HYDROBIOLOGICAL INSTITUTE
ACADEMY OF SCIENCES OF THE CZECH REPUBLIC
ČESKÉ BUDĚJOVICE

44th ANNUAL REPORT

For the Year 2003

ISSN 0232 - 0533

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The staff and field of work

Scientific staff:

Department of production processes:

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	Hydroacoustics and fish behaviour
Mgr. E. Hohausová, Ph.D. (12 months Fulbright Scholarship, Florida, USA)	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
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
Ing. M. Macek, CSc. (12 months UNAM México, Campus Iztacala)	Protozoa–bacteria interactions, fresh water ciliates, biological waste water treatment
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:

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
Ing. M. Růžička, CSc.	Mathematical modelling of reservoirs

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 analysis
V. Lavičková	Documentator
Ing. R. Malá	Bacteriological analyses, cultivation of microbes
Ing. P. Mautschka	Construction of laboratory and field electronic equipment, maintenance of computer nets
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 from September in active service	Microscopy, laboratory analyses
MUDr. J. Zemanová	Zooplankton analyses and culture maintenance

Ph.D. students:

Mgr. M. Brzáková	Phosphorus turnover and sedimentation
RNDr. M. Čech	Fish behaviour in the open water
RNDr. M. Devetter	Pelagic rotifers
Mgr. V. Draštík	Fish behaviour and community structure
Mgr. M. Hladík	Fish migrations
Mgr. K. Horňák	Bacterioplankton community composition and activity
Mgr. J. Jezbera	Protozoan-bacterial interactions
Ing. R. Kyrian (from October)	Soil and water chemistry
Mgr. J. Lodeová (until June)	Identification of cyanobacterial picoplankton
Mgr. M. Mašín	Bacterial interactions, genotypes of bacteria

Mgr. J. Peterka (from August)	Fish foraging
RNDr. M. Prchalová (from June)	Fish behaviour
Mgr. A. Štrojsová	Extracellular phosphatases of phytoplankton
Mgr. J. Turek	Hydrology and water chemistry
Mgr. M. Vašek (from September)	Fish feeding and distribution

Student help:

T. Jůza, Bc.	Fry trawl fishing
M. Kratochvíl, Bc.	Pelagic fish larvae
M. Marešová	Water and sediment analysis
M. Říha	Efficiency of beach seining
E. Zapomnělová, Bc. (from April to June, from August)	Morphological variability of cyanobacteria (genera *Anabaena, Aphanizomenon*)

Civil service:

J. Peterka
(until July)

M. Vašek
(until August)

L. Pokorný
(until August)

P. Štafa
(until September)

J. Jarošík

J. Kaňa
(from March)

1. INTRODUCTION

This year there have been no significant changes of technical or scientific staff at the institute.

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

The Institutional Research Project „Biotic interactions in the pelagic zone of lenitic ecosystems, reservoirs and lakes of different trophy after reduction of emissions in post-communistic Europe" was prolonged till the end of 2004. The Institute prepared a report about its activities and results during the period of 1999–2003 for the third run of the evaluation of Academic Institutes. At the same time a proposal for a new Institutional Research Plan entitled "Structure, functioning and development of aquatic ecosystems" was submitted for the period 2005–2010. Both materials will be evaluated in 2004.

Complex investigations of the Jordán Reservoir continued within the project "Management of water quality in reservoirs" that was financed by the Academy of Sciences as a part of the "Support Programme for targeted research in the AS CR". HBI is responsible for one site in the global LTER (long-term ecological research) and GTOS (global terrestrial observing system) networks – "Reservoirs in Vltava River Watershed". The site is registered in the database of TEMS (Terrestrial Ecosystem Monitoring Site) on web: 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 in supervising students' theses, lecturing and training students at other Faculties (Agriculture and Pedagogical) of the University of South Bohemia and at other Universitites (Charles University, Prague; Institute of Chemical Technology, Prague). Three PhD theses, 2 RNDr, 2 Master theses and 2 Bachelor theses supervised by staff members were completed in 2003 (see list at the end of chapter). Most staff members worked part-time for the University of South Bohemia and vice-versa. Students were active in the HBI as student assistants and part-time members (see list of staff).

Frequently, scientists from abroad have stayed at the institute for the evaluation of the results of joint projects, preparation of publications and planning of future cooperation: M. W. Hahn, M. Schauer (Limnological Inst. Austrian AS, Mondsee), Y. Y. Zhou, X. Y. Cao (Inst. of Hydrobiology Chinese AS, Wuhan, China) J. Pernthaler (Max-Planck Inst. for Marine Microbiology, Bremen, Germany), T. Posch, M. Salcher, R. Psenner (Inst. of Zoology and Limnology, Univ. Innsbruck, Austria), Ana Conty (Faculty of Biology and Environmental Sciences, Univ. of Leon, Spain).

HBI members took part in congresses and conferences abroad (see below) and visited foreign institutions to carry out and evaluate joint experiments and prepare projects: V. Straškrábová (European Ecological Agency meeting, Copenhagen, Denmark, Editorial meeting WHO, Bad Elster, Germany, EC Project CONTINENT – sampling of Lake Baikal, Russia, LTER meeting, Seatle, USA, ALTERnet meeting, Brussels, Belgium), J. Hejzlar (Editorial meeting WHO, Bad Elster, Germany, EC Project EUROHARP – seminar, Oslo, Norway), K. Šimek (FEMS workshop, Mondsee, Austria, Univ. Barcelona, Spain – co-supervisor of a PhD thesis defended in 2003, CRNS joint project, Villefranch-Sur-Mer, France), J. Nedoma (FEMS workshop, Mondsee, Austria, EC Project CONTINENT – sampling of Lake Baikal), J. Vrba (FEMS workshop, Mondsee, Austria, enzyme activity workshop, Salzburg, Austria, ICP workshop, Lugano, Switzerland), J. Kubečka (Echosounding meeting, Oslo, Norway, EFS Symposium, Edinburgh, UK, Ecohydrology conference, Mondsee, Austria), J. Borovec (EC Project CONTINENT – sampling of Lake

Baikal, Internat. Symposium, Carmona, Spain), P. Porcal (Nordic IHSS Symposium, Sundsvall, Sweden), J. Matěna (PERCIS III Symposium – Invited speaker, Madison, USA, Univ. Freiburg – DAAD stipendium, Germany), M. Prchalová (PERCIS III Symposium, Madison, USA), Čech (EFS Symposium, Edinburgh), UK), V. Draštík (ICES Symposium, Bergen, Norway), A. Štrojsová (EC Project CONTINENT – sampling of Lake Baikal, Russia), J. Kopáček (sampling of mountain lakes, Germany, Poland, Slovakia), J. Seďa (short term residences - Univ. Leuven, Belgium, study stay – Univ. Frankfurt, Germany), K. Kaštovská (Algological expedition, Spitzbergen, Univ. Helsinki, Finnland), J. Komárková (Cyanobacterial workshop, Brussels, Belgium)

PROJECTS

Institutional project, Academy of Sciences of CR

1999–2005 AV0Z6017912 Biotic interactions in the pelagic zone of lenitic ecosystems, reservoirs and lakes of different trophy after reduction of emissions in postcommunistic Europe – Hydrobiological Institute AS CR

Priority Research Programs of the Academy of Sciences of CR

2001–2004 No. 08 The effect of climatic and anthropogenic factors upon the living and non-living environment

2001–2004 No. 14 Biodiversity and function of ecological structures

Program Support of Targeted Research in the Academy of Sciences of CR

2000–2004 No. S6017004 Management of water quality in reservoirs

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

2002–2004 A6017201 Pelagic niche of riverine fish in Czech reservoirs – J. Matěna

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

2003–2005 A6017301 Dynamics of morphology and growth of Daphnia as a response to spatio-temporal heterogeneity of environmental conditions – J. Macháček

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

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

Projects sponsored by the Grant Agency of CR

2001–2003 103/01/0201 Operative control of water resources systems in uncertainty conditions – J. Hejzlar (coordinated by the Faculty of Civil Engineering, Czech Technical University, Prague)

2001–2003 206/01/1113 Active movement of photosynthesizing flagellates: ecological costs and benefits study – J. Hrbáček (coordinated by Institute of Botany AS CR)

2002–2004 206/02/0520 Tributary zone as a key factor for fish stock development in reservoirs – J. Kubečka

2002–2004 206/02/0003 Top-down and bottom-up factors controlling bacterial community composition and dynamics in different parts of a meso-eutrophic canyon-shaped reservoir – K. Šimek

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

2003–2005 206/03/1583 Nutrient cycling in the nitrogen-saturated mountain forest ecosystem: 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 206/03/1537 Mechanisms of coexistence of Daphnia species and clones in a stratified reservoir with planktivorous fish predation – J. Macháček

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

Miscelaneous international projects

2000–2003 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, University of California, Davis, USA.)

2001–2003 Linking ecosystem processes and community structure along salinity gradients in tropical marshes – J. Komárková (project NSF US, coordinated by University of California, Davis, USA)

2002–2003 cooperation with WBB, the Netherlands – Understanding of fish role in Biesbosch Reservoirs – J. Kubečka (coordinator: H.A.M. Ketelaars, WBB)

2003–2004 Single-cell analysis of aquatic bacterioplankton: comparing methods and transferring expertise – K. Šimek (bilateral project AS CR – CSIC Spain; with J. Gasol, CMIMA, Barcelona, Spain)

European Communities R&D Program 5th framework

2000–2003 EMERGE European Mountain Lakes: Ecology, regionalization and socio-economic evaluation – V. Straškrábová (coordinated by University College, London)

2001–2003 RECOVER Predicting recovery in acidified freshwater by the year 2010, and beyond – J. Kopáček (subcontracted to Czech Geological Survey, Prague, coordinated by Centre for Ecology and Hydrology, Wallinford, UK)

2001–2004 EUROHARP Towards European harmonized procedures for quantification of nutrient losses from diffuse sources – J. Hejzlar (coordinated by NIVA, Oslo, Norway)

2002–2004 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)

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

2003–2004 ME 617 (KONTAKT / Sino-Czech Scientific and Technological Cooperation, 36–20) The role of extracellular enzymes in the processes of eutrophication in lakes – J. Vrba

CONSULTANCIES

2003 Microscopic evaluation of water samples from coal mining deponies at Sokolov – J. Vrba, ENKI Třeboň

2003 Římov reservoir – water supply risks – J. Hejzlar, South Bohemian Water Supply Association, České Budějovice

GUEST SEMINARS HELD IN HBI

Prof. Roland Psenner (University of Innsbruck, Institute of Limnology and Zoology, Innsbruck, Austria): Alpine Limnology? December 2, 2003. Memorial of M. Straškraba.

(organized together with the Faculty of Biological Sciences, University of South Bohemia)

Dr. Jakob Pernthaler (Max Planck Institute for Marine Microbiology, Bremen, Germany): Which bacteria are common in plankton? A comparison of marine and freshwater systems. (organized together with the Faculty of Biological Sciences, University of South Bohemia)

PRESENTATIONS OF HBI MEMBERS AT INTERNATIONAL CONFERENCES

The 9th Nordic IHSS Symposium on Abundance and Functions of Natural Organic Matter Species in Soil and Water", Sundsvall, Sweden – P. Porcal, J. Hejzlar, J. Kopáček: The amount and photochemical changes of DOM in acidified lake in Central Europe.

International Conference on the 50th Anniversary of the Tatra Mountain National Park, Stará Lesná, Slovakia – J. Kopáček, E. Stuchlík: Long-term trends in chemistry of atmospheric deposition and surface waters in the Tatra Mountains (Invited oral presentation); J. Kaňa, J. Kopáček, P. Porcal, H. Šantrůčková, T. Picek, E. Stuchlík: Chemical and biochemical characteristics of alpine soils in the Tatra Mountains and their impact on lake water composition.

Third Symposium for European Freshwater Sciences (SEFS3), University of Edinburgh, Scotland, UK – K. Šimek et al.: Top-down and bottom-up factors shaping bacterioplankton dynamics and community composition in freshwater ecosystems (Invited plenary lecture); M. Čech, J. Kubečka, V. Draštík, J. Matěna, M. Kratochvíl, J. Frouzová: Seasonal and diel changes of YOY perch distribution in the open water of stratified reservoirs; J. Kubečka, J. Frouzová, M. Čech, H.A.M. Ketelaars, A.J. Wagenwoort, A. Duncan, P.J. Renton: Fish structure and population dynamics in European bankside reservoirs.

4th International Symposium on Phosphate in Sediments, Carmona, Sevilla, Spain – J. Borovec, M. Brzáková, J. Hejzlar: Phosphorus release rates in a small dimictic reservoir.

EnviroInfo 2003, 17th International Conference on Informatics for Environmental Protection, Cottbus, Germany – J. Hejzlar: Nutrient retention – a key element in evaluating types and reference conditions of lakes and reservoirs for the EU Water Framework Directive; J. Borovec: Water quality modelling as a tool for designing restoration and management of a stratified reservoir.

Percis III, The Third International Percid Fish Symposium, Madison, Wisconsin, USA – J. Matěna, M. Čech, V. Draštík, J. Frouzová, M. Kratochvíl, J. Kubečka, J. Peterka, M. Vašek: Distribution of young-of-the-year percids in European reservoirs (Invited lecture); J. Kubečka, M. Čech, J. Frouzová, M. Hladík, E. Hohausová, M. Prchalová: Fish structure and population dynamics in perciform-dominated reservoirs; M. Prchalová, J. Kubečka: Are percid fish overestimated by the gillnet sampling?; M. Vašek, J. Kubečka, J. Matěna: Spatial heterogeneity in diet and size distribution of juvenile perch within a canyon-shaped reservoir.

Rotifera X. International Conference on Rotifers, Illmitz, Austria – Z. Brandl: Copepods and rotifers: coexistence of predators and their prey; M. Devetter, J. Seďa: Clear-water rotifer population declines in reservoir; M. Devetter, M. Štrojsová: Seasonal dynamics and vertical stratification of planktonic rotifers in the Římov reservoir.

Assessing the Variability in Aquatic Microbial Populations: Facts and Fiction, FEMS workshop, Mondsee, Austria – K. Šimek et al.: Are freshwater pelagic ciliates important bacterivores? (Invited plenary lecture); J. Nedoma, A. Štrojsová, J. Komárková, J. Vrba, P. Znachor: Detection and localisation of phosphatase activity in natural phytoplankton using ELF and image cytometry: a novel method versus a common fluorometric assay.

British Phycological Society, Annual General Meeting, Galway, Ireland – A. Štrojsová, J. Komárková, J. Nedoma, J. Vrba: Seasonal study on expression of extracellular phosphatases in the phytoplankton of a eutrophic reservoir.

Enzymes in the Environment: Activity, Ecology and Applications, Praha, CR – J. Vrba: Cell-specific enzyme expression in particular planktonic populations (Invited oral presentation); D. Sirová, J. Vrba, L. Adamec: Enzyme activities in traps of four species of the aquatic carnivorous genus *Utricularia*; J. Nedoma, J. Vrba: Molecular mechanisms underlying non-Michaelis-Menten ectoenzyme kinetics: statistical analysis of field data; A. Štrojsová, J. Nedoma, J. Vrba, J. Komárková: Seasonal study on activity of extracellular phosphatases in the freshwater phytoplankton; M. Štrojsová, J. Vrba: *In situ* detection of digestive enzymes in planktonic rotifers; J. Svoboda, J.K. Fuksa, J. Vrba: Enzymatic activities along a longitudinal river profile discontinued by reservoirs and point pollution sources; H. Šantrůčková, J. Vrba: Prosphatase activity in meadow and forest soils.

International Baikal Symposium on Microbiology: Microorganisms in Ecosystems of Lakes, Rivers, and Reservoirs, Irkutsk, Russia – A. Štrojsová, J. Vrba, J. Nedoma, J. Komárková: Extracellular phosphatase activity in the freshwater phytoplankton: study at the single-cell level; V. Straškrábová, J. Nedoma, K. Šimek, J. Vrba, M. Macek: Significance of pelagic bacterial biomass and activities in oligotrophic lakes.

2003 LTER All Scientists Meeting, Seattle, WA, USA – J. Vrba, V. Straškrábová: Ecosystem change in Czech Republic after a decrease of emissions; Recovery of acidified lakes – case study.

NORLAKE Symposium – Cold lakes, Sohojlandet at Silkeborg, Denmark – V. Straškrábová: Primary production and exudation in "cold" lakes – effect of temperature, oligotrophy or light inhibition?

Fish behaviour in exploited ecosystem, Bergen, **Norway** – V. Draštík, J. Kubečka: The effect of acoustic survey boat on fish behaviour.

International Symposium: Ecohydrology and Physical Fish Habitat Modifications in Lakes, Mondsee, Austria – J. Peterka, M. Vašek, J. Kubečka, M. Hladík: Importance of riverine spawning for dammed lake fish; V. Draštík, J. Kubečka, P. Šovčík: Ecohydrology and fisheries in the Czech reservoirs; M. Hladík, J. Kubečka: The effect of the water level fluctuation on tributary spawning migration of reservoir fish.

STUDENTS' THESES (finished in 2003)

M. Devetter (Ph.D.): The role of rotifer community in the ecosystem of Římov reservoir, Faculty of Biological Sciences USB; supervised by J. Seďa

M. Mašín (Ph.D.): Factors influencing activity and community structure of aquatic bacterial communities in longitudinal transects of reservoirs, Faculty of Biological Sciences USB; supervised by K. Šimek

P. Znachor (Ph.D. + RNDr.): Cell specific primary production of autotrophic and mixotrophic phytoplankton in acidified lakes of the Bohemian Forest, Faculty of Biological Sciences USB; supervised by J. Komárková

M. Prchalová (MS + RNDr.): Acoustic study of fish and invertebrate behaviour in a tropical reservoir, Faculty of Biological Sciences USB; supervised by J. Kubečka

V. Draštík (MS): Fish avoidance of acoustic survey boat in shallow waters, Faculty of Biological Sciences USB; supervised by J. Kubečka

K. Kolářová (BA): Species diversity of the crustaceoplankton from the various environments in the watershed of Římov reservoir, Faculty of Biological Sciences USB; supervised by J. Seďa

M. Kratochvíl (BA): Bathypelagic period in early ontogeny of Eurasian perch (*Perca fluviatilis*, L.), Faculty of Biological Sciences USB; supervised by J. Kubečka

REPORT ON FINANCES

INCOME	
balance from preceding year	1 980.3
support by Academy of Sciences including Priority research programmes	14 322.5
grants from Grant Agency AS CR	1 884.0
grants from Grant Agency CR	4 312.0
other domestic grants	63.0
foreign grants	2 102.6
consultancies	386.2
Total	**25 050.6**

EXPENSES	
salaries	9 219.4
health + social insurance + social funds	3 279.2
other obligatory insurance of persons and property	169.7
student and civil service helpers	242.5
foreign guests exchange programmes	0.0
energy	625.8
gasoline	161.3
maintenance of buildings	105.5
maintenance of cars and equipment	365.8
postage, telephone, internet	159.2
books, journals	516.3
travelling and conference fees	1 267.4
computing, software	334.9
consumables and small equipment	3 188.2
others	808.8
spectrophotometer	331.3
authomatic field data sampling station	902.8
personal car Fabia	442.1
information system	199.0
digital camera	209.3
electrophoresis, weights	321.0
PCR thermocycler	149.0
other durables equipment	436.4
Total	**23 434.9**

BALANCE (a fund for equipment) **1 616.0 thous. CZK**

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 ^oC, 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 2003

VARIABLES	UNIT	MEAN VALUES			
		Slapy		Římov	
		Annual	**Summer**	Annual	Summer
NO_3–N	µg l^{-1}	2436	2305	1499	1305
NO_2–N	µg l^{-1}	22	30	13	16
NH_4–N	µg l^{-1}	79	74	54	33
TON	µg l^{-1}	604	616	451	489
DON	µg l^{-1}	505	488	361	354
TN	µg l^{-1}	3140	3025	2017	1844
TP	µg l^{-1}	45.2	32.4	24.6	18.8
TDP	µg l^{-1}	32.8	19.7	16.0	11.1
COD	mg l^{-1}	19.5	19.3	16.8	18.1
DOC	mg l^{-1}	5.81	5.65	4.42	4.59
POC	mg l^{-1}	0.70	0.88	0.71	1.05
Ca^{2+}	mg l^{-1}	20.0	19.8	12.4	12.0
Mg^{2+}	mg l^{-1}	5.9	6.0	3.1	3.0
Na^+	mg l^{-1}	9.4	10.0	6.6	6.5
K^+	mg l^{-1}	3.6	3.6	2.3	2.3
SO_4^{2-}	mg l^{-1}	31.3	32.0	19.5	18.4
Cl^-	mg l^{-1}	12.1	12.5	6.1	6.0
Alkalinity (Gran)	meq l^{-1}	0.86	0.88	0.51	0.51
Conductivity at 25 ^oC	µS cm^{-1}	225	228	135	132

2.2 Seasonal pattern of temperature and transparency in the Slapy reservoir during 2002–2003

J. Hrbáček has compiled his data on temperature and transparency in the Slapy reservoir measured since January 1988 at weekly intervals, to show impacts of the climatic and hydrological peculiarities of the last two years. Fig. 1 demonstrates the immediate decrease of temperature during high throughflow of the August 2002 flood. Surface temperature then increased to relatively high values. Since the end of October 2002 the temperature was unusually low due to the still high flow, which has replaced more intensively than usual the warmer water of the Orlík and Slapy reservoirs by cooler river water. The period of unusually low surface temperature lasted till the end of April of the following year. Although the summer 2003 was unusually warm, the highest temperatures since 1988 were observed only on few days. The fall was relatively cool.

The flood in 2002 decreased the transparency (Fig. 2) which remained unusually low until April next year. Since the beginning of July 2003 the transparency was unusually high. This phenomenon is related both to the unusual release of surface water from the Orlík reservoir instead of the usual deep water and by the very low throughflow. These two factors very probably decreased the supply of nutrients to the surface water of Slapy reservoir and so decreased the development of algae.

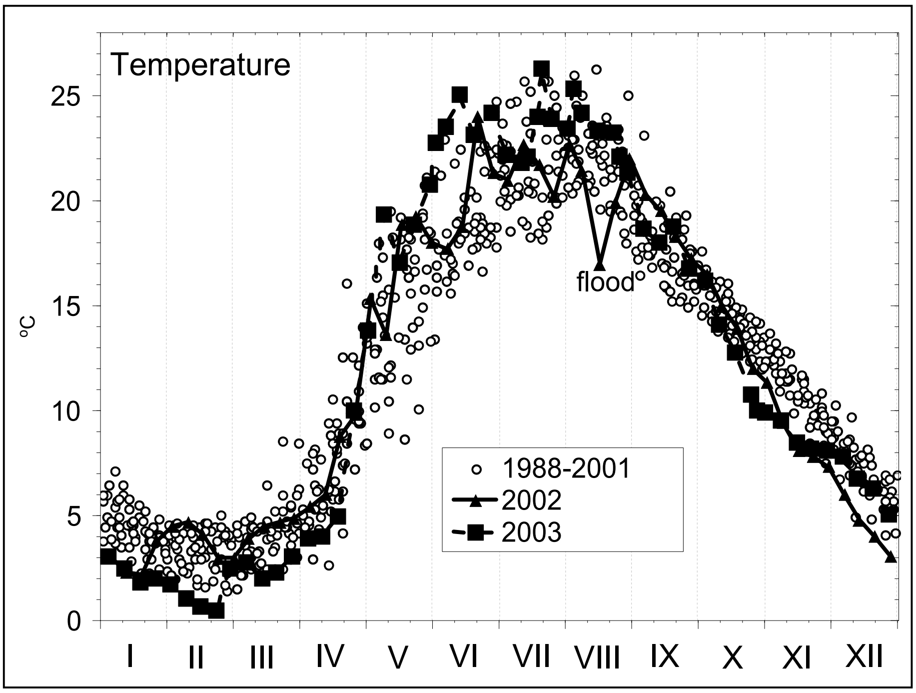

Fig.1: Seasonal pattern of temperature in the Slapy reservoir.

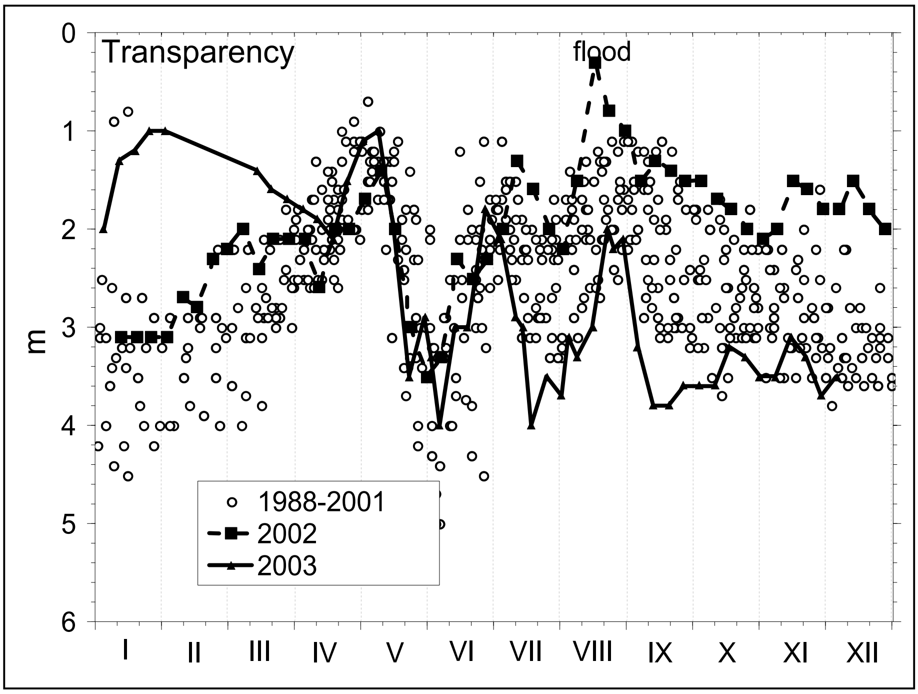

Fig. 2: Seasonal pattern of transparency in the Slapy reservoir.

2.3 Phosphate release from sediments in a hypertrophic reservoir – seasonal and spatial variations

J. Borovec has studied seasonal and spatial changes of P-release from sediment. Differences between P-release rates from sediments measured by sediment core incubation and calculated from pore water gradients were found when investigating the transitional and dam parts of the Jordán reservoir (a small, dimictic, hypertrophic reservoir). Clear seasonal trends of P-release rates with maxima of 40 mg m^{-2} d^{-1} in June and 18 mg m^{-2} d^{-1} in July were found at the transitional and dam parts, respectively, using the incubation method. Release rates lower by one order of magnitude were calculated from the concentration gradients across the sediment/water interface at both sites. Seasonal trends of settling intensity of seston in the reservoir (Brzáková, Annual Report 2002, Chapter 2.3) were in good agreement with seasonal changes of the release rates obtained by the incubation method.

It was shown that P-release from sediments consists of two partly independent processes: (i) the fast decomposition of settling seston, and (ii) release from deeper parts of the sediment, both taking place simultaneously. Our results as well as our experience from other water bodies indicate that the importance of each process depends on the trophic state of the water body. P amounts released from settling seston can be very high in eutrophic to hypertrophic water bodies, thus when investigating such a lake or reservoir it might be necessary to distinguish between both processes. In cases where P-release is accompanied by pore water concentration changes, it is likely to originate in older sediment layers (internal load). On the other hand, when P-release is unaccompanied by pore water concentration changes, the source of the P released is most probably decomposition of freshly settled seston.

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	1.72	2.07
	BOD_5 filtered	0 m	mg l^{-1} O_2	–	1.48
	bacteria DAPI	0 m	10^6 ml^{-1}	2.68	3.52
	bact. beef-pept. agar	0 m	CFU ml^{-1}	335	250
	het. nanoflagellates	0 m	10^3 ml^{-1}	2.182	3.353
	ciliates	0–3 m	per ml	2.90	4.28
	rotifers	0–7 m	per ml	0.787	1.331
	nauplii	0–7 m	per ml	0.090	0.151
	chlorophyll *a*				
	total	0-3 m	mg m^{-3}	11.60	19.64
	>40µm	0–3 m	mg m^{-3}	7.47	12.59
	zooplankton biomass, protein N				
	Cladocera herbiv.	0–41m	mg m^{-2}	78.3	119.4
	Copepoda	0–41m	mg m^{-2}	53.1	72.5
	total zooplankton	0–41m	mg m^{-2}	133.7	196.1
R	BOD_5	0 m	mg l^{-1} O_2	1.74	1.64
	BOD_5 filtered	0 m	mg l^{-1} O_2	–	1.23
	bacteria DAPI	0 m	10^6 ml^{-1}	2.68	3.54
	bact. beef-pept. agar	0 m	CFU ml^{-1}	424	440
	bact. yeast ext. agar	0 m	10^3 CFU ml^{-1}	1.3	2.2
	het. nanoflagellates	0 m	10^3 ml^{-1}	1.327	1.938
	ciliates	0 m	per ml	9.16	15.94
	rotifers	0–7 m	per ml	0.432	0.614
	nauplii	0–7 m	per ml	0.031	0.056
	chlorophyll *a*				
	total	0–3 m	mg m^{-3}	9.75	13.45
	> 40µm	0–3 m	mg m^{-3}	7.56	11.22
	zooplankton biomass, protein N				
	Cladocera herbiv.	0–40 m	mg m^{-2}	84.3	80.2
	Copepoda	0–40 m	mg m^{-2}	63.2	76.0
	total zooplankton	0–40 m	mg m^{-2}	148.2	157.1
C	BOD_5	0 m	mg l^{-1} O_2	1.73	1.68
	chlorophyll *a*	0 m	mg m^{-3}	10.28	15.52
M	BOD_5	0 m	mg l^{-1} O_2	3.00	3.48
	chlorophyll *a*	0 m	mg m^{-3}	8.49	11.59

2.4 Microbial characteristics of the Slapy and Římov reservoirs

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 the Římov reservoir, and mesozooplankton biomass in the reservoirs, based on data by Z. Brandl, M. Devetter, J. Komárková, M. Macek, J. Seďa, V. Straškrábová and K. Šimek, are shown in Table 2.

2.5 Structure–function analysis of the bacterioplankton assemblage in the Římov reservoir

K. Horňák, J. Jezbera, M. Mašín, J. Nedoma, K. Šimek examined changes in the structure and function of the bacterioplankton assemblage induced by different levels of predation pressure (top-down control) and resource availability (bottom-up control). We conducted a manipulation experiment in the canyon-shaped Římov reservoir on 19–23 May 2003. A sample of ~40 l taken from a surface layer of the P-limited dam area of the reservoir and a parallel one taken from the moderately P-limited middle part of the reservoir were size-fractionated into <0.8 µm and <5 µm treatments. Then these different size-fractions (in 2 parallels) were incubated in i) dialysis bags, ii) glass bottles, and iii) glass bottles with phosphate addition. All incubation was done in situ at a depth of ~0.5 m for 4 days. <0.8 µm and <5 µm treatments were compared to unfiltered control treatments taken directly from either the dam or the middle part of the reservoir. Subsamples of ~300 ml were taken daily from all treatments to monitor bacterial abundance, mean cell volume, bacterial production, protozoan grazing as well as bacterial community composition and uptake of radiolabelled substrate.

K. Horňák specifically studied the phylogenetic composition and the defined metabolic activities of the bacterioplankton assemblage by means of fluorescence in situ hybridization (FISH) combined with microautoradiography (MAR). This technique enables simultaneous identification and activity determination of individual cells within the whole bacterial assemblage. Bacteria were identified using group-specific rRNA-targeted HRP-labelled oligonucleotide probes. Incubation with $[^3H]$-Leucine was used to determine the specific metabolic activities of individual bacterial cells. Preliminary results indicate large differences in the activities of different probe-defined bacterial groups.

2.6 Fish stock composition in the Římov reservoir in 2003

The fish stock of the Římov reservoir was monitored traditionally by using night seining. Open water and benthic habitats were also studied by split-beam echosounder, gillnets and pelagic trawl. The inshore area was fished quantitatively according to Kubečka and Bohm, 1991, J. Fish Biol., 38: 935–950. Field work was carried out by J. Kubečka, M. Hladík, M.Říha, J. Peterka, M. Čech, J. Frouzová, M. Prchalová, E. Hohausová, Z. Prachař, M. Vašek, V. Draštík, M. Kratochvíl, T. Jůza, M. Tušer, P. Štafa and L. Pokorný. 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 late August, using seine nets 50 and 200 m long (4 m deep). An area of only one hectare of the inshore region could be fished in 2003. The reason was an extremely low water level and thick layers of bottom sediments, which made the use of seine nets impossible in the upper half of the reservoir. Most of this sediment is a consequence of the 2002 massive flooding.

The 2003 fish stock estimate was the first after the flood of 2002. In 2002, Římov reservoir had been affected by two extremely high flood events within a week of each other. The peaks of discharge in the Malše River above the reservoir were ~350 and 500 $m^3 s^{-1}$ during the two subsequent floods (long-term average water flow is ~4 $m^3 s^{-1}$) and the amount of water which flowed through the reservoir during the two events equalled approximately a triplicate of the total volume of the reservoir. We have no direct data concerning the amounts of fish flushed from the reservoir or into the reservoir from the river and its catchment. It seems, however, that even this drastic event had no significant impact on the total fish stock in the Římov reservoir, since both the mean total abundance and biomass of fish one year after the floods (i.e. in 2003) did not differ significantly from the mean total fish abundance and biomass in the years before the flood event (1999–2002). The increase of the fish biomass compared to the summer 2002 estimate (which was 87 kg ha^{-1}) may also have been caused by increased production and by a higher concentration of the fish stock in the reservoir which had a lower water level in 2003. Roach and bream remain the most important fish species (Table 3). There was an interesting increase in the abundance of small ruffe and dace represented by fish born in 2002 with low share in the biomass. A temporary increase of some species originating from the river and fish ponds in the reservoir catchment (trout, dace, gudgeon, carp, gibel carp, *Carassius auratus*) was recorded in catches throughout the 2003 season, but during the spring and summer their proportion decreased due to emigration and mortality. The cyprinid-dominated fish stock of the Římov reservoir proved to be a very stable system, not influenced much even by the extreme flooding events.

Table 3: Composition of the fish stock of the Římov reservoir in 2003 according to night shore seining estimate

Common Name	Latin name	Abundance ind ha^{-1}	Biomass kg ha^{-1}	% abundance	% biomass
Perch	*Perca fluviatilis*	188.38	6.01	8.07	4.97
Roach	*Rutilus rutilus*	774.04	43.18	33.15	35.71
Bream	*Abramis brama*	390.43	38.64	16.72	31.95
Chub	*Leuciscus cephalus*	1.95	0.02	0.08	0.02
Rudd	*Scardinius erythrophthalmus*	5.86	0.05	0.25	0.04
Pike	*Esox lucius*	2.93	15.09	0.13	12.48
Asp	*Aspius aspius*	61.49	2.24	2.63	1.86
Dace	*Leuciscus leuciscus*	384.58	2.08	16.47	1.72
Bleak	*Alburnus alburnus*	7.81	0.17	0.33	0.14
Ruffe	*Gymnocephalus cernuus*	439.24	1.75	18.81	1.44
Pikeperch	*Stizostedion lucioperca*	11.71	0.34	0.50	0.28
Gudgeon	*Gobio gobio*	53.68	0.28	2.30	0.23
Hybrid	*Abramis x Rutilus*	9.76	0.84	0.42	0.70
Carp	*Cyprinus carpio*	1.95	9.88	0.08	8.17
Eel	*Anguilla anguilla*	0.98	0.35	0.04	0.29
	Total	2334.80	120.92	100.00	100.00

2.7 Diel vertical migrations of bathypelagic perch fry (*Perca fluviatilis* L.): a case study in the Slapy reservoir (Part of the project GA AS CR no. A 6017201)

M. Čech, M. Kratochvíl, J. Kubečka, V. Draštík and J. Matěna studied the behaviour of young-of-the-year perch, the dominant species in the assemblage of fry in the pelagic zone of the Slapy reservoir in late May and mid-June using acoustic methods (SIMRAD EY 500, Sonar5) and complementary net catches (Fig. 3a). This study for the first time elucidates in details the phenomenon of scattering layers observed in several perch dominated lakes and reservoirs (in Czech Republic, e.g., V. Hruška and J. Kubečka, unpubl. data).

During the day of both month, perch fry were present simultaneously in littoral, epipelagic (depth 0–4 m) and bathypelagic (>8, up to 16 m) habitats. Bathypelagic perch fry, forming a scattering layer (Fig. 3a), migrated vertically each day between the epilimnion and hypolimnion, with an amplitude of 11 m in May and 12,5 m in June. This migration seems to be under direct control of the light intensity. At dusk, the migratory bathypelagic fry mixed in the epilimnion with non-migrating epipelagic fry and spent the night close to the thermocline (abundance maximum at 3–4 m in May, 0–2 m in June).

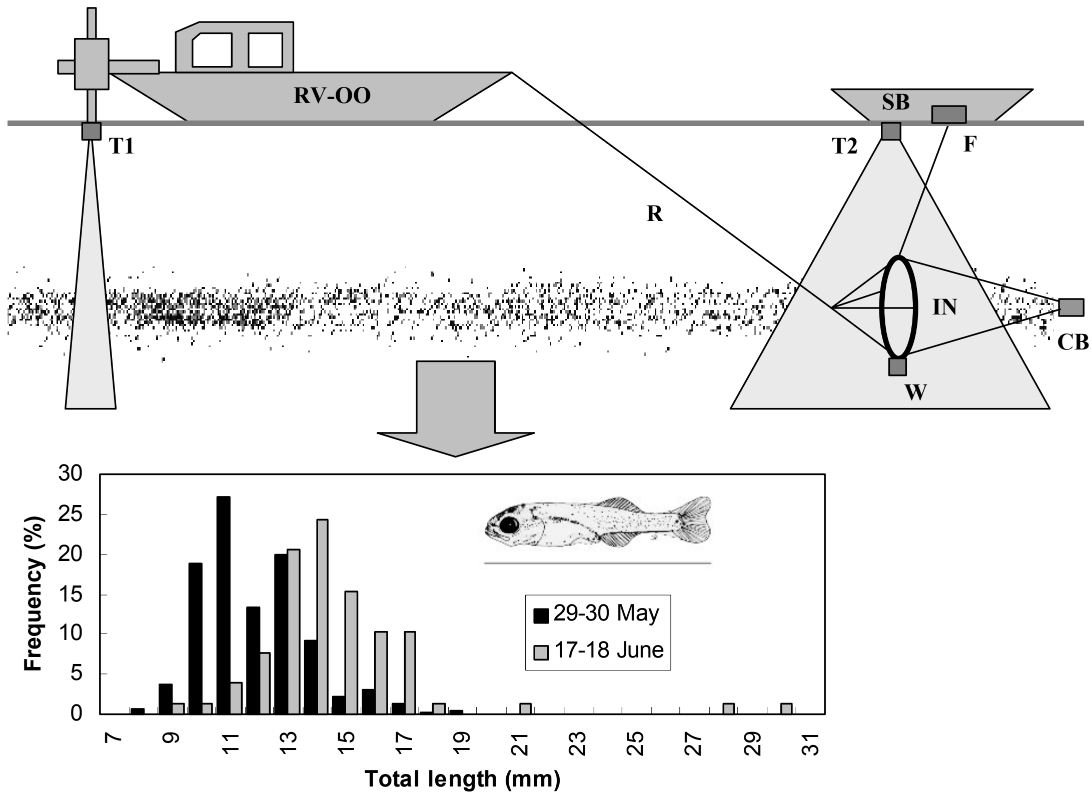

Fig. 3 **a**, Diagram showing the sampling operation and mid-day position of the scattering layer formed by bathypelagic perch fry: T1, circular split beam transducer (beam angle 7,1^{o}); RV–OO, multi-functional research vessel Ota Oliva; R, 50 m rope; T2, transducer of beam angle 60^{o}; SB, support boat; W, 10 kg weight; IN, ichthyoplankton net (2 m in diameter); F, floater; CB, collecting bucket. **b**, Frequency distribution of total length (L_T) of perch fry in the bathypelagic scattering layer (day catches) in May and June in Slapy reservoir.

Contrary to May, in June, shoaling behaviour by some of the bathypelagic perch fry was observed. The shoaling fry remained higher in the water column than the non-shoaling fry. The between-month growth of the perch fry forming bathypelagic scattering layer was very low (average L_T 11,9 mm in May and 14,6 mm in June) (Fig. 3b). The contribution of the bathypelagic part of the population to the total numbers of pelagic perch fry decreased from ca. 18940 inds ha^{-1} in May to ca. 5860 inds ha^{-1} in June, while the density of all pelagic perch fry increased (ca. 96000 inds ha^{-1} in May and 142000 inds ha^{-1} in June).

A comparison of the simultaneous estimations of fry abundance in corresponding layers of the water column, using acoustic and direct ichthyoplankton catches revealed a strong correlation of the results of both sampling techniques both in May and in June. Moreover, in both months the ratio between acoustic and direct ichthyoplankton catches remained the same during the day (ca. 3:1), surprisingly suggesting no increase in between-month bathypelagic fry avoidance of the sampling gear. However, the avoidance reaction to the sampling gear was still more than 5 times higher during the day than during the night.

Diel vertical migrations of bathypelagic perch fry are supposed to be an alternative strategy in reducing fish and aerial predation and/or metabolic cost, but living in cold dark waters results in slower growth rate and smaller sizes compared with epipelagic part of the perch fry population.

The results of the investigation have been submitted as a manuscript to the Journal of Fish Biology.

2.8 Longitudinal and vertical spatial gradients in the distribution of fish within a canyon-shaped reservoir

M. Vašek evaluated gill net samples of fish taken within a morphometrically simple canyon-shaped reservoir with a single major tributary and a longitudinal trophic gradient (Římov reservoir, Czech Republic). Fish were sampled by Nordic survey gill nets (several mesh sizes from 8 to 70 mm knot to knot) installed as surface nets at several offshore areas located along the longitudinal transect of the reservoir. Surveys were carried out in late summertime in 1999–2003. A conspicuous distribution gradient of fish was revealed along the longitudinal transect of the Římov reservoir. The total relative fish abundance and biomass (catch per unit effort) decreased considerably from the upstream end of the reservoir toward the dam. Roach (*Rutilus rutilus*), bleak (*Alburnus alburnus*) and bream (*Abramis brama*) comprised the bulk of catches at all areas. A higher dominance of bream was observed in the fish assemblage in the uppermost, more eutrophic zone of the reservoir. The highest number of fish species and the highest abundance of young-of-the-year fish were also observed in the tributary area. In the lacustrine part of the reservoir, gill net surveys along vertical depth profiles indicated that offshore fish primarily occupied the epilimnion. Although extreme flooding in 2002 did affect the Římov reservoir, it seemed to have no significant impact on the gradients described.

3. LAKES

3.1 Modelling reversibility of central European mountain lakes from acidification

J. Kopáček, V. Majer, J. Veselý (both Czech Geological Survey, Prague), B. J. Cosby (University of Virginia, Charlottesville, USA), and E. Stuchlík (Charles University, Prague) applied a dynamic, process-based model of surface water acidification, MAGIC (Modelling the Acidification of Groundwater in Catchments) to three forest lakes in the Bohemian Forest (Czech Republic) and to four alpine lakes in the Tatra Mountains (Slovakia and Poland).

Part 1: the Bohemian Forest (Majer et al. 2003) – The model was calibrated for a set of experimental records on lake water composition over the 1984–2000 period, and produced hindcast concentrations that compared well with available data, even with older (40-year) irregular determinations of nitrate, chloride, and pH. Water and soil chemistry forecast up to 2050 was based on reductions in S and N emissions presupposed by the Gothenburg Protocol.

Modelled sulphate and chloride concentrations are predicted to decrease to levels from the beginning of the 20^{th} century by 2050. The lake water carbonate buffering system is predicted to be re-established in only two lakes (Černé and Plešné), whose current soil base saturations are 12–15%. Concentrations of ionic aluminium species have decreased sharply, from 110 μeq l^{-1} in the mid-1980s to the current ~40 μeq l^{-1}, and are predicted to decrease below 10 μeq l^{-1} in the 2020s. Diatom-inferred pH in the pre-industrial period was substantially lower than the pH estimated by the model. It is suggested that the diatom pH values, based almost entirely on non-planktonic species data, were biased by an inwash of diatoms from more acidic tributaries into the sediment of these small lakes.

Significant results can be summarised as follows: (1) Simulated sulphate levels were in agreement with the data observed during the acidification progress and retreat only if we used values of soil SO_4^{2-} adsorption capacity 3 to 6-times higher (20 to 40 meq kg^{-1}) than those experimentally found. This indicates the existence of another mechanism of S retention and release besides physical sulphate adsorption to Fe and Al oxides of soils. (2) The catchments' ability to retain deposited N appeared to decline after ~1950 but this was not connected with a sufficient change in the C:N ratio of the soils. Agreement between the modelled and observed concentrations of nitrate was therefore achieved by an empirical restriction of N retention in the soils. Based on their current ability to retain N, the catchments will remain N-saturated and could temporarily produce more inorganic N than they receive due to additional nitrate production from soil N-organic pools. This situation has already occurred in the Černé Lake catchment. (3) Differences in the responses of individual lakes can be explained by different land use over the past several centuries as well as by differences in geology and primary production.

Part 2: the Tatra Mountains (Kopáček et al. 2003) – The model was calibrated for a set of 12 to 22-year experimental records on lake water composition. Surface water and soil chemistry were reconstructed for the 1860–2002 period and forecast up to 2050 based on the reduction in sulphur and nitrogen emissions presupposed by the Gothenburg Protocol.

The lake water chemistry exhibited significant changes during both the acidification (1860 to 1980s) and recovery (1980s to 2010) phases. An increase in lake water concentrations of strong acid anions (SAA; 104–149 μeq l^{-1}) was compensated for by a decline in HCO_3^- (13–62 μeq l^{-1}) and an increase in base cations (BC; 42–72 μeq l^{-1}), H^+ (0–18 μeq l^{-1}), and Al_i^{n+} (0–26 μeq l^{-1}). The carbonate buffering system was depleted in three lakes. In contrast, lake water concentrations of SAA, BC, H^+, and Al_i^{n+} decreased by 57–82, 28–42, 0–11, and 0–22 μeq l^{-1}, respectively, the carbonate buffering system was re-established, and HCO_3^- increased by 1–21 μeq l^{-1} during the chemical reversal from atmospheric acidification (by 2000). The MAGIC model forecasts a slight continuation in this reversal for the next decade and new steady-state conditions thereafter. Gran alkalinity should come back to the 1950's levels (0–71 μeq l^{-1}) in all lakes after 2010. Partial recovery of the soil pool of exchangeable base cations can be expected in one catchment, while only a conservation of the current conditions is predicted for three lakes. Even though the pre-industrial alkalinity values of 16–80 μeq l^{-1} will not be reached due to the insufficient recovery of soil quality, the ongoing chemical improvement of water should be sufficient for biological recovery of most of the alpine lakes in the Tatra Mountains.

3.2 Modelling air temperature at Čertovo Lake

H. Kettle (Edinburgh University, Edinburgh, United Kingdom), J. Kopáček, and J. Hejzlar reconstructed mean daily and monthly air temperatures at Čertovo Lake (the Bohemian Forest , Czech Republic) back to 1961 and 1781, respectively, using daily data from Churáňov (Bohemian Forest) and monthly data from Hohenpeissenberg (Germany). Daily air temperatures varied between −17.7˚C and 23.2˚C in the 1961−2001 period, with an average of 3.8˚C. The average daily error for the mean daily air temperature at Čertovo Lake was 0.7˚C. Mean monthly air temperatures were predicted with a mean absolute error of 0.5ºC and varied between −12.0˚C and 16.2˚C in the 1781−2001 period with long−term averages between −5.3 ˚C in January and 12.3˚C in July−August. Mean annual air temperatures varied between 2.1˚C (in 1829) and 5.1˚C (in 2000), with the 1781−2001 average of 3.4˚C. The long−term trend in mean annual air temperatures exhibited significant variations with 3 distinct periods: (i) temperature fluctuation along the 1781−2001 average between 1781 and 1830, (ii) a colder period from 1830 to 1940 and (iii) increasing temperatures since the 1960s, with the most rapid increase between 1980 and 2001. This increase was predominantly associated with an increasing trend in mean winter and summer temperatures, particularly May, August, and December temperatures.

3.3 Impact of alpine soils on water composition

J. Kopáček, J. Kaňa, H. Šantrůčková, T. Picek (both Faculty of Biological Sciences, University of South Bohemia), and E. Stuchlík (Charles University, Prague) determined the chemical and biochemical characteristics of alpine soils in the Tatra Mountains (Slovak-Polish border), and evaluated their correlation with lake water quality.

Soils and lakes were sampled in fifteen catchments along the mountain range. The amount of soil in alpine meadows varied from 38 to 255 kg m^{-2} (dry weight soil <2mm; average of 121 kg m^{-2}). The average cation exchange capacity (CEC) was 12 eq m^{-2}, average base saturation was 12%, and average pH_{CaCl2} was 4.0. Moraine areas had, on average, 13 kg m^{-2} of <2mm soil in small deposits between stones. Their chemical properties were similar to those of the mineral horizons of alpine meadow soils but they had higher concentrations of P forms. Soil composition was spatially uniform, having coefficients of variation of all parameters between 5 and 115%, and did not exhibit significant differences between the catchments or along the elevation gradient. Variation in pools of soil constituents was ~2-fold higher. Soil organic matter concentration was the parameter that most strongly and positively correlated with N, P, S, CEC, exchangeable base cations, exchangeable acidity, and all biochemical parameters (C, N, and P in microbial biomass and C and N mineralisation rates). Lake water concentrations of organic C, N, and total P were positively correlated ($P<0.01$) with the pool of soil organic matter in the catchments, while NO_3^- concentrations were negatively correlated ($P<0.001$). No correlations were found between C, N, and P concentrations in lakes and soil chemistry, indicating the dominant role of soil quantity over quality for surface water composition in the Tatra lakes. Relatively high concentrations of Ca^{2+}, Na^{+}, SO_4^{2-}, reactive Si, and acid neutralising capacity in some lakes were not explained by soil characteristics, and were more probably related to bedrock composition and structure.

3.4 Primary production and microbial activity in the euphotic zone of Lake Baikal (Southern Basin) during late winter

V. Straškrábová, J. Nedoma and J. Borovec investigated late winter events under the ice in the South basin of Lake Baikal. The site was a regular monitoring site of the Research Institute of Biology at the Irkutsk State University. Data were elaborated together with long term data by L. R. Izmest'eva, G. I. Kobanova, E. A. Maksimova and others. Three years of regular weekly/biweekly monitoring of seasonal changes in temperature, transparency, chlorophyll *a* (Fig. 4) and bacteria (microscopic counts and cultivable colony forming units) in the South basin vertical profile (51°54'195''N, 105°04'235''E, depth 800 m) were evaluated. In March 2003, we made more detailed investigations of the structure and function of phytoplankton and of the microbial loop in the euphotic layer on the same site. The depth of the euphotic zone (up to 1% of surface irradiation) was 35 to 40 m. Primary production (Fig. 5) was measured three times a week with ^{14}C method at 2, 10, 20, 30 and 40 m. The maximum rate was found at 10 m with lower values towards the surface (light inhibition) and towards the lower layers. Total production in cells larger than 1µm in the column was 204–240 mg C d^{-1} m^{-2}, 30–40% of this was in cells 1–3 µm (mostly picocyanobacteria), which represented roughly 9% of total chlorophyll *a* (estimated from pigment analyses and phytoplankton volume biomass by S. Fietz). The major part of the phytoplankton biomass was formed by diatoms (*Synedra acus, Asterionella formosa* and *Stephanodiscus binderanus* var. *baicalense*). The total production (including extracellular) was 235–387 mg C d^{-1} m^{-2} and part of the exudates were readily used by bacteria (particles 0.2 –1 µm). This part amounted to 1–5% of cellular production at 2 to 20 m and 11–77% of cellular production at 20–40 m, i.e. in light limited layers. Between 0 and 30 m chlorophyll *a* concentrations were 0.8 to 1.3 µg l^{-1}, but they decreased rapidly from 1.3 to 0.1 µg l^{-1} towards the depth of 40 m.
Bacteria numbers (DAPI stained microscopic counts) reached 0.5–1.4 millions per ml, their cell volumes measured via image analysis were small (average 0.05 μm^{-3}), often not well countable when erythrosine stain was used. Biomasses were in the range of 6–21 µg C l^{-1}. Heterotrophic protist numbers were rather low, flagellates ranged from 6 to 87 in ml (counted by J. Jezbera), ciliate numbers were 0.2–1.2 in ml (mostly Oligotrichida, determined by M. Macek).

Bacterial production was measured at the same depths as primary production using ^{3}H-thymidine and ^{3}H-leucine uptake. Bacterial abundances, biomasses, thymidine and leucine production were consistently higher by 30–50% in layers 2, 10 and 20 m compared to the deeper layers of 30 and 40 m, where cellular primary production was negligible. Leucine uptake in deeper layers was up to three times lower than in upper ones. Comparison primary and bacterial production we can infer that bacteria can use roughly 20–40% of primary production in 24 h in the layers of 2 to 20 m.

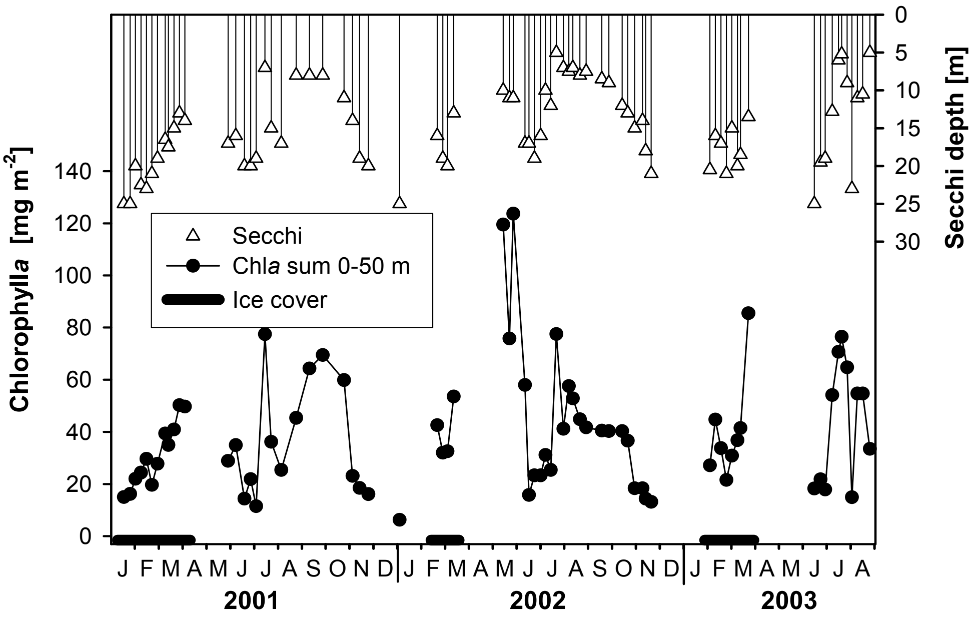

Fig. 4: Lake Baikal – seasonal changes of chlorophyll *a* and transparency in the South Basin monitoring site during 2001–2003.

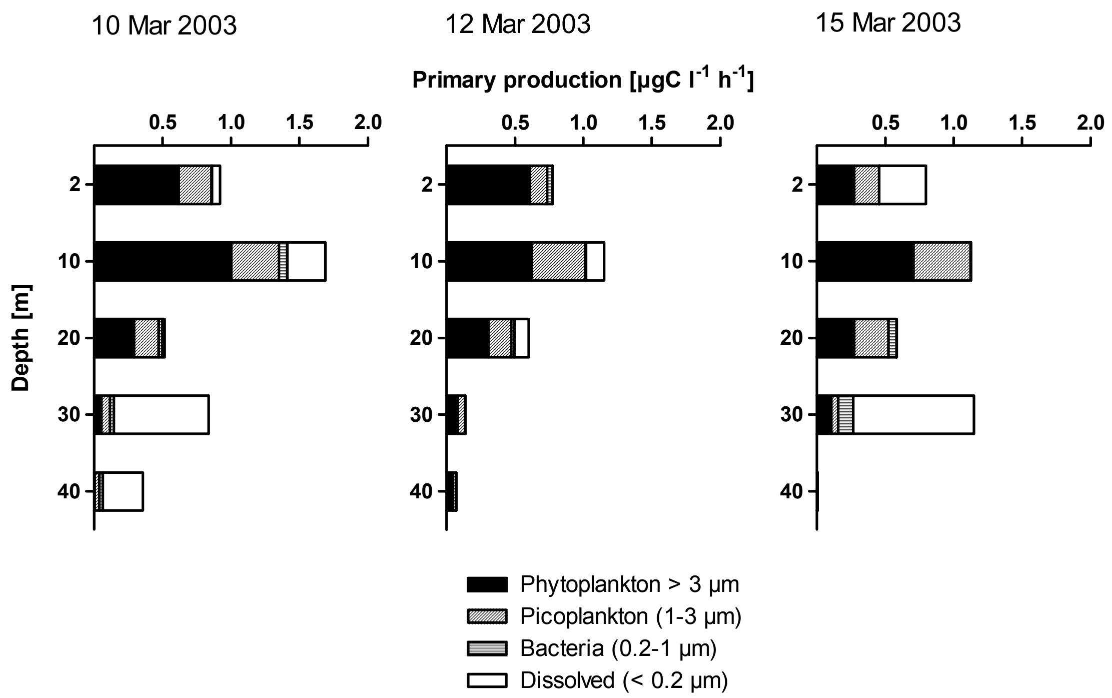

Fig. 5: Lake Baikal – vertical profiles of primary production in the South Basin monitoring site in March 2003.

3.5 Protozooplankton and their activity in a deep monomictic saline lake in a semi-desert area

M. Macek continued the work on the projects at Universidad Nacional Autónoma de México campus Iztacala, Laboratory of tropical limnology (head – Javier Alcocer Durand), monitoring the maar-crater lake Alchichica**,** State of Puebla, Mexico at least once a month (for more details, see AR 2002).

The protozoan assemblage structure was studied with special emphasis on their picophytoplankton-feeding activity and on ciliates in an anoxic hypolimnion. Epifluorescence methods based on chlorophyll autofluorescence and DAPI staining were employed to count autotrophic picoplankton (APP) and total picoplankton (TPP) plus heterotrophic nanoflagellates (HNF) plus ciliates, respectively. Identification of ciliates was performed using the Quantitative Protargol Staining, while the feeding activity was estimated by means of the Fluorescently Labelled Particles (FLP) method.

Even though TPP numbers showed significant periodicity over the last 4 years, HNF did not follow such a pattern. HNF peaked during the first weeks of stratification (generally below 3000 but over 10^4 cells ml^{-1} in June). The genera *Spumella*, *Bodo* and *Monosiga* were the most abundant. At the end of the turnover and then in the epilimnion, the most important ciliate groups were peritrichs (*Rhabdostyla* sp., *Vorticella aquadulcis* complex), and oligotrichs (particularly *Halteria* sp.); all these fed upon APP (typically, 150 and 50 APP $cell^{-1}$ h^{-1}). During stratification, ciliates were concentrated in the oxycline and around the anoxic boundary (up 30 cells ml^{-1}). Gymnostomatids (particularly *Pelagolacrymaria rostrata*) were the most biomass-important. Below the oxycline, scuticociliates (*Cyclidium glaucoma* and *Uronema marina*; even over 50 cells ml^{-1}) were found feeding on APP (up 50 APP $cell^{-1}h^{-1}$), however, not all scuticociliates ingested the offered FLP size. Anoxic ciliates at the very bottom (typically up to 30 cells ml^{-1}; e.g., odontostomatids) did not feed upon APP. At the end of stratification (since September), *Euplotes* sp. dominated the community (5 cells ml^{-1} in October) and, curiously, both unicellular algae (over 2 µm of diameter) and APP were observed inside its vacuoles (150 APP $cell^{-1}h^{-1}$).

Table 4: Important ciliate taxons and their maxima within the water column of Alchichica Lake (State of Puebla, Mexico)

Taxonomical & ecological position	Taxon	Maximum occurrence
picoplankton feeding oligotrichs	*Halteria grandinella* *Rimostrombidium brachykinetum*	epilimnion epilimnion
peritrichs	*Rhabdostyla* sp. *Vorticella aquadulcis* complex	epilimnion (*Nodularia* sp., *Cyclotella* spp.) the whole water column
scuticociliates	*Cyclidium glaucoma* *Uronema marina*	around the limit of anoxia to the bottom around the limit of anoxia to the bottom
hypotrichs	*Euplotes* sp.	from the thermocline through the limit of anoxia
gymnostomatids	*Askenasia* sp. & *Mesodinium pulex* *Lacrymaria* sp. *Pelagolacrymaria rostrata*	epilimnion around the oxycline around the oxycline to anoxia
mixotrophic prostome	*Pelagothrix* cf. *chloreligella*	from the oxycline to anoxia
others	*Chaetospira* sp.	from the oxycline to the bottom
	odontostomatids	1 m above the bottom

Apparently, ciliate distribution was related to APP concentration and/or decay in the respective levels.

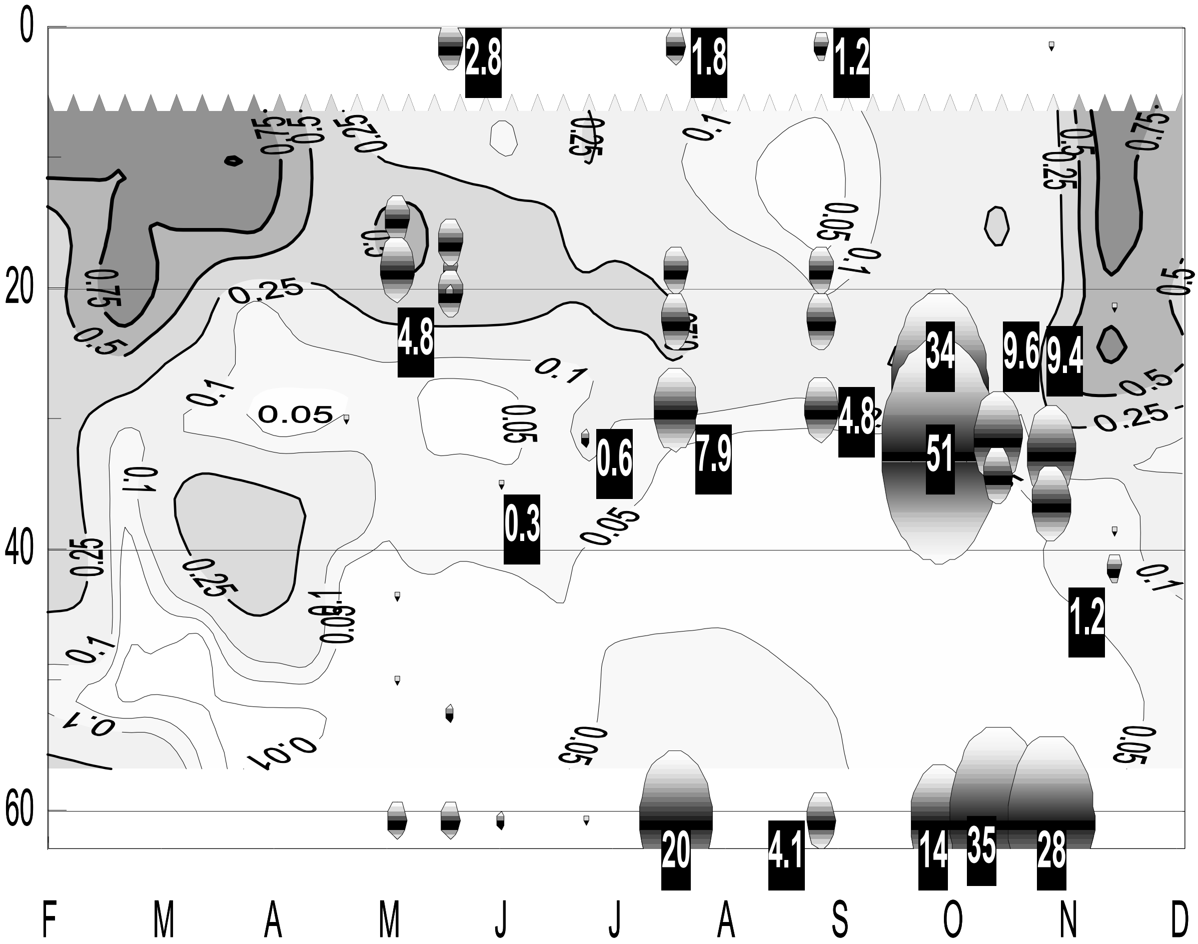

Fig. 6: APP isolines (10^6 cells ml^{-1}) and ciliate numbers (bubbles; cells ml^{-1}) in the water column of Alchichica Lake (State of Puebla, Mexico).

4. SPECIAL INVESTEGATIONS

4.1 Members of a small subcluster of Beta-Proteobacteria sensitively respond to top-down and bottom-up manipulations with bacterioplankton in the Římov reservoir

K. Šimek, K. Horňák, J. Jezbera, M. Mašín, J. Nedoma, J. Gasol (Institut de Ciencies del Mar, CMIMA, Barcelona, Spain), and M. Schauer (Institute for Limnology, Mondsee, Austria) collaborated on a project studying the most important factors regulating shifts in freshwater bacterioplankton composition.

We studied the effects of protistan grazing and nutrient availability on bacterial dynamics and community composition (BCC) in different parts of the canyon-shaped Římov reservoir. To investigate the effects of protistan grazing on BCC, a size-fractionation approach was used. Dialysis bags containing water from the dam area with only bacteria (<0.8 μm treatment), or bacteria and bacterivorous heterotrophic nanoflagellates (HNF, <5 μm treatment), or whole water, were incubated in situ. Top-down manipulations (size-fractionation) were also combined with bottom-up manipulations, i.e. transplantation of samples to the upper inflow parts of the reservoir, which shows increased phosphorus availability. Overall, denaturing gradient gel electrophoresis indicated significant genotypic shifts in BCC that occurred with the sample transplantation to the nutrient-rich areas of the reservoir. Using different probes for fluorescence in situ hybridization (FISH), we detected that members of a small subcluster of Beta-proteobacteria (targeted with the probe R-BT065, 10–50% of total bacteria) were rod-shaped cells of very uniform size and morphology, vulnerable to predation, but very fast growing so that they could sensitively respond to different experimental manipulations. In the absence of grazing in all treatments, the members of the R-BT065 cluster rapidly overgrew other Beta-proteobacteria, showing the highest net growth rate of all studied bacterial groups. Moreover, their proportions tightly correlated with bacterial production and numbers of high nucleic acid content bacteria (usually the most active members of the community) assessed by flow cytometry. In contrast, increasing protistan bacterivory yielded lower proportions of the R-BT065-positive and of high nucleic acid content bacteria. However, this shift was paralleled by increasing proportions of the class *Actinobacteria,* whose members were very rarely ingested by protists, as FISH conducted inside food vacuoles revealed.

4.2 Protistan feeding preferences studied by means of FISH conducted in food vacuoles

J. Jezbera measured protistan feeding preferences using a novel technique – CARD FISH (catalysed reporter deposition – fluorescent in situ hybridization, for a thorough description of the method see Pernthaler et al. 2002; in brief, this method consists in linkage of short DNA oligonucleotide sequences – probes, labelled with the horseradish peroxidase enzyme, to target sequences of 16S rRNA of bacteria, with biochemical detection of marked bacterial cells) conducted on transplant experiment samples from May 2002. EUB338, CF319a, BET42a, GAM42a, RBT065 and HGC69, a group specific probes, were used to target the main bacterial groups common in the water environment and in the food vacuoles of protists. All values were expressed as a percentage of EUB338 probe – universal bacterial probe.

Water collected from the dam area of the reservoir was size-fractionated to either eliminate protistan grazing (<0.8 μm treatment) or to enhance the extent of heterotrophic nanoflagellate bacterivory (<5 μm treatment) compared to a control unfiltered treatment. All treatments were duplicated and incubated in dialysis bags and bottles in the dam area and in parallel transferred and incubated in the middle and river part of the reservoir in dialysis bags only.

Bacteria detected by the HGC69a (Actinobacteria group, Gram positive bacteria) probe were clearly negatively discriminated in terms of grazing, since they permanently constituted between 0% and 5% of the protistan bacterial diet, whereas their presence in the ambient water environment ranged from 10% to 43% of EUB338 detectable bacteria. This was probably caused by their relatively low cell volume, which thus served as a specific way to escape protozoan predation.

R-BT065 bacteria (subclass of BET42a - β-Proteobacteria) were also grazed to lesser extent than their corresponding abundance in the water in almost all variants, except for the bottle treatment, where the opposite trend was discernible. In the middle and river variants, they were nearly double the numbers found in the reservoir, varying from 14% to 44% of all, by EUB338 probe detected bacteria. The percentage usually grew with time in the water environment. Their numbers were positively correlated with BET42a probe-detected bacteria, and followed the same time pattern

Bacteria targeted by the CF319a probe (Cytophaga/Flavobacterium group) exhibited an interesting pattern: at the beginning of the experiment (after 48 hours of incubation), numbers of ingested CFs were much higher than the natural concentrations available in the reservoir. After 72 hours of incubation, both values moved closer to each other, and finally after 96 hours of incubation, freely distributed bacteria in the water column prevailed over the amount of bacteria ingested by the protists. This development was observed in almost all the treatments. The phenomenon might be explained by the formation of filamentous, grazing-resistant bacterial morphotypes, creating a special kind of size refuge.

Bacteria detected by the BET42a probe constituted most of the hybridized cells (ranging from 30% of EUB338 to 62% in the water, and from 15% to 60% in the food vacuoles of heterotrophic nanoflagellates.) A considerable increase in the hybridization with the BET42a probe occured in the bottle, middle and river variants with time. Lowered control of BET42a bacteria by bacterivorous protists was detected mainly at the end of the experiment, after 96 hours of incubation.

Reference:
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4.3 The occurrence of bloom-forming green alga *Pleodorina indica* (Iyengar) Nozaki (Volvocales) in the downstream reach of the Malše River

In mid-August 2003, P. Znachor and J. Lodeová recorded a massive bloom of the green alga *Pleodorina indica* (Iyengar) Nozaki (Volvocales) in the downstream reach of the River Malše in the city of České Budějovice. At distinct sites, extensive scum forming and diurnal changes in the macroscopic appearance of *P. indica* were observed. This alga dominated entirely the river phytoplankton completely (Fig. 7) attaining a biomass of around two thousand colonies per millilitre. The bloom was attributed to the hot dry weather resulting in low flow conditions and warm water temperature. However, high nutrient concentrations will also have been contributing factors. *P. indica* persisted in the river from 10^{th} to 17^{th} August, when it was flushed away.

P. indica (Iyengar) Nozaki is a coenobic colonial green alga assigned to the Volvocales order (Volvocaceae family). Spherical, ovoid or ellipsoidal colonies of 128 or 64 or 32 cells are arranged radially at the periphery of a gelatinous matrix (up to 300 μm long). Cells are spherical or ellipsoidal, each with two equal flagella, a stigma, many contractile vacuoles on the cell surface, and a massive cup-shaped chloroplast with single or multiple pyrenoid. The anterior 1/5 ~ 1/3 of the cells in a colony are small, obligately somatic and nearly spherical (up to 16 µm in diameter). The remaining reproductive cells gradually increase in cell size from anterior to posterior pole (they are up to 25 µm in diameter). The gelatinous matrix forms individual sheaths, which are highlighted after staining with diluted methylene blue.

P. indica, which flourished in the River Malše, is an indigenous species of tropical climate regions. The origin of *P. indica* in the river has remained disputable. We do not know, whether the flourishing of this thermophilic species of green alga might be attributed to the global warming phenomenon, however, this is the first record of a massive occurrence of *P. indica* in the region of Central Europe.

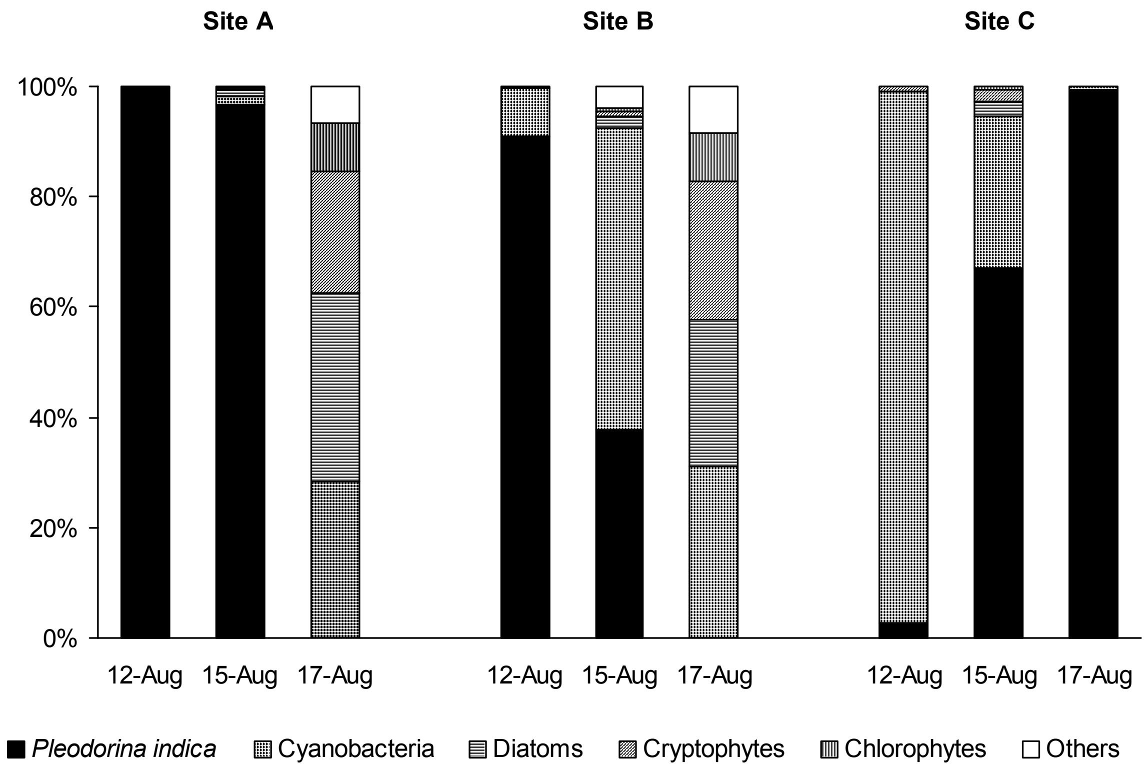

Fig. 7: Taxonomic composition of phytoplankton in a longitudinal profile of the downstream reach of the River Malše. Site A was the most upstream-located site (1 km above the confluence of the Malše and Vltava Rivers). Site B was situated 500 m closer the confluence and site C lay near the confluence in the dead zone of the Malše River.

4.4 Fish dispersal in a network of temporal and permanent water-bodies in subtropics

In 2003, E. Hohausova completed her research on the project "The ecology of fish assemblage in seasonal and permanent water-bodies within the unique Florida Scrub Ecosystem" awarded by the Fulbright-Masaryk scholarship (2002/2003). During the research project she worked on revealing and describing fish dispersal mechanisms in a temporal water network. Archbold Biological Station, where the research was conducted, is a subtropical area protecting a rare habitat type (Florida scrub) where only limited fish research has been undertaken so far. The area has a distinct weather pattern partitioned into a dry season (October-May) with minimum rainfall and a wet season (June-September) with high precipitation. El Niño effects that appeared in the year of the study brought unusually high rainfalls during my study period. El Niño caused an unexpected extension of the wet period, and high rainfall was observed till January 2003. The described weather pattern allowed the development of temporal water bodies during the wet season and the occurrence of connections between them and to permanent water bodies inhabited by fish.

The study included sampling of 5 permanent water bodies (fish sources) and 27 seasonal sites including 7 seasonal ditch profiles and 20 seasonal ponds. Permanent water bodies were sampled for fish composition in the beginning of the study period by means of seining. Seasonal sites were checked for presence or absence of water and for presence of fish in two-week intervals between May 2002 and June 2003. Where fish were present, the sites were sampled by electrofishing. In addition, temperature, dissolved oxygen and conductivity were measured at the seasonal sites.

During the study season, connections between seasonal and permanent water bodies temporarily occurred and fish were observed using these connections to colonise seasonal sites. Sixteen species, of 22 found in the area, were found to use the temporal water network for dispersal. Species richness and mean fish length in the seasonal fish assemblages significantly decreased with distance from a source, showing that mainly small species were able to reach farther locations. The range of distances of colonized seasonal sites and those not colonized did not significantly differ, suggesting that the possibility of colonization of a seasonal habitat did not depend on its distance from a source. Various artificial structures (e.g. sand road, car ruts, soil dumps) were observed to interfere with fish dispersal instead, some enhacing dispersal by unnatural connections among seasonal sites, others hindering dispersal by blocking connection between adjacent locations. Mosquitofish (*Gambusia holbrooki*) was the most successful and most abundant migrant, and the first colonizer of all sites studied. Other small species such as Everglades pygmy sunfish (*Elassoma evergladei*), lined topminnow (*Fundulus lineolatus*), golden topminnow (*F. chrysotus*) and coastal shiner (*Notropis petersoni*) were much less abundant, but succesul in colonizing a number of sites.

Lastly, an updated inventory of the fish assemblage in the area has been compiled.

Manuscripts of publications are prepared in co-operation with Dr. Mike S. Allen, Dept. Fisheries & Aquatic Sciences, UF.

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(* authors from other institutions, R – review)

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