ECRC

The Natural History Museum 1999 Meeting on the Biodiversity of Lake Baikal and a Workshop on the Taxonomy of Lake Baikal Diatoms: The Combined Reports

The MEETING and WORKSHOP were held during the 18-19th and 20-22nd of October, 1999, respectively, at the NATURAL HISTORY MUSEUM OF LONDON, Cromwell Rd. London SW7 3LB, UK

Meeting and Workshop organizers: D. M. Williams, R. J. Flower and G. Reid

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Meeting and Workshop Sponsors: The Royal Society of London and the Darwin Initiative for Biodiversity (UK Government, Department of the Environment Trade and Regions)

ECRC Report Number 62

A combined report on a Meeting about the Biodiversity of Lake Baikal and a Workshop on the Taxonomy of Lake Baikal Diatoms held during the 18-19th and 20-22nd of October, 1999, respectively.

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DECEMBER 1999

The NHM Meeting on Biodiversity in Lake Baikal - 18-19th, October 1999

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INTRODUCTION:

The main aim of this two day meeting was to foster collaboration between biodiversity specialists from western countries and from Russia who share a common interest in biodiversity issues concerning Lake Baikal. The meeting will hopefully stimulate discussion and debate that will facilitate future joint international research interest on the impressive diversity displayed by the biota of this great lake.

In Britain joint research links with Lake Baikal were initiated in the late 1980s as a result of the 'BICER' (Baikal International Centre for Ecological Research) agreement organized and supported by the Royal Society (see D. Jewson, this report). This has resulted in several important UK supported research projects funded principally by the Natural Environment Research Council, The Leverhulme Trust, and the Darwin

Initiative for the Survival of Species. Several of the discussions in this Meeting programme (see below) concern work supported by these bodies.

The general focus of the meeting concerned all aspects of the development, evolution and status of the lake's biota. Mainly using various groups of organisms, from micro-algae to invertebrates and fish, it was hoped that some of the following questions can be addressed during the meeting:

How have the various organisms achieved their levels of endemicity? How well can we define endemicity? Are there groups of organisms that have not appreciably diversified? From where do these organisms originate? What are the past and present distributions of endemic organisms? What might be done to record this diversity? How might diversity research contribute to lake conservation issues.

The generous contributions by the participants, together with funding by The Royal Society and The Darwin Initiative, made this meeting possible.

Monday 18th October 1999

10.00 - 10.20	David Williams	Introduction
10.20 - 10.40	David Jewson	BICER, its aims and achievements
10.45 - 11.15	Dima Sherbakov	Molecular Evolution and Diversity in Lake Baikal
11.20 - 11.50	Roger Flower	Endemic and cosmopolitan diatoms
12.00 - 2.00	Lunch	
2.00 - 2.40	Koen Martens	Speciation in ancient lakes
2.40 - 3.10	David Mann	The diatom epipelon
3.10 -	Open discussion	

Tuesday 19th October 1999

10.10 - 10.40	Oleg Timoshkin	Origins of the Baikal fauna
10.40 - 11.10	Isa Schön	Comparative analysis of Baikalian Cytherissa
11.10 11.40	Anson Mackay	Recent sedimentary records and endemic diatoms
11.40 - 12.00	General Discussion	
12.00 - 2.00	lunch	
2.00 - 2.30	David Williams & Geraldine Reid	Eunotia clevei, a living fossil diatom in Lake Baikal
2.30 - 3.00	Miranda von Dornum, James K Bowmaker and David M Hunt	Molecular evolution of cottoid fish in Lake Baikal
3.05 -	Concluding Discussion	

Note: Several changes to this schedule were made during the course of the sessions due in part to the unfortunate cancellation by Frank Reidl.

PRESENTATIONS:

This meeting was open by David Jewson. Summaries of the talks given by each contributor are as follows:

Dr D. H. Jewson (University of Ulster): **Biological research strategies and the BICER initiative for Lake Baikal.**

This talk introduced the programme and described the role of BICER in promoting international research on Lake Baikal. Thanks were given to the organisers (David Williams, Geraldine Reid and Roger Flower) and to the Natural History Museum, for acting as hosts and providing facilities for this meeting. Also, the supportive role of the Royal Society was gratefully acknowledged.

Lake Baikal is a special place. It is the world's deepest lake at 1,637m and holds nearly 20% of the world's surface freshwater (unfrozen). Another unusual feature of Baikal is that it is oxygenated all the way to the bottom and many animals and plants have become adapted to the unique deep water conditions that occur there. The endemic species recorded in Baikal continues to rise. The usual figure quoted is over 1,500 endemic taxa but the pace of work on Baikal means that we will hear, during the course of the meeting, how this has increased substantially in the last few years. One of the reasons for the high biodiversity is that it is easily the oldest lake in the world, at 20 to 30 million years. There is a long list of such superlatives and, although there has been a lengthy history of Russian research since the last century, until glasnost and perestroika under Gorbachev there was relatively little international involvement. That changed in 1990. What was needed then was access to western equipment and techniques.

With a number of individual agreements being proposed at that time, it was suggested that the various international groups might collaborate. The core of activity was still the Russian Academy and the Limnology Institute under Dr Michael Grachev, but Belgium, Switzerland, Japan, U. S. A. and UK, represented by the Royal Society, supported research through the formation of the Baikal Centre for Ecological Research (BICER) in 1991. A variety of new research programmes were started. However, no one really foresaw how events would develop in Russia but due to the dedication of the scientists involved, BICER as an organisation survived. For example, recently it was possible to get EC funding through INTAS for boat repair, because of the broad European programmes and the necessity to keep the infrastructure going. This type of support has been an essential part of BICER activities. However, the nature of funding has changed and now individual programmes will have to provide more support towards boats, transport, sampling equipment. One positive development is that the original BICER countries are shortly to be joined by Germany, with an inaugural meeting in November 1999 in Potsdam.

One of the areas where BICER has been successful in the past is finding western collaborators for Russian researchers. Within the UK, this has been organised through the Royal Society and a second 5 year term, with 2 to 3 exchanges per year, has just been announced. Research on the lake is really at the frontiers of freshwater science. The three main areas that should be encouraged are lake processes, sediment history and biodiversity. These often overlap, which makes for exciting science. This meeting is an opportunity to discuss the future direction of biodiversity research.

Dr D. Sherbakov (Limnological Institute, Irkutsk): **Molecular phylogenetic studies on invertebrates groups in Lake Baikal.**

This talk described the results of molecular phylogenetic studies on Amphipods, Molluscs (Baicaliidae, Benedictiidae and the genus *Choanomphalus*) and Oligochaets (Lumbriculidae). Other studies referred to included the work on Ostracoda (K. Martens) and Cottoidei (V. Kirilchik). After describing in considerable detail the methods of dating used, the conclusion was made that there are only 2 types of evolutionary history in Baikalian species flocks found so far: one is the gammarid type, this is an ancient most likely polyphyletic species flock with an age at least comparable to that of the lake. The other is the Baikaliidae type: this species flock is young (ca 4 MYR old) which underwent explosive speciation at the beginning of its history. Afterwards this was followed by more or less normal rate of speciation.

This second pattern of evolutionary history is peculiar to all surface-bound species flocks. According to our current views, the main speciation event preceded the Pleistocene cooling and cannot be easily explaining by the lake's palaeo-climatic history, at least as it is understood at the moment.

It was argued that the discrepancy most likely stems from the fact that the record of palaeo-climates could be strongly biased towards events in the pelagic zone since the record is derived mainly from the fossil history of planktonic diatoms.

A case was made for future work that examines the molecular phylogenetic study of benthic diatoms. This could help to resolve current problems. Then a strategical shift towards more general problems could be made whereby geographic adherence to Baikal could be reduced. Baikal should be thought of as:

1. An important source and model for biodiversity in W Europe;
2. A site for numerical estimation of genetic diversity as method to estimate biodiversity;
3. A site where explosive speciation events could be compared with similar elsewhere.

Dr. O. Timoshkin (Limnological Institute, Irkutsk): **Biodiversity of Baikal's fauna: state of the-art research, white spots and prospects for investigations**.

Lake Baikal is one of the most intensively investigated lacustrine ecosystem on the Earth with over than 200 years' history of research. More than 12,000 references on Baikal and Pribaikalye are located in the databases of the Limnological Institute, SD RAS. It has been shown that Baikal represents a most unusual lake ecosystem and therefore it has been included in the list of the World Heritage Sites assembled by

UNESCO in 1996. However, Baikal is still full of enigmas, its natural history cannot be regarded as perfectly understood.

The main aim of the lecture was to show, how many white spots we do have in our knowledge on biology of this "pearl of Siberia". Here the most exciting results of modern biological investigations and the prospects for future research are briefly characterized. First, the lake is inhabited by some 2565 animal and around 1000 plant species and subspecies, over 60% of animal species are endemic. However, this number of fauna species might be doubled in the near future. Second, the author provided brief characteristics of the biodiversity of several of the most exciting taxonomic groups: Sponges, free-living Plathelminthes (Turbellaria), Crustacea Amphopoda and Cottoid fishes. Special attention has been paid to the group of aberrant Kalyptorhynchian flatworms, which is an extremely numerous group in Baikal in terms of the species number: over 70 species are new and are subdivided into 5 new genera, representing a new family. Interestingly, this abundant diversity and the origin of this group cannot be explained by the commonly accepted paradigms like adaptive radiation and natural selection. Third, three types of communities, newly found for Baikal and even for freshwater ecosystems elsewhere (partly), are briefly described: they are the ciliopsammon (specialized interstitial Ciliophorans), freshwater hydro-vent and the cryophilic communities. Finally, a review of the hypotheses on the origin of Baikal fauna is given.

The author gave an account of the results of modern investigations, including molecular-biological data. It was shown that many recent faunistic groups, formerly regarded as "classical" relicts, like Cottoidei fishes, Lubomirskiidae sponges, Baicaliidae gastropods, etc., might be much younger than the lake proper and have much more close phylogenetic relationships with corresponding groups, recently distributed in Palearctic, than it was formerly thought. Scientists still do not have a synthetic theory on the Baikal fauna origin but have a set of hypotheses instead. So, many important questions about Baikal biology are still beyond of our knowledge. The new synthesis of modern information on Baikal natural history is highly desirable. Finally, author believes, that Baikal will play a more and more important role in international science. The scientific discoveries being made around the coasts of this glorious lake, are are changing, correcting, and even rejecting many of the commonly accepted paradigms of general biology, palaeolimnology and geology.

Dr R. J. Flower (ECRC, University College London): **The Darwin Project and the Distribution of Benthic Diatoms Around Lake Baikal.**

Benthic diatoms in Lake Baikal are very diverse and show a high degree of endemicity. Nevertheless, this remarkable flora has received little comprehensive study since the 1930's when B. W. Skvortzov (1939) published a detailed account describing almost 200 taxa (excluding varieties) of which two thirds were thought to be endemic. The potential for revising this flora by applying new techniques (LM and SEM and eventually molecular studies) and establishing a reliable diatom recording facility was recognised in the mid 1990s and lead to a grant from the UK's Darwin Initiative to University College London (UCL), Natural History Museum (NHM, London), and the Limnological Institute (LI, Irkutsk). The main aims of this grant were to initiate several littoral transects for biomonitoring benthic diatoms, to carry out a collection of benthic diatoms from around the entire margin of the lake (at approximately 30 km intervals), and to establish a diatom herbarium and PC database at LI. Investigating the diatom taxa present in some 200 samples from 53 stations around the lake represents a considerable challenge and several additional specialists in particular diatom genera (Dr S. Droop, Dr P. Kociolek, Dr Khursevich, Prof. H. Lange- Bertalot, Prof. D. Mann, Dr. G. Reid) kindly agreed to participate in the taxonomic study.

The lake survey was carried out in late June/early July in both 1997 and 1998 and samples of epilithic diatoms were collected at each SAMPLING STATION from ca 1 and 20 m depth. Frequently, epipelon samples were also collected. All resulting samples are now incorporated into collections held at NHM and LI. Furthermore, samples have been distributed to participating specialists for taxonomic work. Although definitive high resolution taxonomy of many species complexes is not yet available, it is clear that the deep water samples are more diverse and diversity is greater on silt/sand substrates than on stone. Hence, there is good separation of species according to substrate and depth. Frequency analysis of the 1 m water depth samples shows that some taxa are rather patchy in their distribution (e.g. morphotypes of *Didymosphenia germinata*), whilst others show a consistent regional preference (e.g. morphotypes of *F. vaucheriae, A. minutissima*).

The preliminary results also indicate that no taxa, at least in the shallow water samples, show a clear distributional restriction to any one of Baikal's three main basins. On the other hand, this study so far has revealed little information about the distribution of the endemic benthic diatom flora of the lake below 1 m depth. The well known conspicuous endemic benthic taxa tend to be both large and rare and are virtually absent from the shallow water benthic diatom communities. Until taxonomic reviews of the deep water benthic taxa are received it is not feasible to undertake distributional studies of diatom communities present at the ca. 20 m depth zone.

The shallow water benthic diatom communities are dominated by forms (e.g. *Fragilaria vaucheriae* and *Hannaea arcus*) thought to be cosmopolitan in distribution. However, there are subtleties of morphological difference from the cosmopolitan types. SEM investigations of these taxa is needed to establish the precise identities of the baikalian forms. Concordance of diatom community species composition with other groups in Baikal is largely unknown as are floristic links with surrounding lakes. Despite the value of such 'satellite' lakes research, present restrictions in European Union funding themes means that international financing of this work is not *currently* feasible.

Koen Martens (Royal Belgian Institute of Natural Sciences): **Origins and maintenance of biodiversity in ancient lakes**

There are only a dozen or so truly ancient lakes in the world (longevity > 1 Myr), and most of these are characterised by high standing biodiversity, which furthermore has a high percentage of endemicity. Extant biodiversity results from a combination of original immigration, followed by speciation and extinction processes. Studies on speciation in ancient lakes mostly focus on the tempo and mode and on intrinsic and extrinsic factors affecting the process. Speciation can either be gradual or punctuated, and can occur allopatrically (during low lake stands, several isolated basins are formed), parapatrically (along geographical or ecological clines) or sympatrically. Especially the latter mode of speciation is still highly controversial. Lake level fluctuations, as well as other climatic and limnological changes, can then be considered as extrinsic factors promoting speciation. A whole array of biotic (intrinsic) factors promoting speciation in ancient lakes have been cited; most of these are related to limited intralacustrine dispersal abilities and can thus be linked to parapatric speciation. There are three main groups of such intrinsic factors: reproductive modes (including brooding, chromosomal arrangements, etc.); ecological segregation (sediment type, bathymetry,...) and interactive factors (competition, mutualism, ...).

Maintenance of high levels of diversity in ancient lakes was traditionally explained by niche diversification. However, this concept from the ecological balance paradigm, albeit process- related, as it links diversity patterns to adaptive speciation, cannot alone explain the sympatric persistence of dozens of species with very similar requirements. Invoking metapopulation dynamics, a theory illustrating the new ecological flux paradigm, does help to understand how stochastic processes of local extinction and immigration between patches can maintain high diversity levels. But what are the effects of these high (specific) diversities at the ecosystem level? Modern biodiversity studies would label such species flocks with similar niches as redundant species, whose presence or absence has relatively little effect on ecosystem processes and resilience. This as opposed to key stone species, usually predators, which mostly have large impact on ecosystems. Are ancient lakes full of redundant species, in which case their conservation is not a critical issue? These questions are directly related to the degree of ecological stability of long-lived lakes.

Climatic cyclicities occur at different time scales, with oscillations ranging from less than 1000 years, over Milankovich cyclicity (20-100,000 years) to even longer-term changes. Ancient lake ecosystems are long-lived habitats and are exposed to cyclicities within a whole range of time frames. They can therefore hardly be considered stable habitats. Ecosystems can have several so-called stable states, and correlations between levels of diversity and efficiency of ecosystem processes have been demonstrated. Most of these models show a lag-phase between two states: ecosystems can loose a certain degree of diversity (the redundant species) before they change state and level of efficiency of their processes. The redundant species thus provide a buffer for an ecosystem, to survive a certain degree of environmental change (resulting in species loss), before it collapses into a different state. Short-term cyclicity is predictable within the life span of a population, Milankovich cyclicity is predictable within the life span of a species. They can thus be considered selective pressures at both levels. It remains to be shown if such cyclicity acts within the life span of an ecosystem, and if we could assume selection (and hence evolution) at the ecosystem level.

Prof. David Mann (Royal Botanical Gardens, Edinburgh). **Taxonomic and evolutionary implications of diversity studies on the benthic diatoms of Lake Baikal.**

Diatoms are known from the early Mesozoic period and all the major lineages are now discovered. In Lake Baikal, the endemic benthic taxa can all be considered as representatives of genera already described elsewhere. This lake, however, displays a great diversity of benthic diatom taxa and variation occurs at either the species or subspecies level. There are marked differences in the species diversity of genera, of the naviculoid diatoms taxa in Baikal and *Navicula* (sensu stricto), *Sellaphora, Diploneis* are particularly diverse. On the other hand, some genera represented in Baikal are not diverse, examples of these are *Pinnularia, Eunotia, Epithemia.* In Baikal here are also interesting endemic representatives of the predominantly marine genera *Biremis* and *Fallacia.*

The extensive and systematic sampling of the benthic diatoms communities of Baikal in 1997 and 1998, funded mainly by the Darwin Initiative, has produced a valuable collection that provides considerable scope for diversity research. So far, from this wealth of material, one species complex has been examined in some detail. *Sellaphora bacillum* is relatively common in some epipelon samples and morphological examination has shown this taxon to exist as a species-complex with at least five morpho-types present. These variants can be termed 'demes' but as yet their taxonomic significance in Baikal remains to be confirmed. However, extrapolating from the extensive studies of this genus already carried out in the UK, it is likely that the demes present in Baikal are sexually incompatible. If this is so, then these demes should be considered as separate species. This has at least two significant implications: i. the current estimate of benthic diatom species in Baikal could be underestimated by a factor of 5(?) and ii. since these demes clearly occupy the same habitat their existence could evidence sympatry.

Dr Isa Schön: (Royal Belgian Institute of Natural Sciences): **Comparative analysis of Baikalian *Cytherissa***

Ostracods, small bivalved crustaceans, form a significant part of the endemic fauna in ancient lakes. In Lake Baikal and Tanganyika, 90% and 95%, respectively, of the ostracod fauna are endemic. We compare modes of evolution and speciation between two closely related ostracod species flocks from the two most ancient lakes in the world, the *Cytherissa*-flock from Lake Baikal and the *Cyprideis*-flock from Lake Tanganyika. Whereas the former comprises c. 50 (sub-) species in one genus, the latter holds at least 16 endemic species in 7 endemic genera.

Morphological and molecular grouping (COI sequence data) of the Baikalian flock shows a remarkable congruence. Differences are due to "morphological freaks", species with striking valve morphologies, which most likely are an example of convergent evolution.

Not even sequence data from three different genes (ITS1, COI and 16S) are able to resolve the phylogeny of the Baikalian flock completely. This result is best explained by explosive speciation. The Tanganyikan flock, in contrast, shows a well-resolved phylogeny and is monophyletic. The Baikalian species flock is the younger of the 2 ostracod flocks, with an age estimate between 3 and 5 myr. Thus, *Cytherisssa* represents a rather young flock in an ancient lake. Its age estimate coincides with drastic climatic changes in the Baikalian region during the Miocene, during which the cold, oxygenated abyss was formed. These conditions fit very well with the ecological requirements of recent *Cytherissa*-species, which are cold stenothermal.
The *Cyprideis*-flock from the younger lake seems to be the older flock, with of age between 3 and 7 myr. Our age estimate furthermore suggests that this flock could

survive drastic lake-level fluctuations, which even led to the formation of three separate sub-basins 200,000 years ago.

Dr Anson Mackay: (ECRC, University College London): **Diatoms in recent sediments of Lake Baikal**.

This talk began by emphasizing that endemic planktonic diatoms play a central role in the Lake Baikal ecosystem. They are the dominant primary producers in the lake and doubtless have been so in the past since the lake's exceptionally long sediment record is very diatom rich. In recent studies we have sought to develop an understanding of the relationships between endemic planktonic diatom production and life-cycle strategies, diatom sedimentation in the water column, and diatom preservation and accumulation in sediment records.

Our primary aim has been to explore, using quantitative techniques, the potential and limitations of endemic diatoms as indicators of past environmental change in the sediment record. Data from associated projects have been central to our work. These included data from the regular monitoring of phytoplankton crops, samples and data from the deployment of sediment trap arrays and core material from many locations throughout the lake.

Some of the results are striking and provide definitive answers to some of the issues that have long been debated amongst Baikal scientists.

· endemic diatom population sizes are controlled by the physical environment of Baikal, e.g. temperature, ice formation and mixing, rather than by nutrient availability.
· population successions are also controlled by complex interactions with zooplankton
· little diatom valve dissolution occurs in the water column, except perhaps for *N. acicularis*, and some weakly silicified *Synedra* spp.
· only c. 1 % of total diatoms in the water column are finally incorporated in the sediment record
· diatom dissolution occurs principally at the surface sediment - water interface
· preservational differences are species specific and preliminary correction factors are being established
· analysis by canonical ordination techniques suggest that several climate linked variables are significant in explaining some variation in the diatom flora
· inference models constructed as predictors of climatic variables so far, show promise and we are confident that they can improved
· snow depth in March and the July heat balance have been reconstructed over the last 500 years or so, and applied to the core BAIK38. They tentatively demonstrate changes in climate consistent with a cold period coinciding with the Little Ice Age and an ameliorating climate during the last 150 years

Funding was from NERC (contract - No. GR3/10529) and the Royal Society are gratefully acknowledged.

David M. Williams and G. Reid (The Natural History Museum, London): ***Eunotia clevei* and its relatives.**

In this presentation the morphology and systematics of the species *Eunotia clevei* were briefly discussed. The varieties endemic to Lake Baikal (*E. clevei* var. *hispida* and var. *baicalensis*) and *Eunotia lacus-baikalii*. *E. clevei* var. *hispida* is characterised by long, bifurcating marginal spines, evident in both light and electron microscopy. It is possible that the specimens in Lake Baikal all belong to the var. *hispida* which should be elevated to species status.

E. clevei occurs mostly as a fossil, in localities from around the world. The suggestion that it is a living fossil is negated by its occurrence in Lake Hubsgol in Mongolia as well as some additional varieties in Chinese river systems.

Eunotia clevei is unique among the species of this genus in having an Amphoroid symmetry raising intriguing questions as to its phylogenetic position among the Eunotiod diatoms and its possible relationships with the newly described genus *Eunophora*.

Miranda von Dornum (The Institute of Opthalmology, University College London) **Molecular Evolution of Cottoid Fishes of Lake Baikal** (work with James K. Bowmaker and David M. Hunt).

There are three families of cottoid fishes in Lake Baikal, comprising 29 species of which 27 are endemic to the lake. These taxa occupy depth habits ranging from littoral to abyssal, an ecological range which is made possible by the fact that the lake is oxygenated throughout the water column. The phylogenetic relationships within this group have long been a subject of controversy.

In this analysis, nucleotide sequence data for the rhodopsin locus were analyzed phylogenetically for 12 cottoid taxa from Lake Baikal, representing all three extant families in the lake. Data for two outgroup taxa, *Taurulus bubalis* and *Carassius auratus*, were also included. The single most parsimonious tree that resulted indicates that the presently accepted families are paraphyletic. The earliest branching point separates *Cottocomephorus* from the remaining taxa, with 73% bootstrap support. This is followed by a branch leading to *Cottus kessleri*, then a split between two clades containing the remaining taxa: one clade consists of *Batrachocottus*, *Limnocottus*, *Cottinella*, and *Abyssocottus*, while the other contains *Comephorus*, *Paracottus*, and *Procottus*.

The placement of *Comephorus* well within the Baikal cottoid radiation indicates that this unique genus has probably undergone fairly rapid recent morphological evolution, rather than representing an ancient divergence from the other taxa in the lake. Intriguingly, this molecular phylogeny corresponds very well with the depth distribution of taxa in the lake, with abyssal and supra-abyssal species clustering together to the exclusion of littoral and sublittoral species. In addition, although this tree conflicts with morphology-based estimates of phylogeny for this group, it corresponds well with another published molecular phylogeny based on mitochondrial data.

Using these rhodopsin data to estimate the time of branching events in the tree, it is suggested that the age of the Baikal cottoid flock is approximately 4.9 ± 0.8 million years.

A REVIEW OF THE MEETING

Biodiversity research in Lake Baikal currently involves several lines of investigation: evolutionary histories of taxa using molecular studies, molecular systematics, taxonomy and morphological studies of extant taxa, palaeolimnological studies, modern distributions of taxa and the provision of recording facilities for taxonomic and species conservation purposes. Work has previously been overwhelmingly concerned the diversity of animal groups in Baikal. This is the first meeting were baicalian animals and plants (diatoms) have been considered together. However, it is clear that the foci of diversity research on the fauna and flora has been different and that multi-group ecosystem studies at the species and sub-species level remains to be carried out on the biota of Baikal.

The individual topics discussed covered a selective but wide range of recent and current joint research projects on Lake Baikal. Evolutionary histories derived from the analysis of nucleic sequencing data for several groups of Baikal endemic invertebrates were described by Dr Sherbakov. Dr Timoshkin gave a thorough account of the animal diversity in the lake and raised the issue of non-Darwinian evolution of turbellarian reproductive structures. Prof. Mann showed that at least one species of benthic diatom displayed an array of morpho-types (referred to as 'demes') that suggest sympatric mechanisms operating on this and probably other related taxa in Baikal. A more theoretical account of diversity in large lakes was given by Dr Martins who described different evolutionary and speciation processes using ostracods and other examplars. The issue of species redundancy and the wider significance of endemic species flock was also raised here. Dr Schon noted the value of morphological work in setting questions for molecular studies and used ostracods as examples of how to discriminate between young and old species flocks. The value of molecular studies on the visual pigments of Baikal endemic fish can be used to infer phyolegenetic relationships between taxa. Dr. von Dornum suggested that such work could be used to indicate habitat origins for some modern species. More importantly, this work showed the value of using genetic measures rather than morphological criteria when describing evolutionary histories of fish groups.

Diatoms are unique in Baikal because they have an excellent sedimentary record that can be used to test ideas about ecology and evolution. Palaeo-records of diatom diversity, described by Dr Mackay, showed that diversity changes can be linked with climate change in recent centuries. Preliminary results concerning to distribution of diatoms around the lake were used to map diversity of this group and to set ecological baselines for taxa. The value of providing recording and monitoring facilities for baikalian taxa was emphasised.

It was clear that speciation patterns displayed by different animal and plant groups are dissimilar and have occurred at different periods in the past. According to molecular data, fish and Crustacea have markedly different evolutionary patterns. Extant species distributions appear to exist without concordance and as yet there appears to be no strong link between modern endemicity patterns of diatom species and those of other groups. However, since the distribution limits of many modern endemic invertebrate taxa are not well known it is difficult to reach clear conclusions at this stage . The hypothesis that locations of hyper-endemicity show congruence between groups requires specific testing. Diatom data that sets taxonomic limits for at least some endemic benthic taxa should eventually be available from the UK Darwin Project but much work on the taxonomy and distribution of deep littoral taxa (in all groups) remains yet to be done.

Recognition that some diatom species are composed for several morphologically recognisable populations raises more questions about the distribution of these diatom taxa in Baikal. These populations could indicate 'first-steps' (or incipient species, to use Charles Darwin's original terminology) in speciation or that the formally accepted species limits contain inherent variability so that species-complexes exist that contain reproductively independent and stable taxa. Work on the significance of diatom populations is however in its infancy in Baikal. At a higher level, the existence endemic species flocks in several baikalian groups is well known. Their significance was briefly discussed and the majority opinion was that their presence is unrelated to micro-niche adaptation. On the other hand, this hypothesis cannot be ruled out for diatoms. Further, flocks represent a type of species redundancy in the sense that many are superfluous or 'redundant' to the needs of efficient ecosystem functioning. In another sense it was noted that endemic species represent a biological *cul de sac* since they have failed to disperse widely. No consensus was reached about why some groups had speciated so strongly in Baikal and others had not. Endemic diatoms are restricted to the species level whilst in the Crustacea several entire families are endemic. In general, those diatoms recognised as endemic in the literature tend to be conspicuous and uncommon whilst some endemic invertebrates, gammarids for example, are very common. On the other hand, diatom endemicity may be under-estimated since some common forms are suspected of possessing small morphological differences that separate them from cosmopolitan sister taxa. The role of grazing in exerting selection pressure on diatom morphology is unresearched. It was agreed that more research effort should be made to integrated studies of how one group interacts with another in the Baikal ecosystem. Improving links generally, with morphological and molecular studies and with palaeo-records where appropriate, was advocated.

The value of not treating Lake Baikal as a special case but relating its diversity to that elsewhere was emphasised by several contributors. This could be achieved in a variety of ways, three of which follow. Firstly, by comparing characters in endemic baikalian taxa with related taxa elsewhere. Secondly, by comparing evolutionary histories of endemic baikalian taxa with those elsewhere. In this case it was noted (Dr Sherbakov) that a major evolutionary event occurred in Baikal some 3.4 million years ago - did a similar event occur elsewhere? Thirdly, endemic taxa occur in the region around Baikal and these may or may not be closely related to baikalian endemics but since regional aquatic biodiversity is poorly known there remains considerable scope for extending diversity studies in Siberia.

The value of studying speciation in Baikal is that it can lead to a better understanding of evolutionary processes generally. Furthermore, recording of taxa and the value of good taxonomy combined with both past and modern species distributional data is an essential part of lake biota conservation programmes - it is a way of directly measuring diversity change

Future Work: Funding problems for joint research and the reduction in funding for basic research in Russia under the European Union's INCO-Copernicus fifth framework scheme were noted. Despite current funding restrictions, support for joint European involvement in Baikal research is probably best sort through the European Union. This would broaden and help integrate lines of diversity research and would facilitate linkage between diversity topics. Nevertheless, it was considered that bilateral initiatives also offer considerable potential to continue and to expand diversity research in Baikal.

END OF MEETING - 19th October 1999.

Workshop on the Taxonomy of Lake Baikal Diatoms with Special Reference to The Darwin Project on Benthic Diatoms
20-22nd October 1999

Participants and contributors

Dr. Stephen Droop, The Royal Botanical Gardens, Edinburgh, Scotland, UK

Dr Roger Flower, Environmental Change Research Centre, University College London, UK.

Dr. David Jewson, University of Ulster, Coleraine, Northern Ireland, UK.

Dr Galina Khursevich, Geological Sciences Institute, Minsk, Belarus

Prof. Horst Lange-Bertalot, Botanisches Institut, Frankfurt am Maine, Germany.

Dr . Galina Pomaskina, Limnological Institute, Irkutsk, Russia.

Dr. David Ryves, Geological Survey of Denmark & Greenland (GEUS), Copenhagen, Denmark.

Dr Geraldine Reid, The Botany Department, Natural History Museum, London UK.

Dr. David Williams, The Botany Department, Natural History Museum, London UK.

INTRODUCTION

In 1996 several staff at the Environmental Change Research Centre, University College London and The Department of Botany, The Natural History Museum London were awarded a joint project with the Limnological Institute, Irkutsk to investigate benthic diatom diversity in Lake Baikal. This workshop focuses mainly on this DARWIN INITIATIVE Project but some time was also devoted to several issues concerning planktonic diatoms that arose from and earlier workshop (held at University College London, in March 1998).

As part of the DARWIN INITIATIVE Project for Benthic Diatoms in Lake Baikal, collections were made from the lake in 1997 and 1998. Sub-samples were distributed to taxonomic specialists (see below) in particular genera and this workshop is designed to assess progress made on subsequent taxonomic investigations. As indicated earlier, one aim of this project is to establish group diversity with special reference to the endemic taxa and their relationships.

At the March 1998 workshop, diatom slides were distributed for an inter-laboratory counting exercise these results will be examined during this meeting. This is seen as an important step in establishing quality control in joint research using sedimentary diatom analysis.

Also at the March 1998 workshop a protocol was established for joint work on the Baikal collection. This 1998 protocol was stated as follows:

'We regard it as a major priority that, using the Darwin material, as many taxa as possible are described or re-described (where appropriate), validated and attributed to formal botanical names. Where this is not possible without much further work, taxa should be described and imaged and given temporary names.

To meet these objectives within the lifetime of the project we have enlisted the help of a number of taxonomic specialists. These specialists have *initial* responsibilities for working on pre-selected genera according to the following scheme:

David Williams(NHM): Araphid diatoms, *Eunotia*
Roger Flower(UCL): Centric diatoms*, *Eunotia, Amphora*
David Mann(RBG): Naviculoid taxa, *Amphora*
Pat Kociolek (USA): *Gomphonema, Didymosphenia* and related taxa
Horst Lange-Bertalot (BI): *Nitzschia, Surirella*, and *Cymbella/Encyonema**
Stephen Droop (RBG): *Diploneis*
Geraldine Reid (NHM): *Gyrosigma*
Galina Khursevich (Minsk): *Achnanthes* (sensu lato), *Cocconeis*.
Galina Pomaskina and Y. Radionova (Irkutsk): Centrics, *Cymbella*

*with this genus complex it is important to work jointly with taxonomists at the Limnological Institute Irkutsk

To proceed efficiently the project co-ordinators recommended the follow guidelines:

1. In the initial stage of the project each participant should study taxa according to their allocated genera.

2. Each participant can jointly study DARWIN material with other taxonomists, either within the group or from elsewhere following consultation with the co-ordinators..

3. A workshop will be arranged at the Natural History Museum during 1999 and participants will be expected to contribute plates of photographs illustrating taxa from their allocated genera so that an unpublished Baikal benthic diatom flora can be assembled.

4. Participants are requested not to freely distribute DARWIN samples beyond the above group of participants during the initial stages of the project.

5. During the final year of the project (2000/1 AD) the main collections (at the Natural History Museum and the Limnological Institute) will be made available for access according to usual museum regulations.

6. Participants are encouraged to publish results of their taxonomic investigation promptly but giving special consideration to involving our Russian participants where possible. Ideally, we would like to see each participant contributing at least one paper towards a collection of papers introduced by the co-ordinators. All papers should include a reference to the Darwin Initiative Project in the title or in the acknowledgements.

7. Wider implications of the initial taxonomic investigation can be referred to in initial publications but it is hoped that any in depth considerations of the origins and the relationships of the Baikal flora will form a second phase of the work..'

Several aspects of this protocol guide were discussed at the October 1999 meeting (see below).

The Programme: The meeting was held at the Natural History Museum, London and we began with accounts of the distributions of common taxa (Wednesday). The main taxonomic sessions will be on the following two days and was structured as follows:

Wednesday 20th October 1999

2.00	Welcome	Dave Williams
2.15	Accomplishments of the Darwin Project regarding Sampling	Roger Flower
2.30	Accomplishments of the Darwin Project regarding archives	Dave Williams
3.00	Results of transect monitoring - species changes with depth	Galina Pomazkina
3.30	Results of work on planktonic diatoms, especially those in the genus *Cyclotella*	David Jewson
4.00	Comparison of quality control counting of diatoms in sediment Samples	Dave Ryves

Thursday 21 October 1999

10.30	*Araphids, Eunotia*	Dave Williams
11.30	*Achnanthes, Cocconeis*	Dr Khursevich
12.15	Gomphonemoid taxa	Pat Kociolek
	Lunch	
2.00	*Diploneis*	Stephen Droop
2.45	Naviculoid taxa	David Mann
	Break	
4.00	*Nitzschia, Surrirella & Cymbella/Encyonema*	Horst L. Bertalot

Wednesday: Although some minor changes were made in the above programme the workshop began at 2.00 pm 20/10/99:

David Williams (Botany, Natural History Museum, London) opened the workshop by introducing the Natural History Museum and its activities and by defining some objects for the workshop that were related to the diatom collected made as a result of the Darwin Project. Some changes to the programme were noted and apologies for the absence of David Ryves, Pat Kociolek, David Mann and the Darwin Fellow Yelena Radionova were given.

PRESENTATIONS

1. **Roger Flower** (ECRC, University College London) gave a brief account of the distribution of diatoms around the lake that partly recapped on the Darwin Project results presented earlier in the Baikal Meeting. However, the structure of the diatom recording centre, established by the Darwin Project, as the Limnological Institute, was described in greater detail. In essence, all diatom samples collected from around at ca 1 m and ca 20 m depths are recorded on a PC database (devised by David Williams), each sample from each sampling station having a unique 'BK' number. Samples are

made up on to coded microscope slides that are archived at both the Limnological Institute and at the Natural History Museum, London. Samples collected during the diatom monitoring part of the Darwin Project where from two depth transects in the littoral zone at two points (Bolshoie Koty and Baikalsk). These transects were sampled at monthly intervals (see below) and results are archive at the Limnological Institute only. It is anticipated that monitoring of each transect will continue in the future but at a reduced frequency so that samples are collected in late June only.

2. **Galina Pomazkina** (Limnological Institute, Irkutsk) gave an account of the Darwin Project transect monitoring work: During transect sampling in 1998, 533 diatom taxa were identified in the microphytobenthos of the Southern Baikal littoral zone. These included 18 families and 52 species, which according to ecological preferences described in the literature, indicate that they mainly indicate oligotrophic conditions.The representatives of the Class Pennatophyceae are dominant (12 families and 42 species). The class Centrophyceae is represented by 5 families and 10 genera and species are most diverse in the Families Naviculaceae and Achnanthaceae. The highest number of genera are found in the Families Naviculaceae and Achnanthaceae, Fragilariaceae and Gomphonemataceae. The largest number of species is observed in the following genera *Navicula* 101, *Achnanthes* 40, *Cymbella* 33, *Nitzschia* 26 and *Gomphonema* 21.

The structure of microalgae communities on various substrate types was distinguished in the littoral zone of Lake Baikal. In the first and second, vegetation belts the structure of microphytobenthos communities is rather mono-dominant, consisting of representatives of genera *Hannaea*, *Cymbella*, *Cocconeis* and *Synedra*. *Didymosphenia* spp. are present in small in numbers. Community structure becomes complicated with the depth as diversity increases with microalgae of genera rich in taxa (*Navicula, Nitzschia, Achnanthes*). The great number of species dominant in the communities testifies to the heterogeneity and diversity of microphytobenthos in the littoral zone.

The microphytobenthos biomass is different at various sites in Southern Baikal. Its quantity is connected with its development and reflects different sets of ecological conditions. Biomass at the transect locations varies from 0.01 to 3 g/m^2. Each zone has its own characteristic species composition of microphytobenthos. The number of taxa and biomass can be generally referred to "high" gradation according to Zhykinsky's classification.Various degrees of microphytobenthos development were found to depend on water depth and habitat types.

On the western coast of Southern Baikal, the transect extended over a rocky shelf and the species variability is high during the whole year. Rare and endemic microalgae are often dominant or subdominant. At an equivalent depth to the shelf region but on the eastern shore there is a more widely spread microalgal community of small cell taxa.

The seasonal and interannual dynamics of number and biomass of microalgae were studied. The species dynamics is reflected by floristic changes within the dominant communities, by the differential development of individual species. The maximal peak in dynamics occurred in summer when the communities are composed of taxa typical of both the spring-summer and summer periods. Also present during this time, due to settlement, were plankton species. Minimal values are observed in winter when microalgae with small cells were dominant; these taxa were present all the year round.

The zonal distribution of taxa, number and biomass were studied. The fluctuations of these indices depended on the development of macrophyte algae, type of substrate, temperature, hydrodynamic and hydrochemical factors. In winter time, the transparency and thickness of ice plays an important role in determining diatom growth. In Southern Baikal, most of the littoral is divided into vegetational zones and the most productive zone for the microphytobenthos is the 'third' vegetation zone. This zone also differs in showing a more diverse floristic (diatom) composition.

3. **David Jewson** (University of Ulster) described some new work on the endemic *Cyclotella* taxa in Baikal that followed up some discussions made at the first diatom workshop in 1998. Work on *Cyclotella* is continuing, specifically on the relationship of different taxa within the *C. baicalensis* - *C. minuta* complex. A morphological examination of many salient features indicates that there is no clear separation of these taxa according to size and valve structure. Future molecular studies should be undertaken to indicate how these taxa can be distinguished.

Observations on the occurrence of benthic diatom communities at depth were also made: although the abundance of epilithic diatoms were rather sparse at 20 m depth, many species are present. Clearly, these algae can grow well below this depth and theoretical estimations, based on light penetration characteristics of Baikal water, suggest that the maximum depth could be between 40 and 50 m. However, some coastal zones of Baikal exhibit less clear water and here (Maleo More and the west side of the North Basin for example) the depth limit of benthic diatom growth will be less.

4. **David Ryves** (Geological Survey of Denmark & Greenland, GEUS): Dr Ryves was unable to attend the meeting and his presentation was given on his behalf by Roger Flower. A brief account of the diatom inter-laboratory calibration exercise that was initiated at the 1998 workshop was given. In 1998 two samples of Lake Baikal sedimentary diatoms were made up on to glass slides and distributed to the diatom group at Minsk and to the diatom group at the Limnological Institute. Only Dr Ryves knew the sample identities so participants were asked to do 'blind' counts on the two sample slides. Each group was asked to estimate the abundances of common taxa in each slide and to estimate the degree of diatom dissolution. Results of the UK analysis were presented (see Appendix 1). Each sample was analysed for the proportions of common taxa and for estimations of the preservation states of *Cyclotella* and *Aulacoseira* taxa.

In Sample 1 *Cyclotella minuta* was most abundant and in Sample 2 the most common was *Synedra acus v. radians fo. pusillus*. Approximately 30% of *Cyclotella* taxa showed signs of dissolution but this increased to 70% in S2. The full results of the inter-laboratory comparison were given in spreadsheet form and these are represented graphically in Appendix 1. Here, to make the diatom analysis results from the three laboratories show that DDI (Diatom Dissolution Index) results between UCL and Minsk are fairly similar. Dissolution values for individual taxa were given where ca. 10 or more valves were assessed for dissolution.

For taxon frequency estimates, there are some agreements and some differences (see results of comparisons of *A. baicalensis, S. binderanus & S. inconspicuus* counts for slide AQC1, Appendix 1. The frequency results from LI are probably most accurate because here a greater number of valves were counted.

Overall, an encouraging degree of taxonomic harmony was achieved. This is probably sufficient to proceed with interlaboratory co-operative studies involving diatom analysis of Baikal sedimentary material. These results give also give some encouragement for more universal usage of dissolution assessment in diatom analysis but analysts need to careful co-ordination techniques. Taxonomic workshops and use of Internet facilities should be encouraged so that specific image recognition problems can be readily resolved.

Thursday: The workshop began at 10 am and the day was devoted to discussions about individual taxa groups.

5. **David Williams** (Natural History Museum) gave an account of a raphid diatom genus: *Eunotia* and a short discussion on *Hannaea arcus*. *Eunotia clevei* was originally described from fossil material collected in Sweden and appears to be closely related to forms described by Skvortzow as endemic to Baikal (*E. baicalensis, E. clevei v. hispida*). Some *Eunotia* taxa in Baikal also occur in near by Lake Hubsgol in Mongolia. *Hannaea arcus* is very common in Baikal but the relationship of this morpho-species found with *H. arcus* elsewhere requires further study.

6. **Galina Khursevich** (Geological Sciences Institute, Minsk) gave an account of the monoraphid diatoms, *Achnanthes* (sensu lato) and *Cocconeis*. The following species of *Achnanthes* sensu lato were studied in SEM:

Achnanthidium minutissimum (Kutz.) Czarnecki (1994). Length 5.7 - 7.4m , width 1.3 – 2 μ, striae on the P –valve 35 in 10 μ. Occurrence: samples 19, 20, 26.1
Achnanthidium affine (Grun.) Czarnecki (1994). Length 5.8 – 7.5 μ, width 1.8 – 2.3 μ, striae on the R-valve 40 in 10 μ. Occurrence: 9.3, 19, 26.1
Achnanthidium biasolettianum (Grun.) Round & Bukhtiyarova (1996). Length 30 μ, width 7 μ, striae on the R-valve 22 in 10 μ. Occurrence: 25.3
"Achnanthidium" biasolettianum var. *suatomus* (Lange-Bertalot) Length 4.2 – 4.3 μ, width 2 μ, striae on the R-valve 30 in 10 μ
Planothidium calcar (Cleve) Round & Bukhtiyarova (1996)
Length 10.0 – 13.7 μ, width 7.0 –9.6 μ, striae on the P-valve 25-35 in 10 μ, Striae on the R-valve 30 in 10 μ. Occurrence: 9.3, 20, 25.3
Planothidium lanceolatum (Breb.) Round & Bukhtiyarova (1996). Length 8.7 – 27 μ, width 5.0 – 14.0 μ, striae on the P-valve 11 – 16 (18-20) in 10 μ. Striae on the R-valve 15 in 10 μ. Occurrence: 9.3, 12, 20
Planothidium oestrupii (Cleve-Euler) Round & Bukhtiyarova (1996)
Length 14.5 - 16 μ, width 8 – 10.7 μ, striae on the P-valve 12 – 15 in 10 μ. Occurrence: 25.3, 29.2
Planothidium delicatulum (Kutz.) Round & Bukhtiyarova (1996)
Length 9.3 μ, width 4.3 μ, striae on the R-valve 20 in 10 μ. Occurrence: 29.2

Karayevia clevei (Grun.) Round & Bukhtiyarova (1996). Length 11 - 20 μ, width 5.6 – 7.5 μ, striae on the P-valve 10 – 15 in 10 μ, striae on the R-valve 32 – 35 in 10 μ. Occurrence: 12, 22.2
Karayevia laterostrata (Hust) Round & Bukhtiyarova (1996)
Length 7.3 – 10.6 μ, width 3.1 – 5.3 μ, striae on the P-valve 20 on 10 μ,
Striae on the R-valve 20 – 25 in 10 μ. Occurrence: 7.2, 19, 25.3
"Kolbesia" nitidiformis (Lange-Bertalot) Length 9.1 – 10.2 μ, width 3.6 – 4.6 μ, striae on the P-valve 20 in 10 μ. Occurrence: 20, 25.3

7. **Stephen Droop** (Royal Botanical Gardens) gave an account of the genus *Diploneis*. Old papers by Skabitchevsky, Skvortzov and Meyer, and the floras of the 1950s list around 20 *Diploneis* species and infraspecific taxa occurring in Lake Baikal, of which 16 are endemic. Preliminary investigations of samples collected as part of the Darwin Initiative Project suggest that these figures are a gross underestimate.

If patterns of variation in *Diploneis* in Lake Baikal mirror those in the marine species around the coast of Britain (and first results suggest that they do), then the observed morphological discontinuities between populations within individual samples from Lake Baikal represent species boundaries. In that case the number of species of *Diploneis* in Lake Baikal is probably nearer to 100 than 20, and the level of endemism is probably higher than the 80% estimated in the early accounts. Endemic species already identified in samples include *D. meyeri, D. baicalensis, D. late-elliptica, D. turgida* and *D. jasnitskyi*. However, these and several cosmopolitan species listed in the accounts as occurring in Lake Baikal (for example *D. marginestriata, D. elliptica, D. mauleri*) probably each represent several more narrowly delimited species. No culturing work is possible on these taxa at this stage and the study of *Diploneis* species complexes in Baikal is on-going.

8. **Horst Lange-Bertalot** (University of Frankfurt) gave an account of the *Nitzschia* taxa present in the Baikal samples. The diversity of *Nitzschia* species is high in Baikal and of the 78 *Nitzschia* taxa described in the Susswasserflora (volume 2/2) about 60 % of these were found in the Baikal samples. There are three groups present, cosmopolitan taxa, those very near to cosmopolitan taxa (but differ in detail, these are regarded as Baikal 'sippen'), and endemic taxa. *Nitzschia angustata, N. fonticola* and *N. sublinearis* were given as examples of a species complexes that possess several Baikal 'sippen'. Additionally, *N. heufleriana* in Baikal samples was noted as having differences in fibular structure compared with the nominate form. Work to date indicates that six taxa are new and previously undescribed and that three taxa are unknown. Further work may show that these latter three are also new.

A series of photographs of the new and interesting taxa were presented to the workshop participants for discussion. It was agreed that the well known cosmopolitan taxa did not be noted but not described further.

Some time was spent jointly scrutinising several *Nitzschia* taxa from Baikal using the microscope facilities provided by the Museum. There was some discussion on the identity of one taxon provisionally allocated to *Nitzschia* cf. *tubicola* was identified as

N. bacillariaeformis. The presence of *N. bacilliformis*, rather than *N. amphibia* was noted. The similarity of an obviously new taxon under the manuscript name "super-alpina" with *Nitzschia alpina* Hustedt was discussed. *N. lacuum* was present with no apparent differences from the nominate form.

9. **Galina Pomaskina** gave an account of Cymbelloid taxa. It was noted that so far 33 species of *Cymbella* have been identified in the transect monitoring samples from Baikal. Five taxa, probably species, are unknown. The occurrences of *Cymbella* taxa differ markedly between the Bolshoie Koty and Baikalsk transects. At the latter, the near by Polivinka River may exert some influence of taxa occurrences. *Cymbella turgida*, *C. tumida* and *C. ventricosa* were the dominant *Cymbella* spp. present in the shallow water samples. *C. ventricosa* was noted as being the 'old' name, and is represented by a species complex typified most commonly by *C. minuta*. However, *Cymbella reichardtii* and *Encyonema* (*Cymbella*) *lange-bertalotii* Krammer 1997, Bibl. Diat. 36, p. 96., often co-occur with *C. minuta.*

In deeper water samples, endemic *Cymbella* taxa can be common although seasonal variation in numbers is less than in shallow water. *Cymbella stuxbergii* and its endemic varieties are common below 10 m depth.

The *Cymbella* genus was thought to have considerable interest not only in regards of endemic taxa but also in the distribution of its taxa. With further work and planned collaboration with Horst Lange-Bertalot it is hoped to describe several of the unknown *Cymbella* taxa as new species.

Addendum: Pat. Kociolek was unable to attend the workshop but has indicated that most of the Gomphonemoid taxa in Baikal appear to be endemic

DISCUSSIONS

Friday 22nd October was used to discuss issues raised during the preceding two days. Topics discussed included:

1. Numbers of endemic taxa
2. Inter-laboratory calibration
3. Exchange of samples
4. Transect monitoring
5. Producing an iconograph
6. Compiling a checklist
7. Production of a suite of short papers dedicated to the Darwin Project.
8. Time period for restricting general access to the Darwin project diatom samples

Conclusions of the main topics discussed are as follows:

Numbers of endemic taxa: A simple criterion in managing biodiversity is to know how many taxa are present. With diverse microscopic organisms this is a difficult exercise because one can never be sure that sampling is complete, descriptions of many taxa are under revision, and relative abundances of some taxa change through time. It was agreed to refer new findings to earlier diatom inventories. Some recommended references were Meyer 1930, Skvortzov 1937 and Zabelina et al, 1951. The latter reference gives a reasonable summary of taxa known from Lake Baikal up to ca 1950 and are included in Appendix 2. Skabitchevsky's papers should be consulted for the results of taxonomic studies from 1930-1980.

Taxonomic revisions most urgently needed are for *Gomphonema/Gomphoneis*, *Didymosphenia*, *Navicula* (*sensu lato*), and *Diploneis*. Another urgent requirement is to establish the status of the more common shallow water diatoms in Baikal such as *Hannaea arcus*, *Fragilaria vaucheriae (sensu lato)* and the *Cymbella minuta* complexes. Distribution estimates of taxa are currently compromised by poor definition of these taxa from the lake.

Inter-laboratory calibration: Dr Khursevich undertook to complete enumeration of the second test sample as soon as possible (results of this analysis were made available a few days after the workshop ended and are included in Appendix 1). Dr Pomaskina was asked to supply counts for the samples passed to LI in 1998. These have now been carried out by A. Kuzmina and are given in Appendix 1.

Sample exchanges: All the taxonomic experts participating in the Darwin Project have received sub-sets of samples. The Natural History Museum, The Botanical Gardens (Edinburgh) and the Limnological Institute (Irkutsk) have complete sets of samples from around the lake. However, the Edinburgh sample collection contains many additional epipelon samples. The Minsk group had a relatively small set of samples but during the meeting additional samples were made available via Dr Pomaskina from the LI collection. Dr Kociolek has an adequate set of samples but Prof. Lange-Bertalot has few samples with *Surirella* and *Cymbella*. It was agreed therefore to supply additional samples from the LI collection.

Changes in allocation of taxa to each specialist: The list of taxonomists and taxa given in the 1998 protocol guide are confirmed as a reasonable allocation scheme for co-operative work. However two genera, *Pinnularia* and *Cymatopleura*, were not then specified precisely. It was considered appropriate that Prof. Lange-Bertalot should take primary responsibility for these groups, again in close collaboration with LI taxonomists.

Transect monitoring: It was noted by several participants that the value of the work could be enhanced by plotting the percentage abundances of selected taxa against DEPTH as well as against time (sampling season). In ecological papers, the relative roles of grazing, temperature, light, nutrients (only P and Si were limiting in 1997), and growth of macro-algae (*Drepanaldia*) in relation to the composition of benthic diatom communities should be reported more fully. Inferences made at as a result of this could to lead to further work. Furthermore, inter-annual variation is also of great significance for diversity. Notably, the transect work on successional changes indicates that more species are found by sampling fixed transects regularly than are found by single surveys conducted at any one time, such as that carried out around the lake.

Producing an iconograph: It was agreed to assemble an iconograph. This topic provoked considerable discussion about the scope, timing and difficulties of producing of any form of collective image document for the benthic diatoms of Lake Baikal. It was considered that producing a fully documented flora for Baikal (as suggested in the 1998 protocol guide) was not realistic without major new funding and a long term project plan. Producing a diatom image atlas was considered a useful aim, possibly deliverable within five years but, because of current funding and time constraints, it was agreed that the most realistic option was to produce an iconograph (similar to that produced for acid diatoms by the PIRLA group in the USA). Since some participants had already produced their illustrations in the form of plates, an iconograph could be assembled fairly quickly. The following points were made:

- Participants would arrange their diatom images (LM and/or SEM) into standard size plates. In the first instance, these could be sent to Roger Flower for collating.
- The plates should be submitted by about April 2000.
- Initially printed plates will be produced on A4 sized card sheets, photographic or computer generated images may be used
- Each plate must have a scale bar and each LM image should normally be printed at x1500 (exception may be may for very large or small specimens)
- Lay-out of each plate is discretionary
- Each specimen must be numbered and each number listed on a facing page
- Each specimen should be identified to a particular sample
- Species identifications can be given but only if the author has reasonable confidence in a taxon name, otherwise use a cf. or a taxon number as a descriptor.
- Images of specimens of any taxa from the Baikal collection are welcome but the emphasis should be on those thought to be unusual, e.g. endemic
- Images can be either LM or SEM or both.

It was agreed to disseminate the iconograph. Various ways were discussed but hard copy printing was considered too expensive, given funding available. The cheapest alternative is to scan plates and index pages and use PC software to store images on a CD-ROM for distribution.

Compile a checklist: It was agreed to *begin* to compile a checklist. It was noted again that this is not a simple task as it would require:

- A review of the earlier literature
- Compilation of synonymies
- Incorporation of new taxonomic revisions (Darwin Project)
- Check for mis-identifications
- Separation of taxa into endemics (e.g. *D. dentata*), regional endemics (e.g. *E. clevei*) and cosmopolitan taxa

As a practical first step, it was decided to use the checklist already assembled by Dr Pomaskina as a starting point. Dr Flower would provide an EXCEL list of the endemic taxa (see Appendix 2) as recognised up to ca 1950 (i.e. taken from Zabelina et al. 1951 and elsewhere).

Production of a suite of short papers dedicated to the Darwin Project. It was suggested that a suite of short papers dedicated to the Darwin Project should be produced by the participants. These papers could be presented at the 16th International

Diatom Symposium in Greece, 2000. Initial acceptance of this idea has already been given by the Symposium organizers with the suggestion that several should be as posters.

Public access to the collections: The date after which general access to the Baikal collections could be permitted without infringing current research activities was discussed at length. Eventually it was agreed that the current collection should be **temporarily restricted** so that initially participants should have sole access to the collection. It was agreed that the participants would adhere to studies of their allocated groups for a period of five years. Hence, from October 2004 the Baikal benthic diatom collections will be freely available to all.

SUMMARY

The workshop provided a useful forum to assess progress on the taxonomy and distribution of benthic diatoms in Lake Baikal, to exchange information and ideas, and to establish some common goals for future work. In particular, it was agreed to produce an iconograph to help record, disseminate and illustrate the benthic diatom taxa of Lake Baikal. A computer based benthic diatom checklist of Baikal taxa will be established and an agreement was reached to publish a co-ordinated group of short papers on aspects concerning the benthic diatoms collected as part of 1997/98 Darwin Project 1997/98 on Lake Baikal. If an extra year of Darwin funding is forthcoming in 2000 a more comprehensive distribution of taxonomic information is anticipated.

END OF WORKSHOP 22nd OCTOBER 1999

APPENDIX 1

Results of the AQC inter-laboratory comparison

The following histograms and Tables indicate the results of analyses of diatom frequency and preservation made on two different samples of Baikal sediment distributed to participating laboratories by Dr David Ryves in March 1998. The Institute of Geological Sciences, Minsk, and the Limnology Institute, Irkutsk, as well and the ECRC, University College London all participated in this taxonomic analytical control exercise.

The data in this appendix were generated by D. Ryves (now at GEUS), S. Feenya (GI), and A. Kuzmina (LI)

UCL AQC results

Sample DDI **0.48**

Sample UCL1	**Count**	**%**	**Dissolution stage 1**	**2**	**3**	**4**	**Girdle view**	**F index (stage 1/all stages)**
A. baicalensis	67	21.00	39	15	8	5		0.58
A. islandica v. helvetica (spores)	14	4.39	14					
A. islandica v. helvetica (valves)	3	0.94		1	2			
Crateriportula inconspicuus	43	13.48	16	15	12			0.37
Cyclotella minuta (<40 um)	107	33.54	29	10	29	39		0.27
Cyclotella ornata (40-80 um)	9	2.82	3	1	2	3		0.33
Cyclotella baicalensis (>80 um)	7	2.19	2	1	1	3		0.29
Stephanodiscus binderanus v. baicalensis	60	18.81	42	12			6	0.78
Synedra acus v. radians fo. pusilla	1	0.31	1					
Synedra acus v. radians fo. radians	0	0.00						
Synedra acus v. acus	1	0.31	1					
Others	7	2.19	3	1	1		2	
Total	**319**	**100.00**	**150.00**	**56.00**	**55.00**	**50.00**	**8.00**	**0.48**

Sample DDI **0.9**

Sample UCL2	**Count**	**%**	**Dissolution stage 1**	**2**	**3**	**4**	**Girdle view**	**F index (stage 1/all stages)**	**Notes**
A. baicalensis	6	1.70	6						
A. islandica v. helvetica (spores)	2	0.57	2						
A. islandica v. helvetica (valves)	13	3.69	2	11				0.15	
Crateriportula inconspicuus	11	3.13	7	4				0.64	
Cyclotella minuta (<40 um)	18	5.11	14	2	2			0.78	
Cyclotella ornata (40-80 um)	0	0.00							
Cyclotella baicalensis (>80 um)	0	0.00							
Stephanodiscus binderanus v. baicalensis	48	13.64	16	6			26	0.73	
Synedra acus v. radians fo. pusilla	249	70.74	245	4				0.98	60% of valves broken
Synedra acus v. radians fo. radians	2	0.57	2						
Synedra acus v. acus	0	0.00							
Others	3	0.85	1	2					
Total	**352**	**100.00**	**295.00**	**29.00**	**2.00**	**0.00**	**26.00**	**0.90**	

Data from LI

Sample DDI **0.87**

Sample UCL1	**Count**	**%**	**Dissolution stage** 1	2+	**Girdle view**	**F index (stage 1/all stages)**
A. baicalensis	628	37.20	628			
A. islandica v. helvetica (spores)	38	2.25	38			
A. islandica v. helvetica (valves)	5	0.30	5			
Crateriportula inconspicuus	10	0.59	10			
Cyclotella minuta (<40 um)	529	31.34	401	128		0.76
Cyclotella ornata (40-80 um)	96	5.69	90	6		0.94
Cyclotella baicalensis (>80 um)	126	7.46	44	82		0.35
Stephanodiscus binderanus v. baicalensis	205	12.14	205			
Synedra acus v. radians fo. pusilla	0	0.00				
Synedra acus v. radians fo. radians	0	0.00				
Synedra acus v. acus	39	2.31	39			
Others	12	0.71	12			
Total	**1688**	**100.00**	**1472.00**	**216.00**	**0.00**	**0.87**

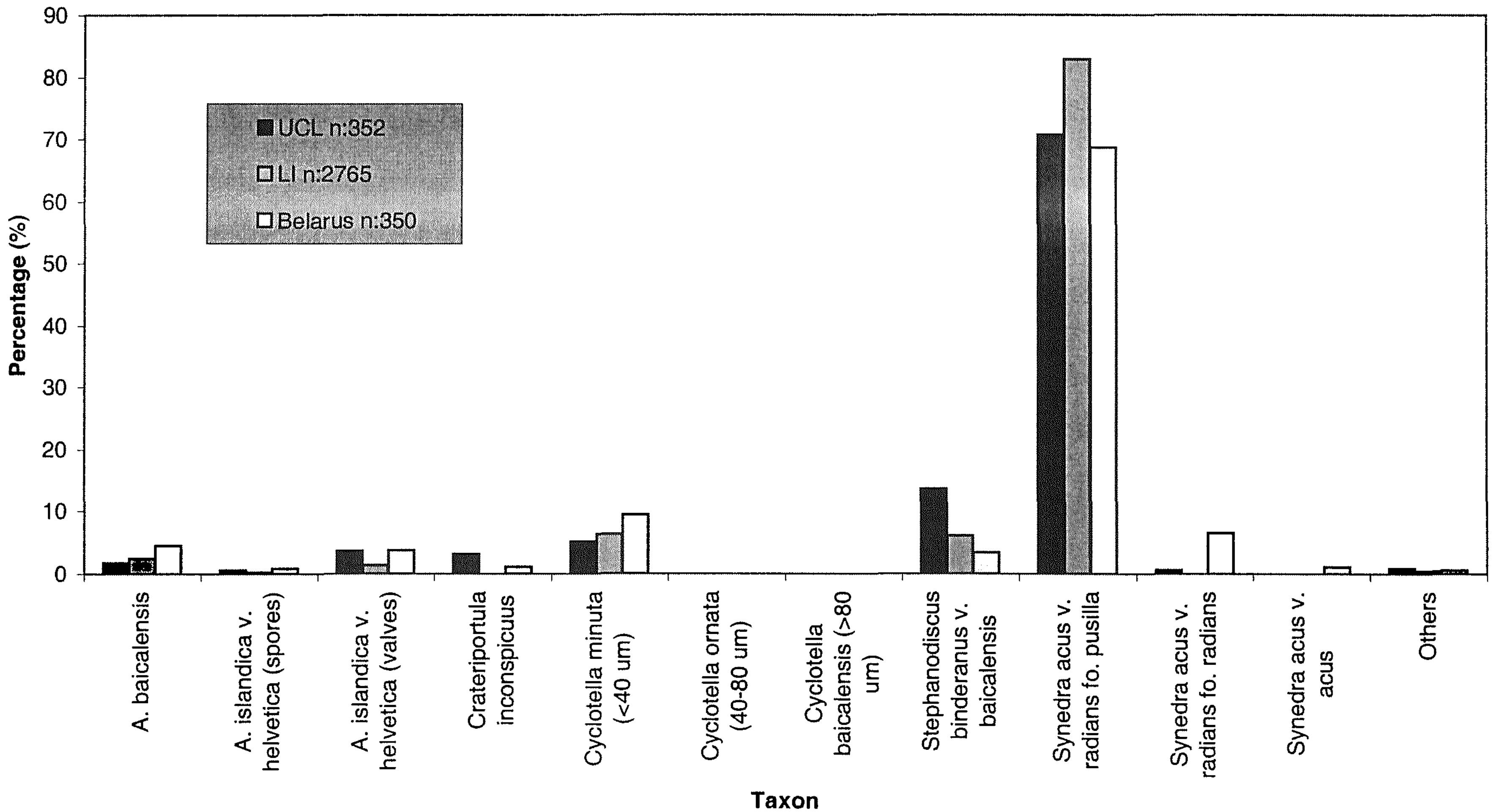
Sample UCL2	**Count**	**%**	**Dissolution stage** No dissolution stages identified	**Girdle view**	**F index (stage 1/all stages)**
A. baicalensis	68.5	2.48	68.5		
A. islandica v. helvetica (spores)	7	0.25	7		
A. islandica v. helvetica (valves)	39	1.41	39		
Crateriportula inconspicuus	0	0.00			
Cyclotella minuta (<40 um)	177	6.40	177		
Cyclotella ornata (40-80 um)	0	0.00			
Cyclotella baicalensis (>80 um)	0	0.00			
Stephanodiscus binderanus v. baicalensis	169	6.11	169		
Synedra acus v. radians fo. pusilla	2291	82.87	2291		
Synedra acus v. radians fo. radians	0	0.00			
Synedra acus v. acus	1	0.04	1		
Others	12	0.43	12		
Total	**2764.5**	**100.00**	**2764.50**	**0.00**	

Data from Belarus- IG

Sample UCL1	**Count**	**%**	**Dissolution stage 1**	**2+**			**Girdle view**	**F index (stage 1/all stages)**	**0.4**
A. baicalensis	161	44.35	87	74				0.54	
A. islandica v. helvetica (spores)	11	3.03	8	3					
A. islandica v. helvetica (valves)	17	4.68	6	11				0.35	
Crateriportula inconspicuus	7	1.93	8	12				0.40	
Cyclotella minuta (<40 um)	120	33.06	23	97				0.19	
Cyclotella ornata (40-80 um)	21	5.79	3	18				0.14	
Cyclotella baicalensis (>80 um)	3	0.83	5	15				0.25	
Stephanodiscus binderanus v. baicalensis	19	5.23	15	4				0.79	
Synedra acus v. radians fo. pusilla	0	0.00							
Synedra acus v. radians fo. radians	0	0.00							
Synedra acus v. acus	2	0.55	0	2					
Others	2	0.55	0	2					
Total	**363**	**100.00**	**144.00**	**219.00**	**0.00**	**0.00**	**0.00**	**0.40**	

Sample UCL2	**Count**	**%**	**Dissolution stage 1**	**2+**			**Girdle view**	**F index (stage 1/all stages)**
A. baicalensis	16	4.57	9	7				0.56
A. islandica v. helvetica (spores)	3	0.86	2	1				
A. islandica v. helvetica (valves)	13	3.71	4	9				0.31
Crateriportula inconspicuus	4	1.14	3	1				0.75
Cyclotella minuta (<40 um)	33	9.43	19	14				0.58
Cyclotella ornata (40-80 um)	0	0.00						
Cyclotella baicalensis (>80 um)	0	0.00						
Stephanodiscus binderanus v. baicalensis	12	3.43	13	7			10	0.65
Synedra acus v. radians fo. pusilla	240	68.57	230	10				0.96
Synedra acus v. radians fo. radians	23	6.57	20	3				
Synedra acus v. acus	4	1.14	3	1				
Others	2	0.57	2					
Total	**350**	**100.00**	**294.00**	**46.00**	**0.00**	**0.00**	**10.00**	**0.86**

AQC UCL 2 slide: % data



APPENDIX 2

A list of endemic diatoms taxa for Lake Baikal

This list is primarily based on the taxa described in Zabelina *et al.* 1951 but also includes some taxonomic information from other published sources and was assembled by R. Flower.

LAKE BAIKAL: ENDEMIC DIATOM TAXA	List of modern taxa to ca. 1951	References: Skv. & Meyer 1928, Skv. 1937, Zabelina et al 1951
Benthic diatom taxa	**Authority**	**Notes**
Achanthes dispar v. angustissima	(Jasnit.) Shesh.	
Achanthes koshovi	Jasnit.	
Achanthes skvortowii	Jasnit.	
Achnanthes bistriata	Skv. 1937	
Achnanthes borealis fo. baicalensis	Foged 1994	This was Foged's only new endemic taxon
Achnanthes calcar fo baicalensis	Skv. 1937	
Achnanthes elliptica	Skv. 1937	
Achnanthes exigua v. baicalensis	Skv. 1937	
Achnanthes hasta	Skv. 1937	
Achnanthes lacus baicali	Skv. 1937	renamed Navicula explorata Hustedt 1960
Achnanthes lanceolata v. baicalensis	(Skv.) Shesh.	
Achnanthes lanceolata v. minor	(Skv.) Shesh.	
Achnanthes meyeri	Skv. 1937	
Achnanthes profunda	Skv. 1937	similar to Achnanthes species (aff. valida Husdt.) L-Bertalot & Krammer 1989?
Achnanthes stauroniformis	Skabitch.	
Achnanthes striata	Skv. 1937	
Achnanthes striata v. rostrata	Skabitch.	
Amphora costulata	Skv. 1937	
Amphora cristodentata	Skabitch.	
Amphora koshovii	(Skv.) Skabitch.	formerly A. sibirica v. gracilis Skv. 1937
Amphora mongolica v. baicalensis	Skv. 1937	
Amphora mongolica v. cornuta	Skv. 1937	
Amphora mongolica v. gracilis	Skv. 1937	
Amphora mongolica v. intermedia	Skv. 1937	
Amphora obtusa v. baicalensis	Jasnitsky	
Amphora proteus v. baicalensis	Skv. 1937	
Amphora rotunda	Skv. 1937	
Amphora sibirica	Skv. & Meyer 1928	
Anomonoeoneis elliptica	Zakrg.	
Caloneis convergens	Jasnitsky	
Caloneis delicatula	Skv. 1937	
Caloneis ignorata	Skv. 1937	

Caloneis latiuscula v. rostrata	Skv. 1937	
Caloneis nubicola v. baicalensis	Hustedt 1960	
Caloneis silicula v. baicalensis	Skv. 1937	
Caloneis silicula v. major	Skv. 1937	
Caloneis zachariasii v. elongata	Skv. 1937	
Campylodiscus fragilis	Skv. 1937	
Campylodiscus fragilis v. punctatus	Skv 1937	
Campylodiscus fragilis v. rigens	Skv. 1937	
Campylodiscus lacus-baicali	Skv. 1937	
Campylodiscus lacus-baicali v. annulatus	Skv. 1937	
Campylodiscus lacus-baicali v. hispidus	Skv. 1937	
Campylodiscus rutilus	Skv. 1937	
Cocconeis placentula v. baicalensis	Skv. & Meyer 1928	
Cocconeis skvortzowi	(Skv.) Shesh.	In Zabelina et al., C. placentula v. baicalensis is syn. but their fig. is not as Skv. &
Cymatopleura solea v. rugosa fo. baicalensis	Skv. 1937	
Cymbell australica v. elongata	Skv. 1937	
Cymbella acuta v. baicalensis	Skv. 1937	
Cymbella caricornis	Skv. 1937	
Cymbella elegans	Jasnitsky	
Cymbella erhenbergii fo. baicalensis	Skv. 1937	
Cymbella gutwinski	(Wisl.) Skv. 7 Meyer 1928	
Cymbella lacustris v. baicalensis	Skv. 1937	
Cymbella meisteri	Skv. & Meyer 1928	
Cymbella navicula	Skv. 1937	
Cymbella skvortowii	Skabitch.	combination of C. turgida v. genuina & C. inelegans v. baicalensis
Cymbella stuxbergii v. baicalensis	Skv. 1937	formerly C. baicalensis Skv. & Meyer 1928
Cymbella stuxbergii v. intermedia	Wislouch 1924	C. stuxbergii & vars. recently confirmed by Williams et al. 1999
Didymosphenia dentata	(Dorogost.) Skv. 1937	
Didymosphenia dentata v. subcapitata	(Dorogost.) Skv. & Meyer 1928	
Didymosphenia geminata v. sibirica fo. anomala	Skv. & Meyer 1928	
Didymosphenia geminata v. sibirica fo. subcapitata	(Skv. & Meyer 1928) Skv 1937	formerly D. geminata v. genuina fo. baicalensis Skv & Meyer
Didymosphenia geminata v. stricta fo. capitata	Skv. 1937	
Didymosphenia geminata v. stricta fo. curvata	Skv. 1937	formerly D. geminata v. baicalensis fo. curvata (curvature is not restricted to Baik
Diploneis baicalensis	Skv. & Meyer 1928	
Diploneis constantinii	(Skv.) Skabitch.	
Diploneis domblittensis v. baicalensis	Skv.1937	

Diploneis jasnitski	Skabitch.	
Diploneis late-elliptica	Skabitch.	
Diploneis meyeri	Skabitch.	
Diploneis rhombica	Skabitch.	
Diploneis skvortzowii	Skabitch.	combination of D. lata & D. elliptica v. baicalensis Skv.
Diploneis skvortzowii v. punctata	(Skv.) Zabelina 1951	
Diploneis subovalis v. baicalensis	Skv. 1937	
Epithemia hyndmanni v. curta	Skv. 1937	
Eucocconeis dorogostaisky	(Jasnit.) Shesh	
Eucocconeis poretzkyi	(Jasnit.) Shesh	
Eucocconeis poretzkyi v. gracilis	(Jasnit.) Shesh	
Eunotia baicalensis	Skv. 1937	
Eunotia clevei v. baicalensis	Skv. 1937	
Eunotia clevei v. hispida	Skv. 1937	
Eunotia lacus-baicali	Skv. 1937	
Fragilaria lacus-baicali	Skv. 1937	
Fragilaria spinosa	Skv. 1937	
Gomophonema innata	Skv. 1937	syn. with Gomphoneis elegans v. quaripunctata in Skv. & Meyer
Gomphoneis baicalensis	Skv. & Meyer 1928	Gomphonema baicalensis in Zabellina
Gomphoneis eriense fo. hastatum	Skv. & Meyer 1928	Gomphoneis (syn?=Gomphoneis) eriense v. baicalensis in Skv & Meyer 1928
Gomphonema clevei v. baicalensis	Skv. 1937	
Gomphonema constructum v. capitatum fo. curta	Skv. 1937	
Gomphonema costulata	Jasnitsky 1924	
Gomphonema delicatula	Skv. 1937	formerly Gomphoneis (syn? Gomphonema) eriense v. baicalensis Skv. & Meyer
Gomphonema delicatula v. bipunctata	Skv. 1937	
Gomphonema firma	Skv. 1937	
Gomphonema innata v. elegans	Skv. 1937	
Gomphonema intricatum v. minor	Skv. 1937	
Gomphonema lanceolatum v. capitata	Skv. 1937	
Gomphonema quadripuncta v. baicalense	Skv. 1937	
Gomphonema quadripunctata	(Ostrup) Skv. 1937	also in Hubsogol Lake = G. quadripunctatum v. genuina and fo. tumida Skv & Me
Gomphonema quadripunctata v. hastata	Wislouch 1924	fomerly G. quadrip. v. hastata & v. genuina & fo robusta & fo. curta Skv & Meyer
Gomphonema sibirica	Skv. & Meyer 1928	
Gomphonema ventricosum fo. curtum	Skv. 1937	
Gyrosigma acuminatum v. baicalensis	Skv. 1937	
Gyrosigma baicalensis	Skv. 1937	

Navicula acuta	Skv. 1937	
Navicula ajajensis	Skabitch.	
Navicula amabilis	(Skv.) Hustedt 1960 nov. nom.	formerly Stauroneis baicalensis Skv. 1937
Navicula amphibola v. baicalensis	Skv. 1937	
Navicula amphibola v. gracilis	Skv. 1938	
Navicula annulata v. baicalensis	Skv. 1937	
Navicula antigua	Skv. 1937	
Navicula argens	Skv. 1937	
Navicula bacillum v. major fo. baicalensis	Skv. & Meyer 1928	
Navicula baicalensis	Skv. & Meyer 1928	
Navicula cingens	Skv. 1937	
Navicula compositestriata	Jasnit.	syn. Navicula granulifera Skv. 1937, Caloneis relicta Skv. 1937
Navicula compositestriata v. rostrata	Skabitch.	
Navicula confervacea v. baicalensis	Skv. 1937	
Navicula constantinii	(Skv.) Skabitch.	syn. Navicula meyeri Skv.
Navicula costuloides	Skv. 1937	
Navicula cuspidata v. elongata	Skv. & Meyer 1928	
Navicula dahurica	Skv. 1937	
Navicula dispersepunctata	Skabitch.	
Navicula diversestriata	Jasnitsky	
Navicula fluens v. baicalensis	Skv. 1937	
Navicula fluens v. subrostrata	Skv. 1937	
Navicula fragilis	Skv. 1937	
Navicula gastrum v. baicalensis	Skv. 1937	
Navicula hungarica v. interemedia	Skabitch.	formerly Nav. costulata v. baicalensis Skv.
Navicula jasnitskyi	Skv. & Meyer 1928	
Navicula jasnitskyi v. constricta	Jasnitsky	formerly Caloneis zachariasii v. constricta Skv. 1937
Navicula jasnitskyi v. obtusa	Skv. & Meyer 1928	
Navicula lacus-baicali	Skv. & Meyer 1928	
Navicula lacus-baicali v. lanceolata	Skv. 1937	
Navicula lacus-baicali v. simplex	Skv. 1937	
Navicula lacustris v. elongata	Skv. & Meyer 1928	
Navicula lanceolata v. tenuirostris	Skv. 1937	
Navicula paradoxa	Skv. 1937	
Navicula psueodogracillis	Skv. 1937	
Navicula pupula v. baicalensis	Skv. 1937	needs transferring to Sellaphora

Navicula schiraka	Skabitch.	
Navicula silicea	Skv. 1937	
Navicula skabitschewskyi	(Skabitch.) Zabelina 1951	formerly N. dahurica Skabitch.
Navicula skabitschewskyi v. elliptica	(Skabitch.) Zabelina 1952	formerly N. dahurica v. elliptica Skabitch.
Navicula subelongata	Skabitch.	formerly Navicula magna, N. magna v. lanceolata, N. magna v. curta
Navicula subhamulata v. gibbosa	Skv. 1937	
Navicula subhamulata v. parallela	Skv. 1937	
Navicula subplacentula v. baicalensis	Skv. 1937	
Navicula subtilissima fo. baicalensis	Skv. 1937	
Navicula unipunctata	Skv. 1937	
Navicula vulpina v. oregonica	Cl.	In Russia only known from Baikal, correct diagnosis?
Navicula werestschaginii	Skv. & Meyer 1928	
Navicula werestschaginii v. curta	Skv. & Meyer 1929	
Navicula wislouchii	Skv. 1937	
Navicula wislouchii v. curta	Skv. & Meyer 1928 1928	
Navicula wornichinii	Jasnit.	
Neidium affine v. amphirhyncus fo. captatum	Skv. & Meyer 1928	
Neidium affine v. capitatum	Skv. & Meyer 1998	
Neidium baicalense	Jasnitsky	
Neidium baicalense v. leve	Jasnitsky	
Neidium bisulcatum v. baicalensis	Skv. 1937	
Neidium dilatum v. curtum	Skv. 1937	
Neidium dubium v. baicalensis	Skv. 1937	
Neidium lacus-baicali	Skv. 1937	
Neidium lanceolatum	Skv 1937	
Nitzschia denticulata v. baicalensis	Skv. 1937	
Nitzschia fonticola v. baicalensis	Skv. 1937	
Opephora martyi v. baicalensis	Skv. 1937	
Pinnularia abnormis	Skv. 1937	
Pinnularia begotensis v. baicalensis	Skv. 1937	
Pinnularia braunii v. scabrosa	Skabich.	
Pinnularia gibba v. baicalensis	Skv. 1937	
Pinnularia hemiptera v. baicalensis	Skv. 1937	
Pinnularia lacus-baicali	Skv. 1937	formerly P. passargerei v. baicalensis Skv. & Meyer 1928
Pinnularia lacus-baicali v. gibbosa	Skv. 1937	
Pinnularia lacus-baicali v. lanceolata	Skv. 1937	

Pinnularia lacus-baicali v. linearis	Skv. 1937	
Pinnularia major v. hyalina	Skabitch.	
Pinnularia pectinalis	Skv. 1937	
Pinnularia pectinalis v. rostrata	Skv. 1938	
Pinnularia polyonca v. scabrosa	Skabitch.	
Pinnularia timofeevi	Skabitch.	
Pinnularia viridissima Skv.	Skv. 1937	
Rhopalodia gibba v. mongolica	Ostrup.	also in Lake Hubsgul, Monoglia
Surirella acuminata v. baicalensis	Skv. 1937	
Surirella biseriata v. punctata	Skv. 1937	
Surirella didyma v. minor	Skv. 1937	
Surirella echinulata	Skabitch.	
Surirella granulata v. baicalensis	Skv., 1937	
Surirella lacus-baicali	Skv. 1937	
Surirella lacus-baicali v. marginulata	Skv. 1937	
Surirella lacus-baicali v. paradoxa	Skv. 1937	
Surirella lacus-baicali v. punctata	Skv. 1937	
Surirella linearis fo. obtusa	Skv. 1937	
Surirella margaritifera	Hust.	??
Surirella nyasse v. baicalensis	Skv. 1937	
Surirella olchonica	Jasnitsky 1924	
Surirella oophora	Skv. 1937	
Surirella prehensilis	Skv. 1937	
Surirella quadricornis	Jasnitsky 1924	
Surirella turgida fo. baicalensis	Skv. 1937	
Surirella turgida fo. baicalensis	Skv.	
Surirella turgida v. skvortzowii	(Meyer) Kiss	formerly S. baicalensis Skv. & S. skvortowii Meyer
Surirella unidentata	Skv. 1937	
Surirrella paucidens	Skv. 1937	
Tetracyclus lacustris v. baicalensis	Skv. & Meyer 1928	T. lacustris in Zabelina et al. 1951

Revisions

Gomphoneis hastata	(Wis.) Kociolek & Stoerm. 1988	formerly Gomphonema quadripunctata v. genuina, v. hasta, & v. baicalensis this also includes G. quadripunctata sensu Skabitchevsky
Gomphoneis tumida	(Sk. & Meyer) Kociolek &Stoerm	formerly Gomphonema quadripunctata v. genuina fo. tumida Skv. Gomphonema quadripunctata v. genuina fo. elongata Skv. & Meyer Cymbella lacustris fo. baicalensis Skv. & Meyer.?
Gomphoneis quadripunctata	(Ostr.) Dawson ex Ross & Sims	Also found in lake Hubsgul
Didymosphenia siberica (Grun.) Schmidt 1899	see Metzeltin & L-Bert.1995	Syn. with D. geminata v. siberica forms curta, elongata, genina Skv. & Meyer
Didymosphenia pumila	Metzeltin & L-Bertalot 1995	Syn. with D. curvata Skv. & Meyer
Didymosphenia curvata Skv. & Meyer	nov. stat.Metzelt. & L-Bert.1995	Syn. D. geminata v. baicalensis, v. siberica forms anomala, curvata*, v. curta also syn. v. curvata fo. elongata, fo. curta Skv. & Mayer, * Skv. 1937

Planktonic diatom taxa

Melosira baicalensis	(Meyer) Wislouch 1924	Aulacoseira baicalensis
M. baicalensis fo. compacta	Skv. & Meyer 1928	
M. baicalensis fo. oblongo-punctata	(Meyer) Wislouch 1924	
M. arenaria v. baicalensis fo. ornata	Skv. 1937	
M. arenaria v. baicalensis fo. punctata	Skv. 1937	
Cyclotella baicalensis	Skv. & Meyer 1928	
Cyclotella baicalensis fo. stellata	Skv. 1937	
Cyclotella baicalenis fo. ornata	Skv. 1937	C. ornata (Skv. & Meyer 1928) Flower 1993
Cyclotella baicalenis fo. minuta	Skv. & Meyer 1928	C. minuta (Skv. 7 Mayer) Antipva 1953