ACADEMY OF SCIENCES OF THE CZECH REPUBLIC
HYDROBIOLOGICAL INSTITUTE
(BIOLOGY CENTRE, INSTITUTE OF HYDROBIOLOGY)
ČESKÉ BUDĚJOVICE

46th ANNUAL REPORT

For the Year 2005

ISSN 0232 - 0533

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Academy of Sciences of the Czech Republic

HYDROBIOLOGICAL INSTITUTE (till 31 Dec 2005)

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SCIENTIFIC SECRETARY: Doc. Ing. J. Kopáček, Ph.D.

SCIENTIFIC COUNCIL:

Chairperson:	RNDr. Jaroslav Vrba, CSc.
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	Prof. Dr. Arnold Nauwerck Institute of Limnology, Austrian Academy of Sciences, Mondsee, Austria

INSTITUTE STAFF AND FIELD OF WORK

SCIENTIFIC STAFF

Department of plankton and fish ecology:

Doc. RNDr. J. Kubečka, CSc. (Head)	Fish population dynamics and scientific sonar techniques
Prof. RNDr. Z. Brandl, CSc.	Ecology of predatory Cyclopidae, predatory food relations
Ing. J. Frouzová, Ph.D.	Hydroacoustics and fish behaviour
Mgr. E. Hohausová, Ph.D.	Fish ecology and behaviour
Doc. RNDr. J. Hrbáček, DrSc. (Scientific Consultant)	Limnology of artificial water bodies, zooplankton, especially *Daphnia*
RNDr. K. Kubečková-Kaštovská, Ph.D.	Phytoplankton analyses, morphological variability of cyanobacteria (genera *Anabaena, Aphanizomenon*)
RNDr. J. Komárková, CSc.	Plankton primary production, phytoplankton analyses, taxonomy of algae
RNDr. J. Macháček, CSc.	Fish-zooplankton interactions, ecology of *Daphnia*
Doc. RNDr. J. Matěna, CSc.	Feeding biology of fish, ecology of chironomids
RNDr. J. Seďa, CSc.	Zooplankton, especially seasonal dynamics of Cladocera and fish-zooplankton interactions
Mgr. M. Vašek, PhD.	Fish feeding and distribution (from March)
RNDr. P. Znachor, Ph.D.	Phytoplankton, autoradiography, microphotography, cyanobacterial bloom ecology

Department of aquatic microbial ecology:

Prof. RNDr. K. Šimek, CSc. (Head)	Aquatic microbiology, bacteria-protozoa interactions, bacterial community composition
Prof. Ing. M. Macek, CSc.	Protozoa-bacteria interactions, freshwater ciliates, (11 months UNAM México, biological waste water treatment Campus Iztacala)
RNDr. J. Nedoma, CSc.	Microbial biochemistry, image analysis
RNDr. V. Straškrábová, DrSc.	Self-purification (BOD), aquatic bacteriology, interactions with phyto- and zooplankton
RNDr. J. Vrba, CSc.	Aquatic microbiology, extracellular enzyme activity

Department of hydrochemistry and ecosystem modelling:

Doc. Ing. J. Hejzlar, CSc. (Head)	Reservoir limnology and eutrophication
RNDr. J. Borovec, Ph.D.	Reservoir limnology, chemistry of sediments
Doc. Ing. J. Kopáček, Ph.D.	Analytical chemistry, soil-water interactions
Ing. P. Porcal, Ph.D.	Aquatic dissolved organic matter
Doc. Ing. H. Šantrůčková, CSc.	Soil biochemistry (until July)
Ing. J. Veselý, DrSc.	Palaeolimnological studies (until July)
Mgr. Berenika Dobiášová	Socio-economic research

TECHNICAL STAFF:

J. Bučková	Cleaner
A. Charvátová	Cleaner
A. Fiktusová	Chemical analyses
Ing. V. Hejzlarová	Chemical analyses
V. Jirák	Building maintenance, electric installations
Ing. J. Kroupová	Chemical analyses
M. Kupková	Phytoplankton analyses
V. Lavičková	Documentator
Ing. R. Malá	Bacteriological analyses, cultivation of microbes
Ing. P. Mautschka	Construction of laboratory and field electronic equipment, maintenance of computer net
Mgr. K. Murtinger	Analytical chemistry
Z. Prachař	Field assistance, zooplankton analyses
S. Smrčková, DiS.	Bacteriological analyses, data processing
D. Šrámková	Secretary, accountant
M. Štojdlová	Biochemical analyses, image analysis
M. Vožechová	Microscopy, laboratory analyses
MUDr. J. Zemanová	Zooplankton analyses and culture maintenance

Ph.D. STUDENTS:

RNDr. M. Čech	Fish behaviour in the open water
Mgr. V. Draštík	Fish behaviour and community structure
Mgr. K. Horňák	Bacterioplankton community composition and activity
Ing. J. Jarošík	Mathematical modelling of reservoirs
Mgr. J. Jezbera	Protozoan-bacterial interactions
Mgr. J. Jezberová	Identification of cyanobacterial picoplankton
Mgr. J. Kaňa	Water and soil chemistry
Mgr. R. Litvín	Mathematical models (until March)
Mgr. Václav Metelka	(since October)
Mgr. J. Peterka	Fish foraging
RNDr. M. Prchalová	Fish behaviour
Mgr. A. Štrojsová	Extracellular phosphatases of phytoplankton
Mgr. M. Štrojsová	Digestive enzymes of rotifers
Mgr. J. Turek	Hydrology and water chemistry

STUDENT HELP:

J. Jan, Bc.
Oldřich Jarolím
T. Jůza, Bc.
K. Kolářová, Bc.
M. Kratochvíl, Bc.
Julia Mudruňková
M. Marešová, Bc.
M. Říha, Bc.
M. Tušer, Bc.

1. INTRODUCTION

The basic staff of the institute has remained unchanged in 2005. Regular long-term monitoring with some special investigations has continued in the Slapy and Římov reservoirs, and so has the research on lakes in the Bohemian Forest and in the Slovakian and Polish High Tatra Mts. Field research has been supplemented by focused laboratory experiments.

The work on the new Institutional Research Plan “Structure, functioning and development of aquatic ecosystems”, approved for the years 2005–2010, started.

The “Support Programme for targeted research in the AS CR” will continue in the HBI through another project “Limnological basis of sustainable management of reservoirs”, approved for the period 2005–2009.

HBI is responsible for one site in the global LTER (long-term ecological research) and GTOS (global terrestrial observing system) networks – “Reservoirs in the Vltava River Watershed”. The site is registered in the database of TEMS (Terrestrial Ecosystem Monitoring Site) on the website: www.fao.org/gtos/tems.

Close cooperation of the HBI with the Faculty of Biological Sciences, University of South Bohemia, has continued under similar conditions as in preceding years. Institute members have also been actively engaged supervising students’ theses, lecturing and training students at other Faculties (Agriculture and Pedagogical) of the University of South Bohemia and at other Universities (Charles University, Prague, Institute of Chemical Technology, Prague). Two Bachelor’s theses and 3 PhD theses supervised by staff members were completed in 2005 (see list at the end of chapter). Most staff members work part-time for the University of South Bohemia and vice-versa. Students are active in the HBI as student helpers and part-time staff members (see list of staff).

1.1 Projects

Institutional project, Academy of sciences of CR

2005–2010 Reg. code AV0Z 60170517 Structure, functioning and development of aquatic ecosystems – Hydrobiological Institute AS CR.

Program Support of targeted research in the Academy of sciences of CR

2005–2009 Reg. code 1QS600170504 Limnological basis of sustainable management of reservoirs – J. Matěna.

Projects sponsored by the Grant Agency of the Academy of Sciences of CR

2002–2005 Reg. code A6017202 Detection, localisation and quantification of extracellular enzymatic activities on cellular and population level in natural lake seston – J. Vrba.

2003–2006 Reg. code A3017301 Modelling of processes in the system "atmosphere-catchment-reservoir" and their impacts to surface water quality – J. Hejzlar.

2003–2005 Reg. code A6017301 Dynamics of Morphology and growth of *Daphnia* as response to spatio-temporal heterogeneity of environmental conditions in a stratified reservoir – J. Macháček.

2003–2005 Reg. code A6005308 Relations between the phenotypic and ultrastructural characters of heterocytous cyanobacteria – J. Komárková (coordinated by Botanical Institute AS CR).

2005–2008 Reg. code IAA600170502 Sinusoidal foraging and the role of fish in reservoirs – J. Matěna.

Projects sponsored by the Grant Agency of CR

2003–2005 Reg. code 206/03/P024 Relationship between molecular and morphological characteristics of planktic and benthic cyanobacteria – K. Kaštovská.

2003–2005 Reg. code 206/03/1537 Mechanism of coexistence of Daphnia species and clones in a stratified reservoir with planktivorous fish predation – J. Macháček.

2003–2005 Reg. code 206/03/1583 Nutrient cycling in the nitrogen-saturated mountain forest ecosystems: History, present and future of water, soil, and Norway spruce forest status – J. Kopáček (cooperation with Faculty of Biological Sciences, University of South Bohemia, České Budějovice; Czech Geological Survey, Prague; Faculty of Forestry, Czech University of Agriculture, Prague; Institute of Landscape Ecology, ASCR, České Budějovice; and Institute of Botany, ASCR, Brno).

2003–2005 Reg. code 206/03/1491 Light-limited phytoplankton in a deep canyon-shaped reservoir: strategy of survival in the period of winter mixing – J. Hrbáček (coordinated by the Faculty of Science, Charles University, Prague).

2003–2005 Reg. code 103/03/0469 Simulation of processes with impacts to water quality in reservior systems – J. Hejzlar (coordinated by Institute of Hydrodynamics AS CR).

2004–2006 Reg. code 206/04/0190 Local genetic differentiation of Daphnia in deep canyon-shaped dam reservoirs – J. Seďa.

2004–2006 Reg. code 206/04/P092 Large scale survey of plant biomass and plant cover by echosounding – E. Hohausová.

2005–2007 Reg. code 206/05/0007 Changes in bacterioplankton structure and functioning in a reservoir related to single-cell activities of major phylogenetic groups of bacteria – K. Šimek.

2005–2007 Reg. code 206/05/P520 Identification of temporal and spatial arrangement of processes of phosphorus cycling – J. Borovec.

International projects

2000-2005 Algal community assessment under different nutrient and grazing intensity regimes: towards optimization of selenium volatilization – J. Komárková (Project of GA of Univ. California, principal investigator: E. Rejmánková, Department of Environmental Science and Policy, University of California, Davis, USA).

2001-2005 Linking ecosystem processes and community structure along salinity gradients in tropical marshes – J. Komárková (project NSF US, coordinated by University of California, Davis, USA).

2002–2005 Understanding of fish role in Biesbosch Reservoirs – J. Kubečka (cooperation with WBB, the Netherlands, coordinator: H.A.M. Ketelaars).

2003–2005 Single-cell analysis of aquatic bacterioplankton: comparing methods and transferring expertise – K. Šimek (a bilateral project AS CR - CSIC Spain – Institut de Ciencies del Mar, CMIMA, Barcelona, Catalunya, Spain, J. Gasol).

2004–2005 Fish stock assessment of the Neusiedlersee – J. Kubečka (coordinated by the Biological Station, Neusiedlersee, Illmitz, Austria).

Project sponsored by the Ministry of education, youth and sports CR

2004–2005 (Czech-France project PAI Barrande) Sources of mortality in *Synechcoccus*, a common planktonic, autotrophic prokaryote – K. Šimek.

2005–2006 (Czech-France project PAI Barrande) Quantification of enzymatic activities at single-cell level using fluorescent labelling and image analysis – J. Nedoma.

European Communities R&D Program 5th framework

2001-2005 EUROHARP Towards European harmonized procedures for quantification of nutrient losses from diffuse sources – J. Hejzlar (subcontracted to NIVA, Oslo, coordinated by NIVA, Oslo, Norway).

2002–2005 CONTINENT High resolution record in the Lake Baikal: A key-site for Eurasian teleconnection to the North Atlantic Ocean and monsoonal system – V. Straškrábová (coordinated by GeoForschungszentrum Potsdam, Germany).

European Communities R&D Program 6th framework

2004–2009 EURO-LIMPACS Integrated Projects to Evaluate the Impacts of Global Change on European Freshwater Ecosystems, EU Contract GOCE-CT-2003-505540 – J. Kopáček (coordinated by University College London)

2004–2009 ALTER-NET A long-term Biodiversity, Ecosystem and Awareness Research Network GOCE-CT-2003-505298 – V. Straškrábová (coordinated by Natural Environment Research Council, UK)

1.2 Consultancies

2005 Fish stock assessment of the Želivka water supply reservoir – J. Kubečka (Vltava River Authority).

2005 Fish stock assessment of the Nýrsko water supply reservoir – J. Kubečka (Vltava River Authority).

2005 Fish stock assessment of the Chabařovice flooded coal mine – J. Kubečka (Mining Authority, Ústí nad Labem).

1.3 Report on Finances

(in thousands CZK)

INCOME	
Balance from preceding year	3325.20
Support by Academy of Sciences (including Priority research programmes)	19216.00
Grants from Grant Agency AS CR	1578.00
Grants from Grant Agency CR	3626.00
Foreign grants	2724.60
Consultancies	1454.50
Others	393.26
Total	**32317.56**

EXPENSES	
Salaries	11931.00
Health and social insurance + social founds	4321.89
Other obligatory insurance of persons and property	199.06
Energy	747.59
Gasoline	263.55
Maintenance of buildings	18.34
Maintenance of cars and equipment	358.55
Postage, telephone, internet	172.12
Books, journals	520.95
Travelling and conference fees	1628.08
Computing, software	149.23
Others consumables and small equipment	2937.81
Others	837.19
Total	**24085.36**

EQUIPMENT	
Two-beam sonar	1848.70
Camera	129.02
Deep freezer and hybridizer	526.90
Submersible fluoroprobe	788.00
Flow injection analyzer	1534.40
WTW water column profiler	115.00
Van (VW Transporter)	690.00
Sterile box	319.96
Other equipment	273.18
Total	**6225.16**

BALANCE (a fund for equipment) **2007.04**

1.4 Presentations of HBI Members at International Conferences

EWAPE 1, The 1st European Workshop on Aquatic Phage Ecology, Thonon, France, 2–5 February 2005

K. Šimek, K. Horňák, J. Jezbera, J. Nedoma, M. Weinbauer, J.R. Dolan, J.M. Gasol: Comparing the effects of resource enrichment and grazing on a bacterial community and viral dynamics in a freshwater reservoir (key note lecture).

Art and Science in Europe 2005, Berlin–Jena, Germany, 21–25 May 2005

J. Nedoma, K. Šimek, K. Horňák, M. Mašín, M. Weinbauer, J. Dolan, J.M. Gasol: Bacterial phylotypes and morphotypes: growth, substrate uptake, ectoenzyme activity, predation.

15th Hungarian Algological Meeting, Hungary, 23–27 May 2005

E. Zapomělová: Stability of trichom coiling in selected strain of the genus Anabaena (Cyanobacteria) during the cultivation.

J. Řeháková: Morphological stability in the family Nostocales.

Acid Rain 2005, 7th International Conference on Acid Deposition, Prague, Czech Republic, 12–17 June 2005

J. Kopáček and R.F. Wright: Factors governing spatial and temporal variability in nitrate leaching from alpine catchments.

P. Porcal, J. Hejzlar, J. Kopáček, J. Nedoma, J. Vrba: Carbon balance in strongly acidified mesotrophic lake.

J. Kaňa and J. Kopáček: Impact of soil and bedrock characteristics on phosphorus concentrations in the acidified Bohemian Forest lakes.

J. Turek, J. Hejzlar, J. Kopáček, J. Žaloudík: Impact of terrestrial nitrogen export on stream acidification in mountain forests.

Z. Melichová, M. Schabjuk, J. Kopáček: Seasonal dynamics of nitrogen forms in an alpine stream in the Tatra Mountains.

M. Svoboda, J. Kopáček, H. Šantrůčková: Tree ring chemistry and changes in acid deposition in two watersheds in the Bohemian Forest (Czech Republic).

E. Stuchlík, P. Bitušík, D.W. Hardekopf, J. Kopáček, J. Tátosová: Complexity of biological recovery from acidification: study based on long-term records, dynamic modeling and paleolimnology of high mountain lakes.

D.W. Hardekopf, E. Stuchlík, J. Horecký, J. Kopáček, J. Kulina, M. Mihaljevič, Z. Pehal: Modeling of a strongly acidified forest stream: Litavka, Brdy Mountains, Czech Republic.

J. Veselý, V. Majer, J. Kopáček: Are inverse changes in Al and Si concentrations coupled in lakes recovering from acidification?

ASLO Summer Meeting, Santiago de Compostela, Spain, 19–24 June 2005

K. Horňák, J. Jezbera, M. Mašín, J. Nedoma, K. Šimek: Uptake of leucine by major phylogenetic groups of bacteria under different levels of resource availability and bacterivory in a canyon-shaped reservoir (lecture).

29th Larval Fish Conference, Barcelona, Girona, Spain, 11–14 July 2005

M. Čech, J. Kubečka, J. Draštík, M. Kratochvíl, J. Peterka, J. Matěna: Bathypelagic distribution and diel vertical migrations of European perch (*Perca fluviatilis* L.) larvae: heritage of marine origin?

J. Peterka, M. Kratochvíl, J. Kubečka, J. Matěna, M. Čech, I. Vaníčková: Diurnal vertical migrations of European perch (*Perca fluviatilis* L.) larvae and juveniles: failure of the foraging hypotheses explanation.

Assessing of the Ecological Status of Rivers, Lakes and Transitional Waters, Hull, Great Britan, 11–17 July 2005

J. Hejzlar and J. Kubečka: Problems in assessing the ecological potential of reservoirs.

J. Kubečka, J. Matěna, M. Čech, V. Draštík, J. Frouzová, M. Hladík, J. Peterka, M. Prchalová, M. Vašek: Fish assessment of the ecological status of Czech reservoirs.

Workshop on Tropical and Subtropical Cyanoprokaryota, Gran Canaria, Spain, 18–22 July 2005

J. Komárková, J. Komárek, E. Rejmánková: Cyanobacterial mats, endangered assemblages from alkaline marshes in Belize.

8th International Phycological Congress 2005, Durban, South Africa, 13–18 August 2005

J. Komárek, J. Komárková: Comparison of phenotype and molecular diversity of cyanobacteria from alkaline marshes in Belize (Central America).

P. Znachor, J. Jezberová, J. Komárková: The occurence of tropical bloom-forming green alga *Pleodorina indica* (Volvocales) in the river Malše (Czech Republic).

Fourth Symposium for European Freshwater Sciences, Krakow, Poland, 21–27 August 2005

M. Prchalová: Gradients of fish distribution in reservoirs.

M. Vašek and J. Kubečka: Fish distribution along a trophic gradient in a canyon-shaped reservoir: implications for future research.

M. Říha: Long-term development of fish populations in Římov reservoir.

V. Draštík: Patterns of fish distribution in natural and cascade reservoirs.

M. Štrojsová and J. Vrba: Direct detection of digestive enzymes in planktonic rotifers (using ELF assay).

A. Štrojsová: Extracellular phosphatases on phytoplankton.

SAME-9, The 9th Symposium on Aquatic Microbial Ecology, Helsinki, Finland, 21–26 August 2005

K. Šimek, K. Horňák, J. Jezbera, J. Nedoma, J. Gasol, M. Hahn, M. Schauer: Influence of top-down and bottom-up manipulations on the R-BT065 subcluster of Betaproteobacteria, an abundant group in bacterioplankton of a freshwater reservoir. (Invited lecture).

10th International Symposium on the Interactions between Sediments and Water, Lake Bled, Slovenia, 29 August – 2 September 2005

J. Hejzlar, P. Boers, B. Kronvang: The assessment of nutrient retention capacity of lakes and reservoirs.

VIIth International Symposium on Cladocera, Herzberg, Switzerland, 3–9 Sep 2005

J. Seďa, Petrusek, J. Macháček: Taxon-specific patterns of *Daphnia* distribution in heterogeneous environment of canyon-shaped reservoirs (lecture).

14th Workshop of the International Association of Phytoplankton Taxonomy and Ecology (IAP), Sapanca, Turkey, 4–10 September 2005

J. Jezberová: Influence of physical-chemical conditions and protozoan presence on the growth and shape of the rod-like picoplanktic cyanobacteria**.**

P. Znachor and J. Jezberová: The occurrence of a bloom-forming green alga *Pleodorina indica* (Volvocales) in the downstreem reach of the river Malše (CR).

E. Zapomělová, K. Kaštovská, P. Znachor, J. Komárková: Morphological variability of coiled representants of the genus Anabaena in natural populations.

A. Štrojsová, J. Vrba, J. Nedoma: Extracellular phosphatases of phytoplankton in freshwaters.

135th Annual meeting of the American Fisheries Society & Symposium Recent Advances in Hydroacoustical Assessment of Fish in Marine and Riverine Environments, Anchorage, USA, 4–17 September 2005

J. Frouzová: Detailed patterns of scattering from lateral aspects of freshwater fish.

J. Frouzová: Spatial distribution and fish behavior in large shallow lake.

M. Čech: Sinusoidal foraging in fishes: simultaneous monitoring by hydroacoustics and underwater camera.

M. Čech: Diel vertical migrations and onhogenetic changes of bathypelagic Perch fry layer monitored by hydroacoustic methods.

J. Kubečka: Patterns of fish behaviour on the spawning grounds of cyprinids.

J. Kubečka: Overestimation of percids caused by gillnet sampling.

J. Kubečka: Comparison of acoustic and netting fish stock assessments in lakes and reservoirs.

Workshop of EU Project EURO-LIMPACS, Athens, Greece, 5–10 September 2005

J. Kopáček and R. F. Wright: Spatial and temporal variability in nitrate concentrations in mountain lakes.

J. Kopáček: Photochemical production of ionic and particulate aluminium & aluminium impact on in-lake phosphorus cycling.

Aquatic Ecology at the Dawn of XXI Century – An International Scientific Conference to the 100th anniversary of G. G. Winberg, St. Petersburg, Russia, 3–7 October 2005

V. Straškrábová, J. Jezberová, J. Komárková, J. Nedoma, K. Šimek, J. Vrba: Microbial loop in pelagic biomass and processes of reservoirs and lakes (invited lecture).

SCA-Symposium on Single-Cell Analysis of Planktonic Microbes, Banyuls sur Mer, France, 17–21 October 2005

K. Šimek, K. Horňák, J. Jezbera, J. Nedoma, J.M. Gasol, M. Hahn, M. Schauer: Responses of the R-BT065 subcluster of Betaproteobacteria to varying experimental manipulations in a freshwater reservoir studied using single-cell analysis techniques (invited lecture).

J. Nedoma and F. Van Wambeke: Detection and quantification of microbial extracellular phosphatase at single cell level using ELF97 phosphate: a comparison of methods (lecture).

UNECE Workshop on Nitrogen Processes and Dynamic Modelling & 6th Meeting of the WGE Joint Expert Group on Dynamic Modelling, Brighton, United Kingdom, 26–28 October 2005

J. Kopáček and H. Šantrůčková: Different effects of NH_4 and NO_3 deposition.

Workshop on Comparative Reservoir Limnology and Integrated Basin Management, Belvaux, Luxemburg, 18 November 2005

J. Hejzlar: Ecological potential of reservoirs.

J. Seďa, A. Petrusek, J. Macháček: Taxon-specific patterns of *Daphnia* distribution in the heterogeneous environments of canyon-shaped reservoirs.

J. Kubečka: Complex fish stock assessment in reservoirs.

M. Vašek, J. Kubečka, V. Draštík. Longitudinal gradient of fish distribution in a canyon-shaped reservoir: Implications for potential biomanipulation.

1.5 Stays Abroad

J. Borovec, *EU-project ALTERnet meetings* (Joint I3/I6 Workshop, Requirements for a European LTER Site Network and Information Framework for Biodiversity Research, Bratislava, Slovakia, 9–11 March 2005), *Brandenburg University of Technology, Department of Ecosystem and Environmental Informatics, Cottbus,* Germany 21–25 November (lecture: P-release from sediments: factors, methods, and experiments).

J. Hejzlar, *EU-project EUROHARP meetings,* **(**WP5 – nutrient retention, Wien, Austria, 14–16 March 2005; WP5 and WP6, Bari, Italy, 9–13 October 2005), *Brandenburg University of Technology, Department of Ecosystem and Environmental Informatics, Cottbus*, Germany, 21–25 November (lecture: The use of mathematical modelling in research and water-quality management of stratified reservoirs).

J. Jezbera, *International Institute of Ecology, Sao Carlos, Brazil,* 17 February – 10 March 2005 (experiments and sampling on Broa and Barra Bonita Reservoirs), *Institute for*

Limnology of the Austrian Academy of Sciences, Mondsee, Austria, 23 May – 2 June 2005 (isolation and cultivation of bacteria, determination using molecular methods), *Leibniz Institute of Freshwater Ecology and Inland Fisheries, Neuglobsow*, Germany, 31 August – 12 September 2005 (experiment at lake Grosse Fuchskuhle).

J. Jezberová, *Institute for Limnology of the Austrian Academy of Sciences, Mondsee,* Austria, 1–15 May 2005 (sample analysing, arrangement of grazing experiments).

J. Kaňa, *Lake Rachelsee,* Germany, 18 May, 23 October 2005 (sampling), *Tatra mountains,* Slovakia, Poland, 27 September – 5 October 2005 (sampling of mountain lakes).

K. Kaštovská, *Svalbard,* Norway, 1 August – 7 October 2005 (sampling expedition).

J. Kopáček, *Lake Rachelsee,* Germany, 18 May, 29 June 2005 (sampling), *Tatra mountains,* Slovakia, Poland, 27 September – 5 October 2005 (sampling of mountain lakes)

J. Kubečka, *University of Vienna,* Austria*,* 31 March – 6 April, 19–21 July 2005 (fish migration monitoring in the river Fisga, Nesidersee-project consultancy, preparation of papers), *Meeting of CEN working group "Fish monitoring" Bratislava,* Slovakia*,* 9–11 May 2005, *Technical University Dresden, Depatment of Limnology, Dresden,* Germany, 1–2 December 2005 (lecture: How to assay fish stock of the reservoir and its limnological effects?).

J. Nedoma, *Max-Planck Institute for Marine Microbiology, Bremen*, Germany, 4–6 December (image analysis, FISH counting).

P. Porcal, *Lake Rachelsee,* Germany, 23 October 2005 (sampling), *Tatra mountains,* Slovakia, Poland, 27 September – 5 October 2005 (sampling of mountain lakes).

Z. Prachař, *University of Vienna,* Austria, 31 March – 6 April, 19–21 July 2005 (fish migration monitoring in the river Fisga, Nesidersee-project consultancy, preparation of papers).

K. Šimek, *International Institute of Ecology, Sao Carlos,* Brazil, 17 February – 10 March 2005 (experiments and sampling on Broa and Barra Bonita Reservoirs), *Institute for Limnology of the Austrian Academy of Sciences, Mondsee,* Austria*,* 23 May – 2 June 2005 (isolation and cultivation of bacteria, determination using molecular methods), *Leibniz Institute of Freshwater Ecology and Inland Fisheries, Neuglobsow,* Germany*,* 31 August – 12 September 2005 (experiment at lake Grosse Fuchskuhle), *CNRS, Station of zoology, Department of microbial ecology, Villefranche sur Mer,* France, 14–24 November 2005 (work on common papers).

V. Straškrábová, *EU-project ALTERnet meetings* (Network Management group, Brussels, Belgium, 9–13 February 2005; Workshop of RA2 and RA3 activities, Hamburg, Germany, 16–20 February 2005; Joint I3/I6 Workshop, Requirements for a European LTER Site Network and Information Framework for Biodiversity Research, Bratislava, Slovakia, 9–11 March 2005; Workshop and council of RA2, Rome, Italy; Working group RA2 workshop "Methods for analysing trends in biodiversity data", Budapest, Hungary, 9–11 May 2005; Workshop of work packages RA3, I3, and RA6, Madrid, Spain, 4–8 August 2005), *Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin,* Germany*,* 9–12 June 2005 (PhD Thesis opponent of Susan Fietz).

M. Štrojsová, *Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany,* 24–27 April 2005 (cultivation of rotifers).

J. Turek, *Tatra mountains,* Slovakia, Poland, 27 September – 5 October 2005 (sampling of mountain lakes), *Lake Rachelsee,* Germany, 23 October 2005 (sampling).

J. Vrba, *EU-project ALTERnet meetings* (WP E1 Core group, Wageningen, Netherlands, 7–9 February 2005; Workshop of RA2 and RA3 activities, Hamburg, Germany, 16–20 February 2005; RA3, Man Forest project preparation, Uppsala, Sweden, 14–17 September 2005; WP E1 core group meeting, AVEC summer school 2005, Peyresq, France, 20–24 September 2005; ILTER coordination committee meeting, Mexico, 26 October – 3

November 2005, E1 core group meeting, Copenhagen Denmark, 18 November 2005) *Lake Rachelsee,* Germany, 18 May, 29 June 2005 (sampling)

P. Znachor, *EU-project ALTERnet meetings* (WP E2, Brussels, Belgium, 12–14 April 2005; WP I4 "science communication", Helsinki, Finland, 11–14 June 2005).

1.6 Foreign Visitors to Hydrobiological Institute

Emanuele **Caravati** (doctoral student), Italy, CNR-ISE Istituto Italiano di Idrobiologia, Verbania Pallanza.

Dr. Gianluca **Corno**, Italy, CNR-ISE Istituto Italiano di Idrobiologia, Verbania Pallanza ***(seminar at HBI: "Bacteria–protozoan interactions and the underlying mechanisms of grazing-resistance in bacteria").***

Dr. Marco **Dignum**, Netherlands, University of Amsterdam, NIOO-KNAW ***(seminar at HBI: "Clarifying a eutrophic shallow lake").***

Solange **Duhamel** (doctoral student), France, CNRS, Laboratorie de Microbiologie, Geochemie et Ecologie Marines, Marseille.

Dr. Martin **Finster**, Austria, Institute for Limnology, Austrian Academy of Sciences, Mondsee.

Inessa **Glebova** (doctoral student), Russia, Irkusk State University.

Dr. Patrick Artur **Grötz**, Germany, University of Hohenheim.

Dr. Martin **Hahn**, Austria, Institute of Limnology, Austrian Academy of Sciences, Mondsee.

Doc. Hubert **Keckeis**. Austria, University of Vienna.

Dr. Geir Inge **Orderud**, Norway, JORDFORSK, Oslo.

Dr. Lilian **Øygard**, Norway, JORDFORSK, Ǻs.

Dr. Thomas **Petzoldt**, Germany, Institute of Limnology, Technical University Dresden ***(seminar at HBI: Reservoir modelling as a thinking aid for systems understanding and water quality management").***

Dr. Thomas **Posch**, Austria, University of Innsbruck.

Dr. Georg **Rakowitz**, Austria, University of Vienna.

Dr. Monica **Tollotti**, Italy, Istituto Agrario di San Michele.

Dr. Mitsunori **Tarao**, Austria, Institute of Limnology, Austrian Academy of Sciences, Mondsee.

Dr. Nils **Vagstad**, Norway, JORDFORSK, Ǻs.

Doc. Josef **Wanzenbock**, Austria, Institute of Limnology, Austrian Academy of Sciences, Mondsee.

Dr. Markus **Weinbauer**, France, CNRS, Oceanographic Laboratory, Villefranche sur Mer.

1.7 Students' Theses (finished in 2005)

O. Hendl, (Bc): Oxygen consumption by sediments of Jordan reservoir. Faculty of Biological sciences USB. Supervised by J. Borovec.

P. Pecháčková, (Bc): P-cycle in extensively managed pond. Faculty of Biological sciences USB. Supervised by J. Borovec.

J. Frouzová, (PhD): The use of the echosounder for freshwater ecosystems studies. Faculty of Agriculture USB. Supervised by P. Hartvich and J. Kubečka.

M. Hladík (PhD): Importance of the tributary zone for development of fish population in a reservoir. Faculty of Biological sciences USB. Supervised by J. Kubečka

M. Vašek (PhD): Fish distribution and predation on zooplankton: spatial heterogeneity within a canyon-shaped reservoir. Faculty of Biological sciences USB. Supervised by J. Kubečka.

2. RESERVOIRS

2.1 Dissolved and Dispersed Substances in Reservoir Water (Slapy and Římov)

Annual and summer mean concentrations of chemical constituents dissolved and dispersed in the surface layers of the Slapy and Římov reservoirs (Table 1) were obtained by J. Hejzlar and J. Kopáček. Samples were taken from 0.1 to 0.4 m depth at the deepest points of the reservoirs, pre-filtered through a 200-µm polyamide sieve to remove large zooplankton, stored in the dark at 4°C, and analysed within 48 h after sampling. Dissolved constituents were analysed in samples filtered through a glass fibre filter with 0.4 µm nominal pore size. Abbreviations in Table 1 are: TON, total organic nitrogen; DON, dissolved organic nitrogen; TN total nitrogen; TP, total phosphorus; TDP, total dissolved phosphorus; COD, chemical oxygen demand; DOC and POC, dissolved and particulate organic carbon, respectively. Summer means: April to September.

Table 1: Mean values of main chemical constituents dissolved and dispersed in the waters of Slapy reservoir and Římov reservoir in 2005.

VARIABLES	UNIT	MEAN VALUES			
		Slapy		Římov	
		Annual	Summer	Annual	Summer
NO_3–N	$\mu g\ l^{-1}$	2778	3524	1510	1251
NO_2–N	$\mu g\ l^{-1}$	30	57	12	15
NH_4–N	$\mu g\ l^{-1}$	27	29	49	34
TON	$\mu g\ l^{-1}$	687	745	581	671
DON	$\mu g\ l^{-1}$	644	628	495	511
TN	$\mu g\ l^{-1}$	3522	4355	2152	1971
TP	$\mu g\ l^{-1}$	51.4	35.5	32.5	28.1
TDP	$\mu g\ l^{-1}$	35.9	13.1	20.8	13.3
COD	$mg\ l^{-1}$	22.7	23.7	18.9	19.8
DOC	$mg\ l^{-1}$	6.80	6.70	5.71	6.15
POC	$mg\ l^{-1}$	0.71	1.22	0.58	0.84
Ca^{2+}	$mg\ l^{-1}$	21.1	21.8	11.1	10.3
Mg^{2+}	$mg\ l^{-1}$	6.0	6.2	2.6	2.4
Na^{+}	$mg\ l^{-1}$	10.4	10.3	5.8	5.2
K^{+}	$mg\ l^{-1}$	3.9	3.8	2.1	1.9
SO_4^{2-}	$mg\ l^{-1}$	27.9	29.2	16.5	16.4
Cl^{-}	$mg\ l^{-1}$	14.9	15.9	5.6	4.8
Alkalinity (Gran)	$meq\ l^{-1}$	0.81	0.73	0.42	0.39
Conductivity at 25°C	$\mu S\ cm^{-1}$	227	231	125	114

2.2 Microbial Characteristics, Chlorophyll and Zooplankton Biomass of the Reservoirs Slapy and Římov

Annual and summer mean concentrations of bacteria, protozoans, microzooplankton, BOD_5 (total and after separating algae by filtration) as well as chlorophyll concentrations in the reservoirs and inflows to Římov reservoir, and mesozooplankton biomass in the reservoirs, based on data by Z. Brandl, J. Komárková, M. Macek, R. Malá, Z. Prachař, J. Seďa, K. Šimek, S. Smrčková, M. Štojdlová, V. Straškrábová, M. Štrojsová, and M. Vožechová are shown in Table 2.

Table 2: Mean values of microbial characteristics, zooplankton, chlorophyll and BOD in the Slapy and Římov reservoirs and inflows. "Summer": April to September. Sites: S–Slapy and R–Římov reservoirs, C–Černá and M–Malše rivers – inflows to Římov reservoir.

SITE	VARIABLE	LAYER	UNIT	MEAN VALUE	
				Annual	Summer
S	BOD_5	0 m	mg l^{-1} O_2	1.52	2.01
	BOD_5 filtered	0 m	mg l^{-1} O_2	–	1.28
	bacteria DAPI	0 m	10^6 ml^{-1}	2.83	4.22
	bact. beef-pept. agar	0 m	CFU ml^{-1}	205	196
	het. nanoflagellates	0 m	10^3 ml^{-1}	1.67	2.76
	ciliates	0–3 m	per ml	2.59	4.62
	chlorophyll *a*				
	total	0–3 m	mg m^{-3}	5.37	9.83
	>40µm	0–3 m	mg m^{-3}	3.69	6.74
	zooplankton biomass, protein N				
	Cladocera herbiv.	0–41m	mg m^{-2}	89.5	143.8
	Copepoda	0–41m	mg m^{-2}	46.5	72.2
	total zooplankton	0–41m	mg m^{-2}	138.2	233.6
R	BOD_5	0 m	mg l^{-1} O_2	2.08	2.17
	BOD_5 filtered	0 m	mg l^{-1} O_2	–	1.64
	bacteria DAPI	0 m	10^6 ml^{-1}	2.55	3.87
	bact. beef-pept. agar	0 m	CFU ml^{-1}	301	259
	bact. yeast ext. agar	0 m	10^3 CFU ml^{-1}	2.1	3.0
	het. nanoflagellates	0 m	10^3 ml^{-1}	1.25	1.95
	ciliates	0 m	per ml	17.89	33.34
	rotifers	0–7 m	per ml	0.410	0.719
	nauplii	0–7 m	per ml	0.037	0.067
	chlorophyll *a*				
	total	0–3 m	mg m^{-3}	4.97	8.54
	> 40µm	0–3 m	mg m^{-3}	3.00	4.82
	zooplankton biomass, protein N				
	Cladocera herbiv.	0–40 m	mg m^{-2}	93.5	110.7
	Copepoda	0–40 m	mg m^{-2}	48.3	63.4
	total zooplankton	0–40 m	mg m^{-2}	142.6	194.5
C	BOD_5	0 m	mg l^{-1} O_2	1.58	1.34
	chlorophyll *a*	0 m	mg m^{-3}	2.02	1.66
M	BOD_5	0 m	mg l^{-1} O_2	2.14	2.12
	chlorophyll *a*	0 m	mg m^{-3}	3.24	3.64

2.3 Fish Stock Composition in the Římov Reservoir in 2005

The fish stock of the Římov reservoir was monitored traditionally by night seining. Open water and benthic habitats were also studied by split-beam echosounder, gillnets, pelagic trawl and purse seine. The inshore area was fished quantitatively according to Kubečka and Bohm, 1991, Journ. Fish Biol., 38: 935–950. Field work was carried out by J. Kubečka, J. Peterka, M. Čech, J. Frouzová, E. Hohausová, M. Prchalová, Z. Prachař, M. Vašek, V. Draštík,, M. Říha, T. Jůza, M. Tušer, L. Piálek and O. Jarolím. Analysis of the catch was done by M. Říha and J. Kubečka. The composition of the catch is given in Table 3.

Sampling was carried out during one week in mid-August, using seine nets 50 and 150 m long. An area of over 1,1 hectares of the inshore region was fished. The estimate of inshore fish biomass was slightly lower compared with previous years with a total biomass of about 77 kg ha^{-1}. The August survey was carried out during relatively low water level when fishing of more upstream sites was impossible due to very thick layers of flooded muddy sediments brought in during the flooding in 2002. Omission of the most upstream and the most productive sites may have caused a slight underestimation of fish biomass compared to previous years. There was no significant change in fish stock. Common bream and roach remained the most important fish species in the reservoir, representing the bulk in both numbers and biomass. The results confirm the remarkable stability of the cyprinid-dominated fish stock of the reservoir.

Table 3: Composition of the fish stock of the Římov reservoir in 2005 according to night shore seining estimate.

Common name	Latin name	Abundance ind ha^{-1}	Biomass kg ha^{-1}	% Abundance	% Biomass
Perch	*Perca fluviatilis*	78.6	4.96	4.79	6.44
Roach	*Rutilus rutilus*	371.7	24.63	22.68	31.95
Bream	*Abramis brama*	510.7	28.65	31.16	37.16
Chub	*Leuciscus cephalus*	9.5	0.08	0.58	0.10
Rudd	*Scardinius erythrophthalmus*	10.6	0.36	0.65	0.46
Pike	*Esox lucius*	1.5	1.52	0.09	1.98
Asp	*Aspius aspius*	74.9	1.39	4.57	1.80
Dace	*Leuciscus leuciscus*	182.3	0.83	11.12	1.07
Bleak	*Alburnus alburnus*	60.2	2.15	3.67	2.79
Ruffe	*Gymnocephalus cernuus*	181.9	1.56	11.10	2.03
Pikeperch	*Stizostedion lucioperca*	119.5	2.99	7.29	3.88
Gudgeon	*Gobio gobio*	17.8	0.16	1.09	0.20
Hybrid	*Abramis x Rutilus*	14.7	1.02	0.89	1.32
Carp	*Cyprinus carpio*	2.3	6.03	0.14	7.82
Eel	*Anguilla anguilla*	2.2	0.61	0.13	0.79
Crucian carp	*Carassius gibelio*	0.6	0.15	0.03	0.20
	Total	1639.0	77.11	100.00	100.00

2.4 Changes in Biomass of Zooplankton 1999–2005 as Induced by the Great Flood

J. Hrbáček analyzed data on zooplankton biomass collected by Z. Brandl and Z. Prachař, in order to compare seasonal patterns of zooplankton development during the 3-year periods preceding and following the great flood in August 2002. Zooplankton was sampled by vertical hauls using an Apstein plankton net with openings of 0.2 mm. Biomass was measured colorimetrically by biuret reaction as protein N; these values were then multiplied by 8.16 to get ash-free dry weight.

There was no clear difference between the seasonal patterns of Cladoceran biomass (Fig. 1) before and after the flood. Very low values occurring from November until the middle of March were followed by seasonal maxima reached by the end of May or at the beginning of June in most years. The second, lower, and less pronounced maxima occurred at different periods in different years, ranging from mid-June to the second half of August.

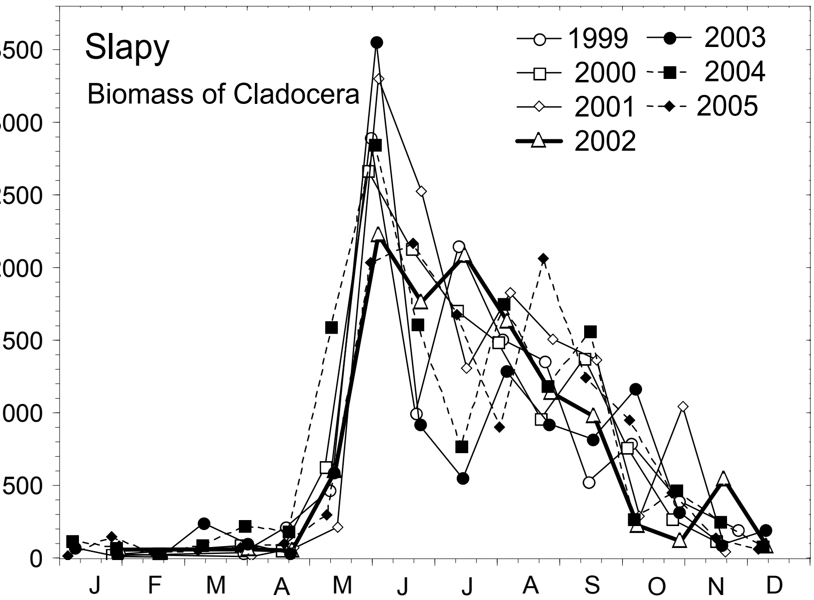

Fig. 1: A comparison of seasonal courses of Cladoceran biomass at Slapy reservoir in 1999–2005.

In contrast, the seasonal courses of Copepod biomass (mostly formed by cyclopoid coppepodits) differed before and after the flood (Fig. 2). In the second part of the season beginning in mid-July, after-the-flood values were in most cases lower than values before the flood. Again, the values were very low from the middle of November until the middle of March. Peak values occurring in the first half of May were much less regular than in the case of Cladocera and their timing was more regular after the flood than before it. The secondary summer peak fell into very different months. These changes in the seasonal pattern of zooplankton biomass indicate, in the interpretation of J. Hrbáček, changes in fish impact on zooplankton resulting from an altered composition of fish-stock induced by the great flood. An alternative possible explanation – alterations in nutrient flow caused by great amount of mud imported by the flood – is less probable because there were no signs of retreat after the first year following the flood.

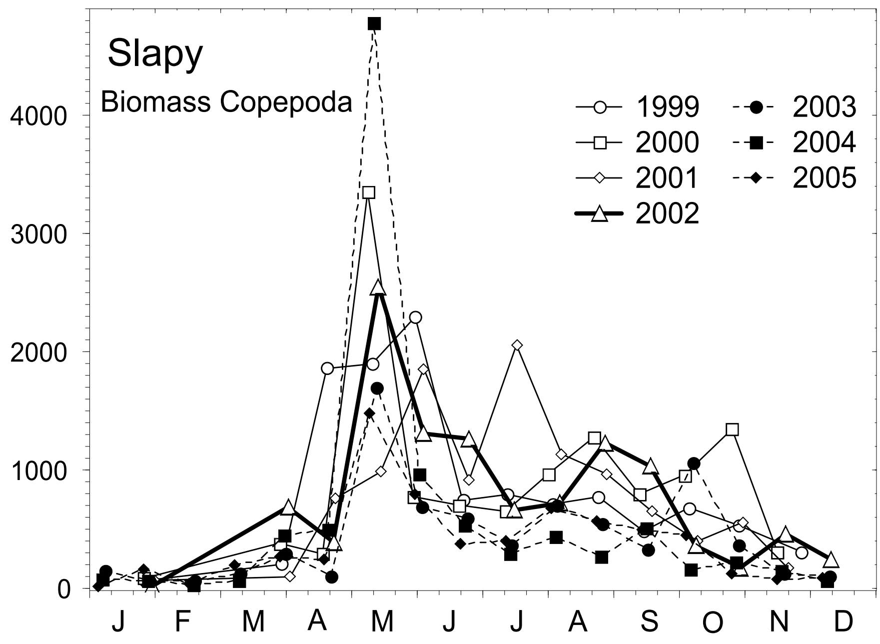

Fig. 2: A comparison of seasonal courses of Copepod biomass at Slapy reservoir in 1999–2005.

2.5 Picoplanktic Cyanobacteria from the Czech Freshwater Reservoirs, their Abundance, Genetics and Morphology

J. Jezberová examined picoplanctic cyanobacteria (PPC) abundances and morphotype variability in two reservoirs – meso-eutrophic Římov reservoir and oligotrophic Nýrsko reservoir. In both cases PPC occurred during the whole year and created maxima of 10^4 cells per ml. Two maxima of PPC arose in early and late summer. The first maximum was formed by single cells only, while colonial types of PPC prevailed in both reservoirs during the second maximum.

J. Jezberová further investigated three phycocyanin-rich strains of *Synechococcus*-like PPC, isolated from the plankton of Czech oligotrophic to eutrophic freshwater reservoirs, in crossed gradients of light and temperature and in combination with two different culture media (BG-11 and WC). The strains exhibited similar growth and reproduction patterns and displayed overlapping ranges of cell size (1.5×0.8 µm) under standardized laboratory conditions (18 µmol m^{-2} s^{-1}; 20°C). Maximum cell elongation (up to 19 µm) occurred in two strains only, in the BG-11 medium at the highest temperature (28°C) and highest irradiance (53 µmol m^{-2} s^{-1}), see Fig. 3. Cell dimensions in the WC medium were constant under most conditions given. Despite the fact that the cell volume in all strains increased more than five times under the lowest light and low temperature (6 µmol m^{-2} s^{-1}, <15°C) in both media, the length/width ratio remained unchanged. The strains differed in the degree of cell enlargement and cell division symmetry as well as in optimum temperature and light dependence. Based on this experimental work two strains could be identified as *Synechococcus* sp. and one as *Cyanobium* sp. This information can be used to support future genetic analyses.

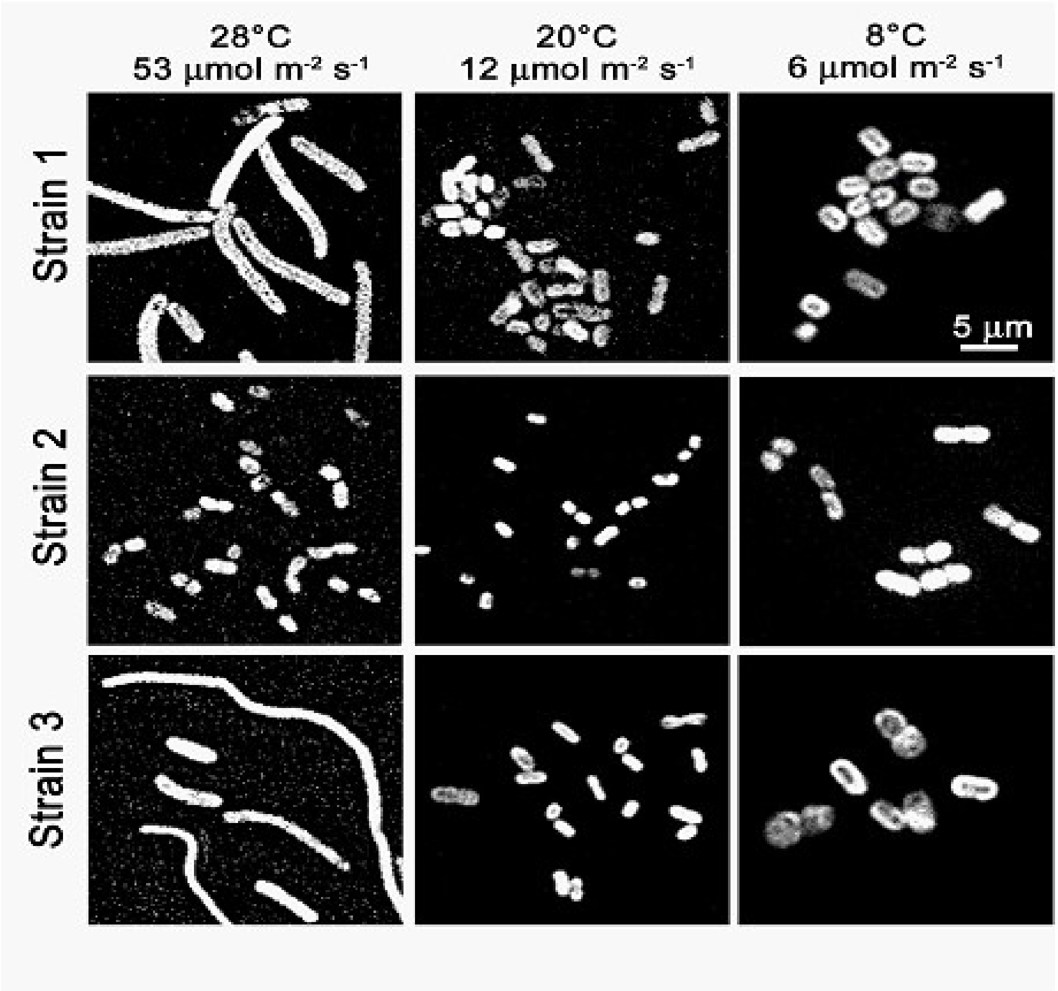

Fig. 3: Morphological differences among three strains of *Synechococcus*-like picoplanktic cyanobacteria taken by epifluorescence microscope. Strains were cultivated in a gradient of light and temperature in a nutrient rich medium (BG11).

2.6 Summer Cchanges of Cyanobacterial Bloom Composition and Microcystin Concentrations in Czech Reservoirs

P. Znachor, J. Komárková, J. Jezberová, K. Kaštovská, and E. Zapomělová summarized the data from 18 reservoirs, which were sampled twice during the summer of 2003 and 2004 for phytoplankton species composition and concentration of intracellular microcystins (MCs). As a consequence of high nutrient loading, most of the reservoirs experienced cyanobacterial blooms of various intensities with the prevalence of cyanobacteria increasing markedly in August, along with a conspicuous shift in species composition towards the dominance of *Microcystis* spp. The cyanobacterial blooms were primarily dominated by *Microcystis aeruginosa* while other cyanobacterial taxa occurred subdominantly and prevailed in only a few of the reservoirs surveyed. Microcystins were detected in 90% of the samples and their amount also increased considerably in August, reflecting the cyanobacterial biomass. However, MC concentrations were lower in 2004 (median 0.8 µg l^{-1}) than during the dry, warm season of 2003 (median 2.8 µg l^{-1}). In *Microcystis* dominated samples, significantly higher amount of MCs ($p<0.001$) occurred than in samples where other taxa prevailed (Fig. 4). Microcystins were positively correlated with chlorophyll *a* and cyanobacterial biovolume ($p<0.05$, $R^2=0.61$ and 0.66, respectively) with the strongest correlation found for *Microcystis* spp. biovolume ($p<0.001$, $R^2=0.87$), this taxon was the most important producer of MCs in Czech reservoirs. The main structural variants of MCs were MC-LR, MC-RR and MC-YR. Our data also indicate that the relative share of MC variants (MC-LR and MC-RR) varies considerably with time, most likely as a consequence of different species and strain compositions during the summer. This study clearly demonstrates a high prevalence of MC–producing cyanobacteria in Czech reservoirs. Therefore, regular monitoring of these reservoirs is highly desirable in an effort to minimise potential health risks to the human population.

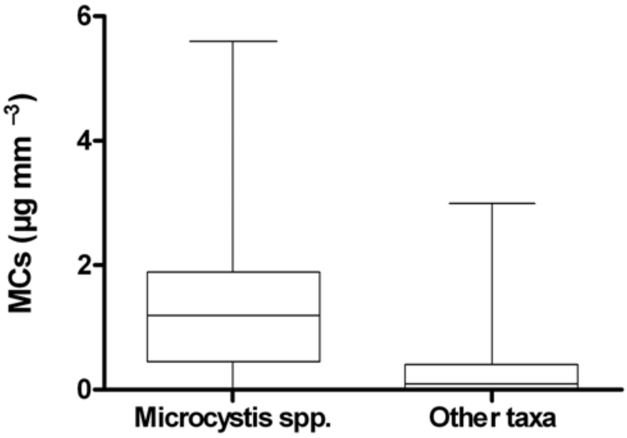

Fig. 4: Box-Whiskers plot of intracellular microcystin content in samples dominated by *Microcystis* spp. and other taxa. Boxes show median values and 25th and 75th quartile, bars indicate maximum and minimum.

2.7 Dynamics of Morphology and Growth of Daphnia as a Response to Spatio-Temporal Heterogeneity of Environmental Conditions *(2003–2005 – project supported by the Grant Agency of the Academy of Sciences of CR)*

J. Macháček, J. Seďa, and I. Slámová worked on this project. In the project, a newly designed method of investigation of morphological and life history parameters of parthenogenetical individuals of cladocerans of the genus *Daphnia* was utilized to estimate the current status of the population in a reservoir, and especially the trend of its development in a given period. The basic principle of the method is to investigate the parameters in selected ovigerous females immediately after their isolation from the reservoir for two successive developmental instars, which are not yet affected by the laboratory conditions, and thus reflect the situation in the reservoir. The following parameters were investigated: (i) somatic length increment of the female between instars, (ii) number, sex and size of the offsprings, (iii) relative filtering setae length (RFSL) in the filtering apparatus of the mother female and its change between instars, which reflects the dynamics of feeding conditions. The method of investigation was used in a study of the dynamics of vertical distribution of dominant cladoceran species *Daphnia galeata* in the Římov reservoir in important periods of the seasonal development of planktonic communities. Based on previous measurements of thermal stratification we sampled cladocerans from four layers of the vertical profile: the epilimnion (0–4 m), the metalimnion (4–7 m), the hypolimnion (12–17 m) and the layer above the bottom, which we call the sub-hypolimnion (25–35 m). The investigations were carried out first in early spring at the very beginning of thermal stratification and the spring phytoplankton bloom (end of April), when daphnids are accumulated mainly in upper layers. Further investigations were carried out in the clear water phase, at the end of clear water and the beginning of summer phytoplankton development. After thermal stratification is fully established (in May) *D. galeata* exhibits stable pattern of vertical distribution with majority of the population in two upper layers and a certain small part in the sub-hypolimnion for the rest of the season. Based on the results of our investigation we were able to draw the following conclusions:

1. At the beginning of the season we did not find significant differences in *D. galeata* parameters investigated, in different layers of the vertical profile. A positive growth tendency was found between instars in all sampled layers.
2. Further development indicates the differentiation of individuals dwelling in the sub-hypolimnion from those in other parts of the water column. The main factor contributing to this differentiation is very probably the large difference in water temperature. The much higher temperature in the upper layers brings a much faster fluctuation of environmental conditions and a faster response of cladocerans to these changes. On the other hand the very low and stable temperature near the bottom acts as a stabilizing factor slowing down the changes in the part of the population segregated in these deep layers.
3. We did not detect an influence of fish predation or fish kairomone on daphnids (somatic vs. reproductive investments, size of offsprings) in the upper parts of the water column, where a higher density of fish was expected. Neither did we detect the existence of more favorable feeding conditions in the deeper parts of the water column.
4. A certain proportion of males in the offspring was registered at the beginning of the season (beginning of May) and almost exclusively in the upper layers of the vertical profile. A second, less intensive production of males was found towards the end of the season (end of August, beginning of September), once more in the upper layers only.
5. The results indicate a gradual differentiation between individuals from the sub-hypolimnion and those from the upper layers, suggesting that the segregation of individuals in the sub-hypolimnion during the season is rather stable and the exchange or migration of daphnids between this and the upper layers is limited.

2.8. Mechanisms of Coexistence of Daphnia Species and Clones in a Stratified Reservoir with Planktivorous Fish Predation *(2003–2005 – project supported by the Grant Agency of CR)*

J. Macháček, J. Seďa, and K. Kolářová worked on this project. The vertical distribution of the dominant cladoceran species *D. galeata* in the Římov reservoir was found to exhibit quite regular seasonal dynamics. At the beginning of the season, soon after the ice melted, the population was almost completely accumulated in the upper, warmer layers. Later in the season, when the thermal stratification was fully established, the bulk of the population still remained in the upper layers (epi- and metalimnion) but a certain minor part of the population was regularly detected in the deepest parts of the water column (sub-hypolimnion). This kind of distribution persisted up to the autumn mixing. When inverse thermal stratification was established at the beginning of winter, an inverse distribution of zooplankton was established as well and the bulk of daphnids was accumulated near the bottom. In this way, parts of the population, which were segregated during the summer season, were mixed. Diurnal changes of *D. galeata* vertical distribution were not found. The second most abundant *Daphnia* species, *D. pulicaria*, was detected for most of the summer season deeper in the water column than *D. galeata*. The two species were thus, to a large extent, spatially segregated.

Using allozyme electrophoresis, we found that the subpopulation from the deep hypolimnion is clearly genetically differentiated from the majority population in the epilimnion. We found significant differences in allele and multilocus genotype frequencies as well as F_{ST} values slightly above 0.05. However, the spatial segregation between the epilimnetic and sub-hypolimnetic parts of the population is not permanent. During winter inverse stratification all the vertically segregated parts of the population are mixed together. Our results suggest that the deep hypolimnetic subpopulation is repeatedly re-established from depth "travellers" in spring and that the genetic differentiation might be both the result of different selective pressures and different depth preferences of various *D. galeata* clones.

We investigated life history traits of clonal lineages isolated from the two subpopulations, one from the epilimnion (0–5 m) and the other from the sub-hypolimnion (25–35 m) in the laboratory experiments. We collected the clones for experiments twice a year, first at the beginning of thermal stratification in May and then towards the end of the season in September. Our results show a trend of longer postembryonic development, bigger eggs in the first clutch and slightly higher somatic increments in the sub-hypolimnetic clones in May. In addition, a remarkable tendency to produce ephippia was registered in these clones as opposed to the epilimnetic ones. In September the results were reversed – the sub-hypolimnetic clones had a shorter postembryonic development, lower somatic increments and a slightly higher number of eggs in the first clutch. *D. galeata* × *cucullata* hybrids were recorded in the sub-hypolimnion. The results suggest that the individual and seasonal development of the subpopulation segregated in the sub-hypolimnion is different from that of the epilimnetic one. A vertically structured environment thus supports the coexistence of species and at the same time, as the diverse parts of the populations are mixed together during winter period, it can contribute to higher overall diversity of species and clones in the reservoir.

Publications:

[1] Macháček J. and Seďa J. Life history response of *Daphnia galeata* to heterogeneous conditions within a reservoir using a laboratory transplant experiment. Aquatic Ecology (accepted)

[2] Macháček J. and Seďa J. Spatial and temporal diversity of *Daphnia galeata* life history traits in vertically structured environment. Hydrobiologia (submitted)

[3] Seďa J., Kolářová K., Macháček J. *Daphnia galeata* in the deep hypolimnion: seasonal spacial differentiation of a "typical epilimnetic" species. Hydrobiologia (submitted)

2.9 Seasonal Changes of Bacterial Activity in the Římov Reservoir

K. Horňák, J. Jezbera, J. Jezberová, J. Nedoma, K. Šimek and P. Znachor studied changes in the seasonal dynamics of bacteria, phytoplankton and protozoa in the Římov reservoir. Samples were taken from 3 stations located in the dam area, middle part and river inflow of the reservoir at intervals of 3 weeks (29 March – 15 November 2005). Abundances and production of phytoplankton and bacteria as well as protozoan abundances and grazing were determined.

K. Horňák specifically analysed abundances and activity parameters of bacteria by means of flow cytometry. Using various fluorochromes, the relative proportion of bacteria with high (HNA) and low (LNA) nucleic acid content was determined. HNA-bacteria are metabolically active cells significantly contributing to bacterial biomass production while LNA-cells usually do not participate in the production processes. Furthermore, the percentage of "live" bacteria (i.e. with intact cell membrane) vs "dead" bacterial cells (with damaged membrane) was estimated. Cyanotetrazolium chloride dye (CTC) was used to indicate the respiratory activity of bacteria. CTC-positive cells are considered to be the most active part within whole bacterioplankton assemblage.

Significant changes in bacterial activity were observed throughout the season. The proportions of HNA-cells, “live” bacteria and CTC-positive cells showed a very similar pattern with two marked peaks in mid-May and the beginning of August in all studied stations. During these two periods, the proportions of HNA-cells and “live” cells reached 50–70% and ~80%, respectively. The percentage of CTC-positive cells ranged from 1 to 10% of total bacterial abundances. Not surprisingly, bacterial abundances tightly followed chlorophyll *a* concentrations. Moreover, all the activity parameters of bacteria were significantly correlated with chlorophyll *a* concentrations. The activity of primary producers seems to be the key factor determining not only abundance but also bacterial metabolic activity.

2.10 Growth Rates of Different Bacterioplankton Groups and Heterotrophic Nano-flagellates in Relation to Phosphorus Availability in a Reservoir

K. Šimek, K. Horňák, J. Jezbera, J. Nedoma, J. Vrba, V. Straškrábová, M. Macek, J. Hejzlar, J.R. Dolan (Station Zoologique, Villefranche sur Mer, France), and M.W. Hahn (Institute for Limnology AAS, Mondsee, Austria) collaborated on the processing of a large data set gained from *in situ* manipulation experiments dealing with responses in microbial community composition and dynamics to marked changes in growth limiting factors.

We investigated net growth rates of different bacterioplankton groups and heterotrophic nanoflagellate (HNF) communities in the canyon-shaped Římov reservoir by analyzing eight experiments conducted in the years 1997–2003, where resource availability and top-down control were manipulated. Water samples were size-fractionated, yielding bacterivore-free (<0.8 μm) and zooplankton-free treatments (<5 μm, top-down uncontrolled HNF), and incubated in dialysis bags in situ or transplanted into differently phosphorus-limited reservoir areas (soluble reactive phosphorus concentrations, SRP, 0.7–96 μg l^{-1}). Using 5 different rRNA-targeted oligonucleotide probes, net growth rates of the probe-defined bacterial groups and HNF assemblages were detected in the bacterivore-free and zooplankton-free treatments, respectively. The growth-rate parameters of Monod’s saturation kinetics of the bacterial subgroups were plotted against SRP concentrations. This yielded significant fits for all the probe-targeted bacterial subgroups (Fig. 5), highly significant differences among their maximum growth rates, but insignificant differences in their saturation constant values. Surprisingly, HNF assemblages grew significantly faster than any bacterial sub-populations studied except for a small but abundant cluster of *Betaproteobacteria* (targeted by the R-BT065 probe), which displayed comparable growth rates along with high vulnerability to HNF predation. Different growth capabilities of the members of distinct bacterial phylogenetic lineages and their differing vulnerability to HNF predation seem to have important ecological implications for their possible life strategies [1] and HNF–bacteria interactions [2] in the reservoir as discussed in detail in two recently accepted papers.

[1] Šimek K., Horňák K., Jezbera J., Nedoma J., Vrba J., Straškrábová V., Macek M., Dolan, J. R. Hahn M.W. 2006. Maximum growth rates and possible life strategies of different bacterio-plankton groups in relation to phosphorus availability in a freshwater reservoir. Environ. Microbiol. (*in press*).

[2] Jezbera J., Horňák K., Šimek K. 2006. Prey selectivity of bacterivorous protists in different size fractions of reservoir water amended with nutrients. Environ. Microbiol. (*in press*).

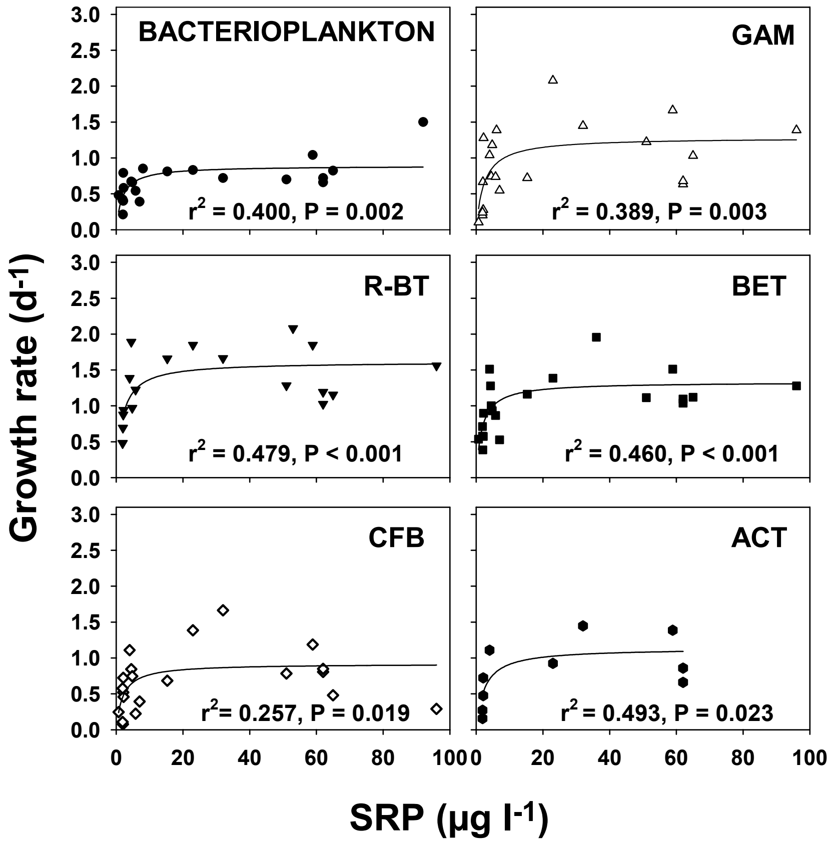

Fig. 5: Summary of growth rate estimates of the total bacterioplankton and of its different phylogenetic subgroups detected with the probes BET42a (BET, Beta-subclass of the class *Proteobacteria*), R-BT065 (R-BT, a narrower subcluster of the *Betaproteobacteria*), GAM42a (GAM, Gamma-subclass of the class *Proteobacteria*), CF319a (CFB, the *Cytophaga /Flavobacterium/Bacteriodetes* group), and HGC69a (ACT – the *Actinobacteria* group), measured under different SRP concentrations in the reservoir. Pooled data from eight experiments were fitted by a hyperbolic Monod function (unbroken line). r^2 – coefficient of the determination for the regression, P – probability.

3. LAKES

3.1 Nutrient Cycling in the Nitrogen-Saturated Mountain Forest Ecosystem: History, Present, and Future of Water, Soil, and Norway Spruce Forest Status *(2003–2005 – project supported by the Grant Agency of Czech Republic)*

This was a collaborative project involving the following scientists from five Czech institutes: (1) J. Kopáček, J. Vrba , J. Hejzlar, P. Porcal, J. Turek and J. Kaňa (HBI ASCR), (2) H. Šantrůčková, J. Šantrůček, M. Šimek, and T. Picek (Faculty of Biological Sciences, University of South Bohemia in České Budějovice), (3) J. Veselý, V. Majer, and D. Sedlický (Czech Geological Survey), (4) V. Podrázský, M. Svoboda and K. Matějka (Faculty of Forestry, Czech University of Agriculture in Prague), (5) P. Cudlín, I. Moravec, and Ewa

Chmelíková (Institute of System Biology and Ecology ASCR). International cooperation (paid from other sources) within the project: (1) J. Schaumburg (Bayerisches Landesamt für Wasserwirtschaft), (2) H. Müller, H. Wagensonner a C. Bässler (WWA Deggensdorf, Regensburg and Passau, Germany), (3) Stephen A. Norton (University of Maine, Orono, Maine, USA), (4) R.F. Wright (NIVA, Norway), (5) M. Williams (University of Colorado, Boulder, USA), and (6) H. Kettle (Edinburgh University, UK).

The major results of the project are as follows: (I) We performed complete mass budget studies on nutrient pools and fluxes in catchment lake ecosystems of the Plešné and Čertovo Lakes. The results suggest a similar impact of forest in both catchments but important differences in the impact of undergrowth vegetation on N cycling. N flux through nitrification and N mineralization was higher in the Čertovo catchment, explaining lower net terrestrial N retention compared to the Plešné catchment. We described the acidification impact on nutrient (P and N) availability, including the role of Al in food web structure and plankton dynamics. (II) Carbon isotopes in tree rings of Norway spruce have indicated negative impacts of atmospheric acidification, N saturation, and the related changes in soil chemistry on forest physiology since the 1950s. (III) Palaeolimnological analysis of the Plešné Lake sediment (chemistry, Cladocera, chironomides, diatoms, and pollen) has shown links between lake biota (chemistry) and climatic changes since soil formation in the catchment. A new relationship between climatic changes and Rb, K, and Cs concentrations enables the dating of >10,000-year old sediments. We observed an ecologically important impact of solar radiation on liberation of Al and Fe from natural organic complexes in surface waters. (IV) We described the relationships between water chemistry (N, Al, base cations) and inter-annual, as well as global climatic changes. Further results of the project include: (1) sulphate desorption from soils and its impact on lake recovery from acidification, (2) factors responsible for P export from soils, (3) key factors predicting ability of non-calcareous sediments to release phosphate, and (4) factors responsible for long-term increase in Si concentrations in the fresh waters studied. Thirty-one papers were published or submitted; 12 papers are in preparation.

The most significant ones follow:

[1] Kopáček J., Brzáková M., Hejzlar J., Nedoma J., Porcal P., Vrba J. 2004. Nutrient cycling in a strongly acidified mesotrophic lake. Limnol. Oceanogr. 49: 1202–1213.

[2] Kopáček J., Klementová Š., Norton S.A. 2005. Photochemical production of ionic and particulate aluminum and iron in lakes. Environ. Sci. Technol. 39**:** 3656–3662.

[3] Kopáček J., Borovec J., Hejzlar J., Ulrich K.–U., Norton S.A., Amirbahman A. 2005. Aluminum Control of Phosphorus Sorption by Lake Sediments. Environ. Sci. Technol. 39: 8784–8789.

[4] Šantrůčková H., Vrba J., Picek T., Kopáček, J. 2004. Soil biochemical activity and phosphorus transformations and losses from acidified forest soils. Soil Biology & Biochemistry 36**:** 1569–1576.

[5] Veselý J., Majer V., Kopáček J., Norton S.A. 2003. Increasing temperature decreases aluminum concentrations in Central European lakes recovering from acidification. Limnol. Oceanogr. 48: 2346–2354.

3.2 Dependence of Ciliates on APP-Feeding in a Deep Monomictic Saline Lake

M. Macek continued work on his projects at Universidad Nacional Autónoma de México *campus* Iztacala, Laboratory of Tropical Limnology (head – Javier Alcocer Durand) together with Dana Peštová (PhD student of the Masaryk University, Brno, Czech Republic). Samples taken monthly from at least 5 depths in a maar-crater lake, Alchichica (State of Puebla, Mexico) were analysed for specific ciliate feeding activity on autotrophic picoplankton

(APP). Epifluorescence methods based on APP autofluorescence and DAPI staining of ciliates were employed. Identification of ciliates was performed using Quantitative Protargol Staining; feeding activity was estimated by means of the fluorescently labelled particles method.

The ciliate assemblage development (weighted column-average) is shown in Fig. 6. A dominance of peritrichs (of the genera *Vorticella* and *Rhabdostyla*) within the assemblage observed during 2004 was not confirmed, which could be related to a rather low peak of a filamentous cyanobacteria, *Nodularia* cf. *spumigena* in 2005; contrary to this, the APP peak (over 1.5×10^6 cells ml^{-1}) observed during the stratification onset was higher and longer than in other years (Fig. 7). Scuticociliates (microaerobic and anoxic) numerically dominated the assemblage as they had in 2003. From the point of view of biomass, gymnostomes (*Phialina* sp.) were particularly important.

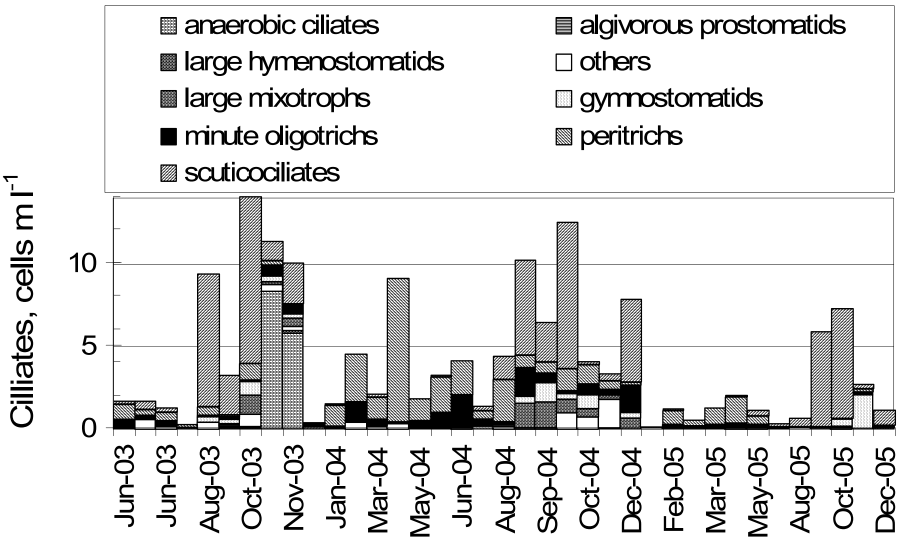

Fig. 6: Annual development of taxonomical-ecological ciliate groups in the whole column (depth-weighted mean).

Only several ciliate species living upon APP were observed within the peritrichs, oligotrichs, hypotrichs and scuticociliates. The most active APP feeders were peritrichous *Vorticella* spp. (typically ingesting 150 APP $cell^{-1}\ h^{-1}$, with a maximum of 2000 APP $cil^{-1}\ h^{-1}$, which represented a clearance rate of up to 2000 nl $cil^{-1}\ h^{-1}$). On the other hand, *Rhabdostyla* sp., which showed an uptake of FLP, was not observed ingesting active-autofluorescing APP. Minute oligotrichs (particularly *Halteria* spp.) and a hypotrich, *Euplotes* sp. (cf. *daidalos*) showed lower activity (up to 1000 nl $cil^{-1}\ h^{-1}$); APP ingestion by scuticociliates was limited to one genus (*Cyclidium*) and to a short period, coinciding with APP decrease in the water body. Other scuticociliates (*Uronema marina*, anoxic *Cyclidium* sp.) did not show APP-feeding activity.

Numbers (sampling average) and clearance rates (average of specimen-specific values) of three of the above mentioned ciliates were plotted against APP numbers and dissolved oxygen (DO) concentration categories (Fig. 8). Three different behaviour patterns were observed: (1) *Halteria* spp. were found throughout a wide interval of APP numbers in oxygenated water, but maximum were observed in microaerobic conditions upon low APP numbers, (2) *Vorticella* sp., which was dominant during the mixing period, was more abundant when APP numbers were higher, without an apparent relationship to DO, but (3) *Euplotes* sp. dominated in microaerobic conditions. Both *Vorticella* sp. and *Halteria* spp. showed similar activity independently of APP numbers, and even in microaerobic to anoxic conditions. The mixotrophic ciliate, *Euplotes* sp., showed a higher clearance rate in microaerobic conditions. As this species can live in anoxic conditions due to the activity of its symbiotic zoochlorelae, the relationship of the water column distribution and activity of this ciliate to photosynthetically active radiation should be tested.

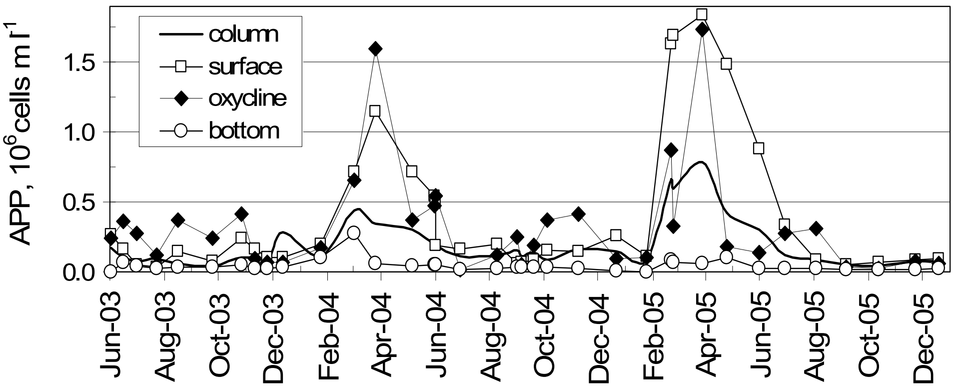

Fig. 7: Annual development of APP numbers in different layers.

Generally, only a small number of ciliate species was able to exploit high APP numbers in the investigated environment. Apparently, higher APP numbers did not lead to better development of the ciliate assemblages. The microbial loop was therefore effective neither as an organic carbon link to higher levels nor as a sink of the primary productivity of APP.

3.3 Photochemical Production of Ionic and Particulate Aluminium and Iron in Lakes

J. Kopáček, Š. Klementová (Faculty of Biological Sciences, University of South Bohemia, České Budějovice), and S.A. Norton (Department of Earth Sciences, University of Maine, Orono, USA) evaluated the effect of solar radiation on in-lake production of ionic forms of aluminum (Al) and iron (Fe). Photochemical liberation of allochthonous organically bound aluminum (Al_o) and iron (Fe_o) and in-lake hydroxide precipitation are important sources of these metals for lake sediments. Mass budgets of ionic Al and Fe (Al_i, Fe_i), Al_o, Fe_o, and particulate Al and Fe (Al_p, Fe_p) were measured for two western Czech Republic forest lakes (Plešné and Čertovo) in the 2000 to 2003 hydrological years. The lakes were net sinks of Al_i, Al_o, and Fe_o and net sources of Al_p and Fe_p. The average Al_o and Fe_o inputs from terrestrial sources (66–110 and 12–17 mmol m^{-2} yr^{-1}, respectively; on a lake area basis) were reduced by 45% and 25% in the lakes. Mass budgets of dissolved organic carbon (DOC), particulate organic C, and Al species indicated that only a minor part of the observed in-lake retention of Al_o could be explained by coagulation and sedimentation of organic matter, or from Al_i hydrolysis and formation of Al_p. Laboratory experiments with a short-time irradiation (~300 nm; ~800 W m^{-2}) of water from inlets to Plešné Lake showed the importance of photochemical processes in the liberation of Al and Fe from Al_o and Fe_o. After 12 hours of irradiation, Al_o and Fe_o concentrations decreased by 54±6% and 70±16%, respectively, compared to the dark controls. The photo-liberated Al_o and Fe_o increased the Al_i and Fe_i concentrations reciprocally, on a 1:1 mass basis. Subsequent hydrolysis of Al_i and Fe_i in lakes forms insoluble hydroxides, increasing sediment concentrations of Al and Fe.

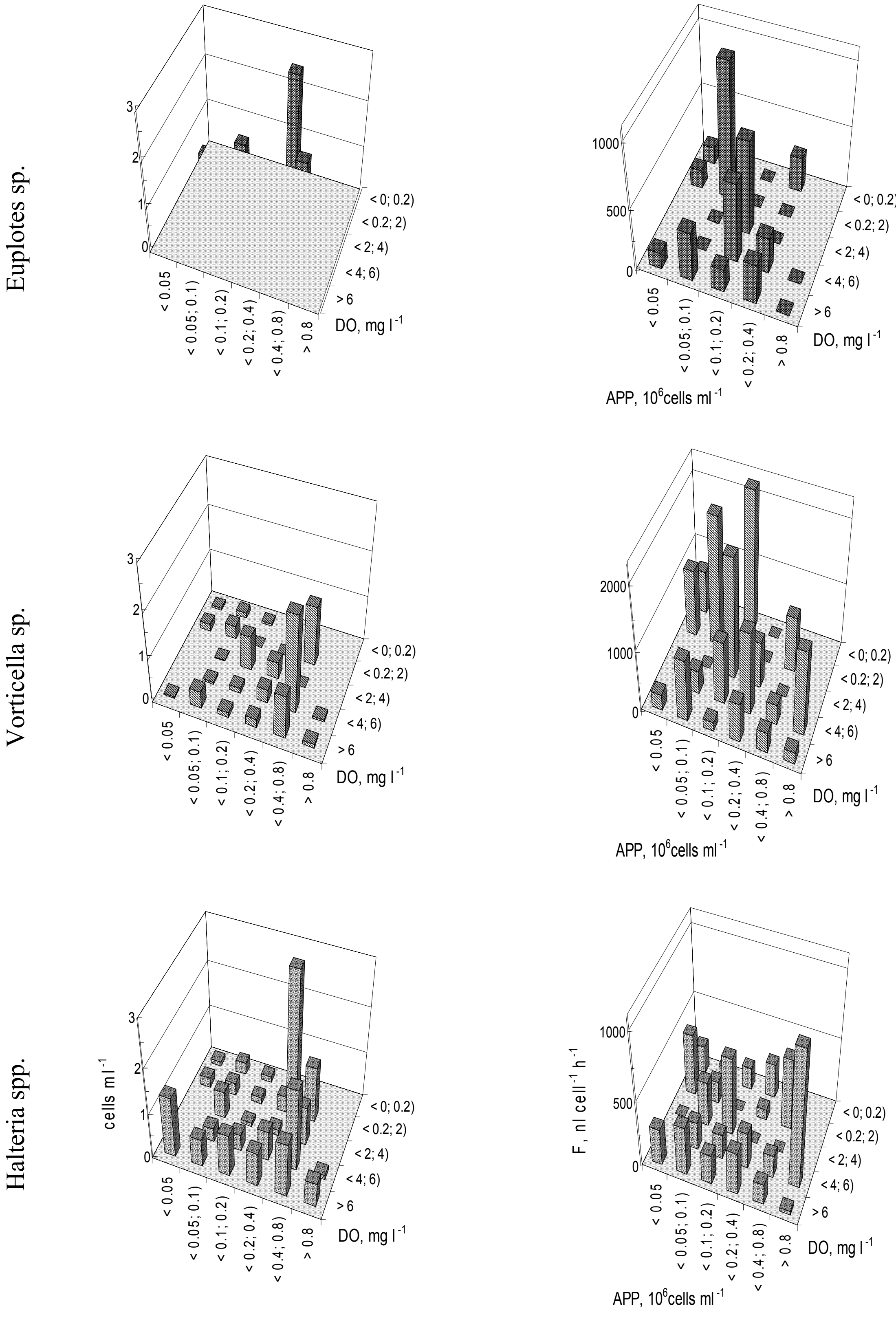

Fig. 8: Abundance (above) and clearance rate (below) relation to APP numbers and dissolved oxygen concentration.

3.4 Aluminium Control of Phosphorus Sorption by Lake Sediments

J. Kopáček, J. Borovec, J. Hejzlar, K.-U. Ulrich (Institute of Radiochemistry, Dresden, Germany), S. A. Norton (Department of Earth Sciences, University of Maine, Orono, USA), and A. Amirbahman (Department of Civil and Environmental Engineering, University of Maine, Orono, USA) analysed sediments from 43 lakes differing in trophic status, pH regime, climate, and P loading to assess their ability to retain phosphorus (P). The release of reactive (phosphate-like) P from freshwater sediments represents a significant internal P source for many lakes. Hypolimnetic P release occurs under reducing conditions that cause reductive dissolution of ferric hydroxide ($Fe(OH)_3$). This hypolimnetic P release may be naturally low or artificially reduced by sediment with naturally high or artificially elevated concentrations of aluminum hydroxide ($Al(OH)_3$). Field and laboratory data indicate that a simple sequential extraction of sediment may be a useful predictor of the sediment's ability to release P. Sequential extractions of sediment P, Al, and Fe using water (H_2O), bicarbonate-dithionite (BD), and NaOH (at 25°C) showed that negligible amounts of P would be released from lake sediments during hypolimnetic anoxia if either: (1) the molar $Al_{NaOH\sim25}$:Fe_{BD} ratio is >3, or (2) the molar $Al_{NaOH\sim25}$:$P_{(H2O+BD)}$ ratio is >25. These ratios can be used as operational targets for estimation of sediment P release potential and Al dosing of P-rich sediment to prevent hypolimnetic P release under anoxic conditions.

3.5 Chemical Composition of the Tatra Mountain Lakes During the Period of their Recovery from Acidification

J. Kopáček, E. Stuchlík, and D. Hardekopf (both Charles University, Prague) evaluated ionic and nutrient composition of ninety-one lakes distributed along the Tatra Mountains (most of the lakes >1 ha and 65% of the lakes >0.01 ha) in September 2004 (15 years after reduction in acid deposition). Eighty-one lakes were situated in the alpine zone and ten were located in a forest, dominated by Norway spruce. The results were compared to similar lake surveys from 1994 (the beginning of water recovery from acidification) and 1984 (maximum acidification). Atmospheric deposition of SO_4^{2-} and inorganic N decreased 57% and 35%, respectively, in this region between the late 1980s and the year 2000. Lake water concentrations of SO_4^{2-} and NO_3^- have both decreased by ~50% on average (to 23 and 19 μmol L^{-1}, respectively, in 2004) since 1984. While the decrease in SO_4^{2-} concentrations was stable throughout 1984–2004, most of the NO_3^- decrease occurred from 1994 to 2004. The declines in SO_4^{2-} and NO_3^- concentrations depended on catchment coverage with vegetation, being most rapid for SO_4^{2-} in forest lakes and for NO_3^- in rocky lakes. Concentrations of the sum of base cations (dominated by Ca^{2+}) significantly decreased between 1984 and 2004, with the highest change in rocky lakes. Most of this decline occurred between 1994 and 2004. Acid neutralising capacity (ANC) did not change in the 1984–1994 period, but increased on average by 29 μmol l^{-1} between 1994 and 2004, with the highest change in rocky lakes. Over the last decade, the proportion of lakes with ANC >150 μmol l^{-1} increased from 15% to 21% and that of ANC <20 μmol l^{-1} decreased from 37% to 20%. The highest decline in H^+ and Al concentrations occurred in the most acid lakes. On a regional basis, no significant change was observed for total phosphorus, total organic nitrogen, and dissolved organic carbon (DOC) in the 1994–2004 period. However, these parameters increased in forest lakes, which exhibited an increasing trend in DOC concentrations, inversely related (p <0.001) to their decreasing ionic strength (30% on average in 1994–2004).

3.6 Chemical Composition of Modern and Pre-Acidification Sediments in the Tatra Mountain Lakes

J. Kopáček, J. Borovec, J. Hejzlar, I. Kotorová (Faculty of Biological Sciences, University of South Bohemia, České Budějovice), E. Stuchlík (Charles University, Prague), and J. Veselý (Czech Geological Survey, Prague) determined the concentrations of major nutrients (C, N, P) and acid soluble metals (Ca, Mg, K, Al, Fe, Mn, Pb, and Zn) in modern (0–1 cm) and pre-acidification (5–10 cm) sediment layers collected from 37 alpine and 3 forest lakes in the Tatra Mountains (Slovakia, Poland) in 1996–1998. Sediment composition reflected the catchment characteristics and productivity of the lakes. In the sediments of alpine lakes, C and N concentrations decreased and Mg increased with a decreasing proportion of vegetation and soil in the catchment. The decreasing Ca:Mg ratios in sediments along the vegetation gradient were inverse to those in water, and could be caused by different ratios of cations in water leachate from catchments and in solids which enter the lake due to soil erosion. Phosphorus concentrations increased with the proportion of moraine areas, with till soils rich in P. Concentrations of C, N, P, and Ca in sediments were positively correlated to their concentrations in water. Sediment concentrations of Al and Al:Ca ratios increased with decreasing sediment and water pH. A negative correlation between water pH and concentrations of organic C in water and sediments indicated the important impact of organic acids on the acid status of the lakes exposed to higher terrestrial export of organic matter. Compared to the pre-acidification period, the modern sediments had significantly higher Fe, Mn, Zn, Pb, and K, but lower Mg concentrations. The Zn and Pb enrichment was more evident in oligotrophic alpine lakes than in more productive forest lakes and was independent of lake water or sediment pH. Concentrations of Fe and Mn concentrations in pre-acidification sediments were similar to contemporary soils and bedrock, while those in modern sediments were higher. The enrichment of the modern sediments with Fe and Mn probably resulted from both their redox recycling and ecosystem acidification.

3.7 Pools and Composition of Soils in the Alpine Zone of the Tatra Mountains

J. Kopáček, J. Kaňa, and H. Šantrůčková (Faculty of Biological Sciences, University of South Bohemia, České Budějovice) determined the basic physical, chemical, and biochemical properties of mountain soils in alpine-zone meadow and moraine areas of the Tatra Mountains (Slovakia, Poland) in 2000–2001. The amount of soil (dry weight soil <2 mm) varied from 38 to 255 kg m^{-2} (average of 121 kg m^{-2}) in alpine meadows and averaged 13 kg m^{-2} in moraine areas. Concentration of organic C was the parameter that most strongly and positively correlated with N, P, S, effective cation exchange capacity (CEC), exchangeable base cations, exchangeable acidity, and all biochemical parameters (C, N, and P in microbial biomass and C mineralisation rates). The relationship between C and P was less straightforward due to inorganic P forms associated with Fe and Al oxides. The average pools of C, N, P, and S, were respectively 696, 41, 2.9, and 1.9 mol m^{-2} (i.e., 84, 5.7, 0.91 and 0.61 t ha^{-1}) in meadow soils, and 38, 2.1, 0.45 and 0.12 mol m^{-2} (i.e., 4.5, 0.30, 0.14 and 0.04 t ha^{-1}) in moraine areas. Soil pH was generally low, with the lowest pH_{H2O} values (3.8–4.9) in the A-horizons. Average pools of CEC were 12 and 0.7 eq m^{-2} in meadows and moraine areas, respectively. The base saturation (BS) was 4–45% (12% on average) of CEC, and was primarily based on Ca^{2+} and K^{+} (~40% and ~22% of BS, respectively). C:N molar ratios (14–20) were only slightly lower than those observed in the alpine Tatra Mountain zone ~40 years ago. Concentrations of C, N, and P in soil microbial biomass were high (on average 1.6%, 3.4%, and 25% of total C, N, and P concentrations), suggesting high microbial activity in alpine soils.

3.8 Pelagic Food Webs in European Mountain Lakes

V. Straškrábová with coauthors summarised data gathered during *2 EU projects – MOLAR (4th framework) and EMERGE (5th framework).* The coauthors involved were M. Macek, M. Blažo, J. Fott, E. Stuchlík, R. Bertoni, C. Callieri, M. Tolotti, L. Forsström and M. Kernan.
Pelagic biota in European alpine lakes (above the local timberline) were investigated in 13 lake districts: Scotland (SC), Southern and Central Norway (SN, CN), Northern Finland (NF), Kola peninsula (RU), Pyrenees (PY), Piedmont Ticino Alps (PT), Tyrolian Alps (TY), Tatra Mountains (TA), Julian Alps (JA), Rila (RI), Retezat (RE) and Western Greenland (SS). In the following text only the acronyms of lake districts are used.

During MOLAR project 10 lakes from SC, SN, CN, RU, PY, PT, TY, TA were investigated and abundances and biomasses of pelagic bacteria, autotrophic picoplankton, heterotrophic flagellates, ciliates, phytoplankton and zooplankton were analysed several times during two ice-free seasons (1996–1997). Species structure was determined in ciliate, phytoplankton and zooplankton assemblages. In 304 lakes selected in lake districts SC, NF, PY, PT, TY, TA, JA, RI, RE and SS, late-summer samples were analysed for bacterial abundance and biomass, chlorophyll*a* concentration and zooplankton abundance and species structure (2000–2001). Phytoplankton species structure was determined in the lakes of NF and TY, and ciliate species structure in lakes of NF.

Bacterial abundances ($0.02–2.7\times10^6$ ml^{-1}) in mountain lakes corresponded to values found in other oligotrophic lakes, except the data from the JA and SS, where the ranges were $0.10–19\times10^6$ ml^{-1} and $3.26–25\times10^6$ ml^{-1}, respectively. Bacterial cells often were elongated and even filamentous. Mean cell volumes and mean cell lengths (per sample) were in the ranges of 0.01–0.91 μm^3 and of 0.4–4.1 μm, respectively, which is outside the ranges found in other oligotrophic lakes and even in eutrophic water bodies (0.06–0.15 μm^3, and 0.5–0.8 μm, respectively). Consequently, bacterial biomasses in mountain lakes were considerable and frequently reached 40–50 μg l^{-1} C, in lakes with filamentous bacteria up to 100–150 μg l^{-1}C and in SS lakes more than 200 μg l^{-1}C.

Autotrophic picoplankton (APP) was very scarce in most lakes. Regular occurrence of APP in abundances surpassing 10^3 ml^{-1} was observed only in lake Lochnagar (SC) with a high natrium content.

Heterotrophic flagellates were regularly found to reach 5–20% (exceptionally 50%) of bacterial biomass. Ciliates usually reached only 1–8% of bacterial biomass, except in NF lakes (8–50% of bacterial biomass). The most abundant ciliate species observed belong to the following groups: large mixotrophic oligotrichs, algivorous prostomatids, large hymenostomatids, gymnostomatids and minute omnivorous oligotrichs.

Phytoplankton biomasses varied considerably among lakes of one district and within one lake seasonally and among depths. Only the values below 160 μg l^{-1} C (range 0.3–153 μg l^{-1} C), were observed in lakes with pH range of 5.3–5.9. In lakes with lower and higher pH values (pH ranges 4.5–5.2 and 5.9–9.4), phytoplankton biomass varied from 1.8 up to 1000 μg l^{-1} C.

Among phytoplankton species, motile and potentially phagotrophic taxa of the families Cryptophyceae, Chrysophyceae, Dinophyceae prevailed, and, usually with lower abundance, also representatives of Chlorophyceae and Bacillariophyceae. In addition, Conjugatophyceae were frequent in NF lake district (higher richness than in TY). Cyanophyceae were found rarely.

Zooplankton species and abundances of prevailing groups differ among lake districts. Daphnids were a dominant group in JA, RE and RI, whereas bosminas prevailed in SC and TY. In NF, copepods are the main component as well as in SS. The highest zooplankton abundances (with different species structures) were found in PY, SC and TY.

Redundancy Analysis was applied to all lake districts except SS to test the response of bacteria to chlorophyll *a* concentration and to the abundance of aggregated zooplankton groups. 12.8% of the variation in bacterial abundances is explained by daphnids (mostly), cyclopids and diaptomids. A series of Partial Redundancy analyses showed that, though the bacterial response to zooplankton plus chlorophyll is statistically significant, the majority of the explained variation is accounted for by proximal variables attributed to the physical-chemical environment of the lakes (nitrates, potassium, temperature, depth and littoral oxygen).

4. SPECIAL INVESTIGATIONS

4.1 Czech Long-Term Ecological Research

The network of Czech LTER sites, a part of International LTER, was established in 1996 with seven sites (visit *www.lter.cz*). V. Straškrábová was the first head of the Czech Committee for the LTER-network (supervised by the National Committee of Man and the Biosphere Programme, UNESCO); J. Vrba has undertaken this duty since 2003.

One of the CZ LTER sites, "Reservoirs in the Vltava River watershed", is fully operated by Hydrobiological Institute. The Slapy and Římov reservoirs have been studied regularly since 1958 and 1979, respectively. Abiotic as well as biotic parameters of the pelagic system have been monitored regularly (see chapters 2.1 and 2.2 in this and all former Annual Reports), recently as a part of the HBI Institutional Project (AV0Z6017912) and Project of Targeted Research AS CR (S6017004).

At another CZ LTER site, the Šumava Biosphere Reserve (Bohemian Forest), HBI, in co-operation with other institutions, has investigated acidified lakes and their catchments from the early 1960s [1]. Since 1997, extensive research of the lakes has regularly been supported by grants from the Grant Agency of CR (recent project 206/03/1583; see also Annual Reports since 1998).

V. Straškrábová, J. Vrba and others are engaged in the EU project ALTER-Net (Network of Excellence), which has a goal of establishing a network of LTER sites in the whole of Europe (*www.lter-europe.ceh.ac.uk*). J. Borovec has organised a reconstruction of long-term databases (chemical, biological and microbiological data from the reservoirs); a system of metadata, compatible with other environmental databases among ALTER-Net Partners is in development.

[1] Vrba J., Kopáček J., Fott J., Kohout L., Nedbalová L., Pražáková M., Soldán T., Schaumburg J. 2003. Long-term studies (1871–2000) on acidification and recovery of lakes in the Bohemian Forest (central Europe). Sci. Total Environ. 310: 73–85.

4.2 Large Scale Survey of Plant Biomass and Plant Cover by Echosounding *(2004–2006 – project supported by a postdoctoral grant of the Grant Agency of the Czech Republic)*

E. Hohausová carried on her project on biomass assessment of aquatic macrophytes by echosounding in an experimental pool in Římov and in field study at Neusidlersee with the help of J. Kubečka, Š. Husák, M. Čtvrtlíková, J. Frouzová, M. Tušer, O. Jarolím a L. Piálek.

A new approach of assessing aquatic macrophytes has been experimentally tested. A scientific echosounder is an instrument typically and widely used for underwater detection fish and their biomass in open waters. We employed a SIMRAD EK 60 echosounder to detect aquatic macrophyte species and to assess their biomass while recording horizontally in an experimental pool. Three widespread species of aquatic plants with a different stem morphology: *Myriophyllum spicatum, Polygonum amphibium* and *Potamogeton pectinatus* were installed in front of the transducer of the echosounder in the experimental pool (a concrete rectangular pool 12×5 m, 1.8 m deep). Single plants as well as patches of different sizes of each species were tested. A range of features characterising the acoustic biomass of the sampled plants were recorded. After the recording, the length of the stems and the dry weight of all used plants (single plants and patches) were measured.

Initial results have shown that the values of experimentally detected acoustic biomass fit the real dry weight of the plants very well (Fig. 9). Calibration curves gained from this study may now be applied to the assessment of biomass of aquatic macrophytes in a variety of field studies.

Regarding distinguishing particular plant species by the echosounder, a statistical difference between curves recorded for each of the studied species was not found, although, the curves of the species were not identical. This means that the echosounder may not be capable of identification of particular plant species, however, other recorded acoustic characteristics might help to solve this task in the near future.

A field survey in the shallow lake Neusiedlersee in Austria brought data about plants recorded in situ. The species *Myriophyllum spicatum* and *Polygonum amphibium* were recorded as single stems and as patches of plants as well. These data will be compared with the experimentally gained curves of the two species.

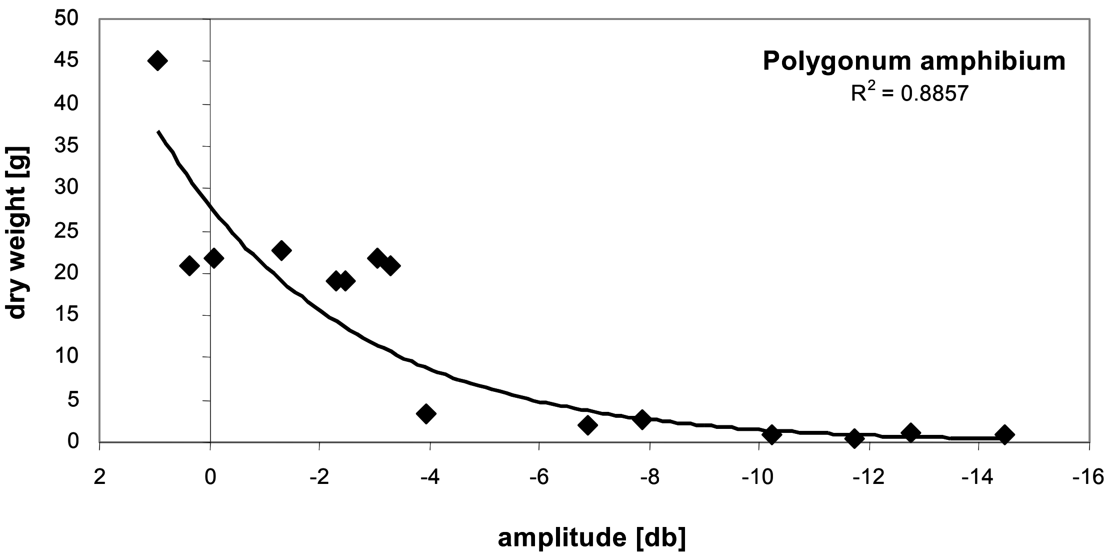

Fig. 9: An experimentally gained curve for the relationship of acoustic biomass (amplitude) and real plant biomass (dry weight) for the species *Polygonum amphibium*.

4.3 Relations Between the Phenotypic and Ultrastructural Characteristics of Heterocytous Cyanobacteria *(2003–2005 – project supported by the Grant Agency of the Academy of Sciences of CR)*

J. Komárková and E. Zapomělová finished work on the project in cooperation with the Institute of Botany AS CR (principal investigator J. Komárek). The project involved cooperation with the University of Helsinki (laboratory of Prof. Sivonen) and CNR Istituto per lo studio degli Ecosistemi, Firenze, Italy (laboratory of Dr. Ventura). The aim of the project was to clarify the relationship between the molecular (genotypic), phenotypic and ultrastructural characteristics of several important cyanobacterial nostocalean genera. The project focused mainly on the genera of planktonic cyanobacteria, which often form potentially toxic water blooms.

Polyphasic evaluation (a combination of classic and molecular approaches) enabled to prove the identity of one portion of the genus *Anabaena* with the genus *Aphanizomenon.* Two genotypicaly different groups (16S rRNA) were distinguished within the genus *Anabaena* (planctonic species with aerotopes and benthic species without them). A new genus, *Cuspidothrix,* was newly described as a result of the genotypical diversity of the previous genus *Aphanizomenon* (e.g. *Cuspidothrix issatschenkoi*). Surveys of species of the mentioned genera were published in the journal Czech Phycology [3]. At the Hydrobiological Institute, E. Zapomělová studied in detail the morphology of planktonic species of *Anabaena* both in natural samples and in cultures (40 strains). The main distinguishing feature between the species, the spirality, was studied on a cross gradient of temperature and irradiance, and under different physical and chemical conditions (turbulence, low in nutrients Pringsheim cultures). The results were compared with ARDRA (Amplified Ribosomal DNA Restriction Analysis) of the strains. The study indicated that spirality as a feature of differentiation between the classic botanical species is not as reliable as had been assumed. Spiral filaments often uncoiled. Molecular analyses also proved a close relationship of straight and coiled species inside the genus *Anabaena*.

Results have been published in following papers:

[1] Komárek J., Komárková J. 2003. Phenotype diversity of the cyanoprokaryotic genus *Cylindrospermopsis* (Nostocales). Czech Phycology 3: 1–30.

[2] Komárek J., Ventura S., Turicchia S., Komárková J., Mascalchi C., Soldati E. 2005. Cyanobacterial diversity in alkaline marshes of northern Belize (Central America). Arch. Hydrobiol./Algol. Stud. 117: 265–278.

[3] Komárek J., Komárková J. 2006. Diversity of *Aphanizomenon-like* cyanobacteria. Czech Phycology 6 (in press).

[4] Zapomělová E., Hrouzek P., Kaštovská K., Šabacká M., Stibal M., Caisová L., Komárková J. Morphological variability in selected heterocytous cyanobacterial strains as a response to varied temperature, light intensity and media treatment. Hydrobiologia (in press).

[5] Zapomělová E., Kaštovská K., Znachor P., Komárková J. Morphological variability of coiled representants of the genus *Anabaena* in natural populations (in press).

4.4 Rotifer Digestive Enzymes: Direct Detection Using the ELF Technique

M. Štrojsová investigated hydrolytic enzymes involved in the digestion of rotifers directly at the site of enzyme action using the ELF (Enzyme Labelled Fluorescence) technique. After enzymatic hydrolysis of an artificial ELF substrate, the fluorescent product ELF alcohol (ELFA) marked the sites of enzyme activity; the time development of the ELFA labelling was studied during incubations from 1 to 4 hours. Phosphatases, β-N-acetylhexosaminidases, and lipases were examined in *Brachionus angularis*, *B. calyciflorus*, *Keratella cochlearis*, and *Lecane closterocerca* from fed-batch cultures. Activities of all studied enzymes were detected in the digestive tract of rotifers, especially in the stomach and intestine. Moreover, the enzymes were detected in the mastax of *L. closterocerca*, whereas the other species were never ELFA labelled in the mastax. Lipase activity was observed exclusively in the digestive tract. Phosphatases were frequently located at the corona of *B. calyciflorus*. In other cases, both phosphatases and β-N-acetylhexosaminidases were rarely detected at the corona, as well as on the lorica and epidermis of all species.

4.5 Detection, Localisation and Quantification of Extracellular Enzymatic Activities on Cellular and Ppopulation Level in Natural Lake Seston *(2002–2005 – project supported by the Grant Agency of the Academy of Sciences of CR)*

J. Vrba, J. Nedoma, A. Štrojsová, M. Štrojsová – in cooperation with J. Komárková, P. Znachor, J. Seďa, K. Šimek and others from the HBI, as well as with X. Cao and Y.Y. Zhou (both from the Institute of Hydrobiology CAS, Wuhan, China) – have adopted, modified and standardised a fluorometric assay using ELF substrates for direct detection of enzymes and quantification of their activity on the level of individual cells and/or organisms (see also part 3.5 in AR 2004).

The main effort of our team has so far been focused on the role of phosphatases in phosphorus cycling. Many P-deficient plankton microorganisms produce extracellular, mostly cell-attached, phosphatases to make ambient organically-bound P available. The distribution of phosphatase activity among natural plankton populations and its ecological significance had been largely unexplored until ELF substrates became commercially available and the ELF technique was developed for plankton. The ELF phosphatase kit had originally been developed for labelling intracellular enzymes for use in histochemistry.

We modified the original protocol of the ELF assay to be more suitable for natural plankton, more similar to standard fluorometric methods, and ready for image cytometry [1]. We omitted any concentration step prior to incubation and successfully applied $HgCl_2$ treatment to prevent the damage of fragile flagellates during post-incubation filtration. The ELF technique was compared with the common fluorometric method with 4-methylumbelliferyl phosphate (MUFP) as a substrate; both ELFP and MUFP appeared to be cleaved by the same extracellular phosphatases. Maximum ELFA fluorescence was detected at pH 8 and rapidly decreased towards higher pH values. At pH >8.5, hydrogen dissociates from the alcohol group yielding a non-fluorescent, water-soluble phenyl anionic form of ELFA. Some samples, therefore, need to be buffered to ensure ELFA precipitation [2, 5].

The PhD thesis of A. Štrojsová, finished during the project, summarises major findings on "Expression of extracellular phosphatases in phytoplankton populations at the single-cell level". Extracellular phosphatases are probably an important factor enabling the persistence of particular phytoplankton species in those aquatic environments where P_i is scarce. The production of phosphatases is common in cyanobacteria, dinoflagellates, diatoms, and chlorophytes, but very rare in chrysophyceans and euglenoids, groups with mixotrophic capacities [2, 3, 4]. Many phytoplankton species have a characteristic pattern of ELFA precipitates, e.g., dots on *Peridinium* and *Anabaena*; linear structures on *Asterionella* and *Fragilaria*; whole cell-surface labelling on *Ankyra* and *Oocystis*. Several natural phytoplankton species produce extracellular phosphatases in abundance, including *Anabaena* spp., *Ankyra ancora*, *A. judayi*, *Ceratium hirundinella*, *Eudorina elegans*, *Microcystis aeruginosa*, *Monoraphidium dybowskii*, *Pediastrum boryanum*, *Peridinium* spp., *Planktosphaeria gelatinosa*, *Scenedesmus* spp. and *Woronichinia naegeliana* in the reservoir and lakes studied. Conversely, other species never showed ELFA labelling in any of our reservoir and lake samples, e.g. *Aphanothece* sp., *Dinobryon divergens*, *Rhodomonas minuta*, *Tetrastrum* spp. Our recent studies have clearly shown that the differences in ELFA labelling within an algal or cyanobacterial population mirror the distinct nutritional status of particular cells. If more of the current phytoplankton populations are ELFA-labelled, then the phytoplankton are more P_i starved [4]. However, extracellular phosphatase activities may change diurnally in lake samples and, therefore, should be interpreted carefully as an indicator of P deficiency [5].

We combined epifluorescence microscopy and image cytometry for quantification of enzyme activity in the whole water sample and at the single-cell level. Cell-specific phosphatase activity was quantified in several algal taxa (*Ankyra ancora*, *Chlamydomonas reindhardtii*, *Chlamydomonas* sp., *Chlorogonium fusiforme*, *Fragilaria crotonensis*, *Koliella* sp., *Monoraphidium dybowski*, *Planktosphaeria gelatinosa*, and *Stephanodiscus hantzschii* [4], as well as in single morphotypes of bacterioplankton [8].

We studied species competition related to individual extracellular phosphatase activities in the Římov reservoir during an *in situ* experiment. A natural phytoplankton assemblage was enclosed in permeable dialysis bags inside two containers of different P_i concentrations. Phytoplankton species produced extracellular phosphatases less often in the P_i-enriched environment than in the P_i-depleted one and their specific growth rates were higher than the corresponding growth rates in the P_i-depleted environment even within those populations that were phosphatase-positive. The competitiveness of the phosphatase-positive species did not increase significantly. The production of extracellular phosphatases, even though it may not be a widespread mechanism for obtaining P_i, could be advantageous for populations surviving in a phosphate-depleted environment [6].

Further, we detected short-term changes in extracellular phosphatase activity both in the natural phytoplankton (Římov reservoir and Plešné Lake) and in a batch culture of *Chlamydomonas reindhardtii*. Natural populations of *Ankyra ancora*, *Monoraphidium dybowski*, *Koliella* sp., and *C. reindhardtii* showed high temporal variability. In culture, phosphatase-positive cells of *C. reindhardtii* were most abundant in the afternoon, apparently before their cell division. In natural phytoplankton, however, only the specific activity of *Koliella* sp. population showed a significant relationship with the time of day. There were sampled likely several microbial assemblages of different physiological status and activity during the day, due to diurnal and/or random changes caused by mixing in the reservoir or lake. Therefore, extracellular phosphatase activity, even if highly variable, did not show any clear pattern of diurnal changes [7].

The ability of species to produce phosphatases, indicated by ELFA labelling, may be connected with different life strategies and morphological adaptations, but it does not seem to be such a simple case. For example two invasive strategists, such as *Ankyra* and *Rhodomonas*, are small-celled species with fast nutrient uptake and replication; the former very often displayed ELFA labelling, whereas the latter never. Extracellular phosphatases are probably a factor contributing to the persistence of particular phytoplankton species in those aquatic environments where P_i is scarce but cannot cause a significant increase in population abundance. More surveys of phytoplankton phosphatases from various aquatic environments are clearly needed before informed generalisations can be made [5].

In addition, we focused on the counter-staining of ELFA labelled heterotrophic microorganisms with DAPI (see also part 3.5 in AR 2004). The ELF assay thus enables the detection on phosphatase-positive protozoa and even of cell-specific activity of extracellular phosphatase in different bacterioplankton morphotypes [8]. We have applied the ELF assay to detect major phosphatase producers in the chronically P-depleted plankton of acidified lakes [10] or severely P-limited cyanobacterial mats of alkaline marshes [11], as well as in traps of aquatic carnivorous plants [12].

We further adopted the ELF assay for detecting enzymes in metazoan zooplankton. M. Štrojsová's MSc thesis dealt with the seasonal occurrence of three enzymes (phosphatases, β-N-acetylhexosaminidases, and lipases) in planktonic rotifers [9]; she is currently expanding this work to include rotifer cultures as part of her doctorate (see the previous part 4.4).

To conclude, the ELF technique provides detailed information about the variability of, in particular, phosphatase activity within the plankton community as well as within one species (population).

The most relevant papers published in impacted journals and submitted manuscripts:

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