



SILnews

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Contributions on a PC formatted disk, in any standard word processor or DOS (ASCII) text, or as e-mail attachments, will assist the Editor.

Editorial

Regional Limnology: Priorities, Progress and Perspectives

I received encouraging feedbacks on *SILnews* 51 from our readers. I believe the credit goes to the *SILnews* contributors for sharing information and thoughts relating to the progress of limnological studies at their respective research institutions. I'm pleased that the reports on regional limnology and the work in progress at different laboratories can be put across through the *SILnews* to our readers. For the present issue of *SILnews* I have received an interesting mix of resumes on different facets of regional limnology highlighting the main study aspects, or the factors that have hindered progress, e.g. in the developing countries. Interestingly, there is a great diversity in the limnological studies in progress and in the approach to tackling the major water-quality problems. Here, I will very briefly comment on the different contributions on limnological studies included on the subsequent pages of this issue.

To start with, Elizabeth Gross and Karl-Otto Rothhaupt provide some good news from the Lake Konstanz, Germany. This largest lake in Germany has in recent years continued to exhibit signs of *re-oligotrophication*--thanks to the nutrient control and sewage collection and treatment measures that are in operation, both in the lake and its catchment, since the early 1960s. The uninterrupted monitoring of the lake's basic water- quality parameters (under-water light conditions, chlorophyll and phosphorus concentrations and macrophytes coverage: see Fig.) demonstrate clear trophic changes since past some years that point to *reversal* of eutrophication, with strong impact on biota in both pelagic and littoral zones of the lake. In the subsequent contribution, Jolanta Ejsmont-Karabin gives us a glimpse into the rich Polish traditions in the field of limnological studies in the picturesque Masurian lakes in the north of Poland. Many of us know of the Hydrobiological Station at Mikolajki, the

oldest scientific research station in the Masurian lake region. Andrey Degermendzhy and Egor Zadereev take us to the far-flung saline, meromictic lakes of Khakasia in southern Siberia, Russia. Although frozen for more than half-a-year and showing lack of fish, the saline lakes reveal that production and mineralization processes in the deeper, unmixed layers continue unabated despite the thick ice layer on the top and subzero temperatures below. Although the field studies in this saline lake area have a short history, they provide us with some new information on the functioning of microbial food web and of the stunted microbial food chain. I personally have had the privilege to visit some of these serene and picturesque lakes on several occasions during summers since 1999 to participate in some very fundamental limnological and food web research that is underway at the Lake Shira field lab (Fig.).

Moving to limnology in the developing countries, Brij Gopal reports in nutshell the main bottlenecks facing the progress of limnology in India but generally true for many developing countries. Both scientific shortcomings as well as socio-political factors seem to be retarding progress. Brij gives examples of issues facing the developing countries, most based on his personal experience in India where progress in limnology is slow and stagnating. In addition to the causes that Brij outlines, it appears that there is inadequate realization on the importance of knowledge of limnology in solving the issues relating to water quality and pollution. In the last half a century (since I as a student of fishery biology had my first lesson in limnology in India), the abuse of water has increased, parallel with the increasing population and economic development. The pace of progress in aquatic studies has been only marginal, and if papers published in scientific ecological journals are a yardstick to measure progress of research work, one can see that quality of research work is generally stereotyped and repetitive. Lacking focus and vision, most such manuscripts are rejected by the editors, many before reviewing. Fortunately, the studies in marine and coastal ecology are more promising. The disparities in

the quality and quantity of research between freshwater and marine and coastal water researches can be narrowed by paying more attention to basic research on freshwater resources. In short, the freshwater studies are not getting the attention they deserve from the politicians and scientists. Moreover, with inadequate funding, limnology as a research discipline has had been both overlooked and lagged behind. There is, however, hope that freshwater studies will pick up with the economic development and help improve the environment for human welfare.

In contrast to the above, some other contributions to the present *SILnews*, however, reveal signs of progress. For example, limnology in Turkey has made a brisk advance during the last 15 years (see contribution by Meryem Beklioglu). This is also notable from an increase in research publications and from the progress in both government-funded and university laboratories. As editor of *Aquatic Ecology*, I have noticed that water-pollution related research (e.g. increase of heavy metals concentrations in macrophytes, fish, etc.) seems to set the trend for limnological studies in Turkey. Many of such studies, however, lack a clear vision about the threat the toxic substances pose to food chain and human welfare. Meryem shows that water-quality problems facing the lakes in Turkey are rather similar to those in Europe and a lot can be learnt from strategies of research in Europe. Hopefully, the pressure to publish will prevail also on quality of papers, and writing in a non-native language, English, will steadily improve.

There are contributions in this *SILnews* from Israel, Sri Lanka, Zimbabwe and Mexico, all in the southern hemisphere. They provide information from these relatively less reported regions. The contribution of Moshe Gophen relates to how climatic factors and hydrology cause a negative water balance, leading to water shortages and increase in salinity of water in a major part of the Middle-East. Such international issues demonstrate the need to prioritize fresh-water acquirement over fundamental limnological research studies. Thus, desalination of water to supplement supplies for human needs is a primary need in the area but probably also a means to relieve pressure on the limited freshwater resources. Upali Amarasinghe helps us to get a glimpse of how culture-based reservoir fishery forms an important part of the freshwater studies in Sri Lanka. In Zimbabwe (see in contribution of Chris Magadza), as in Sri Lanka, water impoundment in reservoirs is essential due to seasonal nature of rains. The country faces some serious problems related to water pollution and water-borne diseases. Lastly, the traditions of limnological research in Mexico appear to be rich. I'm impressed with the spurt of announcements of international

conferences in Mexico and South America where later this year at least four international workshops and meetings (see announcements in this *SILnews*, including one on *Shallow Lakes* (announced in *SILnews* 51) are to be held.

These editorial comments are also meant to motivate our readers to contribute to the *SILnews*: information on limnological studies from different geographical areas is welcome. I hope to come back in the following issues of *SILnews* with news about the rapid developments in limnology in some countries (e.g. China). The readers are also encouraged to provide information and ideas to make the *SILnews* more exciting for us all.

Ramesh D. Gulati
(Editor *SILnews*)

Announcement of 31st SIL Congress 15-20 August 2010 Cape Town, South Africa

The 31st Congress of SIL will be held from 15 to 20 August 2010 in Cape Town, also referred to as the Mother City of South Africa. Overlooking the city is Table Mountain from where the views of the city and surrounds are the best. The area is a national park that encompasses the incredibly scenic Table Mountain Chain stretching from Signal Hill in the north to Cape Point in the south and the seas and coastline of the peninsula. The narrow intrusion of land with its beautiful valleys, bays and beaches is surrounded by the waters of the Atlantic Ocean in the west and the warmer waters of False Bay. The Park is recognised for its extraordinarily rich, diverse and unique fauna and flora - with rugged cliffs, steep slopes and sandy flats. It is a truly remarkable natural, scenic, historical, cultural and recreational asset and although debatable, nowhere else in the world does an area of such spectacular beauty and such rich biodiversity exist almost entirely within a metropolitan area.

Some 2 200 species of plants are found on the mountain that has been declared a World Heritage Site, with many members of the famous Proteaceae family. The dassie (rock hyrax) is the most common animal not to forget the porcupines, mongooses and even snakes. Five dams have been built before 1907 to supply the city of Cape Town with water. They have been the subject of several limnological investigations. The world famous Kirstenbosch botanical gardens are situated on the eastern slopes of the mountain, not far from the University of Cape Town and Groot

Schuur hospital where the world's first heart transplant was done by Dr. Chris Barnard. Visits to Kirstenbosch and Table Mountain will be options for the mid-congress excursions during the 31st SIL Congress in 2010.

Diarise the dates and visit <http://sil2010.ufs.ac.za>

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Greetings to Béla Entz: SIL Member for Sixty Years

[Editor's note: I have had two privileged meetings with Dr. Bela Entz in the Netherland several years ago, and was amazed by his profound fluency of some 8 languages, which included Arabic (see Text). Bela spoke to me freely and in fluent Dutch even though he left the Netherlands almost 80 years ago as a child of 9 years. Bela is now 89 years of age and doing well despite a nearly fatal accident not very long ago. I wish him many more years of healthy life (and SIL Membership). His Hungarian professional colleagues and students are really proud of him and hold him in great esteem. —Ramesh Gulati, Editor, *SILNews*]

Béla Entz has been a member of the SIL since 1948. Between 1950 and 1965 he had been the national SIL representative of Hungary. Since 2003 he is an emeritus member of the SIL. A scientist of international fame, Béla Entz, at the age of 89, actively pursues learning and is in love with limnology. Béla's exceptional talent for learning and speaking different languages dates back to his parental home, and has had a tremendous effect on his whole life. His father, Géza Entz was a professor of zoology and director of the Balaton Limnological Institute in Tihany, formerly known as the Hungarian Biological Institute, Tihany. He spent his childhood at the city of Utrecht (The Netherlands) until his homecoming to Hungary in 1929 when he became a resident of Tihany. His fondness for the Lake Balaton turned him into a dedicated investigator and an admirer of the lake. Béla Entz obtained his doctoral degree in natural history and chemistry at the Pázmány Péter University of Sciences in 1942. From 1943 onwards he served the Limnological Institute at Tihany in different positions: he started as a research fellow, and became a senior researcher. He then became acting director and retired as deputy director of the institute in 1983. During this long-lasting limnological career and activities in Hungary, he worked in Africa (in Ghana and Egypt) between 1966

and 1974 as an expert of the FAO (Food and Agriculture Organization of the United Nations). He worked and published a lot in the field of limnology in several languages, which included Dutch, German, French, English, Italian, Latin, Russian and Arabic. His comprehensive study of Lake Nasser was published in 1988 by the ILEC (International

Lake Environmental Committee, Japan). He worked in Ghana as a limnologist at the Volta Reservoir between 1966 and 1969, and as project manager of the FAO-UNDP Lake Nasser Development Centre Programme between 1969 and 1974. He dealt with the divergent limnological problems of Lake Nasser-Nubia (High Dam Lake) in Egypt.

He made a good use of his wide knowledge gained in Egypt, Kenya, Lesotho, Somalia and Italy as the expert of the FAO and UNEP (United Nations Environment Programme). As a grant holder he visited several countries and gave invited lectures at scientific meetings.

In his homeland he primarily investigated the Lake Balaton. He was mainly interested in the physical and chemical features of the lake and its tributaries. He investigated seasonal changes in water temperature, transparency, oxygen saturation and ice-formation. He carried out water and sediment analyses, studied the relationships between water quality and biota, and the ecology of fishes. His Ph.D. thesis was also based on these fields of limnology. He published about one hundred papers in the national and international scientific journals. His long-term limnological observations on

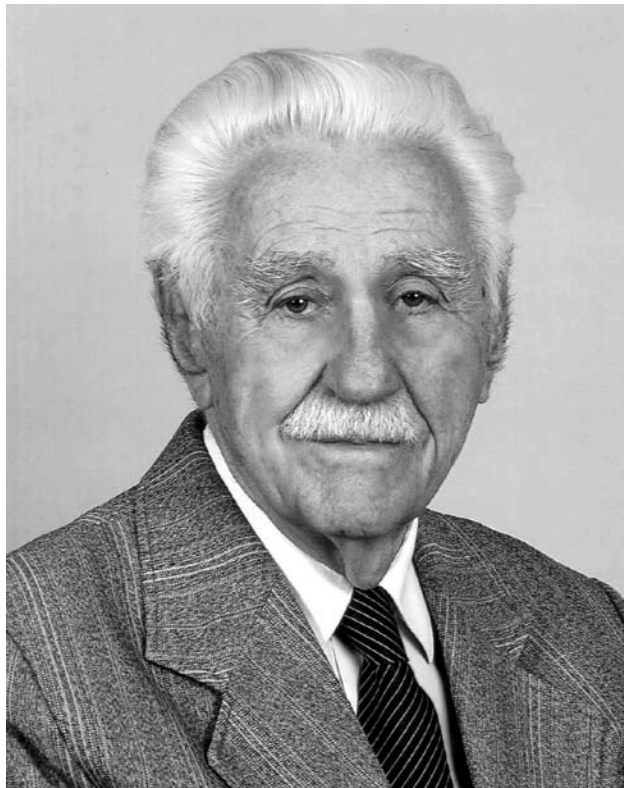
Lake Balaton were published in the book entitled "Changing Balaton".

After retiring in 1983 he still continues studies on the eutrophication of the Lake Balaton and ice formation and related phenomena. Having an enormous experience in tropical limnology, he played an important part in educating experts through his lectures on "Tropical and subtropical limnology and fisheries" at the Agricultural University of Gödöllő. He also gives lectures in hydrobiology and limnology at several universities in Hungary.

He always holds his professional and public audiences spellbound with a fascinating manner of verbal communication. This and his wide knowledge of natural sciences, make him a gifted speaker. He is loved, respected and held in high esteem by his colleagues for his warm nature. Béla Entz has always paid attention to training the younger colleagues to be familiar with the Nature and love it. In 2006, he was conferred a membership of the Hungarian Holy Stephan Academy of Sciences.

During his active life, Béla Entz, handed down the secret of a scientist's love of his profession, a teacher's wisdom and a human being's helpfulness all over the world. We all wish our "Uncle Béla", many more active years and good health so that he can go on with his mission.

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Béla Entz, sixty year SIL member

Lakes: Reports From Laboratories

The Limnological Institute at Konstanz (Germany): Research on and beyond Lake Konstanz

The Limnological Institute at Konstanz was founded by a private initiative in 1946 at Falkau (Black Forest) under the name Hydrobiologische Station für den Schwarzwald or Walter-Schlienz-Institute after the former patron. Hans-Joachim Elster became leader of the institute in 1948. The Volkswagen-Foundation supported the costs of the Stations' new building at Konstanz in 1970 on the shore of Überlinger See, the northwestern basin of Lake Constance. Since 1981, the Limnological Institute belongs to the University of Konstanz, and has a strong collaboration with the University of Freiburg. The Institute

offers teaching facilities, and helps in organizing lectures and seminars at the University of Freiburg. The students from the University at Freiburg attend courses at Konstanz.

Limnology has a strong base in Konstanz, with two full professors (Karl-Otto Rothhaupt, General Limnology; and Bernhard Schink, Microbial Ecology), two associate professors (Rainer Eckmann, Fish Ecology; and Frank Peeters, Environmental Physics), and seven assistant professors [1] covering the fields aquatic botany, bacterial cell-cell interactions, chemical ecology, environmental fluid mechanics, food quality, food web and population ecology, molecular ecology of fish and tropical wetlands. This has enabled us to attract two Collaborative Research Centres (CRCs, in German SFB=Sonderforschungsbereich) supported by the German Science Foundation (DFG). From 1986 to 1997, the project SFB248 "Cycling

of Matter in Lake Constance" investigated nutrient cycling and trophic interactions in the pelagic zone. In 1998, we started the new project SFB454 "Littoral of Lake Constance" [2]. Since 1998, 33 different research groups (presently 14 groups) have focussed on four major aspects of littoral research: microbial communities (macro-invertebrates & macrophytes), microbial communities (algae, cyanobacteria, fungi and bacteria), fish ecology and physical processes (transport, mixing and resuspension). For more details, please see our web link given below.

Research in the littoral zone has proved to be challenging: the littoral habitat is known for its heterogeneity but also for defined zones based on the water level. We had to reschedule our experimental set-ups several times due to unforeseen changes in water level. Both a record

high and record low water level fell within the duration of this SFB; water level reached 5.65 m at the Konstanz gauge in May 1999 (see [5] for impacts on biota), while the level was barely 2.30 m in February 2006. Such strong fluctuations are possible because Lake Constance is a large (total surface area 536 km², upper lake 473 km² surface area, 254 m maximum depth; [3]), not regulated pre-alpine lake. Since the hot summer of 2003, the water level often remained below the average annual fluctuations that range between -2.70 in late winter and -4.00 m in early summer. This decrease exposed large parts of the stony littoral.

In addition, the re-oligotrophication of Lake Constance is a major research topic now, since total phosphorus concentrations at the winter turnover are now <10 µg l⁻¹ versus ~90 µg l⁻¹ in the 1980s. This tremendous change in the trophic state of the lake was brought about by the IGKB (Internationale Gewässerschutzkommission für den Bodensee), an association of the neighbouring states of Lake Constance, founded in 1959, to initiate joint and coordinated measures for the restoration of the lake. Thus, the work of the IGKB has been very successful. In total, more than 4 billion € have since been invested in efficient sewage collection and treatment in inhabited areas surrounding the lake [4]. The ongoing re-oligotrophication has a strong impact on biota in both the pelagic and the littoral zones. Fisheries yields are declining due to reductions in productivity of both phytoplankton and zooplankton ([7]; Straile, unpubl.). Even submerged macrophytes that rely on sediment nutrients show signs of nutrient limitation, and

charophytes and *Najas* species now occupy large parts of the littoral (E. Gross, unpubl.).

A third major topic in our research within SFB454 is the ongoing and apparently accelerated sequence of species invasions in Lake Constance (1965 *Dreissena polymorpha*, 2002 *Dikerogammarus villosus*, 2003 *Corbicula fluminea*, 2006 *Limnomysis benedeni* and 2008 *Crangonyx pseudogracilis*). These organisms strongly affect the macroinvertebrate communities in the littoral zone and are potential prey organisms for fish and waterfowl [8].

Probably in great contrast to the most other limnological centres in Germany associated with more traditional or larger universities, or both, the limnology at Konstanz is rooted in the faculty of biology that is devoted primarily to molecular and biochemical research. This presents us a challenge, to keep ecological research going, but also offers an opportunity, to include new approaches to answer questions, e.g., about the adaptation of certain organisms to environmental changes or the bacterial degradation of allelochemicals [6].

How will the Limnological Institute continue? Although scientists at our institute are involved in a variety of other projects, the SFB is the project that is steering the main lines of research. The current SFB period will expire in mid 2010, and we will have to develop a new concept for a follow-up coordinated research. But before that, we will have to delve into and discuss our major findings on the ecology of littoral zones of lakes at an international workshop at Konstanz in 2009. Please look out for the announcement of this workshop or contact us if you are interested to participate.



Sampling site of macrophytes (*Myriophyllum spicatum* & *Chara* spp.; E. Gross & group) in the littoral zone of Lower Lake Constance near the island Reichenau.

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Elisabeth Gross & Karl-Otto Rothhaupt,
Konstanz, Germany

Hydrobiological Station at Mikołajki, Poland – A Research Site in the Centre of Masurian Lakeland

Hydrobiological Station at Mikołajki is the largest and the oldest scientific station in the Masurian lake region. It was founded in 1951, primarily as a part of the Institute of Experimental Biology. Later, it was incorporated into the Institute of Ecology, the Polish Academy of Sciences. The station has been a part of the Centre for Ecological Research PAS since 2002. From its very beginning, the Station has served as an important site for limnological research in its broad sense. The studies carried out here so far have mainly focused on lake eutrophication and nutrient cycling, ecology of aquatic macrophytes and land impact on lakes. Moreover, numerous guests, both Polish and foreign, visiting the Station perform their own research. Such studies have contributed to the overall scientific production of the Station. This has resulted in more than 830 research publications and award of 50 Ph.D. theses. Recently, a reorganisation of the Hydrobiological Station has resulted in the formation of a consortium of several scientific institutions, all of which can use the available research facilities.

Hydrobiological Station is situated on the western shore of Lake Mikołajski, which is one of the chain of the Great Masurian Lakes (GML). The chain consists of 30 lakes forming a navigable lake system. Lake Mikołajski and other lakes of the system are the primary objects of interests for the Station users though

studies are also performed on other lakes, some of which are very picturesque and dystrophic and form an essential part of the watersheds of the Masurian Lakeland. The Masurian Lakes have been the object of extensive limnological research for many decades. Papers based on data from the GML system cover a wide range of hydrobiological topics including physical and chemical characteristics of lake water, plankton, macrophyte and fish ecology, etc. The vast amount of data from the past serves as a reference for the studies in progress at the Station. The Station provides accommodation and laboratory facilities, road and water transport services, technical and field assistance and so on. Accommodation and other facilities are available to Polish and foreign research workers on a nominal charge of 10-15 Euro per head per 24 hour period. Numerous national and international conferences as well as student courses are also held at the Station. The Station offers facilities for both oral and poster presentations, and small "fireplace room" on site for evening discussions and social get-togethers.

The station's users are now involved in scientific projects focused on: factors determining biodiversity in small- and large-scale habitats changing in time and space and role of the pelagic and benthic micro-invertebrates in microbial loop as well as the structure and functioning of psammon communities of Rotifera, Ciliata and Crustacea.

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Salt Lakes Studies Open New Perspective for Limnologists

Although salt lakes are widely distributed and sometimes unique in their species composition and ecosystem functioning, the attention of limnologists has been focused more on fresh water habitats. Marine scientists consider salt lakes as inland water bodies, but fresh water researchers do not include them into their research agenda, due to certain specific characteristics of salt lakes. This approach is, however, now changing and studies on such lakes are starting to pick up. Researchers of marine ecosystems believe that salt lakes are easier to manage than large marine objects, while inland waters can use lakes varying in salinity as natural ecological and evolutionary laboratories. Thus, salt lakes can be the object of studies for both marine and freshwater scientists alike.

Scientific field station at the shore of Shira Lake (http://www.ibp.ru/field_station/) near the town of Shira (Republic of Khakasia) in the central part of the Altai-Sayan Mountain in southern Siberia (Russia) is one such place where the comprehensive scientific studies of

salt lakes are in progress. There are some 500 lakes exceeding 0.01km² in Khakasia (about 390 of them are fresh and the rest saline). The Institute of Biophysics Siberian Branch of the Russian Academy of Science (Krasnoyarsk, Russia) initiated the scientific investigation of salt lakes in the region in 1994, when also the Field Station at Shira Lake was launched. The lake which is located some 360 km south of Krasnoyarsk is brackish and meromictic (salinity 12 g l⁻¹; maximum depth 24 m); it is permanently divided into oxic and anoxic zones by the chemocline, which is located at the depth of 12-16 m, depending on the year and season. During summer, there are pronounced vertical gradients in light, temperature and concentrations of salinity and dissolved oxygen in the pelagic zone (Degermendzhy & Gulati, 2002). The lake is also characterized by a deep-water algal maximum below the thermocline in summer (Gaevsky et al., 2002) and by a dense population of chemocline bacteria (Pimenov et al., 2003). The pelagic zooplankton community of Shira Lake mostly consists of only three zooplankton species, including a calanoid copepod *Arctodiaptomus salinus* and two species of Rotifera, *Brachionus plicatilis* and *Hexarthra oxitura*, which have stratified distribution (Zadereev & Tolomeev, 2007). An important characteristic of Shira Lake is the absence of ichthyofauna and carnivorous zooplankton. Amphipod *Gammarus lacustris* occupies both littoral and pelagic parts (Tolomeev, Zadereev & Degermendzhy, 2006) and probably serves as top organism in the lake's stunted food chain.

In addition to Lake Shira, there are about 50 lakes of various sizes, which range from freshwater to hypersaline (salinity > 100 g l⁻¹). They are all located within 50 km from the field station, and can be considered as a "natural laboratory" for studying a number of basic problems dealing with species biodiversity and general aquatic ecosystem functioning. For example meromictic Shunet lake (20 g l⁻¹ salinity in mixolimnion, 60 g l⁻¹ salinity in monimolimnion, 6 m maximum depth) has the concentration of chemocline bacteria comparable with Mahoney lake (Canada) which is considered to have maximal concentration of bacteria in chemocline (Lunina et al., 2007).

Research at the field station at Shira Lake has a relatively short history. It is being supported by numerous grants from various Russian and international scientific foundations. The laboratory has produced some 45 papers in peer-reviewed journals in last 5 years. The support and impetus to research now in progress was provided by international cooperation with Centre for Limnology, The Netherlands Institute of Ecology, Nieuwersluis; the



Hydrobiological Station at Mikołajki, Poland

Limnological Station of the Institute of Plant Biology, University of Zurich, Switzerland; and Universidad Autónoma de Madrid, Spain. Shira Lake was the venue of the 8th International Conference on Salt Lake Research (July 2002), which was attended by >100 scientists from all over the world. Currently, an international research project “*New integrative model of lake ecosystem functioning: stability and controllability analysis*” is being carried out in cooperation with the Centre for Limnology (Netherlands). This project is jointly supported by the Russian Foundation for Basic Research and the Netherlands Organization for Scientific Research NWO Project No. 2004 0.47.011.2004.030.). The aim of the project is to couple hydrophysical models developed for stratified lakes by Russian scientists with biological food chain models developed by Dutch scientists and introduce new concepts and ideas (such as infochemical feedbacks, stoichiometric constrains, spatial separation and vertical migrations of hydrobionts) into coupled models.

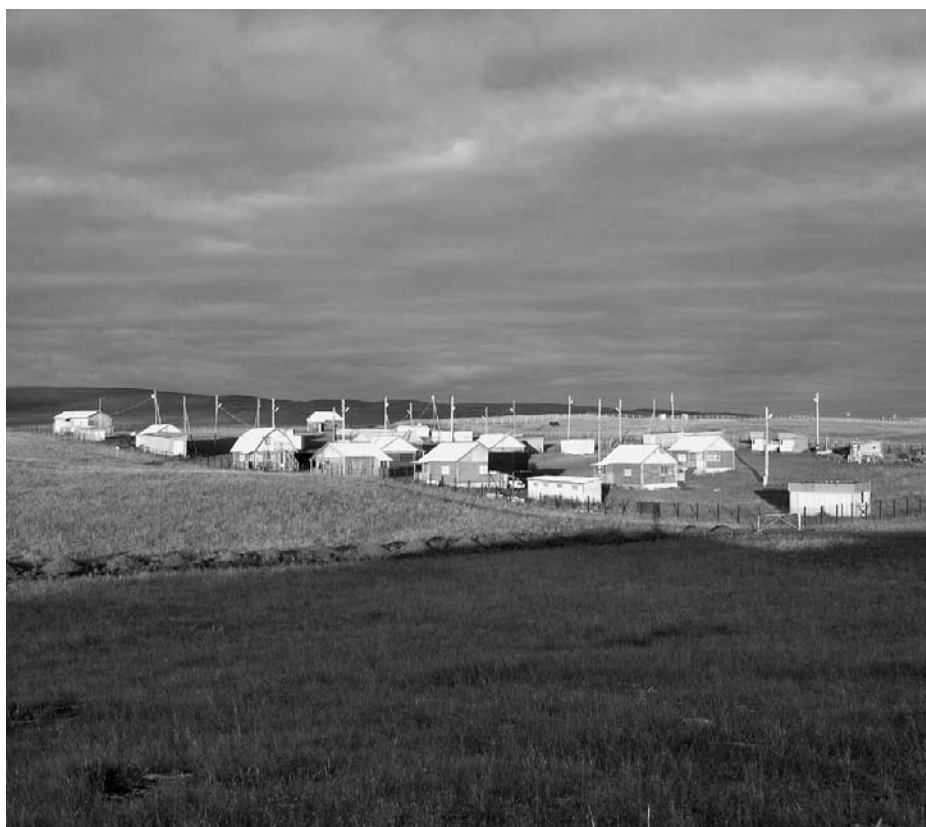
We the Siberian Limnologists look forward to receiving feed-backs for research and scientific ideas from the readers of the *SILnews*. You are welcome to visit the salt lakes of Shira (Khakassia) and to contribute to their scientific exploration.

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Research scientist Denis Rogozin is drilling an ice-hole for winter sampling at Shira lake. (This photo was the winner of *SIL2007* photo contest in “Sampling” nomination).

A view of the Shira Field Station on the shore of Lake Shira at the sunrise.

Regional Limnology

Limnology in Developing Countries

The world seems to be unanimous in acknowledging that water is rapidly becoming the most critical factor in economic development, and that water scarcity is increasing due to rapid expansion of human population and its water requirement for agricultural, urban and industrial growth. This is reflected in the United Nations declaring 2003 as *International Year of Freshwater*, followed by the *International Decade for Action: Water for Life (2005-2015)*. The Human Development Report (2006) focuses on global water crisis. One would expect that limnology will play a central role in finding a solution to this 'global crisis' because it is the only science that seeks to integrate different water-related disciplines and takes a holistic view of inland waters as ecosystems. Moreover, limnology looks at inland water bodies beyond their shoreline to understand the interactions with their watershed, including those at the air-water interface. Unfortunately, this is not happening.

Several limnologists (Brezonik 1996, Moss 1999) have raised their concern and analysed the factors affecting the growth of limnology. In Europe, as a corrective measure, a new limnology education program has been launched only this year, to meet the anticipated demand for trained limnologists (www.quali-limn.org).

Here, I present a developing-country perspective, based largely upon my personal assessment of the Indian situation, which I believe to be generally true for most countries in Asia and Africa.

First, I examine how the developing countries differ from the developed ones in their water

resources? And then, why is limnology not gaining ground in the developing world? The international community classifies the nations into 'developed', 'developing' and 'least developed' primarily on the basis of their GDP and per capita income in US \$, and their status is reviewed periodically. The latest grouping also recognizes 'newly industrializing countries (NIC)', which include countries intermediate between the developed and developing. Such a classification does not take into account the differences in their water resources. Most developing countries lie in the tropical and subtropical belt, but they differ greatly in the wealth of their natural resources, particularly the water resources. Some tropical countries receive very high rainfall but most of them are arid to semi-arid. A significant proportion of the landmass of many developing countries is covered with high mountains. Several large rivers such as the Nile, Ganga, Brahmaputra, Yangtse and the Mekong, flow through these countries. Numerous large lakes are concentrated in Central Asia and Eastern Africa. The precipitation in these countries exhibits strong seasonality and spatial and temporal variability. In India, the annual rainfall ranges from over 500 cm in the east to less than 10 cm in some areas in the west. Although the steep slopes of Cherapunji in northeast India receive the world's highest mean annual rainfall, the area has insufficient water due to a rapid runoff. The Central Highland of Sri Lanka and Western Ghats in India obstruct the monsoon so that the areas lying on their eastern side remain semi-arid despite very high rainfall on the western side. It must also be recognized that the vast majority of inland water bodies in the develop-

ing countries are rather small (<1 to 10 ha), shallow and seasonal. Further, innumerable man-made water bodies of varying dimensions are a prominent feature of the landscape throughout the arid and semi-arid regions. Many of these waters are saline. For centuries, and even millennia, the developing countries managed these variable water resources successfully without the dragon of pollution threatening the

humans. During the past 5-6 decades, increasing emphasis on storage and diversion of water to meet the growing needs of agriculture and hydropower, and flood control measures have rapidly degraded the water resources. Consequently, the inland water ecosystems cannot anymore deliver the goods and services on which the economic development depends. Disposal of untreated wastewaters, catchment degradation and widespread infestation with invasive species, such as water hyacinth, have accelerated the process of degradation (Fig. 1). One could argue that in the pre-industrialization phase, the widespread epidemics of water-borne and vector-borne diseases were responsible for keeping the human populations under control. However, the *Millennium Development Goals* and the declaration of 2008 as the *International Year of Sanitation* provide ample evidence of increasing water pollution and water scarcity.

Now I turn to 'why is limnology not gaining ground in the developing countries?' The present state of limnology has been documented for some countries in the SIL series "Limnology in Developing Countries". Whatever little is done in these countries is generally not published in the mainstream journals because the researchers have difficulties with language and poor communication abilities (see also Williams 1994). It is difficult to analyse the factors at a time when limnology is losing ground (or not able to progress) in Europe and North America because of the lack of adequate public funding, and the discussion revolves around basic limnology *versus* applied limnology. The economic reasons are more than obvious for the developing countries: there is insufficient funding for infrastructure (laboratory equipment, field facilities, scientific literature) and there are few opportunities for interaction and exchange. Assistance from developed countries and international agencies is certainly required but any amount of external support will be inadequate because of the vast diversity of the inland water resources and the huge population in developing countries.

I would argue, however, that funding may not be a constraint if there are compelling circumstances and convincing demonstration of the ability of limnological research to provide solutions to the problems of water resources. Even though it is true that the developing countries cannot afford the luxury of doing 'curiosity-driven' basic research to discover new paradigms, it is rarely recognized that the solution to problems of ecosystem degradation requires an understanding of the structural attributes, processes and



Figure 1. Infestation of water hyacinth in Lake Phewa in Pokhara valley (Nepal). Note also the change in land use/land cover of the surrounding hilly catchment.

functioning of these systems. The inland water bodies are often treated as storages or conduits of water, not as ecosystems.

Almost all limnology-related research has been influenced by national policies that accord lowest priority to ecology and environment. For example, in India the studies on primary production, energetics, food chain transfer and nutrient dynamics initiated during the International Biological Programme in the 1960s were abandoned mid 1970s. At this point, the central Government shifted its priorities to improve water quality and prevent water pollution. Access to sophisticated instruments has allowed analyses of heavy metal and organic pollutant concentrations in water, sediments and organisms. Recent interest in biodiversity has seen a shift towards identifying and enumerating the organisms. There is, however, a lack of taxonomic expertise and the organisms are rarely identified to the species level. Most research in the universities is based on Ph.D.-oriented short-term studies that focus on the status of water bodies rather than on the cause-effect relationships. Limnological research, as in other areas of ecology, has become highly fragmented and compartmentalized. The holistic ecosystem perspective of a water body that requires interdisciplinary long-term studies is rarely pursued, and the watershed and river-basin scale interactions are ignored.

Certain conceptual barriers seem to generally prevent researchers in developing countries from asking searching questions and seeking coherent answers to them. The water resource managers commonly ask, 'how much water is required for particular organisms or for maintaining the ecological functions of the downstream river to an acceptable level?' This aspect, unfortunately, remains uninvestigated in most developing countries (see Shang 2008, for a recent study in China). Instead, there is a tendency to refer to studies in South Africa, USA or Australia, regardless of their applicability. Similarly, phosphorus continues to be accepted as the causative factor for eutrophication, without paying attention to the relative importance of N versus P in tropical waters (see Talling and Lemoalle 1998). If the ideas and solutions based upon research in temperate, hydrologically distinct waters can be applied to the situation in developing country, why should the governments allocate resources or why should we spend time and effort in rediscovering the wheel? Hence, although developing countries continue to seek expertise and funds from developed countries, the problems remain unresolved.

Limnology has received another blow from conservation enthusiasts. In their well-meaning efforts to conserve/protect waterfowl, fish

and biodiversity in all aquatic habitats, the conservationists under the banner of Ramsar Convention have promoted the term *wetlands* to encompass a variety of aquatic ecosystems: streams, rivers, reservoirs, lakes, mangroves, coastal waters and coral reefs (see Boulton and Brock 1999). An appreciation for the distinction between the 'ecological character' of inland water systems for the required management measures seems to be lacking.

Finally, the policy makers in developing countries need to realise that water security cannot be ensured without ensuring the ecological integrity of rivers and lakes and their associated wetlands, that in turn depend upon their specific habitats, hydrology, biota and the watersheds within which they are imbedded.

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Bringing Limnology to the Lakes in Turkey

Turkey is a huge country stretching across 36° - 42° N and 26°-45° E with a great annual variation in precipitation regime from 250 to >2250 mm. This creates a great variety in biomes of aquatic waters: alpine freshwaters, coastal lagoons, and inland fresh and saline waterbodies together covering 10,000 km² of water area. Unfortunately, investigations on the inland waters of Turkey are mostly restricted in their focuses on documenting the flora and fauna. There is a general lack in understanding of the ecology of freshwaters and ecosystem perspective¹.

Over a decade ago, on my return to Turkey from the United Kingdom after receiving my doctoral degree in 1995 I felt to fulfill my urge to promote studies focusing on the ecology of lakes. I especially intended to work on shallow lakes, about which literally little was known and for which the macrophytes were regarded as unwanted weeds. With such a goal in my mind and heart, I started virtually from a scratch to establish a limnology laboratory. I was the first limnologist employed at the Department of Biology, Middle East Technical University (METU) in Ankara. My vision of shallow lake ecology was strongly in support of a top-down control of ecosystem functioning in freshwater lakes. However, this concept was not yet developed in Turkey. As the results of the research I carried out presented the efficiency of biomanipulation^{2,3}. However, over the course of time I have come to realise the indispensable role of hydrology in shaping the ecology of Turkish lakes. This is also true for lakes in the Mediterranean region because of the strong control of the semi-dry Mediterranean climatic system with alternating dry and wet periods predominating in the region^{5,6}. Now, my vision of the ecology of Turkish lakes has matured and in the mean time the Limnology Laboratory at METU (www.limnology.metu.edu.tr) has grown (Photo) and become an inspiring environment carrying out research mostly on the ecology of shallow lakes including the interactions between the biota (or food-web) and hydrology, together with nutrient dynamics in the present as well as in the past using paleoecology. Lately, limnology lab has been leading a snap-shot survey with space-for-time substitution approach aiming to understand the eutrophication in a gradient of shallow lakes funded nationally by Turkish Scientific and Technological Research Organization (TUBİTAK). Preliminary results have already shown that ecology of our shallow lakes holds an intermediate position between north temperate and subtropical ones. Turkey's close economic and cultural access to the EU countries has improved the funding, which has never been so generous as now. There is now a great opportunity ahead for the Turkish limnologists to explore and unravel the ecology of inland lakes, especially in the face of climatic warming. I have already helped to form a consortium project comprising twelve universities and a research institute to investigate impact of climate- hydrology and eutrophication on structure, function and biodiversity of Turkish streams and lakes; this is based on the space-time substitution approach using contemporary and long-term interactions from sediment records. The emphasis of research is on integration of basic (food-web structure and function) and applied sciences (modeling, indicator species).

This should allow developing a comprehensive approach to complex and sometimes non-linear dynamics of aquatic ecosystem to the drivers (hydrology, nutrients). To stimulate scientific competitiveness and to secure close contact with the best research groups outside Turkey, we now have two eminent scientists included as advisors to the project (Professor Erik Jeppesen, Denmark, and Professor David Hamilton, New Zealand). I have already had a close collaboration with Professor Jeppesen, who has been the co-supervisor of several post-graduate students.

Furthermore, the ecology of *Daphnia* has been a fascinating aspect of my research interests at the Limnology Laboratory. Here we perform

research on the chemical communication for predator avoidance of *Daphnia* and the toxicities of salinity and pesticides⁶. Data are also being modelled by life-history and population dynamics of *Daphnia* by Dr. Karsten Rinke from the Limnological Institute, University of Konstanz, Germany, and Dr. Can Ozan Tan from the Department of Physical Medicine and Rehabilitation, Harvard Medical School, USA.

Anticipated effects of the global climate change on aquatic ecosystems in semi-dry Turkey are gloomy. Let's, however, hope that we can be better armed with comprehensive scientific knowledge to mitigate some of these adverse effects.

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Regional Water Planning in the Middle-East: Limnological, Political and Economic Perspectives

The climate conditions in Israeli vary from desert in the south, mild Mediterranean climate in the center and subtropical climate in the north. More than 95% of natural water resources in Israel are being utilized. Rain distribution over Israel (total $7.9 \times 10^9 \text{ m}^3/\text{y}$ = billion cubic meters per year, (bcm/y) varies between 1300 mm/y in the north and <100 mm/y in the southern desert; losses include 70% evapotranspiration, 5% - runoff and 25% infiltration. Total national water supply is 2.11 bcm/y, of which 0.55 comes from the Kinneret-Jordan System and 0.2 from the desalination. Thirty per cent (0.633 bcm/y) of supplied waters is suitable for drinking and domestic consumption. The only available options to enhance fresh-water supplies are sea water desalination and recycling. Lake Kinneret is used as a source of drinking water, domestic, agriculture, industry and aquifer recharging use through the National Water Carrier (NWC) that has been in operation since July 1964. During the last 43 years, the NWC has drawn totally 13 bcm of water from the lake. Due to water-level restrictions, total amount of about 4 bcm of water was released through the south dam to the Dead Sea. Lake-water salinity has been fluctuating between 300 and 330 (ppm chloride) before 1960, 400 during early 1960's, then decreased to 200 ppm in early 1980's, and increased to 280-300 ppm in 2002. Lake Kinneret has become the major supplier of salts to the Israeli soils and aquifers. About 8 million tons of dissolved major ions (Cl, CO₃, Na, Mg, K, Ca, SO₄) deposited onto the soils led to deterioration. The present projects for desalination of Mediterranean waters of 0.5 bcm/y by 2010 include the installation of moderate plants (0.08 -0.150 bcm/y) along the coastal plain.

The hydrological management of the Kinneret-River Jordan system as constrained by the "NWC Management"(NWCMM) is a close-dam strategy, i.e. maximum lake storage by close dam operation. If "Open Dam Management" (ODM) is applied, nutrient-rich water is transported across the lake during winter and



Photo: Limnology Laboratory members (Note: Meryem Beklioglu, 4th from the left, flanked by the staff and students and the ratio 6♀:3♂. Editor SILnews)

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Fig. A view of Lake Eymir. The lake is located 20 km south of Ankara (39°, 57' N, 32° 53' E and altitude, 900 m; area, 1.25 km²; Z_{max} 5.5 m; Z_{mean} 3.1 m; shoreline, 13 km; and catchment area, 971 km²). The lake had been receiving raw sewage effluent for 20 ears and became eutrophic. The restoration measures of the lake involved diversion of the sewage effluents and lake's biomanipulation. Consequently, the clear water was obtained but for a short period, mainly due to a prolonged drought, increase in cyanobacteria blooms and salinity. Limnology laboratory has been monitoring Lake Eymir since 1997.

out-fluxed through the south dam. NWCM operation is resulting nutrient loads increase and the constant pumping from the upper layers accelerates their accumulation. During winter the demand for water is less than in summer, and less water is pumped out (0.023 bcm/month and 0.032 bcm/month, respectively). The ODM will cause an increase of 50-86% of nutrients removal from the lake.

The Dead Sea Destruction

Exploitation of the Dead Sea water for fertilizer production by evaporation, the Kinneret Close Dam policy and consumption of fresh water resources in southern Jordan (between the Dead Sea and Lake Kinneret) resulted in water level decline from 1930 of about 31 m, surface area shrinkage by 310 km² and water volume reduction by about 131 km³. Risky "Sinkhole" formation around the Dead Sea has occurred. The deteriorating ecology, water resources, regional politics, drinking water shortages as well as industrial development and cultural aspects of Israel, Jordan and Palestine, have created a situation that urgently requires international cooperation to develop collaborative projects.

Three projects are outlined:

- 1) The "Northern Project": transport of desalinated Mediterranean waters through the Israeli National Water Carrier and Lake Kinneret to be supplied via the Jordan river to Jordanians and Palestinians. This project together with other sources will meet the Israeli demand for drinking water. The south dam of Lake Kinneret will be mostly open to discharge winter floods through the Jordan River to the Dead Sea. It will enhance nutrients removal from Lake Kinneret, revive the southern Jordan River and increases water supply to the Dead Sea (ca. 0.4 bcm/y) to slow down water level decline. Lake Kinneret waters are naturally recognized by the Dead Sea ecosystem and the development of fine particles of gypsum suspensoids is not predicted. The salts removed from desalinated waters will be discharged to the Mediterranean ocean.
- 2) This Project includes the Red Sea – Dead Sea Canal (RSDSC) for transporting of about 2 bcm/y of Red Sea waters through the eastern part of the Jordanian-Israeli desert (Arava Valley) to the Dead Sea region. Part of the water will be used for energy production, for the desalination process and for tourism development. The 2 bcm/y of Red Sea water will be pumped (60 m³/second) to 125m altitude and then flow by gravity through an open canal and a tunnel to 107m altitude, close to the Dead

Sea Valley and then flow down through turbines for electricity generation to 365m below sea level. The water will be desalinated by reverse osmosis and pumped to Jordan (0.570 bcm/y) and Palestine (0.270 bcm/y). The excess of Red Sea water (app. 1.06 bcm/y), and the wastes will be dumped into the Dead Sea. These wastes are an unknown component to the Dead Sea ecosystem and might cause geochemical deteriorations such as gypsum suspensoids produced by the Red Sea sulfates and the Dead Sea calcium, and might damage tourists enterprises due to predicted microbial blooms resulting from the thermal structure changes.

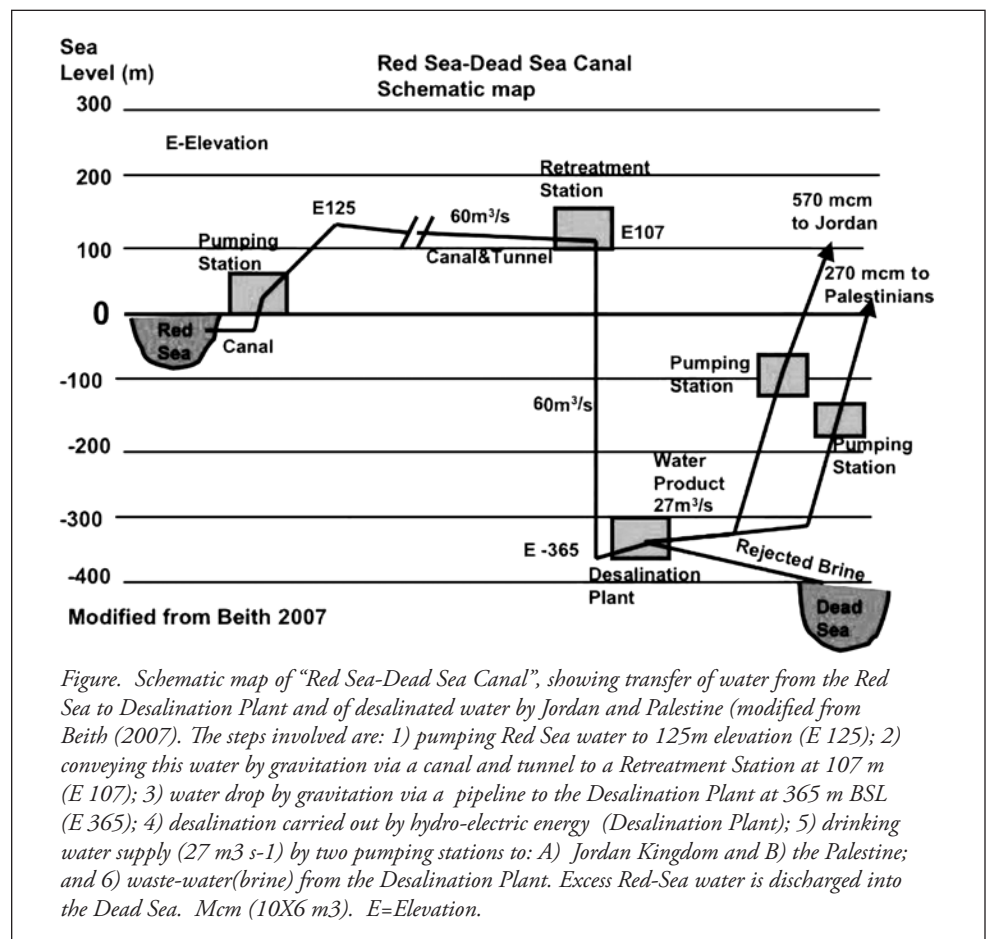
- 3) Mediterranean – Dead Sea Canal: this project includes a gravitational transport of 2 bcm/y Mediterranean waters through the shortest route in northern Israel via Naharaim site, located about 20 km south of Kinneret. Desalinated water (0.8 bcm/y) will be pumped to Jordan. The salts and extra 1.2 bcm/y Mediterranean waters will be transported through a pipe to the Dead Sea. Mediterranean salts contain high concentration of sulphate, and production of gypsum suspensoids is predicted after its mixing with the Dead Sea water and its calcium.

Concluding Remarks

- 1) The Northern project combined with the National Water Carrier will enable integration with Lake Kinneret without negative impact on the lake's water quality because a decline of nutrient loads is predicted.
- 2) The RSDSC is the most expensive alternative and environmental damage to the desert is predicted although no political problems are expected.
- 3) The mixing of Red Sea with Dead Sea waters might have negative impacts on tourism and fertilizer production by Israel and Jordan industries as well as precipitation of gypsum accompanied by change of the biological environment of the upper water mass.
- 4) The Naharaim gravitational project was found to be the most economical but formation of the gypsum suspensoids is predicted in the Dead Sea.
- 5) The Northern and Naharaim projects might cause political difficulties as both are entirely located in Israeli territory.

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Culture-based Fisheries in Village Reservoirs of Sri Lanka

Introduction

In Sri Lanka, the total area of reservoirs is about 175,000 ha (Fernando 1993), which is about 2.7 ha km⁻² of the island; in other words, about 2.7 % of country's area is covered by reservoirs. Among these reservoirs, there are over 12,000 small reservoirs, most of which are concentrated in the dry zone of the country. These village reservoirs cover about 39,300 ha (Mendis1977). Most of them are non-perennial and fill up during the inter-monsoon period from December to January (Fig. 2). Attempts to utilize these seasonal reservoirs for the development of culture-based fisheries were started in 1960 (Indrasena 1965). This involves releasing farm-produced seed fish and recapturing them upon their reaching a desirable size (Indrasena 1965).

Due to high potential yields, the culture-based fisheries in seasonal reservoirs will provide a means of increasing food supply in the rural areas of Sri Lanka. Under a project funded by FAO in 1979-1980, the culture-based, fisheries development trials were carried out by stocking of fingerlings of common carp, and Chinese and Indian major carps of 5-8 cm size. The mean fish yield in some 15 such reservoirs was estimated at 892 kg ha⁻¹ per growing season (Chandrasoma and Kumarasiri 1986). The culture-based fisheries in village reservoirs of Sri Lanka have little impact on the environment because they are dependant on the existing water bodies and do not involve supplemen-

tary feeding. Also, because the water bodies completely dry-up during some months of the year, the seasonal reservoirs do not harbour rich indigenous fish communities. Hence, from the point of view of biodiversity, conservation and environmental protection, the culture-based fisheries in seasonal reservoirs can be considered as a relatively eco-friendly development strategy.

Regulatory process

The aquaculture committees are responsible for the management of culture-based fisheries. Members of the aquaculture committee are actively involved in these labour-intensive activities. A proportion of the profit from the culture-based fisheries is utilized for reservoir improvement..

Species cultured

As the culture period in seasonal reservoirs is 7-9 months, the species suitable for stocking in seasonal reservoirs should reach the marketable size in 6-8 months. In the indigenous fish fauna of Sri Lanka, such species are not available. Exotic tilapias are not desirable because they tend to mature early in life (small size) in small water bodies. As such, culture-based fisheries in seasonal reservoirs exclusively rely on the common carp, and the Chinese and Indian major carps. A stocking density of between 2000 and 2500 fingerlings ha⁻¹ is the suitable, with approximately equal proportions of *Aristichthys nobilis*, *Labeo rohita*, *Catla catla* and *Cyprinus carpio*. *Ctenopharyngodon idella* and *Cirrhinus mrigala* are the other species used. Under the fisheries development plan of Sri Lanka, it is envisaged to utilize 10,000 ha of the village reservoirs annually to develop culture-based fisheries.

Conditions for success of the culture-based fisheries in Sri Lanka

A stocking density of 2000 fingerlings ha⁻¹ has been suggested for achieving an average yield of 750 – 1000 kg ha⁻¹ (Chandrasoma and Kumarasiri 1986). For this objective, fingerling availability, selection of suitable seasonal reservoirs and post-stocking management are essential. Because the fingerlings are not available in sufficient quantities,

a wise use of the available seed stock is made by selecting reservoirs that are suitable for developing and sustaining culture-based fisheries. A study indicates that in Sri Lanka, it is possible to introduce a strategy for rearing of fish fry up to fingerling size in net cages and earthen ponds. Correct timing of production of fingerlings is also necessary for successful implementation of culture-based fisheries in seasonal reservoirs (Fig. 1). Because such fishery activities are community dependent, the final yield from individual reservoirs will not only depend on biological criteria but also on socio-economic factors, including the degree of participation and cooperation within the community, for marketing the produce, etc.

Current research on culture-based fisheries in Sri Lanka

In view of the large number of seasonal reservoirs in Sri Lanka, the reservoirs need a suitability ranking for the development of culture-based fisheries. For such a ranking system or scale, physico-chemical, biological, catchment and hydrological characteristics of the water bodies, as well as socio-economic aspects, need to be considered. De Silva et al. (2005) attempted to develop a ranking system to determine the suitability of 14 non-perennial reservoirs in southern Sri Lanka. They did so using Geographical Information Systems and Analytic Hierarchy Process. The quality weightings indicated that none of the reservoirs included for the ranking could be considered as "poor"; six reservoirs were considered as "fair" seven as "good" and one as "excellent."

Furthermore, Carlson's trophic state indices (TSI) measured on the basis of Secchi-disc depth [TSI (SDD)], TP [TSI (TP)] and chlorophyll a [TSI (Chl-a)] show that the 45 reservoirs studied are characterized by TSI (TP) = TSI (SDD) > TSI (Chl-a), indicating that non-algal particulate matter and colour dominate underwater light attenuation. As TSI (Chl-a) is positively correlated to culture-based fisheries yield, it is useful for planning culture-based fisheries development strategies in non-perennial reservoirs of Sri Lanka (Jayasinghe et al. 2005).

MONTHS																	
M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O
INDUCED BREEDING OF MAJOR CARPS		FRY REARING		FINGERLING REARING			STOCKING IN RESERVOIS			CULTURE PERIOD						HARVESTING	

Figure 1. Correct timing of culture-based fisheries in seasonal reservoirs of Sri Lanka. Rainy season is shaded.

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Limnology News from Zimbabwe

Zimbabwe has a highly seasonal rainfall, now tending to be concentrated in few weeks between December and February. The country has many seasonal rivers...very few that are perennial. With no natural lakes, Zimbabwe has well over five thousand impoundments ranging from small farm dams of a few hundred cubic metres to Lake Kariba (5600 km²), shared by Zambia and Zimbabwe on the Zambezi River.

Limnology in Zimbabwe has had a chequered history. The creation of the first large reser-

voir in Zimbabwe, Lake Chivero (formerly L McIlwaine) on the Manyame (formerly Hunyani) near Harare in 1952, triggered water-quality concerns as the reservoir became hyper-eutrophic within ten years of its impoundment. The lake has a mostly rural and agricultural catchment of some 2136 km², of which nearly 200 km² is urban with a total population about four million. The problems of eutrophication arose when elsewhere in the world, especially for the North American Great lakes, concepts of the linkage between eutrophication and human activity were developing in the 1960s.

Studies on the relationships between wastewater disposal and eutrophication firmly established the impact on the state of the lake of discharge of nutrient-rich sewage effluents from trickle filter sewage treatment works (Robarts 1979, Thornton, 1982). These studies led to the construction of the first Biological Nutrient Removal Sewage Plant in Africa in the mid 1970s, which led to a rapid recovery of the lake from a hypereutrophic state in the mid 1960s to a mesotrophic lake by the early 1980s (Thornton 1982, Magadza 1993). However, since then there has been a steady deterioration in the management of the reservoir. Both the population doubling in 12.5 years in the lake's urban catchment area and poor or no maintenance of the wastewater treatment works, have resulted in Lake Chivero being among the most polluted lakes in the world (Magadza 2003). This change had led to an increase in the health risks to the cities of Harare, Chitungwiza and Norton, for which the lake is a

source of water supply. The lake phytoplankton is dominated by Cyanobacteria (*Microcystis* sp), with an increase in the concentration of soluble-reactive phosphorus from <0.2 mg P l⁻¹ to > 2 mg P l⁻¹. Microcystin concentration varied around a mean of 20 µg l⁻¹ (Magadza 2003, Ndebele and Magadza 2006).

The main problem is that most major cities in Zimbabwe are located along a ridge of high ground that traverses the country. Thus, the processed wastewaters and diffuse sources of pollution, which for the city of Harare, amount to several hundreds tonnes of phosphorus and over a thousand tonnes of nitrogen, drain back into the water supply reservoirs. The situation in Harare has now led to incidences of chronic enteric diseases as well as there are reports of rising cases of liver cancer (Ndebele and Magadza 2006)

Lake Kariba is still the largest man-made lake by water volume (189 km³), with its area of 5600 km², mean depth of 29 m and total length of 287 km (Balon and Coche 1974). However, there are some interesting new findings related to the evolution of the lake's ecosystem. The conductivity of Zambezi floodwaters varies between 40µS cm⁻¹ and 50 µS cm⁻¹, but may rise to as much as 100 µS cm⁻¹ during extreme low flow (Balon and Coche 1974). Earlier, the conductivity of lake water ranged between 40 µS cm⁻¹ at the upstream end and about 80 µS cm⁻¹ at the dam site. Such an increase is attributed to evaporative increase of salt concentrations attributed to the global warming. Further, the

		Metalimnion upper depth	Metalimnion lower depth	Metalimnion median depth	Metalimnion thickness	Metalimnion Gradient (°C m ⁻¹)
1965-68	Mean	17.50	25.00	21.25	7.50	0.53
	S.D.	4.18	3.16	3.45	2.74	0.20
1987-92	Mean	11.25	17.92	14.58	6.67	0.32
	S.D.	4.83	6.89	5.52	4.44	0.13
Difference		6.25	7.08	6.67	0.83	0.21
T-test		0.01	0.00	0.00	0.32	0.03
One factor ANOVA, F		7.27	5.6	7.2	0.17	7.18
One factor ANOVA, p		0.016	0.031	0.016	0.681	0.016

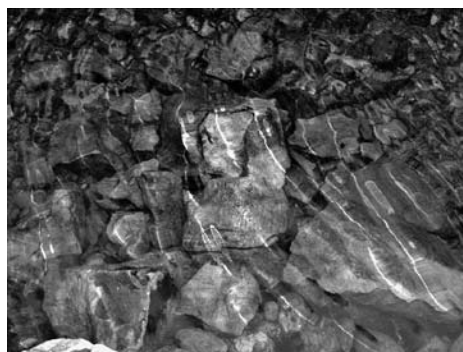


Figure 1 Clear waters of a montane stream, Chimanimani



Figure 2 Algal scum on L. Chivero

thermocline, reported in the mid 1960s to be situated at about 20m depth, has ascended by some 6.6 m. Over all, the mean lake temperature has risen by close to 2°C (Table 1).

The mean lake temperature based on regressing data on water temperature against air temperature shows an increase of about 2°C since the mid 1960s

Unpublished work by Dr. Barbra Douglas in the early 1960s on the phytoplankton of the lake indicated a general preponderance of Chlorophyceae. By the mid 1980s, the phytoplankton consisted mainly of Cyanobacteria (*Cylindrospermum* sp) during the stratification period (Romberg 1987).

In the 1980s, zooplankton showed abundance of large calanoids and daphnids in the pelagic zone while cyclopoids and chydorids were found in the shallow areas (Balon and Coche; Magadza 1980) The current studies show a decrease in zooplankton while phytoplankton productivity (Ndebele pers com.) is dominated by cyanophyceae.

Our laboratory studies indicate that above a mean temperature of 28°C, Cyanobacteria (*Microcystis aeruginosa* and *Oscillatoria* sp) dominate the phytoplankton.

Early during the formation of Lake Kariba it was realised that that there were no local fishes that could utilise the pelagic zone. Thus, *Limnothrissa miodon*, from Lake Tanganyika was introduced in 1968/69 to occupy this vacant niche. This is a planktivorous fish that depends on entomostracans. Catches of this fishery peaked in the early 1990s but has steadily declined, and I quote a local fisherman that their catches per night are now measured “in kilograms, rather than tonnes”. Thus, the rise in lake temperature, changes in phytoplankton composition, decline of entomostracans populations and of pelagic fishery point to impacts of global warming.

The lotic environments have been studied relatively much less in Zimbabwe. The rivers face several threats, especially flow reduction due to climate change, siltation and pollution from agrochemicals and industrial waste. A few fast-flowing streams in the eastern highlands of Zimbabwe are still in a relatively pristine condition. These have recently become the focus of montane stream ecological studies, in conjunction with work on Nyika plateaux in Malawi (Kadye et al in press)

DDT persistently shows up in mothers' milk in the Lake Kariba area. Several of the large water supply reservoirs, such as Lake Chivero, Lake Mtirikwe (formerly L. Kyle) near Masvingo,

and Umguza and Khambi reservoirs in Bulawayo have become hypereutrophic. Effluents from the iron and steel industries at Kwekwe release heavy metals into the Sebakwe River, and Hwange Colliery discharges acid effluent into adjacent streams. In large rivers such as the Save, siltation has destroyed many riverine habitats. Pools have silted up and riffle habitats have been smothered with sand. Consequently, aquatic animals, such as crocodiles, hippopotamus, otters and several fish species, are now absent from large stretches of these rivers, and threatened with extinction. Uncontrolled gold panning has also resulted in the destruction of stream habitats as well as the introduction of mercury and cyanide into the panned streams.

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Exciting Moments in the Mexican Limnology: Past, Present and Future of Mexican Limnology

Limnology in Mexico has a long and impressive history of more than a hundred years. European and North American workers began to study

various freshwater environments from the point of view of taxonomy of aquatic organisms. Notable among them are C.V. Hoffman, H. K. Harring, B. Sámano, V. Brehm, B. Carlin-Nilson and B.F. Osorio-Tafall. They all made pioneering studies on the plankton of various freshwater bodies.

Freshwater bodies in Mexico are found in different climatic zones and are diverse in their types and characteristics. There are ephemeral and frozen high altitude pools, thermal springs, permanent natural and man-made lakes, underground running waters (sinkholes or cenotes), arid (barren) waterbodies, surface and underground rivers and inland saline lakes. Thus, the geological differences among the water bodies make the Mexican limnology unique. As for many other freshwater bodies of the world, the Mexican freshwater ecosystems have also experienced both natural and man-made impacts. For example, the freshwater lakes in the Mexican Valley, which were nearly 100,000 years ago about 35-m deep, have now been reduced to shallow waterbodies that are a few meters deep and some of them have become saline (e.g., lake Texcoco).

The country has 70 large lakes varying in area from 1,000 to 10,000 ha and 14, 000 reservoirs, about 85% of which are <10 ha each. Majority of the lakes in Mexico are natural, and of volcanic origin, while the reservoirs are essentially man-made. Some important lakes in Mexico for which considerable limnological data are available are Charo, Cuitzeo, Pátzcuaro, Zacapu, Zirahuén (Michoacán), Chapala (Jalisco and Michoacán), Amatitlán (Jalisco), Catemaco (Veracruz), Crater Lakes (Axalapasos) (Puebla), el Sol Lake (State of Mexico) and Cuatro Ciénegas (Coahuila). The Secchi-disc transparency in some lakes is as low as a few cm, e.g. Chapala (20° 20' 0" N, 103° 0' 0" W) and Xochimilco (Mexico City) (19° 17' 29" N 99° 5' 52" W), and in others up to 20 m, e.g. Poza de Media Luna (21° 51' 18.6" N; 100° 01' 22.3" W), San Luis Potosí.

Compared with the rivers, the Mexican lakes have received more from the limnologist. Limnology has continued to be an important subject at the both undergraduate and post-graduate levels of most Mexican universities.

The National Association of Limnology in Mexico was formed during 1997 with a modest membership of about 200 workers, which has since then grown to about 250 members. More recently, the periodic meetings on limnology have contributed further to the growth of limnology in Mexico. So far, three such meetings have been held at different cities in the Mexican Republic (1999, Morelia; 2002,

Mexico City; and 2005, Villahermosa). The fourth such meeting is scheduled for this year (see elsewhere the announcement in this SILnews for details). These meetings, although they are at national level, have international character: the Proceedings of the First Mexican Limnology Symposium held during 1999 were published in *Hydrobiologia* (Vol. 467, 2002, Eds. Alcocer and Sarma). In addition, the Mexican Planktonological Society (SOMPAC) with its regular meetings, has also substantially enhanced limnological output of the Mexican waterbodies. The Proceedings of the 14th SOMPAC Meeting held during 2006 in Morelia City will appear this year as a supplementary issue in the journal *Hidrobiológica* (UAM, Mexico City).

Starting with the traditional survey of freshwater organisms, Mexican limnology has witnessed a great expansion and now encompasses many interdisciplinary studies of freshwaters. Information retrieved from standard databases (e.g., Aquatic Sciences and Fisheries Abstracts (ASFA), Biological Abstracts, Zoological Records, etc.) reveals that nearly 500 papers on Mexican limnological studies were published during the current decade (1999 – 2008), which is nearly 40% higher than a decade earlier. While the conventional field sampling of lakes and ponds is continuing, experimental limnology, paleolimnology, studies relating to conservation of freshwater habitats and utilization of wastewaters for aquaculture have also gained foothold. Ecological studies on specific taxonomic groups, e.g. freshwaters plankton, have also contributed to the rapid expansion of the limnological database in

Mexico. For example, the tradition of triennial international meetings of rotiferan zooplankton was initiated by A. Ruttner-Kolisko, the famous Austrian limnologist. Subsequently, this became an international Rotifera group. Mexico had the privilege of organizing the XI Rotifera Symposium at the National Autonomous University of Mexico, Campus Iztacala (Mexico City) in March, 2006 (with the undersigned as the main organizer (Sarma et al. 2007)). A total of 125 participants (including 50 Mexican researchers) from 20 nations participated in the symposium. This year, the VIII International Cladocera Meeting, will be held in Aguascalientes City (Mexico) during 21-25, October. Such international meetings have thus given a boost to limnological investigations on Mexican freshwater bodies. Thus, the current growing trend in Mexican limnology augurs well for research studies in future.



Fig. A: Alchichica lake. Volcanic origin, a crater lake, pH >9, max. depth 60 m, located in the State of Puebla, a high altitude (2345 m above sea level), oligo-mesotrophic, saline lake (salinity 9 g/L). Area of lake: 1.81 km², white rock-like structures are the

For further reading:

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Fig. B: Iturbide Reservoir (Isidro Fabela, State of Mexico, Mexico) (19° 34' 32" latitude N and 99° 25' 48" longitude W), a high altitude (3300 m above sea level) oligotrophic waterbody, maximum depth 25 m, Area of reservoir: <1 km².

INTECOL Wetland Working Group

INTECOL Wetland Working Group and History of the International Wetland Conferences

The INTECOL Wetland Working Group (WWG) was formed at the International Congress of Ecology in Jerusalem in 1978 to encourage research, information sharing and scientific exchanges within the general area of wetland sciences. About 40 people attended the first meeting. At that time there were no internationally based wetland ecology societies, journals or specialty meetings comparable to that available for other biomes like forests, oceans or grasslands (with exception of the International Peat Congresses, which tended to focused geographically and in terms of discipline interests). V. J. Chapman chaired

subsequent administrative efforts to organize an international meeting. The major functions of the WWG has been to organize an international meeting every 4 years, and to join the main body of INTECOL at a larger meeting two years thereafter.

The attendance at the meetings is shown in the Figure.

1980, New Delhi, India

The First International Wetlands Conference took place from 10-17 September 1980 in New Delhi with the assistance of several international

and national sponsors. Approximately 90 people from 20 countries attended 10 days of meeting and field trips. US scientific participation for 12 persons was guaranteed through a PL410 grant to the conferences organizers, D. Whigham. The meeting format consisted of

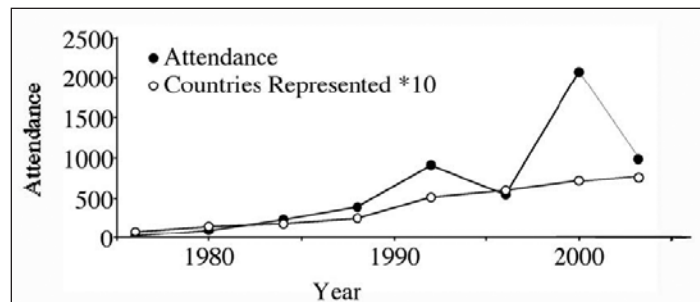


Figure. Attendance at the international wetland meetings supported by INTECOL.

daily conference papers, a mid-week tour to local wetlands and a half-day wrap-up session to write consensus position papers on wetland research needs. Two book volumes (Gopal, B., R. E. Turner, R. G. Wetzel, and D. F. Whigham (editors.) 1982. *Wetlands: Ecology and Management*. International Scientific Publications, Jaipur, India. Vol. 1/2. 514 pp. and 156 pp., respectively) and one conference recommendation and several journal articles resulted. Several conference participants subsequently returned to India for research with colleagues contacted at that first conference.

1984, Trebon, Czechoslovakia

The International Wetlands Conference was in Trebon, Czechoslovakia, June 13-23, 1984. It was hosted by Prof. Jan Kvet and organized by the Department of Hydrobotany, Czechoslovakian Academy of Sciences. Approximately 210 people from 26 countries attended the one-week meeting. The meeting included plenary sessions, shorter afternoon and evening presentations, poster sessions, round-table discussions and field trips. Two conference proceedings have been published based on papers presented at that meeting. One is a special (Pokorny, J., O. Lhotsky, P. Denny and R. E. Turner (editors) 1987. *Waterplants and wetland processes*. *Archiv Fur Hydrobiologie* Vol. 27) and two books (1). Mitsch, W.J., M. Straskraba, and S.E. Jørgensen (editors). 1988. *Wetland Modelling*. Elsevier, Amsterdam. 2). D. Whigham (ed.) Springer-Verlag, publishers) as well as a whole issue of *Aquatic Botany*.

1988, Rennes, France

The International Wetlands Conference was held September 19-23, 1988, at Rennes, France, under the aegis of the University of Rennes and the National Museum of Natural History. It was sponsored by INTECOL, the International Union for the Conservation of Nature and Natural Resources, World Wildlife Fund and in France by the Ministry of Environment, UNESCO/MAB, the National Institute of Agricultural Research, the National Center for Scientific Research. The organizing committee was chaired by Professor J. C. Lefeuvre from the National Museum of Natural History. This third conference was different from the others in several ways. The theme of the 3rd conference was "Conservation and Development: the sustainable use of wetland resources". This theme was chosen to draw interest from developing countries, conservation organizations and to reflect the member's interest in wetlands as a natural resource. The member's interests are strongly scientific as compared to primarily managerial, so that

scientific endeavors dominated the program. Morning plenary sessions (invited), afternoon 15-20 minutes presentations, poster sessions and evening specialty topics were scheduled, as were workshops for a mid-week "hands-on" training session on at least four techniques (Eh measurements, wetland evaluations, and the cotton strip and balsa wood method for measuring microorganism activities). The purpose of the workshops was to allow participants the opportunity to learn a technique well enough to develop expertise on their own. Total registration was about 400 persons representing 37 countries. Excellent field trips were organized before and after the main meeting dates. Publication from materials presented at the conference included post-conference publication of extended abstracts from the poster sessions, a book by the French National Center of Scientific Research (CNRS) and submissions to specialty journals (e.g. *Wetlands Ecology and Management*). There was a definite emphasis on publishing peer-reviewed articles and to avoid symposium-style publications.

1992, Columbus, Ohio, U.S.A.

The International Wetlands Conference was held at Ohio State University, 13-17 September 1992. It was sponsored by several US national federal and state agencies and by numerous international wetland resource agencies (NGO and federal). There were 15 symposia, more than 900 participants representing 52 countries, making it the largest wetland meeting ever. Environmental education sessions were fully represented in a major way. Several books and collections of papers in journals are complete as a result of that meeting. The format of organized symposium, workshops, posters and specialized topics developing into collected journal articles was set for future meetings.

1996, Perth, Australia

The INTECOL Wetland Symposium was held at Perth, Australia in September, 1996, and hosted by Western Australia University and Murdoch University, by A.J. McComb and J. Davis. It was sponsored by several US national federal and state agencies, and, by international wetland resource agencies (NGO and federal) and

Australian institutions. There were dozens of symposia and several great tours and workshops before and after the meeting. Approximately 550 participants from 60 countries attended the symposium. Several books and collections of papers in journals were published as a result of that meeting.

2000, Quebec City, Canada

The INTECOL Wetland Symposium was held in Quebec City, Canada (6-12 August, 2000). The meeting was hosted by C. Rubec, B. Belangér and G. Hood and held jointly with the International Peat Society, International Mire Conservation Group, and Society for Wetland Scientists as the "Quebec 2000: A Global Celebration of Wetlands." Twenty concurrent sessions were held over five days with a mid-week field trip. Pre- and post-meeting tours included trips to the Pacific and Atlantic coasts, Hudson Bay and inland. There were 59 symposia and 72 lecture sessions. Seventy-two

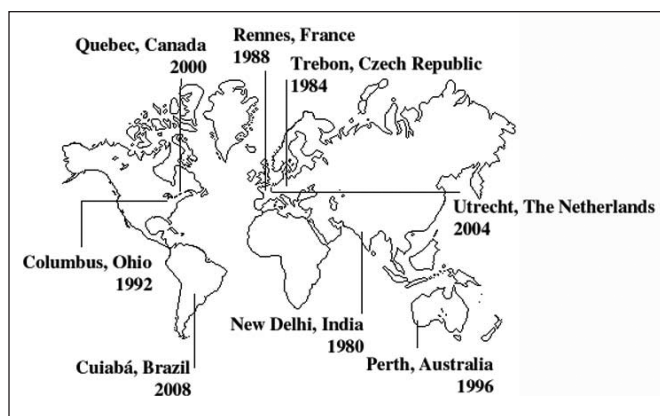
countries were represented by 2,068 delegates making this the largest wetland meeting ever. The WWG presented awards to several members and held a business meeting on the last day. A resolution was passed supporting the conservation of the Nakaikema Wetland (Japan) and discussion of by-laws for the WWG.

2004, Utrecht, The Netherlands

The INTECOL Wetland Symposium was held 25-30 July, 2004, in Utrecht, The Netherlands, under the guidance of Prof. Jos Verhoeven, University of Utrecht. The web site is at: <http://www.bio.uu.nl/intecol/>. The conference mission highlighted the newest developments in Wetland Science with all its major disciplines and reviewed this knowledge in the perspective of integrated water resources management world-wide. There were 787 registered participants from 62 countries. There were 68

2008: CUIABA, BRAZIL

The VIIIth INTECOL Wetland Symposium will be held in Cuiabá, Mato Grosso, Brazil, from 20-25 July, 2008. See announcement on page 16.



oral sessions all in the centrally located city of Utrecht and 25 field excursions. A total of 550 oral presentations and 263 poster presentations were made.

Notes from Prof. Jan Kvet

“It may be mentioned that the Czechs, Poles and Romanians started a large scale series of international collaboration in wetlands ecology during the IBP Program, namely at the meetings in Tulcea (Romania) in 1970, and at Mikolajki (Poland) in 1972. The final outcome of this collaboration was the book “Production Ecology of Wetlands”, edited by D. F. Westlake, J. Kvet and A. Szczepanski. In the fall 1977 Kvet met with Turner in Baton Rouge, Louisiana, and they came to the conclusion that, after the end of the IBP, the international collaboration in wetlands ecology should best continue within the framework of INTECOL. This proposal materialized at the 1978 International Ecology Congress of INTECOL in Jerusalem (which, unfortunately, no Czechoslovakian could attend for political reasons). Dr. V. J. Chapman came to similar conclusions and took the lead in organizing the meeting. Neither of us then expected that this collaboration would eventually develop into such a large scale.”

Major Publications of Groups of Papers Originating from the WWG Symposia

1980-India

Gopal, B., R. E. Turner, R. G. Wetzel, and D. F. Whigham (Editors.) 1982. Wetlands: Ecology and Management. International Scientific Publications, Jaipur, India. Vol. 1. 514 pp.
Gopal, B., R.E. Turner, R.G. Wetzel, and D.F.

Whigham (editors.) 1982. Wetlands: Ecology and Management. International Scientific Publications, Jaipur, India. Vol. 2. 156 pp.

1984-Czechoslovakia

Pokorny, J., O. Lhotsky, P. Denny and R. E. Turner (editors) 1987. Waterplants and wetland processes. Archiv Fur Hydrobiologie Vol. 27.
Whigham, D. F., Dykyjová, D. and Hejny' (eds.). (1993) Wetlands of the World: Inventory, Ecology and Management. Volume 1. Africa, Australia, Canada and Greenland, Mediterranean, Mexico, Papua New Guinea, South Asia, Tropical South America, United States. Kluwer Academic Publishers. Trends in Ecology and Evolution. 9:114-115.

Mitsch, W.J., M. Straskraba, and S.E. Jørgensen (editors). 1988. Wetland Modelling. Elsevier, Amsterdam
Aquatic Botany Issue on Wetlands, 1989.

1988-France

Bulletin d'Ecologie 21(3).
Book from French National Center of Scientific Research (CNRS)

1992-USA

Finlayson, C. M. and A. G. van der Valk. 1995. Classification and Inventory of the World's wetlands. Sp. Issue Vegetatio. 118:1-192; reprinted by Kluwer Academic Publishers, Dordrecht, The Netherlands, 192 pp.
Gopal, B. and W. J. Mitsch (ed.) 1995. The role of vegetation in created and restored wetlands. Sp. Issue Ecological Engineering 5:1-121.
Jørgensen, S.E. (ed). 1995. Wetlands:

Interactions with watersheds, lakes, and riparian zones. Sp. issue Wetlands Ecology and Management 3:79-137.

Mitsch, W. J. (ed.), 1994. Global Wetlands: Old World and New. Elsevier Science, B.V. Amsterdam, The Netherlands.

Mitsch, W. J. 1993. Intecol's IV International Wetlands Conference: A report. International Journal of Ecology and Environmental Sciences 19:129-134.

Wetzel, R. G., R. G. Van der Valk, R. E. Turner, W. J. Mitsch and B. Gopal (Editors). 1994. Recent Studies on Ecology and Management of Wetlands. International Journal of Ecology and Environmental Sciences 20(1-2). 254 pp.

1996-Australia

McComb, A. J. and J. A. Davis (eds.) 1998. Wetlands for the Future. Gleneagles Publ. Adelaide, Australia.

Tanner, C.D., G. Raisin, G. Ho, and W.J. Mitsch. 1999. Constructed and natural wetlands for pollution control. Sp. Issue of Ecological Engineering 12: 1-170.

Zedler, J. and N. Rhea. 1998. Ecology and Management of Wetland Plant Invasions Special issue of Wetlands Ecology and Management Vol. 5:3.

2000 – Quebec

6 special issues of journals

2004-Utrecht

3 special issues of journals: Wetlands as a Natural Resource; and Ecological Studies Vols. 190, 191. Springer Verlag.

Conference Announcements

Rotifera XII

Berlin, Germany. 16-21 August, 2009

Rotifera XII is an international scientific symposium dedicated to rotifers from molecular to ecological science and from basic to applied research including aquaculture.

Rotifera XII will take place in Berlin, Germany from 16 to 21 August, 2009. It is hosted by the Leibniz-Institute of Freshwater Ecology and Inland Fisheries, the Humboldt-University Berlin and the Natural History Museum Berlin.

Rotifera XII will be held in the tradition of previous triennial meetings. The first symposium took place in Lunz, Austria (1976) followed by meetings at Gent, Belgium (1979), Uppsala, Sweden (1983), Edinburgh, Scotland (1985),

Gargagno, Italy (1988), Banyoles, Spain (1991), Mikolajki, Poland (1994), Collegeville, USA (1997), Khon Kaen, Thailand (2000), Illmitz, Austria (2003) and Mexico City, Mexico (2006).

Please find the First Announcement for the Symposium Rotifera XII at www.rotifera-xii.igb-berlin.de

Announcement of The VIII INTECOL Wetland Symposium Cuiabá, Mato Grosso, Brazil, 20-25 July, 2008

The VIII INTECOL Wetland Symposium will be held in Cuiabá, Mato Grosso, Brazil, from 20 to 25 July, 2008. The theme is “Big Wetlands, Big Concerns” and the meeting

consists of 10+ concurrent sessions, plenary talks, workshops and symposium. The host institution is the Universidade Federal de Mato Grosso, and the organizing committee is headed up by Prof. Paulo Teixeira de Sousa Jr. This is the first meeting of the WWG in South America, which is expected to stimulate international and continental-scale interactions, promote wetland education, research and management throughout the region, and give rise to the largest wetland meeting in Latin America. A major field attraction is the Pantanal of Mato Grosso, an excellent example of international cooperation in research and development of wetlands, bordered by three countries. The city of Cuiabá is the gateway to the Pantanal, the state capital. There is an adequate convention center and modestly-priced housing available.

A special effort is being made to facilitate student participation and for international exchanges. See <http://www.cppantanal.org.br/intecol/eng/> <http://www.cppantanal.org.br/intecol/eng/index.php>

Important Deadlines: Early Registration 1 April 2008; Abstracts, 1 May;

Please contact Dr. R. Eugene Turner if you have any queries: eurturne@lsu.edu

VIII International Symposium On Cladocera

Aguascalientes, Mexico, 21-25 October, 2008,

We cordially welcome you to the web page http://academia.uaa.mx/symposium/viii_sic regarding VIII International Symposium on Cladocera 2008. This will be held in the Autonomous University of Aguascalientes (UAA). Aguascalientes City, Aguascalientes State. MEXICO. http://academia.uaa.mx/symposium/viii_sic

For more information contact the organizers Dr. Marcelo Silva Briano, viii_sic@correo.uaa.mx, and Dr Roberto Rico Martínez, rrico@correo.uaa.mx, or call the Department of Biology:

a) International Phone: 00 (52)-449-9107400 ext. 347

b) México phone: 01 (449) 9107400 ext. 347

The 4th Mexican Limnological Congress of the Mexican Limnological Society

City of Xalapa, State of Veracruz, México on 22-24 October, 2008

Organizer: Laura Davalos-Lind (laura_davalos-lind@baylor.edu)

President of the Asociación Mexicana de Limnología: Alfonso Lugo (lugo@servidor.unam.mx)

Recognizing that the water quality and quantity and the education of young limnologists to conduct basic and applied research are critical for the both developing and developed countries, the Mexican Limnological Society organises triennial congresses. The 4th Mexican Limnological Congress will serve as a forum to facilitate exchange of information, stimulate new research and establish collaboration among scientists and educators. The Mexican Limnological Society has approximately 200 members.

Plenary lectures will be given by two prominent scientists Evertt Fee and Alan Covich.

Important dates to remember:

October 22 to 24 Meeting
July 30 Early Registration
July 3 Deadline for submission of Abstracts
October 22..... Late Registration

Registration fees:

Early registration..... \$130 US, Students \$70
Late registration \$150 US, Students \$80

The registration fee must accompany abstract submission.

For more information contact and visit Congreso_limnologia2008@yahoo.com.mx or http://www.uv.mx/citro/congreso_limnologia2008

The Workshop “Managing Alien Species for Sustainable Development of Aquaculture and Fisheries” (MALIAF)

Florence, Italy, 5-7 November 2008

The project IMPASSE “Environmental Impacts of Alien Species in Aquaculture” was funded within the EU’s Sixth Framework Program for Research and Technological Development. Its overall goal is to develop guidelines for environmentally sound practices for the introductions and translocations of species in aquaculture, guidelines on quarantine procedures and risk assessment protocols, and procedures for assessing the potential impacts of alien species (AS) in aquaculture and related activities.

The workshop MALIAF aims at discussing the strategies needed to develop sustainable and profitable aquaculture and fisheries across the world, with respect to AS, with the participation of scientists and managers worldwide. Selected presentations will be published.

Workshop Themes

- Reviews of introductions of AS in different aquatic environments.
- Impacts (environmental, ecological, social, and economic) arising from the introduction of aquatic AS.
- Aquaculture and aquaculture-related operations involving AS.
- Analysis of drivers of the use of aquatic AS.
- Constraints in establishing good practices in the introduction aquatic AS.
- Dispersal mechanisms from aquaculture-related activities.
- Risk assessment and management.
- Quarantine procedures.
- Recommendations on potential mitigation-remediation procedures and contingency plans.

Oral presentations (20 min) and posters are welcome. Deadline for abstract submission and early registration is July 15 (2008). Please visit

the website www.dbag.unifi.it/maliaf for more information.

MALIAF Organizer:

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IMPASSE Project coordinator:

Prof. Ian Cowx, Hull International Fisheries Institute,
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i.g.cowx@hull.ac.uk

Symposium on Carbon Cycling in Continental Aquatic Environments

Rio de Janeiro, 8-10 September, 2008

On behalf of the Post-graduation Program in Ecology of the University Federal of Rio de Janeiro, and with the support of the Brazilian Society of Limnology, I would like to invite you to participate at the Symposium on Carbon Cycling in Continental Aquatic Environments, that will take place in Rio de Janeiro from 8 to 10 September, 2008.

The Symposium will be comprised of plenary sessions, round tables and oral and poster presentations. It will deal with the following themes:

- 1) processes related to the emission, production, consumption and accumulation of carbon in different aquatic inland ecosystems;
- 2) relevance of these ecosystems in the global carbon budget;
- 3) human alteration of the carbon cycle; and
- 4) the main knowledge gaps and perspectives relating to the carbon cycle in tropical ecosystems.

Abstracts are invited for oral/poster presentations at the Symposium and should be submitted by e-mail to: ciclocarb@ufrj.br by 4th of June, 2008.

Additional information is available at the website: <http://www.ppgecologia.biologia.ufrj.br/ciclocarbono/>

A special issue of the journal *Oecologia Brasiliensis* entitled “Carbon Cycle in Brazilian Continental Aquatic Systems” will accept manuscripts for publication. This special issue will have sections concerning: 1) Anthropogenic alterations on the Carbon Cycle; 2) Land – Water interactions; 3) Carbon assimilation; 4) Carbon production; 5) Carbon accumulation; and 6) Carbon exportation

We look forward to welcoming you in Rio in September!

Alex Enrich Prast
Symposium Coordinator
Place: Auditório Horácio Macedo

Announcements/Advertisements

The Launch of Freshwater Reviews—A New FBA Journal

SILnews readers may be interested to note the launch of Freshwater Reviews, the new, peer-reviewed journal from the Freshwater Biological Association. The aim of the journal is to provide informative and authoritative reviews on a wide range of topics in fresh water science, which will appeal to a diverse audience, including academics, students, practitioners and teachers.

To date, Freshwater Reviews has published three articles online:

- 'Picophytoplankton in freshwater ecosystems: the importance of small-sized phototrophs' by Dr Cristiana Callieri;
- 'The kingdom of the shore: achievement of good ecological potential in reservoirs' by Professor Brian Moss and 'Efficiency, energy and stoichiometry in pelagic food webs; and
- 'Reciprocal roles of food quality and food quantity' by Professor Dag Hessen'.

Several more are at various points in the editorial process and will be published in the near future, including reviews on the biogeography of bacterioplankton in inland waters by Drs Jürg Logue and Eva Lindström; phytoplankton of East African Great Lakes by Prof. Jean-Pierre Descy and Dr Hugo Sarmiento; local and global disturbances in streams and rivers by Dr Sergi Sabater; the role of specially designated wildlife sites in freshwater conservation by Chris Mainstone and the developmental history of inland-water science by Dr Jack Talling.

Contributed reviews are invited immediately and may cover any topic within fresh water sciences and their application. They should aim to be between 8000 and 12000 words in length, although shorter or longer articles will be considered. Guidelines for authors are available through the FBA's online journal system at www.fba.org.uk/journals. Submissions should be made via the website. If you wish to discuss a submission please contact the Editor, Professor Colin S. Reynolds at creynolds@fba.org.uk.

Articles are available online as soon as they are published and will also be published in hard copy bi-annually from March 2008. Online access is currently free for the initial promotional period. Subscription rates are very competitive, and are also available from the journal website.

SIL members are eligible for a 10% discount on normal subscription rates for the 2008 issues, when they quote the code: 'FR0208SIL'.

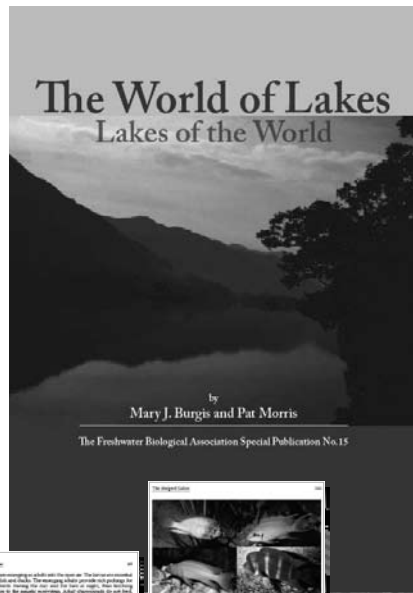
Colin S.Reynolds
Editor Freshwater Reviews
www.fba.org.uk/journals



New from the FBA.....

The World of Lakes: Lakes of the World

by Mary J Burgis and Pat Morris, with illustrations by Guy Troughton



The World of Lakes provides a fully illustrated and clearly written introduction to the fascinating world of lakes, which are shown to be not only scenic attractions but also living communities, as much as cities and forests. Despite their distinct shorelines, lakes are not isolated but constantly interact with their surroundings. Nor are they just water; their many subtle variations have profound effects on the wildlife they support.

The World of Lakes explains the properties of lake water, the formation of lakes, their dramatic seasonal patterns, and the communities of plants and animals that they support. The remarkable variety of the world's lakes is then described: from the frozen lakes of Antarctica, which face perpetual cold and prolonged darkness, to the rich warm waters of equatorial Africa. Having provided a picture of lakes as dynamic but delicate habitats, the authors discuss the crucial question of conservation.

The text is richly illustrated with photographs, drawings and diagrams. The authors' extensive travels and research have enabled them to provide a unique combination of clear explanations and broad coverage making this work of genuine interest to students of biology and geography as well as to general readers.

Naturalists, ornithologists, anglers, holidaymakers and anyone wanting a greater understanding of lakes will be delighted by this book.



Price £25.00*

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*plus p&p, 25% discount for FBA members, Order Code: SPEC 15
ISBN 978-0-900386-76-3; ISSN 1747-1958, 281 pages, First published in 1987 as *The Natural History of Lakes*, by Cambridge University Press. Reprinted by the FBA in August 2007, fully updated with additional illustrations.

Information for Advertisers

SILnews is the official newsletter of the Societas Internationalis Limnologiae (SIL) - International Association of Theoretical and Applied Limnology. SILnews is published three times each year and is distributed to about 3,100 SIL members, libraries and organizations world-wide. SILnews has been published since 1987 and is non-profit.

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vice fee, if applicable) should be forwarded to the SILnews (please contact Ms Denise L. Johnson for information).

We look forward to being of service to you.

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Attention: Manufacturers of Limnological Equipment and Publishers

SILnews accepts advertisements for equipment and publications that will be of interest to SIL members.

SILnews is distributed twice a year to more than 3,000 SIL members and libraries world-wide. If your company is interested in acquiring advertising space in *SILnews*, please contact Ramesh D. Gulati (r.gulati@nioo.knaw.nl) or Ms. Denise Johnson (denisej@unc.edu) the Editorial Office for rates, or use the mailing address indicated on the front page.

A complimentary copy of *SILnews*, in which your advertisement appears, will be sent to you once it has been published. *SILnews* is posted on the SIL web site at <http://www.limnology.org> after it has been published.

Limnology Jobs and Studentship Notices

Notices on the availability of limnologically-oriented jobs and graduate student opportunities are now accepted for publication in the *SILnews* and displayed on the SIL web site at <http://www.limnology.org>. There is no charge for the service at this time, which is available to both SIL members and non-members.

Persons submitting notices should note the four month lead-time for the print edition of *SILnews*; those advertisements with short deadlines should be directed to the web site only.

Submissions should include:

- a short title describing the position (job or studentship);
- location and duration of the position;
- closing date for applications;
- a short paragraph describing the position, including any citizenship, educational or employment prerequisites; and,
- information on where potential applicants may obtain further information, including names of contact persons, telephone numbers, fax numbers, e-mail addresses, and web site addresses, where appropriate.

Submissions may be edited for length and clarity. Those deemed inappropriate to the SIL mandate will be rejected at the discretion of the *SILnews* Editor or the Webmaster. Submissions for the print edition of *SILnews* should be sent to the editor at the address on the cover of this issue.

Submissions for the SIL web site should be sent by e-mail to webmaster@limnology.org or by fax to the attention of Gordon Goldsborough at: +1 (204) 474-7618.

Are you moving?

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c/o Ms. Denise Johnson
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The International Association of Theoretical and Applied Limnology works worldwide to understand lakes, rivers, and wetlands and to use knowledge gained from research to manage and protect these diverse, inland aquatic ecosystems.

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