., two novel planktonic Betaproteobacteria isolated from a freshwater reservoir and emended description of the genus *Limnohabitans*. Int. J. Syst. Evol. Microbiol. 60, 2710-2714.

Lamatsch, D.K. , Stöck, M., Fuchs, R., Döbler, M., Wacker, R., Parzefall, J., Schlupp, I., Schartl, M. (2010) Morphology, testes development and behaviour of unusual triploid males in microchromosome-carrying clones of *Poecilia formosa*. J. Fish Biol. 77, 1459-1487.

Lotter, A.F., Pienitz, R., **Schmidt, R.** (2010) Diatoms as indicators of environmental change in subarctic and alpine regions. In: Smol, J.P. and Stoermer, E.F. (eds) The Diatoms: Application for the Environmental and Earth Sciences. Second Edition. Cambridge University Press, pp. 231-248.

Luoto, T.P., Kultti, S., **Nevalainen, L**., Sarmaja-Korjonen, K. (2010) Temperature and effective moisture variability in southern Finland during the Holocene quantified with midge-based calibration models. J. Quat. Sci. 25, 1317-1326.

Luoto, T.P., Nevalainen, L. (2010) Interferring reference conditions of hypolimnetic oxygen for deteriorated Lake Mallusjärvi in the cultural landscape of Mallusjoki, Southern Finland, using fossil midge assemblages. Water Air Soil Pollution, DOI: 10.1007/s11270-010-0618-3

Medinger, R., Nolte, V., Pandey, RV., **Jost, S.,** Ottenwälder, B. et al. [..] (2010) Diversity in a hidden world: potential and limitation of next-generation sequencing for surveys of molecular diversity of eukaryotic microorganisms. Mol. Ecol. 19 (Suppl.), 32-40.

Nevalainen, L., Luoto, T.P. (2010) Implications for the use of sedimentary invertebrate communities to infer past presence of fish. Knowledge and Management of Aquatic Ecosystems 396, 1-13.

Nolte, V., Pandey, R.V., **Jost, S.,** Medinger, R., Ottenwalder, B**., Boenigk, J**., Schlotterer, C. (2010) Contrasting seasonal niche separation between rare and abundant taxa conceals the extent of protist diversity. Mol. Ecol. 19, 2908-2915.

Okello, W., Ostermaier, V., Portmann, C., Gademann, K.l, **Kurmayer, R.** (2010) Spatial isolation favours the divergence in microcystin net production by *Microcystis* in Ugandan freshwater lakes. Water Res. 44, 2803-2814.

Okello, W., Portmann, C., Erhard, M., Gademann, K., **Kurmayer, R.** (2010) Occurrence of microcystin-producing cyanobacteria in Ugandan freshwater habitats. Environ. Toxicol. 25, 367-380.

Ostermaier, V., Kurmayer, R. (2010) Application of real-time PCR to estimate toxin production by the cyanobacterium *Planktothrix* sp. Appl. Environ. Microbiol. 76, 3495-3502.

Sandberger, L., Feldhaar, H., Lampert, K.P., **Lamatsch, D.K.,** Rodel, M.O. (2010) Small, specialised and highly mobile? The tree-hole breeding frog, *Phrynobatrachus guineensis*, lacks fine-scale population structure. African Journal of Herpetology 59, 79-94.

Šimek, K., Kasalický, V, Horňák, K., **Hahn M.W.,** Weinbauer, M.G. (2010) Assessing niche separation among coexisting *Limnohabitans* strains through interactions with a competitor, viruses, and a bacterivore. Appl. Environ. Microbiol. 76, 1406–1416.

Šimek, K., Kasalický, V., Jezbera, J., Jezberová, J., Hejzlar, J., and **Hahn, M.W.** (2010) Broad habitat range of the phylogenetically narrow R-BT065 cluster, representing a core group of the betaproteobacterial genus *Limnohabitans*. Appl. Environ. Microbiol. 76, 631-639.

Stelzer, C.P., Schmidt, J., Wiedlroither, A,, Riss, S. (2010) Loss of sexual reproduction and dwarfing in a small metazoan. Plos ONE 5: e12854; doi:10.1371/journal.pone.0012854.

Stöck, M., Ustinova, J., **Lamatsch, D.K.,** Schartl, M., Perrin, N. et al. [..] (2010) A vertebrate reproductive system involving three ploidy levels: Hybrid origin of triploids in a contact zone of diploid and tetraploid Palearctic green toads (*Bufo viridis* subgroup). Evolution 64, 944-959.

Weithoff, G., **Moser, M.,** Kamjunke, N., Gaedke, U., **Weisse, T.** (2010) Lake morphometry and wind exposure may shape the plankton community structure in acidic mining lakes. Limnologica 40, 161-166.

Winkler, K.A., **Pamminger-Lahnsteiner, B., Wanzenböck, J.,** Weiss, S. (2010) Hybridization and restricted gene flow between native and introduced stocks of Alpine whitefish (*Coregonus* sp.) across multiple environments. Mol. Ecol. 20, 456-472.

Longer journal articles and book chapters without peer review (ILIM scientists and collaborators in **bold** face)

Pamminger-Lahnsteiner, B., Winkler, K.A., **Wanzenböck, J.** (2010) Verschwinden unsere heimischen Reinanken im Mondsee durch den Besatz mit Maränen? Morphologische, genetische und experimentell-ökologische Untersuchungen. Österreichs Fischerei, Bd. 63 (11/12), S. 300-311.

Diploma/Master's Theses

Laufenstein, N. (2010) Lebenszyklus einer acidophilen *Cephalodella*-Art in Abhängigkeit von verschiedenen Futterkonzentrationen, pH-Werten und Temperaturen. Master's Thesis, Dept Organismic Biology, Univ. Salzburg.

Schärfl, S. (2010) *Euplotes* spp. and *Polynucleobacter* sp. in small running waters - a symbiontic relationship. Master's Thesis, Dept Organismic Biology, Univ. Salzburg

Dissertations

Jost, S.O. (2010) Molecular tools for protist species discrimination and biodiversity assessment. Faculty of Biology, University of Innsbruck.

Keynotes and Named Lectures

Boenigk, Jens (14.03.2010) Species discrimination and biogeography of colourless chrysophytes. 13. Wissenschaftliche Tagung der Sektion Phykologie der Deutschen Botanischen Gesellschaft (DBG) e.V., Insel Reichenau im Bodensee (GERMANY).

Jost, Steffen (14.03.2010) Analysing protist population structures by multiplex single-cell PCR from preserved plankton samples. 13. Wissenschaftliche Tagung der Sektion Phykologie der Deutschen Botanischen Gesellschaft (DBG) e.V., Insel Reichenau im Bodensee (GERMANY).

Kurmayer, Rainer (22.09.2010) Quantifizierung des Auftretens toxischer Genotypen und Bestimmung der Toxinproduktion durch Blaualgen in Europas Gewässern. AGES Akademie, Klimawandel und Cyanotoxine: Public Health Threat?, Vienna (AUSTRIA).

Okello, William (01.09.2010) Molecular and chemical characterisation of microcystin producing cyanobacteria in Ugandan freshwater habitats. 8th International Conference on Toxic Cyanobacteria, Istanbul (TURKEY).

Ostermaier, Veronika (31.08.2010) Time in microevolution of toxin synthesis in cyanobacteria. 8th International Conference on Toxic Cyanobacteria, Istanbul (TURKEY).

Sitoki, Lewis (17.08.2010) Spatial-temporal variability of cyanobacterial dominance and occurrence of microcystins in Nyanza Gulf of Lake Victoria. 18th Symposium of the International Association for Cyanophyte Research (IAC), České Budějovice (CZECH REPUBLIC).

Straubinger, Nadja (15.03.2010) Phytoplanktongemeinschaften und Microcystinproduktion in Kenianischen Gewässern. 13. Wissenschaftliche Tagung der Sektion Phykologie der Deutschen Botanischen Gesellschaft (DBG) e.V., Insel Reichenau im Bodensee (GERMANY).

Straubinger, Nadja (12.03.2010) Phytoplankton and toxin production in Kenyan fish ponds. Vienna Ecology Center (VEC) Science day, Vienna/AUSTRIA.

Wanzenboeck, J. (12.03.2010) RADICAL Risk analysis of direct and indirect climate effects on deep Austrian lake ecosystems -concept for a recently started project. 11. Österreichischer Klimatag "Klima im Wandel, Auswirkungen und Strategien" (Klimaforschungsinitiative AustroClim), University of Natural Resources and Applied Life Sciences, Vienna (AUSTRIA)

Other invited talks

Ostermaier, Veronika (25.05.2010) Zeitliche Aspekte der Microcystinsynthese. Vortrag: Seminar, Limnological Station, Institute of Plant Biology, Univ. Zürich, Zürich (SWITZERLAND).

Stelzer, Claus-Peter (10.06.2010) Evolutionary ecology of asexual reproduction. FB-Symposium, Universität Salzburg (AUSTRIA).

Stelzer, Claus-Peter (23.07.2010) Population and community structure of rotifers in east African saline lakes. AQUALOGY workshop (Prof. M. Schagerl) (AUSTRIA).

Other oral contributions

Jezbera, J., Jezberova, J., Brandt, U., Hahn, M.W. (16.08.2010) Ubiquity of *Polynucleobacter necessarius* subspecies *asymbioticus* results from ecological diversification. 31th Congress of the International Limnological Society (SIL), Cape Town (SOUTH AFRICA).

Straubinger, Nadja (15.03.2010) Phytoplanktongemeinschaften und Microcystinproduktion in Kenianischen Gewässern. Deutsche Botanische Gesellschaft, Phykologentagung, Insel Reichenau an Bodensee, 15.-17. März, Konstanz (GERMANY).

Weisse, Thomas (17.08.2010) Physicochemical and biological properties of the most acidic Austrian lake and an adjacent neutralized lake. 31th Congress of the International Limnological Society (SIL), Cape Town (SOUTH AFRICA).

Poster contributions

Ficker, Harald (02.07.2010) Demographic modelling of whitefish with reference to toxins from cyanobacteria and climate change. SIL Austria - Fresh Blood for Fresh Water 2010, Young Aquatic Science (SIL Austria), Wassercluster Lunz (AUSTRIA).

Kurmayer, Rainer (24.03.2010) De novo genome sequencing and genome closing of the toxic cyanobacterium *Planktothrix agardhii*. IMG Workshop + 2010 DOE JGI User meeting, Walnut Creek Marriott, Walnut Creek, CA (UNITED STATES).

Scheuerl, Thomas (02.07.2010) Genotypic effects of an allele causing obligate parthenogenesis in *Brachionus calyciflorus* (Rotifera). SIL Austria - Fresh Blood for Fresh Water 2010, Young Aquatic Science (SIL Austria), Wassercluster Lunz (AUSTRIA).

Trummer, Philipp (02.07.2010) Cyanobacteria population development and regulation of toxin production in a mesotrophic deep lake in the Alps. SIL Austria - Fresh Blood for Fresh Water 2010, Young Aquatic Science (SIL Austria), Wassercluster Lunz (AUSTRIA).

Wanzenböck, Josef (27.07.2010) Risk analysis of direct and indirect climate effects on Austrian Whitefish Populations - Concept for a recently started project. The Fisheries Society of the British Isles Annual Symposium, Belfast (IRELAND)

Winkler, Gerold (04.07.2010) IPGL - International Post-Graduate Training Programmes in Limnology: Capacity Building for the Sustainable Management of Aquatic Ecosystems in Eastern Africa. SIL Austria - Fresh Blood for Fresh Water 2010, Young Aquatic Science (SIL Austria), Wassercluster Lunz (AUSTRIA).

2.8. Scientifc cooperation 2010

Academy of Sciences CR, Hydrobiological Institute, Ceske Budejovice, CZECH REPUBLIC

Adaptation of Active Fisheries Methods: Pair trawling
Biogeography and within-taxon ecological differentiation of *Polynucleobacter necessarius* subsp. *asymbioticus* and *Limnohabitans planctonicus* (Betaproteobacteria)

Bigelow Laboratory for Ocean Science, Bigelow, UNITED STATES

Niche separation and coexistence of chrysophytes in an alpine gradient

Biology Center of Czech Academy of Sciences, České Budějovice, CZECH REPUBLIC

Ecological diversification within the subspecies *Polynucleobacter necessarius* ssp. *asymbioticus* and environmental ecotype sorting, ESF project FREDI (FWF I 482-B09)

Dalhousie University, Halifax, Nova Scotia, CANADA

Rhodoluna Genome Project

Egerton University, Njoro, KENYA

Development of Educational and Research CAPacity in Eastern Africa for the Sustainable Management of AQUAatic Ecosystems

Fachbereich Organismische Biologie der Naturwissenschaftlichen Fakultät der Universität Salzburg, Salzburg, AUSTRIA

Global warming threatens biodiversity in (ultra)-sensitive high Alpine lakes: an assessment of past, present and future scenarios
Morphology and ecology of endemic ciliates from bromeliads (FWF P20360)
Patterns and processes of adaptation and tolerance to low pH of freshwater plankton)
Allgemeine Limnologische Grundlagenforschung
Ecophysiological adapatations of freshwater protists to extremely acidic conditions

Fisheries Research Institute, Jinja, KENYA

Development of Educational and Research CAPacity in Eastern Africa for the Sustainable Management of AQUAatic Ecosystems

Humboldt Universität zu Berlin, Institut für Biologie und Genetik, Berlin, GERMANY

Genotype determined toxin content in cyanobacteria (FWFP20231)

Institut für Öko-Toxikologie, Wien, AUSTRIA

Risk Analysis of Direct and Indirect Climate effects on deep Austrian Lake Ecosystems

Institut für Ökologie, Universität Innsbruck, Innsbruck, AUSTRIA

Allgemeine Limnologische Grundlagenforschung
Global warming threatens biodiversity in (ultra)-sensitive high Alpine lakes: an assessment of past, present and future scenarios
Niche separation and coexistence of chrysophytes in an alpine gradient

Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, GERMANY

Ecological diversification within the subspecies *Polynucleobacter necessarius* ssp. *asymbioticus* and environmental ecotype sorting, ESF project FREDI (FWF I 482-B09)

Lunds universitet, Lund, SWEDEN

Niche separation and coexistence of chrysophytes in an alpine gradient

Makerere University, Kampala, UGANDA

Development of Educational and Research CAPacity in Eastern Africa for the Sustainable Management of AQUAatic Ecosystems

Massachusetts Institute of Technology, Cambridge, UNITED STATES

Rhodoluna Genome Project (Einzelforschungsprojekt)

Nanjing Institute of Geography and Limnology, Nanjing, CHINA

Ecological diversification within the subspecies *Polynucleobacter necessarius* ssp. *asymbioticus* and environmental ecotype sorting, ESF project FREDI (FWF I 482-B09)

Rotes Kreuz Oberösterreich, Blutzentrale, Linz, AUSTRIA

Global warming threatens biodiversity in (ultra)-sensitive high Alpine lakes: an assessment of past, present and future scenarios

School of Biological Sciences, Liverpool, UNITED KINGDOM

Allgemeine Limnologische Grundlagenforschung

Technische Universität Dresden, Dresden, GERMANY

Patterns and processes of adaptation and tolerance to low pH of freshwater plankton (FWF P20118)

UNESCO-IHE, Institute for Water Education, Delft, NETHERLANDS

Development of Educational and Research CAPacity in Eastern Africa for the Sustainable Management of AQUAatic Ecosystems

University of Hawaii at Manoa, Department of Chemistry, Manoa, UNITED STATES

Genotype determined toxin content in cyanobacteria (FWFP202319)

University of Helsinki, Department of Applied Chemistry and Microbiology, Division of Microbiology, Helsinki, FINLAND

Genotype determined toxin content in cyanobacteria (FWFP20231)

University of Vienna, Faculty of Life Sciences, Wien, AUSTRIA

Time in Microevolution of Microcystin Synthesis, Doc-fFORTE

University of Zurich, Institute of Plant Biology, Zürich, SWITZERLAND

Ecological diversification within the subspecies *Polynucleobacter necessarius* ssp. *asymbioticus* and environmental ecotype sorting, ESF project FREDI (FWF I 482-B09)
Genotype determined toxin content in cyanobacteria (FWFP20231)

Universität Bern, Bern, SWITZERLAND

Global warming threatens biodiversity in (ultra)-sensitive high Alpine lakes: an assessment of past, present and future scenarios

Universität Innsbruck, Innsbruck, AUSTRIA

Allgemeine Limnologische Grundlagenforschung

Universität Innsbruck, Institut für Botanik, Innsbruck, AUSTRIA

Genotype determined toxin content in cyanobacteria (FWFP20231)

Universität Potsdam, Potsdam, GERMANY

Diversity and population heterogeneity of chrysomonad flagellates within an alpine gradient
Niche separation and coexistence of chrysophytes in an alpine gradient
Patterns and processes of adaptation and tolerance to low pH of freshwater plankton (FWF P20118)

Universität Zürich, Zürich, SWITZERLAND

Diversity and population heterogeneity of chrysomonad flagellates within an alpine gradient
Niche separation and coexistence of chrysophytes in an alpine gradient

Universität, Wien, Fakultät für Lebenswissenschaften, Department für Limnologie und Hydrobotanik, Wien, AUSTRIA

Allgemeine Limnologische Grundlagenforschung

Uppsala University, Uppsala, SWEDEN, Typ: Universitäre Lehr- und Forschungseinheit

Ecological diversification within the subspecies *Polynucleobacter necessarius* ssp. *asymbioticus* and environmental ecotype sorting, ESF project FREDI (FWF I 482-B09)

Veterinärmedizinische Universität Wien, Wien, AUSTRIA

Evolution of asexuality in experimental rotifer populations
Niche separation and coexistence of chrysophytes in an alpine gradient

Zentralanstalt für Meteorologie und Geodynamik (ZAMG), Wien, AUSTRIA

Global warming threatens biodiversity in (ultra)-sensitive high Alpine lakes: an assessment of past, present and future scenarios