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The Lake Baikal Region

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The Conference was open to various kinds of contributions by participants. Contributions were made in form of statements, abstracts of papers, scientific papers and posters. Responsible for the contents of each contribution is the respective author.

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NNA-Reports

Volume 14, Special Issue 1, 2001

Content

Federal Law Lake Baikal Preservation

Adopted by State Duma on April 2, 1999
Approved by the Council of Federation on April 22, 1999
Entered into force: 12 May 1999

B. Eltsin, President of Russian Federation, Moscow, Kremlin

CHAPTER 1. BASIC PRINCIPLES

Article 1. Legal Regulation of the Protection of Lake Baikal

1. Legal regulation of the protection of Lake Baikal is performed by means of the present Federal Law, of other federal laws, and by other legal acts of the Russian Federation, as well as by laws and legal acts of subjects of the Russian Federation.
2. If an international treaty of the Russian Federation stipulates regulations that differ from those stipulated by the present Law, applied are regulations stipulated by this international treaty.

Article 2. Ecological Zones of the Baikal Natural Territory

1. The Baikal Natural Territory includes Lake Baikal, the water protection zone adjacent to Lake Baikal, its catchment basin within the Russian Federation, the specially protected natural territories adjacent to Lake Baikal, and also a territory adjacent to Lake Baikal and expanding 200 km towards west an north-west.
2. The Baikal Natural Territory is divided into the following ecological zones:
   the Central Ecological Zone – the territory including Lake Baikal with its islands, the water protection zone adjacent to Lake Baikal, and the specially protected natural territories adjacent to Lake Baikal;
   the Buffer Ecological Zone – the territory outside the Central Ecological one including the part of the catchment basin of Lake Baikal within the borderlines of the Russian Federation;
   the Ecological Zone of Atmospheric Impact – the territory outside the catchment basin of Lake Baikal, within the borderlines of the Russian Federation, propagating up to 2000 km west and north-west of Lake Baikal, where sited are industrial objects negatively affecting the ecological system of Lake Baikal.
3. Ecological zones of the Baikal Natural Territory are introduced according to a procedure established by the Government of the Russian Federation.

Article 3. Borderlines of the Baikal Natural Territory

The government of the Russian Federation approves the borderlines of the Baikal Natural territory and of its Ecological Zones – the Central Ecological Zone, the Buffer Ecological Zone, and the Ecological Zone of atmospheric Impact – suggested by the bodies of state power of the Republic Buryatia, of the Irkutsk Oblast, of the Chita Oblast, and of the Ust-Ordinsky Buryatsky Autonomous District.

Article 4. Treaties on the Distribution of the Responsibilities and Competence Between the bodies of State Power of the Russian Federation an the Bodies of state Power of the Subjects of the Russian Federation concerning the Protection of Lake Baikal

The responsibilities and the fields of competence concerning the protection of Lake Baikal belonging to the bodies of state power of the Russian Federation and to the bodies of state power of the subjects of the Russian Federation may be, according to the Constitution of the Russian Federation, stipulated by treaties on the distribution of responsibilities and competence between the bodies of state power of the Russian Federation and of the bodies of state power of the Republic of Buryatia, of the Irkutsk Oblast, of the Chita Oblast, and of the Ust-Ordinsky Buryatsky Autonomous District.

CHAPTER II. REGIME OF THE PROTECTION OF THE BAIKAL NATURAL TERRITORY

Article 5. Basic Principles of the Protection of the Baikal Natural Territory

A special regime of economic and other activities within the Baikal Natural Territory for the sake of protection of Lake Baikal is established according to the following principles:

priority of economic activities that are not harmful to the ecological system of Lake Baikal and to the natural landscapes of its water protection zone;

comprehensive account of the impacts of economic and other activities upon the ecological system of Lake Baikal;

a balanced approach towards the tasks of social and economic development and the tasks of protection of the unique ecological system of Lake Baikal according to the principles of Sustainable development;

obligatory state ecological expertise.

Article 6. Activities That Are Banned or Limited on the Baikal Natural Territory

1. Banned or limited on the Baikal Natural Territory are the activities that produce negative impact on the ecological system of Lake Baikal:
   chemical pollution of Lake Baikal an of its catchment basin caused by discharge of dangerous compounds into water and atmosphere, by the use of pesticides and other chemicals in agriculture, by the use of the radioactive compounds, by the use of means of transportation, by storage of industrial and municipal wastes;
   physical changes in the state of Lake Baikal, or of its parts, like change of water temperature, oscillation of water level beyond the allowed limits, changes of inflow due to damming of tributaries;
   biological pollution of Lake Baikal due to the use of biological species alien to the ecological system of Lake Baikal, or due breeding and introduction of such species into water bodies that are permanently or temporarily connected to Lake Baikal.
2. Construction of new, expansion and reconstruction of existing economic facilities on the Baikal Natural Territory is not allowed before state ecological expertise of projects of such construction and reconstruction.

3. The list of economic activities that are banned on the Baikal Natural Territory is approved by the Government of the Russian Federation.

Article 7. The Water Budget of Lake Baikal

The following requirements are established with respect to the water budget of Lake Baikal in order to protect it from negative impacts of economic and other activities:

the regime of filling and discharge of the basin of Lake Baikal is determined by a specially empowered state body managing the use and protection of aquatic resources according to laws of the Russian Federation;

it is forbidden to increase of level of Lake Baikal above the maximum values, and to decrease it below minimum values established by the Government of the Russian Federation.

Article 8. Special Demands to Protection and Catch of (Hunting for) Endemic Aquatic Plants

To ensure protection of Baikalian omul whitefish and seals, as well as of other animal and plants species that only occur in Lake Baikal (endemic animals and plants), except or those included into the Book of the Russian Federation, established are permitted quantities of exemption or omul, seals and other endemic animals, and for collection of endemic plants, as well as permitted instruments and time periods of exemption (collection).

Special demands to protection and catch of (hunting for) omul, seals and other endemic animals, and to collection of endemic plants are established by the Government of the Russian Federation.

Article 9. Territories of Traditional Land Use Within the Baikal Natural Territory

1. Territories of traditional land use within the Baikal Natural Territory are established according to laws of the Russian Federation.
2. Relationships with respect to land use and the use of other natural resources on the territories of traditional land use within the Baikal Natural Territory and regulated by laws of the Russian Federation in an accord with the present Federal Law.

Article 10. Peculiarities of Land Use in the Central and the Buffer Zones of the Baikal Natural Territory

The use of land by citizens and legal persons in he Central an the Buffer Zones of the Baikal Natural Territory is performed in an accord with the demands of the present Federal Law.

Article 11. Peculiarities of the Use of Forests in the Central Zone of the Baikal Natural Territory

1. Forbidden in the Central Zone of the Baikal Natural Territory are:
   forests cutting "of main usage" (clear cutting);
   cutting in cedar (Pinus sibirica) forests, except for cuttings necessary to take care of the forests, and for selective sanitary cuttings;
   exemption of lands of the forest occupied by forests of the first group and of lands of the forest fund which are not covered by forests for purposes which are not connected with forestry.
2. Forestry should be aimed at reclamation of native forests and of forests of special value, as its first priority.

Article 12. Tourism and Recreation in the Central Ecological Zone of the Baikal Natural Territory

1. Tourism and recreation in the Central Zone of the Baikal Neutral Territory are organized according to special rules ensuring that the norms of maximum permissible impacts on the environment of the Central Ecological Zone of the Baikal Natural Territory are fulfilled.
2. Rules of organization of tourism and recreation in the Central Zone of the Baikal Natural Territory are approved by state power bodies of the Republic of Buryatia and of the Irkutsk Oblast.

CHAPTER III. NORMS OF MAXIMUM PERMISSIBLE UNFAVOURABLE IMPACT ON THE ECOLOGICAL SYSTEM OF LAKE BAIKAL

Article 13. The Order of Implementation of Norms of Maximum Permissible Impacts on the Ecological System of Lake Baikal

1. Norms of maximum permissible unfavorable impacts for the Baikal Natural Territory are established in an accord with the laws of the Russian Federation and with the present Law.
2. Norms of maximum permissible unfavorable impacts on the ecological system of Lake Baikal and methods of their elaboration are approved by specially empowered federal executive bodies of the Russian Federation and defined according to results of scientific research.
3. List of hazardous compounds, including those belonging to the categories of extremely hazardous, highly hazardous, hazardous, and moderately hazardous for the ecological system of Lake Baikal, are approved by specially empowered executive bodies of the Russian Federation.

Article 14. Maximum Permissible Amounts of Discharge of Hazardous Compounds and of Siting Industrial and Municipal Storage Facilities for Wastes Hazardous for the Ecological System of Lake Baikal

1. Maximum permissible amounts of hazardous compounds to be discharged, and of industrial and municipal wastes hazardous for the ecological system of Lake Baikal to be stored, are established on an account of results of scientific research, and in an accord with the laws of the Russian Federation, with the aim of reduction of these amounts; the permits are reconsidered every year, taking into account the state of environment in the Baikal Natural Zone.
2. The amounts of compounds belonging to the categories of extremely hazardous and highly hazardous for the ecological system of Lake Baikal, discharged by industrial and other objects sited in the Central and the Buffer Ecological Zones of the Baikal Natural Territory, cannot exceed those taken with fresh water.
   The concentrations of compounds of any category of those hazardous for the ecological system of Lake Baikal in discharge to waste waters and gases must not exceed the norms of maximum permissible concentrations of hazardous compounds established for every Ecological Zone of the Baikal Natural Territory.

CHAPTER IV. STATE REGULATION IN THE FIELD OF PROTECTION OF LAKE BAIKAL

Article 15. The Federal Body of Execu-

tive Power Specially Established for State Regulation in the Field of Protection of Lake Baikal

According to the Constitution of the Russian Federation and to the constitutional law "On the Government of the Russian Federation", established is a special federal body of executive power for state regulation in the field of protection of Lake Baikal.

Article 16. Comprehensive Schemes of Protection and of the Use of Natural Resources of the Baikal Natural territory

Economic and other activities within the Baikal Natural Territory are developed within the frameworks of comprehensive schemes of protection and of the use of natural resources which are drafted and approved in an accord with the laws of the Russian Federation and with the legislation of the subjects of the Russian Federation.

Article 17. Ecological Passportization of Enterprises Residing Within the Baikal Natural Territory

Legal persons that perform economic and other activities within the Baikal Natural Territory must have ecological passports of their enterprises.

Special requirements to ecological passports of enterprises residing within the Baikal Natural Territory are introduced by the federal body of executive power specially established for state regulation in the field of protection of Lake Baikal.

Article 18. Closure or Reprofiling of Environmentally Dangerous Enterprises

Closure of reprofiling of environmentally dangerous enterprises within the Baikal Natural Territory is performed according to procedures and schedules stipulated by laws of the Russian Federation.

Article 19. State Environmental Control Within the Baikal Natural Territory

State environmental control within the Baikal Natural Territory is performed by the special federal body of executive power established for state regulation in the field of protection of Lake Baikal, by other specially empowered federal executive bodies, and by bodies of state power of the Republic of Buryatia, of the Irkutsk Oblast, of the Chita Oblast, and of the Ust-Ordinsky Buryat Autonomous District.

Article 20. Monitoring of the Ecological System of Lake Baikal

1. Monitoring of the ecological system of Lake Baikal is performed by the special federal body established for state regulation in the field of protection of Lake Baikal, and by other specially empowered executive federal bodies within the unified system of state environmental monitoring.
2. Federal bodies of executive power, and state power bodies of the Republic of Buryatia, of the Irkutsk Oblast, of the Chita Oblast, and of the Ust-Ordinsky Buryat Autonomous District are obliged to present to the special federal body of executive power established for state regulation in the field of protection of Lake Baikal information on the state of the ecological system of Lake Baikal for the purpose of its analysis and adoption of decisions.

Article 21. Financing of Activities Aimed at the Protection of Lake Baikal

1. Financing of activities aimed at the protection of Lake Baikal is performed by the federal budget, and by the budgets of the Republic of Buryatia, of the Irkutsk Obladt, of the Chita Oblast, of the Ust-Ordinsky Biruat Autonomous District, and from other sources according to the laws of the Russian Federation and to legislation of the subjects of the Russian Federation.
2. A targeted fund for the protection of Lake Baikal is established in an accord with the laws of the Russian Federation.

Article 22. Federal targeted Programs in the Field of Protection of Lake Baikal

1. Federal bodies of executive power elaborate federal programs in the field of protection of Lake Baikal for the purpose of planning and implementation of measures aimed at the protection of Lake Baikal.
2. Financing of federal targeted programs in the field of protection of Lake Baikal is performed according to the laws of Russian Federation.

Article 23. Information on the Environmental Situation Within the Baikal Natural Territory

Citizens and legal persons are given access to information on the environmental situation within the Baikal Natural Territory in an accord with the laws of the Russian Federation.

Article 24. Punishments for Violation of the Present Federal Law

Persons who are guilty of violation of the present Federal Law are punished according to the civil, the administrative, and the criminal codes of the Russian Federation.

Article 25. International Co-operation in the Field of Protection of Lake Baikal

International co-operation of the Russian Federation in the field of protection of Lake Baikal is performed in an accord with the Constitution of the Russian Federation, with the federal laws and other legal acts, and with the international treaties of the Russian Federation.

Article 26. Validity of the Present Law

1. The present Federal Law becomes valid from the day of its official publication.
2. Legal acts of the Russian Federation are subjects to amendment in an accord with the present federal Law.

Introduction

Present State of Co-operation

Russian-German co-operation in the Lake Baikal Region has a long history. Beginning in the 18th century, German researchers made significant contributions to the exploration of Lake Baikal and Siberia as a whole as well as to the distribution of information about its beauty and its richness. Recently the lake has become subject of growing international co-operation. Scientists, private enterprises and NGO's from Russia, Germany and many other countries are actively involved. Special attention needs be paid to German law-specialists who elaborated preliminary studies and assisted during the editorial revision of the Baikal Law.

Russian-German co-operation is presently accompanied by a number of risks and problems resulting in unsteadiness of actions and conflicts between the actors. New initiatives at different levels have been under way, such as projects, conferences, workshops and the establishment of new institutions. Yet, co-operation and funding are difficult to achieve under the current circumstances. Unfortunately initiatives overlap in many cases, often lacking any degree of co-ordination. Competition for financial and personal resources between and within institutions hamper co-operation severely.

It is of primary importance to achieve better co-ordination of the existing initiatives and activities, especially within Germany. In order to achieve agreement on goals for sustainable development and the implementation of the Law for the Protection of Lake Baikal it is also necessary to provide a higher level of co-ordination and integration of actors in the different regions surrounding Lake Baikal.

The Conference

Accordingly, the Alfred Toepfer Academy for Nature Conservation (NNA) and the German Federal Agency for Nature Conservation (BfN) organised a conference on the "Russian-German Co-operation in the Lake Baikal Region" at Schneverdingen (Northern Germany) from November 14 to 17, 1999. The conference focused on the protection and the sustainable development of Lake Baikal. The main intention was to bring together people from existing initiatives and projects, arrange new contacts, illustrate conflicts and promote co-operation and exchange between Russian institutions and German participants.

Delegates at the conference included representatives from governmental and scientific administrations, scientists of the Russian Federation and its constituent territories, scientists from Germany, the United States, Denmark, Slovakia and Belgium, representatives of German mass media and lawyers, representatives of UNESCO, NATO and international NGO's, of the German ministry of commerce and technology and students and tourism managers.

Members of various key social groups joined not only to exchange their latest experiences and intentions for interdisciplinary approaches, but also to plan and prepare innovative projects, thus creating synergetic effects. The establishment of contacts between specialists dealing with standardisation of monitoring systems and the development of the relevant legal regulations was a major purpose. In the course of the conference the participants were given the opportunity to establish new or to strengthen already existing firm and lasting contacts during formal and informal sessions.

The conference opened with an impressive two part tv-report on nature and people of the Lake Baikal Region in different seasons of the year. The film was produced by German television. A number of formal contributions described the current state of international co-operation in Siberia, the present state of the declaration of Lake Baikal as a world heritage site, the problems and opportunities of Russian-German economical co-operation and the limnological uniqueness of Lake Baikal. Based on these key note speeches further presentations and discussions took place in six parallel workshops on the following subjects:

Workshops:

A. Basic research about the Lake Baikal Region
B. Sustainable agriculture, forestry and fisheries
C. Technical environmental protection and standardisation of assessment and monitoring systems
D. Landscape planning and sustainable regional development
E. Nature conservation and tourism
F. Socio-ecological aspects of project development, environmental education and information management

Results and Recommendations of the Workshops

Each of the 6 workshops elaborated a catalogue of current projects and activities and a list of actors. They identified problem areas, potential projects and partnerships and worked out recommendations for the planning and implementation of new projects. The condensed results of these workshops are listed on the following pages.

Workshop A
Basic research about the Lake Baikal Region

Future directions of basic research in the Baikal Region should be:

1. **Hydrography and physical limnology of Lake Baikal**

- The heat budget and ice cover
- Horizontal water exchange between the major lake basins
- Cryogenic conditions in the Baikal Basin and its importance for the dynamics of carbon
- Use of Acoustic Doppler Current Meters (ACDP)
- Tracer studies to assess water mass age at different locations and depths in Lake Baikal
- Modelling physical forcing, vertical mixing and convective processes of Lake Baikal

2. **Cycling of nutrients in Lake Baikal**

- Pelagic nutrient cycling
- Modelling the regional mass balance as controlled by scenarios on climate variability
- Preparation and characterization of reference materials of Baikal water

3. **The pelagic communities and their role in the food-web of Lake Baikal**

- Long-term observations on phytoplankton productivity
- Experimental studies on the factors controlling the seasonal succession of phytoplankton with emphasis on nutrient availability, including trace elements
- The role of fish communities in the pelagic food web, their biology, age composition and population dynamics
- The pelagic microbial communities and micro zooplankton grazing in the food web and the cycling of matter
- Settling fluxes and their role in the carbon and nutrient budgets
- Setting up of a diatom data bank

4. **The littoral and benthic communities and their trophic role**

- Origin and biology and behaviour of the Baikal Seal
- Mapping of the extent of the littoral vegetation by using remote-sensing
- Investigations on profundal communities based on chemo synthesis (methane oxidation) in areas of gas seeps
- Ecophysiology of gastropods and amphipods

5. **The biota of the Lake Baikal – phylogeny, history, and significance for the functioning of the ecosystem**

- Use of Lake Baikal as a natural laboratory for the quantification of genetic diversity
- The quantification of endemic plant and animal taxa of Lake Baikal
- Endangered endemic species within the Baikal Basin

6. **The history of Lake Baikal**

- The tectonic history of the Baikal Rift
- The sediment record of Lake Baikal
- Evaluation of the changes of climate and environment in the Baikal Region

7. **Atmospheric chemistry**

- Development of the station for background continental atmosphere monitoring

Training needs in connection with basic research are:

- Field courses on various aspects of the geology and limnology of Lake Baikal
- Training of scientific divers

Workshop B
Sustainable agriculture, forestry and fisheries

Concerning Sustainable Agriculture, Forestry and Fisheries the participants identified current scientific projects as follows:

- A TACIS project on forestry use in the Baikal region with a volume of about 2.5 Mio ECU, running from 1997 to 2000
- A project on the conservation of biodiversity funded by the Global Environmental Facility (GEF) of about 2 Mio US $, running from 1998 to 2000

Other current or recently concluded projects are:

- Creation and publication of a map on the condition of forests around Lake Baikal – Baikal Wave
- Publications about biodynamic agriculture – Baikal Wave
- Bioengineering as an instrument for erosion protection in Burjatia – University Hannover, students' project
- Sustainable development in the Lake Baikal region – approaches from the Galtai-Kalinovka region – University Hannover, students' project

The participants concluded that a systematic documentation of all international projects in the Baikal region would be urgently needed.

Participants in this workshop identified the need for the following project proposals:

- Biodiversity and pyrogenic succession of forest ecosystems in Siberian cryolithic zone
- Baikal Certification Centre
- Ecological, economic and social impacts of regional climatic changes in the continental part of Eurasia (Buryatia, Mongolia)
- Prospects for sustainable devel opment for the community of Ust-Barguzin
- Sustainable development in landscapes dominated by livestock keeping

- Strategies for minimisation of erosion
- Desertification processes in the Baikal region
- Human impact on steppe ecosystems in the Baikal region
- Impacts of human activities on steppe ecosystems in Baikal region and suggestions for a sustainable development

Workshop C
Technical environmental protection and standardisation of assessment and monitoring systems

Workshop Technical Environmental Protection and Standardisation of Assessment and Monitoring Systems identified the following fields of possible cooperation between Russian and German experts:

1. Environmental Protection in the pulp and paper industries – environmental effects of the improvement of technologies

- Assessment of the possibilities to introduce more environmental friendly technologies into the production process
- Substitution of the chlorine-technology in the bleaching process
- Development of cycling-processes in the pulp production
- Use of low temperature energy in the process of water-cooling
- Introduction of purification technologies for exhaust gases
- Development of management conceptions for 7 Mio t of sewage sludge at the Baikalsk pulp-plant

2. Management of industrial and municipal wastes and waste waters

- Purification of municipal waste waters – adaptation of technologies to Siberian climatic and seismic conditions according to the requirements of the Baikal water quality
- Assessment and evaluation of long term existing landfill sites – development of recommendations for their sanitation
- Analysis of current arising of wastes and ways of their disposal – identification of methods of prevention of wastes and strategies for storage and re-use
- Initiation of transfer of know – how in waste management technologies and common development of adapted technologies according to the local conditions of the Baikal region

3. Monitoring of Lake Baikal and related water resources and terrestrial areas in the catchments – tools to control the environmental situation and the effects of new technologies on the environment

- Monitoring of the quality of surface water bodies in the catchments area – participation in the local governments programme
- Development of an effective monitoring system for the littoral zones of Lake Baikal as a practical tool for the environment agencies for the identification of problematic sites
- Monitoring of water volumes in Lake Baikal using data of the Neutrino Telescope – correlation of physical and limnological data
- Identification of the influence of air pollution of the local industries on the biodiversity of vegetation – methods to control the improvement of the industrial emissions
- Technical Assistance and participation of German experts in the development of the digital atlas of the Baikal natural territory
- Bilateral seminar on environmental quality assessment – demonstration of experiences, adaptation of strategies and methods to the special conditions of Siberia

Workshop D
Landscape planning and sustainable regional development

Participants of the workshop Landscape Planning and Sustainable Regional Development detected the following areas where actions are needed:

1. The role of landscape planning as an instrument of sustainable development

- Planning procedure

  1. Construction of a general plan giving an overview to determine spatial areas of main focus in the core area
  2. Presentation of topics of priority (scale 1: 200000)
  3. Specification of planning at the local level (scale 1: 25000)

- Sectoral planning suitable for the Russian Federation
- In other regions of the RF parallel chains of planning exit
- Important tasks are: connection of the chains of planning
- Holistic planning suitable for Baikal region because here a specific situation exists which cannot be generalised for the whole Federation
- Landscape planning, which integrates other aspects, particularly social and economic aspects

2. Technologies and Information

- Guarantee that data can be dynamically updated
- Application of remote sensing data to update the land use register and to subsequently check the data in test areas
- Further training is no goal in itself but it aims to encourage working methods which are oriented towards planning, problem solving and implementation
- Further education also concerns the understanding of evaluation systems and the subsequent development of goals and measurements

3. Legal Basis of Landscape Planning

- Application of the terms of the Baikal Law: landscape planning as an instrument of 'ecological zonation'
- Determination of implementation regulations
- Specification of the goals of the Baikal Law which concern spatial and landscape planning as well as sustainable socio-economic development
- Definitions of terms in order to narrow the scope for interpretation Determination of the permitted activities/uses (positive formulation, few restrictions)
- Integration of other basic legal regulations such as: 'National Action Plan for the Protection of the Environment' of the Russian Federation and 'Federal Program for the Littoral Zones of the Littoral Zones of the Sea of Azov'

- Changes in the conditions of ownership are no restriction for landscape planning but relevant for the implementation of landscape planning's goals
- Institution-building

4. Public Participation

- Determination of the institutions which are responsible for planning, actors and concerned groups and individuals
- Address the public directly: awareness for the opportunities
- Involvement of the public: which interest groups? In which manner? At what stage of the planning process? At what level of communication? How can participation be organised?
- Involvement of NGO's as a mediator in the course of raising awareness among the population and solving conflicts)
- Organisation of workshops and training courses

5. Regional areas of main focus

- Determination of areas of main focus for planning in the core area (littoral zone and adjacent hinterlands), which do not exclude other planning
  1. Slijudjansker Rayon in the South of the Lake: socio-economic and ecological problems can be solved on the basis of landscape planning
  2. Ust'-Barguzin and Zabaikalskij National Park: other socio-economic, ecological specific characteristics
  3. Severo-Baikal'sk in the North of the Lake: Problem: beginning of the Baikal-Amur railroad and perspectives for Severo-Baikal'sk
  4. Kabanskij Rayon (Selenga River)
- Integration of areas and axes, which might be important in the future

6. Determination of Starting Points for International Cooperation

- Search for funding sources
- Further training of the scientists and other employees of the administration which are currently concerned with planning
- International consulting in the course of the conceptualisation of education systems of landscape planning in the RF; determination of the contents of university courses according to the real situation in the RF-Training by specialists of the RF
- Creation of a co-ordinating commission for the implementation of landscape planning in the Baikal region which includes the involvement of representatives of different areas and countries
- Analysis of other models of landscape planning in Europe

Workshop E
Nature conservation and tourism

Participants of the workshop Nature Conservation and Tourism recommended:

1. The Development of the eco-tourism as one of the priorities in Russian-German co-operation
2. To submit a proposal for the Federal authorities of both Russia and Germany on the creation of the Baikal Biosphere reserve with Zabaikalsky National Park as its basis
3. To suggest the organisation of an International Training-Educational Centre (the village of Istomino) in the Selenga River delta to provide international internships, field expeditions and monitoring research on Lake Baikal
4. To further develop the GIS data base "Baikal" and on dissemination of ecological knowledge among the local population and through the "Internet"
5. To support the suggestion to strengthen the role of the local administration (self-governance) as part of the solution of regional environmental and economic problems
6. To consider urgently the creation of the "Friends of Baikal" Society in Germany
7. To consider expedient the publishing of the international magazine "Baikal and its Problems" and creation of an adequate technical facilities for this
8. To create the site "Baikal" at the Siberian Division of the Russian Academy of Sciences – the first information to include the information from the current conference
9. To suggest the publication of top-priority materials concerning Lake Baikal with translation into European languages
10. To organise an international Conference "Baikal in 3rd Millennium" in 2000 at Baikal
11. To organise aerial fire protection at Zabaikalskij National Park
12. To implement Baikal Seal Protection as a model project
13. To include the wetlands of Tscheewirkujskij Bay within the Ramsar convention
14. To implement a Project "Role of the Germans in the studies of nature and culture of the Baikal Region"

Workshop F
Socio-ecological aspects of project development, environmental education and information management

The workshop socio-ecological aspects of project development; environmental education and information management worked out the following issues/proposals:

Concerning **Information Management:**

Supporting the development of an "Information Centre", which follows a multi-functional approach and which could consist of the following elements:

- Citizens meeting point
- Internet cafe
- Exhibition hall
- Information network
- Clearing house

This should be open for public access, and adapted to different target groups (educators, mass media, administration/ decision makers, general public)

Concerning the **Socio-Economic Aspects:**

1. Developing and supporting NGOs in the field of environment
2. Furthering environmental communication between different stakeholders (such as scientific community, NGOs, industry/business, governmental institutions/local self-governance)
3. Establishing Consultancy for citizens in order to provide support in administrative, legal, social, and indigenous issues
4. Developing an environmental "Health Monitoring Programme"

5. Developing projects for income creating measures for a sustainable use of natural resources

Concerning **Environmental Education:**

1. Supporting initiatives for teachers' environmental training
2. Supporting the publication of didactic, educational related materials and literature
3. Enhancing the incorporation of traditional local knowledge and values into the educational process
4. Promoting the exchange of experience on local, regional, national and international level

Conclusion

At the conclusion of the conference, the participants adopted the following **"Schneverdingen Declaration"**, which highlights the current situation and proposes means and actions for the future development of the Lake Baikal Region with Russian-German co-operation.

The Schneverdingen Declaration

The Participants of the Conference

1. Endorse the necessity to protect, to develop and to establish „World Heritage Sites" at all levels and by all means

2. Recognise the real threatening dangers for the Baikal region, which need to be addressed immediately

3. Support the adoption of the Baikal Law and ensure that this law encompasses aims, obligations and an organisational framework

4. Encourage the Government of the Russian Federation and the regional authorities to actively support the implementation of the Baikal Law including:

- Setting up executive systems as proposed by the law
- Preparing normative acts at federal and regional level
- Developing norms, standards and agreements, which stimulate both nature conservation and sustainable development
- Creating sustainable financial means for the regional development

5. Welcome the Baikal commission's call for involvement of international organisations and experts in the process of further elaborating appropriate norms for the implementation of the law and the protection of the lake; appeals to the German government to support this through meetings of experts in German-Russian environmental co-operation; it also addresses the UNESCO and its Moscow office as well as the international community

6. Support the idea of establishing an international working-group to identify ways and means of appropriate securing funding and to ensure an environmentally sound restructuring of the Baikalsk pulp and paper plant. Efforts to attracting private investors and financiers should have a high priority; to accelerate this process of restructuring a non-commercial basis has to be investigated

7. See that the entire state, university and society process of the development of the region fits into:

- The strict requirements of the UNESCO in its World Heritage Programme, and into
- The demand of the Rio-decisions (1992), especially on the sustainable development in the Rio declaration and in the Agenda 21

8. Realise a requirement for:

- Research (basic and applied)
- Development and testing of model-instruments and institutions
- Institutions for information, documentation, teaching, education and training
- Ways and means to raise and strengthen the level of acceptance of their heritage by the society

9. Have identified, evaluated and recommended a series of projects which address the main problems

10. Seek to ensure all funding institutions utilise the expertise gained here in Schneverdingen for supporting various key projects

11. Consider this kind of expert meeting, which focused on project proposals, to be pointing the way ahead

12. Are convinced, that donors and participants benefited a lot from the Schneverdingen Conference; the "Spirit of Schneverdingen" enthused the experts – and will help the Baikal!

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Einleitung

Gegenwärtiger Stand der Kooperation

Die russisch-deutsche Zusammenarbeit in der Baikalregion hat eine lange Geschichte. Schon im 18. Jahrhundert leisteten deutsche Forscher signifikante Beiträge bei der Entdeckung der Schönheit und der Schätze Sibiriens und des Baikalsees sowie deren Bekanntmachung in der restlichen Welt. Seit kurzem hat das Interesse an internationaler Zusammenarbeit am Baikalsee erneut zugenommen. Wissenschaftler, Privatunternehmer und Nichtregierungsorganisationen aus Russland, Deutschland und vielen anderen Nationen sind hieran beteiligt. Eine herausragende Bedeutung kommt dabei deutschen Rechtskundlern zu, die bei der Erarbeitung des Baikalgesetzes Vorstudien erstellten und die Revision der Endfassung durchführten.

Momentan ist die russisch-deutsche Kooperation nicht ohne Probleme und Risiken, die zu Reibungsverlusten und Konflikten zwischen den Beteiligten geführt haben. Zwar sind neue Initiativen auf unterschiedlichen Niveaus entstanden, wie Projekte, Konferenzen, Workshops oder auch neue Institutionen, jedoch ist die Zusammenarbeit und die Finanzierung unter den heutigen Rahmenbedingungen schwierig. Bedauerlicherweise überlappen sich manche der Initiativen aufgrund mangelnder Koordination beträchtlich. Besonders der Wettkampf um finanzielle oder personelle Ressourcen zwischen den und innerhalb von Institutionen behindern die Kooperation beträchtlich.

Es ist daher von besonderer Bedeutung, eine Verbesserung der Koordination bestehender Initiativen und Aktivitäten zu bewirken, und zwar in erster Linie innerhalb Deutschlands. Zum Erreichen gemeinsamer Ziele für die nachhaltige Entwicklung und bei der Umsetzung des Gesetzes zum Schutz des Baikalsees ist außerdem eine verstärkte Koordination und Integration von Akteuren in den den Baikalsee umgebenden Regionen vonnöten.

Die Konferenz

Vor diesem Hintergrund organisierte die Alfred Toepfer Akademie für Naturschutz (NNA) in Zusammenarbeit mit dem Bundesamt für Naturschutz (BfN) eine Konferenz zur „Russisch-deutschen Zusammenarbeit in der Baikalregion" in Schneverdingen vom 14. bis 17. November 1999. Schwerpunktthema der Veranstaltung war der Schutz und die nachhaltige Entwicklung des Baikalsees. Hauptintention war die Schaffung einer Plattform für einen Dialog zwischen den beteiligten Personen der bestehenden Initiativen und Projekte, die Herstellung neuer Kontakte, das Aufzeigen von Konflikten und die Verstärkung des Austausches und der Kooperation zwischen russischen Institutionen und deutschen Teilnehmern im allgemeinen.

Als Teilnehmer fanden sich rund 200 Vertreter aus staatlicher und wissenschaftlicher Verwaltung, Wissenschaftler aus den verschiedenen Territorien der Russischen Föderation, aus Deutschland, den Vereinigten Staaten, Dänemark, der Slovakei und Belgien, Vertreter der deutschen Massenmedien, Juristen, Abgesandte der UNESCO, NATO und internationaler NROs, aus dem Bundesministerium für Wirtschaft und Technologie, Studenten und Unternehmer aus der Tourismusbranche in Schneverdingen ein.

Unterschiedliche gesellschaftliche Schlüsselgruppen trafen sich nicht nur zum Austausch ihrer neuesten Erfahrungen und Pläne bei interdisziplinären Lösungsansätzen, sondern auch zur konkreten Planung und Vorbereitung innovativer Projekte. Hierbei ergaben sich synergetische Effekte. Eines der Hauptanliegen der Konferenz war das Herbeiführen von Kontakten zwischen Spezialisten im Standardisieren von Monitoringsystemen und die Entwicklung diesbezüglicher gesetzlicher Regelungen. Im Verlaufe der Konferenz wurde allen Teilnehmern die Möglichkeit zur Pflege vorhandener Kontakte bzw. zum Aufbau neuer Kontakte im Rahmen formeller und informeller Sitzungen geboten.

Zur Eröffnung der Konferenz wurde ein für das deutsche Fernsehen produzierter zweiteiliger eindrucksvoller Film über Natur und Menschen der Baikalregion zu verschiedenen Jahreszeiten gezeigt. Im Rahmen einer einführenden Vortragsreihe wurde dem Plenum die aktuelle Situation bezüglich der internationalen Kooperation in Sibirien vorgestellt, gefolgt von der Statusbeschreibung des Sees als Welterbe der Menschheit, den Problemen und Möglichkeiten der russisch-deutschen wirtschaftlichen Zusammenarbeit und der Darstellung der limnologischen Einzigartigkeit des Baikalsees. Basierend auf diesen Schlüsselvorträgen wurden anschließend in 6 parallel abgehaltenen Arbeitskreisen weitere Vorträge und Diskussionen zu folgenden Themenbereichen abgehalten:

Workshops

A. Grundlagenforschung in der Baikalregion
B. Nachhaltige Landwirtschaft, Forstwirtschaft und Fischerei
C. Technischer Umweltschutz und Standardisierung von Erfassungs- und Monitoringsystemen
D. Landschaftsplanung und nachhaltige Regionalentwicklung
E. Naturschutz und Tourismus
F. Sozioökologische Aspekte bei Projektplanung, Umwelterziehung und Informationsmanagement

Ergebnisse und Empfehlungen der Workshops

In jedem der Workshops wurde ein Katalog über laufende Projekte und Aktivitäten und eine Liste der Akteure erstellt. Es wurden Problembereiche, potenzielle Projekte und Partnerschaften identifiziert und Empfehlungen zur Planung und Umsetzung neuer Projekte ausgearbeitet. Auf den folgenden Seiten sind die Ergebnisse zusammengefasst dargestellt.

Workshop A Grundlagenforschung in der Baikalregion

Zukünftige Schwerpunkte der Grundlagenforschung in der Baikalregion sind:

1. **Hydrographie und physikalische Limnologie des Baikalsees:**

- Das Wärmebudget und die Eisdecke
- Horizontaler Wasseraustausch zwischen den Hauptbecken des Sees
- Der Dauerfrostboden im Baikalbekken und seine Bedeutung für die Dynamik des Kohlenstoffs
- Die Verwendung von akustischen Doppler-Strömungsmessern (ADCP) zu Erfassung der Wasserströmungen im Baikal-See
- Die Verwendung von Tracern zur Bestimmung des Alters von Wassermassen in verschiedenen Bereichen und Tiefen des Baikal-Sees
- Die Modellierung des physikalischen Antriebs, der vertikalen Durchmischung und von konvektiven Prozessen im Baikal-See

2. **Nährstoffkreisläufe im Baikalsee:**

- Nährstoffkreisläufe in der Freiwasserzone
- Modellierung der regionalen Massengleichgewichte anhand von Klima-Variabilitäts-Scenarien
- Herstellung und Charakterisierung von Referenzmaterialien des Baikalwassers

3. **Die Freiwasserlebensgemeinschaften und ihre Rolle im Nahrungsnetz des Baikalsees:**

- Langzeitbeobachtungen über die Produktivität des Phytoplanktons
- Experimentelle Untersuchungen über die kontrollierenden Faktoren der jahreszeitlichen Sukzession des Phytoplanktons mit Betonung auf Nährstoffverfügbarkeit einschließlich der Rolle von Spurenelementen
- Die Rolle der Fische im pelagischen Nahrungsnetz, ihre Biologie, Altersstruktur und Populationsdynamik
- Die pelagischen mikrobiellen Lebensgemeinschaften und die Rolle des Mikrozooplankton-Grazing im Nahrungsnetz und den Stoffkreisläufen
- Sinkstoffflüsse und ihre Bedeutung für die Kohlenstoff- und Nährstoffbudgets
- Einrichtung einer Datenbank für die Kieselalgen des Baikal-Sees

4. **Die Lebensgemeinschaften des Uferbereichs und des Seebodens und ihre Bedeutung für die Produktivität:**

- Ursprung und Biologie sowie Verhalten der Baikal-Robbe
- Quantifizierung der Ausdehnung der Ufervegetation unter Nutzung von Fernerkundung
- Untersuchung der mikrobiellen chemosynthetischen Lebensgemeinschaften im tiefen Seeboden in Bereichen austretenden Methans (Methanoxidierer)
- Ökophysiologie von Schnecken und Flohkrebsen

5. **Die Organismen des Baikal-Sees – Stammesgeschichte, Besiedlungsgeschichte und Bedeutung für die funktionellen Beziehungen innerhalb des Ökosystems:**

- Die Verwendung des Baikal-Sees als ein natürliches Laboratorium für die Quantifizierung der genetischen Vielfalt
- Die Quantifizierung der endemischen Pflanzen und Tierarten im Baikal-See
- Gefährdete endemische Arten innerhalb des Baikalbeckens

6. **Die Geschichte des Baikal-Sees:**

- Die tektonische Geschichte des Baikal-Grabenbruch-Systems
- Die Seebodensedimente des Baikal-Sees und ihre Bedeutung für die Paleo-Ökologie und Paleo-Klimatologie
- Bewertung des Klimas und Umweltwandels in der Baikal-Region

7. **Atmosphärenchemie:**

- Entwicklung einer Station für die kontinuierliche Beobachtung der Atmosphäre sowie der chemischen Stofftransporte innerhalb der Atmosphäre im Baikal-Becken

Anforderungen für Kurse im Zusammenhang der Grundlagenforschung:

- Feldkurse über verschiedene Aspekte der Geologie und Limnologie des Baikalsees
  Ausbildung von Forschungstauchern

Workshop B Nachhaltige Landwirtschaft, Forstwirtschaft und Fischerei

In Bezug auf Nachhaltige Landwirtschaft, Forstwirtschaft und Fischerei identifizierten die Teilnehmer folgende laufenden Projekte:

- Ein TACIS-Projekt über Waldnutzung in der Baikalregion mit einem Gesamtvolumen von ca. 2.5 Mio ECU (1997 bis 2000).
- Ein Projekt zur Erhaltung der Biodiversität finanziert von der Global Environmental Facility (GEF) über ca. 2 Mio US $ (1998 bis 2000).

Weitere laufende oder kürzlich beendete Projekte sind:

- Erstellung und Verbreitung einer Karte zur Situation der Wälder um den Baikalsee. Baikal Wave.
- Publikationen über biodynamische Landwirtschaft. Baikal Wave.
- Biotechnologie als Instrument zum Erosionsschutz in Burjatien. Universität Hannover, studentisches Projekt.
- Nachhaltige Entwicklung in der Baikalregion – Ansätze aus der Galtai-Kalinovka-Region. Universität Hannover, studentisches Projekt.

Die Teilnehmer kamen zu dem Schluss, dass eine systematische Dokumentation aller internationalen Projekte

in der Baikalregion dringend benötigt wird.

Die Teilnehmer dieses Arbeitskreises erarbeiteten folgende Projektvorschläge:

- Biodiversität und feuerbedingte Sukzessionen von Waldökosystemen in der sibirischen Cryolithischen Zone
- Baikal Zertifizierungszentrum
- Ökologische, wirtschaftliche und soziale Auswirkungen regionaler klimatischer Veränderungen in Kontinental-Eurasien (Burjatien, Mongolei)
- Aussichten für eine nachhaltige Entwicklung der Bevölkerungsgruppe von Ust-Barguzin
- Nachhaltige Entwicklung in Landschaften mit dominierender Haustierhaltung
- Strategien für Erosionsminimierung
- Wüstenbildungsprozesse in der Baikalregion
- Der anthropogene Einfluss auf Steppenökosysteme in der Baikalregion und Empfehlungen für eine nachhaltige Entwicklung

Workshop C
Technischer Umweltschutz und Standardisierung von Erfassungs- und Monitoringsystemen

Im Workshop Technischer Umweltschutz und Standardisierung von Erfassungs- und Monitoringsystemen wurden die folgenden Möglichkeiten der Kooperation zwischen deutschen und russischen Experten identifiziert:

1. Umweltschutz in der Zellulose- und Papierindustrie – Umwelteffekte durch verbesserte Technologien

- Erfassung der Möglichkeiten zur verstärkten Anwendung umweltfreundlicher Technologien im Produktionsprozess
- Ersatz der Chlortechnologie beim Bleichprozess
- Entwicklung von Prozesskreisläufen bei der Zelluloseproduktion
- Einsatz von Niedertemperatur-Energie bei der Wasserkühlung
- Einführung von Reinigungstechnologien für Abgase
- Entwicklung von Managementkonzepten zur Beseitigung der 7 Mio t Abwässerschlämme an der Baikalsk Zellulosefabrik

2. Management industrieller und städtischer Abfälle und Abwässer

- Reinigung kommunaler Abwässer – Einsatz von an das sibirische Klima, die Tektonik und die Qualitätsansprüche des Baikalwassers angepasste Technologien
- Erfassung und Bewertung alter Abfalldeponien – Entwicklung von Sanierungskonzepten
- Bestandsaufnahme der Müllproduktion und ihrer Beseitigung – Aufzeigen von Möglichkeiten zur Müllvermeidung, -lagerung und -wiederverwertung
- Förderung des Transfers von Knowhow für Abfallmanagement-Technologien und Entwicklung lokal angepasster Technologien

3. Überwachung des Baikalsees, seiner Zuflüsse und des terrestrischen Einzugsgebietes – Mittel zur Kontrolle der Umweltbedingungen und der Auswirkung neuer Technologien auf die Umwelt.

- Kontrolle der Oberflächenwasser-Qualität im Einzugsgebiet – Beteiligung an lokalen Regierungsprogrammen
- Aufbau eines wirkungsvollen Monitoring-Systems für den Uferbereich des Baikalsees als Werkzeug für Umweltagenturen zur Identifizierung von Problemzonen
- Überwachung von Wasserkörpern im See unter Verwendung des Neutrino-Teleskops – Abgleichung physikalischer und limnologischer Daten
- Feststellung der Auswirkung der Luftverschmutzung aus lokaler Industrie auf die Biodiversität der Vegetation – Methoden zur Kontrolle des Rückgangs von Industrieemissionen
- Technische Unterstützung und Beteiligung deutscher Experten bei der Erstellung eines digitalen Atlasses der Naturlandschaften der Baikalregion
- Durchführung eines bilateralen Seminars zur Abschätzung von Umweltqualität – Erfahrungsaustausch und Entwicklung an sibirische Bedingungen angepasster Strategien und Methoden

Workshop D
Landschaftsplanung und nachhaltige Regionalentwicklung

Im Workshop Landschaftsplanung und nachhaltige Regionalentwicklung wurde für die folgenden Bereiche Handlungsbedarf festgestellt:

1. Die Rolle der Landschaftsplanung als Instrument für nachhaltige Entwicklung

- Planungsverfahren
  1. Erstellung eines Übersichtsplans zur Erfassung und Darstellung von räumlichen Interessens-Schwerpunkten im Kerngebiet
  2. Erstellung einer Prioritätenliste (Maßstab 1: 200000)
  3. Detaillierte Planung auf lokalem Niveau (Maßstab 1: 25000)
- Sektorale Planung, angepasst an die Russische Föderation
- Einrichtung paralleler Planungsstränge/-einheiten in anderen Regionen der RF
- Wichtigste Aufgabe ist die Vernetzung der Planungsstränge/-einheiten
- Ganzheitliche Planung speziell für die Baikalregion, deren Situation nicht auf die ganze Föderation übertragen werden kann
- Landschaftsplanung unter Einbeziehung insbesondere sozialer und ökonomischer Aspekte

2. Technologie und Information

- Garantie der dynamischen Aktualisierung von Daten
- Nutzung von Fernerkundungssystemen zur Aktualisierung der Landnutzungsregister und zur anschließenden Überprüfung der Daten in Testgebieten
- Fortbildung sollte kein Selbstziel sein, sondern das Interesse an Methoden wecken, die Planungs-, Problem- und Umsetzungsorientiert sind
- Fortbildung betrifft auch das Verständnis von Bewertungssystemen und die hieraus abgeleitete Entwicklung von Zielen und Maßnahmen

3. Rechtliche Grundlagen der Landschaftsplanung

- Umsetzung des Baikalgesetzes: Landschaftsplanung als Instrument ökologischer Zonierung
- Festsetzung von Umsetzungsregulatorien
- Spezifizierung der Ziele des Baikal-

gesetzes bei Raumordnungs- und Landschaftsplanung sowie bei nachhaltiger sozioökonomischer Entwicklung
- Begriffsdefinitionen zur Einengung des Interpretationsspielraumes
- Festlegung von erlaubten Aktivitäten/Handlungen (positive Formulierung, wenige Verbote)
- Einbeziehung anderer grundgesetzlicher Regulierungen wie: „Der nationale Aktionsplan zum Schutz der Umwelt der Russischen Föderation" und „Das Landesprogramm für die Littoralzonen der Azov´schen See"
- Veränderungen der Bedingungen bei Eigentumsverhältnissen beeinträchtigen nicht die Landschaftsplanung, spielen aber eine wichtige Rolle bei der Umsetzung von Landschaftsplanungszielen
- Errichtung von Institutionen

4. Beteiligung der Öffentlichkeit

- Bestimmung der für die Planung zuständigen Einrichtungen, Akteure, betroffenen Zielgruppen und Individuen
- Direktes Ansprechen der Öffentlichkeit: Bewusstwerdung der Möglichkeiten
- Einbeziehung der Öffentlichkeit: welche Interessengruppen? In welcher Form? Auf welchem Planungsstadium? Auf welchem Kommunikationsniveau? Wie kann die Teilnahme organisiert werden?
- Beteiligung von NROs als Vermittler bei der Bewusstseinsbildung und Problemlösungen in der Bevölkerung
- Organisation von Workshops und Trainingskursen

5. Regionale Schwerpunktgebiete

- Festlegung von Schwerpunktbereichen für Planungen in der Kernzone (Litoralzone und angrenzendes Hinterland), wodurch andere Planungen nicht ausgeschlossen werden

1. Slijudjansker Rayon im Süden des Sees: sozioökonomische und ökologische Probleme können auf der Grundlage von Landschaftsplanung gelöst werden
2. Ust'-Barguzin und Zabaikalskij National Park: andere sozioökonomische und spezifische ökologische Charakterista
3. Severo-Baikal'sk im Norden des Sees: Probleme liegen bei der hier beginnenden Bahnstrecke Baikal-Amur und Plänen für Severo-Baikal'sk
4. Kabanskij Rayon (Selenga)

- Integration von Gebieten und Entwicklungsachsen, die für die Zukunft von Wichtigkeit sein könnten

6. Bestimmung der Ausgangssituation für internationale Kooperation

- Suche nach Finanzierungsquellen
- Weiteres Training der Wissenschaftler und übrigen Angestellten in der Verwaltung, die gegenwärtig mit der Planung beschäftigt sind
- Internationale Beratung bei der Entwicklung von Bildungssystemen bei der Landschaftsplanung in der RF; Anpassung von Lehrinhalten bei Universitätskursen an die konkrete Situation beim RF-Training durch Fachleute der RF
- Einsetzung einer Steuerungskommission zur Einrichtung der Landschaftsplanung in der Baikalregion unter Beteiligung von Vertretern verschiedener Regionen und Nationen
- Analyse anderer Landschaftsplanungsmodelle in Europa

Workshop E
Naturschutz und Tourismus

Die Teilnehmer des Workshops Naturschutz und Tourismus sind der Meinung,

1. dass die Entwicklung des Ökotourismus eine der Prioritäten der russisch-deutschen Zusammenarbeit sein sollte,
2. einen Vorschlag an die Regierungen beider Länder zur Schaffung eines Biosphärenreservats auf der Basis des Zabaikalsky National Parks zu richten,
3. die Einrichtung eines internationalen Trainings- und Ausbildungszentrums (im Dorf Istomino) in Selenga – Delta zu empfehlen für Medizinalpraktika, Feldexpeditionen und Untersuchungen zum Monitoring des Baikalsees,
4. die GIS Datenbank „Baikal" weiter zu entwickeln und die Verbreitung ökologischen Wissens in der lokalen Bevölkerung und durch das Internet zu fördern,
5. einen Vorschlag zur Stärkung der Rolle lokaler Verwaltungen durch mehr Selbstbestimmung bei der Lösung regionaler Umwelt- und Wirtschaftsprobleme zu unterstützen,
6. die Gründung einer „Freunde des Baikal-Gesellschaft" in Deutschland für zweckmäßig zu halten,
7. desgleichen das Erscheinen eines internationalen Magazins „Baikal and its Problems" und die Bereitstellung diesbezüglicher Technik und Logistik zu ermöglichen,
8. eine Internet-Seite „Baikal" bei der Sibirischen Abteilung der Russischen Akademie der Wissenschaften einzurichten – die ersten Informationen sollten die Beschlüsse der aktuellen Baikalkonferenz an die Öffentlichkeit bringen,
9. die Übersetzung allen Informationsmaterials über den Baikal von besonderer Priorität in europäische Sprachen vorzuschlagen,
10. eine internationale Konferenz „Baikal im 3. Millennium" im Jahr 2000 am Baikalsee auszurichten,
11. eine Staffel zum Feuerschutz aus der Luft im Zabaikalskij National Park einzurichten,
12. den Schutz der Baikalrobben als Modellprojekt einzurichten.
13. die Feuchtgebiete der Tscheewirkujskij Bay in die Ramsar Konvention aufzunehmen, und
14. ein Projekt über die Rolle der Deutschen in den Bereichen beim Studium von Natur und Kultur in der Baikalregion einzurichten.

Workshop F
Sozioökologische Aspekte bei Projektplanung, Umwelterziehung und Informationsmanagement

Der Workshop Sozioökologische Aspekte bei Projektplanung, Umwelterziehung und Informationsmanagement erarbeitete die folgenden Ideen und Vorschläge:

Betreffs **Informationsmanagement:**

Unterstützung der Entwicklung eines Informationszentrums mit multifunktionalem Ansatz, der z.B. die folgenden Elemente beinhalten sollte:

- Bürgertreffpunkt
- Internet Cafe
- Ausstellungshalle

- Informationsnetzwerk
- Clearing house

Der Zugang sollte öffentlich sein und sich an verschiedene Zielgruppen richten (Bildungsbereich, Massenmedien, Verwaltung, Entscheidungsträger, allgemeine Öffentlichkeit)

Betreffs **Sozio-ökonomische Aspekte:**

1. Aufbau und Unterstützung von NROs im Umweltbereich
2. Förderung der Umweltkommunikation zwischen verschiedenen Schlüsselgruppen (Wissenschaftliche Gruppen, Nichtregierungsorganisationen, Industrie und Handel, Zentrale und dezentrale Regierungseinrichtungen, u.a.)
3. Einrichtung von Bürger-Beratungsstellen bei verwaltungstechnischen, juristischen, sozialen und bevölkerungsbezogenen (ethnischen) Fragen
4. Entwicklung eines Gesundheitsüberwachungs- und Steuerungsprogramms im Zusammenhang mit umweltbezogenen Fragen
5. Entwicklung von Projekten zur Schaffung von einkommenswirksamen Maßnahmen zur nachhaltigen Nutzung von Naturressourcen

Betreffs **Umwelterziehung:**

1. Unterstützung von Initiativen zur Umweltausbildung von Lehrern
2. Unterstützung bei der Veröffentlichung didaktischer, unterrichtsbezogener und anderweitig relevanter Literatur
3. Erhöhte Einbeziehung traditionellen Wissens und traditioneller Werte in Bildungsprozesse
4. Förderung des Erfahrungsaustausches auf lokaler, regionaler und internationaler Ebene

Schlussergebnis

Als Schlussergebnis der Konferenz wurde von den Teilnehmern einvernehmlich die folgende „Schneverdinger Erklärung" verabschiedet, die die aktuelle Situation beleuchtet und Mittel und Wege für die zukünftige Entwicklung der Baikalregion und der russisch-deutschen Zusammenarbeit vorschlägt.

Erklärung von Schneverdingen

Die Konferenz :

1. bekräftigt die Notwendigkeit, „World Heritage Sites" auf allen Ebenen und mit allen Kräften zu schützen, zu entwickeln und zu gestalten;
2. sieht besonders für die Baikal-Region aktuelle und drohende Gefahren, denen Einhalt geboten werden muss;
3. begrüßt daher, dass das Baikal-Gesetz erlassen wurde und schon Ziele, Verpflichtungen und einen organisatorischen Rahmen vorsieht;
4. regt bei der Regierung der Russischen Föderation und den regionalen Regierungen an, aktiv den Prozess der Implementierung des Baikal-Gesetzes zu beschleunigen, der unter anderem folgendes einbezieht:
   - die Errichtung des Exekutivorgans, das im Gesetz vorgesehen ist;
   - die Vorbereitung der normativen Akte auf der föderalen und regionalen Ebene;
   - die Entwicklung von Normen, Standards und Vereinbarungen, die sowohl den Naturschutz als auch die nachhaltige Entwicklung stimulieren; und
   - die Schaffung von tragfähigen finanziellen Mitteln für die Entwicklung der Region;
5. begrüßt die Aufforderung der staatlichen Baikalkommission zur Beteiligung internationaler Organisationen und Experten an der Ausarbeitung der entsprechenden Normen zur Implementierung des Gesetzes über den Schutz des Baikalsees; fordert die deutsche Bundesregierung auf, dies im Rahmen der deutsch-russischen Umweltkooperation auch durch gemeinsame Expertentreffen zu unterstützen, und wendet sich ebenso an die UNESCO und ihr Moskau-Büro sowie an die internationale Gemeinschaft
6. unterstützt den Gedanken, eine internationale Arbeitsgruppe zu gründen, die Wege und Mittel ausmacht, um finanzielle Mittel einzuwerben und sie für die umwelt- und naturschutzfreundliche Umstrukturierung des Papier- und Zellstoffkombinats Baikalsk zu nutzen. Dabei sollte ein Bemühen um privatwirtschaftliche Investoren oder Kapitalgeber im Vordergrund stehen; parallel und komplementär hierzu ist zur Beschleunigung nach einer nicht-kommerziellen Basis zu suchen.
7. sieht den gesamten staatlichen, universitären und gesellschaftlichen Prozess der Entwicklung der Region eingepasst
   - in die strikten Anforderungen der UNESCO in ihrem Welterbe-Schutzprogramm und in
   - die Forderung der Rio-Beschlüsse (1992) insbesondere zur nachhaltigen Entwicklung in der Rio Deklaration und in der AGENDA 21;
8. sieht daher einen jetzt klarer werdenden Bedarf an
   - Forschung (Grundlagen und Angewandt),
   - Entwicklung und Erprobung von Modell-Instrumenten und Einrichtungen,
   - Einrichtungen der Information, Dokumentation, Lehre, Schulung und Erziehung,
   - Wege und Mittel, die Akzeptanz für ihr Erbe in der Gesellschaft zu erhöhen und zu festigen;
9. hat dementsprechend – wie vorstehend strukturiert – eine Reihe von Projekten aus den verschiedenen

Problembereichen herausdestilliert, bewertet und empfohlen;

10. richtet sich daher an alle Fördereinrichtungen, den hier in Schneverdingen gewonnenen Sachverstand von Experten zu nutzen, um – je nach Förderzielen und Schwerpunkten – einzelnen Projekten eine Förderung zu gewähren.
11. erachtet daher diese Art des Expertentreffens, die auf Projektebene über den Bedarf streitet, als richtungsweisend;
12. ist davon überzeugt, dass Schneverdingen die Geber- und Nehmerlandschaft bereichert hat; der „Geist von Schneverdingen" hat Sachverständige erfüllt – und wird dem Baikal helfen!

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Begrüßung

Johann Schreiner

Sehr geehrte Freunde und Kolleginnen und Kollegen aus Russland, sehr geehrte Damen und Herren,

wir wissen heute, dass Naturschutz als querschnittsorientierte Disziplin auf zwei Säulen basiert;

1. auf wissenschaftlichen Grundlagen, vor allem der

- Bio- und Geowissenschaften, der
- Geistes- und Sozialwissenschaften, und der
- Wirtschafts- und Ingenieurwissenschaften;

2. auf Werten, Werthaltungen und Wertschätzungen.

Es ist Ausdruck einer bestimmten Werthaltung, wenn unsere Gesellschaft kommenden Generationen gleiche Ausgangsbedingungen zugesteht, wie wir sie erfahren durften.

Es ist Ausdruck einer bestimmten Werthaltung, wenn unsere Gesellschaft Tier- und Pflanzenarten oder die Gesamtheit der natürlichen und historisch gewachsenen Biotopvielfalt als Entwicklungspotential für künftige Generationen bewahrt.

Es ist Ausdruck einer bestimmten Werthaltung, wenn unsere Gesellschaft einzigartige Landschaften, wie den Baikalsee, zum Welt-Naturerbe erklärt und sie für künftige Generationen zu sichern versucht.

Doch wie kommen solche Werthaltungen zustande?

Über Informationen läuft der erste Weg:

Über etwas zu lesen und Wissenswertes zu erfahren bildet oft den Einstieg; Informationen werden heute über die Massenmedien verbreitet. Grandiose Filme, wie wir sie gestern abend von Dr. Klaus Bednarz sehen durften, vermitteln nicht nur Wissen, sondern auch Gefühle und Stimmungen.

Sie ebnen damit den zweiten Weg zur Entstehung von Werthaltungen, sie beeinflussen Einstellungen.

Wenn ich im Vorfeld dieser Konferenz Leuten erzählt habe, dass wir zum Baikalsee eine Tagung veranstalten, kam sehr oft die Antwort: „Ist das nicht der See, der austrocknet?" Man erinnert sich also nicht an den Namen des Sees in Russland, dessen Fläche rapide abnimmt, den Aral-See, sondern man assoziiert einen dramatischen Vorgang.

Wir müssen erreichen, dass mit dem Namen Baikalsee auf der Gefühlsebene das Positive, das Einzigartige assoziiert wird, das er darstellt und dass die Antwort vielleicht dann lautet: „Ist das nicht die Perle Sibiriens? Ist das nicht der größte Süßwassersee der Erde? Ist das nicht der See mit dem klarsten Wasser?"

Gerade letzteres war es, das mich 1994 für diesen See eingenommen hat. Vortrag und Workshopleitung bei der damaligen Konferenz zur nachhaltigen Entwicklung der Baikal-Region war für mich Gegenstand rationeller Auseinandersetzung. Ausschlaggebend für meine Begeisterung war es aber, den See aus der Luft zu sehen, auf ihm mit dem Schiff zu fahren, an ihm spazieren zu gehen.

Und da ist noch etwas, das eine persönliche Einstellung prägt, es sind Kontakte zu Personen. Zu Personen, die in ihrer Freundlichkeit und Gastfreundschaft tiefe persönliche Bande haben entstehen lassen. Stellvertretend möchte ich hier Nina Dagbajeva und Arnold Tulokhonov nennen.

Eine Region kulinarisch zu erfahren bietet noch einen weiteren Anknüpfungspunkt. „Naturschutz geht durch den Magen" oder „Gourmets for Nature" sind Schlagworte die diese Sinne charakterisieren. Wer einmal den Omul gekostet hat, sei es gegrillt, geräuchert oder den Kaviar, wer den Amrita, den Kräuterschnaps oder die Liköre mit Sanddorn oder Holunder probiert hat oder auch den Wodka mit eingelegtem Hirschhorn wird diese Region auch in dieser Richtung nicht nur in Erinnerung behalten, sondern wertschätzen.

Sehr geehrte Damen und Herren,

nachhaltiger, dauerhafter Naturschutz beruht nicht nur auf Wissen und Werten. Er muss die ökonomische und soziale Komponente mit einbeziehen. Die Agenda 21, das Handlungsprogramm der Weltgemeinschaft für das 21. Jahrhundert, gibt uns diesen Aufgabendreiklang „Ökologie - Ökonomie - Soziales" vor. Öffentliches Bewusstsein schaffen, öffentliche Zugänglichkeit von Umweltinformationen und Beteiligung aller wichtigen gesellschaftlichen Grup-

pen an Entscheidungsprozessen sind die Instrumente für einen nachhaltigen Naturschutz, einen Naturschutz, der die Lebensgrundlagen der künftigen Generationen sichert.

Vor diesem Hintergrund fand im Mai 1996 am Rande des Deutschen Naturschutztages in Hamburg eine Gespräch statt, an dem Prof. Dr. Martin Uppenbrink, Präsident des Bundesamtes für Naturschutz, Helmut Schmidt, Geschäftsführender Vorstand der Alfred Toepfer Stiftung F.V.S. und meine Wenigkeit teilnahmen. Damals fiel der Entschluss, eine Konferenz zu organisieren, die ein Forum bieten sollte für alle Personen und Institutionen, vor allem aus Deutschland, die am Baikalsee aktiv sind. Sie sollen Gelegenheit haben, zusammen mit den russischen Kolleginnen und Kollegen aktuelle Forschungsergebnisse auszutauschen, interdisziplinäre Lösungen aufzuzeigen und konkrete Projekte der Zusammenarbeit zu entwickeln. Synergien sollen entstehen, die bisher parallele Aktivitäten ablösen sollen.

Zwei wichtige Ereignisse haben in der Zwischenzeit stattgefunden, die den Entschluss, diese Konferenz in Schneverdingen durchzuführen, noch gestärkt haben.

Zum einen ist es die Verleihung des Karpinski-Preises der Alfred Toepfer Stiftung F.V.S. an Prof. Gratchev, den Leiter des Limnologischen Instituts der Sibirischen Abteilung der Russischen Akademie der Wissenschaften, für dessen herausragenden Leistungen. (Ich begrüße Prof. Gratchev ganz herzlich auch bei dieser Konferenz).

Zum anderen war es der Besuch des Dalai Lama, der vor einem Jahr hier in Schneverdingen eine Woche gelehrt hat, bei dem ich Gelegenheit gehabt habe, mich auch über den Baikal-See mit ihm zu unterhalten.

Und als dann noch die Finanzierung durch die Alfred Toepfer Stiftung F.V.S. und das Bundesumweltministerium zugesagt wurde, stand dieser Konferenz nichts mehr im Weg.

Ich danke dem Bundesamt für Naturschutz, Herr Prof. Uppenbrink und Herrn Heinrich Schmauder, dass sie diese Konferenz mit aller Kraft angeschoben und mit vorbereitet haben.

Ich danke der Alfred Toepfer Stiftung F.V.S. und dem Förderverein der Akademie, dass sie für die Unterstützung internationaler Vorhaben der Akademie immer wieder ein offenes Ohr haben.

Ich danke den Mitarbeiterinnen und Mitarbeitern der Akademie (allen voran Dr. Ulrich Werder, Dagmar Krüger und Volker Mielchen), dass sie diese Konferenz so perfekt vorbereitet haben.

Ich danke Ihnen, meine sehr geehrte Damen und Herren, für ihr Kommen und wünsche uns eine erfolgreiche Konferenz, von der eine Welle von Aktivitäten am Baikal, eine Welle der Sympathie für den Baikal und eine Welle der Kooperation und Freundschaft ausgehen.

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Keynotes

International Cooperation in Basic Research in Siberia: Results, Potentialities and Perspectives

Nikolai L. Dobretsov

Abstract

The potential of the Siberian Branch of the RAS consists of a network of 9 academic science centres (59 institutes running research in all disciplines) and a network of seismic, geo- and biosphere stations and solar and space physics facilities. On the basis of leading research institutes of the SB RAS, 18 international research centres were founded to act as 'open laboratories', whose activities are focused on development of new technologies, on joint use of national and world-level installations or on study of unique natural objects. New mechanisms for improving organisational forms of international research cooperation are proposed.

Key words
Siberia, basic research, collaboration, new mechanisms.

Siberia's vast territory, with abundant natural resources of its depths, was always attractive to Russian and foreign explorers. Planned exploration of Siberia was started in early XVIII century by outstanding German scientists invited to Russia by the Russian tsar-reformer Peter the First to found the Russian Academy of Sciences (RAS). This happened 275 years ago; this year the Russian Academy of Sciences celebrated its 275th anniversary.

The first large-scale expedition was organised in 1720, four years before the establishment of the Russian Academy of Sciences. German scientist Daniel Messerschmidt was in charge of the expedition. Over the following seven years he travelled to the Irtysh, Ob', Enissei and Lena river basins. He accumulated much diverse information which is recorded in his 12-volume diary. In particular, he paid attention to volcanic origin of certain rocks of Kuznetsk Alatau, found coal and a mammoth skeleton on the Lower Tunguska River, described silver-lead mines in Dauria. He was also the first investigator of Siberian vegetation.

Upon establishment of the Academy of Sciences, the Academy equipped the most far-reaching expeditions in the history of northern countries to Kamchatka. The first expedition was headed by W. Bering. The second expedition, called the Great Northern Expedition, was headed by Academician G.F. Miller and by I.G. Gmelin (1733 - 1743). These expeditions marked the beginning of long-term exploration of Siberia.

Main task of the expeditions was mapping and detection of natural resources. The expeditions were of comprehensive character, dealing with geology, zoology, botany, mineral and ore prospecting, ethnography and other issues. The expeditions covered by vast territories and wide scope of tasks and made invaluable contribution to investigation of Siberian nature.

Thus, an expedition team headed by botanist I.G. Gmelin, during 10-year trip across Western and Eastern Siberia, accumulated valuable data on nature, minerals and population. In his widely known monograph "Siberian Flora", I.G. Gmelin described 1178 plant species. As stated by leading European botanist Karl Linney, I.G. Gmelin himself discovered as many species as all other botanists together. Less known is his 4-volume monograph "Travel across Siberia", published in Goettingen in 1752 and, unfortunately, not yet translated into Russian. The splendid edition included detailed maps of Siberia, descriptions of everyday life and habits of local peoples and even music of folklore pieces. It is desirable to find an opportunity to reprint this edition and translate it into Russian.

The trip of Peter Pallas was also a remarkable expedition. One of his brilliant guesses was that Baikal is located in a tectonic 'fault' or giant fissure; this conclusion was made accessible to European scientists. Many of his observations formed foundations of young geoscience.

The expeditions were of extreme scientific significance; they resulted in new maps, tens of volumes describing mineral resources, flora and fauna, habits and ways of life of local population, hundreds of boxes with findings, samples and archive documents.

The materials gathered by Gerard Miller, who came to Russia at the age 20 and spent here almost 60 years of his life, are of particular importance for studying the complex process of exploration of Siberia in XVII-XVIII centuries. During his long travel across Siberia he visited almost all large settlements in the Urals and Siberia, worked in local archives and gathered a great number of documents. Many of the documents were practically saved from destruction, because they were stored under elevated humidity and damaged by rats and worms. He dealt simultaneously with history, geography, economics, ethnography, archaeology, linguistics and natural sciences, which determined the versatility of the resources gathered. According to the experts' opinion, "only a small part of these treasures was used by the scholar himself in its fundamental work "Description of Siberian Kingdom". The deed of Miller-archivist is estimated by several generations of researchers, contemporary historians cannot do without his materials..."

Today the Russian Academy of Sciences reprints a series of works of eminent scientists of the XVIII-XIX centuries. In particular, the Institute of History of the Siberian Branch of the RAS has printed the complete archives of G. Miller in Russian.

To prove the value of the expedition results, it is sufficient to say that researchers of the Buryat Science Centre of the SB RAS still use the maps to reveal changes from their comparison with present-day landscapes.

Siberia has always been the place where the local intellectual potential

was continuously replenished by free thinkers, free settlers and deportee, for instance, Decembrists.

Traditionally, Russian science and education institutions were concentrated in Moscow and St. Petersburg. Only in the late 1950s, the Soviet government took a revolutionary decision on extending science to the regions. Affiliations of the USSR Academy of Sciences, then science centres of the Siberian Branch of the Russian Academy of Sciences (SB RAS) and, later, of the Far East and Ural Branches as well as of the Siberian Branches of the Academies of Medical and Agricultural Sciences were founded in the eastern parts of the country. Simultaneously a number of universities was established in close connection to academic research centres, sometimes integrated in the structure of the centres, as, for example, the Novosibirsk State University which makes use of the research facilities and staff of the institutes of the Novosibirsk Science Centre.

Today there is a developed network of science centres and research institutes whose location and research fields account for the local features of specific territories and correspond to the majority of priority trends of the contemporary science. The research potential of the Siberian Branch of the Russian Academy of Sciences, which includes 9 science centres, amounts to 1/5 of the potential of the Russian Academy of Sciences. Almost 50 % of the SB RAS potential is concentrated in the Novosibirsk Science Centre. Furthermore, the wide network of seismic, geosphere and biosphere stations, heliophysics and space physics facilities is spread over the territory of Siberia.

Siberian scientists are engaged in traditional forms of international R&T cooperation: organisation and participation in international conferences, exchange of experts, joint research projects supported by international organisations and funds, etc. Annually, on the average SB RAS scientists together with their foreign colleagues received the total sum of about 3 mil. US$ and the equipment for joint research to the amount of 5 mil. US$ for the support of about 150 grants.

Furthermore, on the basis of research institutes of the Siberian Branch of RAS 18 international research centres functioning as 'open institutes (or laboratories)' were founded (see Table 1).

Activities of the centres are focused on development of new technologies (International Tomography Centre, International Centre for Catalysts Characterisation and Testing), on the exploitation of world-level installations (Siberian Centre for Synchrotron Radiation, International Centre for Aerophysical Studies, Siberian Centre of Solar-Terrestrial Physics), or on the investigation of unique natural objects (Lake Baikal, boreal forests, Arctic, northern territories, etc.). The centres are attractive for foreign researchers because of relatively low research expenses for studies performed with the use of expensive equipment or at unique natural objects, flexible structure and direct character of cooperation, as well as the opportunity of participation in the centre management as a founder or a member of the scientific council of the centre. For the Russian side, this form of cooperation provides an inflow of leading western researchers to Siberia, an additional funding source and acquisition of advanced equipment, as well as a possibility to support and train young researchers.

Over ten years of successful performance of these centres proved efficiency of this form of cooperation. Joint research within the framework of these centres produced numerous interesting results; thousands of joint publications are printed in leading Russian and foreign scientific journals. For example, BICER results were many hundred times reported in "Nature" and other authoritative journals. In my paper I will refer only to selected results, their detailed consideration will be presented by other conference participants.

Within the framework of the Altai International Centre for Humanitarian and Biospheric Research outstanding discoveries were made by archaeologists. At the high-altitude plateau Ukok (Mountainous Altai), permafrost had preserved in burials not only unique complex of artefacts of Pazyryk culture (articles of daily use and art, arm, etc.), but also elements of tissues of men, who had inhabited this region 2500 years ago. The most exciting discoveries were well-preserved mummified bodies of a man and a woman. These discoveries

Table 1. International research centres formed on the basis of leading institutes of the SB RAS Research objects and tools

Unique natural objects	Advanced technologies	World-level facilities
• Baikal International Centre for Ecological Research (Irkutsk) • International Scientific Centre for Socio-Ecological Problems of the Lake Baikal Basin (Ulan-Ude) • Siberian International Centre for Ecological Research of Boreal Forests (Krasnoyarsk) • Altai International Centre for Humanitarian and Biospheric Research (Novosibirsk) • Uvs-Nuur International Centre for Biospheric Research (Kysyl) • International Research Centre for Northern Territories Development (Yakutsk) • International Centre for Active Tectonics and Natural Disasters (Irkutsk) • International Research Centre for Coal and Methane (Kemerovo)	• International Tomography Centre (Novosibirsk) • International Centre for Catalysts Characterisation and Testing (Novosibirsk) • Siberian International Centre for New Information Technologies in Science and Education (Novosibirsk) • Siberian International Centre for Regional Studies (Novosibirsk) • International Research Centre for Physical Mesomechanics of Materials (Tomsk)	• Siberian Centre for Synchrotron Radiation (Novosibirsk) • International Centre for Aerophysical Studies (Novosibirsk) • International Centre of Solar-Terrestrial Physics (Irkutsk-Yakutsk) • International Centre for Closed Ecological Systems (Krasnoyarsk) • International Research Centre for Environment Physics and Ecology (Tomsk)

attracted attention of wide scientific community, in particular, geneticists. Genetic analysis yielded unexpected results: it was established that genetically Pazyryk people were close both to Mongoloids and Europeans, as well as to Northern Samodians, one of northern peoples. This suggests that already at that time races and people were actively mixing.

Another example of centuries-old interaction is the Atlas of Tibetan medicine, prepared for publication with comments of researchers of the Buryat Science Centre of the SB RAS.

The most part of international research efforts is related to environment science and global climate changes. At the Siberian International Centre for Ecological Research of Boreal Forests, for the first time for the northern Eurasia temperature fields are reconstructed with high resolution (up to a year or a season) from tree rings. The scientists managed not only to follow annual temperature changes for the past century, but even to obtain reliable data for the last 900 years. For the last 1.5 ky the data of local chronologies are reduced to a generalised scheme, which shows long-term (within and beyond a century) oscillations of summer temperature for this period. At present, an attempt is undertaken to obtain super-long-term chronologies of Eurasia climate changes for the last 10 thousand years using cross-dating of semifossil wood. It was established that during warming periods (8500-8000 and 6500-6000 years ago) the forest edge line shifted by 4° northward, which allows one to predict consequences of the forthcoming warming.

Interesting results were obtained at the Baikal International Centre for Ecological Research (BICER) and within the framework of other projects focussed on Baikal studies. The most important projects are presented in Table 2.

Lake Baikal attracts attention as a unique site and natural laboratory to study natural environment and climate. Uniqueness of the lake ecosystem is due to its long evolution history (over 30 million years) as an isolated water body with unique water cycle analogous to water circulation in oceans. Of 2500 hy-

Table 2. Major projects executed on Lake Baikal

Project title	Main research subjects	Participants	Average funding per year	Foundation
1. Baikal Drilling Project	a) global change of paleoclimate b) evolution of sedimentation and rifting	Russia, USA, Japan	700 000 US$	RFBR, NSF, Association of Japanese Universities
2. Gas hydrates	a) Evolution of gas hydrates in Lake Baikal b) Information network and data bank on gas hydrates	Russia, Belgium, Norway Russia, Belgium, Norway	72000 US$ 126000 US$	INTAS ENRICH (European Commission)
3. Active tectonics and evolution of sedimentary basins with African lakes	The effect of tectonics on sedimentation, comparing Lake Baikal	Russia, France, Belgium	90000 US$	INTAS, RFBR, CNRS
4. Interdisciplinary research of the regularities of present-day functioning of the lake ecosystem	Physico-chemical and biological characteristics of the ecosystem of Lake Baikal	Russia, UK, Switzerland Japan	62000 US$	RFBR, INTAS, SB RAS
5. Investigation of biodiversity and evolution of Baikal fauna and flora	Taxonomy and philogeny of Baikal organisms, gathering of scientific collection of Baikal algae	Russia, UK, Belgium Japan	45000 US$	INTAS, RFBR, SB RAS, Darwin initiative
6. Deciphering the records of East Siberia paleoclimates using the data analysis of the upper sediments of Lake Baikal	Sampling of bottom sediments, investigation of sediments of Lake Baikal and evolution of diatoms	Russia, Belgium, Japan, Germany	50000 US$	RFBR, INTAS, SB RAS

drobionth species inhabiting Baikal over 75 % are endemic. Phylogeny of many Baikal species was established using the "molecular clock" method from the distinctions in the sequences of nucleotides in mitochondrial gene of cytochrome B. Following these data, species flocks of Baikalian endemics have been formed over the 2-3 million years ago, during the Pleistocene. The speciation peaks were preceded by mass extinction of species caused by drastic changes in the lake ecosystem. As shown below, Baikal sediment records evidence that this moment (about 2.5 million years ago) coincides with inception of active orogenesis and cooling, which resulted in vast mountain glaciers, although the latter did not cover the entire lake.

Baikal is the deepest lake in the world containing 20 % of the world freshwater resources. Water circulation in the lake displays unique features. High-accuracy measurements of vertical profiles of Freon concentrations in Baikal waters made it possible to determine the age of deep waters, i.e. the time elapsed since the water was in last contact with the atmosphere. The bottom waters (10-12 years old) are younger than the core waters (16 years), which suggests that the bottom waters are rapidly replaced by the surface waters via advective transport along the lake boundaries. The same is attested to by high content of oxygen in the whole water mass, with increasing concentration of diluted oxygen in the near-bottom layer. Water exchange in the deep waters is the most intense in early spring and late autumn, when such properties of surface waters as temperature and density are identical to those of deep waters, which initiates deep convection.

For several years the studies on Lake Baikal (as compared to Tanganyika, Malawi and other great rift lakes) have been carried out within the framework of CASIMIR (Comparative Analysis of Sediment Infill Mechanisms in Rifts) project. The main feature of the project was interdisciplinary approach integrating the efforts of various disciplines within geology (structural geology of the basement, neotectonics, sedimentary geology) and geophysics (seismology, heat flow, deep high-resolution seismic sounding) with limnology and hydrodynamics. On the basis of structural information, on land and satellite imagery analysis, topographic modelling, high-resolution seismic profiling and bottom morphology analysis, a detailed reconstruction was made of recent changes in the basin shape and structural processes responsible for the changes were modelled. In addition to geological aspects, which were the main objective of the project, there are several spin offs towards environmental problems of rift basins. In particular, the records of climate changes have been studied in Lake Baikal. The effect of bottom hydrothermal springs on the lake hydrodynamics was studied within the framework of an INTAS project. Recently attention was paid to the availability of gas hydrates in the Baikal sediments and to the effect of their instability on the lake system.

From 1994 to 1997, intercontinental deformations and, first of all, the dynamics of the Baikal rift were studied employing GPS-technologies within a French-Russian project. After data processing and error analysis using the GAMIT/GLOBK software, a short-term mean recurrence for all baselines was obtained (3.1 mm for the north component, 4.1 mm for the east component, 11.6 mm for the vertical component). Obtained GPS results showed that the southern part of the Baikal rift is currently opening with the rate of 5±2 mm/yr. The deformation gradient was observed across the rift zone. GPS measurements were used to constrain the boundary conditions of a two-dimensional finite element model of deformation in the Baikal rift along a lithospheric scale cross section.

Using submersibles «Pisces» the structure of underwater Academichesky Ridge (where the drilling was carried out then) and the adjacent basins were studied. At the depth of 400 m, a warm underwater spring (vent) was found and studied in the northern part of the lake (Frolikha Bay). Owing to ancient methane from the lake bottom sediments, this vent supplies carbon to maintain vital activity of the diverse biological communities that are independent of photosynthesis.

The interest to the lake as an object of environment and climate studies is primarily due to its location at high latitudes, which makes it sensitive to changes in solar radiation. In this region, the changes are the greatest related to inclination and precession of the Earth's orbit. Since the Himalayan uplift, the climate of the centre of the Asian continent is strongly continental, which makes it a perfect site to study seasonal climatic changes. The absence of ice sheets ensured continuous climatic records in the bottom sediments of Lake Baikal over the latest 15 million years, probably up to 30-35 Ma, or since the origin of the Baikal rift. Moreover, the prolonged evolution of Baikal conditioned formation of unique ecosystem of the lake. Furthermore, Baikal is a young developing rift system, and studying its geology one can obtain an idea of general features of the formation of sedimentary continental basins and gather data on geology of a typical rift zone.

The method of multi-channel seismic sounding made it possible to study in detail the structure of bottom sediments (over 8 km thick) of the lake. Of greatest thickness observed are the sediments of the southern and central basins, where turbidites prevail. In the northern basin of the lake depression, the thickness of sediments is up to 3 km, they are younger (£5 Ma) and include a large portion of glacial sediments. Pelagic sediments deposited from suspensions in the mass of the lake water, independently of mountains and glaciers, are formed on uplifts separating the three basins and appeared to be the most suitable for studying paleoclimate variations.

These data gave an impetus to a large-scale project, «Global Change in Inner Asia and the Prediction for Their Development on the Basis of Complex Studies of Lake Baikal», executed jointly by scientists from Russia, Japan and the USA (Baikal Drilling Project). One after another four holes were drilled for continuous core sampling. The hole drilled in winter 1998 (BDP-98) at underwater Academichesky Ridge at the interface between the northern and the central basins exceeded 600 m in depth. The core samples provided unique material for reconstructing past climates for over 10 million years. Regular climate changes that occurred throughout this period are recorded in the composition of bottom sediments: diatom silts were accumulated during warm interglacial periods, while for cooling periods terrigenous silts are prevalent. These data on climate variations coincide with those recorded in Atlantic silts, Greenland glaciers and boreal forests (for Holocene).

Paleoclimatic indicators in Baikal sediments are due to remnants of dia-

toms with their skeletons formed out of biogenic silica dissolved in the Baikal water. The 5 Ma records from diatoms and from biogenic silica correlate well with each other, as seen in the curves for Baikal and oceanic records in comparison with glacial and interglacial periods in Eastern Siberia.

The two curves were compared using a special spectral analysis, which showed that spectral characteristics of fluctuations in Baikal sediments coincide with those of marine and isotope records with predominant frequencies of 100, 41, 23 and 19 ky. The coincidence of recurrence period of the diatom paleoclimatic signal in the Baikal sediments with the frequencies of the Earth's orbit attests to the astronomic nature of the signal.

It should be noted that the Baikal records are better responsive to climatic changes than the oceanic ones. The Figure shows several 100 ky warming stages (5, 7 and 9) recorded both in the oceanic and in the Baikal sediments. The warming stages involve a few cooling cycles due to the precession or changes in inclination of the Earth's orbit. The cooling, due to a greater volume, and hence, greater inertia of the ocean, is poorly pronounced in oceanic sediments but well evident in the Baikal records. Thus, the Baikal records are remarkable for good sensitivity to climatic changes, which must be typical of continental climates, and so is of great importance for compiling global climatic models.

It is fundamentally important to answer the following questions:

1) With what degree of confidence can the ongoing changes be associated precisely with heliospace factors, such as solar activity?
2) What climate and environment changes should one expect in the years to come?

It should be emphasised that while attention is focussed on the effect of solar activity on the latest climatic changes, the contribution of the anthropogenic impact on climate is beyond question, and the problem is one of the quantitative relationship. There are good grounds for believing that the amplitudes of both factors are comparable at present. Because a physical modelling of the processes involving the solar activity influence on the troposphere is still unfeasible, there is no way in which this hypothesis can be verified except by as thorough a retrospective analysis as possible.

There are data on Baikal's level fluctuations and the duration of the unfrozen state of the Angara at Irkutsk, dating back to 1730. These characteristics are known to be closely associated with total atmospheric precipitation. Plots of variations of these quantities are compared with solar cycle lengths and with Wolf numbers. Clearly there is predominantly a consistent correlation (the correlation coefficient is 0.7) between the solar cycle length, Baikal's level fluctuations and the duration of the unfrozen state of the Angara. However, this correlation is violated in some periods. It is interesting to note that these periods correspond to solar activity cycles with the lowest level. This is particularly conspicuous at the end of a secular cycle (1830-1850).

In addition to paleoclimatic data, the drilling on the Academichesky Ridge and other geological studies provided a considerable insight into geology of Lake Baikal in relation to paleoclimate and global changes.

Many other unique results obtained on Lake Baikal by international research teams could be reported, however, these are beyond the frames of the paper.

I would like to note that international cooperation organised within the framework of international research centres operating as open institutes (laboratories) has fully justified itself. It allows for prompt recruitment of creative research teams, each participant making its financial and intellectual contribution to solving complicated problems. This became possible because the infrastructure component of the studies was appreciably ensured by the potential available in Siberia, which is characterised by a number of distinctive features.

The comprehensive character of Siberian science centres (academic towns) favours the performance of inter- and multidisciplinary studies with involving experts from various fields of knowledge. The wide network of test fields, geospheric and biospheric stations equipped with unique installations of national and world level allows for the arrangement of systematic observations, with objects varying from space rays to the Earth bio- and geosphere. Close links between research and education, with inherent priority of research, allows for comprehensive training of high-skilled specialists using advantages of both models, in particular, through summer schools.

However, the crisis evolving in Russia does not allow for due maintenance and development of research facilities; one specific example is the research fleet on Lake Baikal. This circumstance forces us to continue work on improving the organisation forms of international cooperation, which may also suggest an increasing contribution of foreign participants to the preservation and maintenance of these objects. Mechanisms of increasing the involvement of foreign partners may vary.

One of the promising ways could be the transformation of international research centres into research-and-education centres, which should abruptly increase the number of foreign participants, and consequently, the funds allotted for research and education purposes.

The Siberian Branch of the RAS arranged several joint summer schools in Siberia with equal participation of Russian and foreign students and young scientists. As a rule, the schools begin with a brief goal-oriented lecture course delivered by Russian professors in a foreign university and by foreign professors in a Siberian university. As an example, I would like to tell about the experience of the Summer School '97 on Natural and Anthropogenic Impacts on the Environment organised in Altai by the Novosibirsk State University, the Flemish University at Brussels and the United Institute of Geology, Geophysics and Mineralogy of the SB RAS. The school was funded by the Government of Flandria and the SB RAS. Fifteen post- and undergraduates and five professors from each side took part in the school. The second initiative was organised on lake Issyk-Kul with over 10 participants. In 2000, we plan to organise a similar school and would like to propose the German side to take part in it. We believe that the schools should be arranged on a regular basis. After the visit of Max Planck Society delegation, headed by MPS President Prof. H. Markl, to Irkutsk two summer schools for young scientists are planned to be organised in 2000 on Lake Baikal on the basis of the Limnological Institute of the RAS and BICER.

We are ready to present the facilities of the network of geo- and biosphere stations in Siberia for the execution of such large-scale programmes as IGBP, PAGES, START, etc., which should also result in expanded involvement of Siberian researchers in solution of global problems.

We encourage more active participation of foreign scientists in the multidisciplinary programmes supported by the SB RAS on a competitive basis. The major projects selected for funding within the call for proposals for interdisciplinary research recently launched by the SB RAS are presented in Table 3.

The Siberian Branch of RAS together with the Russian Foundation for Basic Research, Russian Foundation for the Humanities and regional authorities launch regional calls for basic research projects. Table 4 presents several examples of the projects supported within the Regional Baikal Call for Proposals. We approached INTAS and other international foundations with the proposal to consider the possibility of launching joint calls supported by regional authorities together with these international organisations. Today the problems encountered by the mankind are so complicated and their solution demands too much efforts and resources that they can be solved only on the basis of joint international efforts.

Analysing results of the recent INTAS and INCO-Copernicus calls for proposals one can notice a slight decrease in the interest to Lake Baikal research. Many experts believe that the first most important information has been already gained. I cannot agree with this opinion.

Table 3. Projects funded within the SB RAS call for proposals for interdisciplinary projects

Project title	Institutes involved	Annual funding
1. Geotomography: theory, numerical methods, development of efficient algorithms, reliability estimate	Institute of Computational Mathematics and Geophysics; United Institute of Geology, Geophysics and Mineralogy; Institute of Mathematics	50000 US$
2. Study of solid nonequilibrium products of mechanochemical transformations; development of new materials and technologies	Institute of Solid State Chemistry and Mineral Processing; Institute of Catalysis; Institute of Chemistry and Chemical Engineering; Institute of Theoretical and Applied Mechanics; Institute of Cytology and Genetics; Novosibirsk State University	40000 US$
3. Information theory of value and system estimates of natural resources	United Institute of Geology, Geophysics and Mineralogy; Novosibirsk State University; Institute of Animal Systematics and Ecology; Institute of Petroleum and Gas Geology; Institute of Economics and Industrial Engineering	40000 US$
4. Basic aspects of gene immunisation and gene therapy by the derivatives of olygonucleotides	Institute of Bioorganic Chemistry; Institute of Automation and Electrometry; Institute of Chemical Kinetics and Combustion; Institute of Cytology and Genetics; Institute of Semiconductor Physics; Institute of Laser Physics; Institute of Animal Systematics and Ecology	40000 US$
5. Climate and environment change in Siberia in the context of global changes (Holocene and Pleistocene)	Limnological Institute; Institute of Archaeology and Ethnography; Institute of Geochemistry; United Institute of Geology, Geophysics and Mineralogy; Institute of Forest; Institute of the Earth's Crust; Buryat Geological Institute; Institute of Permafrost; etc. (16 institutes in total)	120000 US$
6. Siberian gas hydrates	Institute of Inorganic Chemistry; Limnological Institute; Institute of Geochemistry; Institute of Earth's Crust; Institute of Permafrost; Institute of Chemical Kinetics and Combustion, etc. (9 institutes)	40000 US$
7. Palaeogenetic analysis of the gene pool of Siberian population	Institute of Archaeology and Ethnography; Institute of Cytology and Genetics	30000 US$
8. Investigation of the response of near-earth space to abnormal activity of the Sun	Institute of Solar-Terrestrial Physics; Institute of Earth's Crust; Institute of Cosmophysical Research and Aeronomy	25000 US$

Table 4. Projects selected for funding within the Baikal call for proposals «Region-RFBR»

Project title	Executing institutes	Funding
1. Multi-parameter year-round monitoring of water conditions in Lake Baikal using NT-200 complex deep-water neutron telescope	Irkutsk State University, Research Institute of Applied Physics at Irkutsk State University	18000 US$
2. Development of the system of models of trophic interactions of fish in the pelagic ecosystem of Lake Baikal	Siberian Energy Institute (SB RAS)	20000 US$
3. The effect of the Lake Baikal ecosystem on the composition of secondary metabolites (by the example of saponins) of Thalictrum plants	Irkutsk Institute of Chemistry (SB RAS)	10000 US$
4. Cedar forests of Baikal Region: concept, model and technologies of sustainable development	Institute of Forest (SB RAS)	37000 US$
5. Development of seismodynamics models of Baikal depths	Institute of Geophysics (SB RAS)	20000 US$
6. Baikalian Asia in the orbit of Hunnu civilisation: ecology, settlement systems and society structure	Institute of History, Archaeology and Ethnography (FEB RAS)	4000 US$

The lake is a unique natural laboratory and studies should be conducted continuously, including the investigation of biodiversity, speciation, active tectonics (to reveal the nature to tectonic pulses and the discharge of earthquake sites), Baikal basin monitoring, gas hydrates, paleoclimate and many other aspects of sustainable development of the Baikal region.

But the problem should be considered in a wider statement. Siberia on the whole, with its boreal forests, arctic zone and permafrost is itself a natural laboratory without which it will be impossible to understand and predict future global changes. The network of the SB RAS institutes and research stations provides a unique opportunity not only to continue, but also to enhance international cooperation on a broad scope of problems.

Recently the cooperation between the SB RAS and the European Environment Agency has been negotiated, which suggests realisation of joint projects on biodiversity and inclusion of the databases available in the SB RAS in the integrated information network. We believe that German universities and other organisations can also be involved in these activities.

In September 1998, an important international conference was held in Ulan-Ude under the auspices of the Siberian Branch of the RAS, the European Commission, INTAS, Russian Foundations for Basic Research and for the Humanities. The conference considered the results and prospects for international research cooperation on Lake Baikal as a World Heritage Site. General issues of cooperation were dealt from the viewpoint of national and international foundations funding research projects in the region. Basic research projects supported by INTAS, as well as technical assistance programmes within the activities of TACIS, the World Bank and other organisations, were thoroughly considered. The Conference proceedings were published and are distributed here. As a part of the International Conference "Baikal as a World Heritage Site: Results and Prospects for International Cooperation", a poster session for young scientists was held; the proceedings of the latter will be published as a special issue of the Siberian Ecological Journal (No. 6).

I dare to hope that the current representative Baikal Conference organised in Schneverdingen by the Federal Agency for Nature Protection and Alfred Toepfer Academie fuer Naturschutz will allow us to make another important step in building up international basic studies in Siberia and intensify engagement of German scientists and students in joint activities to keep up the traditions of great German scientists of the past.

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The Baikal as a UNESCO World Heritage Site - The Concept, Some Experience and Reflections

Wolfgang Reuther

1 The World Heritage Convention: history, concept and situation

1.1 General information and history

The World Heritage Convention has been adopted on 16 November 1972 by the UNESCO General Conference, unifying drafts prepared by IUCN for an instrument for the protection of natural heritage and by UNESCO for cultural heritage. The World Heritage Convention is unique, in combining the protection of the work of the human creative genius and the evolutionary work of nature. 156 States have now adhered to the World Heritage Convention, making it one of the most successful international cultural and natural conservation instruments.

To date 582 properties have been inscribed in the World Heritage List. 445 of these are cultural properties, 117 natural properties and 20 *mixed* cultural and natural properties in 114 State Parties. These basic statistics highlight differences in the implementation of the World Heritage Convention with respect to the cultural and natural heritage.

The Convention, its philosophy and its practice, namely the everyday protection of natural and cultural heritage sites of *outstanding universal value*, are more relevant than ever. Threats to the very survival of the world's heritage have increased in recent years as a result of poverty in many countries, of neglect, of poorly planned economic growth and development, of civil unrest and military conflict.

The Russian Federation ratified the World Heritage Convention only on 12 October 1989 but the first cultural site was already inscribed in 1990 and the first natural site only in 1995. In July this year I myself attended the ceremony for the inscription of the fourth natural site, The Golden Mountains of the Altai, which followed the Virgin Forests of the Komi, the Volcanoes of Kamtchatka and - the Lake Baikal, the latter adopted in 1996.

1.2 The very concept of the World Heritage

In short the concept of the World Heritage Convention may be explained as follows:

a) The Convention provides for the protection of those cultural and natural properties deemed to be of a most outstanding universal value from an international point of view.

b) The Convention contains a definition of cultural heritage (monuments; groups of buildings; sites and cultural landscapes - Art. 1) and natural heritage (natural features; geological or physical formations; natural sites - Art. 2). There can be mixed sites fulfilling the requirements for a cultural as well as a natural heritage site.

c) The properties suggested by the member States of the Convention must in addition meet the criteria developed in the Operational Guidelines and the test of authenticity.

d) The above guidelines foresee that the natural sites fulfill one of the following criteria (Para 44), namely

- (a) represent
  - (i) major stages of earth's history
  - (ii) on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals
  - (iii) superlative natural phenomena or exceptional natural beauty and aesthetic importance
  - (iv) important and significant natural habitats for in-situ conservation of biological diversity
- and (b) fulfill a number of conditions of integrity
  - have adequate long-term legislative, regulatory or institutional protection and a management plan.

e) The State Party takes upon itself the duty to preserve the property for future generations (Art. 4) to take respective measures (Art. 5) and to regularly report on the state of conservation.

f) A system of monitoring includes systematic reporting by State Parties every five years and reactive reporting under special circumstances.

g) The World Heritage Committee, meeting once a year, is directory and monitoring body, the World Heritage Centre in Paris the Secretariat for the Convention. Through the World Heritage Fund assistance can be provided to certain State Parties for different purposes (conservation, training etc.).

2 The Baikal as a World Heritage site

2.1 The inclusion of the Baikal in the World Heritage list

When the Baikal was included into the World Heritage list in December 1996 the World Heritage Committee formulated the following requirements and recommendations addressed to the State Party:

(a) To ensure the adoption of a Federal Law on the protection of the Lake Baikal.

(b) To reprofile the Baikal pulp and paper mill so that it would not be any more a source of pollution

(c) To reduce the pollution of the Selenga river

(d) To provide additional financial means for the management of the protected areas around the Baikal

(e) To augment support for scientific research and monitoring of the Baikal.

The situation at that time has been quite special in the sense that normally only already protected areas should be admitted by the World Heritage Committee as natural heritage sites. No such protection existed at this moment for the Lake Baikal. That is why the Committee insisted on the adoption of the Baikal Law as a first priority.

Today it can be said that - except the first item – and there only a first, basic step has been made – everything needs to be implemented yet.

2.2 The Baikal – a World Heritage in Danger?

The Baikal has permanently been on the agenda of both, the Intergovernmental World Heritage Committee and its Bureau, which means it has been discussed at least twice a year. The question about the inclusion of the Baikal in the List of World Heritage in Danger was raised

not only once. Even the observer of the State Party concerned, namely the Russian Federation, did not oppose such a decision in 1997. He indicated, that the site was under serious threat because of (a) the status of the proposed Baikal Law, (b) continuing pollution of the Lake by the Baikal pulp and paper mill, (c) increasing pollution at the Selenga river, (d) lack of resources for the protected area and national park management, (e) lack of resources for monitoring and (f) other negative factors such as logging. One of the problems of the World Heritage Committee consisted in the lack of information, as the State Party most often did not meet sufficiently the requests for reports formulated by the Committee or Bureau

The special List of World Heritage in Danger is foreseen by the Convention. The Convention says, that the Committee can include any property appearing in the List of World Heritage, which "is threatened by serious and specific dangers, such as the threat of disappearance caused by accelerated deterioration, large-scale public or private projects or rapid urban or tourist development projects; destruction caused by changes in the use or ownership of the land; major alterations due to unknown causes; abandonment for any reason whatsoever; ... landslides; ....changes in water level. ... The Committee may at any time, in case of urgent need, make any new entry ... and publicise such entry immediately."

However, until now the Committee did not yet take such decision for a number of reasons. As I could understand the behaviour of the Committee – there was the wish not do any harm to the efforts undertaken for the adoption of the Baikal Law and to avoid misunderstandings both at the authorities' and the public level.

I myself could witness, when coming for the first time to the Baikal in September 1998, that especially the local (regional) authorities and the public opinion of the Baikal Regions would not have rightly understood such an inscription into the List of World Heritage in Danger. They could have reacted by turning their back to UNESCO and the international community at this moment and blocking any progress with regard to meeting the requirements made.

However, one can certainly state that this option, to place the Baikal on the List of World Heritage in Danger, is still not yet totally out of sight. Its application will now depend on how further progress is being made by implementing the Baikal Law and eliminating other risks for the Baikal and if the necessary official status reports and relevant timetables will be delivered. The next meeting of the World Heritage Committee will start in a few days and we will see what it has to say on that subject.

2.3 The adoption of the Baikal Law

As indicated above the Baikal did not have any protected status when it was included in the World Heritage List, while there existed protected areas north-east and south-east of the Lake (Barguzinsky and Baikalski zapovednik). At the same time efforts to adopt a special law had already been underway.

The first draft of the law, which was rather far-reaching and detailed, did not make its way through the Parliament. The President for a number of formal as well as substantive reasons vetoed it as being in contradiction with the Constitution. The Duma failed to override the veto because of one vote lacking. Therefore a conciliation group initiated by the Regions concerned elaborated a compromise text. This new text resembled much more a framework law than a detailed prescription of all aspects involved.

The UNESCO Moscow Office organised on 9 March 1999 on the request of the authors and Duma representatives and thanks to the support by the German Federal Agency for Nature Protection and of the World Heritage Centre an international seminar to provide international expertise for the draft. The seminar took place after the first hearing of the law in the State Duma.

The seminar came to the conclusion that - despite some flaws and due to the causes these flaws have - this law appeared to be the best available solution at this time and its coming into force would be a first important step. Therefore the experts recommended the adoption of the law in the form presented to the meeting. At the same time the seminar formulated a number of recommendations to be taken into account when elaborating the follow-up acts and measures. The seminar requested UNESCO and its Moscow Office to assist this follow-up process.

I informed the speakers of both chambers of the Parliament officially about this outcome of the meeting.

The law was then adopted by the State Duma on the 2nd and by the Federation Council on the 22nd April, signed by the President on the 1st May and came into force on the 12th May 1999. This way the first request of the World Heritage Committee had been met.

3 The Law on the protection of the Baikal and its implementation

3.1 The Baikal Law – a positive, general framework for the protection of the Baikal

It would go too far to go into the details of articles of the Baikal Law, although – I am convinced - its provisions will - nolens volens - influence many of our discussions and conclusions. But the text is available in Russian and English and everybody can analyse it against her or his own background. In addition I do think that other participants can much better comment on the different articles.

On the other hand I must say that I have been confronted with a number of criticism, which is quite understandable. People who are not so happy with the text regret mainly that the general character of the law does not allow suing for different aspects and that several questions have been deferred to subsequent decision-making and regulations.

That is why it seems to be justified to bring to your attention some of the main conclusions, which have been formulated at the above seminar. I take the liberty to base myself mainly on what had been kindly formulated by Prof. Winter, University of Bremen.

With regard to substance it can be said that the Baikal Law addresses all major problems of establishing an effective protection regime, e.g.,

- The extension and the character of the protected zones (principle of 3 zones)
- The goals and principles of protection
- The instruments of protection
- The administrative structure of protection.

On the other hand, the following flaws can be mentioned, without being exhaustive:

- The goals and principles have been formulated in a very general manner. (Art. 5). The ultimate goal of protection is confined more to the Lake as such rather than including shores, while in general the jurisdiction of the law covers a wider area.

- Some of the instruments of protection, notably land-use planning (Art. 16) or improvement strategies with regard to the existing industrial installations (Art. 18), could have been more specified. Many would have preferred that the activities to be forbidden or limited (Art. 6) would have been formulated more concretely already in the law.
- The repartition of responsibilities among the different actors and authorities for the implementation of the law have only partly been fixed, the bulk of decision of sharing responsibility is left to further negotiations. This is also true with regard to the organisational structure of the Baikal Agency and financing.

3.2 The main follow-up tasks for the implementation of the Baikal Law

Already on the 13th May the Governmental Baikal Commission has drawn from the different provisions of the law the main follow-up tasks necessary to implement the Baikal Law. The Commission's agenda encompasses, i.a., the following:

(a) Definition of the borders of the three ecological zones prescribed by the law.
(b) Elaboration of a draft agreement to be concluded between the Federation and the different Regions involved, defining the repartition of responsibilities.
(c) Definition of the activities to be forbidden or limited in the central zone.
(d) Revision of the maximal acceptable norms of harmful influences on the ecosystem.
(e) Elaboration of statutes for the future governmental organ responsible for the regulation of the protection of the ecosystem of the Baikal (Baikal Agency).
(f) Creation of a special fund within the Federal budget foreseen in the Law.
(g) Elaboration of executive details on hunting, logging, traditional land-use, development of tourism etc.

The Baikal Commission urged the Federal government to accelerate decision-making on the problems linked to the harmful influence of the paper mill on the ecosystem but did not foresee any action from its own side.

The practice and time elapsed since then shows that the formulation of these tasks was evidently much simpler than their concrete implementation. Until now the Baikal Commission met only once (end of June), when it discussed only the question of maximal acceptable norms of harmful impact on the ecosystem. To the surprise of many members a fully different concept was presented than that in use until now, which had been elaborated already some years ago by the Limnological Institute in Irkutsk.

The basic principle of the concept presented is to agree on a 'complex use of natural resources' rather than to rely on established norms. The proposal foresees the regular (every 1 to 3 years) conclusion of contracts with relevant enterprises affecting the ecosystem. The passport system foreseen in the Baikal Law has not been mentioned in the proposal but the authors say that both ideas are close and may be complementary.

The concept was not yet accepted but the Commission wanted to better study the details of the document, which was only provided during the meeting.

There were other efforts undertaken to work out a scheme for the Special fund within the Federal budget. No other results have come so far to my knowledge.

3.3 The possible role of the international community

The Baikal Commission expressed in its above decision in May the wish that international organisation and experts actively participate in the elaboration of subsequent regulations on the above questions. It recommended in addition unanimously that I should be nominated as a member of the Commission. This allowed me to take part in the 14 session of the Commission on 28th June.

The international community should take up the above offer and request made by the Baikal Commission. It should provide expertise and frameworks for discussion but also make relevant contributions, which could inspire the Russian authorities and experts to find the best solutions for the detailed regulation for the implementation of the Baikal Law.

It would be good, to my mind, if this conference could make already relevant recommendations and offers as well and possibly agree with their Russian colleagues, which are present, on acceptable and effective forms and frameworks in this context.

UNESCO and its Moscow Office – within the limits of our possibilities - are prepared to provide necessary services or act as a framework, which can co-ordinate and mediate different initiatives, if need is or it is wished so by the Russian authorities or the international community. I am ready to discuss things directly here with you.

What seems to be important to say in this context is the following:

Everything and all future developments regarding the Lake Baikal will depend on this process of implementation of the Baikal Law and the quality and effectiveness of solutions to be found and accepted. That is why this is a crucial moment, and a real chance for all involved to be taken. If this chance will be missed, it will not come back again very quickly.

Together with this there is obviously not so much time to do all that because a timetable prescribed by law is to be taken into account. Most of the elaborations have to be presented certainly during the next year and preferably during its first half.

At the same time those authorities who have to implement the Baikal Law and those who might be prepared to contribute to the necessary findings are confronted with a complex and difficult situation in Russia, which is well known to all of us. But it will be made even more difficult with the forthcoming elections for the Parliament (23rd December 1999) and for the President (supposed to take place in July 2000) and the political campaigns all around, which are already underway.

4 The Problem of the Baikal pulp and paper mill

This problem is certainly the most political and the best known problem linked to the Baikal.

The second condition set by the World Heritage Committee for including Baikal in the World Heritage list of 1996 was to solve the pollution problem caused by the paper mill located at the border of the Lake. The problem is even older and no major move has been made during the last ten years, despite the fact that it has been discussed in public and at all political levels. The matter is more complicated by the fact that a whole city of about 20,000 inhabitants are directly dependent on this mill.

For several months the Director of the Moscow Office has undertaken major

efforts to explore ways on how UNESCO and the international community could help to find a solution. In this context, a great number of mostly high-level consultations have been carried out with interested stakeholders at the Federal and local level, including, i.e., different federal and local governmental departments, relevant international organisations, nature protection authorities, the Directors of the paper mill, the mayor of the City of Baikalsk, and with NGO's etc.

A comprehensive report is being prepared for the World Heritage Centre to make it better understand what is at stake and to examine the possibility of offering its support.

What could be said at this moment – in a summarised manner - is the following:

a) There seems to be a real deadlock at the moment and no solution or schedule for further steps is seen on the horizon so far. Most stakeholders seem to be passively waiting. The exception are to some extent the Irkutsk oblast government, the private share holders and some NGOs and private people.
b) The court rejected a lawsuit by the oblast Nature protection authority against the mill, requesting to close it, on the ground of the "higher" economic and social interests of the population of Baikalsk. The results of a protest are not yet known.
c) All those who have tried to develop alternative models, including the private owners and the Governor of Irkutsk, surrendered at the moment where it came to the question, what kind and extent of impact on the lake is acceptable. This concerns also the question if there should be just sought a better technology for the same kind of production, if the mill has to rather radically change its production profile or if closing is indispensable.
d) Any solution, including the closing of the paper mill will need high investments, including a closure (up to m100 USD).
e) In an economic prospect the paper mill may not be any more competitive in a medium-term perspective as it is now for a number of very specific reasons with regard to the much bigger pulp and paper mills existing in the same Region. In that sense the private owners can be interested in contributing to a change of the plant in line with the ecological requests, if they are given a clear perspective in political terms.
f) The Federal government had decided some years ago to sell its control share of actions in order to attract investors to bring the necessary funds for a long-term solution. However, there are signs during the last time that the originally "strategic function" of the mill has been rediscovered and efforts are undertaken to leave the control share with the government. This would mean that certainly no investment could be made during the near future and that the risk of an ecological catastrophe can grow rather quickly.

It is my deep personal conviction that it will in any case be impossible to bring about at once a "100%" solution. Such an approach rather blocks than bring solutions. Any solution must take into account the economic and social interests of the population concerned.

What seems to me the most important is that the process must be started as quickly as possible. A project must be developed foreseeing a clear final solution to be reached over a period of maybe five to ten years.

The international community may, in that context, make contributions in the following directions:

a) Help working out the norms and criteria for the maximal acceptable impact on the lake
b) Help find out alternatives for the pulp and paper mill, wile taking into account results of the several studies already undertaken, including by TACIS, the Limnological Institute in Irkutsk, through the Irkutsk Oblast government and the paper mill itself.
c) Help find reliable investors for the mill
d) Help organise a meeting with representatives of other World Heritage sites, which had also pollution problems in the past, to learn from their strategies to find a solution.

5 Some other aspects concerning the Baikal as a World Heritage Site

5.1 Linkage with MAB

A part of the Baikal region is also recognised as a UNESCO Biosphere reserve under the Man and the Biosphere Programme (MAB). This is an interdisciplinary programme of research and training intended to develop the basis, with in natural and social sciences, for the rational use and conservation of the resources of the biosphere, and for the improvement of the global relationship between people and the environment. Both programmes, the World Heritage and the MAB, are site specific and complementary are collaborating closely.

The UNESCO Moscow Office is planning to organise together with and on the request of relevant Russian partners next year a conference to apply the most recent strategy (the so-called Seville Strategy) to the Russian situation. As the MAB programme is pursuing a concept, which is aiming at harmonising nature protection and human activity, this can be very interesting for the Baikal too. The Baikal Law, by the way, is making use of the zonation concept of the MAB concept.

5.2 Public Awareness and Support, Involvement of Local Population

The MAB approach can also bring about a more proactive behaviour of the population around the Baikal. From my own experience and what was told to me I know that the population sometimes fears that the World Heritage concept may do harm its interests. In general the World Heritage concept too does request a close co-operation with and involvement of the population and the public. It is above all at the individual World Heritage property level, and at the local, national and regional levels, that the implementation and promotion of the Convention can have a real impact. This means also to involve people in all the phases and aspects of a World Heritage site development, from the formulation of the proposal to monitoring and reporting. Possible scenarios of the inclusion of NGO's and the population concerned into the regular reporting system by the Russian authorities responsible for it have been discussed at a training seminar organised by the UNESCO Moscow Office in July this year in Ulan-Ude.

5.3 World Heritage education

The future success of the World Heritage conservation will undoubtedly depend very much on the commitment of the young. Schools are therefore encouraged to take part in the world-wide project 'Young peoples's participation in World Heritage preservation and promotion', which is organised through the

network of UNESCO's Associated schools project.

The UNESCO Moscow Office is now translating a special training kit for teachers into Russian and planning a test phase and a workshop on the evaluation of the latter to promote World Heritage education in Russia. Partners who would like to co-operate are welcome.

5.4 Modification of the Baikal World Heritage Site Concept?

More public support could also come from a change of the Baikal site concept, transforming it into a mixed site. At the above training seminar several participants raised this question, among them a Shaman leader of Buryatia.

In fact the Convention knows, as I mentioned already, not only mixed sites but also so-called 'associative cultural landscapes', which are justifiable by virtue of the powerful religious, artistic or cultural associations of the natural element rather than material cultural evidence, which may be insignificant or even absent.

5.5 Alliances and Networking

New alliances and networking are tools, which can help to resolve many of the problems of the World Heritage sites all over the world, including those of the Baikal.

Increasing threats demand improved implementation of the Convention by State Parties and enhanced co-ordination and integration between the World Heritage Convention and other relevant conventions and treaties (e.g. Biodiversity, Wetlands, Migratory species, International trade in endangered species etc.). A joint web-page of all biodiversity-related conventions has now been created at the address: www.biodiv.org/rioconv.

This is based on the growing recognition, that while each instrument does stand for its own, with its own defined objectives and commitments, there are many linkages and inherent relationships between all of them. Then conventions operate in the same ecosystems. If they are implemented collaboratively, progress can be made with regard to the conservation of biodiversity. The programme approved by the 19th special session of the UN General Assembly (June 1997) on the further implementation of Agenda 21 gives special priority to this approach.

Another tool is the networking of the site managers of the natural World Heritage site in Russia and around the world. A first step in this direction has been made by the training seminar organised in July 1999 in Ulan-Ude and Ust Barguzin for managers of actual and potential World Heritage sites.

Last but not least we must also think about fostering new and maybe unlikely alliance, which come from different threats such as growing urban, industrial and tourism pressure. So, for example, education and awareness may also come from a carefully managed tourism at World Heritage sites and there may be enormous conservation benefits from sensitive and well planned eco-tourism projects.

5.6 New threats?

There may be new threats for the Baikal on the horizon. A law is underway or already adopted by the State Duma to create a special economic zone north of the Baikal, where the Baikal-Amur-railway, the so-called BAM is running. This zone is being created to dig the minerals and ores in this vulnerable landscape. What is known so far is that no special precautions are to be taken with regard to the possible ecological impact, in particular possible consequences for the Baikal. As far as I know the relevant authorities have been requested to give additional explanations on this aspect.

6 The Role of UNESCO and its Moscow Office

The main aim of UNESCO is to assist the State Party to comply in practice with the provisions of the World Heritage Convention and the Operational Guidelines and so to solve all the problems linked to the inclusion of the Baikal into the World Heritage List. This function is mainly carried out by the Paris based World Heritage Centre, which is in the case of Russia supported by the UNESCO Moscow Office.

The UNESCO Moscow Office has tried the last two years to be a mediator between the most different actors concerning the Baikal as a World Heritage site. It has been a partner for initiatives. It has tried to monitor the situation of the Baikal and to inform the World Heritage centre in Paris and committee on the most important developments or threats. It has encouraged the authorities to take the necessary steps and to respond to requests for reports and explanation by UNESCO. It has encouraged and supported those who are actively trying to find solutions for the most acute problems. It has contributed to the final adoption of the Baikal Law as well as to training of actual and potential site managers. This was quite a bit for a very small Office with no special officer for ecology or even for the field of science.

The Moscow Office is willing to continue to play a special role for the Baikal and to help to co-ordinate and mediate for other partners inside and outside of Russia if they wish so. To what extent this will be possible will depend on if our staff in that field will be reinforced the next year. The World Heritage centre is equally prepared to continue to offer its services.

7 Summary

This overlook shows the complexity of the problem of the Baikal as a World Heritage site. At the same time it shows that progress can and has been made.

It seems to me important to underline is that the international community can contribute almost to all of the above mentioned aspects and should try to do so in reality. The next year may become a crucial period with regard to the implementation of the Baikal Law. Maybe also the process to solve the problem of the pulp and paper mill can be started. Actually all other aspects of pollution of the Lake can evidently only seriously be addressed when this last mentioned aspect has got at least a clear development.

This conference could contribute, and I hope it will really do so, to elaborate and agree upon further strategies to co-operate on these common endeavours. Hereby co-ordination of efforts should become a major concern.

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Lake Baikal: A Model Ecosystem for Understanding and Quantitation of Biodiversity

Mikhail A. Grachev

Abstract

It is believed that anthropogenic impacts will soon reduce the diversity of species found in the biosphere and decrease its ability to resist further degradation. Biodiversity has become a keyword for politicians and scientists, but, paradoxically, nobody is able to measure it. Counting of all species and estimation of the abundance of organisms belonging to every of them in an ecosystem of a reasonable size is a very difficult task for many reasons, one of them - lack of highly qualified taxonomists. Conservation of biodiversity will not be feasable unless we find out *why* it changed in the geological past.

Lake Baikal is a large ecosystem, but not as large as a continent or even a rain forest. It has been studied by many generations of scientists, beginning with famous German naturalists of the XVIIIth century. Regular monitoring of some of its biological communities and of the chemical composition of its waters continues since the 1940ies. Lake Baikal was internationally approved as an ecosystem which is still close to its pristine state - this was the pre-requisite of its nomination in 1996 as of a Natural World Heritage site. The last decade, due to international cooperation on an unprecedented scale, resulted in a break-through in our knowledge on Lake Baikal along two major directions:

1. Understanding of its changes on different time scales, from years and seasons to a few million years before present, reflected in historic and sedimentary records;
2. Estimation of the time scale of biological speciation as revealed by the elucidated genetic distances between a few dozens (of the 2000 known) endemic species.

It is due time to propose Lake Baikal as a model ecosystem for understanding and quantitation of biodiversity. International and interdisciplinary cooperation will help to elaborate new approaches which will be applicable to ecosystems of a greater size. Cooperation may involve:

1. Creation of international biological and paleontological *collections*;
2. Creation of a computer data bank based on morphology of individual extant and fossil *specimens*;
3. Co-ordinated studies of *molecular phylogeny*, including molecular adaptation;
4. Modeling of physical and geochemical mechanisms which caused repeated extinction and *nascence* of species in Lake Baikal during the times of rapid Global Change.

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Ecological Problems of Development of Sustainable Agriculture, Forestry and Fishery on the Baikal Region

Valeriy B. Batoev & Valeriy E. Gulgonov

Abstract

The basic problem of rational nature management in the Baikal Region is the low level of technologies. The technologies used in agricultural production stimulate development of erosion processes, contamination of water bodies by stock raising farm effluents.

Though the amount of timber cutting makes up only 6.4% of the overall quantity of timber that can be produced, timber cutting is done with a technology that destroys the soil and undergrowth.

The amount of catch in lake Baikal makes only 60% of the permissible catch norms. Unfortunately, omul and whitefish having the highest market value are generally caught.

Key words

Lake Baikal, agriculture, forestry, fishery

Agriculture

Studies carried out in 1993-1998 showed that the areas of arable land with the decreased humus content had grown by 2.9-8.1%, hay fields – by 2.8-11.9%. At present, 82.9% of arable lands suffer from the depletion of humus. There is a tendency for decreasing the content of such nutritious elements as phosphorus and potassium [1,2]. It is dictated by a sharp drop in the use of organic and mineral fertilizers. In 1998, every hectare of arable lands received 2.8 kg of mineral fertilizes (4.2 kg in 1997) that is less than the minimum required amounts by a factor of 11. In average, the fertilized lands formed only 11.5% of total arable lands; this figure for the Baikal coastal zone is 21.0%. The amount of organic fertilizes decreased in comparison with 1997 and was equal to 0.1 tons per hectare.

To prevent soil deterioration, many farms increase cultivation of sweet clover. So, in 1998, this crop occupied 30% of arable lands in the Eravninsk district of the Republic of Buryat; for the Kabansk district this figure is equal it

15%, the Zaigraevsk district – 14%, the Bichursk district – 6.7%.

Inadequate cultivation of arable lands aggravates the situation. In 1998, the areas of fallow lands decreased by 9.2% in comparison with 1997, and amounted to 23% of cultivated lands. Grain crops shared 62% of total land under cultivation; a two-field crop rotation system is applied when grain crops occupy 67% of cultivated lands.

Anti-erosion methods of crops cultivation, in particular, crop belt alternation aid in prevention of wind and water erosion of soil, but due to financial and economic difficulties, farms fail to sow arable land and cultivate fallow belts which are overgrown with weeds. In 1998, such lands made 163 thousand hectares. Such lands serve not only as a breeding-ground for weed seeds but pests as well. As a consequence of low natural soil layer stability, linear erosion is enhancing more intensively.

At present, more than 60% of arable land and 20% of pastures are subject to erosion, that is why land reclamation and anti-erosion activities are matters of great importance. The value of eroded lands are on Fig.1

In 1998, 3.24 million rubles were allocated from the federal budget to implement the "Land Productivity" program, but this amount of financial resources covers only 19% of needs. The allocated money was spent on improving and repairing a reclamation system.

In 1998, arable lands were treated at an area of 20.4 thousand hectares to fight pests by way of ground spraying; out of them 15 thousand hectares were treated against plurivorous species (souslik *(Citellus)*, alfalfa webworm, locust, etc). As many as 1,400 ha of vegetable fields, 100 thousand ha of annual and perennial grass, 2.2 thousand ha of fruit & berry, radish, and potato were subject to treatment against diseases and pests.

In total, 47.9 tons of pesticides were used in 1998 for fighting pests, weeds and treatment of seeds, out of them 9.5 tons were used in areas adjacent to Baikal Lake (the Kabansky district).

Toxicological survey of agricultural lands was carried out by the "Buryatskaya" agrochemical station in 11 districts of the republic at an area of 10,752 ha. The soil was investigated to detect the content of residual pesticides, namely, 2,4-D amine salt, phenazone and hexachlorocyclohexane. No residues of these pesticides were detected. The selective toxicological survey at an area of 30 ha was conducted in the coastal zone of Baikal Lake (the Kabansky district). In general, soil samples taken from vegetable gardens and reference land plots were analyzed. No excess of heavy metals content in plants and vegetables was revealed; residual pesticides were not detected either. Besides these investigations, surface and ground water sources were monitored to reveal water pollution with chemical substances and wastewater discharged by cattle-breading farms. The analytical data demonstrated no pollution of water with pollutants mentioned above, including hexachlorocyclohexane.

Thus, the impact of agriculture upon the natural environment is perfectly evident. The specific features of agricultural production management and unfavorable economic situation negatively affect the land resources conditions; land is used ineffectively, often at random and is not regulated. To improve the environmental performance, financial resources and complete implementation of environmental protection actions must be provided. The establishment of a permanent monitoring system and development of a land use management mechanism will also to overcome a negative impact on the environment.

Forestry

As of 01.01.1998, according to state statistics, as many as 20.87 million hectares of Baikal lake protection zone were covered with forests, among them 20.38 million hectare belonged to the forest fund and 0.49 million hectare were not incorporated by this fund [1,2].

About 18.1 million hectares of the forest fund area are managed by the Federal Forestry Agency of Russia, including 15.2 million hectares covered with forests, out of them 7.8 million hectares (or 51%) entered into the category of forests under protection or under special protection. According to legislation in force and subsequent regulations clear-cutting is prohibited. A yearly average increase in wood is 28.8 million m^3, including 12.1 million m^3 of those forests are to be exploited.

Data about age structure of forests and distribution of species of coniferous forest are presented on Fig.2 and Fig.3.

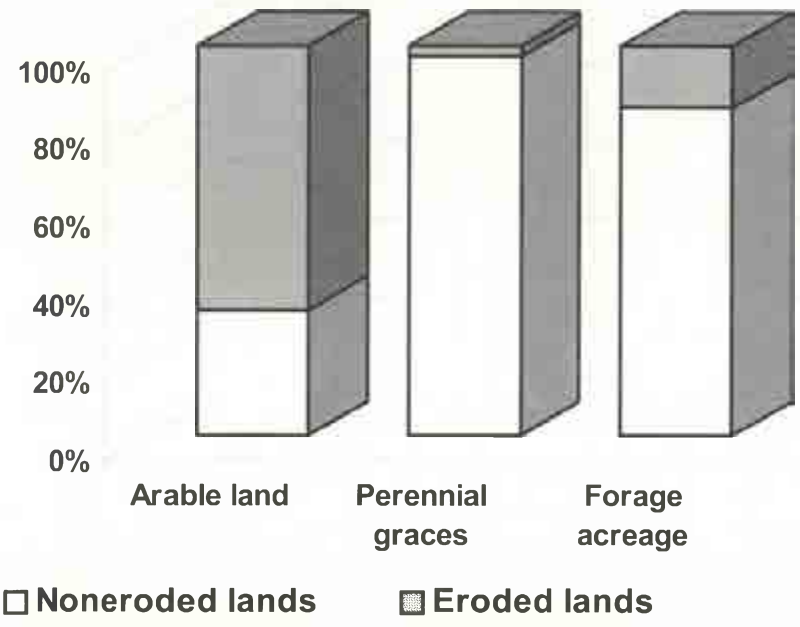

Figure1. Erodibility of land resources

The established yield logging site for clear-cutting (i.e. optimal norm of forest usage established with observance of requirements for annual cutting of mature and overripened stock) was equal to 6.5 million m^3. In 1998, procured were 435.9 thousand m^3 of wood. As compared with 1997, the volume of wood procurement went down by 1.1 times. The use of the yield logging site (a ration between actual cutting and the optimal norm) provided only 6.6%. Clear cutting covered 3.4 thousand hectares and went down by 1.3 times as compared with the previous year.

Tender cutting, selective sanitary cutting, reconstruction cutting covered the area of 16.8 thousand hectares, as many as 578.6 m^3 of liquid wood were harvested. The other cuttings (main cuttings, sanitary works, clearing of silvicultured areas for constructions and other purposes added 387.8 m^3 of wood.

In 1998, the Russian Forestry Agency's (Rosleskhoz) enterprises stocked up 1,402.3 thousand m^3 of liquid wood, what made less than 5% of an average increase in wood.

As compared with the previous year, forests were extremely affected by fires. As many as 1,308 forest fires were registered in the Baikal zone; fires killed over 57.8 thousand hectares of forests.

The forests under Rosleskhoz management were subject to 1,162 fires over the area of 55.7 thousand hectares. An average area destroyed by one fire was equal to 48 hectares, over the previous 5 years this value was 59.4 hectares. Late detection of forest fires contributed to their spreading over vast territories. A failure in providing regular aircraft patrol frights resulted in late fire combating actions aggravated the situation.

A decrease of air patrol flights frequency was caused by non-payments for fire combating works had been carried out in the previous year as well as by inadequate financial resources for fire protection measures envisaged by the state fire protection program.

To protect forests against pests and diseases, forest pathological surveys and forest pathological monitoring were conducted in the Baikal water protection zone on the territory of 4,411.2 thousand hectares. Pest-fighting steps were taken on 3,730 hectares.

As of early 1998, reforestation work was carried out on the territory of 17.4 thousand hectares, among them new trees were planted on 2,816 hectares. Reforestation work done by preferably the natural forest renewal method covered 14.5 thousand hectares, out of them on 5.7 thousand hectares by preservation of young valuable trees when conducting cutting activities. As many as 42.6 thousand hectares of trees were ranked to a valuable category; out of those 7.3 thousand hectares were planted with trees on the land covered by forests.

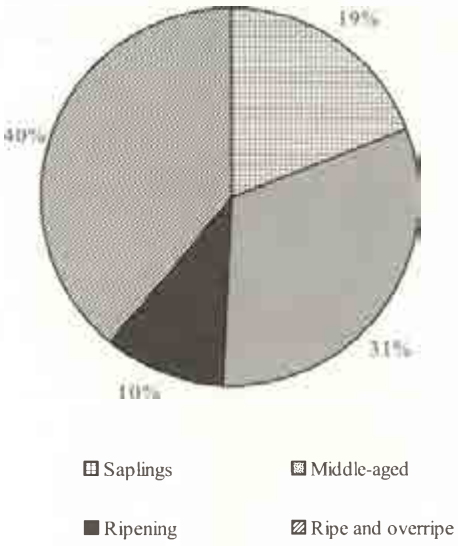

Figure 2. Age structure of forests

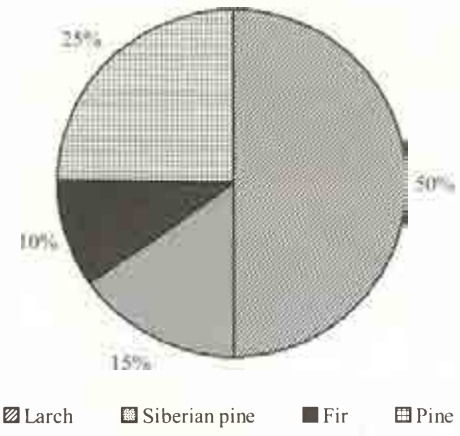

Figure 3. Distribution of species of coniferous forest

Fishery

Fish resources in Baikal Lake are of great value due to their unique species diversity, they include a number of endemic population quite valuable in respect of commercial significance [1,2].

Fish resources of the main commercial significance are as follows (see Fig.4).

Omul. The allowable catch limit was estimated taking into account the maximum value of biological mass of fish population being subject to catching (15.54 thousand tons) and due observation of morphoecological balance of groups.

In 1998, fishery enterprises of different forms of property were licensed to catch no more than 2,800 tons of omul. 2,300 tons of omul were allowed to catch, out of those 1,700 tons from Baikal Lake and 600 tons from rivers after a spawning period. Omul was also caught for breeding purposes. Private persons got single fishing licenses for catching 500 tons of fish.

According to 1998 statistics reports, about 2,419 tons of omul were caught from Baikal Lake, out of those 2,148 tons belonged to juridical persons and 217 tons to private fishermen.

Whitefish. The whitefish reserves in the Chivyrkuisk creek of the Barguzin fishery area were not dramatically changed in 1998. Whitefish was caught only as the additional catch while catching the omul. This fish species also attracted private fishermen. In 1998, whitefish catching from Baikal Lake accounted for 1.27 tons. The reserves of fine-mesh fish (roach, dace, perch) in the lake-sor system of Baikal Lake are rather scantly at present. The overcatching above the allowable limits which took place in 80s (in 1986 the excess was equal to 634.9 tons, in 1987 – 825.3 tons) in combination with unfavorable conditions for fish reproduction (such as lowering of the water level during the spawning period) led to reduction of this fish population. In 1998, 1,577.77 tons of fine-mesh fish were caught.

Perch. A stable drop in the catching of perch in all water bodies has been observed over the past years. In 1998, 40.63 tons of perch were caught from Baikal lake.

Burbot. The specific catching of bur-

bot is performed by fish-mesh nets and burbot traps under the ice only from the northern part of Baikal Lake. As many as 17.7 tons of burbot were caught from that water area. The reserves are in the state of depression.

Ide. The catching of ide was performed in Selenginsky and Severobaikalsky areas. The reserves of ide in the Severobaikalsky region are insignificant, but rather stable. The situation is in complete contrast in the Selenginsky shallow coastal area; ide reserves and its catching are subject to noticeable variations. In addition to it, a large amount of fish is caught illegally, in particular during spawning migrations. At present, ide reserves in the Selenginsk shallow water areas are being exhausted.

The adequate measures aimed at liming ide catching should be taken to restore the resources. For 1998 the allowable catch limit was estimated at the rate of 5 tons; as many as 4.71 tons were actually caught.

Carp. The reserves of carp are stable in the Barguzin fishing area owing to specific features of the Barguzin river's hydrological regime which is favorable enough for reproduction of this fish species. In 1998, the allowable catch limit from the Barguzin river amounted to 6 tons for fishery enterprises and 4 tons for private fishermen. The catch was allowed to perform by nets with cells of 60*60 mm in size over a period of May 1 - June 10. There were four fishery areas in the mid river stream where private fishermen were licensed to catch carp.

The carp reserves in the Selenginsk shallow water area greatly varied. The allowable catch limit for 1999 should not exceed 6 tons in the Posolsk sor and 15 tons in the Proval cove.

Pike. This fish is of secondary importance in the commercial catch. All age groups of pike are subject to catching in addition to the main mass fish species. The number of pike varies depending on the year and spawning conditions. The reserves of pike are much limited by the place of inhabiting and feed availability as well. The conventional places of pike fattening are overgrown with Canafian water thyme (*Elodea*).

In response to pike reserves, the allowable catch limit for 1998 was estimated in the amount of 70 tons, actually 16.31 tons of fish were caught.

Goby is the most numerous species in the Baikal ichthyofauna. Before 1960 goby species had been caught to produce canned fish at the Yuzhno-Baikalsk cannery. Since 1969 the catching of goby has been prohibited as this fish is used for feeding omul shoals.

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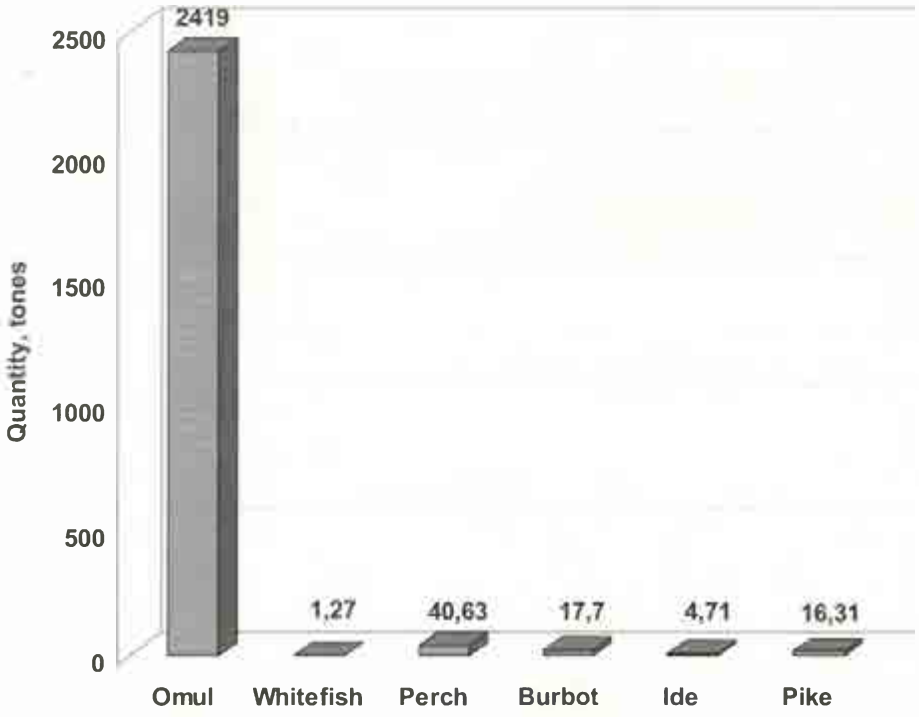

Figure 4. Accounted catch of fish in Baikal region in 1998

Ecologically Oriented Land Use Planning in the Baikal Region

Alexander A. Antipov & Adrian Hoppenstedt

in: *Antipov, A. & Hoppenstedt, A.* (1998): Ecologically oriented Land Use Planning in the Baikal region – Olchon Area
A German-Russian cooperation project, page 46

Abstract

The present framework being a first step towards the project process of „Ecological Oriented Land Use Planing in the Baikal Region" is a concept of objectives and measures for a sustainable development of the Olchon region. This planning process has to be put into concrete terms through spatial and professional specification (sc. 1:25 000) and through realization plans. Important measures have to be carried out (improvement of transportation and energy network; building a model campground; erecting a disposal system for waste and sewage water; support of local handcraft; support of enterprises for processing cattle products.)

At the same time the legal and administrative structural framework for land use planning has to be defined and these instruments have to be prescribed by the „Baikal Law". Without doubt all these measures are only successful if the local population learns to be open towards democratic planning processes, specially concerning environmental and nature conservation. This can be obtained through educational measurements.

The Russian-German co-operation project - in addition to the framework „Catchment Area of the River Goloustnaja" - is planning methodologically another module to introduce the system of land use planning in the Baikal region and over and above that in Russia.

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The History of Elaborating a Regional Strategy of Sustainable Development

Arnold K. Tulokhonov

The overwhelming majority of studies on the subject of sustainable development suggest that its history began with the report of the International Commission for the natural environment and development "Our common future" (1987), written under guidance of Gru Harlem Brundtland – prime minister of Norway. In this report, for the first time the concept of sustainable development as such was formulated, which met the requirements of the world population at present but did not put at risk normal existence of future generations.

From this point of view, the history of the problem goes deep into centuries and may be counted from the times of pagan worshipping of objects of nature having special significance for ancient peoples. People not only believed but, as it seems, felt that we are not the only living creatures on our planet. Thus, according to the Buddhist seeing of the world, our cosmos consists of six worlds populated by visible and invisible dwellers. The basic postulate of Buddhism about reincarnation of man necessity in spiritual growth and willing restriction of a person's needs is of principle importance for the concept of sustainable development.

It is not for nothing that wide spreading of Buddhist Dharma in the West, carried out mainly by the Tibetan community, receives much social response for it meets the necessity in "ecologization" of the mankind's mentality.

The problem of unavoidable ecological crisis was formulated in a more sharp manner by an English abbot T. Maltus who two centuries ago warned about future over population of Earth and proposed to control birth rate.

Speaking about the history of this subject, we cannot ignore classical aphorisms of K. Marx saying "A civilization, if it develops spontaneously and is not intentionally guided, leaves a desert after itself" and "Human projects neglecting the great laws of nature bring nothing but sorrow".

Not trying to give a full historical account on how the concept of sustain-

able development developed, it can be mentioned that beginning from the late 70s, the number of scientific publications on the subject reached 2000. We would like to point out the book "The limits of growth" (1972) by D. Meadows in which the author was first to formulate economic requirements to social development, first of all to limiting resource consumption. In 1992, his new work "Beyond the limits of growth" and the fundamental research of the US vice-president A. Gore "Balanced planet" analyzing the advantages and disadvantages of the "American" way of life and what is more important – the condition for balance between the needs of man and possibilities of nature were published. It is very significant that the second person of the richest country in the world states the necessity if exchanging ecologically-clean technologies , creating a system of international agreements and mutual responsibility, preserving a balance between the rates of consumption and production.

In the complete form, the ideology of sustainable development, as we have mentioned it, was presented in the documents of the Conference in Rio. In the final declaration consisting of 27 principles of recommendatory character, we single out the following:

- people who should have the right to healthy life in harmony with nature must be the core of attention;
- protection of the natural environment must become an essential component of progress and cannot be analyzed apart of it;
- development must equally meet the needs of the present and future generations;
- it is necessary to reduce the gap between living standards of the rich and the poor;
- all states have the sovereign right to use their natural resources but they have to bear responsibility to the world community for possible negative effects. Undoubtedly, such recommendations of advisory character are hardly suitable for regional research and represent significance to us only in respect of methodology.

Nevertheless, before we pass on to the theory of solving regional tasks, we must admit that this concept cannot be regarded as the only way of solving ecological crisis. Its main disadvantage is that it does not suggest any real actions and gives no answers to the following questions:

1. How to limit resource consumption in developed countries?
2. How to limit birth rate?
3. How to distribute material wealth between developed countries and poor ones?
4. Is private property compatible with sustainable development?
5. Is society ready to solve global problems?

That is why it is clear why this concept was subject to criticizing. Thus, S. B. Lavrov (1995) rejects the western models of social development and points out social, economic and regional aspects of solving ecological problems. His conclusions are pessimistic in regard to practical realization of the sustainable development concept. N. N. Moiseev who regards this concept as one of "the most dangerous delusions of the mankind" is even more categorical. In his opinion, humanity is already unable neither to reduce anthropogenic impact on nature, nor brush aside global ecological problems. That is why one must speak not about the sustainable development concept but about a strategy for the human race for a certain period of time, its joint actions ensuring co-evolution of man and the natural environment. According to N. N. Moiseev, this strategy must focus on (1) technological conversion of industry and (2) establishing ecological paradigm in people's mentality.

The main provisions of the concept are analyzed by S. Kurginyan (1995) regarding it as a concept stopping development. He is confident that the solution of global problems is possible only in the process of a new revolution which will transform society on the basis of radically new technologies and denial of consumerism.

The concept of sustainable development does deserve some criticizing for it somewhat resembles some religious postulates or the theory of building communist society in which there is no poor or rich or exploitation and so on. But admitting nobleness of these goals, we nevertheless cannot name any real ways of reaching these goals except violent redistribution of the national riches, and we must admit that society is not morally ready to accept this concept. The majority of people can limit their needs only in extreme situations when their conduct is conditioned by other priorities.

But it is necessary to admit that the concept of sustainable development and the decisions made at the conference in Rio were the first to point at intergovernmental level at impending catastrophes and the necessity of joint measures. From now on, every state must define for itself its participation in the process of self-salvation, and though nobody but Japan has made real contributions, the process has already started. It is especially important that in the past decades there was a large number international agreements aimed at solving global ecological problems: climatic changes, preservation of forests and so on.

Thus, the survey of opinions on theoretical aspects of sustainable development shows that much must be done at both global and regional levels. These two levels can be found in the problem of preservation of lake Baikal.

Baikal is a unique natural object that can be regarded as a part of the World Heritage in accordance with the requirements of the Convention on preservation of the World cultural and natural heritage adopted on November 16, 1972 by the UN Global Assembly on the problems of education, science and culture.

Ecological tension in the Baikal region was caused by an extensive growth of nature management rate in connection of plowing virgin-land and layland, Construction of Baikal-Amur railroad and paper-mill plants in Zabaikalye. In spite of the fact that in the nearest past, there were three governmental decrees aimed at nature protection at Baikal water basin adopted and considerable amount of material resources allotted, just a few optimists could claim that the condition of the natural environment was improving there. Moreover, new problems emerged which could not be solved by way of building sewage treatment plants or creating new technologies. All this makes us believe the task of preserving lake Baikal passes from the economic category to the social-political one. This calls for a more scrupulous analysis of the social aspects of ecological problems caused by departmental approach to development of the region's economy.

In the period of centralized planning of the economic system, here, as it was elsewhere, industries that hardly conformed to the natural conditions, tradi-

tions and culture of the local population emerged. At that time, when the main bulk of funds was allotted to new industrial objects, the republic had to use every possible way in order to make "the Center" approve construction of possibly bigger industrial enterprises which as a rule were constructed without regard to the social and ecological factors.

Thus, economic development of the Baikal region up to the present time can be regarded as an attempt to improve the material wealth of society by way of building various industrial objects which was a priority area. And if the latter was implemented to some extent, material wealth remained only in plans which caused all the complex of modern ecological-social problems.

In the present situation, the enterprises having no additional funds and unable to increase their production output on the one hand and restricted by ecological regulations on the other have nearly reached a deadlock. A still more complicated situation is emerged in the region as a whole: the regulations require a considerable increase of sewage treatment plants and other nature-protective measures which can only be done by way of reducing investment in social infrastructure.

Principally speaking, no one is against building nature-protecting objects and the majority of people when answering the question "What must be done immediately and what afterwards?" first mention protection of the natural environment. But when a person has to choose between solving social and ecological tasks, he usually chooses the former. And it is understandable because the ecological threat in the region is not always evident whereas everyone needs food and a place to live.

The elections of deputies of the State Duma in 1995 evidently show the pretentious character of such ecological declarations. In the Republic of Buryatia, the party "Kedr" representing the interests of nature protection supporters was voted for by only 1.2% of the population. The distribution of votes among the districts is somehow related to their distance from Baikal. The majority of those who are concerned about Baikal live in the districts adjacent to the lake whereas the number of them is the smallest in Bichursky, Tarbagataisky and Mukhorshibirsky districts. Even those who live near Baikal are mostly concerned about the problems of land ownership and other economic issues.

That is why the approaches to solving ecological problems here are so different from the western ones where it has already been understood that it is impossible to solve ecological problems in a single country, and we only declare these slogans, a resident of Chicago or Toronto is sincerely worried for Baikal. At the same time, there is hardly a person who is seriously worried about the condition of the St. Petersburg dam saying nothing of pollution of the Rhine or Azov. In other words, the rich and the poor have different priorities.

When society is concerned about the present day, the ecological problems are secondary importance. It is necessary to admit to extreme conservatism of public authorities in regard to nationalized ownership of land. Judging by the experience, they take nature-protective measures only when compelled by public opinion and the anthropogenic changes reach their highest level.

The ecological situation in particular parts if the Great Steppe (according to L. N. Gumilev) testifies to this fact. Aral has undergone unreversable changes. The landscapes of Kalmikia undergo catastrophic destruction. And now the state has to spend tens and hundreds times more than it could have spent on preventive measures.

In this respect, it is possible to draw an analogy to a person who has to spend much less money in order to prevent a disease than to treat it. If we draw the analogy to Baikal, Buryatia and Mongolia we can state that the condition of the natural environment has not undergone significant changes there. But it does not mean that it is necessary to save nature only after a catastrophe like the one of Aral has happened.

It becomes more and more important to elaborate a system of people's conduct when their every action is judged only in regard to preservation of the natural environment. Man is not the "king of nature" but its constituent part, and the most important principle of his attitude to nature is adaptability, that is maximum adaptation to the natural conditions of a territory. It can be established not only by means of technical measures but also by creating sufficient social conditions stimulating those forms of nature management that are the most specific of the people inhabiting the territory alongside with preservation of their culture and traditions.

It is the most characteristic of the peoples of Zabaikalye that the dominating form of agricultural activity they indulge in is stock-raising. In its turn, nomadic cattle-breeding was prevailing in stock-raising. In farming, the priority was given to producing forage and grain cultures which were the most adapted to the harsh local conditions. Such system of land use was the most economically-efficient and preserved productivity of agricultural lands.

But implementation of a well-known slogan "we cannot wait for nature's disposition, we must take it by force" gradually unified agricultural production in the region. The plowing of virgin-land and layland in the 50s had the most negative effect on the condition of agricultural sector: growth of arable land was stimulated at the expense pastures which sharply undermined the forage basis of stock-raising.

Changes in the agricultural infrastructure were accompanied by significant social changes in the countryside. With the best intentions – to improve living conditions of farmers, instruction on enlargement of rural populated areas at the expense of "unpromising" villages were issued. As a result of this policy from 1939 up to 1989 according to official statistics, 1259 settlements disappeared only in Buryatia, though there was no improvement of living conditions of farmers. On the contrary, century-long economic, household and cultural traditions of the local population were forsaken. Alienation of the land user from the object of his labor took place and caused dependence, indifference to the results of labor and other negative social effects.

Besides, high concentration of population in large rural populated areas caused the concentration of agricultural industry and increasing anthropogenic impact on the natural environment, especially on pastures. At the same time, nomadic stock-raising which took up the most productive pastures, contracted in many respects.

Having lost the traditional forms of economy, the local population could not fully adapt to new industrial forms of production, since the establishing of large cattle-breeding farms, pig farms

and other agricultural objects was not sufficiently provided with forage, waste purification facilities, staff training.

As a result Evenk nation suffered the greatest harm. As a result of "the improvement of living conditions" it nearly almost lost its ethnic peculiarities and is on the verge of disappearance. With transition of Evenks to settled life, the taiga lost its master replaced with transitory hunters and timber cutters who regarded it not as one's home but an object of exploitation.

Among the other social-ethnic factors of nature-management, the revival of religious attitude to nature as to mother or home is of special importance. All aboriginal peoples of Siberia had a system of prohibitions on timber-cutting, seasonal fishing and hunting. The basis if these prohibitions was made up of the cycles of nature, concern about preservation of fauna, unique natural landscapes and objects – degraded rocks, springs and so on which protected them from destruction.

Unfortunately, the struggle against religion lead not only to the destruction of churches and Datsans but also of that spiritual attitude toward nature which was always specific o the local population. Besides, the industrialization of the republic was accompanied with a significant migrant flow, and a considerable part of the migrants had a clearly marked transitory mentality.

Analyzing by these examples the interrelation between society and nature from the position of systemic research, we come to a conclusion that it is possible to reach harmony only under conditions of adaptive nature management, when the final result is obtained with at minimum energy costs.

According to the historical experience, it is supposed to carry out maximum anthropogenic activity in the natural systems with the aim to maximally use the natural potential and intentionally modify it in order to satisfy the needs of society but without breaking the general balance of the geosystems.

The new legal regulations on land use focused on revival of the rent forms of managing may be regarded as the first step in solving the formulated goals. But we should take into consideration that a significant part of land resources of the Baikal region was subject to intensive erosion, as a result of which possible tenants and land owners will probably face large-scale capital expenditures on restoration of land's fertility. Besides, up to the present moment, there have been no scientifically-approved land cadastre and, accordingly, norms of payment for land which significantly hinders the whole process of land privatization.

The return to the traditional forms of nature management has the meaning of "Closer to nature" rather than "Back to nature", but paying maximum attention to solution of social problems.

The solution of all the problems is possible only under condition of a radical change in our way of thinking which has been marked with utilitarian attitude to nature. This is why it is of principal importance to carry out ecological education of the new generation based on the principles of integrity of man and society, of the generation which is not infected with separatism and nationalism and admitting that Baikal belongs not only to those who live on its shores but to the whole mankind.

Global concepts must be adapted to the regional conditions. It leads to the necessity to single out the basic components of the strategy of sustainable development in the region:

1. substantiation of choosing the Baikal region as a model territory of sustainable development on Russian and international scale;
2. singling out the elements of the object of research reflecting its natural and social-economic specific features: the nucleus, buffer zone and the zone of influence;
3. the estimation of the condition of the natural and man-made systems, social-economic characteristic of the condition of society (first of all – definition of the scale of anthropogenic impact on nature. It is of principal importance to extend the temporal range of the research which will make it possible to obtain a more objective observation series, that is to begin the observation from the beginning of the 20th century, from the construction of the Trans-Siberian railroad and the Stolipin reform which initiated the development of agriculture in the region. The industrial development began only in the pre-war years);
4. pointing out the factors conditioning the state of the natural environment and forming the social structure (in particular, it is necessary to point out the possibilities to establish self-sufficiency, conditions for political stability, readiness of the population to accept the principles of sustainable development);
5. defining legal and economic stimuli of improving nature-protective activity;
6. defining of the conditions for successful implementation of a program of a balanced development of the region. In our mind it is the following:
   a) transition of economy to ecosafe science-intensive technologies and conforming to the principles of adaptive nature management;
   b) universal ecological upbringing, establishing ecological priorities in mass mentality.

It is evident that the concept of sustainable development of the region may be regarded as a scheme of such strategy.

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Eco-Economic Problems of Baikal Region Development

Irina I. Dumova

Abstract

Reforms in Russia have put forward new priorities in the regional economy. A great number of problems have arisen in this domain and many theoretical and, and particular, practical approaches showed to have been poorly elaborated. Serious difficulties come from the imperfect federal legislation for regulating complicated social and economic processes, as well as from the fact that the available home and foreign reformation experience has not been as yet properly digested and adapted to provide a relevant basis for the regional management policy. The situation is the more so critical as many social problems and problems of land use, that stem from the past but are closely related to the present economic space formation, are vital, acute and call for realistic, regionally-specified solutions rather than speculative discussions, especially when speaking about Lake Baikal, a site of World Heritage, and the Baikal Region.

It should be stressed that the very system of regional nature management has been subjected to essential changes, namely:

1) the former system of nature management, that had shown to be efficient in national parks and reserves, was destroyed but the ecological rights have not been delegated to the regions;
2) environment protection and the structure of regional economy have fallen into a stronger mutual influence and dependence, where the scale of environmental problems is proportional to the total negative effect of industrial enterprises on the environment that can manifest with some delay in time;
3) federal finance allotment for environment protection has reduced and a vital necessity arose to direct the limited investment for the best efficient objectives of environment-protection activities;
4) establishment of institutional structures or legislation activity has created no basis for the market mechanism of nature management.

Territorial regulation of nature management is becoming an extremely important mean to support large-scale proportions in emplacement of productive forces and promotion of integration among different industries, between urban and rural areas, and among individual territories. As a result of combination of internal and external factors, all elements of the threat to regional ecological safety became brought together. More specifically, the destructive factors are de-industrialization of economy and use of outdated technologies, uncertainty in property rights for natural resources, degradation of scientific and technological potential, as well as an increasing deteriorating effect of industrial centers around Lake Baikal, inside and outside the Irkutsk Region.

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Round Table

Lessons of "Lake Baikal Preservation" Federal Law Accepting and Priority Problems of its Verification

Irina I. Maximova

Lessons of "Lake Baikal preservation" Federal Law accepting.

Russian Federal Law "Lake Baikal preservation" came into effect May 12, 1999. The process of its development and accepting began in 1990 in the Supreme Board USSR, then in the Supreme Board of RSFSR, further in State Duma of first calling, and it was finished just now in State Duma of second calling (Fig. 1).

Its accepting was finally caused by the interests coordination of Federal executive power and Representative authority, Subjects of Federation, Sciences Academy of Russia and international organizations. It has allowed to find valid legal possibilities for including of new standards in Russian legislation which are necessary for legislative ensuring of unique object preserving of legal regulation - Lake Baikal.

Necessary and sufficient terms for accepting of the Federal Law.

The lessons of the present Law are formulated as terms, necessary for its accepting, and those factors, which have

allowed to accept it, that is - sufficient terms (Fig. 2).

Necessary terms:

1. Existence of Party (Parties) active interest which is (are) for the legislative initiative of its including, which should allow to realize its constant development and accepting. In case of absence of even one Party interest, it is necessary the absence of active counteraction. Or it is in a short way: total real interest should be more tan total counteractions.

2. Obligatory participation in development and accepting of the Federal Law ponderable now departments of President Administration of Russian Federation.

Shortly: participation decision – making person.

3. The possibility of influence on the concept and text completely depends on direct participation the representative of these interests in close working group at the all stapes of work. Shortly: including in process.

It is impossible to accept of different Federal Laws without presence even of one of the given terms, that is evidently shown on an example of our Law.

The work with the Law has allowed to formulate and complete list of the factors, or sufficient terms, which were weighed by the experts:

1. Coordination of interests of federal executive power and representative authority, Subjects of Federation, Russian Sciences Academy, international organizations, public, that is - Parties participated in making decision, expressing by including in the text of legislative standards only in possible for accepting volume. The term " the coordination of interests " is estimated in 45 % of success.

2. The conceptual development work, global preparation of the Law's text (stored knowledge) - more than 40 variants were reviewed and analyzed for 10 years, practically all experts in close areas of a science and legislation participated in working out these variants, the work of the German experts in this way has been in a high level of professional since 1992.

The condition " conceptual development work " is estimated in 10 %.

3. Complex professional work of the experts in all fields of knowledge with the text. The specified factor is 15 %.

4. Political lobbying - 10 %.

5. Economic lobbying - 20 %.

The list of sufficient terms is typical for accepting of all Federal Laws, however each of the factors weight, certainly, considerably and sufficiently differs.

Prime problems of Federal Law verification

The basic positions of the accepted Federal act (Fig. 3)

1. The Federal Law is "frame". The direct normative acts are accepted within the framework of the federal and regional legislation.

2. The Federal Law creates conditions for preservation of unique natural object, World Heritage Area - Lake Baikal on the basis of observance ecological and safe - environment requirements and balanced social and economic development.

3. Federal Law introduces limitations and standards of economic activity system in sphere of its influence, particularly:

3.1. Dividing into ecological zones of the Baikal natural territory.

3.2. Special norms of permissible influences on Lake Baikal ecological system.

3.3. The economic and administrative management levers of Law implementation are introduced

3.4. The criteria's of referring kinds of economic activity to a category of prohibited and limited are introduced.

4. Federal Law provides for definition of executive power federal institute, specially authorized to implement government regulation of Lake Baikal preservation.

5. Federal Law establishes purpose budget fund to Lake Baikal preservation.

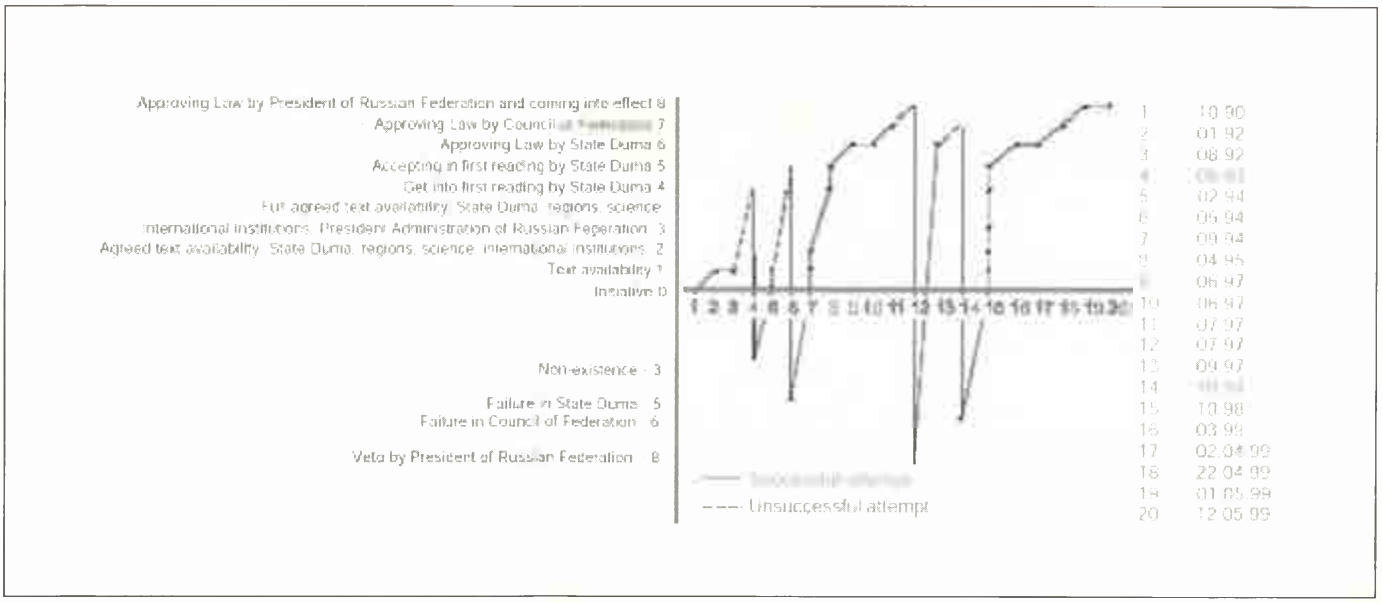

Figure 1. Basic steps in developing process and in implementing "Lake Baikal Preservation" Federal law: Failures and Winnings

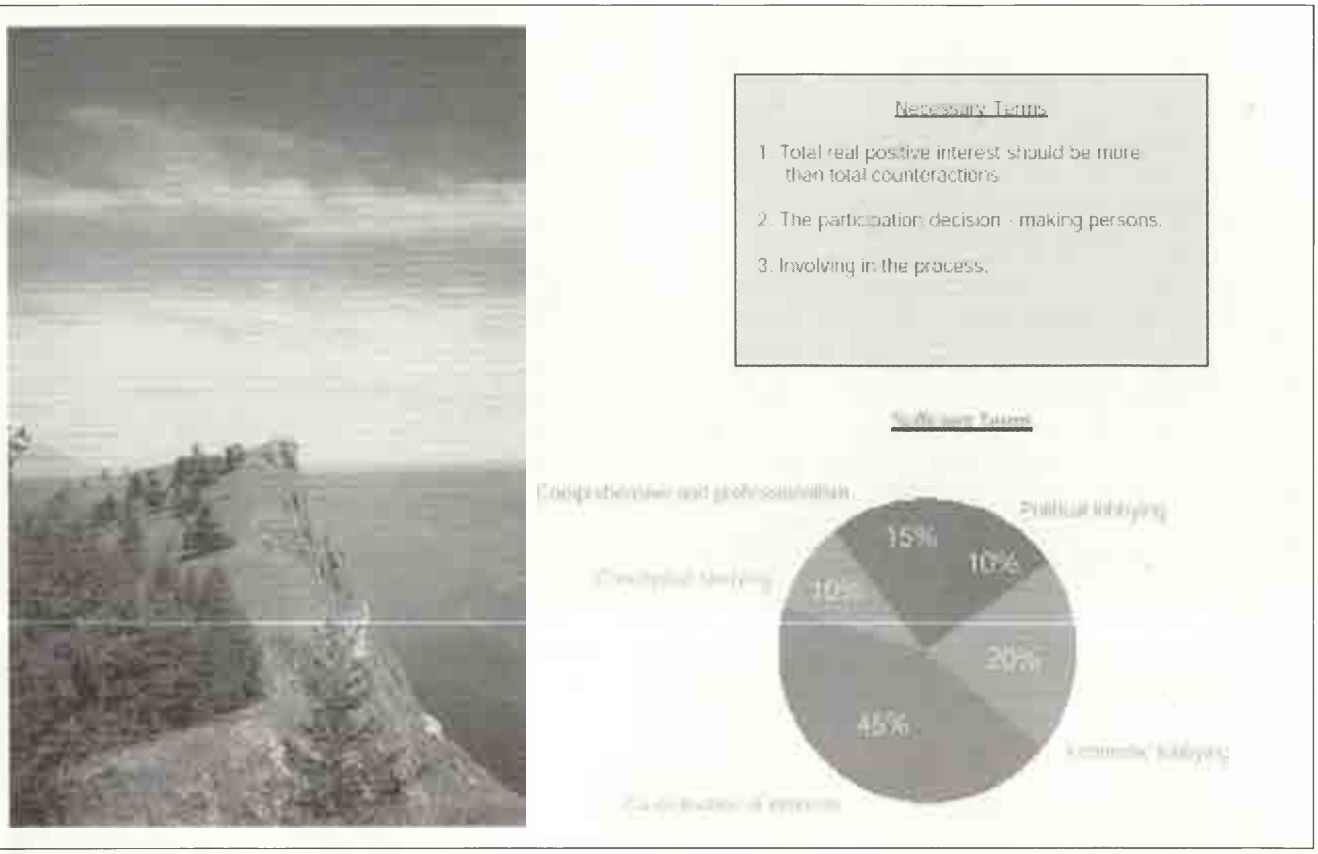

Figure 2. Lessons of Federal Law accepting

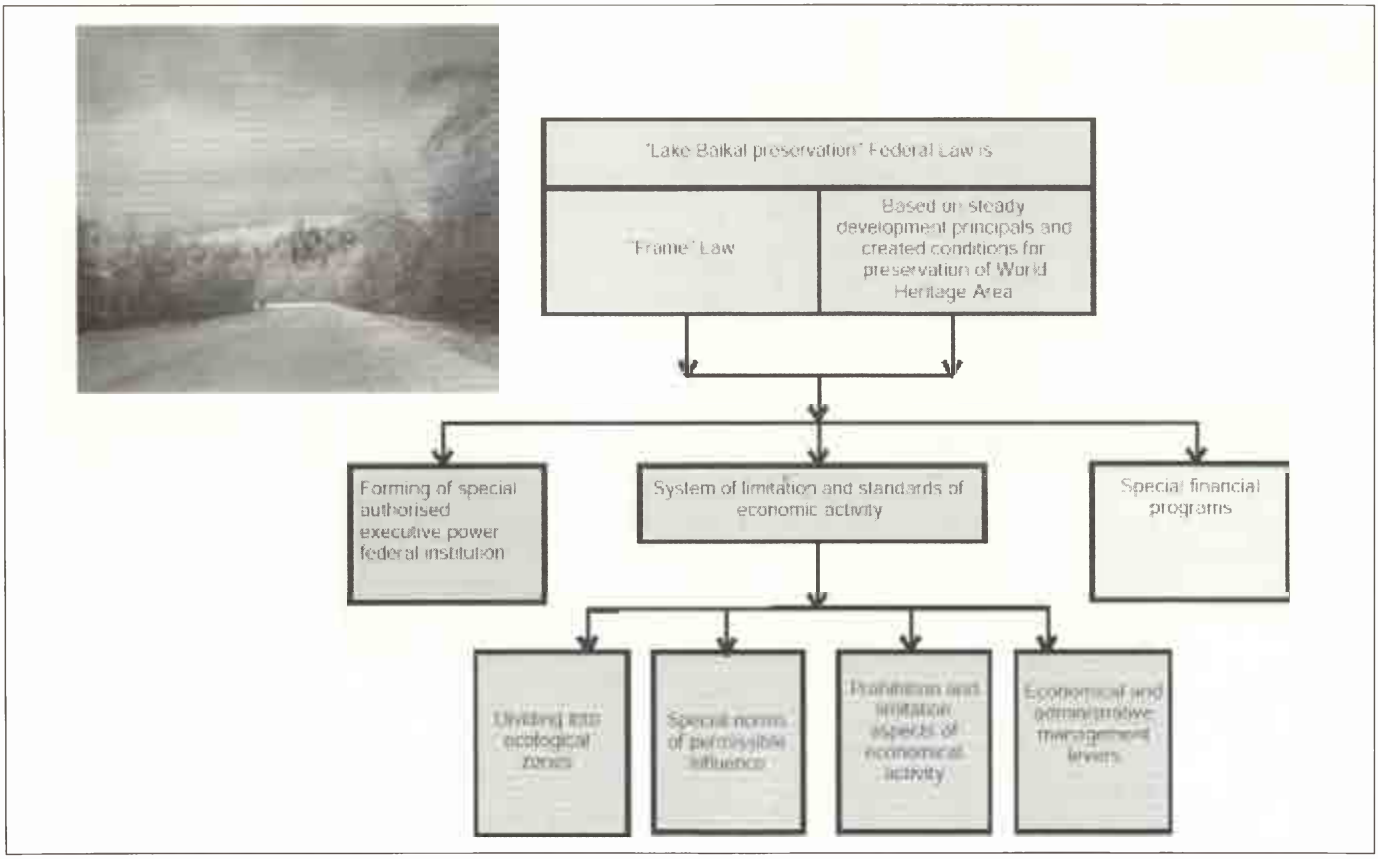

Figure 3. Basic articles of "Lake Baikal preservation" Federal Law

Russian and German consultations, which have arranged since 1992 and organized from Germany party by Federal Environmental department, have played the essential role in preparation of the Law's conception and text. The examination of Law's draft was made in March of this year under aegis of the Moscow bureau of UNESCO and BFN and this draft was accepted. The plans of this Law's implementation, in addition to current problems, were also discussed at all working meetings (Tab. 1). First variants of Law's text had much more norms of direct action. During working process, the text has gained " frame character " and first of all because of the positions agreement necessity. Therefore the range of norms, which is necessary to establish as the additional legislative acts for implementation of accepted Federal Law, has extended essentially.

The full list of necessary "Lake Baikal preservation" Federal Law consists of 23 Russian Federation normative acts (Fig. 4). There are 6 normative acts amount them, without accepting of which Law's implementation is impossible. Unfortunately, only one of these 6 - "Definition of a executive power federal institute" is included in the Plan of Events accepted by Government of Russian Federation.

General characteristic of a present-day situation

Priority problems of this Law's verification are the real possibility within the framework of present Russian legislation system and its implementation working out and accepting a number of conceptual normative acts at a federal level, without which the Law is not affected. It consists of systems of financing and management; norms of permissible influence on ecological system of Lake Baikal; dividing into ecological zones of Baikal natural territory; legal, economic and administrative mechanism of closing or changing the activity of dangerous productions; dividing objects of authority and power between federal and regional government institutions.

Now any of the priority normative acts is not accepted (Tab. 2). Even Government Resolution of executive power federal institution definition fails to accept, specially authorized for performing of government regulation in field of Lake Baikal preservation, in connection with the uncoordinated position of different federal institutions, each of which is interested in mentioned authorities. The preparation of the normative acts for financing, norms of permissible influence and changing the activity of Baikal Pulp and Paper mill is begun, however all these developments are not made by the federal power. Besides the absence of financing and uniform working group does not allow to prepare these documents purposefully and productively.

Formation of a management system

One of the important problems is the formation of a management system (Fig. 5). As the initial information for reviewing of a question the following parameters are determined of formed management system:

Requirements to a management system:

- The responsibility for regulation object;
- Authorities on realization of the accepted decisions;
- Embodiment of activity consolidation of federal and regional power, world community and public for Baikal preservation.

Regulation object (list of regulation aspects in field of Lake Baikal preservation):

- Ecology and nature management;
- Relationship of Federation and subjects, regional policy;
- Finance and economy;
- Social matters.

Influential government institutions in sphere of Lake Baikal preservation government regulation:
Federal:

- The Ministry of Nature
- The Ministry of Finance
- The Ministry of Fuel and Energy
- The Ministry of Economy
- The Government Committee of Ecology
- The Russian forestry

Table 1. International examination of Lake Baikal Law draft

Basic aspects which need coming into effect special normative acts for implementation "Lake Baikal preservation"

May, 1992	September, 1992	March, 1999
1 **Landscape and ecological "frame" plan of development Baikal region.** 2 **Idea of "easy" tourism in Baikal region.**	1 **Working out complex plans.** 2 System of administration levers and Law implementation control. 3 System of uniform Law implementation. 4 Ensuring of Baikal commission's effective activity. 5 Ratio of national parks and inhabited localities.	1 **Complex schemes of conservancy and landscape planning.** 2 **Tourism.** 3 Management. 4 Clear and detailed regulations of special authorised institute. 5 Multilateral Baikal's agreement between federal authority and executive power. 6 Federal normative act of ecological certification. 7 Normative acts of federation subjects in planing of nature management. 8 Biological pollution. 9 Prohibited and limited types of economical activity. 10. Land tenure. 11. Forest utilisation. 12. Baikal's water levels regulation. 13. Traditional nature management. 14. Inhabitants participation.

1. **Administrative.**
   1.1. Definition of the executive power federal institute.
   1.2. Regulations of the executive power federal institute.
   1.3. Agreement for the dividing the matters of jurisdiction and authorities.
   1.4. Dividing into ecological zones.
   1.5. Ecological certification of entities.
2. **Financial.**
   2.6. Purpose budget fund for Lake Baikal preservation.
3. **The levels of warrantable influence.**
   3.7. Levels of warrantable influence ecological system of Lake Baikal.
   3.8. The list of activities which are prohibited in Central zone.
   3.9. The list of activities which are prohibited in Buffer zone and in Zone of atmospherical influence.
   3.10. Limitations of activities in ecological zones.
   3.11. Water levels of minimum maximum in Lake Baikal.
4. **Events for Lake Baikal preservation.**
   4.12. Change of profiling program for Baikal Pulp and Paper mill.
   4.13. Intergovernmental program for Selenge river.
   4.14. Complex scheme of preservation and utilisation of Lake Baikal natural resources.
   4.15. Governmental control and monitoring of Lake Baikal ecological system.
5. **Nature Management.**
   5.16. Preservation and catching of endemic species of animals and collection of endemic hydrophyte.
   5.17. Limitations of forest utilisation.
   5.18. Structure and procedure of organisation of traditional nature management territories.
   5.19. Organisational rules for tourism and rest in Central zone.
6. **Science.**
   6.20. Purpose programmes in the area of scientific investigations of Lake Baikal.
7. Information.
   7.21. Open information of Lake Baikal.
8. **Punishment.**
   8.22. Additions to civil, administrative and criminal legislation.
9. **General.**
   9.23. Modification of normative acts of Russian Government.

Figure 4. Normative acts of Russian Federation which are necessary for implementation of "Lake Baikal preservation" Federal Law: science's and officials point ov view

- The Government Committee of Fishery

Regional:

- Administration of Irkutsk region
- Government of Republic Buryatiya
- Administration of the Chita region

Thus, the existing situation can be characterized by Russian national proverb "To many cooks spoil broth", that means:

1. Dissociation.
2. Lack of coordination.
3. Lack of governmental regulation.
4. Lack of Government responsibility.

Ideally the formed management system of Lake Baikal preservation should satisfy to above mentioned requirements to a management system. The norms of the Federal Law allow to real-

Table 2. Present state of the decision - making process of high priority normative acts

Parameter	Executive federal power institute		Finance	Norms of permissible impacts	The agreement of limitation authority	Baikal Pulp and Paper mill
	Definition	Position				
1.Specialists: - on federal level	✓	✓	✓	✓	×	×
- in the regions	✓	✓	✓	✓	×	✓
2.Including normative acts in plan by Government's instructions.	✓	×	×	×	×	×
3.Forming of conception	×	×	↗	↗	×	↗
4.Agreement of conception.	×	×	↗	↗	×	↗
5.Working out of text.	✓	×	✓	✓	×	×
6.Analysis of federal and regional government institutions proposals.	✓	×	↗	↗	×	×
7.Approval of text.	×	×	×	×	×	×
8.Providing working out of normative acts with finance.	↗	×	×	×	×	×

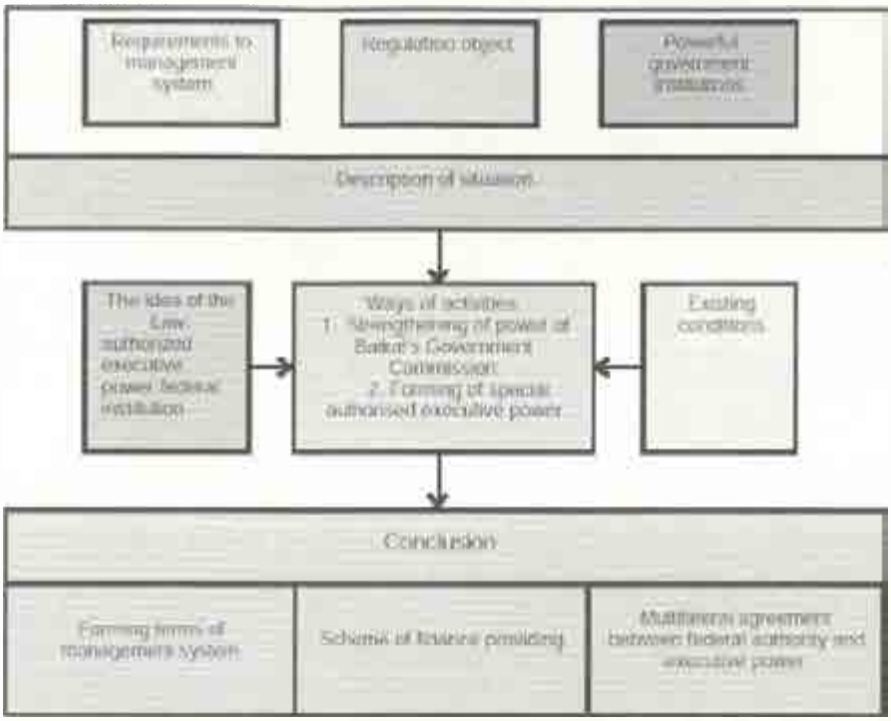

Figure 5. Organization of management system

ize idea of creating executive power federal institute. However norms of Federal Law are insufficient to realize these requirements. The subjective circumstances are necessary. An evaluation of existing circumstances is followed below:

1. There are no influential powers which meet requirements interested in creating of government institution.

2. There is a confrontation between The Ministry of Nature and The Government Committee of Ecology for superiority when there are full absence influential federal and regional power support of any of these institutions.

3. Hopelessness forcible appointment of any of existing federal institutions without the agreement with the Federation subjects and without endowing this institute with such authorities, which would allow to influence on other federal institutions in all matters of Baikal resolutely.

4. Practical actions of regions in creating of an executive power interregional institute and Baikal parliament without participation of the federal power, that lead to tearing away of the federal power by regions.

The following variant of actions is offered taking into account the characteristic of present government regulation system of Lake Baikal preservation matters and existing circumstances.

1. The government of Russian Federation should make a decision of Baikal governmental commission power strengthening, which consolidating all interested federal government institutions and regions, endowed it with functions of formation conceptual coordinated decisions of Baikal's matters. The precedents of such difficult problems decision in Russian legislation are available: the governmental coal commission on, on north delivery and other. This decision will allow:

To disclose a possibility of collegiate decision making;

To liquidate confrontation of one institutions and indifference others;

To establish the mutual responsibility of federal and regional powers.

2. In this case there will be no disagreements in endowing with the special authorized institute status of Russian Government Committee of Ecology, just Russian Government Committee of Ecology - in connection with a purpose priority of Baikal's ecological problems. Thus the basic functions of the above mentioned federal institution will be executing and coordination.

Conclusions on formation of a management system:

1. Terms of a management system forming:

Detailed dividing of powers between Baikal governmental commission and Russian Government Committee of Ecology;

The participation of the highly professional specialists, which are independent of the contradictory parties, in work;

Analysis and application of world experience and international experts.

2. Scheme of financing:

It is inseparably linked with forming of a management system

Simultaneous development and accepting of the scheme of Baikal preservation events financing.

3. Multilateral agreement between federal authority and executive power. Management system predetermines conception of multilateral Baikal's agreement between federal and executive power.

Federal budget on 2000 is considered in Russia Parliament at present time (Fig. 6). If we compare the budget on 1999 and the project on 2000, it is possible to see, that:

Share of preservation of the environment expenses in total expenses of

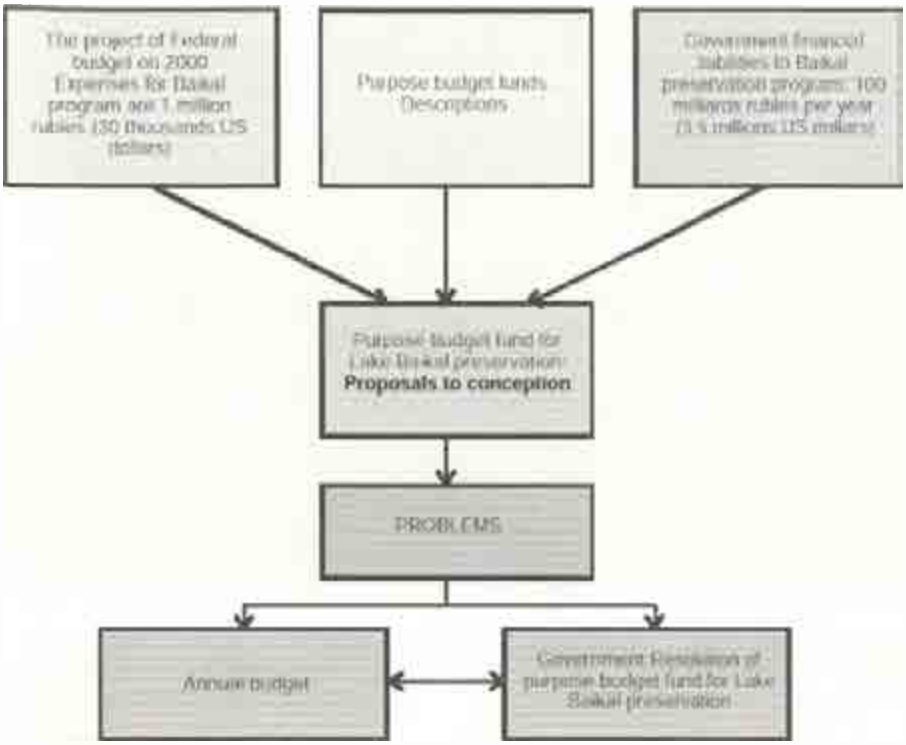

Figure 6. Financing

federal budget in 1999 was planned in a volume of 0,37 % (2,15 milliards rubles) and in 2000 – 0,32 (2,69 milliards rubles);

Lake Baikal preservation purpose program expenses was planned in 1999 in the amount of 6,85 million rubles, which was 0,32 % of total preservation of the environment expenses. In 2000 it is offered to spend for the Lake Baikal preservation purpose program 1 million rubles only and accordingly to reduce share of Lake Baikal preservation purpose program expenses in total preservation of the environment expenses to 0,037 %.

So, the Russian government can find only 30 thousand US $ in 2000 for Lake Baikal preservation, while its obligations according to affected special Russian Federation Government Resolution of Lake Baikal preservation are 100 milliards rubles per year (approximately 3,5 million US $).

"Lake Baikal preservation" Federal Law establishes the creating of purpose budget fund for Lake Baikal preservation. The parameters of purpose budget funds are defined by the Budgetary Code of Russian Federation:

1. Such fund is formed in a composition of the budget.
2. At the expense of the purpose incomes or deductions.
3. Is used under the separate estimate.
4. Main manager - public authority federal institute.
5. The financing is realized through Federal Treasury of the Ministry of Finance of Russian Federation only.

The following concept of purpose budget fund forming for Lake Baikal preservation is offered:

1. The fund is formed only at a federal level.
2. The directions of its expenses are defined by a Baikal Governmental Commission.
3. The main manager of fund is defined Russian Government Committee of Ecology.
4. The incomes of fund are formed from deductions of existing types of the incomes.
5. An essential condition is the full lucidity of Fund.

The basic moment allowing to implement purposeful coordinated policy, is the establishment for apportion of the amounts from purpose budget fund of Lake Baikal preservation is the decision of a Baikal Governmental Commission. Besides the conclusion of a Baikal Governmental Commission about the efficiency of using of the fund's amounts is sent to Government of Russian Federation, to the UNESCO and is published in the periodic editions.

It is necessary to decide the following problems for realization of the offered concept:

1. Annual including in the Federal budget.
2. To develop and to accept the special Government Resolution of Russian Federation satisfying to the following conditions:

a) Exception of dissociation and inefficiency of financing.

b) Avoidance inter-institutional confrontation in connection with endowing to Baikal Governmental Commission with deciding authorities.

c) Dividing of authorities and scientific evaluation.

d) Guaranties to the investors and lucidity.

Norms of permissible influences on Lake Baikal ecological system (Fig. 7)

The norms of permissible influences on Lake Baikal ecological system were accepted according to the Resolution of CK KPSS and Council of Ministers USSR in 1987 for the period till 1995. The developer of these Norms was the Siberian branch of Russian Science Academy, that was approved by federal institutions. Thus, these Norms were the inter-institutional normative act, were affected till 1995, however they actually work on the basis of the letters Russian Government Committee of Ecology. Actually, any court can cancel more rigid, in comparison with the all-Russian legislation, requirements to Baikal's pollutants.

"Lake Baikal preservation" Federal Law has defined the following contents of special norms of permissible influences on an ecological system of Lake Baikal:

The lists of materials in categories of danger;

The specifications of permissible influences;

The lists of forbidden types of economic activity;

Limitations of types of economic activity;

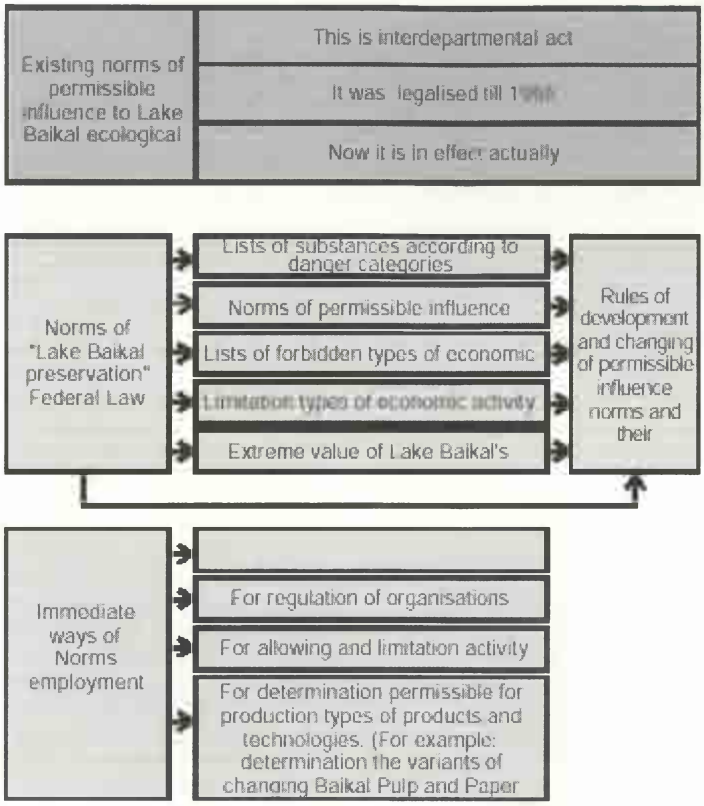

Figure 7. Norms of permissible influences on Lake Baikal ecological system

Limiting values of water levels in Lake Baikal;

The order of development, changing of norms of permissible influences and their application.

Priority directions of Norms application are:

estimation of pollution payments;

regulation of organizations activity;

the allowance or limitation of activity;

definition the possible to producing types of production and technologies

(For example, at definition of variants changing the activity of Baikal Pulp and Paper mill).

The program of changing the activity of Baikal Pulp and Paper mill (Fig. 8)

High priority problem of Lake Baikal including in the List of the World Heritage terms realization is stop of Lake Baikal pollution by the Baikal Pulp and Paper mill.

Now (under the report on 1998) the damage to natural environment by activity of mill is in 6 times more than the cost of its products. And, it is necessary to take into account, that the mill works continuously , meets all requirements of the nature preservation legislation, pays always wages and salaries and pays all necessary taxes to the State. According to the opinion of industrials federal institutions this entity is the best in the industry. Nevertheless, all update parameters do not show of its activity at all, if it is allowed the existence of the entity with above mentioned parameters of environment damage.

The present situation concerning the decision of a Baikal Pulp and Paper mill problem can be characterized as follows:

1. There is always a movement of public around of the present problem.
2. Problem of Baikal Pulp and Paper mill - political card in any election campaign.
3. The power frankly stays idle.
4. Stopping of Lake Baikal pollution by Baikal Pulp and Paper mill is a term of including of Lake Baikal in the List of the World Heritage
5. The situation has become more acute in connection with accepting of "Lake Baikal preservation" Federal Law and preparation of the sub - legislation normative acts, one of which is Russian Government Resolution of types of prohibited activity's list establishment in Central zone of the Baikal natural territory.
6. Economic limits of present technology Baikal Pulp and Paper mill . In a real configuration of present production process Baikal Pulp and Paper mill is economically unprofitably and it can not

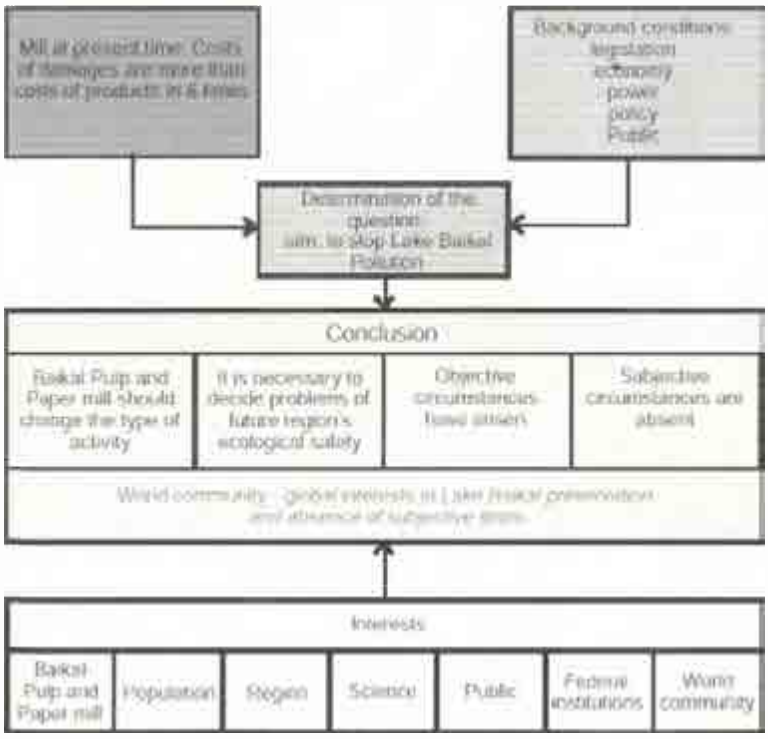

Figure 8. Question - Changing Baikal Pulp and Paper mill activity program

exist long. The cause of this is its low capacity of pulp production - 160 thousands ton per year, while in Irkutsk region in Ust - Ilimsk - 1200, and in Bratsk - 800. The market of pulp is in the European part of Russia and in China practically. Now, while other entities work on 10-20 % capacity, Baikal Pulp and Paper mill owing to saved qualified Board and effective management works stable. But after reinstating of other entities this mill will not have place in this market. It is necessary to change of assortment of products.

Besides it, the physical deterioration of the equipment is 90-95 %. Therefore according to evaluations of the entity's experts, and the clearing structures will be not able work no more than 3 years. It means, that without of attracting the investments and changing the activity of Baikal Pulp and Paper mill in 3 years the problem of Lake Baikal pollution will arise in a problem of ecological catastrophe on Baikal.

7. The existence of present Baikal Pulp and Paper mill production process is an irresistible barrier to development of fresh water and tourism business.

In the world everyone knows about Baikal Pulp and Paper mill, and they consider, that as a result of its work of Baikal has turned in gutter. It is results of our short-sighted propagation and absence of any actions of power within 30 years. It does not give a possibility of the global project of Baikal drinking water production development , which could have an enormous economic efficiency. In this case it is possible to make Baikal a tourist object only.

From above mentioned we can make a conclusion: he has got rid itself and does not give to develop something new, objectively its presence at present conditions on the bank of Baikal is impermissible. Statement of a problem is following: all objects of production, infrastructure and home gardens should meet the Norms of permissible influences on an ecological system of Lake Baikal.

Limitations:

1. The decision of social problems of the city.
2. Providing stable work of a municipal services
3. Creating of an economic basis of city's life.
4. Image: the created configuration of region should have safe image as minimum.
5. Liquidation of accrued pollution (saved slag and dome of subterranean waters pollution).

The ways of the present problem decision depend on interest of structures having possibility of the decision of such difficult problems. For this purpose it is necessary to define interests all involved in process parties. Without sowing the full list of interests, we will describe only their vital interests, taking into account, that, certainly, that everybody is interested in preservation of Lake Baikal:

1. Baikal Pulp and Paper mill - economic benefit of production process.
2. Population of city - stable work - Congenial environment
3. Management of Irkutsk region - social arrangement of the population
4. A science - to save Lake Baikal as unique object of study
5. Sociability - self-affirmation
6. Federal departments - self-conservation
7. World community - to save Lake Baikal as World Natural Heritage Area, source of drinking water, natural habitat of endemic flora and fauna.

So, everyone is vital interested in preservation of Lake Baikal: a science and world community. From them - there are no objective limitations in active steps world community makes these steps only, as any science will conduct active steps only up to the possible conflicts with the power. It is possible to rely on the help (but not as alternative: work or Baikal) of population. The temporary allies are: , Board of Baikal Pulp and Paper mill region power, public and Russian Government Ecological Commission.

Conclusions:

1. Baikal Pulp and Paper mill has got rid itself, does not give to develop something new and threatens to existence of Lake Baikal.
2. The task consists in the decision of a problem future of all region of Baikalsk city so that all objects of production, infrastructures and the home gardens would meet the Norms of permissible influences on an ecological system of Lake Baikal.
3. All objective circumstances of a possibility of the solving the problem of Baikal Pulp and Paper mill have ripened: legal, economic, psychological.
4. The subjective conditions of the solving the problem of Baikal Pulp and Paper mill in Russia are absent: unique vital interested in generated power is science, however it has no neither government's authorities, nor economic possibilities. Neither federal, nor the regional power is not interested and can not be in update economic conditions to decide this question. The business is not ready to undertake the given problem owing to its costs, scandalousness and rather long terms of payback a capital investment.
5. The unique actually interested power which has not limitations in achievement of result, namely - stopping of Lake Baikal pollution by Baikal Pulp and Paper mill is the World community.

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Workshop: Basic Research about the Lake Baikal Region

Basic Results and Problems of Studies of the Siberian Cryosphere

Vladimir P. Melnikov

Abstract

In studies of ecological problems, the cryogenic systems determined by the triunity of the system-forming factors (cryogenic conditions, processes and formations) should be considered in combination with the system-forming media (atmosphere, hydrosphere, lithosphere, covers, and biosphere). Together, they make the Earth cryosphere.

As one of the specialized directions of Earth sciences, geocryology studies ecological aspects of the Earth cryosphere from the stand of minimum ecological risk related to economic development of perennial cryolithozone areas, increasing natural resources of the cryolithozone and upgrading technologies of their use under harsh climatic conditions.

Increase in the efficiency of the use of our actual knowledge of the Earth cryosphere for solving multidisciplinary ecological problems seems to be integration of knowledge gained by specialized sciences within the framework of one superscience which is Earth Cryology. This conception is being realized at the Earth Cryosphere Institute of the Siberian Branch of Russian Academy of Sciences (ECI SB RAS).

Key words

cryogenic systems, cryogenic conditions, cryogenic processes, cryogenic formations, earth cryosphere, earth cryology, ecological risk, natural resources.

The most prominent features of the territory of Russia, which is the landscape providing sustainable food supplies to the Russian ethnos, are Lake Baikal, abundant mineral resources including virtually all of the elements of Mendeleev's table, and a zone of negative temperatures in the lithosphere going to a depth up to 1.5 km near the world cold pole in Yakutia. These features attracted and will, for many years ahead, attract attention of the world community from scientific and economic viewpoints.

This year, the finding of a whole mammoth carcass in the north of Krasnoyarsk territory is again a means to satisfy nostalgic human feelings for passed epochs since it gives hope for getting a living mammoth by cloning. On the other hand, this 'natural refrigerator' stores deadly viruses and bacteria, some of which have long been forgotten, whereas others are simply unknown to modern science.

The phenomenon of deep freezing of the earth crust had been revealed long before the birth of the Russian Academy of Sciences, and it has virtually been the focal point of research since the first years of Academy's existence. Discovered by land explorers, this phenomenon has subsequently drawn attention of geologists, hydrogeologists, civil engineers, meteorologists and gradually crept into the zone of interests of virtually all Earth sciences. This interest stems from the fact that in Earth sciences all subjects of research are to a definite extent associated with cryogenic conditions, cryogenic formations and cryogenic processes in the past, present and future of our planet, i.e. with the factors that form the system of Earth Cryosphere.

Water and heat, which are the two primary acting principles in the cryosphere formation and transformation, are at the same time the most important resources indispensable for the survival of the biosphere and mankind.

Five of the six demographic billion anniversaries took place in the 20-th century. All factors related to the unprecedented growth of world population and industrialization forced man to look

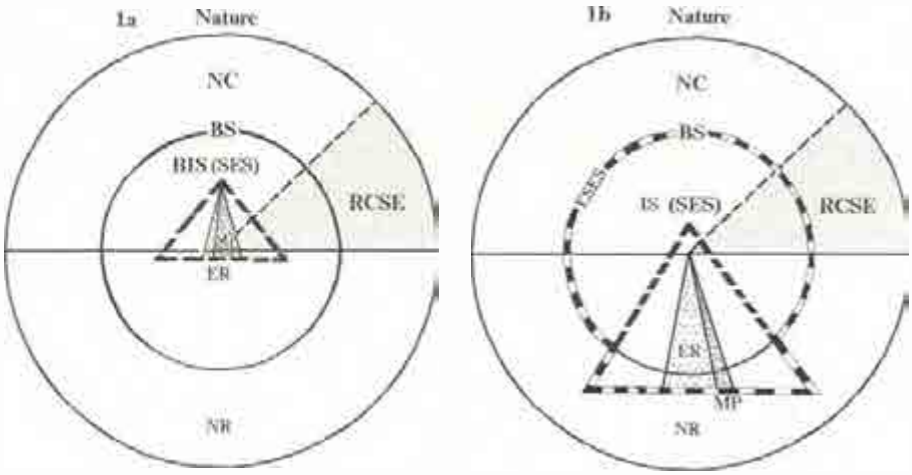


Figure 1

differently at natural conditions and natural resources, i.e. the major wealth sustaining the existence and perspectives of the Earth biosphere, including man.

In Figure 1 (a, b), the large circle symbolizes the natural wealth of our planet Earth. Its components are potential natural resources (NR) and natural conditions (NC). The small circle indicates the part of natural wealth that supports the existence and development of the Earth biosphere, including man. The resources of the 'pre-industrial' human society (socio-economic system) do not go beyond the frame of biospheric resources. They are designated in form of a PIS triangle (Fig. 1a). Inside this triangle, the human society is indicated as labour resources (LR). The 'industrial' society (Fig. 1b) enlarged appreciably the consumption of natural resources and brought them outside the frame of the biosphere and the natural wealth providing for its existence. On the other hand, the industrial society decreased the dependence of man on natural conditions. Inclusion of the ecology of the entire biosphere into the sphere of Mankind's interests (ecologo-socio-economic system) introduces into the man's resource base all of the welfare sustaining the existence and development of the biosphere (green contour) and thereby increases again the share of natural conditions.

It is known that in order to maintain normal functioning of both human society and individual ecosystems of the biosphere, changes in the most important life-support resources (water and heat) are permissible only within definite quantitative and qualitative limits.

Natural cryogenic systems act as the crucial regulator of water and heat resources. Huge amounts of energy and mobile water circulate in cryogenic and postcryogenic processes (i.e. they are released and bound in cryogenic formations), whereas cryogenic conditions determine the possibility of the occurrence of these processes. For this reason, the natural cryogenic systems forming together the Earth cryosphere are components of most systems that support homeostasis of Nature: climate-forming, exogenic geodynamics as well as those providing for water turnover, and geochemical and biogeochemical

Cryosphere - *this is natural cryogenic systems*

System - forming factors

1. Cryogenic conditions
2. Cryogenic processes
3. Cryogenic forms

System - forming mediums

Atmosphere
Hydrosphere (surface-waters)
Lithosphere
Covers (ice, glaciers, snow)
Biosphere

Figure 2

cycling of elements. Therefore, differentiation of cryogenic systems (Fig. 2) is determined by both the triunity of the system-forming factors (cryogenic: conditions, processes and formations) and the system-forming medium (or media depending on what of the life-support systems of Nature is under consideration).

Figure 3 features a scheme of distribution (maximum and minimum areas in the intrinsic temporal cycle) of regions characterized by cryogenic conditions, processes and formations. An irregular scale of latitudes in the scheme is associated with this situation. It also indicates: weight of ice (gas hydrates) in cryogenic formations and mean times of their existence. The scheme allows one to judge about the width of the Earth cryosphere development and the scope of its seasonal variation.

The involvement of huge masses of cryogenic formations composed of snow covers and sea ices in the climate-forming system of the Earth makes climate more stable (the larger the exchange currents, the more difficult is it to upset dynamic equilibrium of the system).

One can hardly overestimate the role of the Earth cryosphere in the system of water exchange between continents and oceans. The cryosphere acts as a gigantic demineralizer and accumulator of freshwater in ice sheets (nowadays, they contain 700 annual runoffs of all world rivers). The Earth owes to the cryogenic conditions in the atmosphere (considering specific structure of water) the existence on its surface of: freshwaters with their biota, the well-developed river system, which is respon-

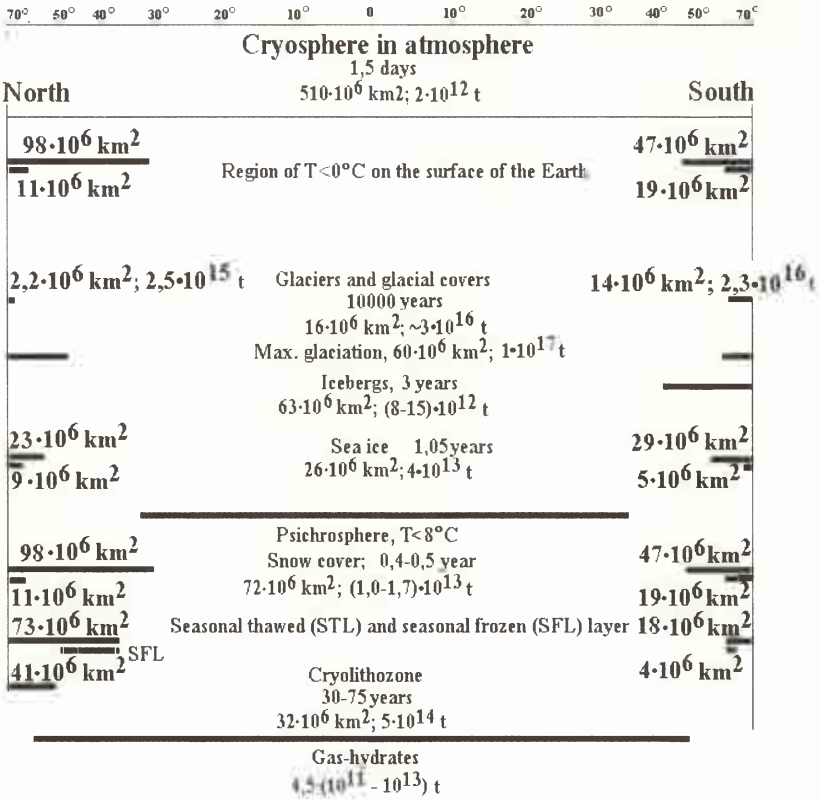
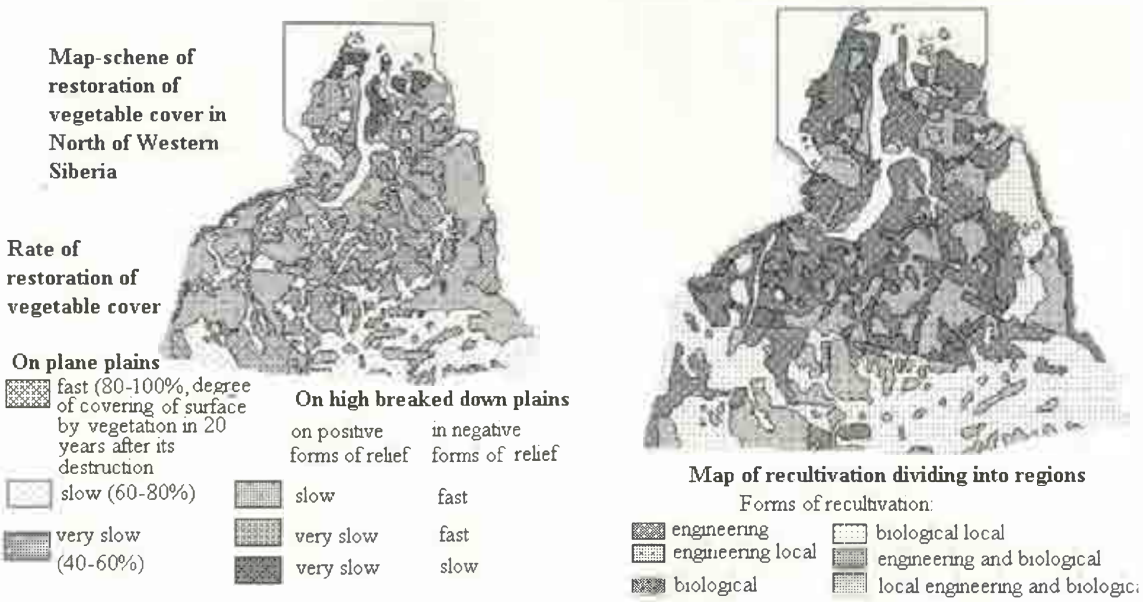


Figure 3



Type of vegetation in cryolithozone and its stability

Name of type	Dominant vital forms	Stability to antropogenous influences
meadow	meadow grasses	stable
bog	bog grasses and mosses	average stable
bushes	bushes	average stable
tundra	bushes, mosses and linches	weakly stable
forest	trees, mosses and linches	weakly stable and unstable

Figure 4

sible for the actual salinity of the World ocean, and the modern terrabiosphere, which depends strongly on the level of atmospheric precipitation.

Landscapes of high and middle latitudes on the Earth are determined by the availability of the cryolithozone and by changes occurring in it. For instance, in the absence of perennial cryolithozone the territory of Central Yakutia would be a semi-desert.

The cryosphere itself is homeostatic because the phase transition includes a feedback element on which homeostasis is based, i.e. the respect of Le Chatelier's principle; an example of a more complex form is the halocline of the Southern ocean, which is maintained due to thawing of marine ices and creates conditions for their formation.

In Russia, the study subjects of nearly all Earth sciences are situated within the borders of the cryosphere. But individual natural cryogenic systems are investigated specially and most intensively by the following sciences: geological (engineering geology and hydrogeology); oceanic physics, meteorology and atmospheric physics, physical geography and those dealing with water problems. And only two sciences study solely the cryosphere: glaciology (a direction of physical geography) and geocryology. It is noteworthy that the latter formed as a science concerned with man's impact on the cryolithozone and the resulting ecological problems. From its early days, geocryology developed approaches to the estimation of natural and anthropogenic impacts on the environment.

The achievements of glaciology are widely known: 'Glaciological Dictionary' [1] is the most complete reference book on the Earth cryosphere, while 'Atlas of World Snow-Ice Resources' [2] is the most fundamental work in Russian glaciology of recent years. For this reason, let us confine ourselves to the illustration of the ecological character of some geocryological studies carried out in recent years mostly at ECI SB RAS.

These are primarily the works aimed at preventing or reducing the ecological risk resulting from underestimation of geocryological conditions and their possible variation (natural or under the impact of economic development of territories) and also the studies on recultivation of anthropogenically disturbed landscapes.

A computer map of cryogenic geological processes occurring in the Russian cryolithozone [4] was compiled using the electronic landscape base of a scale of 1:7 500 000 [3]. Zoning of the territory with developed perennial cryolithozone was performed on the basis of landscape indices with consideration of iciness and lithology of Quaternary deposits. Within the borders of differentiated regions one distinguishes the distribution and ecological significance of nine most important (nivation, frost fissuring, solifluction, thermokarst, ice-crusting, as well as cryogenic: bulging, weathering and deserption) cryogenic geological processes. This map enables one to take into account the cryolithozone peculiarities in planning the ecologically safe economic development of individual areas.

It served as the base for compiling a Prognostic map of the consequences of global climate warming (using Pavlov's scenario) by 2020 and 2050. This map indicates natural-territorial complexes, within the borders of which perennially frozen deposits will degrade totally or

partially during the next two and five decades, respectively. Enhancement or inhibition of destructive cryogenic processes, as well as their generation or loss of activity by the above dates are also shown [5].

Systematization and analysis of perennial series of observations (over 25 years) [6] allowed differentiation of the dominant viable forms of various types of vegetation in the north taiga and tundra zones of West Siberia and determination of their resistance to anthropogenic stresses (the table in Fig. 4). Here, there are also two other maps based on these materials: a schematic map of the rates of recovery of vegetation cover and a map of recultivative zoning of the north of West Siberia. One of the most interesting studies is the work of investigators from Moscow State University who generalized the experience gained in northern and eastern regions of Russia in the course of housing construction, industrial development, mining activities and transportation [7]. The results of this work made it possible to compile maps of zoning of the territory with developed perennial cryolithozone with respect to ecological risks in various natural-technical systems; such maps are useful for feasibility studies aimed at the substantiation of economic development of individual regions. Studies (discussed below) of the use of natural resources situated in cryospheric areas may be regarded as a relatively new direction in geocryology.

The interest of geocryologists in gas hydrates is due to the following reasons:

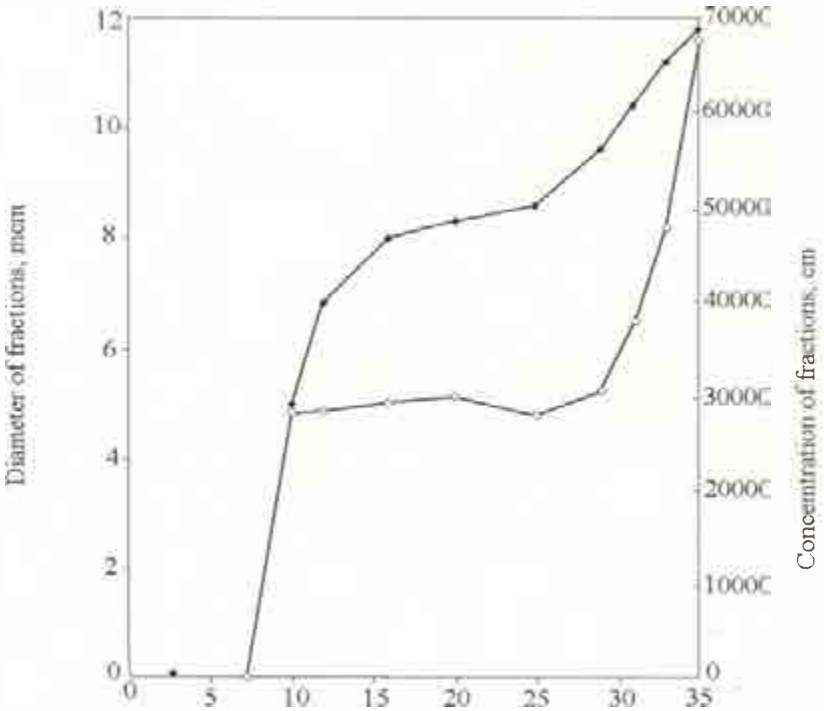
- it is believed that the Earth interior contains tremendous reserves of natural gas in the hydrated state. This enables one to consider gas hydrates as a potential source of crude hydrocarbons;
- gas hydrates are a solid hydrated formation. Their behaviour influences processes occurring in the cryolithozone; therefore, their accumulations are a component of the Earth cryosphere;
- changes in climatic conditions may be conducive to the break of the equilibrium state characteristic of hypothetical gas hydrate deposits. This will induce an appreciable emission of gaseous hydrocarbons that will enhance the greenhouse effect. For this reason, prediction of global climate warming requires knowledge of the character of gas hydrates occurrence in the lithosphere and their stability;
- technogenic gas hydrates formed on the walls of pipelines in the course of transportation of humid gaseous hydrocarbons at negative temperatures can lead to eventual plugging and rupture of pipelines. This must be taken into consideration, when planning and realizing economic activities in the North.

Researchers of ECI SB RAS investigate the thermobaric conditions of the existence and formation kinetics of gas hydrates in both free solution and dispersed media. The latter state is closer to natural conditions.

Relevant experiments have shown that addition of sulfanol (surfactant concentration (in % w/w) up to 0.1) leads to a drastic acceleration of formation and loosening of gas hydrates [8]. This may be used for preventing failures of gas pipelines.

Studies of the dynamics and kinetics of gas hydrate formation in dispersed media have shown that accumulation of gas hydrates in clays occurs only upon mineralization of pore moisture [9]. The heat of gas hydrate formation in clays is lower than that in the free solution. This implies the decrease in the stability of hydrates entrapped in them under the impact of changes in external conditions (global climate warming). Conditions of gas hydrates formation and accumulation in moist clays depend on the thickness of wetting films on the surface of mineral particles. Therefore, lithology and hydrochemistry of profiles must be taken into consideration in the estimation of perspective zones of gas hydrates occurrence.

In most existing techniques the kinetics of gas hydrate formation is judged about from changes in indirect parameters which are dependent on the volume and configuration of experimental equipment. This leads to subjective conclusions. The method of multiwave extinction (weakening of light flux) al-

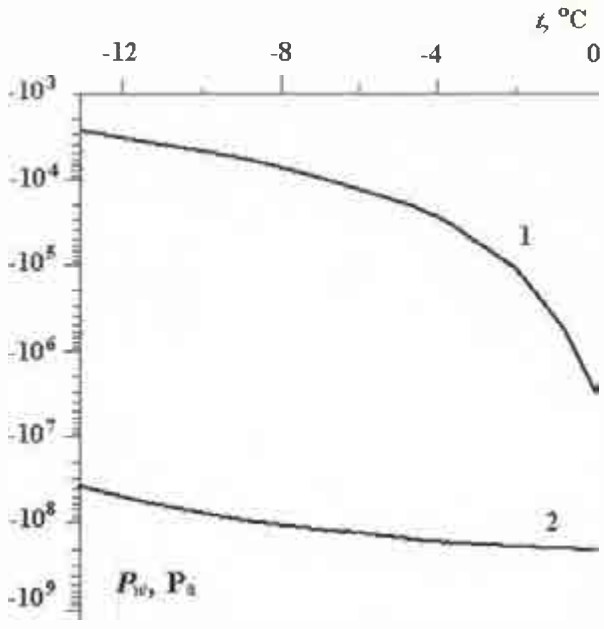


Changes of resizing (•) and number of hydrate fractions (○) under hydrate-forming of tetrahydrofuran

Figure 5

Total view of cryoscopic for observation of cryogenic microprocesses

Figure 6



Dependence of pressure in water drop into ice (P_w) vercus local temperature of the sample (t).
1 - ice with real viscosity, 2 - rigid ice

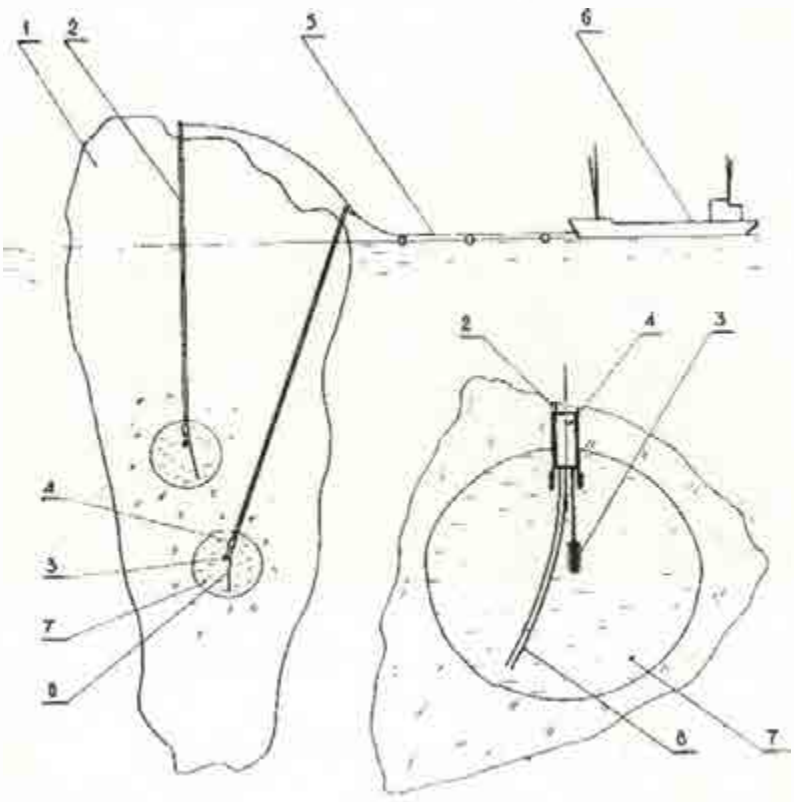
Figure 7

lows simultaneous determination of the size and concentration of particles in the dispersed phase. To realize it, a special setup and experimental procedure were developed, which allow direct detection of particles of hydrates at their volumetric concentration in the system on the order of parts per million at temperatures ranging from -10 to +20°C and pressure up to 7 MPa. This allows one to judge about early stages of gas hydrate formation (Fig. 5) [10].

The problem of the use of gigantic resources of freshwater 'lost' in melting icebergs in not new in glaciology, but investigation of the peculiarities of ice deformation under long-term loads has allowed a new insight into this problem [11]. A cryoscopic installation designed at ECI SB RAS (Fig. 6) allows visualization, recording and reproduction of details of the microprocesses occurring in frozen samples. The absence of gas emission inside migrating liquid drops in ice had no explanation for a long time. It was expected to occur due to strong tensile stresses in a drop determined by different densities of phases. The estimates derived using a relevant mathematical model considering viscous ice deformation point to a substantial reduction of stresses (Fig. 7, curve 1).

A patented technique of water extraction from icebergs is based on conclusions drawn from this theory (Fig. 8) [12]. A well is drilled in ice and a cavity of required diameter is produced using a heater. Due to a reduced pressure in the cavity created using a pump and owing to a higher oceanic pressure, the ice flows toward this cavity and melts at its borders, while the water is pumped out into a transport vessel. For a discharge of about 30 metric tons per day, the cavity radius is 3.3 m and the ice flow rate at its borders is on the order of 1 mm/s.

Special mention should be made of the results, reported by investigators from Moscow State University and Institute of Soil Science and Photosynthesis of RAS, which provide evidence of a rich biosphere existing in frozen buried soils [13]. The assumption of deep penetration of the biosphere under frozen strata makes it possible to consider the region of perennial cryolithozone development as 'an optimal natural object



Way of fresh water extraction from iceberg.

1 - icebrerg body, 2 - pipe of the well, 3 - heater, 4 - pump, 5 - pipeline, 6 - tanker, 7 - water cavity, 8 - water intake.

Figure 8

for bioevolutionary constructions' and also as the area of increased microbiological hazard.

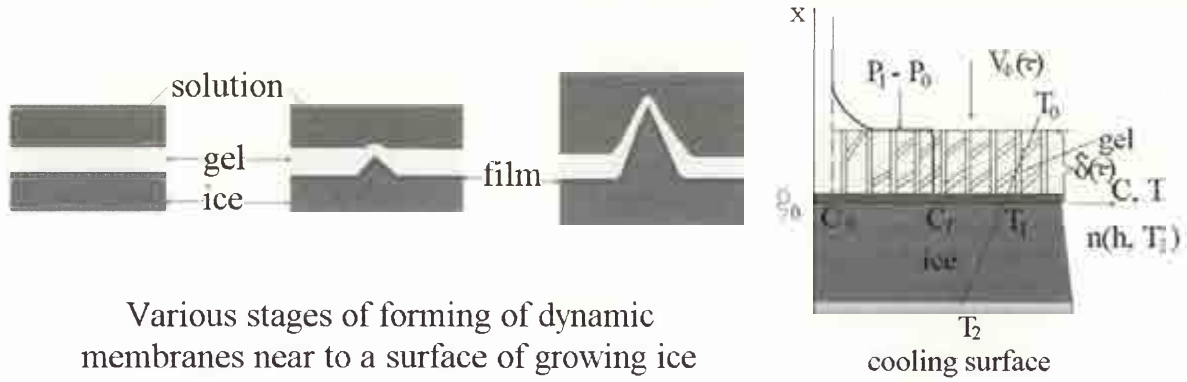
The field dealing with the development of technology for the rational use of natural resources is the oldest one but here too modern studies are underway.

G.I. Smorygin from ECI SB RAS predicted theoretically and detected formation of dynamic membranes upon crystallization of aqueous colloidal solutions (Fig. 9). The mechanism of their formation is as follows. Detachment of colloidal particles by the growing ice leads to a 2-3-fold increase in the polymer concentration at the surface and to the formation of a layer of gel-membrane. This membrane restricts the water access to the growing ice surface (hydraulic conductivity decreases 3-5 times) and entraps (concentrates) substances contained in the liquid phase. Random protrusions on the growing ice surface stretch the polymeric film decreasing its hydraulic resistance and leading to the dendrite-type growth of ice in the bulk of gel.

Thus, freezing from the liquid phase results in the release of purified water in the form of ice and formation of stable (after thawing) gel interlayers which concentrate in them the compounds contained in the mother liquor. This effect can be used for cryogenic: purification of water, dehydration of structured colloidal solutions, concentration of useful substances, preparation of ice composites, etc.

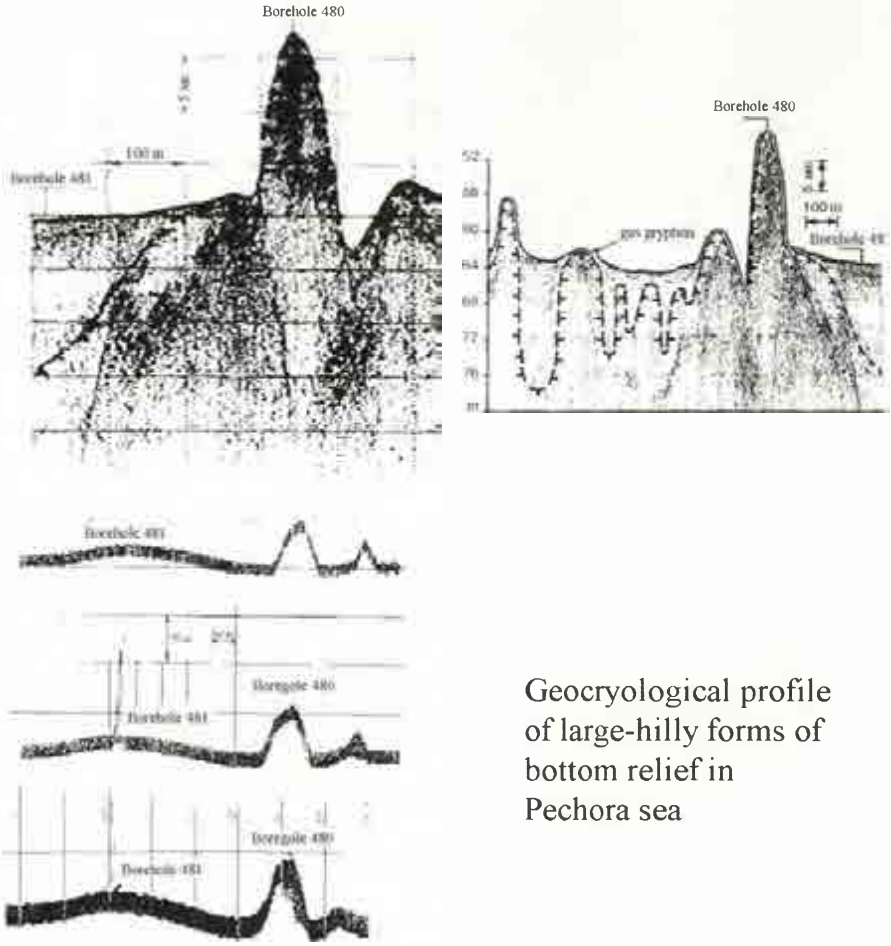
At ECI SB RAS (G.I. Smorygin), a novel method has been devised for building ice-compositional structures based on the use of water-soluble polymers (concentration not less than 0.5%). This protects the ice constructions from the action of water fluxes and extends their operational life. This technique may be applied for making artificial ice constructions on coasts of arctic seas (wharves), on shelves (ice islands), at ice collectors at northern hydroelectric power plants or temporary ice dams.

In recent years, geocryologists are becoming more actively involved in interdisciplinary international and national



Various stages of forming of dynamic membranes near to a surface of growing ice

Figure 9



Geocryological profile of large-hilly forms of bottom relief in Pechora sea

Figure 10

projects (State Scientific-Technological Programmes (SSTP): 'Study and Use of World Ocean' and 'Global Environment and Climate Change'.

In this context, mention should be made of the participation of investigators from ECI SB RAS, Moscow State University and VSEGINGEO (National Institute of Geology) in the compilation of the Circumpolar Map of perennially frozen deposits and ground ices [14]. It is of 'high scientific significance both from the viewpoint of general estimation of the scope of surface and underground glaciation at the actual stage of Earth development and from the stand of comparative estimation of natural conditions and general ecological perspectives for the countries situated on northern continents'.

Equally interesting is the model reconstructing the history of Arctic cryolithozone development in the late Pleistocene-Holocene, which was devised by researchers from Moscow State University. It will serve as the basis for predicting the development of Arctic cryolithozone in the future [15].

Revision, analysis and generalization of geocryological materials collected by investigators from ECI SB RAS during many years of their participation in engineering-geological studies of different scope on the shelf of Barents and Kara seas have made it possible [16]:

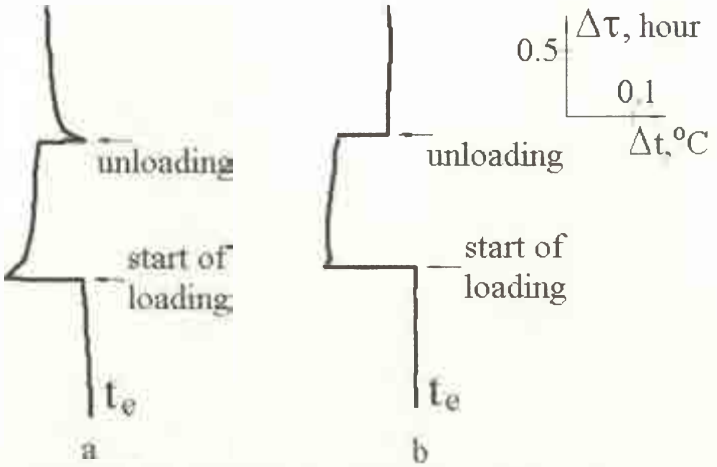
- to compile a map of geocryological zoning of the shelf of Barents and Kara seas, which may be used as the base for projecting larger-scale engineering-geological studies on the shelf;
- to construct a model of the cryolithozone development on the Barents-Kara shelf that considers transgressive-regressive cycles in the development of the Arctic basin and paleoglacials. This model was used for differentiating zones of degradation of perennially frozen strata within the Kara shelf boundaries.

Analysis of the structure of the subaqual cryolithozone resulted in the hypothesis which related the formation of ice massifs in the Quaternary deposits of Pechora shelf to the throttle effect arising upon degassing of deposits of hydrocarbons. Based on this hypothesis, a prospecting indicator was proposed for locating hydrocarbon deposits from the results of seismo-acoustic studies [17]. In particular (the upper part of Fig. 10), drilling at the site of seismo-acoustic anomaly opened an icy 'diapir' among Quaternary loams lined with frozen sands. According to seismo-acoustic data, analogous diapirs are not rare at this site. The hypothesis of 'throttle' mechanism (associated with the presumed degassing of gas hydrates) of their formation was put forward prior to drilling the well 481 between 'diapirs', while in the course of drilling through frozen sands a strong outburst of gas took place (the lower part of Fig. 10). This confirmed the 'throttle' hypothesis, though the gas source may be not gas hydrates but rather accumulation of gases under the frozen horizon caused by degassing of a gas deposit from the deeper horizons resulting from tectonic perturbations induced by nuclear test explosions near the Novaya Zemlya coast.

Unfortunately, analysis of the results of interdisciplinary studies is indicative of their low efficacy [18, 19]. In our opinion, this is due not to the insufficient developmental level of respective specialized sciences but rather to the absence of integral informational space indispensable for solving concrete problems. Creation of such a space is not the task of specialized sciences but rather of superscience, such as geology, biology, economics, and others.

Since ecological problems are closely related to the structure and evolution of the cryosphere, the establishment of adequate information space for their solution (and this is far from being an emergency step) should be done with participation of the superscience Cryology which integrates knowledge gained by all specialized sciences studying the Earth cryosphere.

ECI SB RAS has developed a conception of integration (within the framework of this superscience) of all types of information derived by different sciences



Temperature change of frozen soils under overburden pressure (σ = 3 MPa).

(a) Sandy loam, t_e = -0.5 °C.

(b) Clay, t_e = -0.75 °C.

Figure 11

(and also in the course of economic activities). The purpose of such integration is to optimize formation of integral knowledge and to use it for the rational address of natural resources and in interdisciplinary studies. The conception defines the study subject of Cryology - cryogenic conditions (spatial), formations (substantial) and processes (dynamic, evolutionary), as well as ways of integration, adaptation and application of knowledge in the form of:

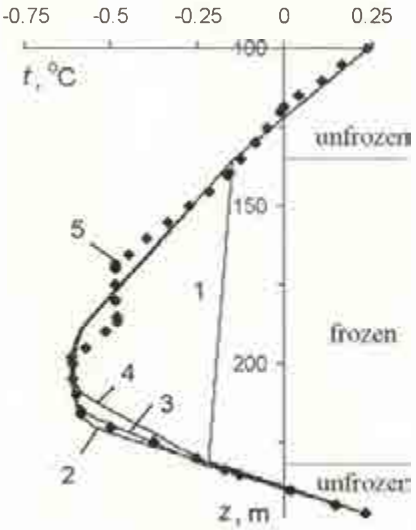
- a forum (journal, United Scientific Council, conferences) for the coordination of studies, selection of knowledge and specification of its distribution;
- logistics for the extraction, formation, processing, storage, dissemination and use of knowledge with the application of up-to-date technologies and technical means.

In the light of this conception, ECI took an active part in organizing and holding annual international conferences at the Pushchino Centre for Biological Research of RAS and acts as the basal organization for publishing the Russian-language journal 'The Earth Cryosphere'. The integration should not be restricted to collection, systematization and adaptation of relevant information derived in specialized sciences studying various aspects of the cryosphere. Unavoidable analysis of information and of specific interdisciplinary problems gives birth to new directions for studies and outlines fields of practical application of their results.

An example of 'integrational' direction are the studies aimed at creating the physics of cryogenic processes, which are underway at ECI SB RAS within the framework of the project headed by Ya.B. Gorelik.

The graphs plotted from diagrammic bands (Fig. 11) point to a barothermal effect: the frozen ground is cooled in the course of uniaxial compression and drainage of moisture resulting from thawing. This experiment demonstrates a shift of the ice-water phase equilibrium point in a porous medium since the load on the sample is lower than that required for the melting of bulk ice at the initial negative temperature. In principle, this effect can explain the hitherto unclear results of precision temperature measurements. The quasi-stationary distribution of temperatures within the boundaries of the relict frozen stratum (observed, curve 5; calculated, curves 2-4) different from the stationary one under existing thermodynamic conditions (curve 4) may be explained by the melt-away in the thickness of segregational ices and the resulting barothermal effect (Fig. 12) [20].

A mathematical model has been constructed for the segregative ice liberation in epigenetically freezing grounds, which fits appreciably better (than all previous models) the results of experimental studies conducted at ECI (photograph 'a' in Fig. 13). It makes it possible to interpret the 'non-monotonous' distribution pattern of segregational ice and to outline conditions of massive ice formation (Fig. 14a). The use of this model explains the cyclicity of the intensity of ice release observed in profiles (Fig. 13b-d) by the rhythmicity of hydrologic conditions in the region of epigenetic freezing of layers of dispersed deposits (Fig. 14b) [21].



Temperature distribution in hole № 11 near Salekhard sity, Tyumen region

1 - initial temperature (equilibrium state of frozen layer), 2 - after 100 years, 3 - 500 years, 4 - after 1000 years, 5 - natural data.

Figure 12

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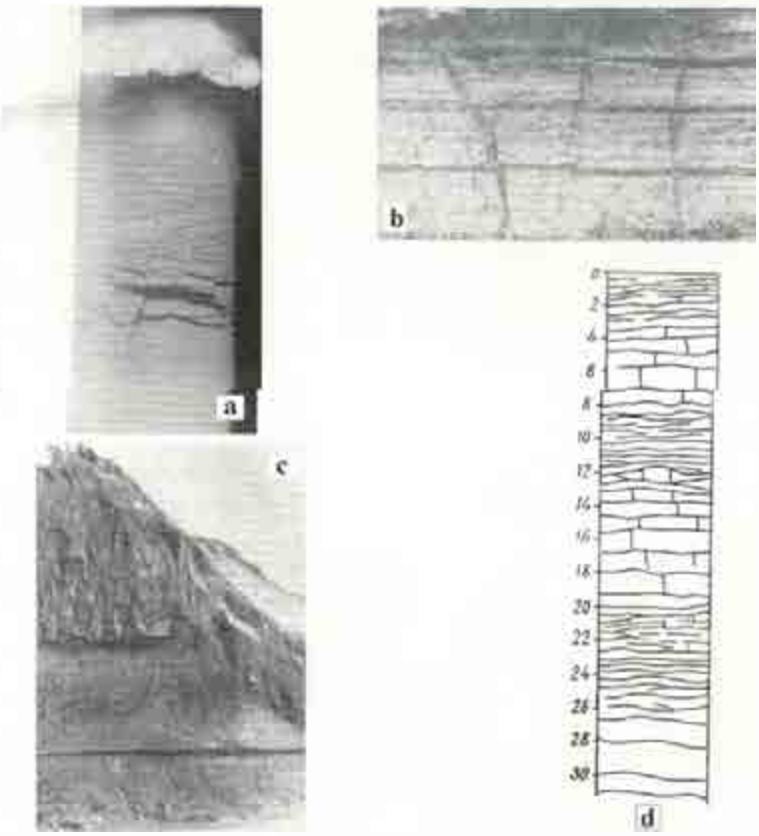

Cryohenic texture of artificial and natural origin.
a - texture of laboratiry origin, b - layer-net texture in natural frozen soil (Popov et al., 1985), x - power ice layer (Trofimov et al., 1980), d - nature texture with condensed and rarefied zones (Popov et al., 1985).

Figure 13

of cryogenic geological processes in the Russian cryolithozone (scale 1: 7 500 000). In: *Itogi fundamental'nykh issledovanii kriosfery Zemli v Arktike i Subarktike* (Progress of Basic Research on the Earth Cryosphere in Arctic and Subarctic) (Novosibirsk: Nauka): 279-286 (in Russian).

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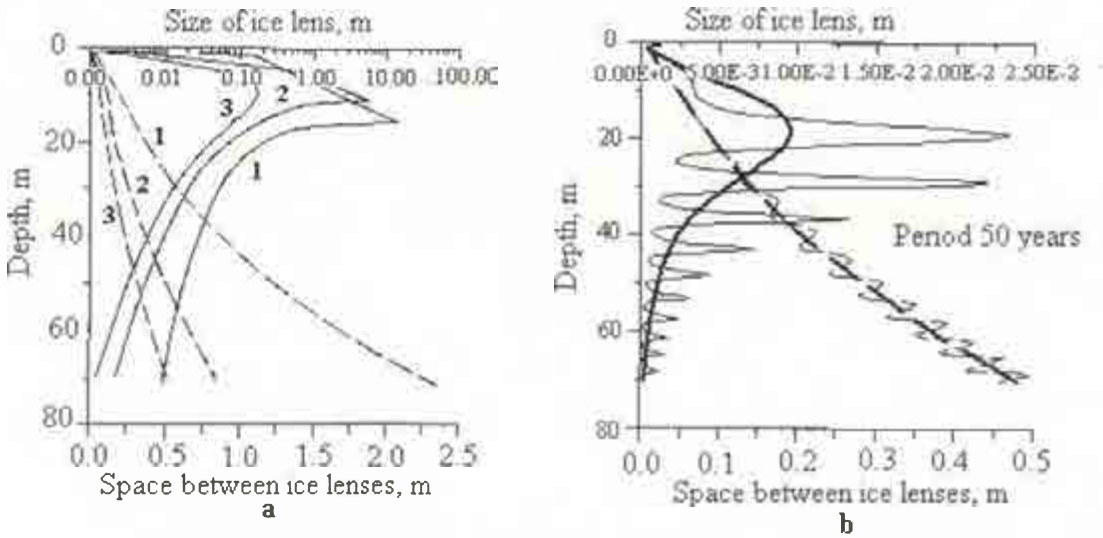

Calculation pictures of the ice content distribution by depth.
a - monotonous freezing for different surface temperature (°C): -5 (1), -10 (2), 15 (3).
b - freezing with influence of water source hydrologic rythmic. Thick line - stable level of water source, thin line - oscilation of the level. Solid line - size of ice lens, dot line - space between ice lenses.

Figure 14

Modelling of gas hydrates formation in porous media, *Proc. 2-nd Intern. Conf. on Natural Gas Hydrates,* June 2-6, 1996, Toulouse, France, pp. 541-548.
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Project of Deep Water Drilling on Lake Baikal

Mikhail I. Kuzmin

Abstract

The Baikal Drilling Project has been performing for 10 years. Russian, American and Japanese scientists take part in the project. For a short span of time (from 1995 to 1997) the German colleagues had been participating in the project. The actual deep water drilling started on Lake Baikal in 1993. Since that time 5 bore holes have been drilled: on the Buguldeika saddle in the winter of 1993-1994; on the Academician Ridge in 1996 and 1998; in the South basin in 1997 and on the Posolskaya bank, which is considered to be the southern termination of the Buguldeika-Selenga saddle, in 1999.

The main goal of the project is to study global changes of the environment and climate in the Central Asia. The continuous sedimentary sequence from the Academician ridge is of great significance. A 200-m core (1996) and a 600-m core (1998) were obtained from the Academician Ridge. The paleomagnetic data obtained in laboratories of four countries showed a good correlation between each other. They also indicate that BDP-96 hole covered a span of 5 Ma. The variations of diatom and biogenic silica contents are good paleoclimatic indicators for Baikal sediments. It should be noted that the paleoclimatic Baikal record well correlates with the marine record. However, the Baikal record is better responsive to some cooling epochs, typical of the Holocene and for instance V, VII, IX stages.

In addition to the biogenic silica content, good paleoclimatic indicators are the contents of a number of elements, physical properties of sediments, mineral composition of the terrigenous fraction as well as composition of clay minerals. It the most likely that the diatom content results from the changes of lake productivity, while the geochemical and mineralogical features of sediments derive mainly from features of the weathering in the watershed area. The comprehensive studies of these parameters will give the possibility to restore the paleoenvironment in more detail.

The geophysical logging made in BDP-98 bore hole allowed the exact determination of the depth of a number of geophysical discontinuities. It was also revealed that the changes of seismic velocity result from the lithological and physical features of sediments. These data permit refining of a number of problems, concerning sedimentation in the Baikal sedimentary sequence, as well as refining of features of geological-tectonic history of this rift lake.

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Natur und Ökologie des Baikalgebietes

Norbert Wein

Der Baikalsee ist ein Grabenbruchsee, der sich noch heute ständig vertieft und ausweitet, so dass er trotz seines hohen Alters von 20-25 Millionen Jahren noch nicht durch Sedimente ausgefüllt worden ist. Er ist damit der älteste See der Erde und weist damit auch die älteste Seefauna – Tiere, die in anderen Seen schon lange ausgestorben sind – auf.

Der Baikalgrabenbruch stellt die tiefste Spalte des Festlandes dar. Er ist Teil einer ganz Ostasien durchziehenden und über 1500-2000 km deutlich zu verfolgenden Rissbildungzone, an der sich praktisch Ostsibirien von der Mongolei und China löst. Die maximale Tiefe der Bruchzone reicht bis 1181m unter den Meeresspiegel. Zieht man aber eine bis zu 6000m mächtige Sedimentschicht ab, so ergibt sich für die kristalline Bruchzone eine Tiefe von rund 7000 m. Einschließlich der Randgebirge ergibt sich für das ganze tektonische System eine Vertikalkomponente von annähernd 10.000 m (siehe Abb. 1).

Diese Bruchzone ist, wie bereits erwähnt, noch immer aktiv. Die beiden Baikalufer driften mit einer Geschwindigkeit von 2 cm pro Jahr auseinander, was der Driftrate zwischen den Kontinenten Südamerika und Afrika oder zwischen den Ufern des Roten Meeres entspricht. Dieser Vorgang wird von Erdbeben begleitet, weshalb das Baikalgebiet und die Bruchzonen-Verlängerung zu den seismisch aktiven Regionen gehören. Im Baikalsee und seiner Uferzone werden jährlich bis zu 2000 schwache Beben registriert. Alle 10-12 Jahre kommt es zu mittleren und alle 20 Jahre zu stärkeren Beben. Am 31.12.1881 sank bei einem derartigen Beben ein 200 km² großes Stück des Selengadeltas unter den Seespiegel und bildet seitdem die heutige ‚Proval-Bucht' (= Einsturzbucht).

Die Baikalufer sind i.a. recht steil und setzen sich unterhalb des Seespiegels in einem Unterwasser-Steilabfall fort. Am Ostufer der Insel Olchon erfolgt der Steilabfall von einem 800m den See überragenden Gebirgszug in einem 45-Winkel bis zur tiefsten Stelle des Sees in 1637 m Tiefe.

Nur das Südostufer des Sees, von Kultuk bis zum Selengadelta, zeichnet sich durch eine Uferterrasse aus, auf der zahlreiche Siedlungen (Sljudjanka bis Babuschkin) liegen, und auf der auch die Autostraße und die Eisenbahn verlaufen.

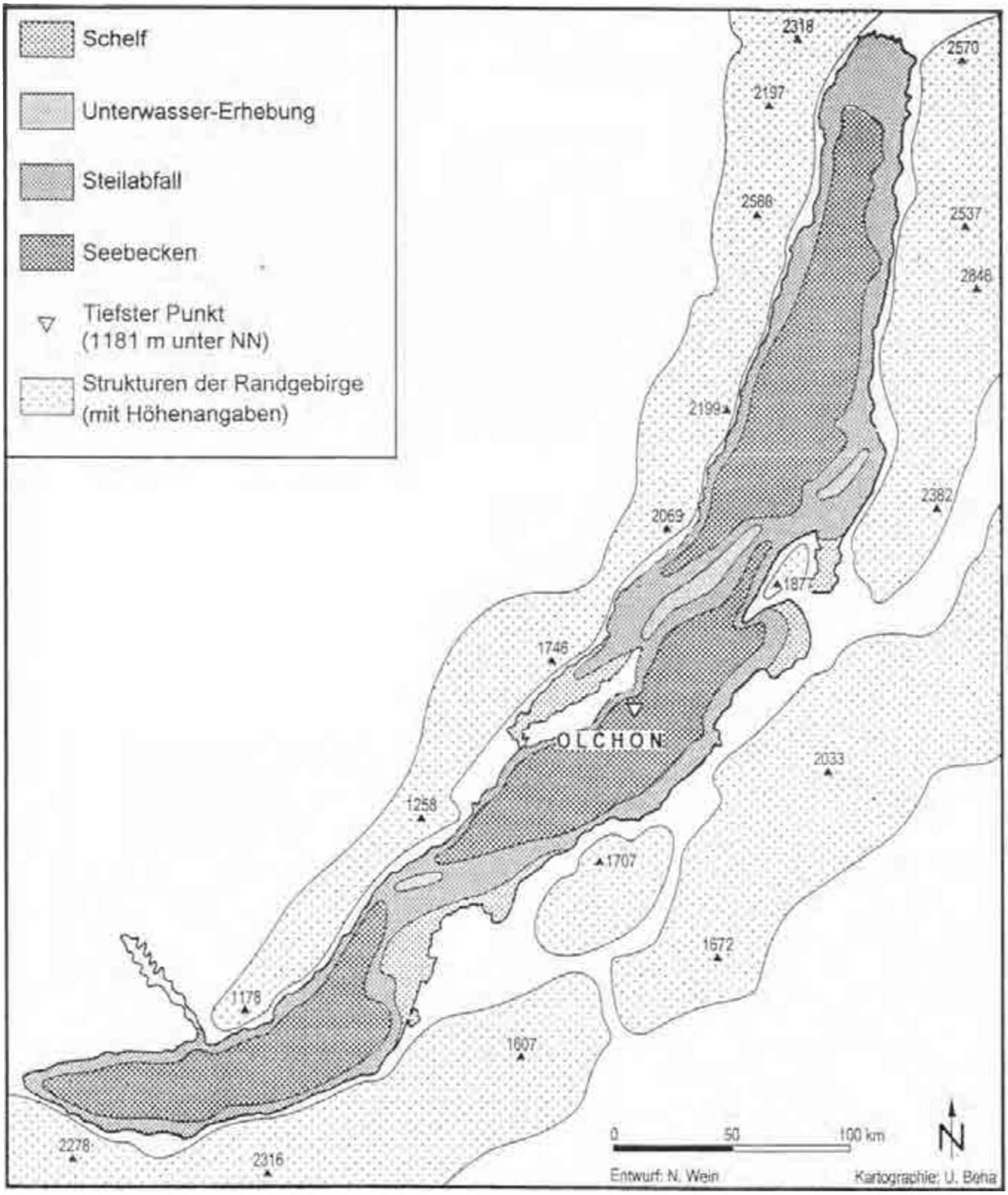
Die Baikalbruchzone ist untergliedert in mehrere Becken, von denen drei den See-Hohlraum bilden und zwei in deren Verlängerung als das Bargusiner Becken und das Obere-Angara-Becken in der östlichen Uferregion in Erscheinung treten. Die drei Seebecken, die durch Unterwasserschwellen voneinander getrennt sind, weisen (von Nord nach Süd) maximale Tiefen von 890 m, 1637 m und 1432 m auf.

Aufgrund dieser Tiefenwerte, mit denen der Baikal jeden anderen See der Erde übertrifft, weist er auch das größte Wasservolumen aller Seen auf. Wenn alle Flüsse der Erde den (angenommen!) leeren See füllen müßten, brauchten sie dafür 300 Tage. Das Wasservolumen beträgt 23.000 km³, was einem Fünftel der globalen Süßwasservorräte entspricht. Mehrere Flüsse fließen dem Baikal zu, von denen der größte die Selenga ist, auf die bei einer Wassereinleitung von durchschnittlich 900 m³/sec. rund 40% des Zuflusses entfallen. Der einzige Abfluss ist die Angara, die an der Austrittsstelle eine durchschnittliche Wasserführung von 2000 m³/sec (was etwa der durchschnittlichen Wasserführung des Rheines bei Düsseldorf entspricht) aufweist. Im Verhältnis zum gewaltigen Wasserinhalt sind die Zu- und Abflüsse nicht sonderlich hoch, was einen nur langsamen Wasseraustausch des Sees bewirkt. Die Folge ist eine hohe Verweildauer des Wassers im See, die maximal 400 Jahre beträgt. Das bedeutet, dass eingeleitete Schmutz- und Schadstoffe sich über einen langen Zeitraum akkumulieren können.

Der größte Schadstoffeinleiter ist das Zellulosekombinat von Baikalsk (am südlichen Seeufer). In den achtziger Jahren wurden von täglich 400.000 m³ Brauchwasser 250.000 – 260.000 m³ in unzureichend gereinigter Form in den See zurückgeleitet. Wie Galazij (ehem. Direktor des limnologischen Institutes in Listlvjanka am südl. Seeufer) 1988 schrieb, sind von diesem Werk bis zu diesem Zeitpunkt in 22 Jahren 1,5 Mrd. m³ Industrieabwässer eingeleitet worden. Dieses Situation ist besorgniserregend, wenn auch Meldungen wie die aus dem SPIEGEL (Nr. 4) von 1979, der See stünde kurz vor dem biologischen Umkippen, übertrieben waren. Der Irkutsker Hydrogeograph Korytnyj schrieb 1997, dass die ‚Zonen negativer Beeinflussung des Sees' nur einige Prozente der Seefläche betrügen und der See somit kaum irreversiblen anthropogenen Veränderungen ausgesetzt sei. Für den nach wie vor guten Zustand des Wassers spricht auch die Tatsache, dass es – in 1,5 l-Flaschen abgefüllt – mit Erfolg als Tafelwasser in Japan verkauft wird.

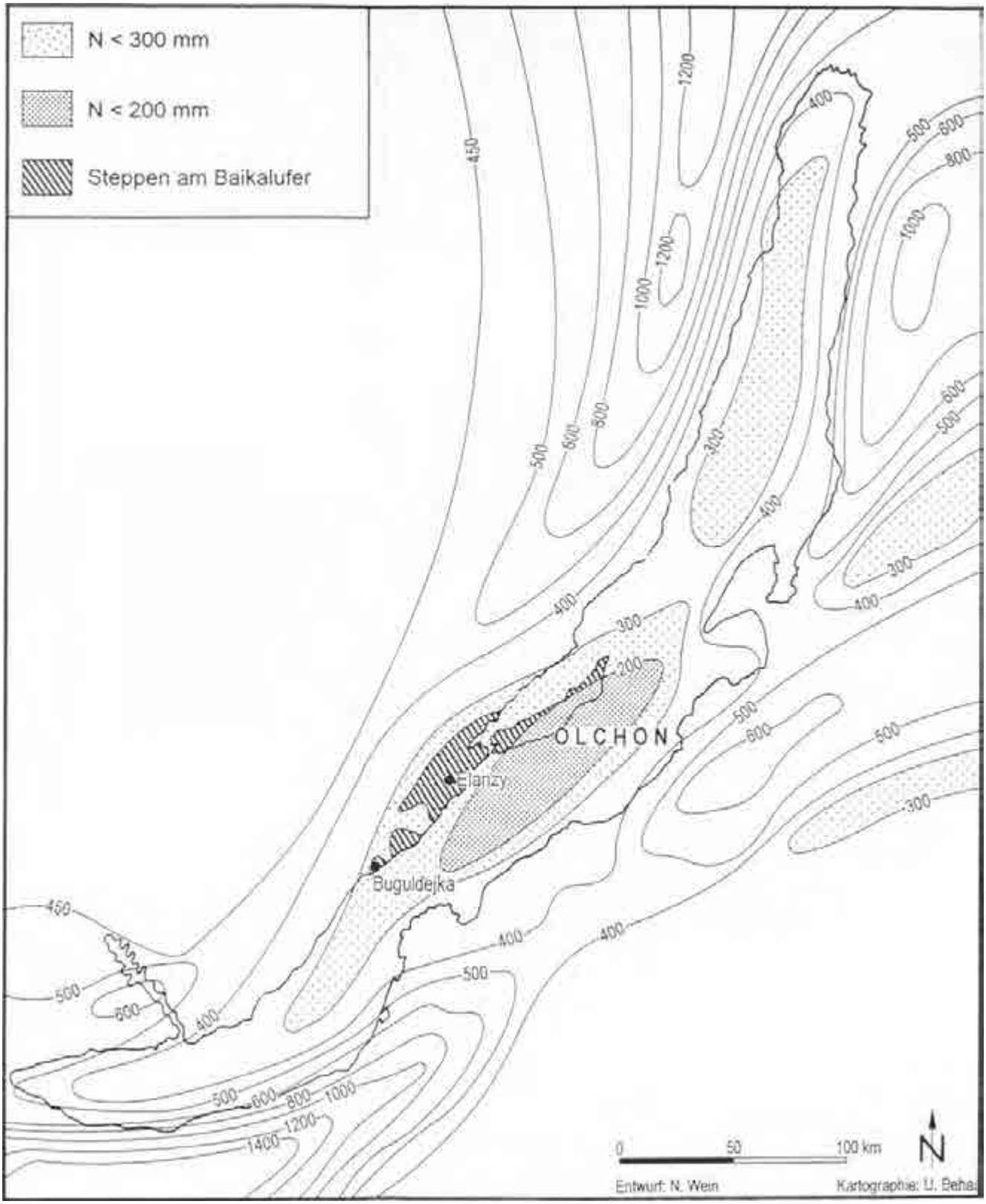
Das Baikalwasser ist überaus rein und besitzt nur einen äußerst geringen (wiederum den geringsten aller Seen !) Mineralgehalt. Der See ist damit extrem oligotroph, d.h. nährstoffarm, und weist eine – im Vergleich zu anderen Seen – geringe biologische Produktion auf. Dafür aber zeichnet er sich durch einen hohen Artenreichtum aus. Von den rund 1500 Tierarten sind rund zwei Drittel endemisch, kommen also außer im Baikal nirgends mehr vor und verdienen allein aus diesem Grund besonderen Schutz. Zu diesen endemischen Bewohnern gehört der Epischurakrebs, eine Garnelenart, der sich durch eine hohe Filtrierleistung auszeichnet und mitverantwortlich für die Klarheit des Baikalwasser ist. Allerdings ist dieser Krebs überaus empfindlich gegenüber ökologischen Veränderungen und reagiert auf kleinste Wasserverschmutzungen. Würde diese Population geschädigt, würde das ganze Selbstreinigungssystem des Baikals beeinträchtigt !

Im Winter ist der Baikal eisbedeckt, wobei der Prozess des Zufrierens im Nordteil im Schnitt um den 21. 12. und im Südteil um den 16.1. abgeschlossen ist. Die Eisbedeckung währt im Norden 6-6,5 und im Süden 4-4,5 Monate. Die Eismächtigkeit ist abhängig von der Dikke der Schneeauflage. Im westlichen Uferbereich, wo der Wind den Schnee fast völlig abweht, ist das Eis etwa einen Meter mächtig. Im östlichen Uferbe-



Morphologische Struktur des Baikalbeckens

Abb. 1. Morphologische Struktur des Baikalbeckens



Niederschlagsverhältnisse im Gebiet der ‚Baikal-Wanne' (Seebecken und Randgebirge) und Lage der Steppen in der Uferregion

Abb. 2. Niederschlagsverhältnisse im Gebiet der 'Baikal-Wanne' (Seebecken und Randgebirge)

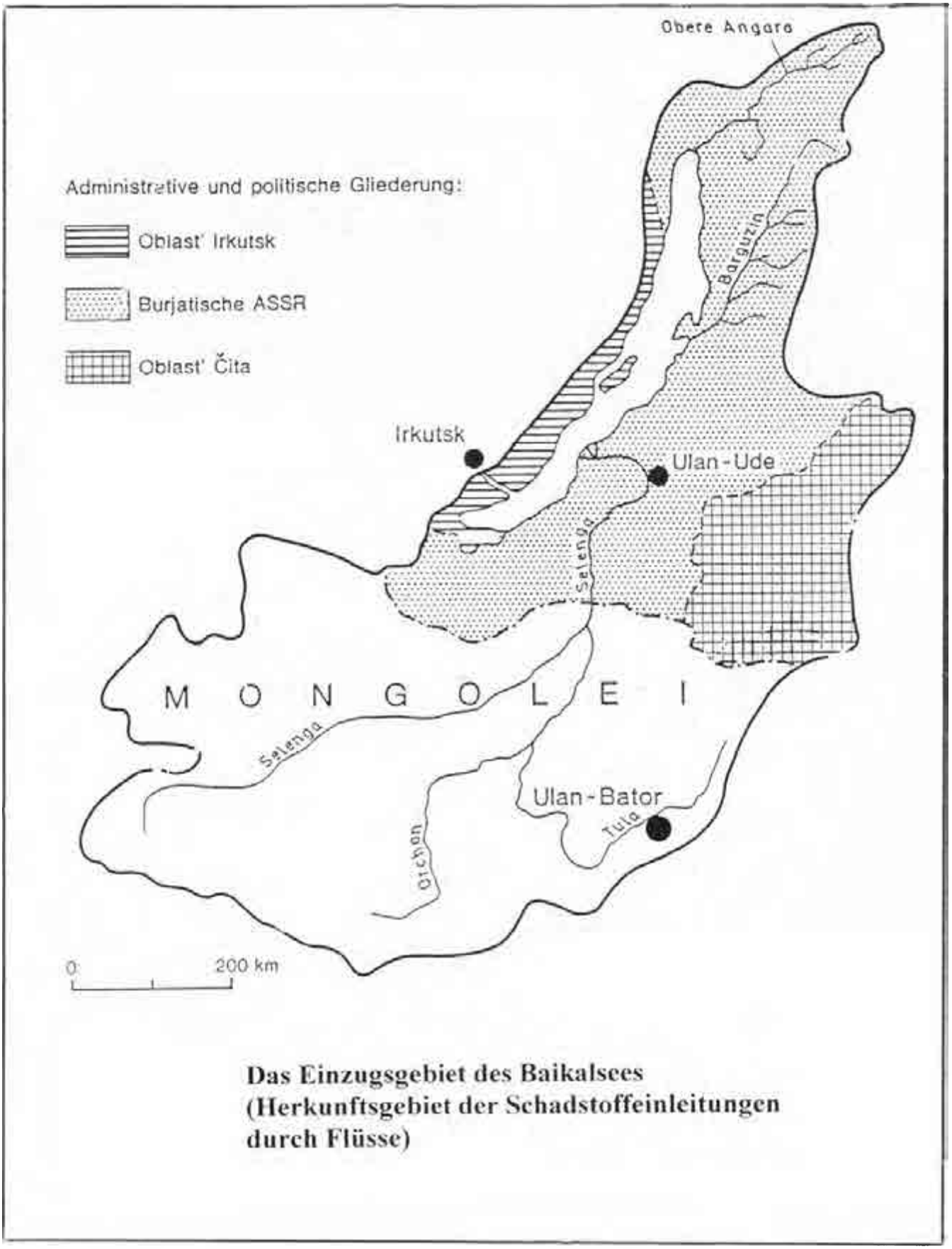


Abb. 3. Das Einzugsgebiet des Baikalsees (Herkunftsgebiet der Schadstoffeinleitungen)

reich, wo die Schneedecke bis zu einem Meter dick werden kann, beträgt die Eismächtigkeit nur etwa 50 cm. Das Eis besitzt bei diesen Dicken eine hohe Tragfähigkeit, so dass der Baikal im Winter von Fahrzeugen befahren werden kann. Hinderlich für den Verkehr sind Spalten, die sich bei extremen Kälteeinbrüchen bilden und 0,5-4,0 m Breite erreichen können, wie auch Eiswälle, die sich im umgekehrten Fall, bei einer plötzlichen Erwärmung (oder der allgemeinen Erwärmung gegen Winterende) bilden und 1,0-1,5 m Höhe erreichen. Spalten wie auch Wälle verlaufen parallel zur Haupterstreckungsrichtung des Sees.

Um die ökologische Situation zu erfassen, muss der Blick über den eigentlichen See hinaus gerichtet werden. Der See und die ihn um bis zu 2000 m überragenden Randgebirge bilden eine Hohlform, die auch anschaulich als die ‚Baikalwanne' bezeichnet wird. Diese ‚Wanne' stellt einen einzigartigen Geokomplex, in dem See und Uferregion sich gegenseitig beeinflussen, dar. So übt der See durch eine Dämpfung der Extremtemperaturen eine ausgleichende Wirkung auf das Klima aus. Die Jahresamplitude erfährt dabei eine Reduzierung um 8°-10°. Die Beckensituation der ‚Wanne' hat eine Absenkung der Niederschläge in ihrem Inneren zur Folge. Die durchschnittlichen Niederschlagsmengen über dem Seekörper liegen bei unter 300 mm und sinken im Zentrum sogar auf unter 200 mm ab. Diese Bekkensituation bringt aber auch einen hohen Sonnenreichtum mit sich. Die südliche Seehälfte und die entsprechende Uferregion weist 2200-2700 Sonnenstunden im Jahr auf (zum Vergleich: Düsseldorf = 1340) und übertrifft damit deutlich die Kurorte am Schwarzen Meer. Dieser Sonnenreichtum stellt eines der natürlichen Potentiale für eine touristische Erschließung der Seeregion dar (siehe Abb. 2).

Die Randgebirge weisen demgegenüber für einen stark kontinentalen Raum hohe Niederschlagsmengen auf. Das Baikalgebirge am Nordwestufer empfängt bis zu 1200 mm, das gegenüberliegende Bargusiner Gebirge bis zu 1000 mm und das Chamar-Daban-Gebirge am Südufer bis zu 1400 mm Niederschlag. Auf relativ kurze Entfernung kann somit eine Abfolge von rund 300mm bis auf 1200 mm registriert werden, was eine entsprechende Abfolge in der Vegetation zur Folge hat. Die Spannweite der Vegetation reicht von trockenen Steppen im Gebiet des mittleren Westufers (Buguldejka – Elancy) sowie auf der Insel Olchon bis zu Bergtaigawäldern in den Randgebirgen. Die Wälder sind großenteils lichte Kiefernwälder mit einem Unterwuchs, der oft aus dem daurischen Rhododendron besteht (der mit seinen roten Blüten im Frühsommer der Taiga eine farbige Prägung verleiht), teils auch Lärchenwälder, die sich im Herbst durch ihre Goldfärbung auszeichnen. Die Tierwelt der weitgestreckten Wälder umfasst Zobel (bekannt: der Bargusiner Zobel), Bären und Elche.

Diese Wälder üben eine Schutzfunktion im Hinblick auf den Wasserkörper des Sees aus. Werden sie im Raubbauverfahren gefällt (was in sozialistischer Zeit die Regel war), so sind Erdrutsche und Schlammströme, die das Wasser beeinträchtigen, die Folge. Aus diesem Grund ist die Holznutzung heute eingeschränkt und mit strengen Auflagen belegt. Vor allem soll die Einrichtung dreier Nationalparks mit einer Gesamtfläche von 10.000 km² zum Schutz der Wälder und damit des ganzen Baikal-Landschaftssystemes beitragen.

Bezüglich der Reinhaltung des Sees muss der Blick noch weiter gerichtet werden, über die Uferzone hinaus auf das sogenannte Baikalbecken: das Einzugsgebiet des Baikalsees bzw. der ihn speisenden Flüsse. Dieses Baikalbecken umfasst eine Fläche von 540.000 km². Davon gehören rund 300.000 km² zur Mongolei, die über die Selenga und ihre Nebenflüsse Orchon und Tula an den Baikal angebunden ist. Alle Schmutz- und Schadstoffe, die in diese Flüsse eingeleitet werden, landen im Baikal! Dazu gehören auch die unzureichend geklärten Abwässer der von Industrie geprägten burjatischen Hauptstadt Ulan-Ude wie auch die der mongolischen Hauptstadt Ulan-Bator. Über die Selenga erfolgen damit beachtliche Abwassereinleitungen in den Baikalsee. Unterhalb der Selengamündung ist die Wasserqualität des Sees auf einer Strecke von 130-150 km deutlich beeinträchtigt. Schutzmaßnahmen, die auf den Erhalt der Wasserqualität gerichtet sind, müssen daher das gesamte Baikalbecken umfassen, einschließlich seines mongolischen Anteiles, was nur über eine internationale Kooperation zu erreichen ist (siehe Abb. 3).

1989 ist auf russischer Seite ein Dreizonen-Schutzplan aufgestellt worden, der Nutzungsbeschränkungen und hohe Auflagen für den sibirischen Teil des Baikalbeckens umfasst. Wie weit er wirklich befolgt wird, kann hier nicht ausgesagt werden (Skepsis ist angebracht!).

Das Baikalgebiet wird aber nicht nur von Wassereinleitungen bedroht, sondern auch durch Luftschadstoffe. Das Herkunftsgebiet der Luftschadstoffe wird durch die vorherrschende Windrichtung, W und NW, bestimmt. Es sind vornehmlich die Emissionen aus dem parallel zur Angara sich erstreckenden Industriegebiet von Irkutsk-Tscheremchovo (jährlicher Schadstoffausstoß = 800.000 t), die in das Baikalgebiet verfrachtet werden. In dem von den Luftschadstoffen betroffenen Gebiet kann man (wie z.B. zwischen Ust-Ordinsik und Buguldejka) heute abgestorbene Wälder antreffen. Die Schadstoffe gelangen aber als Staubniederschläge auch in den See und machen dort 6% aller Industrieemissionen aus. Auch lokale Schadstoffemissionen beeinträchtigen die Ökologie des Baikalgebietes. Dazu gehören vor allem die Emissionen aus dem schon erwähnten Baikalsker Zellulosebetrieb. Schon von ferne ist eine breite, pilzförmige Schadstoffwolke zu erkennen, die sich aufgrund der Beckensituation und der vorherrschenden Hochdrucklage fast ständig am südöstlichen Seeufer erstreckt. Um Baikalsk sollen dadurch bereits mehr als 100.000 ha Wald durch diese Luftschadstoffe geschädigt und zum Teil auch vernichtet worden sein.

Um den in der Welt einmaligen Geokomplex Baikalsee und Uferzone in seinem ökologischen Reichtum zu erhalten, müssen vielfältige Maßnahmen in einem Raum, der das mongolische Ulan-Bator genauso wie das regionale Zentrum Irkutsk umfasst, ergriffen werden. Es ist zu hoffen, dass internationale Hilfe und Zusammenarbeit zur Bewältigung dieser Aufgabe beitragen werden.

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Gas-Hydrates and Gas Seeps in Lake Baikal, Siberia

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A. Golmshtok, A. Kremlev, M. Grachev & A. Duchkov

Abstract

The presence of gas hydrates in the sediments of Lake Baikal has recently been evidenced, both by multi-channel seismic profiling (Golmshtok et al., 1997) and by deep drilling (Kuzmin et al., 1998). This is the only reported occurrence of gas hydrates in a confined fresh-water basin. Chemical analysis of the drilled hydrates show that the enclosed gases are mainly methane of biogenic origin (Kuzmin et al., 1998). The hydrates seem to occur only in the deep Southern and Central Basins of the lake, near the large Selenga Delta. On seismic profiles, they can be inferred thanks to the presence of a 'Bottom simulating reflector (BSR)', an acoustic feature representing the interface between hydrate-containing sediments above and hydrate-free but perhaps gas-charged sediments below. The Baikal BSR has the typical characteristics of a 'classic' BSR and its position is in accordance with the pressure/temperature phase-boundary conditions for methane hydrates.

During summer 1999, the Baikal gas hydrates have been re-investigated in much larger detail using a multidisciplinary approach. New seismic profiles show that the depth of the BSR is locally strongly fluctuating, particularly in the vicinity of a major, active, intra-basin fault. Here, the BSR expresses undulations and vertical displacements of up to almost 250 m, and does no longer mimic the lake-floor morphology. Locally, the BSR is even entirely disrupted by a vertical 'acoustic chimney' that extends upwards to the lake bottom. High-resolution side-scan sonar mosaics over the area of this deformed and disrupted BSR show irregularities on the lake floor, in contrast to areas above a regular BSR where the lake floor is absolutely smooth and flat. At least three large craters have been identified and one of them coincides with the observed 'acoustic chimney'. They are aligned almost parallel to the fault, which is displacing the lake floor by about 30 m. The craters were mapped in detail by echosounding. They have a diameter of up to 800 m and their central part is depressed by about 10 m. Echosounding has also shown venting above the craters or along their rims, evidenced by an acoustically impenetrable plume extending 10-25 m above the lake floor. CTD-measurements within the plume showed no significant drop in optical transmissivity of the lake water. Heat-flow values measured over the entire area show a generally slightly increased heat flow compared to common values for the Baikal Basin. A good correlation between heat flow and changes in the depth of the BSR was observed. In the craters, heat-flow values are highest, but they are never abnormally high. This observation and results of CTD-profiling, which show no changes in bottom-water temperature at the venting sites, suggest that the craters represent cold seeps. Preliminary results of the chemical analyses of bottom-water and sediment pore-water samples indicate the presence of increased levels of methane, possibly of hydrate origin.

Our observations suggest that the Baikal gas hydrates are locally destabilizing due to a structurally controlled upward flow of fluid and heat, and that this results in active venting of methane and possibly also other gasses at the lake floor. Tectonic activation (by earthquakes ?) of these thermal anomalies may lead to large-scale destabilization of the hydrates and to the release of enormous volumes of methane in the lake water and the atmosphere, a process that may have profound effects on the unique ecosystem of Lake Baikal. In view of such a possible scenario, it is very important to conduct further studies about the stability characteristics of the Baikal gas hydrates.

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Principal Scientific Schools of the Siberian Branch of the RAS and Current Research in the Earth Sciences

Valery D. Ermikov

Abstract

Siberian research schools in the Earth sciences were initially formed from representatives of leading research schools of European Russia and of Tomsk and Irkutsk universities. Today as much as 26 academic institutes are running research in this field at the SB RAS. Comprehensive character of science centres of the Siberian Branch allows these schools to apply multidisciplinary approach in order to provide high-level solutions to most part of contemporary problems, including planet Earth's evolution, global change, catastrophe prediction, etc. Some results obtained within the studies of Siberian objects are presented.

Key words

Earth sciences, multidisciplinary approach, scientific cooperation

Siberia's territory encompasses major mineral resources of the Russian Federation. Such unique natural objects and landscapes as Lake Baikal, the great Siberian rivers, permafrost, south Siberia mountains, etc. are found here. As much as 26 Earth science institutes were founded at the Siberian Branch of the RAS to study these and other objects. Research staff of the institutes equals to 20 % of the research potential of the Siberian Branch.

The institutes were formed around world-known Siberian schools in the Earth sciences. Siberian experts and schools in oil geology, paleontology and stratigraphy, magmatic and metamorphic petrology, mineralogy and ore genesis, geotectonics and geodynamics, geochemistry, as well as in mining, hydrodynamics and hydrogeology, limnology, geography and geocryology, are internationally recognised.

In 1957-1958, under establishment of the Siberian Branch of the RAS recognised scientists were invited from many cities (Moscow, Leningrad, Kiev, L'vov, etc.) to lead the principal research trends. A considerable part was played by the Tomsk and Irkutsk geological schools, involving well-known experts from the oldest Siberian universities.

At the same time, the scientists at the head of research trends were empowered to select gifted students from every university and invite them to Siberia. Thus, the combination of the youth and expertise, mutual enrichment by representatives of different research school, active contacts with industry are still characteristic of Siberian research teams working in the Earth sciences.

Application of multidisciplinary approach by high-skilled researchers specialised in various related disciplines makes it possible to tackle fundamental theoretical problems in the Earth sciences and complicated contemporary problems in the planet's functioning and evolution. Among the problems are gas hydrates, global climate and environment changes, natural and anthropogenic hazards, environment geochemistry, in particular, distribution and evolution of radionuclides in ecosystems, etc. To encourage researchers the Board of the Siberian Branch of the RAS supports targeted multidisciplinary research programmes and selects projects on a competitive basis. Involvement of foreign researchers in the programmes, given the support of international grants, will raise the level of research results and provide access to them for a wider international scientific community. Some of analogous results will be presented by speakers during the Conference and illustrated in the present paper by the example of the Baikal Region and other regions.

Siberian school of oil geology was founded by Academician A.A. Trofimuk, who was awarded a honourable State Order of the Hero of Labour in 1944 at the age of 33 for discovering large-scale oil fields in Bashkiria. In Siberia, representatives of this school made a decisive contribution to the discovery of oil in the Western and Eastern Siberia. In particular, they were first to discover giant petroleum and gas fields in the oldest (<900 Ma) sediments that occupy immense space in the Siberian platform. The property of natural gases to occur in solid gas hydrate state in the Earth's crust was first found. According to the estimate of Prof. A.A. Trofimuk, the gas hydrate reserves are continuously renewable and exceed natural gas resources of all ordinary gas fields of the planet by two orders of magnitude.

Under the leadership of Academician B.S. Sokolov, noticeable advances were made by paleontologists and stratigraphists, which ensured the geochronological basis of geological reconstructions. Followers of this research school made a considerable input to the studies of evolution of organic world of the planet. One of their major achievements is justification of the Vendian system of deposits formed over 600 Ma ago and characterised by unique species of living organisms.

Formation of the Siberian school of metamorphic petrology is associated with the names of Academician V.S. Sobolev and his disciples, one of which is Academician N.L. Dobretsov. Research in physico-chemical conditions of genesis of magmatic and metamorphic rocks of the Earth's crust and the upper mantle made it possible to justify discrimination principles of metamorphic facies and the related minerals. The team of Prof. V.S. Sobolev made a major contribution to the discovery and study of diamond deposits in Siberia, other regions of Russia and in foreign countries. One of the latest achievements of the school is substantiation of ultra-high pressure metamorphism for the rocks of the Kokchetav massif (Northern Kazakhstan) supported by the discovery of diamond microinclusions and high-pressure polymorphic modification of silica in primary minerals of the Kokchetav rocks.

Basic studies in experimental mineralogy, carried out by representatives of

this school, allowed to synthesise and investigate over 100 compounds, to grow crystals of diamond, emerald, alexandrite, ruby, sapphire, opal, etc. Simultaneously, new equipment for growing crystals, in particular, designed for growing diamond crystals of up to 4 carats and bigger, was developed.

Of importance are the results of long-term studies on fluid regime of deep-seated processes in the lithosphere, which confirm their evolution since Early Precambrian.

The team of Irkutsk geologists arrived at valuable conclusions concerning the mechanism of continental rifting and the role of deep-seated magmatism on old platforms, the dependence of composition of mantle melts on the lithospheric thickness, deep thermal regime and tectonic stresses. They succeeded in studying the Mesozoic stage of the development of structures of the eastern Asian continent.

Lately, comprehensive problems of petrology and tectonics have been expanded to the field of depth geodynamics, research and simulation of processes that occur in the Earth's interior, where "mantle plumes", periodically breaking through from the border of the liquid core into crust and upper mantle, and the two-layer mantle convection control deep-seated processes. Main stages of formation of large mineral deposits, in particular, Norilsk rare-metal deposits and probably hydrocarbons, are related to the activity of these plumes. A fundamentally new scientific school, supervised by Prof. N.L. Dobretsov, was formed in the field of geodynamics. Deep-seated geodynamics becomes a theoretical basis for geotectonics, which plays a special role in understanding the geological evolution of the planet, through studying the structure of the Earth's crust, as well as states and interrelations of its fragments, and the input of the neotectonic movement (neotectonics) to the relief formation. A considerable contribution to formation of the Siberian tectonics school was made by Academicians A.L. Yanshin and Yu. A. Kosygin. The latest large-scale project in geotectonics was the publication of two sheets (transsects) of the "Geodynamics Map of the Paleoasian Ocean" drawn up by a team of geologists from Russia, Mongolia, China and the USA. Allied studies were carried out on tectonics and lithology of sedimentary basins, in particular, on potassium content, which resulted in the detection of the world-greatest potassium-bearing Nepa basin.

The doctrine of magmatic and ore formations, advanced by Academicians Yu.A. Kuznetsov and V.A. Kuznetsov, gained world-wide recognition and ensured new insight into the origin of volcanic rocks and the related ore deposits. With account of new geodynamic approaches, the theory of ore and magmatic formations and their role in various geodynamics settings of the continental and oceanic crust is continuously updated.

Siberian geochemistry school, launched by Academician L.V. Tauson and Corresponding Member F.N. Shakhov, combines basic research with wide application of the advanced physical, physicochemical and radiogeochemical analytical methods of search and assessment of deposits of gold, rare and radioactive elements. For the search of deposits, geologists of Buryatia and Irkutsk use plants' capacity to accumulate chemical elements supplied from the soil. Studies on geochemical monitoring are intensely developed.

Under the guidance of Academician N.N. Puzyrev and Corresponding Member E.E. Fotiadi, the school of geophysics elaborated theoretical foundations for obtaining and processing geophysical information, methods of deep seismic sounding adapted for Siberian conditions. The theory and techniques of multiwave seismic prospecting made it possible to increase radically the efficiency of detection of mineralisation, first of all petroleum and gas, and to proceed to direct discovery of their deposits. Geotomography is intensely developed in cooperation of experts in mathematics and mathematical geophysics with geophysicists. As a practical application of this trend, the methods of tomography of large objects are being elaborated, which allows for detecting defects.

Irkutsk scientists initiated a new scientific trend, paleoseismology. The paleoseismic technique of studying earthquakes by evidence of strain and faultings in the crust, developed by the school of seismologists, headed by Corresponding Member V.P. Solonenko, provides reliable prediction for their location, magnitude and recurrence.

To work out scientific foundations of earthquakes prediction, experimental seismic parties and expeditions collect geophysical data throughout the territory of Siberia and automatically process the information. These teams and expeditions are supervised by the institutes and by the Geophysical Survey of the Siberian Branch of the RAS.

In mining sciences, the Siberian school in non-linear geomechanics and mining geophysics is well known for the creation of scientific foundations of the development of mineral deposits at great depths and in difficult geological conditions. The school was founded by Corresponding Member T.F. Gorbachev. Among important results of the school is the discovery of zonal disintegration of rocks around subterranean roadways.

Of significance are the studies focused on the decrease of the gas dynamic activity of coal beds, elaboration of scientific foundations and techniques for the development of mineral deposits using advanced techniques and under permafrost conditions.

For the first time in Siberia, under the guidance of Corresponding Member E.V. Pinnecker, wide-scale studies of ground waters were accomplished, that provided a basis for fundamental and practical generalisations. As a result, a 6-volume monograph "Fundamentals of Hydrogeology" was published. Construction of large hydropower engineering structures on Siberian rivers brought about grave problems concerned with their functioning and the destruction of reservoir banks. Studies of the coastline hydrodynamics made it possible to predict and prevent destruction of tens of kilometres of coasts.

The Siberian school of geographers, founded by Academician V.B. Sochava, proposed a doctrine of geosystems. One of the main applications of the doctrine is comprehensive mapping of the territory. A number of atlases was prepared and published (Atlas of the Amur Region, Atlas of Mongolia, Atlas of Lakes Hovsugul and Baikal; Ecological Atlas of

the Irkutsk Region is in print.

The doctrine served as a basis for studies on the impact of socio-economic factors on the environment, for geographic modelling and mapping. One of the examples of application of the ideas of this doctrine is landscape planning for model territories of the Baikal Region performed together with German colleagues.

Nearly two thirds of the territory of Siberia and the Far East are occupied by thick beds of permafrost rocks which were thoroughly studied by Academician P.I. Melnikov and his school. At present, teams of Siberian permafrost researchers in Tyumen and Yakutsk continue to study cryosphere and main characteristics of permafrost rocks, their spread, thickness, composition, structure and temperature regime. Results of these studies are required to evaluate global change consequences and to solve various problems concerned with construction in the North and economic development of northern territories.

Siberia is rich in water resources, among which are great rivers and the world largest fresh water Lake Baikal. The Lake is unique natural laboratory that attracts interest of scientists from all over the world. The Irkutsk limnologists, guided by Corresponding Member M.A. Grachev, in collaboration with scientists from Belgium, Germany, USA, Japan and other countries carry out comprehensive studies of the lake, including problems of water circulation and renewal, sedimentation, evolution and functioning of its ecosystem, and many others. In recent years the work proceeds with regard to nomination of Lake Baikal as a World Heritage Site and the necessity of creating a model territory of sustainable development of its basin.

On the threshold of the XXI century, the mankind faces new problems caused by the exhaustion of natural resources, global changes of natural environment and climate (pollution, warming, permafrost destruction, greenhouse effect, etc.), that makes the Earth sciences play the first roles among other sciences.

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Table 1

	Russia	Siberia	Canada	USA	China
Area, thousand km²	17,075	9,653	9,976	9,373	9,597
Population, thousand persons	148,306	25,530	28,434	263,814	1,203,097
Population density, persons per km²	8.7	2.7	2.9	28.1	125.4

Siberia's share in natural resources of Russia

- fuel and power resources – over 80%;
- prospected gas reserves – 85%;
- prospected coal reserves – 75%;
- prospected petroleum reserves – 65%;
- potential hydroelectric power resources – 45%;
- timber resources – over 50%;
- large deposits of ferrous, nonferrous, rare and noble metal ores and various minerals, including diamonds.

Biodiversity of Animals and Plants and Ecology in Siberia

Vladimir K. Shumny & Nikolay A. Kolchanov

Siberia is a vast area in North Asia spreading from the Urals in the west to Okhotsk Sea coast in the east, from the Arctic Ocean in the north to Kazakhstan, Mongolia and China in the south. Enormous variability of landscape zones is typical for Siberia. Territories bordering with Arctic Ocean are occupied by tundra, to the south – by forest tundra and further – by forest zone, mainly, by taiga. Neighboring to Kazakhstan, Mongolia and China forest steppes and steppes are located. By an altitude, Siberian landscape is characterized, on one hand, by the large plains such as West-Siberian Plain, and on the other hand, by mountain massifs, for example, Altai, Sayan Mountains, and mountain systems of East Siberia. Large marshes are present in Siberia too. Water resources are represented by numerous amounts of broad rivers and lakes, including the famous lake Baikal. The variability of soil types and forest resources is enormous, so is diversity of plant and animal resources. Thus, a huge variability of ecological systems and wealth of plants and animals characterize Siberia.

For studying biological resources in Siberia, Siberian Branch of Russian Academy of Sciences (SB RAS) has a powerful system consisting of 10 institutes of biological profile, united under the aegis of the United Biological Science Council of SB RAS. These institutes provide a large-scale research of biological resources in Siberia, including flora, fauna, forests, soils, rivers, lakes, and marsh systems. A monitoring of environment is performed, together with the studying of consequences of the anthropogenic influence on the nature in Siberia and on the human health. The strategies of optimal utilization of these resources are being worked out.

Institutions dealing with Earth Science, Chemistry and Physics study the atmospheric, geophysical, climatic, cosmic-physical parameters, the knowledge of which is necessary for analysis of Siberian ecological systems, their monitoring, and forecasting of their future development. Scientific institutions providing research of biological diversity of animals and plants and ecology in Siberia are located in Novosibirsk, Tomsk, Krasnoyarsk, Irkutsk, Ulan-Ude, Yakutsk, Kemerovo, Tyumen, Omsk, Chita, Barnaul, Kizil.

During 40 years of SB RAS functioning, many thousands of expeditions aimed for studying biological resources and ecology in Siberia were organized. At present, these studies are performed within the frames of more than a hundred of scientific projects supported by the institutes of SB RAS. These studies are accomplished according to four main directions of international community steady development adopted in 1992 by the United Nations Special Assembly. These directions are the following: (i) inventory of biological resources in Siberia; (ii) development of a strategy of optimal usage of biological resources in Siberia; (iii) conservation and reconstitution of biological resources in Siberia; (iv) studying gene pools.

Forests

Institutes of SB RAS located in Novosibirsk, Krasnoyarsk, Irkutsk, and Ulan-Ude are engaged in inventarization and research of forest resources in Siberia. Exceptional interest to this problem is caused by the fact that 75% of the area occupied by Boreal forests are located in Russia, and about a half of them – in Siberia. The Boreal forests are extremely valuable, because they produce a considerable bulk of atmospheric oxygen of our planet. Besides, it is important to study Boreal forests since they provide a constancy of biodiversity at the levels of genetics, species, and ecosystem. In order to study Boreal forests, on the base of Sukachev Institute of Forest in Krasnoyarsk, a special Siberian International Centre for Ecological Research of Boreal Forests was organized. This organization has produced a geoinformational system "Ecosystemic management in Boreal forests" that applies an information obtained by cosmic monitoring from NOAA satellites. This system enables to study a direction of productive processes in forests; to evaluate the probability of occurrence of forest fires and the centers of pest distribution; to study the consequences of human economic activity; to estimate the rate of forest reconstruction. Actually, this technology permits to make prognosis of natural catastrophes in the forest systems (such as forest fires, freshets, hurricanes, disruption of vegetation under the action of dries or insects-pests) and to take preventional care for their obviation or softening the subsequences. The importance of this system's development is associated with the evidence that Boreal forests are easily hurtable under the action of both natural and anthropogenic factors. In addition, they are hardly (and very slowly) regenerate in natural conditions.

One more geoinformational system using the cosmic monitoring of environment in Siberia is being developed by the Institute of Computational Mathematics and Mathematical Geophysics in Novosibirsk. It is well known that one of the integral parameters characterizing plant community is the vegetation index. An algorithm for index calculation on the base of the information obtained from satellites was developed. This technology enable to recognize vegetation at the territory studied, to evaluate its intensity, and to perform the data as a 3-dimentional representation of vegetation index. The technology developed may be applied for searching the regions of global ecological catastrophes, both contemporary and those that took place dozens years ago.

Soils

Institute of Agrology and Agrochemistry in Novosibirsk and other institutes of SB RAS study the soils of Siberia, compile their maps, analyse their qualitative and quantitative characteristics, the mechanisms of soil degradation, and develop technologies for their reconstruction. The vast territories in the North of Siberia are occupied by the permafrost. Soil covering in the permafrost region is similar in appearance to the normal ones. However, they are easily damaged under the action different factors and hardly regenerate to initial condition. The reason is that they are composed of

soil masses intersticed with pieces of ice particles. The presence of large permafrost massifs in Siberia raises the question about the impact of permafrost ecosystems in supporting the greenhouse gas balance. It is well known that in nature, if the temperature rises and permafrost melts, the carbon dioxide emission takes place. Naturally, if the ice dipped into the soil melts due to technogenic activity then the rapid and irreversible alterations of cryolytozone structure occur. The alterations are accompanied by emission of enormous masses of carbon dioxide from the soil into the atmosphere. It is well known that the share of carbon dioxide in the so-called greenhouse gas family increasing the temperature equals up to 40%. According to estimates of Yakutsk scientists, the permafrost of a single Siberian region – Yakutia contains more than 10 billions tons of carbon dioxide. Thus, Siberian soil conservation in the permafrost regions is of global planetary importance under crucial climatic alterations and global warming.

Rivers

Large rivers are important components of Siberian ecosystem. One of the goals of institutes of SB RAS is to study flora and fauna diversity of these water systems. In particular, Institute of Biophysics SB RAS makes a large-scale monitoring of one of the biggest Siberian rivers – Yenisei. During many years, the industrial plants working with radioactive materials have polluted the Yenisei's waters. The study of distribution of radionuclides in benthal alluviums in Yenisei have demonstrated their irregular distribution. This phenomenon is explained by the fact that radioecological state of Yenisei is formed as an aggregate of hydrophysical, hydrochemical and hydrobiological processes. In this connection, the isotope's distribution mode in benthal alluviums is mainly determined by a specificity of nucleotide's migration along a food chain.

Marshes

Siberia is characterized by a large area of marsh ecosystems. With this respect, West-Siberian Plain is of especial significance. By concentration of marshes and peat accumulation intensity, it occupies the leading position all over the world. More than 40% of peatbogs in Russia are localized in Western Siberia. In particular, here are the famous Vasugansky marshes, the worldwide largest natural marsh complex that is an ecological memorial of a top rank. It is well known that methane is of biochemical origin, being a biowaste product of specific methane-producing bacteria referring to strict anaerobes living mainly in aquiferous layers and water substrates. Due to the above reasoning, marshes play an important role in carbohydrate gas production, primarily, that of methane. It was estimated that for one third, the greenhouse effect is produced by methane. During the last decades, Western Siberia is exposed to an extensive anthropogenic pressure, mainly due to gas and oil production. So, complex studying of the marshes, their current state and evolution under the action of natural and anthropogenic factors is one of the utmost ecological problems studied by the institutes of SB RAS.

Flora

Biological Institutes of SB RAS conduct extensive studies devoted to conservation of flora biodiversity in collections, including genetical ones. These studies are gaining in importance under conditions of enlarged anthropogenic influence on ecological systems of Siberia. In particular, Central Siberian Botanical garden of SB RAS introduces into culture and reserves as collections of valuable medicinal herbs. For instance, in the Institute of Cytology and Genetics, the biodiversity of such a notable plant as Miscunthus is being studied. The technologies for introduction of Miscunthus are being developed for solving some ecological problems in Siberia. Miscunthus has a large complex of valuable features and can be used in biotechnology for energy-intensive production of alcohol and other types of fuel; as a raw material for chemical and paper industry production; as a source of food for domestic animals. The Miscunthus plantings are very effective in controlling soil erosion, in recultivation of technogenically destroyed and polluted areas.

Recently, the predominant conception states that a species may be conserved only within the frames of community, which this species enters as an element. Basing on this new paradigm, strategies for conserving the defence and conservation of plant and animal biodiversity in Siberia were developed. At the first stage of this approach, an extensive study of plant and animal biodiversity is performed by the institutes of SB RAS. The results of these studies were published in dozens of monographs and hundreds of papers.

Siberian botanists of the Central Siberian Botanical Garden (Novosibirsk) have summarized the results of their researches in a 14-volume fundamental compendium "Flora of Siberia" containing the detailed description of plant resources in Siberia including higher plants, lichens, algae, fungi, plant communities and ecosystems, their classification and inventarization.

"The Green Book of Siberia", the first Russian compendium dealing with description of rare and conserved plant communities is published. In addition, "The Red Book" of Novosibirsk Region containing the data on endangered plant species was edited under the guidance of the Central Siberian Botanical Garden.

The work on providing complete and systematic approach to the knowledge on flora and fauna biodiversity completed with applying modern informational technologies should be especially noted. With these aims, an Internet accessible computer atlas composed as a digital library "Biodiversity of Siberian Fauna" is being developed. It may be considered as the future global informational resource for providing scientific research and planning scientific events on the problems of ecology in Siberia and con conservation of its biological diversity.

Fauna

Institutes of SB RAS provide a large-scale research on biodiversity and ecology of Siberian fauna, on populational density and distribution of vertebrates and invertebrates. Multiyear studies of amphibia and mammals in West Siberia are being performed by the Institute of Animal Systematics and Ecology. These researches cover all the variability of animal species in different landscapes and geographical zones.

In particular, a map marking the main centres of acridae reproduction bursts was constructed. Locust is known to be one of the most dangerous pests in

North and Middle Asia. As is known, after the breakdown of the Soviet Union, the effective locust pollution control performed on the South territories of the USSR as well on the territories of the neighboring countries was dropped. With this respect, an information obtained by the scientists of the Institute of Animal Systematics and Ecology will be extremely valuable for future reconstruction of the locust control system mentioned above.

An extended research with application of cytogenetical methods to analysis of biological variability of animals is provided by the Institute of Cytology and Genetics of SB RAS. The karyotypes of different species are being studied together with analysis of cytogenetical variability in populations of various geographical and ecological zones. Among the perspective species, there are those with genetical status sensitive to unfavourable environmental conditions, in particular, Chironomus Thummi Thummi. It was shown that pollution of an environment causes typical inversional chromosomal rearrangements in Chironomidae. Due to this reasoning, the studying of chromosomal variability provide the valuable information about the state of environment, type and extent of pollution in water reservoirs. During more than 40 years of research, the Chironomus populations are studied all over Siberia. Actually, based on these data, it is possible to construct a global map reflecting the type and extent of water basins pollution in Siberia. The results of these studies are summarized in a special database on natural, populational, and evolutional biodiversity of chromosomes in Chironomidae.

Much attention of the scientists of the Institute of Cytology and Genetics of SB RAS is paid to conservation of wild and aborigine animals gene pools. To this purpose, a large Experimental Farm was organized at the Altai territory. Animals of different species such as aurochs and Yakut horses are bred there in natural conditions. Yakut horse breed adopted to the extremal Yakutian climate have unique abilities to survive at very low temperatures (up to –60°C), to born offspring into the snow, and to graze by the food gained out of the deep snow.

Human genome and ecology in Siberia

The scientists of the Institute of Cytology and Genetics of SB RAS are engaged in a large-scale studying of gene pools of some ethnic groups in Siberia. Here, people live under conditions of increased technogenic pressure on their traditional environment. In particular, in collaboration with the Institute of Geology, Geophysics and Mineralogy, the Institute of Chemical Kinetics and Combustion, the Institute of Inorganic Chemistry, and the Institute of Computational technologies of SB RAS, a complex research of technogenic load on the gene pools of Northern ethnic groups is provided by the Institute of Cytology and Genetics of SB RAS. The data obtained give the evidence on enormous ecological misbalance in the tundra region. This misbalance is caused by anthropogenic activity caused by oil and gas production, non-ferrous metallurgy production, and recent nuclear tests at the polygon "Novaya Zemlya". As a consequence, the dwellers of these regions are characterized by increased frequencies of cancer and secondary immune deficiencies occurrences. Blood cytogenetic analysis have revealed that the frequency of chromosomal aberrations is increased both in aboriginal people (adults and children) and in those living in the North for at least 20 years in comparison with the control populations. Among these chromosomal rearrangements are those referred to specific markers of radiation treatment, namely, rings and dycentrics.

Institute of Cytology and Genetics of SB RAS in collaboration with the Institute of Therapy of Siberian Branch of Russian Medical Science study human genetical markers sensitive to unfavorable environmental factors. A perspective polymorphic marker was found among the genes regulating the macrophage functioning. The association of this polymorphism with diseases affecting the age of life may be related to environmental conditions. This phenomenon may be the result of (i) genotype differences by viability at the early stages of ontogenesis (differential mortality of the offspring) or (ii) differences in reproductive function of treated by radiation individuals with different genotypes (differential parental reproductive abilities).

Informational technologies

The results of studying plant and animal biodiversity and ecology in Siberia, obtained by the institutes of SB RAS, are represented as a huge bulk of papers, monographs, atlases and databases. On the base of accumulated for 40 years information, Siberian Branch of RAS organizes the global informational system on ecology and biodiversity of flora and fauna in Siberia. This system will include: (i) digital libraries containing an information on plant and animal biodiversity and ecology in Siberia, (ii) description of the main Projects of SB RAS on the related problems (in total, about 100 Projects) prepared for publication as a special book; (iii) Web-page containing a description of SB RAS Projects on plant and animal biodiversity and ecology in Siberia.

All the Projects on plant and animal biodiversity and ecology in Siberia performed by the institutes of SB RAS may be subdivided into the following three groups: 1) informational projects aimed to construction of databases accumulating multiyear research on the problems listed above; 2) publishing projects directed to publication of the data on plant and animal biodiversity and ecology in Siberia issued as atlases, maps, and monographs; 3) research projects. The current version of the Web-site will be demonstrated at the Conference computer presentation. On the base of these informational resources, an International Conference is being organized that will take place next summer. At this Conference, all the main directions of researches in SB RAS devoted to plant and animal biodiversity and ecology in Siberia will be discussed.

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First International Expeditions on Lake Baikal and Diatom Research

Yelena V. Likhoshway & Richard M. Crawford

Abstract

In the 18th century a number of German scientists, including Messerschmidt (1720-1727), Gmelin senior (1733-1743), Pallas and Georgi (1771-1774) travelled through Siberia and visited Lake Baikal. During these expeditions, many different samples were taken and have since been preserved in various collections and museums. But during its long geological history, Baikal has collected its own record of climate and environmental change in its bottom deposits. Perhaps the most useful components of the biological record are the hard siliciuos cell walls of countless diatom algae. One of the most important genera of these diatoms, fossil and recent, is *Aulacoseira,* not only in Baikal, but also in freshwaters world-wide. We trace the study of this genus from the early days of exploration of the Baikal region when diatomaceous earth samples were delivered from Siberia to Germany in the 18th century, through the period of the establishment of diatom systematics with links to several notable German diatomists of the 19th and 20th centuries, and to the present day when diatoms have become a powerful tool of stratigraphic correlation and have been proven to be the most sensitive signals of past climate changes in the sediments of Baikal. Finally, we note the importance of the *Aulacoseira* genus for evolutionary science, demonstrate how these studies depend, even today, on the samples and knowledge of the early German travellers and scientists, as well as on proper maintenance of existing invaluable biological collections.

Keywords

first travellers, Baikal, diatom collections, *Aulacoseira*, fossil record.

Professional Russian science stems from the time of Tsar Peter I. He established the St. Petersburg Academy of Sciences in 1724, and the latter became a centre that organized numerous expeditions to explore all regions of Russia. German-speaking travellers took part in many of them. Messerschmidt and Gmelin senior, then (in the time of empress Ekaterina II) Pallas and Georgi travelled through Siberia and visited Lake Baikal.

Daniel Gottlieb Messerschmidt (1685-1735) was born in Danzig (Gdansk) and graduated from Halle University. He was invited to St.-Petersburg by Tsar Peter I in 1716 and asked to explore Siberia. He travelled through Siberia in 1720-1727. It was the first scientific expedition to this region. On arrival to Tobolsk, he assembled a team which continued the travel to the East. The following persons were permanent, or temporary members of this expedition: captain Fillip Johan Tabbert (Strahlenberg), officer Schenning, and a junior officer Daniel Kappel – Swedish prisoners of war; a 16-years old artist Karl Gustaff Schulman; a servant and translator Peter Kratz; a cook Andrew Gesler; two Russian servants; a 15year-old Russian boy Ivan Putintsev, who was purchased for 12 rubles.

After long and thorough exploration of many regions of the Urals, and of West Siberia, the expedition arrived at Irkutsk in December of 1724. Here Messerschmidt determined the latitude and the longitude of the city and studied bones of a mammoth found on the shore of the Arctic Ocean. The Governor's office in Irkutsk delivered bones of this fossil animal directly to his apartment. For an unknown reason, the Russian boy was sold here for 16 rubles. The expedition was joined in Irkutsk by a merchant from Delhi who had a Russian wife and knew local languages and traditions. At the end of February, the expedition crossed ice-covered Baikal on sledge and came to Udinsk (Ulan-Ude). Messerschmidt studied the native people, prepared collections of birds, plants and minerals and described some new bird and plant species. A Tungus philosopher Kara Bandi brought Mongolian, Tungus and Chinese manuscripts, translated the history of Chingiz-Khan from Mongolian. Later, Messerschmidt left the Baikal Region and reached Chita far to the East. On his return, he again crossed ice-covered Baikal in the spring of 1725. In Irkutsk Messerschmidt learned that his patron, Tsar Peter I had died early that year. In February 1726, Messerschmidt arrived in Moscow, and in March reached St. Petersburg. The end of his life was full of sorrow. After more years of travels around Siberia, Messerschmidt was forgotten by everyone. He decided to return to his motherland, took books, manuscripts and part of his natural collections in order to study them in Germany, but lost almost everything in a ship-wreck. To continue his studies and descriptions of Siberian samples, he returned in 1731 to St.-Petersburg and died here in poverty in 1735. A significant part of his collection was destroyed by a fire in 1747. His manuscript „Forschungsreise durch Sibirien 1720-1727" (A Scientific Travel through Siberia of 1720-1727) was published in Berlin for the first time in 1962, more than two centuries later. Some of Messerschmidt's manuscripts have survived and are now stored in the St.-Petersburg Archive of the Russian Academy of Sciences.

Johann Georg Gmelin (1709-1755) was born in Tübingen. In 1727, he graduated from the medical department of the Tübingen University, and moved to Russia. In 1731 he became a member of the St.-Petersburg Academy of Sciences, a professor of chemistry and natural history. For 28 years he lived in Russia. He travelled through Siberia in 1733-1743 as a member of the "Great Northern Expedition". Gmelin as a naturalist joined the on-land party headed by a historian Prof. Gerhard Friedrich Miller. An adjunct of the Academy, naturalist Georg Steller, a student Stepan Petrovich Krasheninnikov, a magister Johann Fisher, a translator Jacob Lindenau also took part in this survey. Gmelin was mostly involved in natural sciences – he studied flora, fauna and minerals. In Irkutsk, he collected evidence on earthquakes in the Baikal Region. The St.-Petersburg Academy of Sciences published his manuscript "Flora of Siberia" which contained descriptions of 1178 plant species. He took a one-year vacation and went to Germany, decided to stay there, and never returned to Russia. As

a professor of the Tübingen University, he published a book "Travels through Siberia" in 1751-52 in German without a permission from the St.-Petersburg Academy of Sciences. The book was translated into many European languages, but was never published in Russian. The name has special significance for diatomists because it was Gmelin´s son J F Gmelin who formally named the first diatom genus Bacillaria in 1791 after which the phylum Bacillariophyta is named. The species itself had been illustrated unmistakably by O.F. Müller (1730-1784) another microscopist from Berlin, as Vibrio pacillifera in 1786.

Peter Simon Pallas (1741-1811) was born in Berlin. He studied at Universities of Germany, England and The Netherlands. He wqs invited to Russia by the empress Ekaterina II in 1767 as an outstanding scientist and was asked to "invent something new in his science". Pallas was a thorough interdisciplinary worker and fulfilled many projects. By education he was a zoologist and paid great attention to studies of animals in the field. He was one of the founders of modern ecology. In his earlier papers, he discussed the idea of evolutionary changes of biological species, and can be regarded as one of the predecessors of Darwin. At that time, the idea of evolution in biology was a heresy. The famous Russian scientist N.A. Severtsov noted: "Before Pallas, there was no climatology or physical geography". Pallas discovered and described many new animal and plant species. He visited Irkutsk and Lake Baikal in 1772 and asked a member of his expedition, Georgi, to study this region in detail and headed to the East to study the border of Russia and China. On the way back, he helped Georgy to finalize the description of Baikal and the Baikal Region. After he returned to Saint-Petersbourg, he received many honors, became a teacher of the grandson of Ekaterina II, the future Emperor Alexandre I. He lived in Russia for 42 years, and returned to Berlin when he was 70. He is author of more than 170 papers. His book "Travels Through Different Provinces of the Russian Empire in 1768-1774" was published in German, and subsequently translated into Russian and published by his student Zuev. Later it was also translated into English and French. His monograph "Zoogeographia Rosso-Asiatica" was published after Pallas died. The name of Pallas was given to a volcano on Ketoy Island (Kuril Archipelago), to a reef near New Guinea, to a plant genus *Pallasia*, to the crustacean genera *Pallasiella, Pallasea*, to a type of iron-containing meteorites (pallasite) and to a street in Berlin.

Johann Gottlieb Georgi (1729-1802) was born in Pomerania (now Northern Poland) He became a doctor of medicine in Sweden. He learned that the Russian government was recruiting scientists, and asked for a position as a member of one of the planned expeditions. In 1770 he came to St.-Petersburg, where his colleagues soon nick-named him Ivan Ivanovich. In 1771 he headed to Siberia as a leader of one of the detachments of the famous expedition of Peter Pallas. In 1772-73 his party thoroughly studied Lake Baikal and its environments. He drafted a detailed map of the lake (Fig. 1), proposed a hypothesis on its origin and described its climate, flora and fauna. He gave the first scientific description of the notorious Baikalian whitefish omul (*Coregonus autumnalis migratoris* Georgi). For the rest of his life he stayed in Russia and fulfilled his numerous duties as a member of the St.-Petersburg Academy of Sciences. His book „Bemerkungen einer Reise im Russischen Reich im Jahre 1772" (Description of a journey to the Russian Empire in 1772) was published in 1775. The book presents geographical descriptions, data about mines, rocks, minerals and other natural resources. This book is written in old German, and has never been translated into modern German, Russian or English languages. A copy of this book is stored in the library of the Baikal Museum in Listvyanka.

German scientists and travellers were very thorough, curious, and honest people. Their descriptions reveal many details, and certainly can be used for the reconstruction of the pristine environment of the Baikal Region of the middle of the 18th century. Their descriptions and notes can be very useful in discovering, for example, whether there was a "Little Ice Age" in Siberia – this cold interval identified all around Europe ended in the middle of the 19th century. At times of the "Little Ice Age", the River Thames was regularly covered by ice in winter, and, as we see from paintings of famous Dutch artists, people in The Netherlands used to travel the dykes using skates. As far as we know, nobody has attempted to study the climate change in Siberia using monographs of the first scientific explorers of Siberia.

An example of such thorough descriptions of this kind is taken from the monograph by J.G. Georgi. "Over the Ikat there is a path to Baunt. At the Bauntian, or the easterly side, the slope is gentle and not high. On the Barguzin side, the slope is very steep for 15 verst (ca. 15 km)... The Ikat River joins the Karga River which flows through the Marik steppe, a rather large plane. Marik is birch (*Betula daurica* Pallas) in the Tungus language. The steppe is followed by narrow mountains. A hot spring is found in these mountains 1 km from the right shore of the Karga River on a rocky step of a mountain about 30 m high. The spring is so strong that it gives rise to a small creek, that steams and never freezes over its full length. The water at the source is so hot and has a foul taste, such that one cannot submerse one´s hand into it. It smells like gun-powder and has a bad taste. In winter the spring is the assembling place of uncountable snakes...In some, but not in all years, omuls ascend into the Karga River. In this year they arrived on the 14th of August to Barguzin, and on the 26th here. On horseback, we had to step aside in order to let pass a large swarm of these fish which one could discriminate singly in the transparent water... A third lake, or better, a bed of a former lake, is called erroneously Lake Urumskoe. It lies near the Pupuguy and Barguzin Lakes. The space between the three lakes is occupied by salt plants and common reed, and also by salt flowers. The bed of the former lake has a diameter of approximately 1 km... A new, beautiful *Ranunculus* was among them, which Academicus Pallas also found near the Onon salt lake, and named it *Salsuginosus*. On the South-Western shore there was a hill consisting of purest sodium sulphate, prepared for transportation to St.-Petersburg. The whole bed of the lake was covered with dirty-blue mud. I tried to dig into the bed as far as possible, and found: 1. Layer of salt one to three thumbs thick (2-5 cm). 2. Grey-blue clay 1 to 2 feet thick (30-60 cm). 3. Layer of salt having the thickness of the size of a palm (10 cm) to one foot (30 cm). 4. A thin layer of sandy clay. 5. Salt again, and

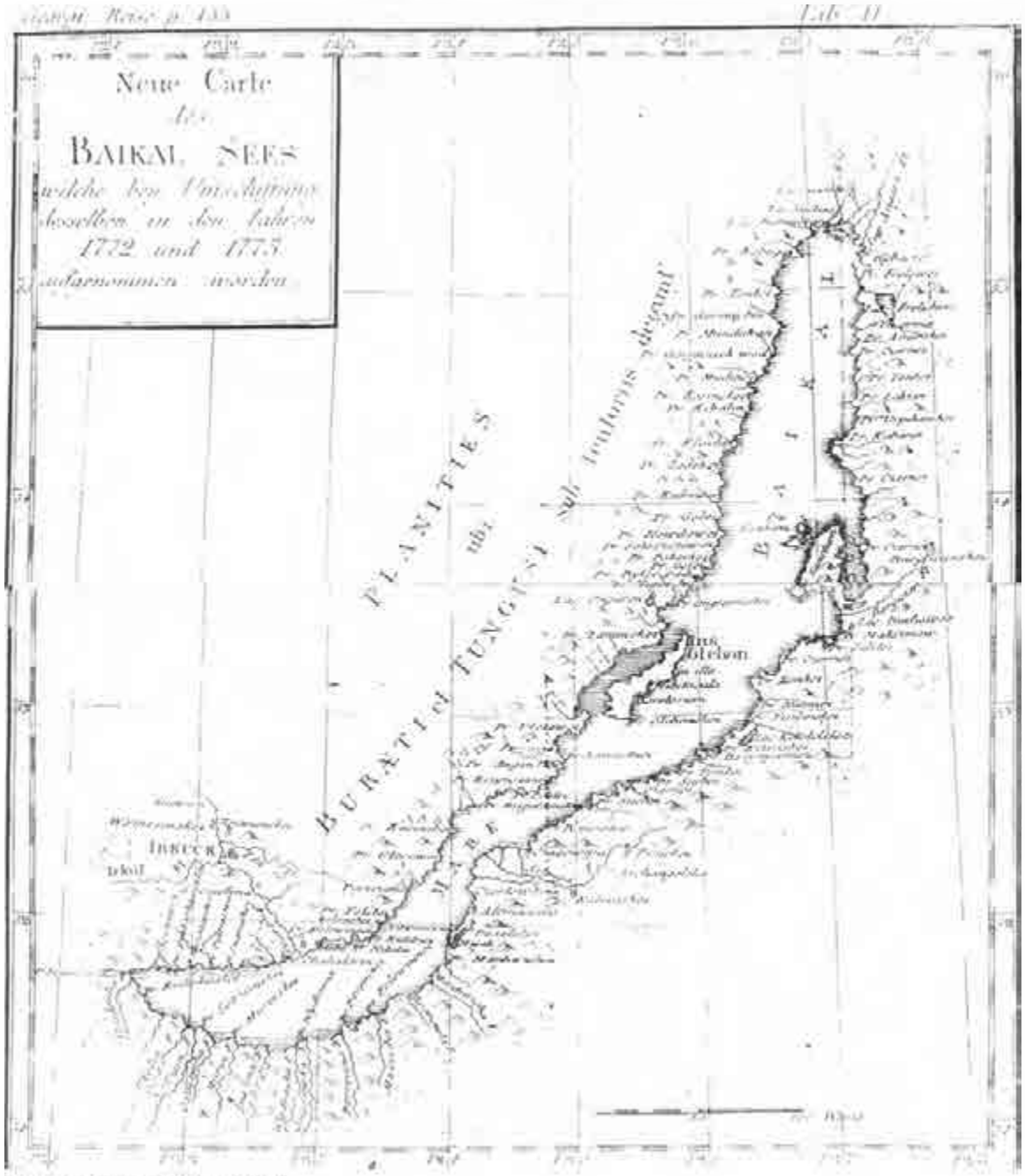

Figure 1. Map of Lake Baikal

similar laminations down to 5 feet (1.5 m). I could not dig deeper because water filled the pit very fast..." A paleoclimatologist of today would immediately understand that Georgi had discovered a record of recent alternating wet and dry climates, and that the climate at the time of Georgi was dry.

It seems to us most probable that it was the blue clay from Urumskoe Lake which was brought by Georgi to Germany, subsequently appeared in a geological collection, and later on became type material in which the well-known German microscopist Ehrenberg found a new species of the diatom genus *Gallionella* early in the 19th century. Thus began a long association between German diatomists and one of the most common and important genera of freshwater diatoms – a genus that has played a major role in understanding the Baikal ecosystem though the name has twice been changed.

Christian Gottfried Ehrenberg (1795-1876) was arguably the most renowned microscopist of his day and described thousands of new species of micro-organisms from material that he collected himself and from specimens sent to him from all over the world. His collection has survived fire and warfare and is preserved to this day as one of the two most important in Germany at the Museum for Natural History at the Humbolt University in Berlin. In this collection are specimens of a diatom genus, *Gaillonella*, for which Ehrenberg described several of the early species in numerous publications of which his "Infusionsthier-

chen" (1838) and Mikrogeologie (1854) are classics and illustrated the commonly held belief at the time that diatoms were animals. Some of the species were removed soon afterwards by Ehrenberg's great contemporary Friedrich Traugott Kützing (1807-1893) to *Melosira* – a large genus that included most freshwater diatoms occurring in chains (Melosira meaning a string of beads) and a few brackish and marine taxa too. Kützing was self-taught as a naturalist until he attended the University of Halle (as had Messerschmidt before him) and later taught at a gymnasium in Nordhausen. His diatom work was completed in his free time and no less than 25 species appeared in *Melosira* in his "Bacillarien oder Diatomeen" published in 1865. In subsequent years more species were added by German workers and others but the work of Otto Müller (1837-1917) also from Berlin, is especially significant. In addition to describing some new species of *Melosira* from African lakes, Müller recognised the ability of these diatoms to form valves of different morphology within the chain of cells and noticed that chains usually break apart at one of these valve types – the first step towards the realisation that these diatoms can alter their chain length in response to the environmental conditions.

Notwithstanding the fact that in 1848 the English diatomist Thwaites had proposed a new genus for the planktonic freshwater Melosiras, they remained in this genus until formally transferred to *Aulacoseira* in 1979 by Reimer Simonsen. Simonsen was the first curator of the Friedrich Hustedt diatom collection at Bremerhaven. This collection is probably the largest in the world created by one man as Hustedt was extremely prolific in his publication and in describing new diatom taxa (some 2,000). Like Kützing, he was a schoolteacher and did all of his work in his freetime until given a stipendium by the City of Bremen.

In 1924 Stanislav Wislouch a Pole who wrote his scientific papers in Polish, Russian and in German, renamed a species *Melosira baikalensis* that Konstantin Meyer (1881-1965) had identified as *Melosira islandica*, Meyer described 3 new genera and 32 new species from Baikal though it is possible that what Meyer observed was indeed *Aulacoseira islandica* as both taxa frequently occur together in Baikal with *A. baicalensis* usually dominant. Until we examine any type material that Meyer and Wislouch may have deposited in their collections we shall not be in a position to evaluate the taxonomy. Nevertheless, both species play important roles in the water column of the lake.

Four years later, Alexander Skabitchevsky (1904-1991) working from the University of Irkutsk, gave a classic description of the life cycle of *M. baicalensis* within the lake after two years of close study. He also described some sexual stages including the formation of the auxospores and showed how closely the process follows seasonal changes within the lake. In 1953 Skabitchevsky showed the importance of the spore stage in a related species *Melosira* (now *Aulacoseira*) *islandica* also with respect to the seasonal changes. So far, the species is known to produce spores only in Baikal and in the Russian far east Hanka Lake.

In subsequent years it was realised that the phytoplankton of the lake sometimes produced large blooms of *Aulacoseira* and these became known as "*Melosira*" years. Gradually it was realised that these blooms were a response to events within the lake which differed in timing and intensity from year to year. Recently the diatom biologists and hydrographers from Russia, Switzerland and the U.K. have collaborated to synthesise a valuable understanding of the functioning of the water column in Baikal. The team, headed by and Nick Granin David Jewson and Mike Sturm of Irkutsk, Northern Ireland and Switzerland respectively, have investigated the lake for 5 years and are beginning to understand its population dynamics. They suggest that the exceptionally long fossil record within the sediments of the lake will lead to a finer interpretation of the changes that have taken place within and outside the lake over the past 20 million years and also help us to appreciate evolutionary changes within the genus *Aulacoseira*. The genus is particularly important because it has a record in the sediments of Baikal stretching back to the Miocene, has a number of species some of which respond with morphological changes to the environment, and it is a genus that is geographically widespread. When combined with the uniqueness of Baikal's extreme system, we are confident that these studies will be rewarding but they ultimately rely on a foundation of sound taxonomy. Accurate recognition and identification of the taxa within the sediments is vital. Because the silica cell walls are hard and durable, type specimens can be cleaned, embedded and stored as permanent microscope preparations for reference purposes and a number of type collections of diatoms exist throughout the world. Two of the most important of these are in Germany, those of Christian Ehrenberg in Berlin and Friedrich Hustedt in Bremerhaven We have used both of these in our studies of the genus and now come full circle in our story. Recently we have begun to study *Aulacoseira granulata* which is also found in Baikal and we were delighted to find in Berlin at the Natural History Museum, material that Georgi had collected in Bargusin in 1772 from where the layers of blue clay had been described. He then presumably gave material to Klaproth, a colleague of Ehrenberg's who in 1841 cited Bargusin as one of the localities for this species which he named *Gaillonella granulata* and which has subsequently been found all over the world.

We regard the first famous German travellers and naturalists who explored Siberia as part of the Russian scientific community. Their cradles were in Germany, but they later faithfully served Russian science, for the benefit and prosperity of Russia.

Lake Baikal contains a unique continuous sedimentary record of the paleoclimates of the last few million years consisting of alternating layers of diatomaceous earth belonging to interglacials, and of diatom-barren clays accumulated during the periods of global glaciations. There is so much to comprehend in these records yet a great part of the story is there for us to read. If we interpret that story accurately, using a sound taxonomy then we can hope to decifer the record of past global climate change in Lake Baikal.

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Results of Belgian-Russian Collaboration on the Study of the Tectonic Evolution of Lake Baikal[1]

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1. Introduction

The Belgian-Russian investigation of Lake Baikal started in 1989 by an agreement on scientific collaboration between the Federal Scientific Institutes of Belgium and the Siberian Branch of the Russian Academy of Sciences. The aim of this agreement was to promote multidisciplinary studies focusing on the investigation of rifting processes in large deep lakes such as Lake Baikal and Lake Tanganyika, and to contribute to the understanding of the formation and the evolution of these deep rift basins.

Although the agreement was only involving the Belgian Federal Scientific Institutes, progressively teams from Belgian universities joined the on-going research projects, and finally the collaboration, involving from Russian side several Siberian institutes, was also extended to scientific teams from France, Italy, the Netherlands and Switzerland.

Since the beginning, and interdisciplinary approach has been promoted. Different disciplines such as structural geology of the basement, neotectonics, sedimentation processes, have been combined with geophysical disciplines : seismology, geothermics and high-resolution reflection seismics.

Thematic teams have been created, each joining scientists as well from Russia as from Europe. This resulted in an intensive exchange of knowledge and techniques. Joint field expeditions as well onshore as offshore have been organized, scientific meetings and exchanges of scientists.

2. Scientific achievements

The major scientific achievements are related to the role of basement structures in the rifting process, the importance of external forces on the evolution of the Baikal basin, the kinematics of basin formation and evolution, and the importance of hydrothermal processes and their relation to the bottom heat flow.

2.1 The role of basement structures in rift basin formation and evolution

It is well known that the location of deep rift basins such as the Baikal and the Tanganyika-Malawi rift present

1 Preliminary Version

many features in common (*Melnikov* et al., 1998) and more in particular a strong structural link with the basement configuration (*Theunissen* et al., 1996).

In the case of the Baikal rift, the basin itself develops at the rim between the Archaean craton and Proterozoic orogenic belts which have been repeatedly reactivated during the subsequent geological history of the region. Orogenic fold belts occur as the Paleoproterozoic belt (Olkhon and Primorskiy) in the south-west and Mesoproterozoic belt (Pribaikalskiy fold zone) to the north-east.

Not only this major crustal discontinuity – the limit between cratonic blocks and linear mobile belts – has influenced the emplacement of the main rift structures. When considering the main border faults of the Baikal rift, which all are located along the western side of the lake and which are the ones which have constantly influenced the basin evolution, it appears that these border faults are imposed on particular structures within the Proterozoic rim zone and more precisely within the Paleoproterozoic zone (*Theunissen* et al., 1993).

Leading structural weaknesses within the Paleoproterozoic (Olkhon-Primorskiy) fold belt comprise on the one hand the NE trending high grade ductile metamorphic Olkhon lateral transpression shear fold belt and on the other hand the NE striking retrograde Primorskiy strike-slip shear fault zone separating the Olkhon fold belt from the craton. As a matter of fact, the limit between craton and mobile belt is a lateral shear fault zone which originated in the Paleoproterozoic and was subsequently reactivated at different crustal levels.

A major link between basement structures and rift leading faults is consequently the inheritance by the rift of steep shear zones which are assumed to prolongate deep in the crust, and possibly extent over the entire lithosphere.

When considering this link in more detail, some questions appear, for example when comparing the Obruchevskiy fault and the Primorskiy fault.

The Obruchevskiy fault extends in the lake and along the southern boundary of what on surface is known as the Olkhon fold belt. The latter is a high grade metamorphic belt of highly folded predominant amphibolitic rocks, marbles and gneisses defining complex structures with characteristic weakly and locally moderately to NE and SW plunging fold axes and mineral linear fabrics. The structural style has been interpreted as a transpressional zone resulting from a sinistral *oblique-lateral displacement (Theunissen* et al., 1993) of Paleoproterozoic sequences along the Archaean craton. The Obruchevskiy fault zone may correspond with the southern boundary of the obliquely accreted Olkhon terrane. The complex structured Olkhon transpression belt underlies the Academician ridge. Although as a basement segment boundary fault the Obruchevskiy fault is a leading fault, its accommodation on changing stress field conditions will propagate in a more complex internal accommodation of the transpressional segment under the Academician ridge.

The Primorskiy fault zone is a rectilinear NE striking lateral shear fault largely occurring in between the craton area and the Paleoproterozoic Olkhon fold belt. As the sharply outlined western boundary of the Olkhon shear belt, the Proterozoic Primorskiy lateral shear fault separates two contrasting structured domains (craton in the west and Olkhon shear belt in the east) and clearly constitutes the preferential site of any structural accommodation of the basement on changing stress field conditions. This is well evidenced by the sharply on land outlined fault scarp of the modern Primorskiy fault which strictly follows the older shear fault and defines a leading boundary fault of the central sub-basin of the Baikal rift.

In conclusion, the elongate and deep continental Baikal rift is clearly controlled by a pre-existing basement weakness (fold belt flanking a cratonic block) with specific structural characteristics (a fundamental and deep seated strike-slip fold belt), particular structures (steeply inclined and deep in the crust extending strike-slip faults) which have been repeatedly reactivated in subsequent regional evolution and became in that way lubricated and specific structural weaknesses for preferential reactivation during rift related accommodation.

2.2 Passive to active rifting process in basin origin and evolution

The Baikal Rift System, with uncompensated deep-water basins, presently develops in the middle of a continental plate which is dominantly submitted to compressional stresses. The same region was already affected by highly extensional strain and stress field during the Mesozoic, but without development of a typical chain of deep rift basins (*Ermikov*, 1994; *Delvaux* et al., 1995a; *Van der Beek* et al., 1996). Instead, small and shallow volcano-sedimentary grabens spread over a broad area, associated with metamorphic core complexes in a detachment-style tectonics (*Delvaux*, 1997).

During its Cenozoic evolution, the Baikal Rift System has been submitted both to periodical changes in far-field stress regime, governed by modification of kinematic processes at the plate boundary, and to the growing influence of locally generated lithospheric buoyancy extensional forces, supposedly related to the development of an axial mantle upwarp during rifting (*Petit* et al., 1996; *Delvaux* et al., 1997). In the last decades, there has been a considerable debate about the leading "passive" or "active" role of locally generated stress, and of far-field stresses generated by the distant India-Eurasia collision. This distinction between "passive" and "active" rift appears no longer appropriate, as the tectono-stratigraphic, volcanic and stress state evolution of the Baikal Rift Zone suggest that rifting was initiated as a "passive" mechanism, from which it evolved progressively into an "active" mechanism (*Delvaux* and *Klerkx*, 1994).

2.2.1 Neotectonics and present-day stress field in Altai-Sayan

In the Altai-Sayan region, stress and strain are transferred between the Tian Shan compressional belt and the Baikal Rift Zone. This region is characterized by a scattered seismicity with several of the strongest Asian earthquakes for this century. Combined investigation of neotectonic structure, stress field and fault kinematics were undertaken to evidence the spatial and temporal variability of the present-day stress field in this region, to precise the timing of appearance of the modern stress field and tectonic structures, and to improve the knowledge of the Altai-Sayan geodynamics in the context of the India-Asia convergence.

A data set of 220 earthquake focal mechanisms was used for stress tensor inversion to determine the present-day stress field. This was complemented by the stress inversion of fault-slip data measured in the field in age constrained rocks, to determine the paleostress evolution. Combining with a detailed kinematic analysis of the deformation history in relation with the stratigraphic evolution at the margins of the Chuya and Zaisan sedimentary basins (*Delvaux* et al., 1995b; *Thomas* et al., submitted), it was possible to determine that the onset of the modern (neo-) tectonic stage occurred in the Middle Pleistocene (3.5 Ma). It is characterized by a strong intensification of tectonic movements and the establishment of an transpressional to transtensional stress field over a vast region, from the Tian Shan range in Kyrgyzstan, to the southwestern extremity of the Baikal Rift System. In the Baikal rift itself, this period correspond to the transition between the "slow rifting" and "fast rifting" stages of *Logatchev* (1993) or "proto rift" and "active rift" of *Delvaux* et al., (1997).

Stress inversion results evidence an important spatial variability of the present-day stress field, both in the orientation of the principal stress axes and in the tectonic regime. The regional stress regime is transpressional in Altai and West-Sayan, to transtensional in Tuva and East-Sayan. The S_{Hmax} direction changes from NW-SE in South-Altai, to N-S in West-Sayan and to NE-SW in Tuva and East-Sayan. Several factors may influence the homogeneity of the stress field and kinematic movements: partition of tectonic movements (typical for transpressional settings), influence of crustal topography, presence of major structural discontinuities, interaction of blocks...

2.2.2 Stress field fluctuation and basin evolution in the Baikal rift

Integration of existing conventional geological data and stress tensor inversion from fault slip data and earthquake focal mechanism data allowed to reconstruct the stress field through time, and its controlling effects on the development of Lake Baikal (*Petit* et al., 1996; *Delvaux* et al., 1997; *Sankov* et al., 1997).

The Baikal rift zone originated under conditions of continental-scale compressive stress field, linked to the combined effects of the India-Eurasia collision and convergence, and to the Pacific-East Asia subduction (first-order stress field). Rifting started in the Late Oligocene by the development of transtensional basins, in a stress regime dominated by NE-SW to ENE-WSW horizontal compression ("proto rift" of "slow rifting" stage), reactivating pre-existing basement discontinuities along the suture zone between the Siberian platform and the Caledonian Sayan-Baikal fold belt. In the course of rifting, the kinematic regime changed progressively from passive transtension to active extension. In the Late Pliocene, a strong increase in tectonic activity and the installation of a pure extensional regime in the central part of the rift zone marks the onset of the "active rift" or "fast rifting" stage.

The appearance of extensional stresses in the intraplate compressive setting is believed to originate from buoyancy forces, caused by progressive lithospheric upwarp under the axis of the Baikal Rift. The tectonic intensification in the Late Pliocene corresponds to a plate-scale tectonic pulse, felt also in the Sayan, Altai and Tian Shan regions of Central Asia. This contemporaneity suggests that the transition between the two rift stages in the Baikal rift zone is related to an external influence, rather than to the arrival of the asthenospheric diapir at the base of the crust. The mantle upwarp under the Baikal Rift Zone is induced by extension rather than being the cause of extension. It was probably initiated during the early transtensional stage in the Late Oligocene-Early Miocene. Once initiated, it progressively triggered rifting by the appearance of extensional buoyancy stresses generated by the lithospheric instability.

It appears therefore that the major controlling factors for the Baikal rift development are: (1) a relatively cold and strong lithosphere, (2) the presence of lithospheric discontinuities that can be tensionally reactivated, (3) the rheological contrasts between the lithospheric blocks, on both side of the suture zone at the margin of the Siberian craton and their orientation relative to the intraplate stress field, (4) the progressive onset extensional forces generated as the consequence of lithospheric destabilization in a compressive stress regime and (3) the fluctuation of intraplate stress field in function to the general dynamics of Asia.

Deep and uncompensated rift basins only appeared after a plate-scale change in tectonic regime. This change caused the intensification extensional tectonics in the Baikal Rift Zone, but also intensification of compressional tectonics in the Tian Shan, Altai and Sayan regions. This difference is due to the particular setting of the Baikal Rift Zone along the SE margin of the Angara-Lena plate, in relative parallelism with the regional horizontal principal compressive stress direction.

One important conclusion concerns the southwestern termination of the Baikal Rift System in East Sayan. It appears that the East-Sayan massif, with the Khubsugul and Tunka depressions, is tectonically different from the Baikal rift, but kinetically linked to the South Baikal Basin. Therefore, the Khubsugul and Tunka depressions should be no more considered as part of the Baikal Rift System, but to the Altai-Sayan transpressional belt.

2.2.3 The Teletsk graben: a possible equivalent of the initial Baikal basin

The Teletsk lake is located in southern Siberia (Altai). It is an elongated (about 50 km long), narrow (3 to 5 km wide) and deep depression, the water depth reaching 332 metres in the north and gradually decreasing to 200 metres in the south. The aerial part of the basin is delimited at both sides by steep walls. The steep slopes exhibit the typical morphology of young fault scarps, characterized by triangular facets, spurs, tectonic steps and paleoseismic dislocations (*Delvaux* et al., 1995).

The Teletsk basin is located at the junction between two major strike-slip zones that belong to the active dislocation zones which affect the Central Asian continent : the NW oriented dextral Shapshal strike-slip zone and the NE trending sinistral West-Sayan strike-slip zone. The Teletsk trough itself almost parallels a north to northwest trending shear zone. Recent work (*Buslov* and *Sintubin*, 1995; *Delvaux* et al., 1995)

evidences the kinematics of block movements in Altai during the Cenozoic and shows that this Paleozoic suture was the main structure controlling the formation of the through. The Teletsk depression may consequently be considered as a giant tension gash originating by the relative movement of crustal blocks along strike-slip faults with opposite sense of movement.

A programme of single channel seismic profiling (*Selesnez* et al., 1995), combined with a seismic refraction profile have attempted to define the structure of the sedimentary fill in the basin. The sediment thickness in the southern part is assumed to reach at least 700 metres, even as much as 1 km.

Considering in a first approximation a constant sedimentation rate varying between 0.8 and 8 mm/year (*Bobrov* et al., 1999), a maximum age of 1 Ma has to be considered for the formation of the basin. During that period the lake bottom dropped down along the steep border faults by a least 2.5 km, possibly even 4 km.

The basin is assumed to have developed in two stages : during a first stage, the southern basin was formed mainly by movement along listric faults which reactivate the Teletsk strike-slip fault. During a second stage, which started about 50,000 years ago, the combined movement along the Teletsk fault and the West-Sayan fault resulted in the formation of the northern basin as an imbrication of adjoining transverse, rhombic sub-basins (Dehandschutter et al., in press). Simultaneously, the southern basin deepened by movement along the border faults. The rate of deepening of the southern part could have reached 1 cm/year.

The Teletsk basin is an example of an extensional basin which forms under the effects of external stress applied on the Central Asian continent by the Himalaya collision. The rejuvenation of a pre-existing zone of weakness in the crust, in casu a major shear zone, plays an important role in locating and activating the border faults. The most surprising result of the investigation of the Teletsk depression is the velocity of the deepening of the basin, which, during certain periods, possibly reached 1 cm/year. In maximum 1 Ma the basin deepened by at least 2.5 km.

The complex structure of the basin architecture and its strong link with the basement structure is another characteristic of a young basin, in its initial stage of development.

Although the present geodynamic framework of the Teletsk graben is not comparable with the Baikal rift, the mechanism of a tectonic basin such as Teletsk, in its initial stage of evolution, may be illustrative of the processes which operated in the Baikal rift when the basin started to form.

2.3 Hydrothermal processes and heat flow in the Baikal rift

An extensive set of data on heat flow measurements has been collected in Lake Baikal since the late seventies (*Golubev*, 1982; 1987; 1995). The major characteristics are strong variations in heat flow values, and locally high values reaching up to thousands of mW/m² (*Golubev* et al., 1993). This variable heat flow distribution is indicative of a heat transport which is more complex than a simple increase in heat flow related to the rifting processes at depth.

In the frame of the Belgian-Russian collaboration, new and detailed heat flow mapping has been performed in several of these anomalies. It is shown that these high heat flow peaks are isolated anomalies, with an extent of no more than 2-4 km (*Golubev* and *Poort*, 1995). Outside these anomalies, the heat flow has a background value of 50-70 mW/m². The heat flow anomalies are located at the sides of the sedimentary basin, in areas of complex fault patterns. Both, the small surface extent and the structural control of their location, suggest that they are related to a process of intense fluid circulation. This process of convective heat transport by fluids has been approached by numerical modelling.

In a simple model of upflowing fluids along a conduit, an estimation has been made of the relative importance of conductive versus advective heat output at the local anomalies. At a single anomaly an extra heat output is calculated of 1-9 MW, with the contribution of direct heat output by discharging fluids smaller than the heat lost by the upflowing fluid to the wall rock. Compared to the background heat output of the northern Lake Baikal, all the known heat flow anomalies together increases the heat output for only 5%.

A two-dimensional modelling that allows for heat transport coupled to fluid flow within a context of rifting processes, showed the feasibility of a regional groundwater circulation in the Baikal rift with the occurrences of surface thermal anomalies preferentially at the sides of the basin. Significant anomalies (> 100 mW/m²) in the basin occur when the fluid flow is supported by a large water table gradient in the surrounding uplifted flanks and when the fluids in the basin are canalised due to sediment heterogeneity. The model does not predict, however, the observed strong surface thermal anomalies; density effects and tectonic forces along deep basement faults can possibly account for more drastic, localised heat-fluid transport. On the other hand, the model predicts that heat redistribution has increased the total amount of heat output over the basin by 2-10%, which fits the estimations based on the local heat flow anomalies (*Poort* and *Polanski*, 1999).

These results suggest that the surface heat flow pattern and increased heat output over the Baikal basins is the result of groundwater circulation on a regional scale, and does not need the heat input of a deep thermal anomaly. The absence of a regional surface heat flow anomaly has been supported by a kinematic model of extension, which was employed to assess the deep lithospheric structure and associated thermal perturbation across the Baikal rift (*Poort* et al., 1998). Although topography, gravity anomaly patterns, and P-T estimates from mantle xenoliths (Vitim plateau) suggest a possible asthenospheric upwarp beneath the northern Baikal basin, the model does not predict a significant (> 10 mW/m²) increase in regional surface heat flow.

2.4 Kinematics of recent rift basin evolution

The most recent changes in the architecture of the lake basin occurred mainly along the western border of the lake in the transition zone between the Northern and the Central Baikal basins. The formation of Maloe More is the most significant expression of these changes.

The transition between the Northern and Central basins is marked by the

Academician Ridge accommodation zone which is an elevated zone trending obliquely compared to the geometry of the basin. Academician Ridge is considered as a transfer zone in the rift basin geometry, which is shown to have been active in a recent past (*Mats* et al., in press; *Kazmin* et al., 1995). As a matter of fact, the structural link between the North and Central Baikal basins is formed by the Olkhon Island - Academician Ridge – Sviotoy-Nos structural high. This complex structure, oblique to the major border faults, is controlled by normal fault systems with opposing polarity. Indications exist for an active left-lateral movement along this zone.

The western margin of the Central Baikal basin is marked by a change in the direction of the major border fault system, from a NE-trend to a NNE-trend, between Maloe More and the North Basin. Incipient basins develop in the relay zones formed by overlapping left-stepping faults from the region of Zama, to the area of Zavarotny.

This region has been investigated by combining satellite image interpretation, digital elevation modelling (DEM) of both land topography and offshore bathymetry, field structural investigation, echosounding and high-resolution seismic profiling.

The Zama sub-basin corresponds to a graben-like depression that develops along the western shore of the lake at the junction of Maloe More and the North basin, partly onshore. It is controlled by the Zunduk-Primorsky fault splay, at the northern extremity of the Primorski border fault. This structure possibly initiated in the late Neogene (*Mats*, 1993) and is still presently active.

Further north, an elongated onshore depression forms, stretching from Ongurion up to Kocherikova. It consists of several young sedimentary basins, separated by more or less meridionally trending highs, which locally evidence a tilted block morphology.

Along the western border of the North Baikal basin, the Zavarotny relay ramp develops between two contemporaneous overlapping left-stepping segments of the Baikalsky fault system, parallel to each other. A complex system of basins and horsts is revealed in this area, controlled by approximately N-S trending faults, oblique to the major NNE-SSW oriented border faults.

The horsts are formed by narrow tilted basement blocks, giving rise to small half-graben type basins of different polarity.

A general characteristic of the whole area consists in the left-stepping character of the overlapping fault systems and the slight obliquity of the sub-basins developing between the normal fault systems. This characteristic might be indicative of a component of strike-slip movement during recent deformation.

Earthquake focal mechanisms for the Central Baikal area are typical for normal faulting at mid-crustal level (*Golenetsky* et al., 1996). Stress inversion of 24 focal mechanisms for the period between 1991 and 1992 indicates that the stress field at mid-crustal depth is extensional, with vertical principal compression and horizontal principal extension in a NW-SE trend. In this context, faults which are not strictly orthogonal to the principal extension direction may exhibit a significant lateral component of movement.

It is consequently postulated that left-lateral strike-slip movement along the Academician Ridge transfer zone is responsible for the formation of Maloe More and the small basins which exist as well on shore as offshore in relation with fault splays and relay zones between faults, a process which is still active at present.

A project of numerical kinematic modelling has been initiated in order to test the postulated hypothesis based on field data.

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Workshop: Sustainable Agriculture, Forestry and Fisheries

Boreal Forests of Siberia, their Ecological, Biospherical Role and Possible Transformation at Global Warming

Anatoly P. Abaimov

Abstract

The climatic features of Siberia and their influence on the structure and productivity of boreal forests are considered. The forested area of Siberia is estimated to be 471,7 million hectares, the growing stock – more than 40 billion m^3, the carbon store – about 79,6 billion tons. 36 tree species and 104 bush species grow in Siberian forests. Permafrost covers about 50% of the Siberian area. The long-term tree-ring chronologies obtained is established can be used for the reconstruction of variations in tree-growth and summer temperature (on millennium scale)

as well as of precipitation fluctuations (on secular scale). The wildfires in Siberia are shown to be the major ecological factors, disturbing the environments, structure and biological diversity of forest ecosystems, directions and rates of the progressive successions.

Key words

Siberia, boreal forests, wildfires, transformation

Introduction

According to estimations of FAO the area of closed boreal forests of the planet is about 920 mln ha. The share of Russia makes up 73 % of their total area, of Canada and USA (Alaska) -22 %, of North European countries -5 % (Forest resources..., 1995). In the current age essential reduction of tropical forests as a result of harvesting and agricultural cultivation of the territory, and technogenic press on environment inevitably result in increase of biospheric, ecological and resource role of boreal forests (*Pisarenko*, 1997).

Biodiversity of boreal forests, the productivity as well as the peculiarities of their structure and dynamics in many respects are defined by a variability of climatic and geographical conditions (*Isaev*, 1997). Antropogeneous transformation of a forest cover of boreal zone of Russia and its technogenic contamination have resulted in a series of regions in emergency of ecological situation and danger of natural environment modifications (*Kharuk* et al., 1996).

The efforts of a scientific public in the latest years are directed to search of optimum ways to provide sustainable forestry, preservation of biological diversity and raise of forest ecosystems role in stabilization of ecological processes. These problems are actual for specially protected territories of Siberia and, first of all, for the basin of lake Baikal, which is a Site of the World Natural Heritage. The general area of the basin of this unique lake on the territory of Russia is estimated 24 mln ha, 20,2 mln ha covered by forests including, or 72%. 50,2 % of forests has here special condition of economic activity, as they fulfill various protective functions (*Vorobyov* et al., 1999).

According to ecological principles of natural use adopted at the UN con ference in Rio de Janeiro on Environment and Development (1992) the states must provide protection, sustainable forest management and development on the basis of collective responsibility for planetary ecology.

Climatic conditions of Siberia and their influence on a structure and productivity of forests

Siberia is one of the largest forest regions in Eurasia. It extends from the Ural Mountains in the West to the Pacific Ocean Mountains in the East and from the Arctic Ocean in the North to the boundaries with Kazakhstan, Mongolia and China in the South. Its western part is occupied by vast West Siberian Plain. In the middle there is the Central Siberian Plateau. The southern and the eastern parts are Altai, Sayan, Baikal and North-East mountain systems. Altitudinal difference is more than 4500 m.

The geographical location of Siberia in middle and high latitudes of the northern hemisphere determines its climatic conditions and natural features. The climate of the most Siberian area is strictly continental. The average annual temperatures are below zero almost everywhere and in the north it ranges from -12 to -18° C. In some places the average January temperature goes below -50° C.

The sum of active temperatures varies from 400-800 degree-days in the north to 2200 - in the south. Accordingly, the growing season varies from 40-70 days in the north to 100-120 days in the south. Annual precipitation varies between 200-900 mm, decreasing from the west to the east. 60-80 % of annual precipitation falls in the warm season.

Large extension of Siberia determines the diversity of its natural landscapes. Among them are steppe (4,3 %), forest-steppe (4,9 %), taiga (42,4 %), mountains (34,7 %), tundra and forest-tundra (13,7 %). The spatial differentiation of the vegetation cover is determined not only by latitudinal zonality but by vertical zones in the mountains in the south and north-east.

The main consequence of Siberian continental climate is formation of permafrost. Permafrost covers about 50 % of the Siberian area and affects the soil formation process, the temperature and hydrological regime of the soils. Continuous permafrost determines tree species composition, productivity and dynamics of the forest ecosystems (*Pozdnaykov*, 1986; *Abaimov* et al., 1998).

The forested area of Siberia is 471,7 million hectares, which is 60,7 % of the total forest's area of Russia. The total growing stock is more than 40 billion m^3, what makes about 11 % of the world growing stock. The coniferous prevail in Siberian forests. They make 87 % of the area and 88 % of the growing stock. The productivity of Siberian forests is not so high. Stands of the III - V quality classes prevail here (about 70 %). High classes of quality (I-II) are characteristic of only 7,6 % of stands. More than 20 % of tree stands is of low productivity (Va-Vb quality classes). Annual average tree increment makes about 1,31 m^3 per 1 hectare (Sokolov et al., 1994). The average growing stock makes 150 m^3 per 1 hectare in mature tree stands. But, in the most productive forests a growing stock of 400-500 can be found, sometimes 600-800 or more m^3 per 1 ha.

36 tree species and 104 bush species grow in Siberian forests. The main forest forming species are: Siberian larch (*Larix sibirica Ledeb.*), Gmelin larch (*L. gmelinii (Rupr.)Rupr*)., Cayander larch (*L. cajanderi Mayr*), Scotch pine (*Pinus sylvestris L.*), Siberian pine (*P. sibirica Du Tour*), Siberian spruce (*Picea obovata Ledeb.*), Siberian fir (*Abies sibirica Ledeb.*), common birch (*Betula pendula Roth.*), aspen (*Populus tremula L.*). Larch forests cover about 52 % of the total Siberian forested area, Scotch pine - 16 %, spruce and fir - 11 %, cedar (P. Sibirica) - 8 %, broad-leaved species - about 13%.

The large forested area of Siberia and great variability of climatic, geological, hydrological and soil conditions determine the biological diversity of forest associations in different natural zones, their quantitative and qualitative characteristics, ecological importance, economical and social role.

For example, Siberian northern larch forests are characterized by low productivity, peculiarity of vital tree forms, low thickness, high natural fire danger and small floristic diversity (*Abaimov* et al., 1997a, b). But, these subarctic forests are of great significance as an inhabitation of about 20 ethnic groups of aboriginal.

In southern Siberian mountain forests are characterized by the greatest variety and productivity. So, in the basin of lake Baikal the stands of coniferous species occupy 77,5 % of the forested area including one with a dominance of larch - 33,6, pine - 29,1, Siberian pine - 12,2, Siberian spruce and Siberian fur - 2,7%. Broad-leaved species predominate on 11,8 % of the area. Shrub communities including *Pinus pumila* occupy 10,6 % of total forested area (*Vorobyov* et al., 1999). Here maximum ecosystem and floristic diversity of forest communities is observed, and the vertical differentiation in distribution of vegetation is expressed. During the glaciation the mountains of the south of Siberia played the role of ice refugia and were the areas of intensive speciation. The presence of a large number of endemic species of plants and animals testifies to it.

For the reasons explained it is considered to be actual to continue investigations in lake Baikal basin from the viewpoint of development of the optimum approaches to preservation of their biodiversity at different levels of organization, extremely important protective role, as well as from the viewpoint of the prognosis of successions of forest vegetation under the influence of the disturbing factors at different scenarios of global warming (*Vaganov, Pleshikov,* 1999; *Vorobyov* et al., 1999).

Carbon of Siberian forests

The common evaluation of carbon store in forest ecosystems of Russia was carried out by a group of Russian and American contributors under the guidance of professor V.A.Alexeev and doctor R. Birdsey. This report was published in 1994 in Russia and later in the USA (Carbon.., 1998). This work most adequately reflects a summarized store of carbon in the forests of the former USSR.

According to the calculations the carbon store of forest ecosystems in the country on the whole makes up 117,9 bln tons, including 67,5 % in Siberia of a summarized store. The share of carbon concentrated in the soils, is 46 % of its total store. The bog ecosystems accumulate 28,2%. On the average there are 153,2 t. of carbon per 1 ha of forested area. In high latitudes and permafrost conditions the forests accumulate about 90 t/ha.

The information about stores is the basis for carbon balance development and its dynamics in boreal forests taking into account the antropogeneous factors and foreseen climatic modifications. The next stage should become an evaluation of variability of annual production in forest ecosystems of various natural zones of Siberia, research of a balance between respiration and assimilation, influences of fires, cuttings and other violations on a carbon balance and its emission in an atmosphere.

Now such research is carried out on the initiative of professor E.-D. Schultze by the Max Plank Institute in cooperation with the Institute of Forest SB RAS in forest and bog ecosystems of the middle stream of Yenisey river. It is supposed to be proceeded within the framework of the Yenisey transect of IGBP (NES) program and in other natural zones of Siberia.

Obtaining of a large number of new data from different geographical spots is necessary for development of models of expected spatial and temporal transformations of boreal forests. It will require joint efforts of scientific groups of different countries, search of possible sources of financing and can be a subject of the new international projects. The solution of these tasks will allow to define a role of boreal forests of Russia in a global carbon cycle, to select optimum ways of economic impact on forests, which would promote their biospheric role as of carbon accumulator and stabilizer of natural processes.

Climatic monitoring and dendroclimatic study in Siberia

Recently made climatic ordinations of forest zones and biomes for Siberia let systematize the whole diversity of zones and altitude belts and establish the indexed system of zones and ecoregions in supply, continentality, moisturing. The system of forest zones and of their variants can be considered on the axes of climatic parameters as the necessary stage for forecast modeling and for analysis of forest association dynamics under global climate change.

The computer version of forest zones and bioms of Siberia shows that the shift of potential borders to the north will

number in hundreds and thousand kilometers (*Nasimova, Polikarpov,* 1996; *Monserud* et al., 1998). The closed forest area will decrease at the expense of expansion of forest-steppe in the south, the coniferous forests will be shifted to the north, and the role of Scots pine and birch will increase in them. Prediction of change of forest zones in the new climatic situation agrees with the expected large fires on the Siberian territory.

Paleocarpological reconstruction of a history of Siberian forests at the boundary with zonal tundra has allowed to fix repeated modifications of the zone boundaries in the Holocene (*Koshkarova* et al., 1998). At maximum warmings of a climate 8500-8000 and 6500-6000 years ago the forest boundary was on 4-6° to the north of the modern. In the periods of cooling 4500 and 2000 years ago the boundaries of the zones were displaced to the south by 1-2°. Formation of the most northern boreal forests of modern appearance began approximately 2000 years ago. Within five last centuries in Siberia the tendency of wood vegetation movement towards the North is observed.

Several years ago the systematic dendrochronological study in collaboration with Swiss Federal Institute for Forest Research was started in Siberia to cover the whole territory of the boreal zone by set points where the long chronologies can be built and tree growth response on the main climatic changes can be obtained and analyzed. The first step of this study was focused on subpolar region where tree growth is limited by summer temperature changes and the modern trend in climate dependent of variability of tree growth could be revealed due to possible temperature trend.

The analysis of tree-ring chronologies obtained for subarctic region along the transect 4500 km long (from the polar Urals to Chukotka) showed that all of them contained a very strong climatic signal, mainly, June-July temperature.

Based on wood of living trees remained on a surface of mortal trees remains and semi-fossil wood from alluvial coastal sediments by a method of cross dating the tree-ring chronology for the eastern part of the Taimyr peninsula was constructed with the duration 2209 years (since 212 AD up to 1996 AD). The models for reconstruction early summer and average annual air temperatures on parameters of a variability of a radial increment of trees of *Larix gmelinii (Rupr)* (*Naurzbaev, Vaganov*, 1999) are obtained. At the analysis of tree-ring chronology continuous during two millenia cycles of various duration were detected: about 180 years, secular (78-90 years) and intrasecular (44, 28, 11, 6,6-6,9 years). The dating of mortal trees has shown, that on the upper boundary of the Putorana mountains forest in conditions of sharp continental climate they can preserve on a surface during more than 1900 years.

At reconstruction of long modifications of average annual temperatures by tree-ring chronologies it was of interest to compare the obtained data with the other indirect sources by dynamics of average annual temperature of air in northern hemisphere. For this purpose the data of reconstruction of a modification of temperature in high latitudes under the analysis of a relation of isotopes of oxygen in ice cores of Greenland were used.

Overlapping of reconstruction on a calendar scale from the end of the XII-th century till the present time has shown a good coherence of data, especially on positive and negative extremums (*Naurzbaev, Vaganov,* 1999). It has allowed to make a conclusion, that the long fluctuations of average annual air temperature on the Taimyr agree well with global changes of a temperature regime in northern hemisphere. The obtained tree-ring chronology can be used for the analysis of regional singularities, as well as for global changes of temperature in boreal zone of Eurasia.

The analysis of a radial increment of Scotch pine trees in the basin of lake Baikal has allowed to find powerful regional climatic signal (*Andreev* et al., in press). It is conditioned by precipitation fluctuations during a hydrological year. The correlation analysis has confirmed, that dynamics of trees increment registered long-term fluctuations of integral indices of a water regime - dynamics of a drain of the river Selenga and water level changes in the lake. The reconstruction of a water regime indices testifies that during the last 250 years the dynamics of precipitations and of the lake level has not undergone essential modifications. Detected cyclicities allow to create a statistical model of the prognosis of lake Baikal level dynamics.

Role of fires in transformation and successions of forest vegetation

The forest fires in boreal forests of Siberia are the major ecological factor, disturbing a relative equilibrium of natural processes, transformation of environments of tree stand growth, directions and rates of progressive successions (*Abaimov, Sofronov,* 1996; *Goldammer, Furyaev,* 1996; *Stocks* et al., 1996; *Valendik,* 1996; *Abaimov* et al., 1997b; *Vaganov* et al., 1998).

Annually in Siberia up to 25-30 thousand forest fires take place, and the fire covered area varies by different estimations from 3-5 up to 8-10 mln. ha. Ground fires dominate absolutely in forests of Siberia, but their impact on forest ecosystems depends on both environmental conditions and biology of tree species.

So, in the permafrost zone catastrophic ground fires quite often result either in perish of larch stands or in radical transformation of their structure and biological diversity (*Abaimov* et al., 1997b, 1998). In middle and southern subzones of taiga ground fires usually damage only a part of the youngest conifer trees, and also birch and aspen. Catastrophic fires are here a principal reason of substitution of coniferous species by broad-leaf trees. Such scenarios are often observed in the basin of lake Baikal and other mountain areas of the south of Siberia. The recurrence of forest fires on the same forest sites varies in different natural zones significantly. In southern and middle subzones of taiga it makes 20-40 years (*Furyaev,* 1996), and in high latitudes - 60-80 and even 100 years (*Abaimov* et al., 1997b; *Arbatskaya, Vaganov,* 1997).

The receiving station of information from the American satellites NOAA, installed by NASA in Krasnoyarsk five years back, is included in 1999 in the a world net of global ecological monitoring. The receiving of operative satellite information on the appearing centers of for-

est fires allows not only to register areas of damaged forests, but also to take effective measures to suppress fires by ground services.

The quantitative estimation of carbon and other gas emission excreted at wildfires, for the first time was undertaken on the initiative of J. Goldammer in 1993 in northern part of the Krasnoyarsk region within the framework of field experiment FIRESCAN. The reports on this experiment were represented at the XX-th World Congress IUFRO in Finland and are known for the experts. Now by employees of our institute together with the colleagues from Germany, Canada, the USA and Japan several research projects in various natural zones are being fulfilled, they are aimed at the study of influence of wildfires on emission of carbon to the atmosphere, transformation of an environment and succession of forest vegetation.

In a stage of study the project «Small Satellite for Fire Detection and Observation» (FOCUS) is. On the initiative of the German space agency and Center of global monitoring of fires the project assumes creation and launching of specialized forest fire satellites. They will be a part of an integrated world control system of fires. On separate problems of construction principles development of an onboard equipment for filing forest fires the cooperation with the Institute of Forest is presupposed.

Ecosystem Forest Control and Sustainable Forestry

The concept of sustainable development of forests is founded on the ecosystem principles of forestry management with the help of GIS-technologies. It provides balanced, permanent forestry without essential decrease of sustainability and biodiversity of forest ecosystems, role of forest vegetation in the stabilization of natural processes at local, regional, national and global levels.

Now in Russia the change of the approaches to forest management happens. It requires revising usual principles of definition of harvesting, forestry information provision, operative analysis methods development to find alternative variants of economic impact on forest ecosystems with consideration of their ecological role and economic availability (*Vaganov* et al., 1997; *Problems.*, 1998; *Vaganov, Pleshikov,* 1999).

Unfortunately, we do not have practical experience in ecosystem forest management yet. Therefore important direction of research in cooperation with the foreign colleagues is the development of the theoretical approaches and practical methods of sustainable forestry in new economic conditions. As the first step in this direction we consider the Russian-American project «Ecosystem management in boreal forests of Central Siberia». It has been fulfilled within five years on an example of model territory in the central part of the Krasnoyarsk region. Its purpose is the development of the methodology of permanent forestry in boreal forests of Siberia with its consequent adaptation in other forest regions.

Generated at the first stage of realization of the project GIS includes cartographical data (climatic, topographical, soil and landscape maps of a different scale, map of vegetation, fuel map etc.), computer data base about composition, structure and dynamics of the pilot territory forests, peculiarities of successions of forest vegetation under the influence of various factors.

The information base of GIS has allowed to begin creation of the detailed plans of forests management. These plans should make a local hierarchical level and become a separate block in a control system of a regional level.

Transition to ecosystem forest management and to sustainable forestry is a complex, multilevel task. Its realization includes not only multidisciplinary research, obtaining and analysis of operative satellite information and forests inventory data, but also further extension of GIS of both levels, interaction with systems of forest monitoring.

Taking into account the illustrated above large variety of forest cover of Siberia and extremely non-uniform economic development of its territory, transition to ecosystem management of boreal forests within the limits of this huge region will require adaptation of developed principles and GIS-technologies to local conditions.

Conclusions

High variability of climatic and geographical conditions defines biological diversity, productivity, regional peculiarities of structural organization and dynamics of boreal forests of Siberia.

Forest fires are the major factor disturbing an equilibrium of natural processes. They change an environment, structure and biological diversity of forest ecosystems, directions and rates of the progressive successions.

The most important tasks of Siberian boreal forests study are:

- definition of their role in a global balance of carbon;
- quantitative and qualitative evaluation of fires on annual production of forest ecosystems, emission of gases in an atmosphere and transformation of an environment;
- prognosis of a modification of biological diversity of forest ecosystems, zonal boundaries and structure of forests at warming of a climate;
- development of principles and methods of organization of sustainable forestry on the basis of ecosystem management, complex forest monitoring with the account of world experience and modern GIS-technologies.

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Sustainable Forestry and Certification, a Promising Concept for the Baikal Region?

Jochen Godt & Robert Mayer

Abstract

Sustainability and forestry in Germany are discussed from a historical point of view. New certification systems introduced by the Forest Stewardship Council and the Pan European Forestry Certification are described and compared. Consequences for future sustainable development of forestry in the Baikal region are reflected. By a given certificate in forest management, positive images of the Baikal region as a Model Territory of Sustainable Development for the World can be set.

Key words

sustainability, forestry, FSC, PEFC, Buryatia, Baikal

1 Introduction

In contrast to practices in agricultural land use, forestry and its management systems have long time been accepted as being one form of land use systems with little influence on natural ecosystems. Industrialisation in forestry and the devastation of vast forest landscapes mostly in boreal and tropical rain forest ecosystems have led to increasing criticism, triggered by awareness concerning global change and climatic influences. The recognition that national / regional land use practices - apart from other influencing factors - are dominating the global climate made world-wide counteracting necessary. Discussion on world-wide voluntary activities started resulting in efforts to implement the results of international discussion on sustainable development on a national scale and to promote local activities. Basis for these activities was the forest declaration of Rio in 1992, of which the most important principles have been implemented into "Agenda 21", the programme of the German government for sustainable development (*Deutscher Bundestag,* 1998). The principles are referring to the use of timber and other forest products, the maintenance of forest ecosystems as habitat and protection of water, soil and climate. Public participation, especially in form of NGOs (Non-government Organisations) such as nature conservation groups is pointed out as one important principle in defining locally adopted principles and criteria. The realisation of these principles and criteria in forest practices should be guaranteed by introducing a certification system, giving a certificate for excellent forest management and enterprises.

2 Sustainability in forestry / forest management in FRG

Historical aspects of sustainable forestry

Restrictions in forestry of Germany are documented as local forest rules since the turn of the first to second millennium. In the middle ages forest devastation by cattle grazing and unrestricted use of timber were the causes for forest rules. *V. Carlowitz* (1713) used in his book "Silvicultura Economica" for the first time the term "nachhaltig" = sustainable. "Nachhaltigkeit" (sustainability) at that time referred to sustainability of timber harvest only. The timber harvest should not exceed the increase of timber by natural production. In the middle of the 19th century sustainability was extended to the yield of timber and finally to the production of timber, including soil as a production factor (*Speidel* 1972). But it must be kept in mind, that apart from most foresters being interested in mere economic profit, the idea of silviculture based on wholistic concepts has been practised by a small group of foresters at that time already. *Karl Gayer* (1889) defined sustainability in a much broader understanding, including the forest ecosystem as a whole. Today the ideas of Karl Gayer, formulated in his book "Der Waldbau" (Silviculture) are fundamental for "silviculture close to nature", being promoted by the "Arbeitsgemeinschaft Naturgemäße Waldwirtschaft", ANW. The ANW was founded in 1950. Formed by an "outsider group" of foresters the ANW was scarcely accepted within its own profession. But today, the principles of 'silviculture close to nature' are widely accepted, mostly among the young generation of foresters. Their principles can be found in the new silvicultural concepts of public forestry of the Federal States of Germany. Today sustainability in forestry of FRG is no longer restricted to simple timber production. It is widely accepted that - apart from timber production - the rules of "Waldfunktionslehre" (Concept of multifunctional forestry) (*Dietrich* 1953) are relevant in respecting the responsibility to maintain and improve the protection and recreation functions of forest ecosystems. In the European Conference of Ministers from 37 countries (Helsinki 1993) an international definition of sustainability in forestry was set up:

'Sustainable management means the care for forest land and its use in a way, which maintains biological diversity, productivity, ability for natural regeneration, vitality and ability at present and in future to fulfill important ecological, economical and social functions on a local, national and global scale and which does not cause any damage to other ecosystems'

(translated from *Schumacher* 1996)

Early certification efforts of NGOs in Germany

Long time before Rio 1992, nature conservation groups in Germany have already been working out principles and criteria for future forest management in concordance with nature (for a review see *Godt, Dittmar* and *Weiger* 1997). Environmental protection groups in Germany and in Canada / America (BUND, NABU, Greenpeace Germany, Robin Wood, Friends of the Earth) have formed their own principles and criteria including a whole certification system. In Germany the following criteria as minimum standards have been set (Tab. 1). Before official installation of the Forest Stewardship Council in Mexico (see below) two certification systems by NATURLAND and ECOTIMBER have been

Table 1. Comparison of minimum standards for certification of excellent forestry in FRG; ECO TIMBER (1996) und NATURLAND (1996) (Dittmar 1997)

Elements of Forest Management	Criteria	Minimum Standards ECO TIMBER (1996)	Minimum Standards NATURLAND (1996)
Clearcut	bigger than one tree length in diameter	minimum of three years without any clearcut before certificate can be given	not allowed
Tree species composition	tree species selection and mixture	not mentioned	main goal: tree species adaptable to site conditions, exceptions (e.g. afforestation) possible
Tree regeneration	natural tree regeneration	with high priority	with high priority
Forest practices	kind of forest practices	not mentioned	selected thinning an single stem management as a rule
Pesticides, Fertilizers and Liming	renunciation on use of pesticides and fertilizers	no use at least since 3 years before certification	no use at least since 1 year before certification
	liming (Calcium-Carbonate)	not mentioned	after soil analyses and in checked cases only
Techniques	road construction and road development	not mentioned	no new roads in general
	net of temporarily used roads	important	minimum distance 40 m
	driving in the whole stand at harvest	excluded	excluded
	use of harvester	restricted to young coniferous stands with lack of thinning	no restriction
	use mineral oil for saw chain	not mentioned	biologically decomposable oil only
	use of horses	recommended	recommended
	use of regional manpower	high priority	not mentioned
	export of crown material	not mentioned	allowed if necessary for protection against insects only
Hunting	natural regeneration satisfactory?	strict hunting according to habitat of capacities first, fences or single stem protection second	natural regeneration of main tree species natural vegetation type must be possible, protection by fence or single stem protection only during forest ecosystem reconstruction
Nature conservation	principles / guidelines	protection of natural dynamics	natural dynamics must be possible
	old trees	not mentioned	increase in storage of old trees required
	standing dead trees	minimum storage in public forest 3 %, in private forest 1 % of older trees	10 % of storage
	special sites	priority: protection of rare species	protection even on sites that have no official status according to nature conservation law
Reference areas	in public forestry	not mentioned	in the coarse of 3 years at least 10 % of forest land
	in private forestry	not mentioned	development of an own concept, apart from small private forest enterprises 10 % of forest land as a goal

established and are still existent at present. Their criteria are looked upon as being more restrictive than those given by the German FSC group later. Those forest enterprises which have been given a certificate before installation of FSC, have been accepted as being in agreement with the FSC criteria.

3 Certification of forest management as a result of the Rio conference 1992

FSC world-wide

FSC international was established in 1993 in Oaxaca / Mexico. The task of FSC was fixed as follows (http://www.fscoax.org/index):

"MISSION STATEMENT

- The Forest Stewardship Council A.C. (FSC) shall promote environmentally appropriate, socially beneficial, and economically viable management of the world's forests.
- Environmentally appropriate forest management ensures that the harvest of timber and non-timber products maintains the forest's biodiversity, productivity, and ecological processes.
- Socially beneficial forest management helps both local people and society at large to enjoy long term benefits and also provides strong incentives to local people to sustain the forest resources and adhere to long-term management plans.
- Economically viable forest management means that forest operations are structured and managed so as to be sufficiently profitable, without generating financial profit at the expense of the forest resource, the ecosystem, or affected communities. The tension between the need to generate adequate financial returns and the principles of responsible forest operations can be reduced through efforts to market forest products for their best value.

ACTIVITIES

- FSC shall promote Principles and Criteria of Forest Stewardship through a voluntary accreditation programme for certification of forest management. FSC shall evaluate and accredit certification bodies based upon adherence to FSC Principles and adherence to FSC Guidelines for Certification bodies.
- FSC shall conduct educational activities aimed at increasing awareness of the importance of improving forest management, and the advantages of certification as a tool for this.
- FSC shall also provide guidance and assistance on forest management issues to policy-markers, forest managers and legislators.

TENETS

- The FSC Principles and Criteria are intended to apply without discrimination to tropical, temperate and boreal forests world-wide which are managed for production of forest products. FSC values equally the environmental, social and economic aspects of forest management included in the Principles and Criteria.
- FSC shall be a non-profit non-governmental organization, and shall remain independent from control by commercial interests, and government, multilateral and bilateral agencies, although collaboration with these entities will be sought.
- The Forest Stewardship Council A.C. seeks to complement national legislation and international treaties and agreements promoting environmentally appropriate, socially beneficial and economically viable forest management. FSC shall promote equitable access to accreditation and certification, and shall avoid discrimination against shall-scale certification bodies or forest operations."

IUFRO aspects of sustainable forest management

Several working groups within the **I**nternational **U**nion of **F**orest **R**esearch **O**rganisations (IUFRO) are devoted to sustainability in forest management. In 1998, IUFRO organised an international conference on indicators for sustainable forest management in Melbourne, Australia. The concept of sustainability was generally adapted and the following resolution was accepted in which additional research work regarding the improvement of criteria and indicators was required (http://www.iufro.boku.ac.at):

- "Sustainable forest management is an evolving concept and C&I (criteria and indicators) can elaborate, demonstrate and motivate progress towards achieving that goal. Criteria and indicators reflect the values and perceptions of forests in society. While many of these values are in turn a reflection of human culture and knowledge, the process of recognizing and incorporating stakeholder issues and aspirations in sustainable forest management requires a framework within which to facilitate shared decision-making based on open sharing of information. The scientific community has a responsibility to support this process by improving and extending our understanding of forests and human society. Organizing our research efforts and knowledge to support the implementation of criteria and indicators of sustainable forest management will lead to improvements in public policy, forest management decision-making and the implementation of a philosophy of adaptive management."

4 The German Forest Stewardship Council (FSC)

In 1997 the German Forestry Council (DFWR), a union of forest landowners, decided not to take part in FSC discussions. After a long time of discussion in October 1997 the German FSC Working Group was established with 37 members, including members from the ANW. In 1998 the first general assembly was held and in August 1998 draft standards were completed and sent to FSC Secretariat for further informal discussion. In April 1999 the German FSC group accepted the final version of German standards. In September 1999, 4.938 ha of forest are certified in Germany (http://www.fscoax.org).

Tab. 2 gives an overview on the German principles and criteria.

Pan European Forest Certification (PEFC)

Although DFWR decided not to take action in the certification process at all in 1997, he introduced its own certification system one year later on a european scale. The Pan European Forest Certification Council (PEFC) was founded on 30th June 1999 in Paris. In July 1999 the German PEFC was founded in Bonn in order to introduce and to survey PEFC in

Table 2. Principles and selected criteria of FSC Germany

Principle referring to	Criteria
(1) Compliance with law and FSC principles	■ law must be respected ■ payment of taxes etc. must be guaranteed ■ international treaties and agreements must be respected ■ protection of forest against illegal use
(2) Tenure and use rights and responsibilities	■ definition necessary ■ use of rights of population must be respected ■ use of procedures avoiding or reducing conflicts
(3) Indigenous people	■ no indigenous people in Germany
(4) Community relations and workers rights	■ use of local manpower ■ protection of workers health ■ trade unions accepted ■ information of employees and local people
(5) Benefits from the forest	■ economical aspect ■ optimal use of forest products ■ reduction of harvesting damages ■ goal: high standard quality of timber ■ promotion of multifunctional forestry ■ use of forest products should not exceed natural production
6) Environmental impact	■ forest stands adapted to site conditions ■ single stem and / or group harvesting ■ no clear cut ■ tree species according to natural vegetation type ■ priority on natural regeneration ■ restricted planting in special cases only ■ promotion and use of natural dynamic processes ■ afforestation including succession phases ■ reduction of game on a level adequate to natural regeneration and habitat capacities ■ planting or seeding of tree species not belonging to natural vegetation type restricted ■ support of transition of stands with unnatural composition towards stands adequate to site conditions ■ no harvesting of full tree incl. branches etc. ■ protection of endangered species and biotops ■ no afforestation in small landscapes unsuitable for forest ■ ecological functions and values are to be maintained, improved or restored ■ development of long lasting storage of dead trees and trees suitable as biotops ■ excluding representative areas from timber use as reference areas: in public forests 5%, private forests: orientation at public forest reference areas ■ harvesting techniques must respect stand, soil and water protection ■ no mechanical soil treatment ■ protection of natural forest types along water lines and no drainage of soils ■ no use of biological or chemical pesticides and fertilizers (exceptions after analyses of necessity and alternatives possible) ■ no use of genetically manipulated organisms
(7) Management plan	■ a management plan must be worked out documenting size, intensity of management practices etc.

Table 2. (continuation)

Principle referring to	Criteria
(8) Monitoring and assessment	■ a controlling system must be worked out dealing with: condition of forest, yield of forest products, trading market, measures of forest enterprise, social and ecological impacts
(9) Maintenance of high conservation values forests	■ special care in protected areas and in those areas with high values for nature conservation
(10) Plantations	■ single age and single tree species forests in agreement with principles 1-9. Christmas tree plantations accepted if the area of these plantations does not exceed 5% of total area

Germany. Hereby a second certification system, mostly supported by the forest land owners, has been introduced in competition to the FSC system. Both systems agreed to make decisions on a majority basis of at least 75% of votes only. By these regulations the trust of single stakeholders in not being dominated by other stakeholders has increased. On the other hand there are 2 seats only for nature protection groups from 18 seats altogether in the PEFC council. From nature protection groups this fact was interpreted that they should play a minor role in the PEFC system - if ever they will take action in it. At the moment, important nature conservation groups in Germany are not ready to collaborate with PEFC (*Steenbock* 1999). In addition, everyone who is willing to, can be a member of FSC and vote for his own interests. The PEFC membership is based upon organisations, not individuals. The goal of the PEFC system is certification on a regional scale. F.e. public forest enterprises of a whole federal state can be group-certified. The PEFC guidelines published so far (30.8.1999, http://www.dfzr.de/pan-euro/index.htm) are less diversified than those given by the FSC system. F.e. there are no concrete data concerning reference areas, storage of dead wood etc.

It is not yet clear which of the two systems will find more acceptance - but it is quite certain that the trading market and thereby the consumers will decide upon the success.

5. Consequences of certification in Europe for the Baikal region

Of course, environmental, social and economic circumstances in Central Europe are quite different from those in Siberia or the Baikal region. Therefore simple taking over of European systems can not be recommended. Nevertheless, the discussion on sustainable development can profit from the experiences in other countries. There are lots of indications yet already that certification of forestry in Germany and the public claim for sustainable development is a severe issue of the society. At present the demand for certified timber and timber products is increasing. If timber or timber products from the Baikal region should be exported they will have to face the competition on the international market, where certified products will be preferred in future. Sustainable development of the Baikal region should be promoted in future. The system of certification, being examined in other countries already, would be a suitable and promising way. All relevant groups of the society can be included in evolving principles and criteria of sustainable development in forestry and in the Baikal region in general. By a given certificate in forest management, positive images of the Baikal region as a Model Territory of Sustainable Development for the World can be set.

Which FSC principles will be most relevant for the Baikal region?

The Russian Academy of Sciences / Siberian Branch (1994) has given some statistical data concerning crucial aspects of forestry in the Baikal region (Tab. 3). From these data one can conclude that special emphasis should be directed to the following points when elaborating principles and criteria for sustainable forestry in Buryatia:

- avoidance of clear cut in order to prevent fires and to maintain primary forest
- promotion of natural regeneration with primary forest tree species
- use of careful harvesting techniques
- single stem harvesting in areas vulnerable to soil erosion
- promotion of uneven aged forest stands by silvicultural means
- promotion of mixed tree species composition close to primary forest ecosystems
- reduction of air pollution impact
- introduction of controlling systems for sustainable use of forest products
- compliance with law concerning protected areas
- research programmes on physical and chemical status of soils affected by global warming and on stability of forest ecosystems in the taiga and forest steppe regions
- reference areas with minimum human impact
- public participation in decision making processes

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Table 3. Forestry in the Baikal region (The Russian Academy of Sciences / Siberian Branch 1994)

Forested area in the Baikal region	34 Mio. ha
Irkutsk region	37 %
Buryatia	30%
Chita	17%
Mongolia	20%
Zonation according to Baikal law:	
Central Zone (protected zone)	4.5 Mio. ha (13%)
Buffer Zone	18.5 Mio ha (54 %)
Zone of Atmospheric Pollution Impact	11.3 Mio. ha (37%)
Tree Species	
Pine	31%
Larch	33%
Cedar	12%
Spruce / Fir	4%
Small leafed Species (birch, aspen, shrubs)	about 20 %
class of trees in young age due to extensive forest utilization and forest fires	70 %
timber reserve	4.5 billion m^3, (3.6 coniferous species)
mean annual increment for all forest types	around 1.46 m^3 / ha
mean annual increment for conifers	around 1.39 m^3/ha
mean annual increment for small-leafed tree species	around 1.96 m^3/ha
calculated felling in Central and Buffer Zone	17 million m^3
1960s	11.7 million m^3
1982	4 million m^3
1993	up to 40.000 ha
yearly felling area	10 % of total forest area
area logged, resulting in secondary forest and low productivity	40.000 ha (26.000 ha promotion of natural regeneration)
reforestation / year	

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Sustainable Agriculture in the Lake Baikal Region

Volker Mielchen

Abstract

Sustainable Agriculture is the economic use of ecosystems in order to produce renewable materials which satisfy (basic) human needs. Ecological, social and economical needs of current and of future generations must be taken into account.

In the Baikal region agriculture has a strong link to nature conservation: It has a certain impact on the nutrient and toxin input into rivers and thus into Lake Baikal. Covering much space it is the main factor which determines the structure of landscapes. Only if agriculture is closely adapted to ecosystems, landscape functions, including resource production and biodiversity conservation, are secured in a long-term perspective.

The project of the Hannover University study group approaches the complex matter by a holistic research and planning approach at a local, regional scale which is supplemented by a study of agriculture in the Burjat Republic. The concept of sustainability is adapted to each level. Interviews in two *rayons* help to analyse administrative and market structure. This provides a context for sustainable agriculture in the Baikal region. In the town of Galtai-Kalinovka, 65 km south of Ulan-Ude, and specifically on one private farm the project analyses the natural potentials of the area (mostly steppe): this includes a mapping of the land uses, vegetation, a rough calculation of grassland productivity, soil analysis and conclusions about the susceptibility to erosion as well as a rough sampling of nutrient input into groundwater and surface water. In combination with the opinions gathered by several interviews among the local population and officials, this leads to scenarios for a sustainable agriculture in the town area and to recommendations for the private farm.

Agriculture in the Baikal region is facing the double challenge of restructuring in the context of increasing influences of the world market and providing subsistence for much of the population. Although the ecological situation is rather sustainable, agricultural ecosystems suffer from overgrazing and erosion. The social situation is rather uncertain because many people feel worried about the outcome of system changes and have difficulties to realise the new opportunities for private initiatives. The economic situation is still rather sustainable because local subsistence farming is functioning well. Private farmers and small farms are still underprivileged through the administrative and political system. Generally, capital for investments is missing and market structures are difficult to organise and enter.

Locally adapted varieties of cattle and grain as well as modern efficient and well-co-ordinated management, which takes into account the carrying capacities of ecosystems, need to be developed through ongoing, participatory processes among farmers, local consumers, scientists. The Hannover project might provide some inspiration for further exchanges of knowledge and technologies in the agricultural sector between Germany and Siberia.

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Ecological, Economic and Social Impacts of Regional Climatic Changes in the Continental Part of Eurasia (Buryatia, Mongolia)

Presentation of a Research Proposal under the INTAS Open Call 99

Robert Mayer

Abstract

A team of several research groups from the European Union (Germany, Greece), from the Russian Federation and from the Republic of Mongolia has elaborated a research proposal which has been submitted under the INTAS Open Call 99 in August of this year. It is presented here in order to put the proposal into discussion and to show the scientific context in which it is to be understood.

Global changes will have their specific features on the regional level, manifested in the heat and moisture regime. Also the frequency of extreme and catastrophic phenomena will have a specific, regional character. Their estimation and the estimation of their impact on ecology, economics and social environment of the regions, primary output of the project, are an important aspect of decision-making. In the regions with insufficient moisture provision such as Buryatia and Northern Mongolia, the forecasted warming may cause instability of ecosystems and in the economic infrastructure as it has developed in the past.

Changing environmental conditions in the most affected areas will call for early planning of strategies to avoid negative economic and social effects. These strategies have to take into account specific local and regional conditions. The project will provide important elements for an action program for a few selected communities/urban settlements in context with their related regional land use systems.

The output of the project will not only be useful in predicting the areas most likely to be affected by climatic changes, but will provide basic concepts to counteract negative effects on the ecological as well as on the socio-economic level.

Key words

Climatic change, dendrochronology, sustainable development, forest growth, land use, regional economy.

Objectives

The main objective of the project is to detect, on the basis of a multi-disciplinary study, the natural and anthropogenic constituents of regional climatic changes and forecast their ecological, economic and social impacts for the continental (forest, forest-steppe and steppe) territory of Buryatia and Northern Mongolia.

The project includes the following tasks in a stepwise order:

a) reconstruction of long-term temperature and precipitation variations and trends by the use of available historic weather records as well as that of dendrochronology (tree-ring analysis) as indirect indicator in order to define the natural and anthropogenic constituents of climatic changes on the examined territory;
b) to analyze the interrelation between climatic changes, as expected according to possible scenarios, and the factors governing productivity of forest vegetation and cultivated plants, as e.g. temperature regime, humidity, forest fires, insect outbreaks, floods, with the focus on trends in the dynamics of these ecologically significant factors and their regional distribution
c) estimation of the expected variations (average and extreme) in primary productivity of steppe and forest-steppe ecosystems under conditions of the regional climatic changes,
d) to define the ecological constituent which conditions the losses in agricultural areas with the aim of their rehabilitation and preservation;
e) estimation of the economic impact that regional climatic changes may have on profitability and structure of agriculture and forestry of the given area;
f) estimation of social impacts with the aim to work out recommendations on the improvement of the infrastructure of economy, migration and resettlement of the population.
g) the definition of elements for Sustainable Development on a regional level, adapted specifically for areas protected according to the "Baikal Law" and preparation of an action program in selected subregions, taking into account forecasted changes under various scenarios.

The institutions and scientific groups responsible for single tasks according to their experience and skill are given in Tab. 1.

Background

Climatic data show that the past decade was the warmest in history of weather records, and the year of 1998 has been the hottest on the globe (*Mann* et al, 1998 a,b). The global warming tendency is manifested in regional observations as well. Thus in Zabaikalye, principal watershed of lake Baikal and largest agricultural area of Eastern Siberia and Mongolia, beginning with 1920, there has been a steady increase in annual temperature averages. It remains still unclear what the role of natural and anthropogenic factors in climatic changes is. That is why the analysis of natural and anthropogenic changes in large regions, especially in the continental part of Eurasia, is of great significance, since warming processes in the northern hemisphere are transformed on the regional level into changes in heat balance of and moisture regime, and may fail to meet global climatic change trends.

It is most reliable to isolate the natural constituent of climatic changes through long-term weather records. Unfortunately, there are no long-term

Table 1. Team Identification

	Research Teams
P 1	Institute for Landscape Ecology in Planning, Kassel Faculty of Urban and Rural Planning, University of Kassel, Germany *R. Mayer* in cooperation with, Institute for Landscape Planning and Nature Conservation Faculty of Landscape Architecture and Environmental Development, University of Hannover, Germany *Ch. v. Haaren*
P 2	Laboratory for Social and Cultural communication, Mytilini, Greece University of the Aegean, Department of Cultural Anthropology, *S. Chtouris*
P 3	The Baikal Institute of Nature Management SB RAS Ulan-Ude, Rep. of Buryatia, Department of Nature Resources, *A. Tulokhonov, T. Khantashkaeva*
P 4	The Institute of Forest, Krasnoyarsk, Russia Department of Forest Monitoring, SB RAS *E. Vaganov*
P 5	The Institute of Geography, Irkutsk, Russia Department of Economic and Social Geography, SB RAS *S. Ryashchenko*
P 6	The Institute of Biology Ulan Bator, Republic of Mongolia Department of Dendrology, Academy of Sciences *Ch. Dugarzhav*

observation sequences (150 years and more) for Siberia and Mongolia, and the meteorological station network is sparse. An yet it is possible, in order to carry out reconstruction of past climatic changes with high time resolution (a year, a season) to use, as an indirect source of information, annual tree-rings which let detect long-term (living trees – up to 600-700 years) climatic changes (*Fritts*, 1976; *Schweingruber,* 1996; *Vaganov,* 1996 et al). During the past decade, a network of dendro-climatic stations covering the whole territory of Buryatia was created, which made it possible not only to obtain tree-ring chronologies of vast territories but also to carry out quantitative reconstructions of temperature and precipitation changes conditioned by anthropogenic factors (*Vaganov* et al, 1996; *Briffa* et al, 1995, 1998; *Mann* et al, 1998; *Jacoby* et al, 1996). It was proved that the temperature changes in the mountainous part of Mongolian Altai coincide with the global trend (*Jacoby* et al, 1996), while the cyclic variations in atmospheric precipitations and in the discharge characteristics of the Selenga river basin are mostly 25 – 30 and 10 – 11 year long (*Andreev* et al, 1999). These pioneer works constitute a valuable data base for a more detailed spatial-temporal analysis of climatic variations on the territory of Buryatia and Northern Mongolia.

There are many branches of economy in Buryatia and Mongolia that depend upon climatic changes. A large amount of information testifies to the dependence of agricultural yield on climatic changes, especially in the regions with low humidity (*Chirkov,* 1984; *Pasov,* 1986; *Vaganov,* 1989). Long-term observation sequences have proved that the frequency of forest fires depends upon temperature rise, especially in summertime (*Panushkina, Arbatskaya,* 1999; *Stocks*, 1996, 1997; *Goldammer, Furyaev,* 1996; *Fosberg* et al, 1989). Reconstruction of climatic changes in the past, based upon tree-ring chronologies, may be used as indicators for forest fire frequency (*Swetnam,* 1993; *Larsen, MacDonald,* 1995; *Arbatskaya,* 1998). Tree-ring chronologies of different species of trees make it possible to define and carry out the quantitative estimation of losses in productivity caused by insect outbreaks (*Swetnam,* 1994; *Filion* et al, 1995; *Pleshanov,* 1982). The retrospective tree-ring analysis was also used to analyze the frequency of floods (*Agafonov,* 1999; *Schweingruber,* 1996).That is why the creation of a developed network of dendro-climatic stations in Buryatia and Northern Mongolia will help collect necessary information on the past changes in these natural phenomena that have determining influence on economic management on the examined territory.

On the other hand, the use of these reconstructions and the available archives on the economic damage done by natural catastrophes caused by climatic changes makes it possible to detect "background" dependencies describing the interrelations within the natural c limatic changes.

There is much material on damage estimation in the Baikal Institute of Nature Management SB RAS. The analysis of the flooding dynamics on the territory of the Republic of Buryatia leads to the conclusion that the frequency of floods has significantly increased due to both the natural and anthropogenic factors. In this respect, it is necessary to carry out a retrospective analysis of changes in farm land structure and the estimation of the industrial resources subject to flooding. On the basis of these activities, it is possible to estimate the ecological-economic damage done to economic objects and ecological systems of the Republic of Buryatia by floods.

Regional climatic changes not only affect industrial and land use development, but have social consequences as well. They are manifested, e. g., in the specific medical-ecological, demographic, epidemiological and social situation, which often implies growth of social tensions as a result of migration flow, climatic discomfort, growth of anti-social phenomena such as crime, drug-addiction and others. The deterioration of climatic comfort in continental parts of Eurasia will be expressed in terms of the intensification of continental climate, growth of sand storm frequency, daily and

seasonal air temperature fluctuations and radiative climate constituent. The medical-biological effects of these factors on humans are well studied in the context of medical climatology in various parts of the world. On theoretical level, the medical-ecological significance of climatic factors is forecasted rather well. The population groups leading a less settled way of life (such as cattle-breeders, hunters, etc) are affected by intensifying climatic discomfort most of all. The adaptation of migrants becomes more difficult. Epidemiological consequences are associated with outbreaks of infectional epizooties of wild and domestic animals. The fact of intensification of epizootic processes during the years when the growth of climatic discomfort took place (including the draught years in Zabalkalye) has been shown in many studies (*Zhovty,* 1976, 1974; *Nekipelov* et al, 1955, 1968). Sharp climatic fluctuations within a short period of time are very significant for the epidemiological situation. Epizooties of animals mean not only growing epidemic threat but also sharp productivity reduction of stock-breeding farms and hunting resources. There are numerous facts testifying to the presence of direct connection between social processes (first of all, demographic ones) and specific features of climatic conditions. It has been proved by our demographic-ecological studies carried out in Pribaikalye and Zabaikalye focussed on adaptation problems of migrants, migration intensity, and age structure disproportions (*Misevich, Ryashchenko,* 1988; *Bashalkhanova, Sorokina,* 1991; *Bashalkhanova* et al, 1993) which, as a result, causes greatest harm to the region's economy.

Tasks and participation of scientific groups

The multitude of tasks within this interdisciplinary research program requires an intensive team discussion and good coordination. General project coordination is done, according to the rules set by INTAS, by the European Side, i. e. by the Institute of Landscape Ecology in Planning at University of Kassel, Department for Urban and Landscape Planning. On the Side of the Russian Federation, coordination will be secured by the Baikal Institute SB RAS in Ulan Ude, Buryatia (see Tab. 1).

The Institute of Forest SB RAS in Krasnoyarsk will be the responsible co-ordinator for the expansion of the dendro-climatic station network, and for the tree-ring chronologies dating back at least 300 to 350 years as a base for spatial-temporal temperature and precipitation reconstructions for Buryatia and Northern Mongolia, possibly separating natural from anthropogenic factors.

Simultaneously it is planned to create a regional database for the extreme natural phenomena like droughts, early autumn frosts and snowfalls, floods, forest fires, etc. This task is co-ordinated by the Baikal Institute SB RAS in Ulan Ude, with the Institute of Biology in Ulan Bator as main contributor.

Based upon the data bank created, the Institute of Geography SB RAS in Irkutsk will come up with a zoning of the territory according to the statistical characteristics of long-term climatic variations and the alignment of the created map with the vegetation, topographical, population displacement maps and the map of the extreme natural phenomena. By using geo-information technologies subregions are identified with the most extreme climatic changes to be expected.

In addition to these factors, agricultural output dynamics dependant upon climatic changes is put into a statistical model. By use these models possible agricultural output changes, following the forecasted scenarios of changes in the main climatic variables, are calculated. Thus subregions with highly unstable agricultural output (according to the dendro-climatic station network and forecasted climatic sequences) identified and possible agricultural production losses can be estimated. This includes calculation of possible limitations on hayfield production and the quantity of agricultural animals. Coordination of this task is addicted to the University of Kassel and the Baikal Institute in Ulan Ude.

The latter institute will also be responsible for the combination of ecological and economic damage forecasts from various climatically-conditioned sources of the singled out territorial subunits and comparison of forecasted values with "background" ones, distinguishing the districts with the highest risk for future damage, with regard to ecological as well as to economic damage.

In order to counteract possible future damage it is necessary to define of criteria for Sustainable Development on a regional level. Co-ordinator for this task will be the University of Kassel. It is intended to select a number of sensitive sub-regions in order to serve as examples for the Baikal Region as a whole. The criteria are adapted specifically for areas protected according to the "Baikal Law", taking into account ecological and social conditions of living, the interests of the local population in an improvement of the economic situation, as well as the restrictions put up by the protection of the natural environment.

Methods

The multidiscipline character of the project implies the utilization of a methodological complex for the estimation of the effects caused by regional climatic changes. The first stage of the project will be creation of a database of a spatial-temporal variability of the principal climatic variables (temperature and precipitation) according to long-term tree-ring chronologies. Here, the use of conventional dendro-climatic methods is suggested: a) construction and estimation of statistical characteristics of long-term tree-ring chronologies; b) estimation of climatic response functions and reconstructions of the main climatic variables (temperature and precipitation) over long (300-400 years) periods of time; c) construction of regional chronologies, singling out and reconstruction of regional climatic changes and dendro-climatic zoning.

Secondly, on the basis of the archive materials, a database of spatial-temporal manifestations of extreme and catastrophic phenomena in the ecosystems (draughts, harvest failures, forest fires, insect outbreaks) will be created. The combination of dendro-chronological and climatic data on extreme and catastrophic phenomena in the context of the available geo-informational system will make it possible to carry out complex zoning of the examined territory according to the intensity of the extreme manifestations of climatic

changes. The success of implementation of the stage will be estimated according to the following criteria: 1) adequacy of the reconstruction climatic variable models in accordance with dendro-chronological data; 2) correspondence of zoning according to the complex of extreme and catastrophic phenomena to the available systems of zoning of the examined territory: physical-geographical, agricultural-climatic, forest-fire, hydrological zoning systems.

In order to obtain information on forest fire frequency, three sources are used: archives of the regional branch of air forest protection agency, data on the forest fire reconstruction by way of analysis of fire scars on tree discs collected in various districts and available space photographs of the examined territory The combination of these indicators will make it possible to create statistical models of forest fire frequency variations depending on the current climatic conditions in the examined sub-units of forest. Dendrochronology of arboreal species in flood lands is used to date past high water levels in rivers and spring floods.

A result of these investigation will be: 1) qualitative evaluation of "background" frequencies of extreme and catastrophic phenomena on the examined territory and in separate singled out territorial sub-units. (natural changes); 2) qualitative evaluation of the frequency of these phenomena at possible scenarios of regional climatic changes with the use of both forecasts by available climatic models (GCM) and empiric data on dendro-climatic reconstructions; 3) qualitative evaluation of the past and expected economic damage calculated with the use of alternative methods (Fankhauser, 1995).

At this stage, the qualitative methods and estimation in the context of ecological-economic models will be combined with high-quality expert estimations including both the modern data and hydrological analogies available in a concrete area. The criteria for successful implementation of this stage will be in the form of recommendations for the local administrative bodies of Buryatia and Northern Mongolia aimed at adequate measures on the reduction of possible damage caused by expected climatic change and its extreme manifestations. These recommendations will take into account possible "payment" for practical actions aimed at damage reduction and may be used in more general comparisons provided for the Kyoto protocol.

Expected results

The analysis to be carried out on the territory of steppe Buryatia and Northern Mongolia chosen as the research objects will make it possible to estimate the impacts of regional climatic changes according not only to pure climatic parameters and integral characteristics of changes in thermal and water condition but also to the complex of the economically significant characteristics of the territory.

Another important result of the project implementation will be practical recommendations of social character aimed at reduction of the negative impact of regional climatic changes on the displacement employment infrastructure of the population, and also on main procedures aimed at prevention of the negative effects. These recommendations are directed towards the authorities of Buryatia and Mongolia on different levels, national, regional as well as local, where concrete action plans are to be worked out.

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Baikal - A Phenomenon of Nature Chances for the Coexistence between Utilization and Protection

Christian Opp

Abstract

Many hydrographical and limnological data of Lake Baikal show that this is a lake of superlatives. Lake Baikal is well-known as the deepest lake (1,637 m). It has as much water as the Baltic Sea, and as much as North America's five Great Lakes. Its water volume of 23,600 cub.km represents 20% of the fresh water of the earth. Lake Baikal draws its water from an area of 571,000 square kilometres. His length is 636 km, the maximum width reaches 80 km, minimum – 27 km. Lake Baikal receives 58.8 cub.km or 82.7% of water from the tributaries annually. 13.1% stemming from precipitation, 1.2% from condensed moisture. The greatest inlet is the Selenga River. Its drainage basin surrounds 447,060 square kilometres or 83.4% of the whole catchment area of the Lake Baikal. After covering a distance of 1,024 kilometres, the Selenga flows into Lake Baikal forming a big delta. The only one outlet of the Baikal via the Angara River has a discharge of 60.9 cub.km. If non of the Baikal water evaporates from the Lake's surface and if it is not replenished by rainfall, it would take some 387 years for it to flow out. The effect of such a large body of water not only shows in the hydrograph of the Angara River, but in the annual air temperature curve as well. In the centre of the largest land mass on earth climatic effects occur that are typical of oceanic regions. In general, Baikal is a cold lake. In August the warmest temperatures of the water surface rise to +8 – 10 degrees C on the open sea, to +12 – 14 degrees C on the shoreline, to +16 – 18 degrees C on a few number of bays. In the north of the lake an ice sheet is forming in November, in the Maloye Morye in December. Between 10th and 15th of January the whole Baikal is covered by ice. In the south the ice remains in April, in the north of the lake till June. In general, Lake Baikal's water quality is very good due to hydrobiological, hydrochemical, hydrophysical and tectonic factors. Neotectonic movements and the location of the Lake Baikal within a large rift valley system were of major importance for its Tertiary and Quaternary development. The occurrence of many endemic animal (60%) and plant (15%) species is closely related to the peculiarities of the development and the long existence of the Lake Baikal.

Man-made damages of the lake water and of the surrounding Taiga and Steppe ecosystems have been observed in recent decades. The worst contamination of the Lake Baikal are caused by the Baikalsk pulp-and-paper mill, the Selenginsk board-and-paper mill, the BAM (Baikal-Amur-Railway) and the contaminant load of the Selenga River. Environmental problems in the Baikal region are also caused by air pollution stemming from the industrial corridor of Irkutsk-Angarsk, by forestry, agriculture, tourism and others. Citizens' initiative groups, non-governmental and governmental organizations try to prevent further damage to Lake Baikal's environment. The different strategies of environmental protection are based on a system of protected zones. The Baikal basin within the frontiers of the Russian Federation is divided into three zones: the core zone, the buffer zone, and the zone of influence. The first one, embracing the territories bordering the lake, includes the Baikal preservations Baikalsk and Barguzin, the Pri-Baikal National Park and Trans-Baikal National Park, as well as district forestries of Buryatia and Irkutsk Region. Nature management in this zone is the most limited one. The second zone includes the valleys of Upper Angara, Barguzin, Jida, Selenga (on the territory of the Russian Federation) rivers and Chikoy river head. The regime of limited nature management organized here, is intended for fulfilling the measures on environmental control and eliminating the negative impact on Baikal via the hydrologic drainage basin. The third zone includes the remaining territory of the catchment area (within the frontiers of the Russian Federation). All activities are allowed, if the laws of environment, water and natural resource protection are observed. The "Baikal law", basing on the system of protected zones, which was drafted in 1993 is not sufficient for guaranteeing lasting protection of the natural resources of the Baikal region.

Both restrictions given by the governments of Buryatia or of Irkutsk Region and "good advices" from foreign experts of nature protection do not promote environmental activities of the local people. Only measures for the improvement of the economic situation of the local people at the same time are a guarantee for their participation in environmental protection. Therefore and because of the global significance of the Lake Baikal the international community is called upon not to leave the people of the region alone in their fight for a better life, for the coexistence between utilization and protection of this unique lake and its environment.

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Workshop: Technical Environmental Protection and Standardisation of Assessment and Monitoring Systems

The Manifestation of Solar Variability in Hydrometeorological Characteristics of Lake Baikal and of the Baikal Region Climate

V. A. Kovalenko & G. A. Zherebtsov

Abstract

The fact that heliospace factors influence the climate is beyond any doubt at present. The question about the degree and mechanism of sauch a correlation remains to be answered. All models testify to the fact that the most dramatic changes would occur in midland areas of Eurasia. In accordance with these models, East Siberia, including Lake Baikal, as they lie in the middle of the continent, are therefore in the zone of intense climatic and environmental changes. Hence it is of interest to analyze long series of observations which makes it possible to study long-term trends caused by the influence of both heliospace and anthropogenic factors. An analysis was made of the possible influence of heliospacefactors on variations of hydrometeorological parameters of Lake Baikal and the Angara river, and on changes of radiation balance elements and surface atmospheric air temperature at the Baikalregion's stations.

The analysis revealed a high degree of correlation between the duration of a solar activity cycle and long-term fluctuations of Baikal's level, the water inflow rate into the lake and the duration of the ice-free state of Baikal and the Angara.

An 11-year periodicity was revealed in the distribution of scattered radiation spanning the time interval 1939-1986.Scattered radiation maxima that are most conspicuous at the spring-summer period correspond to solar activity minima and togalactic cosmic-ray intensity maxima. A statistically significant decrease in direct radiation during the period from 1940 to 1986 was detected for station Irkutsk, as well as for the other stations in the region which are not affected by industrial effluents and emissions. This suggests the conclusion about its global character and no association with the anthropogenic factor.

The warming in the Baikal region is observed as a rise of temperature during the winter months (i.e. the climate decreases in severity) while in the northern hemisphere on the whole the warming occurs through an increase in summer temperatures. Convincing evidence for the actual manifestation of solarvariability in climate characteristics of the Baikal region is presented. A numerical estimate is obtained of this influence on the surface air temperature. A high degree of correlation (the correlation coefficient = 0.97) is established between the mean power of a solar activity cycle and the surface air temperature in the Baikal region as averaged over the solar cycle period.

It is shown that the main meaningful variations in air temperature in the region for the period 1881-1960 were caused by solar variability. The amplitude of temperature variations during this period is 1 degree. Since the 60s till the present, with the solar activity influence remaining, a clear effect of another factor is observed, the role of which has been progressively increasing, and in the last decade it came to exceed the contribution of solar variability. During 1960 to1997, the rise in temperature, not associated with solarvariability, was by 1.7 degree.

An analysis of the surface air variations showed that the changes occurring to date are especially pronounced during the winter-spring period and are most likely associated with a reduction of the stationing time of the Siberian anticyclone. This suggests that the mechanism, by which the factors of regional climate variability are realized, is the global atmospheric circulation rather than a local change in energy balance of the atmosphere.

Attention is given to the detected high degree of correlation between the mean power of a solar cycle and the surface temperature in the Baikal region, with emphasis on the departure of the temperature observed during the last 30 years from a well-established pattern.

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Eintrag von Trichloressigsäure in die Vegetationen verschiedener Klimazonen – Drohen neue globale Gefahren aus der Luft ?

Ludwig Weissflog

Der Probleme Anfang

Für das Auftreten leichtflüchtiger Chlorkohlenwasserstoffe (CKW) in der Umwelt kommen sowohl natürliche als auch anthropogene Quellen in Betracht. So entstehen z.B. C_2-Halogenkohlenwasserstoffe auf natürlichem Wege weltweit bei Biomassebränden in den Savannen und Steppen aber auch bei solchen in borealen und mediterranen Wäldern.

Vertreter dieser Substanzklasse werden aber auch von der chemischen Industrie auf Grund ihrer speziellen physikalisch-chemischen Eigenschaften synthetisiert und in großem Umfang in der textil- und metallverarbeitenden Industrie als Reinigungs- und Entfettungsmittel sowie in der Leichtindustrie als Lösungshilfsmittel verwendet.

Weitere anthropogene Quellen sind chemische Stoffwandlungsprozesse, die während der Verbrennung von Steinkohle in Großkraftwerken, der Müllverbrennung, der Mülldeponierung, speziell in Sondermülldeponien, der Chlorbleiche von Rohzellulose und der Chlorierung im Verlaufe der Trinkwassergewinnung ablaufen.

Zum Beispiel gehört die Substanz *1,1,1-Trichlorethan* (CH_3CCl_3) zu dieser Gruppe der leichtflüchtigen CKWs. Es werden derzeit jährlich weltweit ca. *0,65 Millionen Tonnen* hergestellt. Diese Chemikalie gelangt bei ihrer Emission sowohl in die Atmosphäre als auch in die Hydrosphäre. Nach Angaben in der Literatur muss auf Grund der hohen Flüchtigkeit dieses leichtflüchtigen C_2-Chlorkohlenwasserstoffes mit dem 100%igen Eintrag der industriell produzierten Menge in die Umwelt gerechnet werden.

Aufgrund der höheren Industriedichte ist besonders die nördliche Hemisphäre von diesen anthropogenen Einträgen betroffen. Mit der ansteigenden Industrialisierung, speziell der süd- und südostasiatischen Staaten und des dort derzeit praktizierten Umweltschutzes, ist auch auf der Südhemisphäre mit schnell zunehmenden Einträgen dieser Chlororganika zu rechnen.

Im Gegensatz dazu kann besonders auf dem afrikanischen Kontinent südlich des Äquators im Verlauf riesiger Biomassebrände in den dortigen Savannenlandschaften die Freisetzung leichtflüchtiger CKWs, auch des *1,1,1-Trichlorethans*, beobachtet werden. Dabei ist jedoch oft schwer festzustellen, ob diese Brände natürlich oder anthropogen begründet sind.

Globale Windsysteme und Meeresströmungen sorgen für eine Verteilung der von den jeweiligen Emittenten ausgehenden Substanzmengen über den gesamten Erdball. Es wird deutlich, dass diese bedeutenden Quellen sowohl Punktquellen als auch diffuse regionale und überregionale Flächenquellen sein können.

Erhöhung des ökotoxischen Potentials durch Schadstoffwandlung

Während des Lufttransportes ist auch *1,1,1-Trichlorethan* oxidativen, pho-

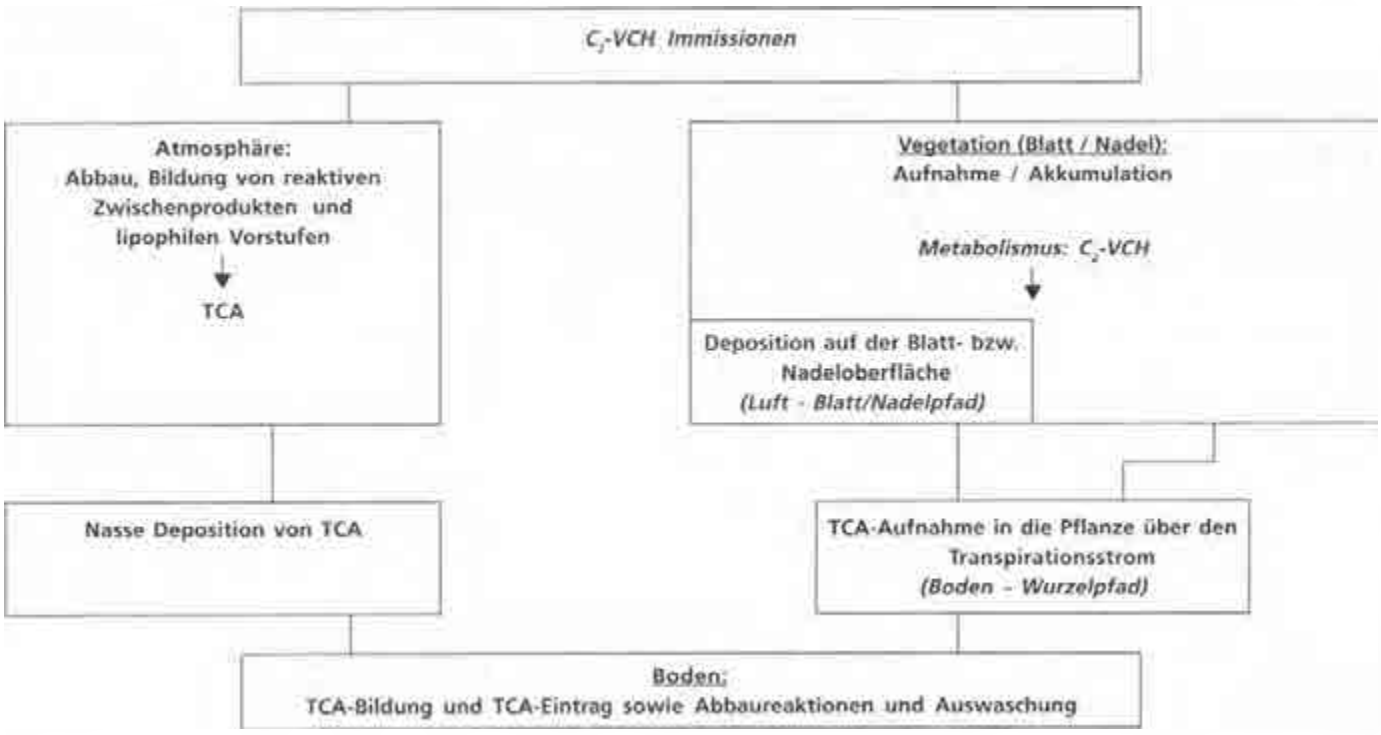

Abb.1: Verteilung und Abbau von C_2-Chlorkohlenwasserstoffen (C_2-VCH) in terrestrischen Ökosystemen

tolytischen und hydrolytischen Prozessen ausgesetzt. Diese können zu einer Veränderung ihrer ursprünglichen Struktur und damit ihrer chemischen und physikalischen Stoffeigenschaften sowie ihrer potentiellen biologischen Wirksamkeit führen. Es können auf diesem Wege auch Umwandlungsprodukte entstehen, die für bestimmte Pflanzen mehr oder weniger toxisch sind. In Abb.1 ist die Verteilung und der Abbau von C_2-Chlorkohlenwasserstoffen (C_2-VCH's) in terrestrischen Ökosystemen dargestellt.

Die genannten atmosphären chemischen Prozesse werden von klimatischen Faktoren, wie der Intensität der unterschiedlichen UV-Strahlungstypen, des Wasser- und des Staubgehaltes sowie des Stickoxid-, Ozon-, Perhydroxy- und Hydroxylradikalgehaltes in der Troposphäre, beeinflusst. Darüber hinaus spielen jedoch auch geographische und meteorologische Gegebenheiten bei der Verteilung der Schadstoffe in den verschiedenen Ökosystemen der jeweils von den Depositionen betroffenen Gebieten eine entscheidende Rolle.

Bei diesen atmosphärenchemischen Oxidationsprozessen werden aus leichtflüchtigen C_2-Halogenkohlenwasserstoffen (Halogen = Fluor, Chlor, Brom) neben anderen Substanzen auch C_2-Halogencarbonsäuren gebildet.

Für die aus dem atmosphärenchemischen Abbau aller relevanten C_2-Chlorkohlenwasserstoffe entstandene Trichloressigsäure finden sich in der Literatur für Deutschland für die Teilkompartimente Luft und Regenwasser folgende Konzentrationsangaben:

* städtische Luft: 3 ng/m³ und
* Regenwasser: 6,4 µg/l

Letztere Angabe ergibt rein rechnerisch für Mitteldeutschland bei einem mittleren Jahresniederschlag von ca. 600 mm einen jährlichen Eintrag von ca. 3,8 mg CA/ml.

Die bei diesen Prozessen u.a. entstehende, stark phytotoxisch wirkende Substanz Trichloressigsäure (TCA; Cl_3CCOOH) ist Gegenstand dieser Ausführungen und wird von uns als Leitsubstanz für das mögliche Auftreten auch anderer Chlorcarbonsäuren verwendet.

In der Literatur werden für die Mono-, Di- und Trichloressigsäure folgende Toxizitäten angegeben:

* EC_{50}-Toxizität 200, 600 bzw. 1200 µmol/l für das Wachstum von Bohnenzellsuspensionen
* EC_{10}-Toxizität für Algen von 0,2 µmol Monochloressigsäure/l bzw. 0,8 µmol Trichloressigsäure/l.

Trichloressigsäure und ihre Derivate wurden in den späten 40er und frühen 50er Jahren international in der Landwirtschaft in Mengen von 15 - 30 kg TCA-Natrium/ha (1,5 - 3,0g TCA-Natrium/ha) besonders als Herbizid gegen monocotyle Gräser eingesetzt. In den meisten europäischen Ländern ist der Einsatz dieser Substanz als Herbizid untersagt.

Über den spezifischen phytotoxischen Wirkmechanismus der Trichloressigsäure ist nur wenig bekannt. In der Literatur wurden in diesem Zusammenhang über die Veränderung der Zusammensetzung der kutikulären Wachse berichtet. Gleichfalls festzustellende Veränderungen des pflanzlichen Wasserhaushaltes infolge eines sich damit verändernden Transpirationsverhaltens könnten z.B. damit im Zusammenhang stehen.

Verbreitung atmogen gebildeter Trichloressigsäure

In den letzten zehn Jahren wurde der atmosphärische Eintrag von Trichloressigsäure in forstwirtschaftlich genutzte Fichten- und Kiefernbestände wissenschaftlich speziell unter dem Aspekt der mittel- und nordosteuropäischen Waldschadensforschung untersucht. Globale Betrachtungen der Wirkungen von TCA-Einträgen auf Wildpflanzenarten und deren Biozönosen spielten hingegen eine untergeordnete Rolle. Vor vier Jahren begannen wir mit Hilfe internationaler

Tab.1: TCA-Konzentrationen in zweijährigen Kiefernnadeln (Pinus sylvestris L.) in den Jahren 1996-1999 an verschiedenen südamerikanischen, nordwest- und südafrikanischen, sowie ost-, nordost- und südosteuropäischen Backgroundstandorten.

Standort	Vegetationstyp	TCA [µg/kg Frischnadel]
Ushuaia, Tierra del Fuego (Argentinien), in Nähe von Kap Hoorn, 150 m N.N.	Gebirgswald	5,00
Concepción, Pazifikküste (Chile), 50 m N.N.	Küstenwald	6,10
Potrerillos, Ostseite der Anden (Argentinien), 1500 m N.N.	Gebirgswald	8,00
Kap der guten Hoffnung (Südafrika), 200 m N.N.	Hartlaubwald	1,59
El Portrillo,Teneriffa/Kanarische Inseln (Spanien), 1850 m N.N.	Gebirgswald	8,17
Lovozero/Kola-Halbinsel (Rußland), nördl. des Polarkreises, 130 m N.N.	Borealer Nadelwald	5,15
Zvenigorod, 40 km westl. von Moskau (Rußland), 150 m N.N.	Osteurop. Mischwald	5,28
Kluchorpaß, westl. Kaukasus (Karacaj-Cerkesische Rep./Rußland), 2200 m N.N.	Gebirgswald	3,54
Athy, östl. Kaukasus (Rep.Dagestan/Rußland), 1500 m N.N.	Gebirgswald	4,29
Elbrus-Massiv, mittl. Kaukasus (Kéberdej-Balkérische Rep./Rußland), 2000 m N.N.	Gebirgswald	5,28

Tab. 2: TCA-Konzentrationen in zweijährigen Kiefernnadeln (Pinus sylv. L.) in den Jahren 1996-1999 an verschiedenen belasteten südamerikanischen, nordwest- und südafrikanischen, sowie ost-, nordost-, südost- und südwesteuropäischen Standorten.

Standort	Vegetationstyp	TCA [µg/kg Frischgewicht]
Puente del Inca, Ostseite der Hochanden (Argentinien), 2800 m N.N.	Gebirgssteppe	43,10
Lagos (Portugal), 30 m N.N.	Küstenwald	47,79
Elandsfontein, Highveld (Südafrika), 1100 m N.N.	Savanne	43,80
St.Cruz de La Palma/Kanarische Inseln (Spanien), 1000 m N.N.	Gebirgswald	118,89
Astrachan-Nacalovo (Rußland), 20 m N.N.	Halbwüste	27,40
Godschur, ca. 120 km südöstl. von Wolgograd (Rep. Kalmykien/Rußland), 200 m N.N.	Schwarzmeer-Steppe	68,91
Nord-Karelien, südlich des Polarkreises, nahe finnischer Grenze (Rußland), 300m N.N.	Borealer Nadelwald	37,89

Projekte Untersuchungen zum atmosphärischen Eintrag von TCA in besonders sensitive aride und semiaride Gebiete Südamerikas und Südost-Europas sowie in arktische Regionen Nordrusslands als einem neuartigen, zusätzlichen Faktor der Wüstenausbreitung. Diese Forschungen konnten im vergangenen Jahr auf südafrikanische Regionen, die ebenfalls von der Wüstenausbreitung betroffen sind, ausgeweitet werden.

Die im weiteren vorgestellten Messergebnisse basieren auf Untersuchungen mit dem Biomonitoring-System „2-jährige Kiefernnadel" verschiedener *Pinus-Species*. Dies ermöglicht auf Grund des Lebensalters der Koniferennadeln (minimal 2-jährig bis maximal 7-jährig), im Gegensatz zu anderen Laubbäumen, gesicherte integrierende Immissionsmessungen über einen Zeitraum von einem Jahr. Vergleichende Betrachtungen sind auf Grund der sich stark ähnelnden chemisch-physikalischen Eigenschaften der speciesspezifischen kutikulären Wachsschichten und der biochemischen Charakteristika der verwendeten Kiefernarten möglich.

Die in Tab. 1 zusammengefassten Ergebnisse lassen erkennen, dass die TCA-Gehalte in den untersuchten Kiefernnadeln sowohl der von anthropogenen Aktivitäten nicht oder kaum beeinflussten Gebiete bzw. Messstandorte Südamerikas, Südafrikas, der Kanarischen Inseln, des arktischen Teiles der Kola-Halbinsel als auch die des westlichen Kaukasus die globale Backgroundbelastung widerspiegeln.

Die Tab. 2 enthält dagegen Angaben über TCA-Gehalte in Kiefernnadeln von Messstandorten, welche sich teilweise bis zu über 300 Kilometer entfernt im Lee von in Frage kommenden industriellen und urbanen Emittenten befinden. Dabei liegen die besonders betroffenen Standorte in der südamerikanischen Hochgebirgssteppe der Anden östlich von Santiago de Chile, im südafrikanischen Highveld, auf der Insel La Palma (Kanarische Inseln), in der südrussischen Steppe nordöstlich des Kaspischen Meeres und in Gebieten der Kola-Halbinsel nördlich des Polarkreises.

Vergleichswerte zur TCA-Belastung des semihumiden Mitteldeutschlands wurden innerhalb weiterer Projekte erhoben (Tab. 3). Die TCA-Konzentratio-

Tab. 3: TCA-Konzentrationen in zweijährigen Kiefernnadeln (Pinus sylv. L.) in den Jahren 1996-1998 an verschiedenen belasteten Standorten in Mittel- und Norddeutschland.

Standort	Vegetationstyp	TCA [µg/kg Frischgewicht]
Ringsdorf (Brandenburg)	Nadel-Laubmischwald	36,58
Jessen/Elster (Brandenburg)	Kiefernforst	41,44
Emden (Sachsen-Anhalt)	Kiefernforst	37,13
Dübener Heide (Sachsen-Anhalt)	Kiefernforst	27,26
Gernrode/Harz (Sachsen-Anhalt)	Nadel-Laubmischwald	19,07
Hettstedt (Sachsen-Anhalt)	Kiefern-Laubmischwald	90,83
Kap Arkona/Insel Rügen (Meckl.-Vorpommern)	Kiefern-Laubmischwald	30,69
Serrahn/Nationalpark Müritz (Meckl.-Vorpommern)	Kiefern-Laubmischwald	25,35

Tab. 4: TCA-Konzentrationen [µg/kg] in zweijährigen Kiefernnadeln (Pinus sylvestris L.) und Bodenproben an verschiedenen südrussischen Standorten im April und Juli/August 1997.

Standort	Probe	TCA	
		April	Juli/August
Kluchorpaß, westl. Kaukasus (Karacaj-Cerkesische Rep./Rußland), 2200 m N.N.	Kiefernnadel *Boden*	3,18 *0,04*	3,54 *0,09*
Kislovodsk/Kurpark, westl. Kaukasus (Rußland), 300 m N.N.	Kiefernnadel *Boden*	4,99 *0,22*	- -
Kislovodsk/Plateau, westl. Kaukasus (Rußland), 600 m N.N.	Kiefernnadel *Boden*	4,00 *0,31*	5,20 *0,21*
Kislovodsk/Observatorium der RAS, westl. Kaukasus (Rußland), ca. 30 km südl. von Kislovodsk, 900 m N.N.	Kiefernnadel *Boden*	3,91 *0,24*	5,15 *0,35*
Elbrus-Massiv, mittl. Kaukasus 2000 m N.N.	Kiefernnadel *Boden*	7,25 *0,46*	5,28 *0,39*
Krasnyje Jar (Rußland) ca. 40 km nördl. von Astrachan, 30 m N.N.	Kiefernnadel *Boden*	- -	3,15 *0,32*
Astrachan-Nacalovo (Rußland), 20 m N.N.	Kiefernnadel *Boden*	20,73 *1,09*	27,40 *1,06*
Cernyje Jar (Rußland) ca. 180 km nördl. von Astrachan, 50 m N.N.	Kiefernnadel *Boden*	- -	10,37 *n.n.*
Elista (Rep. Kalmykien/Rußland) ca.250 km südl. von Wolgograd, 150 m N.N.	Kiefernnadel *Boden*	6,85 *0,34*	10,07 *0,22*
Godschur (Rep. Kalmykien/Rußland) ca. 120 km südl. von Wolgograd200 m N.N.	Kiefernnadel *Boden*	28,43 *0,08*	68,91 *0,22*
Zvenigorod (Rußland) 40 km westl. von Moskau	Kiefernnadel *Boden*	5,28 *0,10*	- -

nen [µg/kg] in zweijährigen Kiefernnadeln *(Pinus sylvestris* L.*)* und Bodenproben an verschiedenen südrussischen Standorten sind in Tab. 4 vergleichend aufgeführt. Emissionsfaktoren verschiedener, bei der Chlorbleichung von Zellulose entstehender C_2-Chlorkohlenwasserstoffe sind in (Tab. 5) zusammengefasst

Zusammenfassung

An allen untersuchten Standorten kann ein gezielter anthropogener Einsatz von TCA mit absoluter Sicherheit ausgeschlossen werden. Zwei mögliche Aufnahmepfade sind für die Ausbildung der TCA-Gehalte in der Vegetation zu nennen: der *Boden/Wurzel-Pfad* und der *Luft/Nadel(Blatt)-Pfad*. Für die im Bioindikationssystem Kiefernnadel nachgewiesenen Gehalte kommen deshalb neben möglichen geringen atmosphärisch in den Standortboden eingetragenen TCA-Mengen als wesentlichere Quellen nur Depositionen der als Sekundärschadstoff atmosphärenchemisch durch Oxidation von *1,1,1-Trichlorethan* gebildeten Trichloressigsäure bzw. deren lipophilere Vorprodukte in Betracht. Dies dürfte ebenso für die anderen möglichen, hier nicht betrachteten Halogenessigsäuren zutreffen. Auf Grund der im Boden südrussischer Standorte nachgewiesenen geringen TCA-Gehalte, die wiederum in keiner Korrelation zu den in den Nadeln der an den gleichen Standorten wachsenden Biomonitoring-Kiefern nachgewiesenen TCA-Konzentrationen stehen, gehen wir davon aus, dass bodenmikrobiologisch gebildete, aber auch über den Luft/Boden-Pfad eingetragenen TCA-Mengen nicht zu den wesentlichen Quellen für das Auftreten von TCA in der Vegetation gerechnet werden sollten.

Erste eigene Untersuchungen zeigen, dass TCA-Einträge speziell in die Vegetationen semiarider und arider Gebiete den dort vorherrschenden Trockenstress für Pflanzen auf Grund ihrer phytotoxischen Wirkung verstärken und somit die

Tab. 5: Emissionsfaktoren leichtflüchtiger C_2-Chlorkohlenwasserstoffe, die bei der Produktion von Zellulose während des Chlorbleiche-Prozesses anfallen [g / t Zellulose].

Substanz	**Emissionsfaktor**
Tetrachlorethen; (C_2Cl_4)	0,01-0,02
1,1,2-Trichlorethen; (C_2HCl_3)	0,50-1,00
1,1,1-Trichlorethan; ($C_2H_3Cl_3$)	0,30-0,70
1,1,2,2-Tetrachlorethan; ($C_2H_2Cl_4$)	2,00-10,00

Vegetationen durch die Verringerung der Pflanzenbedeckung des Bodens weiter destabilisieren. Dieser Prozess der Destabilisierung verstärkt z.B. in den zwischen Kaspischen Meer, Schwarzen Meer, Kaukasus und Wolgograd liegenden südrussischen Gebieten die auf mehrere anthropogene und nichtanthropogene Einflüsse zurückzuführende Wüstenausbreitung.

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Recovery of Municipal Waste – A short summary of current recycling strategies in Germany

Gunther Weyer

In the last three decades in Germany the dealing with waste has changed intensively. In 1972, when the first German waste management law came into force, waste disposal has been characterized by the deposit of unsorted untreated waste in former mineral workings. Whilst the following time this way to deal with waste has been acknowledged as environmentally unsound and not sustainable.

Therefore big efforts were made to develop a waste management strategy, that minimizes environmental impacts of waste disposal and supports the saving of natural resources and energy. Below, the current recycling efforts for municipal waste are summarized based on the situation in Lüneburg County, that is quite similar to other German regions.

It is not intended to propagate the transfer of German waste policy to the region of Lake Baikal, but maybe the thinking about waste management under different conditions can be stimulated.

In Lüneburg County (1.6 million inhabitants, 15,505 km^2) the total arising of municipal waste in 1997 was about 970.000 tonnes. A share of 240,000 tonnes was separated for recycling or recovery (paper, glass, plastics, textiles, timber). Additionally another share of 135,000 tonnes of organic waste was processed to a quantity of 82,000 tonnes compost.

The remaining amount of 613,000 tonnes was disposed in nine landfill sites (491,000 tonnes) and one incineration plant (122.000 tonnes). 3,400 tonnes of difficult waste was separated and brought to special waste treatment plants. The recovery rate of about 36 % was reached by the following activities:

Paper, cardboard, glass and metals are collected for re-processing in industry at high rata. The collection of paper, cardboard and glass is organized by the local governments and the DSD Corporation (see below). People can deliver paper, cardboard, glass and partly tins and textiles to container stations, which are distributed in residential areas (about one station per 500 inhabitants).

Additionally there are street collections for packages and for paper and cardboard. The collection and the marketing of used clothes and scrap are managed by commercial dealers.

Between 60 and 75 % of the packagings, that have been putted into circulation, are returned by the German packaging collection and recycling service called „Duales System Deutschland - DSD". These recovery rates are required by law. The costs for recycling are putted up on the prices of the products, which then are marked with a green spot imprinted on the packages and containers.

In landfill sites, organic wastes are one of the most difficult materials, because they decompose and form landfill gas and leachate. In Lüneburg County the green waste like tree loppings or grass cutting is given to composting facilities. In addition some local district councils has introduced a separate sanitation service for organic waste from households like kitchen waste and food residues. Organic waste from canteens, restaurants and food manufactures are usually collected by commercial recyclers.

Construction and demolition waste contains a lot of materials, that can be re-used in civil engineering and landscaping. In Lüneburg County the recovery of construction waste has substituted landfillung widely. After minimisation of toxic compounds in sewage sledge nearly all of it (1996: 45.000 tonnes) is recovered in farming for fertilisation without environmental harm.

In opposite to the dealing with municipal waste, the minimisation and disposal of industrial waste had required the development of specified conceptions for each industry.

This year the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety had set out their aim, that beginning in 2020 all municipal waste in Germany should be recovered. This aim requires the combustion of different burnable wastes in „waste to energy plants", that generate heat and power.

Finally the discussion of the best practice in waste management in Germany is not finished at all.

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GIS-Based Monitoring of Selected Littoral Zones of Lake Baikal

Klaus Schmieder & Horst Tremp

Abstract

In large lakes the establishment of littoral GIS has proven to be a valuable basis for monitor the integrity of ecological littoral state. Although littoral zones cover only a small part of the whole Lake Baikal surface area they can be seen as transfer zones connecting the catchment area with the main basin of the lake. Just as the intensity of nutrient turnover due to elevated temperatures and the importance for fish should be mentioned.

To determine the integral trophic status of littoral zones - mainly bays - submerged macrophytes can be used. The indication values of the holarctic distributed macrophytic species of Lake Baikal are probably comparable with alpine lakes (Lake Geneva, Lake Constance), where a wealth of information is available. These species show very sensitive changes in water quality and have been very useful in indicating nutrient loading of lakes and rivers since many years.

Beside the bioindicator based monitoring of selected aquatic littoral-zones, features of the semiaquatic shoreline should be implemented in a monitoring program. It covers rock cliffs, rocky shores, periodical overflowed fens, sandy beaches etc.. The same types – but man influenced – should be compared and evaluated due to their influence of the nutrient loading of Lake Baikal.

To establish a littoral GIS remote sensing methods play a major role. Combined with field surveys or verified training areas they provide classification possibilities of even submersed features like submersed macrophyte beds.

In 1993, submersed vegetation of the whole littoral zone of Lake Constance was mapped with a combined field survey and aerial photo interpretation method by the Institute of Landscape- and Plant-Ecology at University of Hohenheim. The survey was the third of its kind after 1967 and 1978, including a period of fast eutrophication in the sixties and seventies (mainly caused by increasing phosphate concentrations) and a subsequent period of decreasing trophy, due to the international efforts of the countries and states in the catchment area in eliminating phosphate from waste water. The research project should furnish information upon the current situation of nutrient impact in the litoral zone of Lake Constance. By that means the measures of redevelopment of the riparian states should be controlled for success.

The use of a geographic information system (GIS)-software enabled to create geographically referenced maps of distribution areas of submersed macrophyte species and of a calculated index of nutrient load on base of the indicator values and the abundance of species.

As a result of the project a geographic information system of the shore area of Lake Constance was created which contains data on distribution of submersed macrophytes in 1967, 1978 and 1993, a survey of the littoral sediment quality in 1993 and an evaluation of human landuse intensity of the shore area in 1967, 1978 and 1993. This information system provides a useful tool for monitoring the shore area of Lake Constance and also for futural plannings in landuse, development, renaturation and nature protection.

The methods developed at Lake Constance are well transferable to other large lakes with littoral areas covered with submersed macrophytes and could produce useful information for landuse management on the shore areas of Baikal.

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Workshop: Landscape Planning and Sustainable Regional Development

Prospects for Sustainable Development in the Community of Ust-Barguzin (Barguzin Rayon/ Buryat Republic)

Silke Behrend, Martina Richwien & Robert Mayer

Summary

In the debate on sustainable development in the Baikal region, in our judgement, an essential point hasn't found enough attention in the debate upon future development of the region until now: the concept of sustainable development on the level of the grand Baikal region has not yet found sufficient correspondence and application on the level of local community - where people live and work. In the documents of Agenda 21 local authorities are given the key role in the implementation of sustainable development, for this its the administrative level which is closest to individual people (sect. III/chpt. 28 of Agenda 21).

Taking the community of Ust-Barguzin (Republic of Buryatia) as an example, the question is raised here, which are the conditions for a community for a future economic development respecting the criteria of sustainability.

Key words

regional development, self-government, municipality, Ust-Barguzin

Background

The authors took part in an excursion to the Baikal region in 1996. It was organized within a scientific students project by the universities of Hannover and Kassel and was supported by the Bundesamt für Naturschutz and VW foundation. The intention of the project was to offer an opportunity to students to know the region and to work out conditions and potentials for sustainable development during a two months stay in the Barguzin region. As a result it turned out that such potentials, although clearly to be identified for the Baikal region in general, were difficult to be recognized and put in use on the local level. It remained unclear which institution or individual could take the lead in sustainable development of the community.

Departing from current discussions and activities related to Local Agenda (Agenda 21) in Germany and other west European countries, these questions were raised at the beginning of a second stay of the authors in the Republic of Buryatia from February to May 1999, supported by the German Academic Exchange Service (DAAD). During this stay we were able to intensify our studies of the socio-economical situation in the settlement of Ust-Barguzin already known from 1996. In addition, we tried to investigate general conditions for regional development in Buryatia in present time. One of the goals was to develop ideas for a co-operation in this field in the context of a joint Buryat German scientific project.

Our stay was supported by the Baikal Institute of Nature management in Ulan Ude, providing literature and statistic material. A multitude of interviews were carried out with collaborators of scientific and government institutions, administration, NGO's as well as with families and private persons in the Barguzin Rayon. The results of our stay is reviewed here in short, thus trying to outline potentials and possibilities for a sustainable development in the Baikal region.

Planning objectives

Lake Baikal, oldest lake and largest by depth in the world, with unique nature and landscape, was internationally recognized as Biosphere Reserve in 1990 under UNESCO's Man and the Biosphere (MAB) Program and was inscribed by UNESCO on the Register of World Heritage Sites in 1998. Many international meetings were held during which conservation and protection of the lake was discussed and specified as an important task for the whole of the world community. Planning objectives were set up, reflecting the goals set by IUCN rather than the interests and necessities of the local communities of living in the region.

UNESCO also recommended to establish a legal base for the protection of the lake. Outlines of such an international convention, shortly called Baikal law, were proposed to the Russian Parliament (Duma) in 1992 already. After its ratification in early 1999 there exists now a legal frame for the protection of Lake Baikal.

One of the main features of the concept proposed by the Davis expertise was the zoning of the Baikal watershed with land use recommendations according to ecological potential and sensitivity, which was then implemented into the Baikal law (*RAS-SB* 1994, part III, p. 33). Departing from seven basic categories of land use, i. e. agriculture, settlements, industrial lands, nature reservation, forest, water and adjacent airshed, which were further divided into 25 different land use zones, distributed over 3 areas: the core area, the buffer area and the remaining area, a land use policy is recommended which takes into account the cultural and economic the traditions of the different ethnic groups living in the region (*Davis Exp.* 1993, p. 16/17).

For implementation of the law and co-ordination of land use policies the international Baikal commission was installed. The commission is supposed to initiate and support the measures recommended by the land use concept and to dispose, as legal body, for the "Baikal environmental protection funds" installed as a special item in the budget of the Russian Federation.

The Baikal commission takes the role of being an instance superior to local interests. The authors of the Davis expertise, although deploring the lack of communication and information exchange between administration and government units as well as between

scientific institutions in the region, express the hope that the Baikal commission successfully may overcome this handicap and promotes co-operation (*Davis Exp.* 1993, p. 106/107).

In our judgement, an essential point hasn't found enough attention in the debate upon future development of the region until now: the concept of sustainable development on the level of the grand Baikal region has not yet found sufficient correspondence and application on the level of local community - where people live and work. In the documents of Agenda 21 local authorities are given the key role in the implementation of sustainable development, for this its the administrative level which is closest to individual people (sect. III/ chpt. 28 of Agenda 21). A land use concept must avoid to appear, from the perspective of the community, as a mere list of rules and regulations. The advantages and chances for perspective planning lying in the concept of sustainability must be clearly pointed out. The community must see the possibilities to become active in their own interest, and activities in agreement with the criteria of sustainability must be supported - mentally, institutionally and financially.

The question is raised here, taking Ust-Barguzin in the Barguzin Rayon (Republic of Buryatia) as an example, which are the conditions for a community for a future economic development in this specific region? Which are the starting points on the community level where local action can be successful and, at the same time, respect the criteria of sustainability? Do we find to date any correspondence on this level of overlaying legal settings and conceptual policies? Which role plays the concept of sustainability in the discussion on the community level, if there is such a role at all?

Apart from the local socio-economic situation in Ust-Barguzin we try to elucidate the economic boundary conditions which are given for the Republic of Buryatia within the Russian Federation. In order to understand the present options for regional planning in this part of Siberia we try to put a short look upon the tradition of territorial planning descending from former Soviet Union which is largely responsible for the economic and spatial structures here, and for the problems linked to these structures.

Ust-Barguzin, a community on the shores of Lake Baikal

The settlement of Ust-Barguzin situated in the southern Taiga zone, on the eastern banks of Lake Baikal, south of the mouth the Barguzin river. The surroundings are characterized by forest taiga, beaches of sand and gravel stretch along the Barguzin bay. The coastal plain in which the settlement is embedded is made up to a good part by the swampy lowlands along the mouth of the mountain rivers. The Barguzin valley is one of the northernmost examples of the Inner Asian steppe.

Even in the sparsely populated Republic of Buryatia (3 inhabitants per km²; *GRB* 1995), Ust-Barguzin takes a peripheral position. The main settling regions in the Republic are the southern Rayons along the Transsib Railway and in the valleys of the rivers Selenga and Uda. Another track of settlements is the Baikal-Amur Railway at the northern tip of Lake Baikal

The Barguzin Rayon counts to the most sparsely populated Rayons in the north of the Republic. Only 28.000 inhabitants live on an area of 18.500 km² of which 10.000 live in Ust-Barguzin and 5.000 in Barguzin, administrative capital of the Rayon. The remaining are distributed over 33 villages and small settlements with a few buildings, almost exclusively situated in the southern Barguzin valley (*GRB* 1995, p. 35). The community of Ust-Barguzin includes the settlement of Ust-Barguzin and the villages of Maksimicha, Kurbulik, and Gusicha.

According the structure of the settlement and its type of buildings Ust-Barguzin has the character of a village. With the exception of the main road , *"Uliza Lenina"*, which leads to the ferry over the Barguzin river and a few side roads most roads are not paved. The road plan takes the form of a grid, indicative for the period of systematic planning connected with the resettlements of the fifties. With the exception of a few enterprises and public buildings as well as some sparse apartment buildings, small one family houses with fenced yard and kitchen garden are prevailing. The houses are usually built from strong timber beams in the traditional Siberian manner, often beautifully decorated with carved wood and painted.

Ust-Barguzin is a predominantly Russian settlement, while most of the villages in the Barguzin valley are almost exclusively inhabited by Buryats.

In the following we try to outline local economy, community administration, and common living of the inhabitants of Ust-Barguzin not based upon a systematic investigation but rather upon fairly representative interviews and informal talks in the years 1996 and 1999 with individuals, families, administrators, business-men and -women, and various representatives of development projects (TACIS), government institutions (including National Park) and non government organisations (NGO's) in Ust-Barguzin and Ulan-Ude. Also included are information and data taken from the official "Program for the soci-

The location of Ust-Barguzin

al-economic development of the Barguzin Rayon for the years 1998 to 2005" (MERB) as well as accessible statistical material.

Economic situation in Ust-Barguzins

In spite of its rural character, taken from the economic structure Ust-Barguzin is an industrial settlement. This is in contrast to the Barguzin valley where agriculture dominates. Traditionally, fishery and forestry are the most important industries. The most important enterprises in the past were, till the beginning of the general economic crisis in the late eighties, the fishery, the meat, forestry and timber enterprises, and a few enterprises in the food sector (a bread factory). There existed also a central repair unit for machines and vehicles of the agricultural and forestry sector, as well as two road construction enterprises, one of which was specialized in the construction of public roads, the other one of forest roads, the latter at the same time functioning as transport enterprise. The timber enterprises have almost ceased to exist since the years of the market reforms because they a run with a technology completely out of date, thus not attaining profitability.

All the other enterprises are close to insolvency or have already closed down. A representative from the administration in Ust-Barguzin described a common practice by which enterprises are saved from bankruptcy just by refoundation of a new enterprise under a new name in the same site and business.

The fishery enterprise, for example, counted about 350 workers (45% women) in 1996, thus still being one of the largest enterprises in Ust-Barguzin. It belonged to the enterprise "Baikalrybchos", with various establishments spread over the region. It was transformed into a stock company, but close links with the government continued to exist in the form of financial subsidies, credits at favourable conditions and deliveries of fish at guaranteed prizes to government authorities. This situation was seen as positive by the director of the enterprise for it seemed to guaranty the maintenance of the enterprise at a modest level. Today, though, the fishery enterprise is, as most other enterprises, close to insolvency. A refoundation as described is intended, and the company is also part of an initiative of the Mayor of Moscow, Luschkow (see below).

It can be seen from this example that an incomplete or fictitious re-structuring of the economy is prevailing and reforms are thus delayed. Financial funds are lost in enterprises out of date which are missing for the build-up of a modern industry. The consequences show up in a drastic lowering of industrial production. The official "Program for the social-economic development of the Barguzin Rayon for the years 1998 to 2005" predicts the reduction in productivity and profit from fishery products in 1997 to be as high as 93%, from timber products 92%, bread products 83% and meat products 92% (*MERB*).

The private sector is made up essentially by small enterprises in the trade and transport sector. In 1996 there existed in Ust-Barguzin about 20 retail stores, in parts public as well as private. Since then an number of private stores has been closed down.

The trade with raw timber and its export to China seems to be in the hands of small enterprises, the most profit share going to seller and trader. The regional economy takes very little profit from this trade. Long-term economic thinking and ecological consciousness are deficient. The selling of timber takes place in auctions within the standing forest. Control of cuts and trade through forest authorities is insufficient due to insufficient equipment.

These examples may show the way in which the communities are subject to the general economic deterioration. These are, on one hand, symptoms of the deep economic crisis and, at the same time, contribute to its aggravation.

Development of tourism, intended to be a main economic branch in the future as expressed in the Davis expertise, in the "Ecotourism Masterplan for Lake Baikal" (1994), as well as in the statements from the Buryat Minister of Economy, also belongs to the objectives of the "Program for the social-economic development of the Barguzin Rayon for the years 1998 to 2005" (*MERB*). In order to promote this intention the administration of the Rayon installed a section for tourism.

The most important actor in the field of nature tourism in Ust-Barguzin is the Sabaikalskij National Park. The park administration has constructed trails in the territory of the park, provides simple tourist facilities and organizes hikes and excursions for tourists guided by park rangers. In Ust-Barguzin there exists a small enterprise which operates a hotel boat in which national as well as foreign tourists are hosted during the summer months. Since 1990, when the first foreign tourists reached Ust-Barguzin, a small private tourist sector developed in spite of the existence of large hotels and tourist facilities from earlier years (the hotel of the fish enterprise, for example). But the quality of these hotels did not comply with the expectation of many tourist, especially with regard to equipment and catering.

In its present state the tourist sector can not yet be seen as an efficient and valid economic branch for Ust-Barguzin. Private lodging of tourists is seen, to date, rather as an additional source of income apart from other sources. But it can be considered as a starting point for further economic development although compatibility with the criteria of nature protection and sustainability has yet to be investigated.

Since economy is down, private subsistence becomes the main economic activity for the Ust-Barguzin population. This includes growing of vegetables and potatoes and smallhold cattle and poultry in the first line, but also fishing, hunting, collection of mushrooms, berries, nuts (from Siberian Pine) and the processing of various products. Introduced in the economic statistics, the profit from this sector would take a dominant position taking into account that a majority of the population depends upon subsistence. This is confirmed when looking at the official statistics of the Republic of Buryatia: for 1998 the share of individual smallholder farming in agricultural production of Buryatia amounts to 66% (*GKSRB*, 1999). Even those who still keep an employment are often forced to secure their own living and that of their families by this sort of side economy.

Living in Ust-Barguzin

In our interviews with people from Ust-Barguzin living conditions during the last few years were specified as bad and in lack of any perspective. Similar results are provided by a poll organized on behalf of the Parliament of Buryatia in 1996 for the whole of the Republic (*Karnyschew* 1996). Living of most people is characterised by unemployment and inflation, irregular or missing payments of salaries and pensions. No official data

are available for the unemployment in the community but in the discussion with various persons the unemployment rate (included the covered unemployment) was estimated to range between 50 and 70%. For the whole of the Barguzin Rayon the percentage of earned income of the population is officially given to be 35 % (*GKSRB,* 1999). Since 1991 the gross income of the population has dropped to half until 1997 while at the same time funds for unemployment payments have decreased as well for one third. These conditions clearly stress the importance of subsistence economy for the survival of most individuals mentioned above.

In a rapidly changing society, as we find it here, the importance of family relations and mutual help can not be overestimated, a situation in which the family often forms the only fairly intact social network after the almost total breakdown of industrial enterprises. And yet the situation in the families is increasingly complicated by unemployment and loss of social orientation. In this context alcoholism must be mentioned, a problem which played a role in soviet times already, but which is severely aggravated in the present economic situation. Our interview partners from Ust-Barguzin often attributed essential responsibility for the deterioration of family structures to alcoholism.

Possibilities and restrictions of autonomous community administration

Social and medical infrastructure as well as cultural and educational matters in Ust-Barguzin are largely restricted due to the bad economic situation in the whole of the Russian Federation. Although the periphere rural parts of Eastern Siberia belonged to the underdeveloped regions already during the past soviet times, the situation has worsened recently as a consequence to the general economic crisis. Public funds are only available for basic supply on the lowest level, sometimes less than this. This judgement is materialized by the close down of cultural programs and facilities, closing of child care centres and decreasing medical care, breakdown or substantial reduction in public traffic. In the proposal for the Budget of the Republic of Buryatia for the year 1999 the amount of expenses for local demand is adjusted to "social minimum standards" which, in turn, depend upon the "level set for the overall budget of the Republic" (*BRAC* 1999). The Buryat Republic is one of the poorer members within the Russian Federation, thus forming an "acceptor" in the federal budgetary balancing. Within the Buryat Republic itself most of the 21 Rayons come up with only a marginal part of their own budget. In the "Program for the social-economic development of the Barguzin Rayon ..." the budget for 1997 figures with 32% of internal and 68% of external (federal) input (*MERB*). Dependency of the Rayon from external financial input via the "funds for the support of autonomous local administration in the Republic of Buryatia" is steadily increasing. In spite of these transfer payments there is a constant budgetary deficit which amounted to 24% of the expenses in 1997. The vice director of the administration describes the situation for Ust-Barguzin as being even worse. The community budget is covered by internal sources only to about 5 to 7%, and similar figures are given for the 1999 estimates for the whole of the Rayon (*BRAC* 1999). The responsibility for the budget is given, according to the Buryat administration rules, to the rayon and not to individual communities. The same is true for the settlement of local tax rates. In view of unemployment and a low profitability or even close down of the local industry, a budgetary statement becomes almost obsolete for the community.

On the other hand, due to the administrative structures given it is principally difficult for the community to implement own ideas and concepts of development. Although Ust-Barguzin holds about one third of the population of the rayon there are only 4 representatives of the community in the regional parliament with a total of 25 seats which makes it difficult to pursue the interests of a industrial settlement against the interests of the rest of the Rayon which is predominantly occupied by agriculture activities.

In their own judgement, the work of the Ust-Barguzin administration is characterized self-critically as "being more intuitive than planful, following a clear perspective". Most of the word done at the lower administrative level therefore is necessarily directed towards the solution of trivial and all-days problems rather than towards policies of sustainable development. The inability of the administration of Ust-Barguzin, due to structural and institutional deficits, in taking influence on the future development of the community can largely be explained by the heritage coming from the centralised administration system, especially when it comes to territorial planning, installed during the soviet period. We will take a short look upon this heritage.

Territorial planning in the Soviet Union

The development of the settling system in the Soviet Union, and especially in Siberia, was characterized by a highly extensive land use concept prodigal in the use of space and resources. Till the end of the 1960ties territorial planning was mainly consisting in the implementation of new industrial complexes. Only after the elaboration of a "General scheme for settlements on the territory of the USSR" in the seventies a concept for spatial planning was put in function for the whole of the territory. In the Soviet Union the spatial planning was largely inspired and determined by economic policies and was intended to respond to the requirements of the industry with regard to the distribution of industrial sites over the country. Thus the general scheme for settlements was based upon the "General scheme for the development of the productive forces and the distribution of industrial sites of the USSR". And yet it had no obligatory character, and usually the reality of the spatial organisation of the industrial sites was well apart from the recommendations of the planners, a fact which is explained by the dominant position of the centralized industrial ministries and their subdivisions. In practice the decision on the use and distribution of resources was in the first line up to the ministries of the union, without much influence from regions and (*Brade & Grimm* 1998).

The industrial development, especially that of Siberia, to its present structure was thus determined mainly by the economic interests of the central authorities of the union. *Stadelbauer* (1986, p. 11-33) describes the European-Russian (industrial) settlement of Siberia as a continuous sequence of economic activities. Industrial project of the Soviet Union were based upon the resources in energy and raw materials of Siberia.

Unlike Western Siberia, due to its large distance to the European industrial centres the industrialization of Eastern Siberia did not start until the accomplishment of the Transsiberian Railway about one hundred years ago. For a long time there existed only a few poles of devilment, the Territorial Production Complexes (TPK) like, e. g, Bratsk-Ust-Ilimsk or traditional centres like Irkutsk. But these poles were not linked with each other in a sort of grid structure as we see it in Western Siberia. Large regions in Eastern Siberia remained sparsely populated and industrialized.

Although Buryatia is one of the less developed members of the Federation, with deficient infrastructure, during soviet times it was attributed a certain strategic importance with respect to the influence of Eastern Asia and China. This ended in a relatively high concentration within the military sector. A large part of the industry belonged to the military-industrial complex, as for example aviation and space (*RAS-SB* 1994, part II, p.1). Even food industry was oriented towards the supply of army members. Buryatia was a largely closed, isolated region. The director of the Industrial Support Centre in Ulan-Uda sees many today-problems of Buryatia linked to this heritage, i. e. in the isolation, mentally and factual, due the poor infrastructure with regard to connection with its neighbour regions Irkutsk and Tschita. One of the largest problems in the Buryat economy is the conversion of the armament industry. The Buryat Institute for Working Problems estimates that 30 to 40% of the industrial employees will loose their employment due to conversion (*Manzanova,* 1996, p.56).

Today new legislation allows for a larger influence of the republic, regions and administrative territories within the Russian Federation upon the decisions. The decision process is intended to be much more decentralized. But the process of developing a legal frame for spatial development in the RF is in its very beginning. In general, the relation between directive planning and regional development has been shifted since the installation of free market economy. After the cease of the central economic planning system, regional planning has to find and to define dependable and sustainable conditions for the development of regions (*Brade & Grimm* 1998, p. 59). During soviet times, the elaboration of planning projects for regions or general planning for cities were put in order by a government planning commission and by a few large planning and project institutions. Still today the influence of the centre upon planning and decisions on the region is large. There is for example a variety of committees and institutions in Moscow which are actively planning for regional development in regions spread over the Federation (*Kirkow* 1997, p. 48).

It appears to us, under these conditions, that regional and community administration must be ready to accept planning ideas and proposals coming from the region or community itself, and it should then consequently make use of its right to act as planning authority, taking into regard the principles of sustainability and incorporate them in their policies

Planning objectives translated to the community level of Ust-Barguzin

Looking at the present situation in Ust-Barguzin from the viewpoint of the general objectives for sustainable development it becomes clear that conceptual, legal and institutional guidelines have found, until now, little or no correspondence on the community level. The economic conditions in Buryatia are very unfavourable and the same is true for any socially and ecologically sustainable development. On the other hand, weakness and breakdown of old industrial and institutional structures offer the chance for a new beginning, taking into regard aspects of sustainability.

The vice director of the Ust-Barguzin administration mentioned three main sectors in which good chances for development in the community are seen:

- foundation of small enterprises
- restructuring of old enterprises
- development of tourism

Hereby the main quality of the small region around Ust-Barguzin is seen in the nature potential. The idea of nature conservation and protection, and of an economy adapted to the sensitivity of the natural system has already been introduced in the program for the socio-economic development of the Barguzin Rayon. It was also considered by the initiative for the foundation of Moscow-Barguzin Company (see below). It is planned that small enterprises are founded for processing of natural products of the region.

There are more items taken from the principles of Agenda 21 to be found in the development program for the Rayon, as e. g. "partnership for sustainable development". This means participation of the population in the decision processes of the community. Also "the key role of the local authorities in the implementation of sustainability goals" is taken into account to a certain extent by stressing the efforts for the development of the human potential, i. e. making use of manpower and human skills, search for employment etc.

A closer look reveals however that the program for socio-economic development, part of a government program under the same name for all of the 21 Rayons, carries to a large extent a directive character. Although it clearly specifies and calls upon the actual situation and existing problems in the Rayon, but does not derive a valid strategy in order to solve the problem. Various goals are defined but concrete steps or guidelines for implementation are not proposed.

Some essential goals of the program obviously were incorporated by the Moscow-Barguzin Initiative for the foundation of an enterprise in the form of a stock company. The Initiative was lanced by the Mayor of Moscow, Luschkow, and it is a typical example for the way economic affairs are negotiated in Russia between interested partners, avoiding federal structures and mechanisms, and by which persons from the centre (Moscow) can gain direct influence upon the regions. The actions of the enterprise seem to be directed to the integrated development of the Barguzin Rayon. They include the foundation of small enterprises in which agricultural and nature products are processed and traded. Fishery and fish processing, timber production and manufacturing as well as support and consulting of farmers, business organisations and trade are in the program of the company, in which the Rayon is supposed to hold 50% of the share. (The joint-stock company „Moskow-Barguzin")

Many of the individual project are located in Ust-Barguzin, including the restructuring of the fish factory. Until now there is little financial transfer and active support seen from Moscow, and it remains obscure who the investors for the various enterprises will be. It is reported that the community of Ust-Bar-

guzin and the administration of the rayon participated in the definition of the action program of the Initiative. In view of the miserable economic situation, certainly every help and contribution from outside are welcome. But in our judgement the Initiative is seen from the Barguzin side rather idealistic, with a certain naivety and little criticism. Too much influence from Moscow upon the activities of the company is not feared.

Some of the most active persons in Ust-Barguzin, individuals with own plans of founding small enterprises, a non-governmental-organisation (*Ecological Centre*), employees from the National Park, teachers, some of the administrators have already begun to think about the future of the community.

Thus, National Park employees have taken the lead in nature conservation and protection. They promote the ideas of ecology and resource protection in the debate on community development. A NGO "In common for the Baikal" has been founded as a joint initiative from National Park and Ecological Centre with the goal to promote nature protection and especially environmental education. On the program are questions like sustainable use of forests and forest protection. The Ecological Centre has started with actions to raise the sensibility of the population towards question of urban development, protection of green zones etc.

The National Park is active in the sector of nature tourism. This initiated private lodging projects and services for foreign tourists. The first tourist family enterprise was founded. As the first project within the Moscow-Barguzin initiative the plant was founded for filling and selling mineral water from the region. It will soon take up production.

All of these activities are singular events. A common strategy is not yet found which could give a valid perspective for the community. Especially there is yet little co-operation between administration, individuals and interested citizens. Participation takes place mostly on paper but rarely is reality. The chances of such co-operation is not yet fully recognized and administration still tends to be sceptic towards active citizens who want to interfere.

In order to promote the development in the community towards ecological, economic and social sustainability it is necessary to break and put down with this mentality, and to arrive at a culture of common planning in the form of a dialogue. This is, in our opinion, the only way to unite all energies and to come to a strategy leading to practical guidelines. In this way overall concepts expressed in very general terms, often concentrated upon land use problems, can be kept in view and at the same time respond to social and economic interests and necessities on the local level.

The use of such an approach should also give access to government funds, as e.g. the Baikal funds installed for the implementation and promotion of sustainable development. Money can thus been spent in manner that makes sense with respect to development goals. At the same time the community could form a powerful and well informed group of personalities able to take up the dialogue with institutions like the Baikal Commission.

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Current Problems of the Buryatian National Parks within the Baikal Region

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Abstract

National Parks are the second strictest category of protected areas in Russia. Buryatia has two National Parks: Zabaikalsky (or Trans-Baikal-) National Park and Tunkinsky (or Tunka-) National Park. The first was founded in 1986. Its area is 246,000 ha, 37,000 ha of this being water. The Zabaikalsky NP is located on the eastern shore of Baikal, and it includes the peninsula of Svyatoy Nos, the southern part of the western slope of the Barguzinsky Mountain Ridge, the Ushkanyi and Chivyrkuiskiye islands, and Chivyrkuisky and Barguzinsky Bays. On the north it borders the protected area of Barguzinsky Zapovednik – the first Russian strong protected area, which was established in 1916. The relief is middle-mountainous and high-mountainous. The bottom height belt is occupied by Larix sibirica forests. Higher Pinus sylvestris and Larix sibirica forests with Pinus cembra ssp. Sibirica are spread. Between 400-500 m and 1,000-1,200 m above sea level dark coniferous forests of Abies sibirica, Picea obovata, Pinus cembra are to be found. Higher they change to Larix and Abies forests. From a height of 1,400-1,500 m above sea level mountain tundras and rocky slopes are spread. On the Barguzinsky Mountain Ridge are alpine meadow sites. On the north and around river mouths bogs are numerous. Typical taiga animals live here: roebuck, musk deer, brown bear, sable wood grouse, hazelgrouse, and black grouse. On the Ushkanyi Islands there are Baikal seal rookeries. In Chuvyrkuisky Bay live Arctic cisco, cisco, grayling, id, darter, and pickerel. The Trans-Baikal National Park belongs to the World Natural Heritage Site "Lake Baikal" (after Zapovedniks and National Parks of Russia 1998).

The Tunkinsky National Park was founded in 1991. It corresponds to the Tunkinsky District of Buryatia. Its area is 1,183,700 ha. The NP occupies the valley of the Irkut River, a tributary of the Angara, with the adjacent ridges of Eastern Sayan and Khamar-Daban. Absolute heights range from 668 m to 3,172 m above the sea level. The Taiga consists of Larix sibirica and Pinus sylvestris. Tundra is present; alpine glades are to be met. There can be found Sibirian roe, roebuck, elk, musk deer, sable, common weasel, Sibirian weasel, Alpine weasel, Mustela eversmanni, otter, skunk bear, wolf, fox, brown bear, lynx, and Alpine hare In the river valleys mineral water springs are located on the rivers Kyngargy and Maly Khangoldoy (after Zapovedniks and National Parks of Russia 1998). The Tunkinsky National Park is located out off the catchment area of the Lake Baikal, but it belongs to the Baikal Region.

The Zabaikalsky NP fulfil all regulations of National Parks. There are only one way going into the Park. 40.1% of the Park belong to the totally protected area (zone 1). Also in the other zones there are officially no land use, with the exception of hay harvest and fisheries. Industrial fishing is forbidden, traditionally fishing is allowed. But most of the fishers do not accept environmental laws. In the post-soviet area the number of tourists became smaller.

Although only some thousand of tourists come during the summer time now, the infrastructure of the Park is not sufficient. That is why most of them are wild tourists who let damages. During the years of the Soviet Union the number of tourist coming to the Zabaikalsky NP was higher, but the came organized and did not let damages.

The area of the Tunkinsky NP is traditionally used by the local people. In the centre of the Tunka valley, near to the Irkut River, there are fertile soils used as arable land. From the centre of the valley to the mountain ridges cattle grazing is occurred all over the Park. Wood clearing, especially in the neighbourhood is a common practice in the Park. On the bottom of the mountain slopes, connected with tectonic lineaments, a great number of different mineral springs are the basis for tourism here. For example the well-known spa of Arshan. The cleaning of the sewage of the health houses is far-reaching unsolved. Although the Tunka NP covers a very large area, wild tourism is a serious problem. Especially near the mountain creeks there are a lot of places covered by garbage. Together with car washing in the river valleys these practices of wild tourism are the reason for pollution of water there. Most of the local people who were working in the former state farms within the Tunkinsky NP have loosen their job. That is why the local agricultural production is on a very low level. But most of the products for supplying the tourists coming from the Irkutsk Region. Even in the spa villages the people can life a little bit better. The farmers far from the spa villages have no possibility to sale their agricultural products.

Due to the fact that the park administration of both the Zabaikalsky and the Tunkinsky Park does not receive money for the fulfilling of park functions from the government, there is a big lack in the budget of the Buryatian National Parks. The only money to build up the infrastructure stemming from the tourists fee. Without changes in the state and local policy and without international help for self-help the National Parks of Buryatia have only very low chances to fulfill the main important tasks of a National Park. Whereas in the Zabaikalsky NP landscape planning procedure gives the basis for the future park management, in the Tunkinsky NP there is a big lack of scientific based planning and management of the natural resources and the economic development of the park and district areas.

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The Initiative "Baikal Environmental Wave" on the Protection of Lake Baikal

Marina P. Rikhvanova

Abstract

"Baikal Environmental Wave" was founded in 1990 by a small group of people who became aware of the global environmental crisis and also of their responsibility to the whole world and to future generations to preserve Lake Baikal. Our fears for Lake Baikal, which for us are inseparably linked to the fate of the people living on its banks, are grounded, as on one hand the commercial sector in Russia is growing rapidly, while on the other hand state and control is weakening. The goal of "Baikal Environmental Wave" is now to find solutions to both the ecological and the economic crisis.

Sharing ones experiences of democratic development

Employees of the organisation are constantly undertaking new qualifications on up-to-date methods of democratic management, including strategic planning. We use this experience for the development of our organisation and also share this information with people from local organisations who want to learn new ways of working. Such methods help us to unite differing interests and work together towards common goals for both the individual organisations and for the various classes of society. This is important in finding a way to sustainable development.

The collection, processing and distribution of ecological information and making this information available

"Baikal Environmental Wave" collects up-to-date ecological information, analyses it and prepares the information for educational institutions, state organisations and the general public. In our library we have over 1000 books, textbooks and periodicals on ecology, in both Russian and English. We have six mobile libraries for rural schools, a unique initiative in the Baikal region. Employees offer help and consultation to visitors of the library.

"Baikal Environmental Wave" prepares and distributes an "Eco-digest," a collection of various ecological updates from different sources, to more than 100 organisations, including 75 newspapers in the Irkutsk Region and the Republic of Buryatia. Wherever possible our employees gather information on local ecological problems, make important English-language material on ecology available to the general public through translation and publishing. We work together with scientists and prepare scientific material for the general public, so that information on local environmental problems is made available to a wider audience. To realise these goals we produce videos, leaflets and brochures and publish a quarterly journal "Volna" (The Wave). The journal unites like-minded people (distribution to more than 600 addresses, circulation of around 2000), is distributed not only throughout the Baikal region but throughout the whole of Russia (it was voted the best "green" journal in Russia in the competition "Russian Ecology" in 1998.)

Lobbying on the most important ecological problems to obtain concrete results

"Baikal Environmental Wave" works constantly with local and Federal governments and commercial organisations, with Russian and foreign NGO's and also with the mass media. The questions to which we pay special attention are the preservation of Lake Baikal and measures to lower toxic substances in the environment.

The campaign "Baikal – World Heritage Site"

Together with other organisations, our organisation prepared documents for the inclusion of Baikal in the list of World Heritage Sites. This project has now developed to become a campaign for the collection and distribution of information, creating informational material and the conduction of practical activities on the shore of Lake Baikal. With support from the local public and administrative structure of the Irkutsk and Chita Regions and the Republic of Buryatia, "Baikal Environment Wave" in 1999 organised the first "Baikal Day."

Baikal Business Incubator

We are especially interested in protecting Lake Baikal for the consequences of the activities of the Baikal Pulp Mill, and from firms discharging waste-water directly into the lake. Together with other organisations we carried out a public hearing on the project of re-profiling the pulp mill. Unfortunately, the project has been worked on only by the employees of the paper mill itself, therefore could not be truly alternative. For this reason we began to develop a project in the town of Baikalsk to develop a business-incubator for the development of future businesses. The aim of this organisation is to help people to survive and begin their own businesses if the number of working places at the pulp mill were to be reduced or the mill were to close. The organisation will work in the Slyudyanka Region, carrying out an educational programme of economic and ecological preparation for future businesses. This project is supported by local and regional administration.

Public ecological inspection

"Baikal Environmental Wave" has begun an initiative of *independent ecological inspection* to control and prevent ecological destruction and to support the protection of biodiversity in the UNESCO World Heritage Site in the Baikal area. This project is supported by the following state environmental protection organisations: the Irkutsk Regional Committee for the protection of the environment; the Buryat Republic Committee for ecology and land management; the Irkutsk Regional Department for the control and rational use of hunting resources and the State Nature Reserves "Barguzin," "Baikal-Lena" and "Baikal." This ecological inspection has been in place since the beginning of 1999 and since then we have carried out many measures to improve the ecological situation in the region.

Toxic Wastes

We have a project named "toxic waste and human health." The aim of this project is to unite state, commercial and social organisations in order to solve the problem of pollution of the environ-

ment through toxic substances in the Baikal region. We have published a lot of material on dangerous domestic and industrial waste (especially organochlorines), and ways of avoiding their production (in the journal "Volna," in leaflets, booklets and brochures). To resolve the problems of rubbish and rubbish-burning in the town Irkutsk we are, together with the ecology department in the local town administration, conducting a "clean courtyard competition," in order to stop rubbish and leaves being burnt. We plan to organise a Russian-American seminar to exchange experiences on "How to organise the collection and processing of solid waste."

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SIBERIA

SAR Imaging for Boreal Ecology and Radar Interferometry Applications

Christiane Schmullius

Background and rationale:

Russia's vast forests are a natural resource of global importance, both economically and ecologically. They already serve Russia and the world as a source of wood, a symbol of wilderness, and a critical stabilizer of the global climate. These forest areas host 21-22% of the world's growing stock and contain 11% of the world's live forest biomass. The boreal forests of central and western Siberia represent the largest unbroken tracts of forest on Earth and are listed as "Last Frontier Forests" by the World Resources Institute. Hence, the region is of increasing interest to international organizations with conservational and climatological objectives as well as for political and industrial reasons.

The scope of the proposed CEO project is to produce a forest map of central Siberia using the operational SAR satellites ERS and JERS and new radar interferometry techniques. This map serves as a unique planning and monitoring tool for a sustainable management of the natural resources of Siberia, its socio-economic development as well as climate change aspects.

In brief:

Radar remote sensing has become an increasingly important tool for observations of forest ecosystems. Current available spaceborne SAR data have been used in several programmes to observe tropical, temperate and boreal forests. In recent years the use of multitemporal images has led to the biggest advances in the field. ERS multitemporal intensity and Tandem data have shown sensitivity to discrimination of deciduous/coniferous species (scatterers: leaves and twigs), burned and logged areas, land use classes, freeze/thaw effects, forest height under some conditions and biomass estimation up to 50 t/ha. JERS multitemporal intensity and repeat-pass interferometry analyses have demonstrated the complimentary information content of L-band data with respect to forest type discrimination (scatterers: branches) and more contrast for forest/non-forest identification.

SIBERIA merges the advantages of operational SAR satellites by analysing dual-frequency composites and interferometric products. SIBERIA will demonstrate the feasibility of radar remote sensing technology for large-scale vegetation mapping and will combine and refine state-of-the-art technology and techniques. Where interferometric coherence allows, high quality digital elevation models will be generated.

SIBERIA serves:

- The primary objective of the project is to support the development of sustainable management policies and regimes at the strategic and operative levels in order to manage the Russian forest resources in an efficient and ecological way. This development is to be based on up-to-date information on forest resources and related variables where existing inventory material is to be validated and confirmed. The scientific and commercial importance of this project is supported through customers from strategically important organisations.
- The acquired radar images will establish an initial data set to enable research about the dynamics of boreal ecosystems. This may include natural factors such as forest fire and insect damage as well as anthropogenic factors such as logging and deforestation.
- The participating and associated customers, who until now have not used remote sensing as an environmental tool, will gain an understanding of the technology and specific training in radar remote sensing techniques.
- SIBERIA will create the basis for further development of an operative forest information system, with monitoring capabilities, in a GIS environment to be used at the local and regional levels. Russia currently does not have any sufficient forest monitoring system. Only 60% of Forest Fund Area are under fire protection.
- Results of the Project will improve both information on the state of the Russian boreal terrestrial biota (specifically forests) and will provide data for the development of special forecasting models, e.g., to predict forest fire danger.

Participating Customers as Consortium Members:

1) International Institute of Applied Systems Analysis (IIASA), Austria.
2) Institute of Forestry of the Siberian Branch of the Russian Academy of

Sciences (IFRAS), Krasnoyarsk.
3) East Siberian Forest Inventory and Planning Enterprise (ESFIPE), Krasnoyarsk.
4) Regional Forest Service (IFS), Irkutsk.

Participating Customers through Letters of Interest:
5) IGBP - North Eurasian Studies (NES), Max-Planck-Institute for Biogeochemistry, Germany.
6) Greenpeace International, Greenpeace Forests Campaign, Amsterdam and Moscow.
7) Federal Research Center for Forestry and Forest Products, Institute for World Forestry, Hamburg, Germany.
8) Fire Ecology Research Group, Max Planck Institute for Chemistry, Germany
9) DFG Sonderforschungsbereich "Baikal Riftsystem" (in evaluation phase), Humboldt Universität + Freie Universität Berlin + Universtität Potsdam.
10) Remote Sensing Laboratory, Institute of Geography, Irkutsk.

Data source and use:
Space Data:
1) ERS-1/2-Tandem Data: special full-cycle Tandem Phase for Ulan Bator receiving station in September/October 1997,
2) multitemporal ERS-2 data: received by DLR mobile receiving station from May to July 1998,
3) JERS-1 scenes (partly multitemporal): within framework of Global Boreal Forest Mapping (GBFM) acquisition spring 1997 to July 1998,
4) SPOT Vegetation,
5) NOAA AVHRR.

Non-space data:
- The classification and estimation of forest variables in the SAR satellite data will be supported by Reference Data collected and compiled from different information sources such as:
- Forest maps with stand descriptions. The maps will be in scales ranging from 1:10.000 to
- 1: 50.000.
- Aerial photos, with usual scales ranging from 17.000 to 1:25.000.
- Sample plots measured in the field.
- Landscape and soil maps.
- Aggregated data by landforms of different scales generated by IIASA, to control the up-scaling procedure.
- Russian forest map at scale 1:2.5 Mio.
- Siberian forest map at scale 1:1.0 Mio.
- Forest maps from separate regions at scale 1:100.000 to 1:300.000.

Geographic Area:
South Central Siberia from 89 to 111 degrees Eastern longitude and 52 to 60 degrees Northern latitude.

Deliverables:
The three prime deliverables of the SIBERIA project comprise:
- A map: covering an area of 2 million square kilometres of the taiga forests of Eastern Siberia indicating the spatial distribution of boreal forests of different types and biomass densities.
- A large database: containing not only the forest classification used to produce the map but also the remotely sensed data from which the classification was derived.
- A proven methodology: for building up a multi-satellite data set and using the assembled remotely sensed data in a sophisticated way to derive a reference forestry map over a significant part of the Earth's surface.

Schedule: 24 months

Total Budget (including funding from EU CEO + INCO + INTAS, BMBF/DLR, Swiss funds and ERS data costs through ESA AO):~ 4 Mio Ecu. This number does not include costs for deployment of DLR DFD mobile receiving station and JERS acquisition and processing (to be supplied through NASDA's Global Boreal Forest Mapping project).

Other comments significant to European dimension:
- Scientific benefit: first large-scale exploitation of two operational SAR satellites and application of recent algorithms for SAR image analysis and interferometry (proof of concept).
- Economic benefit: establishment of a planning tool for the European (and Russian) forest industry.
- Political factor: support for a sustainable socio-economic development and stabilisation in Eastern countries.

Contribution to CEO objectives, CEO programme:
- Generation of a large-scale planning tool and monitoring baseline for an environmentally and economically crucial area of global importance by using purely remote sensing data as an independent source of information.
- Introducing the concept of radar remote sensing (sensitivity to vegetation structure) and advantages of interferometry to a wider public: ministries, non-governmental agencies, timber industry, international research programs.
- Input to large international efforts, such as

1) JRC activities in the framework of an Eurasian boreal forest mapping initiative,
2) FAO global forest assessment,
3) CEOS-IGOS Global Forest Cover Database.

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Untersuchungen zur Landschaftsentwicklung, Geomorphologie und Bodengeographie des westlichen Sibiriens (Altai-Sajan-Gebirgsland und Unteres Jenissejgebiet)

S. Bussemer & G. Guggenberger

Abstract

Die Geowissenschaftler der Universität in München und Bayreuth führen seit 1994 gemeinsame Exkursionen mit sibirischen Wissenschaftlern durch (Kamtschatka, Altai, Nordsibirien). Daraus ergaben sich mit dem Sibirischen Altai und dem Unteren Jenissejgebiet zwei regionale Forschungsschwerpunkte.

Im Altai standen bisher Regelhaftigkeiten der Bodenverteilung im Waldgürtel im Mittelpunkt des Interesses. Aktuell werden die expositionsbedingten Wälder am Südrand der sibirischen Taiga auf ihre Verteilungsmuster und Erhaltungsbedingungen hin geprüft. Darauf aufbauend ist ein Projekt zum aktuellen Charakter des Wüstenrandes sowie seiner holozänen Entwicklung im Gebiet des Tschujatals geplant.

In Nordsibirien wird der Bereich der polaren Waldgrenze am Jenissej bodengeographisch und bodenökologisch untersucht. Als geomorphologisch homogenes Untersuchungsobjekt wurde die Karginsker Terrasse mit fluviatilen Sedimenten gewählt. Die Normböden ändern sich am Übergang von der geschlossenen Taiga zur Waldtundra signifikant und ermöglichen weitere Detailuntersuchungen zum Stoffhaushalt der Landschaften.

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Man on Baikal: History of Interaction with the Environment

I. Naumov

Key words

Baikal, Environment, History, Man, Interaction

The purpose of this report is to acquaint the recoder with the history of interaction the man with Environment on Baikal and to offer the educational project.

Environment, natural-climatic and landscape living conditions basically influenced, as known, human history. And, in particular, they influenced economic activities, culture, mode of life and character of folks. Peoples of the World had to consider with environment at each stage of their development.

The ancients looked for more favorable places of living for their surviving. Especially they were attracted by big water reservoirs such as rivers and lakes, because living near them was much more easier. Often big water reservoirs served as the source for the conceptions for civilizations. At that time a man was influenced by them and tried to adopt to the environment. He formed the modern image of these reservoirs in the process of his activity. And so *a* human been and nature historically felt the mutual influence upon each other.

And Lake Baikal is not an exception. It has fed and given to drink since the ancient time. Baikal is situated in the region of intersection wooden and steppe landscapes. There were ancient wood and steppe civilizations on its shares. The penetration of different folks and their cultures took place there.

People, coming to Baikal shares called one of the World's wonders in different languages and they added «sacred», impressed by its greatness and beauty. Not occasionally etymology of its name was disputed by the different folks. So, the ancient Tiurks called it Bai Kul, that means «Rich Lake». The Ancestors of Buryats – Bai Gal – «Standing fire» (according to the Buryats lagent there was a volcano at Baikal's place, and after its explosion lake formed.) And in ancient Chinese Chronicles (the 2nd century B. C.) They called it respectfully Bei Hai – «the Northern Sea».

At the same time Lake was much more less subjected to the human's influenced in the comparison with other big Europe and Asian reservoirs, because of its remoteness from the basic centers of civilization. There are a lot of historical and cultural monuments of different epochs on its shares and near by. They help us to retrace the history of interaction of the Man and Environment on Baikal, its mutual influence and interaction of different cultures.

The most ancient settlements of the

ancient man in Siberia, which are about 40 thousand old, were found *exactly* in Pribaikalje (Malta, Buret and others). As for the lake's shares there were found just separate findings of the Paleolithic Period, but the settlements have not been found till now. Apparently a man appeared on Baikal's shares later – in the Mesolithic epoch. So, during the building of BAM (Baikal – Amur Railway) on the North of Baikal in the Kurli bay Mesolithic settlements were found. Generally the question about the time of man's appearing on Baikal has not been studied and it needs a further investigation.

In any way, in the Neolithic Period, 6-7thousan years ago, the shores of Baikal were settled by a man. The Neolithic settlements were found all over the shore from the Shamanka cape in the southern part of the lake till Nizhneangarsk in the North. The mass coming to the shares was connected with the gradual changes of the environment. By that time the basic food: mammoths, woolly rhinoceroses and other big animals had been disappeared. The man had to look for other sources of existence, improving the technique of stone's processing and creating absolutely new products. That was a bow and arrows, ceramics, etc.

Also the Baikal fish became an important source of feeding. The man of Neolith mastered the art of fishing. In ancient Baikal settlements pepples-plummets, fish-hooks from bone and wood, stone fish-baits, and also fish bones and scale were found.

As for Neolithic man's influence on Baikal and environment, we think that it was minimum because of small number of people and their weak material and technological equipment. But Baikal's influence on ancient people was much more stronger. In fact the shore landscape determined the places of their location and their occupation.

In the «Bronze Age» epoch, from the beginning the 1st millennium B.C. the northern broad, so called the broad of the 'Tombstone graves» culture. The great territory of the Central Asia, from Baikal till the Gobi desert and from Manchzuria till West Mongolia was occupied by people of this culture. The monuments of the «Tombstone graves» culture are situated on the both Baikal's shores. People of this culture were cattle-breeders. Having come to the lake they taught to native tribes a cattle-breeding. In their turn, they borrowed from native people fishing, which became to play the important part in their life on lake Baikal.

«Tombstone graves» culture was known as a large center of the «Bronze metallurgy» in the Eastern Asia. These metallurgical industry was situated to the east of Baikal, there were rich and easy of access deposits of non-ferrous and precious metals – copper, tin, lead, and silver. On Baikal's shores tracks of metallurgical industry have not been come cross yet. However there were found a lot of things from bronze and other metals.

«Tombstone graves» creators had also well-developed art culture. The pethroglifs – rock drawings made with raddle - are the best illustrations.

Bronze age's pethroglifs were found at some places on the lake shores. Under these rock drawings special credence for sacrifices were.

At the end of the 3rd century B.C. in the steppes of the Central Asia the first large union of Hun tribes was formed. It's north frontier was near Baikal.

At the end of the 1st millennium B.C. and at the beginning of the 1st millennium A.D. There was one more culture, so called «Elginskie graves» on the Western Baikal shore. The base of its economy formed cattle-breeding, fishing, and hunt. In 1998-1999 archaeologists and geologists of Irkutsk State Technological University found two well remaining centers of ancient metallurgy of the «Elginskie graves» on the Baikal shores near Chernorud settlement.

In the middle of the 1st millennium A.D. Baikal and the territories near Baikal were settled by Tiurkish speaking Kurikan tribes. They formed the tribe union. According to ancient Chinese chronicles Kurikans, as their predecessors, were occupied in cattle breeding, fishing, hunting, and even farming, Kurikan culture was distinguished by their highly skilled processing of iron. Kurikans made weapons, chain armours, sicles, plough shares and even special shoes for moving on the ice from iron.

In the 10th – 11th centuries under the pressure of nomadic Mongolian speaking tribes one part of the Kurikans had to move north, and the other part, having stayed in the territories adjoining Baikal, mixed with newcomers from the South has been living on Baikal till now. The place of Buryat tribes living was called Barguchzin-Tokum country at the neighbouring people. Buryats settled the Baikal's shores quite dense and ousted other peoples little by little. In the North of Baikal only small in numbers and not formed as united whole Evenk tribes were continuing to live. The Evenks were wood hunters for fur-bearing animals. The Buryat names became established on the lake shores little by little.

As for economic activity, the Buryats in general were continuing to live as their predecessors. The main Buryats' occupations remained the same. That were cattle breeding, fishing, hunting. At the same time , they improved them. So, during the fishing the Buryats started to use small nets, made from horse-hair. It let to fish more.

Thanks to the fact that the Buryats have kept their culture, traditions and habits till nowadays, we may judge about their interactions with environment in ancient times. And as long as Buryats inherited economic type and culture of the peoples, having inhibited the Baikal shore in earlier times, we may also consider that their predecessors had analogous interactions with environment.

In general care attitude to nature was a character feature of Buryats and more ancient people. The Buryat tribes like their predecessors depend on environment, and so they lived in harmony with it. They observed ancient rites that were believed to influence the success of the hunt. Each tribe and family had their deities and ghosts. The spiritualization of nature and object, close connection with environment led them to resort to ritual acts. Any important deed, either a hunt, a fishing, a wedding, a birth or a burial could not happen without them. Sacrifices, the highest act of any rite was impossible without ritual credence – an obo, ongons and shaman himself.

Especially respectfully Buryats concerned to trees, as all their life was connected to a tree. They believed that trees possessed particular strength. Touching the tree promised health. Buryats also thought that if a man cut a tree for no reason he would shorten his and his descendants' lives. Cedar, fir, pine, larch and birch were held sacred, near them rites were carried out.

But Baikal was certainly the main character in Buryat's rites. The Buryats, as well as their predecessors, worship-

ped water element, since Water had left from Heaven, on which all life on the land depended. The Buryats guessed, that Baikal was a reflection on the land and display as its highest mercy. They believed, that the land of Bargudzin-Tokum is marked by Eternal Blue Heaven's mercy. Making the rite of white mares' milk sprinkling in Baikal's waters, they asked Heaven about mercy and indulgence.

There are a lot of myths, legends and fair tails about the lake. All of them emphasize its wisdom and greatness. The mythical fish Abarga zagahan lived in its depth, which was considered to be an ancestor and the queen of all fishes. Every year in spring Buryats made sacrifices and the rite of milk sprinkling in honour of this fish. In the waters of Baikal Burhot and Swan swam, Eagle soared above them. These above-mentioned animals are mythical ancestors of Buryats.

In general, speaking about man's interaction with environment at the moment of Russian pioneers appearing, it is necessary to note, it was distinguished with harmony. The economic influence of the man was rather insignificant. On the contrary, the ancient man felt powerful influence of environment, both physical, and spiritual. Just environment has formed the man's occupation and his culture, spiritual world and traditions of the careful attitude to nature. Later the Baikal's inhabitants felt this influence too.

In the middle of the 17th century on the Baikal shores the new people appeared. In 1643 the Russian Cossacks group of Kurbat Ivanov reached the lake in the island of olkhon area. From that moment Russian groups visited Baikal regularly, collecting yasak – a kind of taxes - from the local population. Soon the first settlements – Nizhneangarsk fortress(1647), Barguzin fortress (1648), and then others were built there.

The Russian Christian settlers have brought the traditions and skills of economic activity. The exploration of Baikal after connection of Siberia to Russia began to pass more intensively. On its shores, where it was possible, Russian have engaged agriculture. Also the settlers have improved methods of fishing. Instead of individual instruments of fishing and small hair networks the large networks began to be used (in the 17th century their length quite often exceeded 200 meters). The motivation of fishing on Baikal has also changed. If local population earlier had fished for their own needs only, Russians began to do it with the purpose of the next sale. The new methods were applied in a hunt the fur animals too, that also was caused by the pursuit of profit.

The coming of Russians on the lake's shores has resulted in the beginning of navigation and development of the transport communications there. In the second part of the 18th century the Moscow – Siberian road was built on the western Baikal shore near the source of the Angara river. Its continuation began in 100 kilometers near Ambassadorial monastery. People forwarded through lake on horses in winter, and on courts in summer. In 1744 for the organization of Baikal navigation on the special Admiralty was formed in Irkutsk. In 100 years on lake the first steamers have appeared on the lake. In the middle of the 19th century the Krugobaikal road was constructed through the southern end of Baikal from Irkutsk and further on the eastern shore. It has allowed to establish the reliable all-the-year-round message with the eastern areas of Siberia.

The connection of Siberia to Russia promoted the beginning of scientific study of Baikal, about which it was not known almost anything by then. During the 18th century Baikal has visited some scientific expeditions, which have allowed to make and issue the first geographical card of the lake and its shores in 1775. In 1868ã. the famous scientist B.Dibovski began the Baikal complex research,

As a whole to the beginning of the 20th century the influence of the man on Baikal, certainly, has increased. Approximately for 250 years the development of lands, convenient for agriculture, and construction have resulted in cutting down of woods in some areas of coast and change of coastal landscapes. Perhaps, the greatest loss to nature was brought by unchecked pursuit of furs. In 1684 the Russian government was forced to enter the interdiction on production of a sable in Pribaikaljie. And in subsequent it periodically entered similar interdictions. However it was not possible to restore live-stock of a sable .

At the same time, it is impossible to speak about any irreversible influence of the man on Baikal in that time. The human activity scales were rather insignificant yet. For instance, agricultural lands and the inhabited localities on the lake's shores occupied the very small area. Fish stocks have not appreciably decreased.

In its turn environment also continued to render appreciable influence on the man. As well as native population, Russian settlers were compelled to adapt to its conditions. It was showed in economic activity. On the Baikal shores the most important occupation of Russian population became not agriculture, and fishery. The environment has rendered the powerful spiritual influence on Russian. They were fascinated by Baikal's beauty and greatness, and they have involuntarily liked respect to it. There are a lot of the written and oral sources, telling about it. The process of the mutual penetration of Russian and Buryat cultures also influenced the attitude to the lake. So, the expression " sacred Baikal " became a part of Russian folklore. From the Buryat Russian have apprehended some traditions and customs connected to the careful attitude to nature. In their turn Buryats have begun to adopt more consumer attitude to nature, and also some skills of economic activity, unknown by them, including agriculture.

At the boundary of the 19th and 20th centuries the man's interaction with the environment on Baikal begin to change. The influence of the man on the lake grows caused by technical progress during the 20th century and connected with it.

The beginning to this process was put by railway construction. In 1898 Transsiberian railway was built on a Baikal shore near the source of the Angara. Then their construction was continued further on east. In 1899 for a ferry through lake the special ice breaker - ferry - "Baikal" has constructed. Their displacement was more than 4000 thousand tons. It could take 25 cars and 300 passengers. The ice breaker got over the ice, that thickness was a meter. It was the second in the world on capacity in that time. Other few steamers were built to transport cargoes and provide the railway construction. At that time construction of the railway around of lake was being continued. On Baikal the builders came across with a very hard relief and the construction lasted for seven years. Nevertheless in they managed to construct the Krugobaikal site of the Transsiberian railway of length more over than 300 kilometers, on which there were more than 50 tunnels and galleries, and a lot of other complex technical structures in 1905.

The railway has not changed external

shape of the Baikal shores only, but also has resulted in acceleration of economic development of Pribaikalje. On coast of lake A lot of new inhabited localities, the first industrial enterprises - railway workshops, ship-building shipyard, factories on fish's processing have appeared on the lake's shores. The fish catching and the timber cutting volumes were increased.

Especially the industrial activity on Baikal has amplified after October revolution of 1917. A lot of industrial enterprises(basically mining and timber industries) and inhabited localities were built at the coast, including two cities – Baikalsk and Severobaikalsk. And the extreme consumer approach to a nature, which was spread in public consciousness was fixed as a basic of economic policy. Development of Baikal, as well as all country passed under the slogan "the Man should not wait favors from a nature, our task is to take them at it!". The main goal was the fulfillment of the economic plans at any cost, instead of care of safety of the environment and its resources.

The acceleration of economic development was accompanied by appreciable growth of the population on the lake's shores, basically at because of migration from the European part of the USSR. (Today about 150 thousand of the man live on the Baikal shores and more than 1,5 millions live nearby from their) New migrants, unfamiliar with local traditions, were subjected to the consumer attitude to the nature most of all.

As a result, in economic activity the people began to use technologies, which rendered the extremely negative influence on an environment. For example, an wood float on the rivers, running into Baikal, and then it was raft towage on lake applied at the timber cutting near the coast. By the amplified (strengthened) rates, without the account of real stocks was conducted Fishing in The Baikal waters was conducted by the amplified rates, without the regard of real stocks. Many industrial enterprises and inhabited localities, including Baikal pulp and paper combine notorious all over the world, were constructed without the regard of the requirements of environmental safety. So, in particular, Severobaikalsk city, appeared on lake coast during the BAM's construction, had no sewage systems until recently and it sewage got directly in Baikal.

Result of human activity in the 20th century became the large damage put to an environment on Baikal. It is both pollution, and having undermined fish stocks, etc., it was spoken and written a lot about it last decade, when the problems of Baikal were widely discussed by the Russian and international public and when many facts and scales of damage are known for steel.

The negative phenomena increased gradually, so at the second part of the 20th century the process of comprehension that a man has broken balance with the Baikal environment began. The main role in it belongs to science. Economic exploration of Baikal in the 20th century has had one obviously positive party - it promoted development of scientific researches. Since the end of the 19th century their volume subjects have been continuous amplified. Baikal and its coast have been studied by geographers, biologists, geologists, biologists and representatives of other sciences. They have paid attention of society to danger of the economic development way, chosen before. The scientists have convincingly shown uniqueness of lake and necessity of its preservation and protection. In 1980-1990 they managed to attract public interest in Baikal problems both in Russia, and abroad.

As a result the tendency to reappraisal of the consumer attitude to the Baikal environment was appeared recently. To it, in particular, testify appearance in Pribaikalje of public environmental movements and amplification of the Russian nature protection legislation, and also the fact, that in 1996 of UNESCO has included Baikal in the list of the world heritage's objects. The opportunity to not allow irreversible man's influence on lake can appear today. However it is a very difficult task. The influence of the consumer attitude to nature among the population is far from being overcome.

The important role in its decision should play a science and education, especially higher education. The task of the last one is to inform up to experts to be, on which the next development of society depends, saved knowledge of Baikal, show a history of interaction of the man with lake and to convince them of necessity of the careful, harmonious attitude to environment. Baikal area represents perfect educational range in international scale, because of, as already marked, its historical and cultural monuments of different epochs, reflecting interaction of a man with the environment were kept not bad.

On the Baikal's example we may see the history of interaction of the man with an environment. This history is continuously connected to a history of the peoples living on lake's shores. The peoples coming to Baikal brought their customs and tradition, their skills of economic activity. And it was directly reflected in the attitudes of the man and environment. Therefore the probable projects of scientific and educational expeditions should include obligatory finding - out of questions. What peoples did occupy and what peoples do occupy the Baikal coast? What are their culture, their life, their national psychology? How did they influence the environment? What was the influence on process of formation and development of the peoples of region shown in? How was the state influence on economic and culture evolution of the population shown? What is the modern state of interaction of the man with the environment? The concrete definition of each project of scientific and educational expedition is possible after definition of its participants, terms of realization, material and technical opportunities of realization. The scientific and educational expedition could be lead together with Irkutsk State Technical University, which has educational base on Baikal and possesses experience of organization of the international educational expeditions.

These expeditions will decide in passing one more important humanitarian task, that is to promote mutual understanding for development of the international cooperation. As the future of the world in a determining degree will depend on ability of the peoples to understand each other. And such understanding can give only acquaintance to a history and culture of the different peoples, their attitudes with the environmental world.

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Workshop Nature Conservation and Tourism

Sarma 1999
An International Research Camp on the Central Baikal – Science and Tourism –

Hans-Heiner Bergmann

Abstract

From mid-July to 5th August 1999, an international camp for Russian and German scientists and undergraduate students was jointly prepared and managed in the Pribaikalsky National Park close to the village of Sarma on the Maloie Morie. Sponsoring came from DAAD (Deutscher Akademischer Austauschdienst), some German firms and banks and private persons from the Osnabrueck area, lower Saxony, Germany. The camp was paid as a whole by the German side including kitchen, tents, food, and some scientific material. Later, the camp was left in the hands of the Russian partners and will be available for other practical field work of international or Russian groups.

Working organization was in small working groups including German and Russian scientists and students. Projects were planned before, using knowledge and know-how from both sides. The results will be published as a monograph in English language in the Irkutsk Pedagogical University. There will be papers on the vascular plant flora, bird fauna, breeding biology of duck species, ecology of bird predators and sociobiology of small bird groups. Bird studies appear to be especially interesting as birds are high ranking bio-indicators for the state of ecosystems.

As an exchange, during the subsequent 10 day period, the German participants were invited to live in the flats of the Russian participants in Irkutsk. During this time, we had the opportunity to get a closer insight into the Russian way of living in the city including datcha and banja. Also, a course of Russian language was offered to the German participants by the Linguistic University of Irkutsk.

The whole project has increased our mutual understanding of thinking and living both in Russian and German participants. Also everybody's knowledge of German, Russian and English languages was increased. A base for future field work was laid. Scientific results for a better understanding and possible conservation needs of some terrestrial Baikal ecosystems were achieved. At the same time, such a project might be a model for future developments in the field of sustainable science tourism.

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– Let's Work Together –
Report on the First Russian-German Ecological Work-Camp on Olchon Island/Baikal

Susanne Müller & Andreas Schmidt

Abstract

1. NaturErleben e.V. is a registered non-profit making society which was founded in 1993 by natural scientists, industrial engineers and educators. The society's aim is to set up and implement innovative ways of environmental education, especially through the promotion and evolution of Nature Experience Areas (NEXA).

2. NEXA is a new category of land use, which was included in the law of nature protection of Schleswig-Holstein (S-H) in 1993. The NEXAs are areas, where people are invited to deepen their relationship to nature by experiencing nature and nature interdependencies with all their senses. The aim of these areas is to connect the demand for recreation in healthy natural surrounding with aspects of (Eco-)Tourism, regional development and nature conservation.

3. As a part of the Russian-German project "Ecologically oriented land use planning in the Baikal region" NaturErleben has developed a concept for a camping site in Olchon County on behalf of the *Gesellschaft für Technische Zusammenarbeit* (GTZ) in 1996/97. The concept based on draft plans of the Institute of Geography IFG SA RAW (Irkutsk) and the *Planungsgruppe Ökologie und Umwelt* in Hannover. It was worked out in

cooperation with the local administration and the IFG with the support of the conservation organisation "Baikal Wave" and many other local groups and people.

4. An important step on the way to the "foundation stone" has been the "knowledge exchange visit" in 1997 of a Russian delegation in Northern Germany. While visiting different projects concerning sustainable land use and environmental protection, the participants developed the idea of creating an information centre as an integrated multifunctional part of the camp-site.

5. Since the development of the camp-site has been interrupted, NaturErleben decided to continue the idea of combining opportunities for recreation with ecological information and nature experience by conducting youth exchange and ecological work-camps.

6. In autumn 1998, a group of ecologically interested young people from the island of Olchon visited Schleswig-Holstein to meet like-minded young people and to exchange experiences concerning ecological problems and their (future) solutions; in the summer of 1999, a group of young Germans visited Olchon to work together with the inhabitants of Chuzir/Olchon and Russian tourists. They also discussed first steps towards an ecological-cultural Information Centre as part of the touristic base of Nikita Bencharov in Chuzir.

7. The next step will be a multilateral seminar with young people from lesser developed rural regions of four different countries (a.o. from Russia/ Olchon). Our aim is to work out concrete measures to promote "gentle" tourism and the idea of NEXA - not least as a personal perspective for the participants; the results of the seminar shall be implemented within work-camps in the following years. 'Recreation', 'information' and 'practical nature-protection-work' shall be part of the work-camp and shall be developed as principles of ecologically orientated tourism on the island of Olchon.

8. Our idea is to increase the interest, enthusiasm and responsibilty of young people for nature and for their own future by initiating local participation projects with short distances from the planning to its realization.

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Research and Conservation in the Watershed Area of the Baikal, North Mongolia, Khan Khentie.

M. Mühlenberg, J. Slowik, M. v. Velsen-Zerweck, P. Melchert, R. Samjaa & D. Choimaa

Abstract

In North Mongolia rises the main inlet of the Baikal sea, the Selenge river. A tributary of the Selenge is the Orchon river, of that the Eröö is an affluent. The Eröö, the Tuul, and the Minj (further north) rise in the Chentie area, which forms a southern tip of the Sibirian taiga. The habitat quality of that region is crucial for the conservation of the Baikal sea. Most of this area is under protection as the Strictly Protected Area of Khan Khentie covering 12.000 km², completed by the Nationalpark Terelj with other 3000 km². The forest habitat in that area extends to about 10.000 km². The rainfall ranges between 300 to 500 mm/ year. The region is situated at the southern border of the permafrost. In Mongolia the conifer taiga forest turns directly into the steppe. The transition zone is called "forest steppe". That region is most intensively used by human beings, because timber, water, and productive pastures are available. We established a research station at the western buffer zone of the Khan Khentie Strictly Protected Area, 320 km north of Ulanbator.

Conservation problems arise with illegal logging, illegal hunting, water pollution by gold-mining, and fires caused by humans. Our research activities are based on a co-operation between the National University of Ulanbator (faculty of Biology) and the Centre for Nature Conservation of the University of Goettingen (CNC). We are going to learn how far the deviation goes from natural conditions in the virgin forest in relation to human impact and which indicator system can be used for a sustainable forest management maintaining most of its biodiversity.

The main objectives of our programmes are

1. to assess the conservation value of the West Chentie region in terms of national and international importance
2. to analyse the habitat mosaic in the forest in relation to natural factors like topography, fire, and soil conditions. We want to look if the distribution of the herb vegetation corresponds to the pattern of tree species or if the chance and fire mix up the association.
3. to study the effects of the increased fire frequency on the forest regeneration. Attention is paid to the large scale change of dynamics, analysed by the different pattern of the habitat mosaic.
4. to compare the variability of bird

and small mammal communities in the different habitats. Birds are used as indicators of habitat quality in quantitative terms of bird assemblages, guild structures, and target species.

5. to analyse the composition of the fish fauna and the age structure of the salmonid populations, a comparison between natural rivers and affected rivers by mining and overfishing. Studies of sedimentation will be one important measure for monitoring. The freight of sediments in the rivers depends on the habitat quality in the watershed (e.g. forest cover). The sedimentation in the Baikal sea could change the whole biotic community.
6. to study the butterfly fauna in regard to biogeography and genetics in comparison to the European populations (palaearctic species)
7. to survey the distribution and density of the Maral deer in managed and unmanaged forests. The antlers of the deers are collected and sold to China. That activity is one of the factors which is said to increase the frequency of fires in the forest.

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Tourismus als Wirtschafts- und Begegnungsfaktor

Winfried Westhoff

Im Programm zu diesem Workshop ist der etwas missverständliche Titel: „Tourismus als Wirtschafts- und Begegnungsfaktor" ausgewiesen. Dabei geht es hier nicht darum, anderen Workshops in Wirtschaftsfragen zur Baikalregion Konkurrenz zu machen. Mir geht es bei dem Titel darum, Tourismus als Begegnungsfaktor in Ergänzung zu den anderen Fragen zu betrachten.

Von vielen wirtschaftlich schwachen Regionen dieser Erde wird Tourismus als das Rezept zur wirtschaftlichen Gesundung gesehen. Tourismus nur unter wirtschaftlichen Erfolgsaussichten zu betrachten, führt in vielerlei Hinsicht in die Irre - wie wir wissen. In Russland wird Tourismusentwicklung heute noch weitgehend als Chance betrachtet, schnell viel Geld zu verdienen. Westliche Reiseveranstalter betrachten Russland als Chance, mit geringem Einsatz kurzfristig optimalen Profit zu erwirtschaften. Dieser Trend muss in perspektivische Zusammenarbeit umgeformt werden. Es soll nicht verkannt werden, dass dem noch immer politische Unsicherheiten entgegenstehen. Wenn wir hier von der Bedeutung von Tourismus in der Baikal-Region sprechen, sollten wir vielleicht zunächst ein paar Zahlen kennen, die das Volumen kennzeichnen: Im Jahre 1998 wurde die Irkutsker Region von 17 800 Touristen besucht. Davon waren 45 % -also 8.050 Touristen aus dem Ausland (ohne frühere Sowjetunion). Diese verteilten sich auf 154 Hotels mit 6403 Betten. Wenn man unterstellt, dass die Firma Intourist nur ca. 50% der Touristen bedient hat, verbleiben noch 4000 Touristen, die sich auf 153 Hotels verteilen. Das sind 26,14 Touristen je Hotel. 84 Firmen haben eine offizielle Lizenz für internationalen Tourismus. Dies sind aktuelle Zahlen des „Committee für Kultur, Sport und Tourismus" in Irkutsk (Alexander Zolotorev am 17. November 1999).

Doch wie gesagt, möchte ich mich hier nicht besonders mit der wirtschaftlichen Bedeutung des Tourismus befassen. Tourismus nur unter wirtschaftlichen Gesichtspunkten zu betrachten, ist selbstverständlich zu kurz gegriffen. Eine Tourismusentwicklung, die sich nicht auch die Frage stellt: „Was macht der Tourismus mit den Reisenden und den Bereisten?", ist in vielerlei Hinsicht gefährlich.

Ich möchte diese Annahme mit einigen Beispielen aus meiner Praxis in Sibirien veranschaulichen: Als ich das erste Mal in Burjatien am Baikal war, hatte sich unser Fahrer hoffnungslos in der Zeitplanung verkalkuliert. Die Verpflegung war längst aufgebraucht und ein Lebensmittelgeschäft nicht zu erreichen. Er ging zur nächstbesten Hütte, wies bei der dort wohnenden Familie auf mich und kam wieder mit einem Brot und einem Omul in Zeitungspapier eingewickelt – von Kosten keine Rede! Als wir am Baikal Ausschau hielten nach Unterkünften, die unserem Anspruch und unserer Verpflichtung aus dem deutschen Reisevertragsrecht gerecht würden, wurden wir von unseren Partnern in Ulan Ude einfach nicht verstanden.

Ich erlebe bei meinen Reisen, dass die wenigen Tsarten-Familien zwischen Baikal und Khuvsgul als Attraktion begriffen werden. Dort tauchen an manchen Tagen mehrere Gruppen mit 40, 50 oder mehr Touristen auf, bringen Kugelschreiber, Wegwerfkameras und ähnliches Zivilisationsgerümpel in abgelegenste Bergregionen mit - und verschwinden wieder mit einem attraktiven Foto mehr für ihre Sammlung. Da verlassen sich Clubs von Bikern darauf, dass sie in der endlosen Steppe schon eine Familie finden, die ihnen aus Gastfreundschaft ihre Verpflegung sichert. Die kultische Handlung eines Schamanen wird aus Erwerbsgründen Touristen dargeboten, die das Gesehene oft nur als „Ringelpietz" begreifen.

In Sibirien leben viele ethnisch unterschiedliche Volksgruppen, die noch nie einen Touristen zu Gesicht bekamen. Diese zu bereisen, wird von westlichen Reiseveranstaltern als Marktlücke erkannt und zum Verkaufsschlager werden. Die Liste von Beispielen ließe sich endlos fortsetzen.

Was will uns das sagen? Wir sehen im internationalen Tourismus sehr oft, dass Tourismus Vorurteile schafft und vertieft. Sie kennen den bei uns oft scherzhaft gebrauchten Begriff von der „sibirischen Toilette"? Wenn das für westliche Touristen vor Ort auch nur einmal zur Wirklichkeit wird, bestätigt sich deren ungewisse Erwartung zur Realität. Vorurteile sind aber sehr schlechte Berater, wenn es gilt, materielle und ideelle Investitionen in die Zukunft zu tätigen. Sich dem Anderen behutsam zu nähern, ist Voraussetzung, um sich vertraut werden zu können. Mit dem Anderen und dessen Lebenswirklichkeit vertraut zu sein, ist Voraussetzung für Entwicklung von Beziehungen - auch von wirtschaftlichen, besonders von perspektivischen Beziehungen im Tourismus.

Fazit:

Im Sinne der sozio-kulturellen Entwicklungen von Reisenden und Bereisten, muss Tourismus auch als Begegnungsfaktor begriffen werden. In interkultureller Begegnung liegt eine Entwicklungschance für Wirtschaft und Tourismus. Dabei will ich nicht missverstanden werden: Es geht mir bei Annäherung nicht um Angleichung im Sinne von kultureller Nivellierung, sondern um den Zugang zu der beiderseitigen Lebenswirklichkeit. Im Rahmen von Strukturplanungen im Tourismus sollte interkulturelle Begegnung ein Planungsfaktor sein oder werden!

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Diving Sports, Tourism and Scientific Diving

Peter Röpstorf

Abstract

Lake Baikal is an unique Lake for diving due to the clearness of the water in spring, the impressive underwater landscapes with the steep slopes at the western shore interrupted by the canyons of small rivers, and the peculiar endemic organisms as sponges, gammarid crustaceans, molluscs and cottoid fish. In the recent time private firms were founded (Alpindustria-Baikal, Aqua-Eco), offering diving courses on international level (CMAS and PADI) with modern equipment and also tours on Lake Baikal. Some of these companies are interested in collaboration with German tourist firms and in offering their services to German tourists.

These diving courses and equipment are too expensive for the average Russian citizen. There is a big need in scientific diving at Lake Baikal, because for ecological and faunistic research diving is often the only way of sampling and observation of processes. The big scientific institutions - the Limnological Institute of the Siberian Branch of Russian Academy of Science and the Baikal Museum - have ships, laboratories and diving groups, but the equipment is old and not regularly checked. The Limnological Institute has an own diving station in Bolshiye Koty, the Biological Station of the Irkutsk University. Last year the Freie Universitaet of Berlin placed a compressor and a motorized rubber boat at the institute's disposal, but actually there is a big lack in diving suits and other equipment.

The potentialities of diving in Lake Baikal are demonstrated and possibilities of collaboration, helping to re-establish the scientific diving at Lake Baikal will be discussed.

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Conservation of the Baikal Seal (*Phoca sibirica*): AMBA projects

Peter Vrsansky

Abstract

The problems, success and the future strategies for the research and conservation of the Baikal Seal are sketched. Baikal seal population of 40-80 000 individuals is heavily damaged by overexploiting of the population, with malformations, mass deaths, twins-births etc. observed recently. Additionally, several sub-populations are found to be directly endangered by extinction. The Avuanga project (Sub-Project no. AMBA/AN/A/5.2000/12) aimed to the protection of the species is proposed as the model project of the International co-operation in the Baikal region. The basis for this is the past success, psychological reasons, financial availability, good scientific background and perfect documentation of the project.

Key words

Seals, Mammalia, Pinnipedia, Phocidae, Phoca sibirica, Conservation, Behaviour

Introduction

Conservational projects «AMBA Projects International» focus to the protection of the Earth terrestrial ecosystems with global meaning. In the territory of the Russian Federation, four of 20 such areas, defined as AMBA biosphere are represented: Ussuriland, Northern Siberia, Kuril Islands Archipelago. The fourth one is the northern Territory of the East bank of Lake Baikal, including the Zabaikalsky National Park, Barguzinsky State Nature Reserve and some adjacent areas. This area should present a model Territory of UNESCO World Heritage.

The project at the deepest lake in the world containing typical and endemic animals is appointed for the preservation and studies of Phoca sibirica, the only freshwater seal. Documentation include the underwater behaviour of the species. In 1997-2000 members of the project directly saved seven seals from the sealers' nets, and by protection of the area saved at least 400 seals from being hunted. Basic observations of the species' behaviour were made. We also studied and documented pups in the nest, and we are describing a new form of the seal, which may be a new species. The detailed observation of its be haviour and morphology together with more detailed studies of territoriality and the earliest development of the pup have been made (*Vrsansky* et al., in press).

AMBA projects is the first scientific and conservation project honoured and controlled by the presidium of the Russian Academy of Sciences. The project is prepared in co-operation with the Ernst-Arndt-Moritz University (Greifswald), NABU (Germany), The systematic association (Oxford), Royal Botanical Garden of Edinburg, Paleontological Institute in Moscow, Biological and the soil Institute, the Pacific Institute in Vladivostok, the Limnological Institute in Irkutsk, the Smithsonian Institution in Washington, AMNH, New York, Comenius University, Bratislava, the Slovak Academy of Sciences, BNHM, London, and TESCAN, Prague. The project has generated international interest and recognition, and is operating under the auspices of UNESCO. Documentation contains more than 20,000 photographs (international prizes: UNESCO World Heritage, Microworld prize, Zikmund and Hanzelka prize, Main prize of the Slovak association of travellers, Prize for the best project of the Czech geographic society, Koktejl magazine prize, LENS award, The systematic association (Oxford), BBC Wildlife photographer of the Year, Highest Slovak Academic Award, Award of an alternative Nobel prize winner Michael Succow).

Project no. AMBA/AN/A/5.2000/12 Avuanga project

The Avuanga Project is focused on studies and protection of the Nerpa of the Lake Baikal, Phoca sibirica (*Gmelin* 1788). Species is peculiar for its longevity, the maximum of age of both sexes being 56, and with the average weight of adults about 75kg is one of the smallest seals.

The Baikal seal is Baikal's, the deepest and one of the most beautiful lakes in the world, top of the food-chain pyramid. All the lake's problems are reflected in its highest particle. The seal has been the head and eyes of the lake for millions of years. Isolation for millions of years leads to changes and evolution. The species must have adapted to the lake's unique conditions and environment. There are not many animals on the Earth that had to undergo such vast and drastic changes of the environment. At the beginning life emerged from the ancient ocean to dominate land, to later return back where it came from. Within this long period of time Nerpa has also changed its habitat from the salt to the fresh water. Another change that Nerpa underwent took place when it started following its ancestors in their annual migrations to the deltas of rivers. At present it is the only seal restricted to the fresh water. This is another reason why we should start protecting this truly unique animal, the emperor of the borning ocean - Baikal's Nerpa.

The expeditional part of the project is dedicated to the memory of Vladimir D. Pastukhov, the man that dedicate all his health and life to the Nerpa, and who was supporting our project and plans for future up to the last minute of his life.

Objectives and achievements

The main objectives of The Avuanga Project (2000-2001) are to investigate the behaviour of Phoca sibirica, and to estimate the actual environmental risk to the seal throughout the lake.

As the Nerpa is the top of the food-chain pyramide of the Lake (and the highest regulator of the Lake's ecosystem), it will help to understand the whole ecosystem and to propose the plan for its development.

Parallel, AMBA biosphere and model for the UNESCO WH sites in Russia will be presented for the region of the Zabaikalsky National Park, Barguzinsky State Nature Reserve and Ushkanie Islands.

Islands its self will be evaluated as the model of the small and relatively isolated ecosystem with the principles

of migration and self-regulation.

The Baikal seal is listed in the 1996 IUCN Red List of Threatened Animals as Lower Risk- Near Threatened. The species is especially vulnerable because it is restricted to only one lake. Once the waters of Lake Baikal are polluted the danger of extinction of the famous Nerpa would be especially high. The industrial and economic development of the region has already added pollution and human disturbance. Therefore the risk of several seal's populations becoming extinct is on the rise.

The stationing of four people on the three islands that contain the Baikal seal resting places will provide direct protection against human disturbance. This was very effective during the previous project, and the estimation of protected seals is about 100 per year (for four years it is about 1/100 of the population) and it saves the only resting population.

The project provided the baseline data on population dynamics of the species with the emphasis on relation between Phoca sibirica and habitat quality. Because of increasing pollution of the environment investigation of the seal's tolerance to the changes appear essential.

The behavioural profile include detailed observations of the mother- juvenile relationship, juvenile weaning, formation of social contacts, male and female territoriality in different seasons, sexual behaviour, feeding activities such as hunting strategy and effectiveness (achieved by direct underwater observations), and overall circadian and seasonal activity. Our data provided the baseline for further studies, and could be used in adjusting future conservation activities to specific species requirements.

The previous observation of that seals respond to the Earthquake deserves more interest.

The results of the project will be published as a Monograph.

Timetable

February - March 2001

Observations of the nursing mother-juvenile relationship. Underwater observations, which will continue throughout the whole expedition. Census of breathing holes in the neighbourhood of the Ushkanie Islands, population dynamics (data since 1989). Vocalisations.

April 2001

Observations of juvenile development, social groups formation.

June - October 2001

Protection of the only resting population at Ushkanie Islands. Investigation of feeding strategy, circadian activity, local movements. Emphasis on habitat selection, changes of population structure throughout the season and individual differences in Baikal seals. Behavioural studies of a recently discovered new or new form of freshwater seal. Intensive underwater observations.

November 2001

Morphological, Biochemical and Pharmacological evaluation of the death seals. Monograph presentation.

Personnel
(Avuanga subproject)

Peter Vrsansky. Chair-person of the AMBA Projects International. Has led seven UNESCO projects in the past as well as five expeditions at Lake Baikal. Responsible for the Project.

Silvia Alexy. Zoology student (Vienna). Behavioural studies of *Phoca sibirica.*

Yurij Budeev. Ranger of the National Park in Ushkanie islands. Ten years involved in *Phoca sibirica* studies. Publishing his results is part of the project

Tomas Cieselski (Gdansk) Pharmacological evaluations of the seals.

Nikolai Dobretsov. President of the Siberian Branch of the Russian Academy of Sciences. Guarantor of the project.

Mikhail A. Gratchev. The director of the Limnological Institute RAS. First published results of the seals' disease. Academician, Professor. Guarantor of the project.

Petra Ihringova. Zoology student, with three year experience at Ushkanie islands. Studying the seals at the resting place. Responsible for the document preparations.

Alexandr Kuzin. One of the preeminent Russian specialists on water mammals, with thirty years of praxis. Opponent of the Scientific Monograph to be published. Professor.

Róbert Oruzinsky. Ecologist, with experience at Ushkanie islands. Studying the seals at the resting place, and internet presentations.

Evgeny Ovdin. Science Director of the Zabaikalsky National Park. Scientific supervisor of the project. Participate in the AMBA projects for five years. Will secure formal affairs of the project.

Mikhail V. Pastukhov. Responsible for the morphological and Geochemical evaluation of the craniological material of seals. Participated in the project for two years.

Zbynek Pavlacik (Prague). Top journalist in the Czech Republic. Manager of the students excursion to Baikal.

Alexandr Timonin. Previously had lived on Ushkanie Islands for ten years, and has led a National Geographic expedition for three years. Participate in winter territorial observations and census.

Marcel Trnovsky. Forest engineer. Participated in the observation on the new-born seal. Responsible for the preparation of the forest plan for the AMBA biosphere Model.

Alexandra Zahradnikova. Specialising in ethology. Spent a year studying the Baikal seal. Concentrates on study of behaviour.

Discussion

In general, and from the scientific point of view, Baikal seal represents one of the most interesting animals at all, but the only observation that were recognised by the prestigeous scientific literature were the causes of mass deaths (*Gratchev* et al.,.1989; *Likhoshway* et al. 1989). These are particularly caused by over-hunting of the population, by the immunity system weakened by the organic waste in the Lake and by distemper virus. In spite of former and fact that seals face mass deaths annually, official data of hunters still claim the balance in the population.

The major specialist on seals, warning the bad situation of the species died recently, but left several considerable articles and a monograph as a result of his life observation (*Pastukhov*, 1993 and other citations there).

Due to the territorial protection to the species at the Ushkanie Islands, tourism presents a stress to seals, and it is important to limit the number of visits to the islands (that is currently strongly under permission) and to co-ordinate visits.

The observations and particularly protection of the population in the «wild» condition is important due to

ethological, psychological, scientific and cultural reasons.

Such observations not disturbing the population appeared to be essential even for the general science opinion. Observation of the facial and morphological variability of seals allow to create hypothesis of the isolated Lake's basins of the significant size (seals must live at least for several thousands of years in the smallest of the Lakes) in the past (*Vrsansky* et al., 1995, 1999). These observations are recently supported by authorities (*Grachev*, in preparation). The idea of isolated Lakes, namely central basin (Southern) and number of small northern lakes was firstly discussed by *Kozhov* (1973). Our observation indicate rather large aquatory of the two and possibly more lakes. The preliminary results indicate two species of seals (*Vrsansky* 1999), with Phoca sibirica with at least two very different subspecies (*Vrsansky* et al., 1999).

Our ideas of the migration and occurrence of the seal in Baikal through the Parathetys have been discussed recently (AMBA Project. 1999).

The global census of the species is of exceptional value, since the precise data are essential for understanding the definitive state of the population. Data obtained by 1998-99 are more precise than ever, still, they are fragmentary, allowing to assume the population roughly to 40- 80 000 individuals (*Vrsansky* et al., 1995, 1999), including all the subpopulations and subspecies. The more detailed census has been recently conducted by the group of M. Pastukhov, but the data obtained did not allow the better assumption.

Ramsar Convention application to the Baikal region is important as opening of another value to the natural habitats of the region. Recognising the wetlands as the contribution to the culture of Buriat Republic will help to recognise another natural values as well.

The same is truth for the biosphere and inclusion of the aquatory to the protected zone. In spite of the commonly present migrations of numerous taxa, even partial protection of the aquatory will provide significant help for aquatorial organisms of the Lake (f.e. seals). Additionally, aquatory with comparatively stable currents of biomass have been selected.

Conclusions

- *Phoca sibirica* is in critical situation with some populations facing extinction; and needs prompt help. The detailed global census of the species is essential.
- The main reasons of presenting the Avuanga project- the protection of the Baikal seal as a model projects are:
- Project is specific and comparatively easy to proceed
- Baikal seal and seals in general represent psychological archetypes that may be easily recognised by decision-makers, as well as by general public (Avuanga is Inuits' myth hero)
- Baikal seal is the top of the food chain pyramide and thus its protection is a protection of the whole Lake (it is a local project with global meaning)
- The Nerpa's only resting place is easy to protect, and it is among the most valuable places at Baikal (local protection- global consequences)
- There is several year tradition of the German- Russian collaboration in this project
- Project run successfully for four years
- The best specialists are already involved in the project
- Other proposed projects of AMBA are:
- Biosphere at the territory of the Zabaikalsky National Park and Barguzinsky State Nature Reserve (possibly as UNESCO WH model)
- Inclusion of the Aquatory addicted to the Sviatoi Nos, and Ushkanie Islands to the protected zone of the Zabaikalsky National Park
- Inclusion of the wetlands of the Tchivirkuiskii bay into the Ramsar Convention

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Workshop: Socio-Ecological Aspects of Project Development, Environmental Education and Information Management

Russian-German Cooperation in Sibiria The Lake Baikal Region

Wolfgang Adamczak

Funding of Projects and the Internet

As an initiative of Chamber of Commerce and Trade Kassel (IHK Kassel) and Comprehensive University of Kassel (GhK) in 1992 it was established East-West-Centre, a society aiming to support the East-West-Co-operation in Economy and Science. East-West-Service Centre of IHK Kassel and East-West-Science Centre (Ost-West-Wissenschaftszentrum) at GhK are acting as operative units. The aim of the East-West-Science Centre is to support the scientific and artistical exchange with Central Eastern and Eastern European countries as well as to convey information on each of these countries. The Centre provides a forum for discussions between scientists from East and West, supports the transfer of new social and environmentally friendly technologies, strengthens the dialogue between science and social practice also towards Central Eastern and Eastern European countries and provides advice and information. Not least, the cultural exchange particularly in the field of arts should be deepened by the East-West-Science Centre. Continuing offers and programmes are currently available for the following countries: Poland, Russia, Czech and Slovak Republic, Romania and Hungary.

The functions of the centre are:
- Initiation of co-operation projects in science and teaching
- Organisation of scientific events on East-West related topics
- Development of further education offers relating to Central Eastern and Eastern Europe at the GhK
- Publications
- Investigations and collection of data on Eastern Europe

The OWWZ initiates and supports projects related to Central Eastern and Eastern Europe that:
- are preferably regional oriented and pick up on existing partnerships;
- practice-oriented sciences contribute to the improvement of local structures, e. g. in general and vocational education and further training, modernisation of economy and administration, new ecological development;
- support a reform and modernisation of teaching in higher education, giving advice to development of new study structures particularly in Economics, Social Studies and Humanities;
- initiates long-term and result-oriented research co-operation.

If you want to do all the above mentioned scientific co-operations, you have to find partners, which have competence in doing lectures or research at that subjects. But if there is no sympathy between partners, it is difficult to establish well working co-operation. But if there is both but no money co-operation will not work at all. When you plan to make co-operation projects between scientific partners, you should look how to finance it from the begin on. Much more complicated to manage are projects, that will not do "only" research, but try to implement scientific results into practice as it is subject of this conference. It will be most important to find funding programmes and to handle them with competence and in time.

What do you want to do ?

Experienced scientists know their sciences, the literature, the colleagues, they have ideas and strategies. That is the prerequisite. But first of all you should become clear what do you want to do.

Do you want to make
- An educational stay
- A research stay
- A joint research project
- Basic research
- Applied research
- Implementation of research results
- A joint educational project
- Lectures ?

Do you want to make
- A short trip (up to three months)
- Or a longer stay (a half year or more)?

Do you want to establish a
- Bilateral (with scientists from one foreign country) or
- Multilateral (with partners from several countries) projects?

In dependence on the above mentioned topics the institutions, which will support your idea and the way to make your grant proposal, are often quite different. Academic exchange organisations will finance abroad trips, research funding institutions are sponsoring research projects. Some funding institutions will only support basic research, some others wants implementation of research results. Let us look to the possibilities of funding east-west co-operation.

How to find information

East West-Science Centre has since 1993 established a pool of "Information on funding scientific and research co-operation between East and West" mainly in the view of German Scientists. At December 1998 it was published the 9th and final print edition, because much better is a look into WorldWideWeb. There you can find more topical information, because updating of information can be made continuously. To look into the whole WWW becomes more and more important, because there you

can find information that is
- immediately disposable
- topical
- authentic
- and democratic

What does this mean?
- You put on a key and you have it. You have not to order and to wait for a copy
- The dissemination of printed (or copied) information needs time. On the way to you it might get lost its topicality
- Information is true, because it is given into WWW, where it has been generated
- Everyone who has access to Internet, can get information. You have not to ask for permission or to wait, until your superior is back from an important workshop in Schneverdingen...

In the appendix you will find a list of institutions and WWW addresses, that are funding the topics of our conference.

But let us now look to the address of EWSC: http://www.uni-kassel.de/ owwz/ . Information is given in English language. You will find there a list of funding institutions and their programmes. But you will find an investigation tool too, which allows you to look for specific funding organisations, for regions, that are involved, for application modalities and so on quickly. As you can see there are a lot of funding possibilities.

I will show a few examples. To support transfer and co-operation between Eastern and Western Europe, the European Union established specific programmes for multinational co-operation. Well known is the TACIS-programme, which shall help to reconstruct human resources development, education and training (including managerial and manpower training). As in all EU-programmes you must have several partners in between the EU and out of Eastern Europe. If you will establish an academic teaching project with several partners, TACIS is a suitable programme.

Beyond this there are programmes for co-operation with certain categories of third country. For Russia, which is not in the pre-accession phase for EU-membership this means support for research and technological development potential (including through INTAS for the NIS, provided that a new agreement is reached between its members on its continuation), co-operation in areas of mutual interest (including satellite applications, regional problems linked to the environment and health), if it is defined as interest of EU. Participation to the other 5th framework programmes activities may take basically the form for other States in the pre-accession phase that partial association with one or more complete specific programmes could be envisaged,

The detailed conditions under which Russian research activities may participate in the framework programme, including the financial arrangements, will be specified in the decision which will be adopted pursuant to Article 130j of the Treaty. But the essential condition as in all EU-programmes is the multilaterality of the projects relating to countries and to the co-operation of research institutions and industrial firms.

The Deutsche Forschungsgemeinschaft (German Research Community) has co-operation contracts with partner-organisations in whole Europe. In Russia there are Academy of Sciences (RAN) and Russian Foundation for Basic Research (RFBR). DFG is the largest funding organisation of sciences in Germany. In 1998 DFG support for science and research was 2.2 billion German marks. There are programmes to promote scientific co-operation with scientists from Middle East an Eastern Europe and the States of former Soviet-Union. Herein long-lasting research projects can be financed. It is important to know, that only German partners are allowed to make applications at DFG. Russian Partners have to make applications at their national institutions mentioned above.

The Volkswagen-Foundation, the greatest private science foundation in Germany, has established a few programmes, which cover the whole spectrum of sciences and of the regions of Middle East and Eastern Europe. You can find examples including co-operation with Natural and Engineering Scientists and such including the Humanities and Social Sciences.

How to make a proposal

First of all you know your partner(s) from conferences, from literature and you have to decide, whether you will make a bi- or a multilateral project. If you will get a grant from EU, you have to make a multilateral one. Than you have to decide, what type of project solves best your problem. Is your problem academic teaching, an educational visit or a research question ? Next step is to make a short outline that involves what you will, how you will do it and why you will do it, a time-table and a list of estimated costs. With this in your head (or on a sheet of paper) you can contact funding institutions. Before that you have looked, whether there are programmes that fit with your interests. You should know, too, that the condition of most programmes of East-West-co-operation is, that the applicant is (one of) the partner(s) out of Western Europe.

As a rule you should never send a well worked out proposal to a funding institution, but try to phone with your short outline in the back. So you can save much work. Let me say why.

- Most programmes are not specific for e.g. ecology but will fund wider parts of sciences. Your interpretation of the programme can be wrong and your specific topic will not be supported. If this is the problem, you need to do no further work.
- Your ideas fit the programme not wholly. So you have to decide, whether you want to make your ideas fit the programme or not.
- In the best case your topic and your outline finds the applause of the funding foundation. Then you can work out your proposal immediately.

I hope, that this short guide may be helpful for you. But if you have any question don't hesitate to call, to send a fax or an e-mail. If all fails to help you to find money to realise your ideas, I would propose to do what I said a few years ago at a conference in Prague:

go to the Prague Castle into the golden lane and try to make gold out of stuff as in the ancient times. I suppose some businessman in our times succeed already in doing that. But that is another topic especially of economic sciences!

Appendix

WWW-Addresses of Research and Funding Organisations A short Selection

Russia

http://hp.iitp.ru/
Russian Academy of Sciences (RAN)

http://intra.rfbr.ru/
Russian Foundation for Basic Research (RFBR)

Germany

http://www.dfg.de/
DFG (Deutsche Forschungsgemeinschaft)
German Research Community

http://www.volkswagen-stiftung.de/
Volkswagen-Stiftung
Volkswagen Foundation

http://www.avh.de/
AvH (Alexander von Humboldt-Stiftung)
Alexander von Humboldt Foundation

http://www.daad.de/
DAAD (Deutscher Akademischer Austauschdienst)
German Academic Exchange Service

http://www.bmbf.de
BMBF(Bundesministerium für Bildung und Forschung)
Federal Ministry of Education and Science

http://www.dlr.de/ib/
Internationale Büro (IB) des BMBF
International Office of BMBF

http://www.bmu.de/
Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit
German Federal Environment Ministry

http://www.umweltbundesamt.de/
Umweltbundesamt (UBA)
Federal Environmental Agency

http://www.dbu.de
Deutsche Bundesstiftung Umwelt (DBU)
German Federal Foundation for Environment

http://www.bmz.de/
Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung
Federal Ministry for Economic Cooperation and Development

http://www.gtz.de/
Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ)
German Technical Cooperation

http://www-fes.gmd.de/
FES (Friedrich-Ebert-Stiftung)
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http://www.liberale.de/institutionen/fnst/
Friedrich-Naumann-Stiftung
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(Federal Foundation Rosa Luxemburg)

Western Europe

http://www.cordis.lu
CORDIS-Databases
(Community Research and Development Information System) of EU

http://www.etf.it/
ETF (European Training Foundation)

http://www2.cordis.lu/cost/home.html
COST (European Cooperation in the field of Scientific and Technical Research)

http://www.esf.org
ESF (European Science Foundation)

http://www.intas.be/
INTAS (International Association for the promotion of co-operation with scientists from the New Independent States of the former Soviet Union)

Worldwide Addresses

http://www.who.int/
WHO (World Health Organisation)

http://www.un.org/
United Nations

http://www.unesco.org/
UNESO (United Nations Educational, Scientific and Cultural Organization)

http://www.unep.org/
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Land-Resource-Management in Transition: Problems and Solutions among the Indigenous Peoples of the Far North

Florian Stammler

Abstract

Siberia with its vast Taiga forests and Tundra ranges and with richest mineral resources is the main source of hard-currency income for the Russian Federation. Therefore, definition of property rights on the resources and of ways how they are to be exploited are a key issue in the current processes of transformation. One major question is to be answered by these developments: Will it be possible to meet the needs of all actors living or interested in Siberia, or do different directions of resource use exist, which are mutually exclusive?

First findings show, that differences and possible conflicts go along the following border-lines:

- Are resources over or under the earth-surface to be used?
- Is a traditional or industrial way of resource use intended?

There are three main groups of actors with different interests in the resource-rich Siberian region: 1. The State, 2. the Russian and foreign enterprises, and 3. the indigenous peoples.

1. Siberia's share in Russia's scale of mineral resources ranges from over 60 to over 90%. Due to economic contstraints, the state as an actor in Siberia is interested in providing a legal framework for resource exploitation that meets the interests of domestic and foreign companies engaged in this branch of economy. At the other hand, in the constitution of the Russian Federation the state has committed himself to protect the environment especially in the territories where the so-called small indigenous peoples of the North live.
2. The economic enterprises are mostly interested in exploiting the mineral wealth ensuring the highest profit for the least costs. Due to their temporary engagement in the region, they will hardly invest in environmental protection or sustainable development, unless they are pressed by an ecologically conscious publicity or a legal framework.
3. The indigenous residents of the territories with mineral resources are interested in ensuring the ecological balance of their "on-surface resources" like reindeer pastures, hunting- and fishing grounds, which are the basis of their physical and economical revival.

Concrete conflicts emerge, when the state gives licenses to exploit e.g. an oil or gas field on lands, which at the same time serve as pastures for reindeer breeders. Exploitation of the fields in Russia mostly destroys the environment in a way, that traditional resource use is no longer possible. In west Siberia, we find numerous examples for that.

There have already been attempts to solve this conflict of interests and to combine the traditional and the industrial way of resource exploitation. Each party is acting according to its own means of power and influence. As the indigenous peoples usually are in the weakest position, they become deprived of their traditional lifestyle. The result is social marginalisation, with the consequences of alcoholism, drug abuse, prostitution, criminality and high suicide rates.

A solution of the conflicts between industrial and indigenous resource use can be found only through a clear definition of land rights. Whereas in soviet times, the indigenous population often was deported off their lands, or had to leave it due to pollution of water and pastures when the oil explorers came, today the indigenous peoples fight for the registration of their clan- or community-territories.

With registered land-users (not yet private owners), negotiations have to be carried out on the conditions of mineral resource exploitation. Unfortunately, until now these negotiations result mostly in poor material compensation of the ecological damage caused by the exploitation, instead of applying international standards and legislation. Damages are, if at all, to be reconstructed instead of prevented.

In order to improve this threatening status quo, the following issues seem to be most imprint, for the Baikal Region as for West Siberia as well:

- A clear legislation without contradictions considering all interest groups.
- Concrete possibilities for implementing the legislation, trying to reduce the amount of corruption.
- Creating an ecological consciousness among the Russian and the indigenous population in the society imposing a kind of public pressure on observing environmental standards
- Cooperation between Russian and Western experts in implementing the above-mentioned measures, recurring on experiences of the West, without simply "importing western models".

The successful or unsuccessful implementation of such measures will show, whether a liberal political and economical system is more capable to combine measures of economic development and environmental protection than the soviet one was.

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Ecological Ethics and Environmental Education: Problems of Transformation in Siberia

Anna Gossmann

Abstract

The status quo

The vast ranges of Siberia are experiencing growing environmental stress and destruction. This is due to industrialisation and a large-scale influx of population from the more southern regions of Russia, who come to work in resource- rich regions. During the Soviet time, industrialisation of the North was ideologically considered testifying the progress of the communist society. Under such circumstances, environmental protection, ecological ethics and education did not exist in the society, except among the indigenous residents of Siberia living far away from the "benefits of soviet civilisation". Due to a standardised, union wide educational system, the younger generations grew up with a relationship to their environment, that was characterised by ignorance.

In Siberia as special case, the climatic conditions additionally hinder an ecological consciousness to evolve: It is always considered that there is left enough empty land, and the impacts of damages are not so directly obvious like in western countries with high population density. But at the other hand, the biological diversity of the Siberian North and the reproduction capacity of nature are very low. In consequence, the impact of industrial development and population density on certain places exceeds the carrying capacity of the ecosystem.

Under these circumstances, a general ecological ethics cannot evolve in the society. In all regions of Russia, at present this lack of ecological consciousness is a decisive barrier to the success of environmental protection measures.

Ecological consciousness

Until now, the population mostly reacts with escaping from the results of environmental destruction by moving to other places, which they begin again to over-exploit. In the Republic of Yakutia, considered one of the most advanced regions in Russia concerning environmental issues, there are still numerous examples for this lack of ecological consciousness. Only if the damage is high enough to be felt by the people, it remains for them only to assess it and to find out alternatives for continuing their lives like before.

At present, most measures are directed to cope with the consequences of environmental destruction, *recultivating, restoring* polluted areas instead of *preventing* the pollution. An ecological ethics is only beginning to emerge among people and official bodies, that argue, it is better to keep the natural wealth for future generations and prevent damage, than ensuring a short time profit for the economy. The declaration of the Lena Delta as a nature reserve in Yakutia proves this hopeful direction, as well as the natural heritage status of the Baikal.

Ecological movement

The end of the Soviet union was followed by the evolvement of an ecological movement. Analysis of the Yakutian case show, that this movement operates along ethnical border-lines. This could at the long term be the cause of social conflicts among the different ethnic groups. The immigrant population, especially Russians, is accused by native activists to be responsible for considerable damages of the environment and for the loss of the natural basis of survival for the indigenous residents of the land.

The actions of the ecological movement are focused on:

- proclaiming the revival of traditional indigenous ecological knowledge,
- applying traditional techniques in hunting, fishing, and animal breeding,
- applying modern techniques for water clearing and
- using environmental sustainable methods of industrial development

However, due to lack of money and considering the current status of the Russian economy, these measures are not likely to be implemented at present.

Solutions proposed

Ecological ethics, however, begins in every day life. On this very basis, it has to be formed by education. The solutions are simple, but until now poorly carried out in Siberia:

- The introduction of courses in school promoting the responsibility of man for nature, more concrete the recultivation of traditional resource use techniques.
- Creating a publicity for environmental issues through advertisement. Here, the media can play an important role, providing information about the state of environment, publicating the analysis of water quality, ozone values, smog alarm in the industrial cities and so on.
- Using and extending the information network in order to connect distant regions and people with similar problems, in order to provide the possibility for joined actions for improvement of the status quo.

After implementing these measures, an ecological consciousness will emerge in the following decades, a process that has begun similarly in the West a few decades before. Applying know-how and experiences, Russian-Western cooperation can be fruitful in this direction, but without copying western models in Russia, but in combining them with the local possibilities and traditions such as indigenous resource use, which in cooperation can be optimised ecological more sustainable.

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Public Involvement in the Local Ecological Issues Solution

Nina Dagbaeva

People in the Baikal region need to have access to information about natural social environment so they can participate in the decision making processes which concerns their villages, towns and regions. Information management via modern communication technologies a possible approach to meet this challenge.

A big data Bank "Knowledge of Baikal" concerning water quality, air and soil pollution is the main results of Tacis-project "Ecological information and public awareness promotion in the Baikal Region". The ecological information was analyzed and collected and is located in the Baikal Institute in Ulan-Ude and Limnological Institute in Irkutsk. The current problem now is to work out this huge information to make it understandable for the people. Another one problem is the translation of data into the English language to make it available for the International access.

In 1996 Lake Baikal was declared The World Heritage site, and in 1999 the Russian Federation passed the Low for the Protection of Lake Baikal. These recent developments present new opportunities for the protection of the Lake Baikal and the sustainable development of the region. But practical implementation of the Low is accompanied by several problems.

Negative ecological consequences of anthropogenic activities cause deterioration of social conditions of population's life and first of all – human health. The situation is complicated by the economic crisis in Russia during its transition towards the free market, by the low technological level of production, and by unemployment.

Thus, today in the Baikal region there is the imbalance of the hole trend of modern human well-being – ecology of the environment, economic development and social processes – each of these components are experiencing serious moments of crisis. The key of our conference hardly requires a discussion, the point that the balanced solution of problems of ecological, economical and social character will lead towards sustainable society, which is not outweighed by hopelessness. However, the ways, which will lead towards this goal out not be standardized, since the roots of the problems and modern state of lakes and rivers in the different parts of the globe are different.

The first steps in this direction have been taken, and the recognition of Lake Baikal as s part of our Word Heritage adds much to it. In general, in our opinion, the strategy for realizing sustainable development must take into consideration the following conditions:

1. Baikal's unique ecosystem makes it necessary to prioritize ecological tasks over economic. It is impossible to raise living standards by using raw materials in a traditional industrial manner.
2. The complimentary nature of the Mongolian and Russian states interests in regard to issues concerning the Lake Baikal watershed require cooperation in policy.
3. Regional imports should be given priority over exports.
4. The interests of both indigenous people and incomers should be considered.

These conditions lead to the following goals:

1. To raise living standards until one standards to realize the interconnection of our well-being and the state of the environment.
2. To maintain political stability considering the multi-ethic characteristics of the region.
3. To reduce and stabilize the amount of emissions of pollutants.

Eventually, the necessity for the creation of new environmental behaviour patterns should become more evident. Humans are not the Masters of nature but a component within it, and the adaptability to natural conditions is the primary objective.

The complexities of realizing the sustainable development are caused by the known situation – the amounts of production don't grow up due to both economic conditions on the one hand and environmental requirements on the other.

Only 50 000 people inhabit the territory which was declared World Heritage Site. But many more live in the larger region including the large cities of Ulan-Ude and Irkutsk. This region addressed in the Baikal Law because of its significant effects on the lake. The duty to preserve Lake Baikal can only be fulfilled if solutions have positive effects on the standard of living of these people. We believe that the main task of the development of cooperation is the stimulation of economic activities in the Baikal region. Especially people who directly depend on the lake as a source of income should have a chance to increase the standard of living. For those people Lake Baikal, its biological richness, its surrounding landscapes and its natural resources, is a source of wealth and social respect.

For us, who inhabit the Baikal region, Baikal is not only water reservoir, it is our sacred place, is our spiritual spring. And we try to protect they purity, we try to do it, we have to do it, we will do it.

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Problems of an Initial Stage of Ecological Education in the Baikal Region

Alexandra Ottens & Tatiana Alaeva

Abstract

Global ecological problems and global Ecological Education are concepts closely interconnected among them. Ecological Education should be considered not only as a process of development of sensual and aesthetic perception of a nature and awareness of existing correlation at a person, but also as a process of forming respect for all creatures and comprehension of the personal a responsibility for nature condition.

After conference in Rio de Janeiro (the 1992) a concept "stability" was actuated. It is a rational approach to the solution of a dilemma caused by interaction of the person and a nature, providing the management an environment and its resources in a way to maintain the present consumption. For reaching stability of ecological formation and education it is necessary to promote ecological awareness among Population as the purpose of all educational reforms at all levels of training. One from means of reaching it is the continuous ecological education, since family, garden, school, technical school, high school etc., such education should have purposeful, systematic character, since it represents a complete system enveloping all life of a person. It must aim at forming at the person world outlook, based on uniting with a nature, as well as developing of anthropogenic principles. Hence, the system of continuous ecological education in any region of country is necessary. Taking into account that fact, that our future generation and we are the hosts of Lake Baikal, such a system is now formed in our region. For example school - garden "Sadko" ¹ 108 works successfully, where the creative group on ecoeducation is working and some gardens of the city have a task – to create ecological passport of the territory.

The practice of activity with growing up generation has shown, that children of any age can be explained of difficult concepts and it's possible to form right points of view about nature processes, with the help of correct use both combination of visual and verbal methods. Therefore nowadays it is necessary to understand a significance of ecological formation and education in pre-school educational establishments. The ecological education of children under school age is knowledge of living that are near to the child, in correlation with environment. There fore elaboration of right ecological polity is of great importance.

In this respect the ecological games can and should promote development of ecological awareness and positive activity. With the help of such games a teacher shows children a variety of the natural phenomena and helps to understand, that all have needs, living beings good environmental conditions. Due to games a child understands its role in of maintaining preserving environment. As the main contents of life of the child of preschool age is a game, the author considers, a game to be the most natural way of ecological education. The elaboration of a child's ecological game - travelling is offered to our attention "Where does a streamlet live?"

Analyzing the level of ecological education in Ulan-Ude pre-school establishments the following outcomes were obtained: 1) all establishments focus on ecological subjects. The methods of activity with children vary here rather widely (selection of fairy tales with ecological emphasis, ecological proverbs and sayings (n/s ¹ 59), conversation and reading about motherland, training opened lessons on ecology (n/s ¹ 9), organization of the exhibitions of applications, modeling, pictures about nature (n/s ¹ 8), as well as introduction the "Endangered Species List" of Buryatia). 2) Unfortunately, "alive angles" are phenomenon that is not often in Ulan-Ude nursery schools. Probably, it is connected to shortage of money resources to purchase and maintain animals; 3) Excursions to nature are not often. It is connected with unfavourable location of nursery schools within the city; 4) As for the special programs with ecological emphasis such a situation takes place: the basic number pre-school establishments uses the program by Vasilyeva, which does not provide special ecological activity. However at present time the tutors prefer to choose ecological subjects. That's why many nursery schools include elements of the different ecological programs in their plans, such as "Rainbow", " Our house is Nature", " We are inhabitants of the Earth ". Now it is necessary to intensify activity of ecological education among children under school age by drawing them into ecological activity.

In conclusion it is necessary to remark that because of difficulties of financial character in many pre-school establishments the subscription to periodic is reduced, that's why the tutors can not afford obtaining actual information on ecological problems and ecological education. The tutors need methodical provision of the ecological contents because of deficiency of information about a condition of natural objects in Buryatia, as well as about a way of solving basic ecological problems in the Baikal region etc. Many teachers would like to have in the methodical arsenal ecocards of city and republic, regularly to receive the information on an ecological condition of the regions, about discoveries in the field of ecological researches, about a condition flora and fauna of the republic. The gardens with a nomenclature of didactic material to occupations have considerable difficulties.

As a whole, the comprehension of importance initial ecoeducation by the teachers of pre-school establishments of Ulan-Ude takes place. This year a nursery school "Crystal" opens an ecological class for training and conversations on the subject on environment. It is necessary for tutors to use in their activity not only ready elaboration of teachers of Moscow and central cities of Russia in " a pure kind ", but adapt them for conditions of our region, taking into account traditions and household activities of the local population.

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Additional Contributions

Air/Space-Borne Repeat-Pass Pol-D-in-Sar Image Overlay Interferometry and its Application to Geo-Ecological Stress-Change Monitoring within the Selenga Delta, Kudara-Polygon, Se Baikal/Buriatia Using Sir-C/X-Sar Mission 2: 94-10-08/09 Tien-Shan Data Tracts

Continuation of ground-truth collection, and of comparison of various polarimetric, interferometric, and polarimetric-interferometric vegetative scene characterizations

Wolfgang-M. Boerner, Yuadkoun Dhiantravan, Harold Mott, Vernon A. Miller, Shane R. Cloude, Konstantinos P. Papathanassiou; Robert N. Treuhaft, Yunjin Kim, David A. Imel, Antony Freeman, Paul Rosen, Jakob J. vanZyl; Christiane K. Schmullius, Juergen Gabriel, Albrto Moreira, Kostas P. Papathanassiou, Andreas Reigber; Dashi D. Darijapov, Vladimir N. Suchkov, Gennadij I. Tatjkov, Sergeij B. Bulgakov, Tsyden Kh. Tsybjitov

In this succinct review, we will evaluate the potentials of 'Polarimetric Scattering Matrix Decomposition, Entropy Classification versus Interferometric DEM, and Polarimetric-Interferometric Vegetated Scene Classification' by comparing the host of novel algorithms developed by members of the ONR-NICOP-WIPSS-COLLABORATORY. Specifically, in context with the "BWNHHPS Ground-truth Collection Mission" for establishing the "Terra Digitalis Baikalum" as described in the "IC-BWNHPS MONITORING RPORT", produced by members of the "Collaboratory Terra Digitalis Baikalum", it is necessary to compare and evaluate the applicability of various different coherent, purely polarimetric, purely interferometric versus coherent polarimetric-interferometric classification algorithms for extracting altitudinal (height of canopy versus undergrowth and forest floor) and transverse (horizontal branches, shrubs, ground vegetation) parameters of vegetated natural (estuary, wetlands, virgin taiga), agricultural (fields, meadows and domesticated forest regions), rural farming hamlets, and of the rugged forested mountain ranges of the neighboring Khrebet Darban and Khrebet Ulan-Burgassy on the Eastern side of Baikal Lake.

For this, we use fully polarimetric (coherent scattering matrix), differential (repeat-pass)), interferometric SAR image data sets, acquired by the Shuttle Imaging Radar SIR-C/X-SAR Mission 2 of 1994-10-08/09 along the TIEN-SHAN tracts (122.20/154.20) within the 'Baikal Rift Zone' of Inner Asia (Mongolia and Buriatia). The performance as well as the accuracy of the different novel approaches is compared in order to generate, step-by-step, a vegetative elevation model of the rather diversified "Kudara Polygon" test and control site. By smoothing the multi-frequency, multivariate image data sets, and by implementing the collected and existing ground-truth information for generating the '3-D Kudara Polygon Vegetation Elevation Model' , it is the goal to extract homogeneous test and control sites for the validation of the existing and rapidly increasing number of UWB-POL-D-IN/TOMO-SAR Repeat-Pass Environmental Stress-Change Monitoring algorithms.

Thus, it is one of the prime objectives to develop a permanent Global Network of Multi-disciplinary Ground-truth Collection Test & Control Sites ,such as the Kudara Polygon within the BWNHPS of BURIATIA, for support of current (ERS-1/2, JERS, RADARSAT, etc.) and near-future space imaging missions such as the SIR-C/X-SAR Mission 3: SRTM (shuttle radar topography mission), the fully polarimetric ENVISAT (ERS-3), RADARSAT-2, ADEOS (JERS-2: PAL), and the fully Polarimetric-Interferometric (LIGHT-SAR and ECHO-SAR) missions to ensure the compatibility of the different UWB-POL-D-IN/TOMO-SAR image feature decomposition, characterization, and identification approaches.

Background

During the Seventh Annual Airborne Earth Science Remote Sensing Workshop of 1998-01-15/16 at the NASA-JPL von Karmann Auditorium, an Introduction [1] was presented of various Polarimetric SAR feature characterization/identification [2], and especially of the CLOUDE-POTTIER H/A/a-Entropy [3 - 5] and the CLOUDE-PAPATHANASSIOU PIPCO (Polarimetric- Interferometric Phase Contrast Optimization) algorithms [6 - 7]. The "fully polarimetric" L/C-Band image data sets collected during the SIR-C/X-SAR Mission 2 (1994), Repeat-Passes (94-10-08: 122.20/94-10-09: 154.20) of the TIEN-SHAN tracts along the Baikal Rift of Inner Asia were selected for the determination of geo (tectonic)/eco (agriculture & forestry)-environmental stress-changes occurring within the "Kudara-Polygon Ground-Truth Collection Site (N52.16*/E106.67*)" within the Selenga Delta at the E-SE Shoreline of Baikal Lake in Buriatia, SE Siberia, Russia [1].

The associated, previously (1996) initiated Ground-Truth Collection project in the "Baikal Lake Basin" within the "Baikal Rift Zone", was extended and ex-

panded with support of UNESCO/ WORLDBANK, INTAS, NATO, ONR, RAS for the RAS-SB-BSC Institutes of Environmental and Radio-Cosmo (Space)-Geo-Sciences [8], because the "RAS-SB-BSC KUDARA-POLYGON" lies in the center of the "BWNHPS (Baikal World Natural Heritage Protection Site)", containing almost all of the existing diversified geophysical, geo-aquatic, geo-ecological and anthropogenic stress phenomena encountered on our terrestrial planet. Beyond the first joint EAST-WEST Ground-Truth Collection Excursion (WMB) of 1997-09/09-16, several additional excursions (WMB+VAM+ChKS +WKV: 98-09/05-07; ChKS: 99-01/07-09) with research scientists (DDD+TKhT+ BChD) of the RAS-SB-BSC in Ulan-Ude, were conducted. This region of the mighty SELENGA Stream - - the major contributory to Baikal Lake - - Estuary is unique in that it encounters, in addition to the geo-ecological (e.g., severe flooding) and anthropogenic environmental stresses, also severe tectonic stresses continuously at work within "BLB" (6 major earthquakes at the order of 5.2 on the Richter scale and higher were recorded since 1997 September within BWNHPS). This makes the BLB, extended over the entire "Baikal Rift Zone" of Inner Asia, a prime candidate for executing extensive and highly precise Geo/Eco-logical Ground-Truth Collection on a year-around, around-the clock basis in support of current (ERS-1/2, JERS, RADARSAT, etc.) and future (SRTM, RADARSAT-2, ENVISAT, ADEOS, LIGHT-SAR, etc.) Space Remote Sensing missions. These multi-disciplinary ground-truth collection efforts in support of establishing the "Terra Digitalis Baikalum" are rapidly and well developing as reported in [8].

Also, during the last year, since the Seventh Annual Earth Sciences Workshop of 1998-01-15/16, very considerable progress was made by the international team of collaborators of the 'ONR-NICOP-WIPSS-COLLABORATORY' on advancing UWB-POL-D-IN/TOMO-SAR image overlay theory, image processing and technology, and its application to "unsupervised image feature interpretation". Primarily and foremost, the major contributions relevant to this project were forth-coming from (i) DLR-OPH/IHFT (Wolfgang Keydel, Alberto Moreira, Konstantinos Panagiotis Papathanassiou, Shane R. Cloude, Andreas Reigber, Christiane K. Schmullius, Ernst Lueneburg and Wolfgang-M. Boerner), (ii) NRL-RSD/ISS (Jong-Sen Lee, Thomas L. Ainsworth, Dale L. Schuler, and Mitchell R. Grunes), (iii) DDRE (Ernst Krogager and Soeren N. Madsen), (iv) U-Nantes-IRESTE/SEI (Eric Pottier, Joseph Saillard and many highly capable post-graduate research assistants), (v) NAWC-AD-PAX (James S. Verdi, Stephen J. Krasznay, Wolfgang-M. Boerner), (vi) U-Niigata-IE (Yoshio Yamaguchi, Hiroyoshi Yamada, Jian Yang, and many talented graduate assistants), (vii) UIC-EECS/CSN (Wolfgang-M. Boerner, Harold Mott, Vernon A, Miller and collaborators), and most profusely also at (viii) NASA-JPL/RSE+ESD (Robert N. Treuhaft, Yunjin Kim, Anhua Chu, Paul Rosen, Tony Freeman, Jakob J. van Zyl) - - - as will briefly be summarized. Most importantly, it was shown and demonstrated that purely polarimetric (scattering matrix), purely interferometric (dual antenna), and especially coherent polarimetric-interferometric - - plus its multi-sensor polarimetric-tomographic extension POL-TOMO-SAR - - allow the identification of scene-characteristic scattering mechanisms at hitherto unknown clarity and depth. In addition, a variety of novel complementary "Differential Ecological Elevation Maps: DEEMs" were generated at various laboratories of the ONR-NICOP-WIPSS COLLABORATORY which are of immediate relevance in a great many different geo/eco-environmental stress-change monitoring disciplines for the Remote Sensing of the Terrestrial and Planetary Covers. In essence, considerable progress was made towards the NASA-JPL Earth Sciences Air/Space-Borne Remote Sensing mission.

Conclusions

Thus, it is one of the prime objectives to develop a permanent Global Network of Multi-disciplinary Ground-truth Collection Test & Control Sites ,such as the Kudara Polygon within the BWNHPS of BURIATIA, for support of current (ERS-1/ 2, JERS, RADARSAT, etc.) and near-future space imaging missions such as the SIR-C/X-SAR Mission 3: SRTM (shuttle radar topography mission), the fully polarimetric ENVISAT (ERS-3), RADARSAT-2, ADEOS (JERS-2: PAL), and the fully Polarimetric-Interferometric (LIGHT-SAR and ECHO-SAR) missions to ensure the compatibility of the different UWB-POL-D-IN/TOMO-SAR image feature decomposition, characterization, and identification approaches.

Ideally, in order to further strengthen and substantiate the creation of the "Terra Digitalis Baikalum", it is desirable to conduct re-occurring 'International Multi-Platform Measurement Campaigns over the Baikal Rift Zone", centered within the BWNHPS, and operated out of Ulan-Ude - - the capitol of the autonomous Republic of Buriatia. Such an endeavor should include all of the existing advanced air-borne imaging platforms such as the NASA-AIR/TOP-SAR, the DCRS-EMI-SAR, the DLR-E-SAR, the ONERA-RAMSES, the NASDA/CRL-PAL-SAR , the RAS-IREE-SAR, etc., in order to establish the non-existing international environmental remote sensing standards and procedures.

And, most importantly, it was not just a mere accident that we chose to select the "SACRED BAIKAL LAKE" within the Baikal Lake Basin of the Baikal Rift Zone, but in response to one of the most urgent global "Environmental Rescue Missions", we cite here in due recognition of the NASA-JPL Earth Sciences Remote Sensing mission, the famous epitaph [9]:

"Wenn wir den Baikal nicht retten, können wir auch unseren Planeten Erde nicht retten!"

Academician Valentin Afasaneyeviich Koptyug
late President of the Russian Academy of Sciences
Siberian Branch at Novosibirsk

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Fire in Ecosystems of Boreal Eurasia and its Significance to the Baikal Region

Johann G. Goldammer & Matthias Rhein

Preface

This paper, submitted to the International Baikal Conference 1999, consists of three parts. Part I introduces the role and impacts of fire in ecosystems of boreal Eurasia as significant to the Baikal region. It is an updated short extract of the FAO report "Fire in Europe and Temperate-Boreal Asia", prepared by the first author as the Eurasian component of the global fire analysis "Public Policies Affecting Forest Fires" of the FAO in 1999 (*Goldammer* 1999, *FAO* 1999). This extract is confined to the Russian Federation and the immediate neighbours of the Baikal region, namely Mongolia and China.

Part II provides a synopsis of the ongoing EU-financed TACIS project "Improvement in Forest Fire Response System" (TACIS ENVRUS9701), which has a regional component in Irkutsk.

Part III summarize the activities and publications of the Max Planck Institute for Chemistry, Biogeochemistry Department, Fire Ecology Research Group, which also hosts the Global Fire Monitoring Center (GFMC), concerning fire research and development in the Russian Federation with significant relevance to the Baikal region.

PART I: Fire in Ecosystems of Boreal Eurasia

1. Introduction: The Eurasian boreal forest and fire

More than seventy percent of the global boreal forest cover are in boreal Asia, mainly in the Russian Federation, and represent the largest unbroken forested area of the globe; the remainder is in Canada and Alaska, and

relatively small areas of boreal forests are found in the Northeast of China and in the Nordic countries. The distinct climatic seasonality in the Eurasian boreal forest zone is characterized by a short vegetation period and low average temperatures and favours the accumulation of organic layers and widespread formation of permafrost soils. Both features critically determine species composition and dynamics of the forest landscapes in which bogs and grasslands are intermixed. The main coniferous tree species are pine (*Pinus* spp.), larch (*Larix* spp.), spruce (*Picea* spp.), and fir (*Abies* spp.); the main broadleaf trees are birch (*Betula* spp.), poplar (*Populus* spp.), and alder (*Alnus* spp.).

Over evolutionary time periods boreal ecosystems have been subjected to climate changes, and species were forced to migrate in accordance with advancing and retreating glacial land cover of icecaps. The boreal forest biome as developed in the present interglacial - starting ca. 10,000 years ago - has been subjected to inter- and intra-annual climate variability associated with multi-year drought periods and extreme dry years, coupled with lightning fires and insects outbreaks.

The impacts of anthropogenic climate change on the boreal zone and its ecosystems as currently predicted by global circulation models (GCM's) are severe. Increase of average annual temperatures may lead to longer and warmer vegetation periods, typically characterized by increased occurrence and length of droughts and lightning activities. With increasing human interferences the danger of extreme and extended wildfires may also increase. Fires, droughts and melting of permafrost may release high amounts of carbon to the atmosphere, thus accelerating processes of current atmospheric changes critical for global climate change.

The carbon stored in boreal ecosystems corresponds to ca. 37% of the total terrestrial global carbon pool (phytomass and soil carbon). Thus, the magnitude of the boreal forest area suggests that it may play a critical role in the global climate system, e.g. as potential sink or source of atmospheric carbon.

2. Disturbance by fire or associated with fire

2.1 Natural and human-caused fire disturbances

The distinct climatic seasonality of the boreal zone with a short vegetation period and low average temperatures leads to the accumulation of organic layers and widespread formation of permafrost soils. Both features critically determine species composition and dynamics of the forest landscapes in which bogs and grasslands are intermixed. Over evolutionary time periods boreal ecosystems have been subjected to climate variability, and species were forced to migrate in accordance with advancing and retreating glacial land cover of icecaps.

The boreal forest biome as developed in the present interglacial - starting ca. 10,000 years ago - has been subjected to inter- and intra-annual climate variability associated with multi-year drought periods and extreme dry years, associated with lightning fires and insects outbreaks. Among natural disturbances, fire (lightning fire) is the most important factor controlling forest age structure, species composition and physiognomy, shaping landscape diversity, and influencing energy flows and biogeochemical cycles, particularly the global carbon cycle since prehistoric times (cf. monographs and synopses e.g. by *Sofronov* 1967, *Sherbakov* 1979, *Wein* and *MacLean* 1983, *Kurbatsky* 1985, *Johnson* 1992, *Sannikov* 1992, *Furyaev* 1994, *Shugart* et al. 1992; *Goldammer* and *Furyaev* 1996). Small and large fires of varying intensity have different effects on the ecosystem. High-intensity fires lead to the replacement of forest stands by new successional sequences. The prevailing low-to medium-intensity surface fires (98% of all fires run as surface fires) favour the selection of fire-tolerant conifers such as pines (*Pinus* spp.) and larches (*Larix* spp.) and may repeatedly occur within the lifespan of a forest stand without eliminating it.

Large-scale forest disturbances connected with drought and fires are known from the recent history. The Tunguska Meteorite Fall near Yenisseisk (ca. 60°54'N-101°57'E) on 30 June 1908, a cometary nucleus explosion at ca. 5 km altitude, was one of the more exceptional events which caused large-scale forest fires in the region of impact. Several years later, from June to August 1915, the largest fires ever recorded, occurred as a consequence of an extended drought in Central and East Siberia (Tobolsk, Tomsk, Yeniseisk, NE Irkutsk, S Yakutsk regions). *Shostakovich* (1925) estimated that the fires were burning ca. 50 days in the region between 52-70°N and 69-112°E. The main center of fires was between Angara River and Nijnya Tunguska, and the total area burned was estimated at 14.2 million ha. However, the smoke of these fires covered the region between 64-72°N and 61-133°E, corresponding to ca. 680 million ha. It is not clear, however, whether lightning, humans or a combination of the two were the primary cause of the extended fires of 1915.

In boreal Asia fire has been for long time an important tool for land clearing (conversion of boreal forest), silviculture (site preparation and improvement, species selection) and in maintaining agricultural systems, e.g. hunting societies, swidden agriculture, and pastoralism (*Viro* 1969, *Pyne* 1995, 1997). In addition to the natural fires, these old cultural practices brought a tremendous amount of fire into the landscapes of boreal Asia. In the early 20th century, the intensity of fire use in the agricultural sector began to decrease because conversion of forests into agricultural systems had been accomplished, and traditional small-sized fire systems (treatment of vegetation by free burning) became replaced by mechanized systems (use of fossil-fuel driven mechanic equipment). Despite the loss of traditional burning practices, however, humans are still the major source of vegetation fires; only 15% of the recorded fires in the Russian Federation are caused by lightning (*Korovin* 1994).

Statistics compiled by the Russian Federal Forest Service show that between 17,000 and 33,000 forest fires, mainly human-caused, occur each year, affecting up to 2 million ha of forest and other land. Since fires are monitored (and controlled) only on protected forest and pasture lands, it is estimated that the real figures on areas affected by fire in Asia's boreal vegetation is much higher. Observations from satel-

lites indicate that during the 1987 fire season approximately 14.5 million ha were burned (*Cahoon* et al. 1994). In the same fire season ca. 1.3 million ha of forests were affected by fire in the montane-boreal forests of Northeast China, south of the Amur (Heilongjiang) River (*Goldammer* and *Di* 1990, *Ende* and *Di* 1990).

2.2 Other disturbances and fire: Non-sustainable forestry, industrial emissions and radionuclear contamination

2.2.1 Forestry

Traditional forestry practices and low-impact and sustainable use of non-wood forest products in boreal Asia are subjected to dramatic changes which are stimulated by increasing national and international demands for boreal timber and pulpwood. This has resulted in the widespread use of heavy machinery, large-scale clearcuts, and thereby in the alteration of the fuel complexes. Many clearcut areas reportedly are not regenerating towards forest succession but are rather degrading into grass steppes which may become subjected to short-return interval fires. The opening of formerly closed remote forests by roads and the subsequent human interferences bring new ignition risks. These direct effects on the ecosystem are in addition to the indirect effects induced by climate change, and both together will certainly contribute to an unprecedented change in fire regime.

2.2.2 Industrial emissions and nuclear accidents

Additional fire hazards and environmental consequences which are still mainly unpredictable are created on forest lands affected by industrial emissions. Russian scientists reported that in the Russian Federation ca. 9 million ha of forest lands are severely damaged by industrial pollution (*Pisarenko* and *Strakhov* 1993, *Kharuk* 1993). While it is known in general that availability of inflammable fuels makes dying and dead forest stands more susceptible to fire than living stands, other mechanisms are still unknown. For instance, what will be the effects of combusting those chemical depositions which have caused the die-back of forests? How will these agents be converted and re-distributed? Many open questions remain to be answered.

The problems arising from fires burning on terrain which has been radioactively contaminated by nuclear weapons tests and technical accidents or disasters are highlighted in para. 4.1 of this report.

3. Fire statistics

Within the northern hemisphere the most complete dataset on forest fires is periodically collected and published for the member states of the Economic Commission for Europe (ECE). It includes all Western and Eastern European countries, countries of the former Soviet Union, the U.S.A. and Canada. The last data set covers the period 1994-96 (*ECE/FAO* 1997).

3.1 Fire Statistical Data of Russia, Mongolia, and People's Republic of China

Russian Federation

After the breakup of the former Soviet Union (FSU) the Russian Federation inherited most of the forest cover. Thus, forest fires play only a limited role on the non-Russian territories of the FSU. No statistical data are available from Azerbeijan, Kyrgystan, Tajikistan, and Uzbekistan. Kazhakstan reports 12,753 ha burned annually between 1994 and 1996 and Turkmenistan 522 ha/year for the same period.

The official fire statistical information to this report was provided by the Federal Forest Service of the Russian Federation in August 1998 and covers the decade 1988-1997. No final information of the severe fire situation in the Russian Far East during the months August to October 1998 is available at the stage of preparation of this report. Daily satellite image updates and archived data can be found through the homepage of the Global Fire Monitoring Center (GFMC). The information provided in Table 1 (Annex I) shows that in the course of the last 10 years the number of forest fires fluctuated from 17,600 to nearly 33,000. The highest intensity of fires was recorded in 1996, when 32,833 fires burnt an area of 1.3 million ha.

However, referring to paragraph 2.2 of this report it must be observed that these numbers cover only fires which are monitored and controlled on protected forest and pasture lands. Satellite-derived observations suggest that the real figures on areas affected by fire in the territory of the Russian Federation is much higher, e.g. the figure of 14.5 million ha for the year 1987 (*Cahoon* et al. 1994). Currently a complete decadal study of archived NOAA AVHRR satellite observations for the 1980s is underway (*Cahoon* et al., in prep.).

People's Republic of China

In the North of the People's Republic of China, in the immediate vicinity of the Trans-Baikal Region, the temperate-boreal forests and steppes are the most fire-affected vegetation types. The mountain-boreal forest of the Daxinganling mountain range, Heilongjiang Province, Northeast China, is dominated by pines (*Pinus sylvestris* var. *mongolica*) and larches (*Larix gmelinii*) which are favoured by the continental climate. About 70% of the annual precipitation of 350 to 500 mm occurs between May and August. The months March to May, and September/October are the months with highest fire danger. Forest ecosystem dynamics and species composition of the mountain-boreal forest are characterized by regular natural and - more recently - human-caused fires (*Goldammer* and *Di* 1990). The forests in Inner Mongolia are dominated by larch, Mongolian Oak and birch. The larch is the original vegetation which would be replaced by oak and birch or popular (in wet areas) if fires frequently burn over in a short time.

The largest fire in the recent history occurred in the Daxinganling region during the exceptionally dry months of May-June 1987. The fire affected a total land area of 1.2 million ha, thereof 1.14 million ha forest. These fires had an exceptionally high intensity and spread rate. For instance, the main fire front travelled 100 km within 5 hours and burned a total of 400,000 ha of forests within 32 hours on 7 and 8 May 1987. More than 200 people were killed by the fire, 56.000 people lost their home, and 850,000 m^3 processed wood, and additionally infrastructures (bridges, railroad

tracks, electricity and telephone lines) were burned (*Zheng* et al. 1988, *Di* and *Ju* 1990, *Goldammer* and *Di* 1990). Evaluation of long-term statistical data reveal that between 1950 and 1990 a total of 4,137 people were killed in forest fires in the People's Republic of China (*Goldammer* 1994).

Further evaluation of fire data archived in the Jiagedaqui fire station revealed that between 1966 and 1987 recurrent fires burned a total of 5.6 million hectares of forest and non-forest land in Heilongjiang Province which has a forest cover of 5.26 million ha. Thus, this number includes repeatedly burned-over areas. In 1966 10.4% of the forested area was burned, and in 1987 17.4% of the forest area was affected by fire (*Goldammer* 1993). In the period 1966-86 more than one third of all fires were started by lightning. The relative share of natural fire causes has become today due to increasing human ignition sources. This is reflected by the official data of 1997 where less than 10% of all fires were started by lightning. *Wang Dong* (1998) reports that in the decade 1986-96 the annually burned area in Heilongjiang Province and in the Inner Mongolia Autonomous Region was 95,000 ha and 31,000 ha respectively.

Mongolia

In Mongolia, fire is a major factor which determines spatial and temporal dynamics of forest and steppe ecosystems (*Wingard* and *Naidansuren* 1998, *Valendik* et. al 1998). It also drives the trend of forest formation, varying with altitude. Out of the total of ca. 17.5 million ha of forest land (corresponding to ca. 8.1% of the territory of Mongolia) ca. 75% are coniferous (predominantly larch [*Larix sibirica*] and pine [*Pinus sylvestris*]) and deciduous forest (with extended occurrence of birch [*Betula platyphylla*]). More than 4 million ha are disturbed to different levels either by fire (95%) or by logging (5%). Logged areas have increased drastically for the past 20-25 years. 600,000 ha of cuts have not yet recovered.

The steppe zone covers approximately 40% of the Mongolian territory and serves as main pasture resource for ca. 30 million heads of animal husbandry. It is assumed that most of today's steppe vegetation is on fire-degraded former forest sites (*Naidansuren* 1998).

The highest forest fire danger is characteristic of low-mountain pine and larch stands growing on seasonally freezing soils. These stands are distributed on Khentey, East Khentey and Khubsugul foothills which are characterized by an extremely continental climate. During a year, air temperature fluctuations can amount to 90°C, with the summer maximum being +40°C. Annual precipitation ranges 250 to 350 mm. In exceptionally dry years, this value does not exceed 200 mm in forest regions. The majority of forest fires burns within the central and eastern parts of the forested area. This can be attributed to the predominance of highly fire susceptible (highly flammable) pine and larch stands. Moreover, the economic activity is much higher as compared to other parts of the region. In Mongolian forests, fire seasons are usually discontinuous, i.e. they have two peaks of fire danger. One peak is observed during long dry spring (from March to mid June) and accounts for 80 per cent of all fires. The other fire danger peak falls within a short period in autumn (September-October) and it accounts for 5-8 percent of fires. In summer, fires occur very rarely (only 2-5% of the total).

In one of the most sparsely populated countries in the world, it is difficult to obtain accurate information on fire history and causes. First fire history studies conducted by *Valendik* et al. (1998) indicate that most forest fires are induced by steppe fires invading adjacent forest stands. Lightning fires are common in the mountain taiga belt because of increasing storm activity in late May and early June. Extreme fire seasons occur every three years in Mongolia. These seasons account for almost half the number of fires and 1/3 of the total area burned over the past decade. The mean fire interval varies from 9 to 22 years depending on forest type, slope aspect, and human ignition sources.

The first attempts to manage fire did not begin until 1921 and remained limited to local town fire departments until the 1950s. Relatively accurate records are available after 1981.

It is clear, however, that Mongolia is experiencing a dangerous increase in wildfires. From 1981 to 1995, forest and steppe fires burned an average of 1.74 million ha annually. In 1996 and 1997, the area affected by fire was 10.7 and 12.4 million ha respectively - an increase of more than sixfold. The areas hardest hit by these increases have been the forested regions. The typical forest fire season (1981-95) swept through some 140 thousand ha (on average 8% of the total area burned), already a large area. However in 1996 and 1997, this figure radically increased to nearly 18 times the previous average - some 2.5 million ha annually, corresponding to ca. 22% of the total land area affected by fire. In these two years alone more forested areas burned than were harvested over the last 65 years (for detailed references see *Naidansuren* [1996] and *Wingard* and *Naidansuren* [1998]).

4. Socio-Economical Background and Environmental Impacts of Fire: Implications on Fire Management Strategies and Public Policies

In this section selected examples are given on specific fire phenomena and fire problems in various countries of Europe and temperate-boreal Asia. Statements or problem descriptions were either defined by government agencies or individual analysts. The problem definitions or solutions proposed are not necessarily reflecting official policies or programmes.

4.1 Fires in radioactively contaminated terrain: Belarus, Russia, and Khazakhstan

According to *Dusha-Gudym* (1996) the following territories in the Russian Federation were contaminated by radionuclides between 1949-1993:

Nuclear weapons test sites

Nuclear weapons testing in the atmosphere began on Semipalatinsk Nuclear Testing Ground (now Republic of Khazakhstan) in 1949. After these tests the radioactive material was transported by air flows over considerable distances. The forests of Altai Area adjacent to Semipalatinsk Region, particularly the unique Lentochnyie Groves were contaminated by radioactive pre-

cipitation which included dozens of different radionuclides. In 1950-1963 a total of 1,977 fires were recorded in Lentochnyie Groves; the total area of fires was 46,946 ha. Information concerning radioactive contamination of forests was not available in the 1950s and 60s, thus no measurements were made regarding both the rate and density of soil contamination by radionuclides, and concerning specific Contamination of fuels and products of their combustion by radionuclides. Radiation and pyrologic conditions can only be reconstructed by calculating and modelling the processes of decay and migration of radionuclides that took place in the forests during those years.

Industrial accidents

Technical failures occurred at the "Mayak" Industrial Corporation (Chelyabinsk Region) in 1949-1956, 1957 and 1967. Mayak Industrial Corporation is located east of Kyshtym town, Chernobyl Region. The first accident happened in 1949-1956, when radioactive waste was dropped into the river system of Techa - Iset - Tobol. The second failure took place on 29 September 1957 when an explosion in the radioactive waste storehouse released cloud of radionuclides which crossed the territory of Chelyabinsk, Cverdlovsk and Tyumen Regions. The area of the territory with a density of soil contamination by Sr-90 over 0.1 $Ci \cdot km^{-2}$ was greater than 23,000 km^2. The third failure in spring of 1968 was due to the fact that radionuclides had been spread by wind from the Karachai Lake banks exposed to erosion as a result of drought. The terrain affected by radioactive deposits were conifer and hardwood forests of the Southern Urals and the Zayralskaya Plain.

On the Siberian Chemical Complex Tomsk-7 a tank containing about 20 m^3 of low-active liquid uranium and 500 g of plutonium exploded on 6 April 1993. A mixture of radioactive gases was released to the atmosphere and formed a cloud. Radioactive precipitation was monitored over the area of approximately 200 km^2 covered by forests. Radioactive traces were observed in the southern taiga region of the Western Siberian Plain.

The Chernobyl Nuclear Power Plant Accident

The Chernobyl Nuclear Power Plant accident of 26 April 1986 is considered as one of the greatest technogenic disasters of the 20th century. Chernobyl radioactive fallouts took place mainly over the zones of broadleaved and mixed forests. The highest level of soil contamination by radionuclides (mostly by Cs-137, also by Sr-90 and Pu-239) was in the Dneprosvko-Pripyatsky, Bryansky and Central Districts of the broadleaved forests zone. The major Chernobyl radioactive traces are found in the forests around Melekhov-Mokeev where the fire season lasts 160 to 180 days between April and early October. Within the 30-km zone around Chernobyl and in some areas into which the former inhabitants migrated forest fires occur regularly. Moreover, on the above territories, fires take place on vast areas of abandoned (evacuated) lands, e.g. meadows, pastures, kitchen gardens and farmsteads which are covered with thick grass that becomes highly flammable. By 1994-1995 fires were observed on 955 ha of abandoned lands. In the 30-km protection zone around the Chernobyl power plant fires occurred over the forest area of 17,000 ha in the years following the disaster. A forest fire on an area of 1 ha can generate 0.5-1 to 2-3 t of radioactive ash and incomplete combustion. Ash and partially burnt fuels represent open sources of ionizing radiation, and the level of contamination often equals that of radioactive wastes.

Fire-generated transport of radioactive materials

Dusha-Gudym (1996) reports that the fuels burnt in forest fires contain radioactive caesium, strontium and often other long-life elements such as plutonium. In products of fuel combustion, i.e. in ash and partially burnt fuels, the concentration of radionuclides sharply increases. A part of the radioactive ash remains on the fire site, and the other part is released in smoke aerosols and transported over various distances.

In August 1992 in the region of Novozybkov, where multiple forest and peat fires took place, the Cs-137 content in atmospheric air was 70×10^{-5} $Bq \cdot m^{-3}$ (for comparison: in August 1992 the Cs-137 average content in atmospheric air over the whole zone of Russia contaminated by radionuclides from Chernobyl was 1.75×10^{-5} $Bq \cdot m^{-3}$, i.e. it was by 40 times lower).

These fires alone were not severe enough to explain such sharp increase of radiocesium content in the air. The sources of huge smoke plumes were located at a considerable distance from Novozybkov, on the territory of the adjacent regions where forest fires covered thousands of hectares. Besides Cs-137, both Sr-90 and Pu-239 were found in smokes of the above fire. Research work carried out in 1993 confirmed the results of our investigations of 1992 that proved the presence of Pu-239 in aerosols of smokes in forest fire in the region of Zlynki town.

4.2 People's Republic of China

In the People's Republic of China the main sources of wildfires are human-caused: Fires escaping from agriculture maintenance burning, camp fire set by hunters, mining operations, collectors of non-wood forest products, and fires started alongside roads and railroads. Lightning is a frequent fire cause in the end of spring fire season in the Northern forest region, especially along the border with Russia.

Wang Dong (1998) reports that in accordance with the "Forest Fire Prevention Act" a series of measures are carried out to prevent human-caused fires. Every year during the last decade the local government announces the beginning date of the fire season and period of the fire ban. At the start of the fire season, at almost every entrance of forest region fire prevention checkpoints are set up which control permits and inspect matchboxes and lighters carried by people. Spark arresters of automobiles are also checked. During the fire season, each train travelling through a forested region must have a watch guard on the tail car. In some places of high fire risk, e.g. along down-slope railway tracks where braking trains often produce sparks, ground patrols prevent fire ignitions. Any uncontrolled fire use is not allowed during the fire-ban period. A lightning-detection system has been established in the Daxinganling mountain forest region.

4.3 Mongolia

Except evidence by tree ring records, no information is available on wildfires in Mongolia in archived and historic documents before 1921. *Naidansuren* (1998) explains this with the fact that by Mongolian tradition nature has been treated sensibly due to the high dependence of nomadic people and livestock on well-preserved grazing resources.

Increasing amounts of wildfires occurred during the period of rapid social-economical development in the 1950s and 60s. The reason was an increase of population and agricultural machinery and equipment, the construction of the first railway, and the increasing forest use construction materials, timber trade and fuel supply. As a consequence of increasing fire occurrence, the Government of Mongolia established an aerial fire guard service in the provinces Khubsugul, Selenge, Arkhangai, Dornod and Khentii. These services were equipped with helicopters and smokejumpers. Today the Forest and Steppe Fire Prevention Department (SFPD) is under the jurisdiction of State Civil Defence Department (SCDD). Each of the 21 Mongolian provinces has a local civil defence department responsible for wildfire suppression.

Fire causes

In an investigation of wildfire-causes *Naidansuren* (1998) explains the missing or less reliable fire statistical data during the periods of the presence of foreign military troops on the territory of Mongolia and the transition to the market economy. As already stated in this report (para. 3.1.6) the majority of fires (60-90 %) start in spring when warm, windy and dry weeks coincide with the begin of human activities in the forests and steppes after the winter break, e.g. hunting, antler collection, logging, and fruit gathering. The reason for an increasing occurrence of wildfires in Mongolia is primarily negligence (escaped campfires, antler collectors, military, railways, tractor pipes, plantation cleaning, spark from chimneys, children, powerlines).

5. Fire Science Programmes with Relevance to Regional Fire Management and Policy Development

5.1 International Programmes

International Geosphere-Biosphere Programme (IGBP)

The international vegetation fire research community has organized itself through various mechanisms. The International Geosphere-Biosphere Programme (IGBP) is the most interactive platform on which several major international and interdisciplinary fire research programmes have been designed and implemented.

One of the operational IGBP core projects is the International Global Atmospheric Chemistry (IGAC) Project. One of the activities of its foci is oriented towards investigating the impact of biomass burning on the biosphere and atmosphere (Biomass Burning Experiment [BIBEX]). Since 1990 several research campaigns have been conducted. For the boreal Asian region the "Fire Research Campaign Asia-North" (FIRESCAN) began in 1992 FIRESCAN addresses the role of fire in boreal ecosystems and the consequences for the global atmosphere and climate (FIRESCAN Science Team 1996).

IGBP-IGAC-BIBEX closely co-operates with the research programmes mentioned in the following paragraphs. One of the major expected impacts of all programmes is to stimulate exchange in research and development between the countries formerly divided by the Cold War (*Goldammer* and *Furyaev* 1995).

IGBP Northern Eurasia Study

Additional fire experiments will be conducted jointly with scientists collaborating in the IGBP Northern Eurasia Study. It will be a joint effort of scientists representing several IGBP Core Projects, the Biospheric Aspects of the Hydrological Cycle (BAHC), International Global Atmospheric Chemistry (IGAC), and Global Change and Terrestrial Ecosystems (GCTE) Projects. The unifying theme of the IGBP Northern Eurasia Study is the terrestrial carbon cycle and its controlling factors, and the study's overall most important objective is to determine how these will change under the rapidly changing environmental conditions projected under global change (*Steffen* and *Shvidenko* 1996). The IGBP Northern Eurasia Study will consist of an integrated set of experimental and observational studies at a number of scales, modelling and aggregation activities, and supporting databases and GIS capabilities. The major elements are transects and network sites, a water, energy, and carbon flux study, and detailed studies of disturbance regimes.

The fire component of the IGBP Northern Eurasia Study will have four components: (i) fire manipulations at individual forest sites; (ii) a series of campaigns based on aerial and space-borne research platforms; (iii) the construction of a fire database, relating the frequency, extent, and intensity of fires to vegetation and climatic conditions for present and historic conditions; and (iv) development of aggregated models of forest fire frequency and extent, responsive to global change variables.

International Boreal Forest Research Association (IBFRA)

The International Boreal Forest Research Association (IBFRA) was founded in 1991 after a meeting of the International Panel on Boreal Forests in Arkhangelsk, Russia. The Fire Working Group (originally called "Stand Replacement Fire Working Group [SRFWG]) was one of the first working groups created under the IBFRA, and to date it has been the most active. Following an organizational meeting in Siberia in 1992, the Fire Working Group has strongly promoted and facilitated co-operative international and multi-disciplinary boreal forest fire research between Russia and western boreal countries of Europe and North America (*Fosberg* 1992, *Stocks* et al. 1996a). A number of collaborative studies dealing with global change/fire issues, remote sensing, fire behaviour, fire danger rating, fire history and fire ecology and effects have been initiated. A major conference and field campaign was carried out in central Siberia in 1993 in cooperation with FIRESCAN, with follow-up research activities planned beyond the year 2000. The "International Crown Fire Modelling Experiment" (Ft. Providence, Northwest Territories, Canada) began in 1997-98 with a co-

operative involvement of European and Russian scientists and will continue in 1999 (see http://www.nofc.forestry.ca/fire/ fmn/nwt/). A major fire research programme involving scientists from the U.S.A., Poland and Russia is underway at present in Poland and Russia. It is designed to look at fires of various intensities in European and boreal Asian pine forest ecosystems.

International Union of Forestry Research Organizations (IUFRO)

Until the early 1990s the IUFRO Fire Research Section 8.05 (former Subject Group S 1.09) was dormant except acting as co-sponsor several fire conferences. When the group was activated in 1994 it was recognized that several international organizations had developed focused forest fire research programmes, such as the aforementioned IGBP and the IBFRA. At the IUFRO XX World Congress in Finland it was agreed to keep the group alive as a liaison node between IUFRO and the other fire research programmes. The XX World Congress was utilized as a forum in which boreal fire scientists evaluated the FIRESCAN Bor Forest Island Fire Experiment (*IUFRO* 1995). IUFRO continues to cosponsor UN-FAO/ECE International Forest Fire News and the Global Fire Monitoring Center. At the XXI World Congress (Malaysia 2000) the fire group will sponsor a fire science meeting with focus on Southeast Asia. Considering the fact that fire science is most advanced in the ECE region, IUFRO supports the concepts of the FAO/ECE/ILO Team of Specialists on Forest Fire and the fire science projects under the IGBP to share expertise with other regions of the world.

5.2 Fire Research

In Russia several facilities of the state research organization the Academy of Sciences, and the universities conduct research in basic questions of fire ecology, fire behaviour, and technology development for fire intelligence and management:

The Sukachev Institute of Forest of the Russian Academy of Sciences, Siberian Branch, Krasnoyarsk, is the Russia's Center of Excellence in fire research. The main foci are in fire ecology, biogeochemistry (carbon cycling), fire history, fire and fuel mapping, prescribed burning, use of remote sensing in fire management and fire impact assessment. The institute was host of the first international fire conference and fire experiment in modern Russia (*Goldammer* and *Furyaev* 1996, *FIRESCAN Science Team* 1996). The institute also hosts the International Laboratory of Forest Fire Ecology of the International Forestry Institute (IFI) in which several non-Russian scientists are members. The IFI Headquarters in Moscow has a focus on fire database management, remote sensing of fires, and the development of a Geographic Information System (GIS) for forest fires (*Korovin* 1996).

State forest research institutes involved in fire research are located in Krasnoyarsk, Ivanteevka (Moscow Region), and St. Petersburg. Focus of work of the Research Institute for Forest Fire Protection and Forestry Mechanization (VNIIPOMleskhoz), Krasnoyarsk, is mechanical equipment for fighting forest fires on the ground (*Yakovlev* 1992). The Forest Research Institute St. Petersburg has specialized on spaceborne detection of fires and particularly the development of airborne fire suppression technologies, including additives (retardants).

The Far East Forestry Research Institute (FEFRI) in Khabarovsk has a research focus on fire problems in the Far East of the Russian Federation. The institute hosted the 1999 International Conference on "The World's Natural Forests and Their Role in Global Processes" (15-20 August 1999). The in-tandem workshop "Fire on Ice" (14-15 August 1999) reviewed the state of knowledge in the dynamic interactions between climate variability, fire regimes, and permafrost in boreal circumpolar ecosystems. Special attention will be given to the changing active layer and the release of radiatively active gases. The formulation of future joint research projects will be discussed which will address the consequences of climate change on fire regimes and permafrost thawing and its consequences on ecosystems, biogeochemical cycles and atmospheric chemistry. The workshop is a joint activity of the IGBP Northern Eurasia Study (IGBP-NES), the Biomass Burning Experiment (BIBEX of the IGBP Core Project International Global Atmospheric Chemistry (IGAC), the Fire Research Campaign Asia North (FIRESCAN), the International Boreal Forest Research Association (IBFRA) Fire Working Group, and the Global Fire Monitoring Center (Max Planck Institute for Chemistry, Biogeochemistry Department). Workshop participants will be fire and permafrost scientists actively involved in northern circumpolar research.

Laboratory of Forest Pyrology of the Research Institute of Forest Chemistry (VNIIHLeskhoz), Ivanteevka, Moscow Region, is the leading fire laboratory which investigates the effects of fire on radioactively contaminated terrain (see para.4.1).

At University level international cooperative efforts in the area of forest fire behaviour modelling were initiated in 1994. The Canadian government translated a comprehensive Russian monograph on "Mathematical Modelling of Forest Fires and New Methods of Fighting Them" by A. Grishin, Centre on Reactive Media Mechanics and Ecology, Tomsk State University. An international conference "Mathematical and Physical Modelling of Forest Fire and Ecology Problems", was held in Tomsk in July 1995. A number of North American fire modellers participated, and the conference proceedings are published (*Grishin* and *Goldammer* 1996).

7. Conclusions and Outlook

The work summarized in this paper reveals an existing rich knowledge on the functional role of fires in ecosystems of boreal Eurasia. The application of fire management systems based on fire ecology, however, has not yet found its way to implementation. The Baikal Region due to the fact that the Soviet forestry establishment focussed on fire control (fire exclusion) and the current

8. References

The numerous sources cited in Part I of this paper can be found in the original publication of the FAO report by *Goldammer* (1999) (see reference list at end of Part III).

PART II:

SYNOPSIS OF TACIS PROJECT ENVRUS9701: "IMPROVEMENT IN FOREST FIRE RESPONSE SYSTEM"

1. Introduction

The framework for the project was drawn up by the Federal Forest Service of Russia about three years ago. It was submitted to the European Commission, Directorate DG1a, and tendered in June 1998. The consortium consisting of HTS (UK), TAESCO Europe (Germany), and HCG (Finland), won the tendered and commenced project activities in November 1998. The project has a planned duration of 24 months. The Federal Forest Service of Russia is the project beneficiary, and its line department, the Aerial Forest Protection Service (AVIALESOOKHRANA) is the project partner. The project works at the federal and the regional level with Irkutsk being its pilot region. It consists of two basic components, namely a management support and a technical assistance component.

The management support component is mainly concerned with broader policy, management and institutional issues relating to forest protection, especially wildland fire management, which is conceived as an integral part of sustainable forest management. It aims to assist in the integration of the Forest Protection Information System (FPIS) to be developed and sustainable forest management strategies with existing forest protection and management systems so as to ensure that project results translate into improved responses to forest fires.

The technical assistance component consists of three development tasks; namely the development of a fire detection and monitoring capacity using remote sensing, the development of a spatial forest protection information system, and the integration of information products with the existing forest protection system.

2. Project objectives

The overall goal is to support the establishment of forest management systems that will enable the implementation of sustainable forest management . Specifically, the project will aim to: (i) foster the development of sound and cost-effective fire and phyto-sanitary monitoring systems; (ii) improve information standards in support of monitoring and management objectives; (iii) support local management systems in making effective use of available information; and (iv) improve the response to forest fires, pests and diseases.

3. Planned outputs

Planned outputs in support of the objectives are: (i) a comprehensive forest protection system integrated with a sustainable forest management strategy; (ii) an operational fire and phyto-sanitary monitoring and information system in Pushkino that will assist forest protection and management at federal level; (iii) an operational fire and phyto-sanitary monitoring and information system in Irkutsk and Pushkino to address forest management/protection issues at regional level; and (iv) established links between federal, regional and local stakeholders so as to enable them to improve their response to forest events.

4. Project activities

To achieve the envisaged outputs the project will provide: (i) management support including consultation on policy, legislative and regulatory, institutional and economic issues, so as to assist counterparts in the development of an integrated forest protection system; and (ii) technical assistance to develop a federal and regional monitoring capacity by improving monitoring and information systems, improving information products and their use, improving links between stakeholders and responding to their specific needs, and training of staff and users.

5. Contacts

Updates and details on the project can be obtained via the project's website (http://www.uni-freiburg.de/fireglobe/programmes/techcoop/tacis.htm) or the project contact stated below.

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PART III: Summary of activities and publications of the Max Planck Institute for Chemistry, Biogeochemistry Department, Fire Ecology Research Group, and the Global Fire Monitoring Center (GFMC) (Head: J. G. Goldammer), concerning fire research and development work in the Russian Federation and with significant relevance to the Baikal region.

1. Past and Present Involvement in Fire Research, Management and Policy Development in Russia

1991 First visits to the forest sector in the Soviet Union. Partners: Aerial Fire Service "Avialesookhrana" of the Federal Forest Service of Russia, Academy of Sciences

1993 Convener of the first scientific East-West Conference "Fire in Ecosystems of Boreal Eurasia", Krasnoyarsk, July 1993

1993 Organizer of a large fire experiment and research campaign (Fire Research Campaign Asia-North -- FIRESCAN) with the "Bor Forest Island Experiment", Krasnoyarsk Region. This was the first international scientific fire experiment conducted on Russian territory. All boreal nations (Russia, Canada, USA, Sweden, Finland, Norway, PR China) and Germany participated in the experiment

1993 NATO conference "Science Policy: New Mechanisms for Scientific Collaboration between East and West", Novosibirsk

1995 Co-Chair, International Conference "Mathematical Modelling of Forest Fires", Tomsk (with Prof. A.Grishin)

1996 Co-Chair, UN FAO/ECE Seminar "Forest, Fire and Global Change", Shushenskoye (with Deputy D.Odintsov)

1998 Co-Chair, "First Baltic Forest Fire Conference", Warsaw, Poland (with strong Russian participation)

1999 Convener, Workshop "Fire on Ice", Khabarovsk, in conjunction with the International Conference "The World's Natural Forests and Their Role in Global Processes" (Co-Chairman)

Current Functions

J. Goldammer is member of the Scientific Council of the Siberian Centre for Ecological Research of Boreal Forests (Krasnoyarsk) and of the International Laboratory of Forest Fire Ecology (Krasnoyarsk). He is co-ordinator of the fire component with the IGBP Northern Eurasia Study (IGBP-NES), Yenissei Transect, and since 1999 he is backstopper of the EU-TACIS Team "Improvement of Fire Management in the Russian Federation" (1998-2000).

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World Experience of Soil and Landscape Studies as a Necessary Component of Sustainable Development in the Baikal Region

N. A. Martynova

At the end of XX century the mankind revealed some changes of global scale antropogenic pollution of the environment, which are caused by depredatory exploitation of natural resources and large-scale antropogenic pollution of the environment. Both types of impact lead to fast degradation of nature.

In light of new paradigm philosophys of interaction of the nature and society and problems of environmental protection essentially differently appear. This surroundings is the naturally - historical biosphere (in comprehension of Vernadsky) with all by its nodal structurally functional amounting, including planet soil cover. It was built by long evolution changes of the Earth and is being a unit of planet connections. The soil or pedosphera is area of the tight interaction of different near-surface geospheres, epicyclic unit with numerous functions.

Today the main purpose of environmental protection becomes not saving of its separate components (mainly biological), but preservation of the nature as unit with all its amounting. During achievement of the given purpose the saving of soil diversity (the preservation of different soil differences on the representative areas) appears one the central problems. The success in the solution of this problem directly depends on maintenance of the indispensable reasons of the special soil conservation and, first of all such as: well-timed creation of the Soil Red data Book; mining of the theory of a soil and nature conservation as a whole from stands of the functional approach; the termination of further nonrational development of unrenewable natural resources; recovery broken down landscapes etc.

Some scientists consider that to preserve biological diversity, representative samples of all ecosystems must be set aside in national parks, scientific reserves, or similar protected areas. Large natural areas protect diversity better than similar but smaller areas. The important consideration then, is to be certain that all of a region's ecosystems are represented in a system of protected areas large enough to be ecologically stable. Of all the geosystem components soil known to be most capable of accumulating in formation on the main stages in landscape development and reflecting current changes in the external conditions.

Baikal and Hubsugul Lakes and the landscapes around them represent of the united natural system of regional level, in which the conservation unic properties of the process have been taken place resulting of them basin landscapes. Baikal-Hubsugul basin belong to that territories, whose sustainable development has national, and, also great international importance. Such territories could be given priority attention in international strategies of environment policy.

The affiliation of efforts of scientific miscellaneous countries helps to decide vital ecological problems, to rally efforts for achievement of the intended purposes. In this aspect the experience of realization of joint international complex research expeditions is very indicative. Such forms of co-operation favour not only finding - out of scientific trues and more effective knowledge of nature laws and place of the person within it, but also allows to like spirit of other nation, realization of its cultural traditions and national values. Russian-Mongolian complex Hubsugul expedition of Irkutsk and Mongolian State Universities - vivid example of such cooperation, which one is prolonged already about 30 years. The cooperation of two universities has helped not only to learn natural resources of Mongolia both to elaborate and to insert in effecting the scientific guidelines of the participants, but also bring up new highly professional scientific staff. The participation of student's youth on expeditions provides eligibility and special significance of education of a spiritual beginning. The researches of expedition were directed on analysis of biocenosises of Hubsugul Lake region and their significance for economy of Mongolia.

The large attention of expedition was given to research of landscapes of a unique field of phosphorites of Mongolia. Investigated fosfoorite soils are characterised of a large quality of total and mobile phosphorous, which determine definite propeties. There are different "exotic" classes of soil and landscapes, which are produced by their chemical properties (polymetallic, copper ores, etc) are present in Baikal and Hubsugul lakes regions. Marked increases scientific, natural and aesthetic value built on the guidelines of outcomes of researches of national Parks of Baikal and Hubsugul Lakes.

The unique natural complexes of Baikal and Hubsugul basins, its unusual biogeochemical properties of soils and landscapes, environmental, historical and aesthetic value creations conditions for development of education, science and culture cause the needless of the solving the problems of rational nature management and environment conservation, development of the programs of sustainable use of natural resources evaluation of landscapes recreational loads biological, geological resources, unique objects of nature etc; considerable participation together with other countries scientists in projects for more comprehensive account of antropogenic effects on basins nature

The establishment of a program for the rational use of natural resources in the lake Baikal basin requires that a large number of measures be carried out for the protection of air, water, soils and vegetation, for controlled use of biotic resources, and for introduction of enlightened forest management. Establishment of an integrated system of protected areas is particularly noteworthy among the complex of measures for protection of the lake basin environment.

In light of this, a large national parks in the Hubsugul and Baikal lakes area were created and should be developed.

In addition to protecting the unique ecosystem of lakes, parks would allow preservation of standard natural complexes typical of planetary boreal taiga and boreal steppe types mountainous Asian system.

Baikal and Hubsugul lakes and the parts of the lake's basins, directly adjacent to it, should be designated as special state area with a particular regime of land use and environmental protection in the form of a Baikal State National Park. It is recommended by a comprehensive Programme of Land Use Policies of Lake Baikal Region to expand of Pribaikalsky National Park and with Khamar Daban National Park and Okinsky, Olchon, Tunkinsky and Zakamensky natural antropological reserves, should be joined with Mongolia's Lake Hubsugul national park to form an international peace park. International cooperation & rich world experience can give a large support to do this.

The social aspect of ecological education predetermines not only dilating, recess of knowledge, perfecting of a system of continuous ecological education, but also creation of capabilities of operational use of knowledge, realization of regional social - ecological monitoring. In this connection we see two paths of perfecting of a system of ecological education: modify structure both natures of ecological education and intrusion of the new forms of formation and education.

The education of new nature protection intellection both cultures of a use of land and agriculture - that alone path and general problem of preservation of a naturally - historical biosphere, from the solution of which it depends future of our civilization. Therefore reinforced mining and intrusion of theoretical and applied aspects of preservation of soil cover at perfecting a system of continuous ecological education will help to introduce rather substantial contribution to preservation of natural resources of the Baikal region as World Heritage Site.

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Guiding Projects for the Protection of Lake Baikal and the Sustainable Development of its Region through Information Management

Ulrich Werder, Michail Gratchev, Heinrich Schmauder, Johann Schreiner & Arnold Tulokhonov

Abstract

Information management supports the interpersonal exchange of information within networks. Its implementation requires special media like electronic information systems. Platforms for direct communication also have to be organized. The status of Lake Baikal as a World Natural Heritage Site implies opportunities for sustainable development. But the transformation process in Russia is accompanied by problems leading to some unsteadiness and conflict among the actors. Cooperation and funding are difficult under these circumstances. Unfortunately, initiatives lack coordination. Thus, an evaluation is necessary at this stage to determine common objectives for further cooperation and to help to create synergies.

Key words

information management, nature conservation, sustainable development, Lake Baikal

Information Management

Nature conservation and sustainable development in the Baikal region can benefit from information management. The approach improves existing cooperation and helps to establish new forms of partnership. Information Management is a concept which supports the interpersonal exchange of information at all levels and between different sectors and people. This facilitates the cooperation of a variety of interested participants: private people, businesses, conservation authorities, research institutes and educational facilities. In order to create guidance through information management some specific tools are needed.

- Organizational structures and institutions need to provide spaces for communication. This can be real locations and events but also virtual networks and sites in the internet.
- Access to information about a certain subject is necessary. Again electronic data banks, like virtual libraries or Geographic Information Systems (GIS), will be increasingly important.
- Information and actors need to be linked in working networks.
- The successful marketing of the process and results is crucial for the future availability of information and a funded realization of projects. Good access to mass media is therefore crucial for the success of information management.

As we can see electronic facilities have a large potential for solving problems related to information and organization. Electronic media must be more than an academic domain, though. Here is a new chance for democratic structures of decision making. New forms of exclusion from the booming digital tech-

nologies must be avoided by all means. A region with certain infrastructure deficits like the Baikal region has a special duty to assure such a democratic development. So, on top of new technologies, platforms for direct communication have to be organized where people can meet to establish suitable forms of co-operation and participation.

Collaboration for Lake Baikal

Starting in the 18th century, Germans have made significant contributions to the exploration of Lake Baikal and to the distribution of information about its beauty and value. Recently, the lake has become the subject of growing international cooperation. Scientists and NGO's from Russia, Germany and from many other countries are involved. Special emphasis must be given to the assistance by German law-specialists during the making of preliminary studies and the editorial revision of the aforementioned Baikal Law. However, the involvement of Germany in processes of cooperation is still insufficient. It is inadequate with regard to Germany's position as a leading European nation.

In 1996 Lake Baikal was declared ‚World Heritage Site' and in 1999 the Russian Federation passed the Law for the Protection of Lake Baikal. These recent developments present new opportunities for the protection of Lake Baikal and the sustainable development of the region.

On the other hand, the continuing transformation process is accompanied by several risks and problems. This leads to unsteadiness of actions and some conflict among the actors. New initiatives at different levels have been under way, such as projects, conferences, workshops or the establishment of new institutions. Yet, cooperation and funding are difficult under the current circumstances. Unfortunately initiatives overlap to a certain degree, lacking co-ordination. Competition for financial and personal resources between and within institutions disturb the successful transfer of information. So now it is primarily important to achieve a better coordination of the existing initiatives, especially within Germany. In order to develop a consensus on goals for the sustainable development of the Baikal region which derive from one large concept it is also necessary to achieve a high degree of coordination and integration of the actors in the different regions surrounding Lake Baikal. Moreover, initiatives in various countries and the international funding institutions would benefit from better coordination.

During the past years Lake Baikal has become a life laboratory for the study of global changes in the environment (especially climatic changes) as well as for researching the evolution of species. Due to the establishment of the 'Baikal International Research Center of Ecological Research' (BICER) major progress has been made in the effort to contribute scientific information regarding important problems. This information is not only of local significance. It also provides facts to a better understanding of processes which are related to the whole planet's evolution. Only here, in the sediments of Lake Baikal, the paleoclimate of 5-10 million years of the biggest continent is documented. Here, one of the most important centres of evolution with about 2500 endemic organisms exists. Since species have not been able to migrate, they have evolved within an ecosystem which is practically isolated. As we can see, the international interest in the lake is indeed justified.

Today it is well-known that Lake Baikal has water with a unique purity. With 20% of the world's above-ground fresh water supply, Lake Baikal is the biggest fresh water reservoir of humanity. Only through the use of modern tools and methods this could be proved and documented. Much more effort is needed to preserve Lake Baikal's water quality. The cooperation between Russia and Germany in this area is intensive. Still, is could be more efficacious through an improved flow of information and better coordination. We believe that a German institution should become a full member of the BICER, like the Russian Academy of Sciences, the Royal Society London and a number of other renown international, scientific institutions. Such a step would not only be important for the development of ***basic research*** but also for academic education. Already numerous German students have undertaken field trips to Lake Baikal, training to become ecologists, limnologists, sedimentologists, hydro-physical engineers or specialists for atmospheric chemistry or aerosols. A successful work of students and young scientists in Siberia is a main indicator for the ability to solve scientific but also more practical problems. Moreover, many personal relations establish.

In order to make decisions effectively and in order to produce measurable results by the means used for the protection of Lake Baikal, it is necessary to provide correct information about the condition of the ecosystems This information should accumulate according to precisely defined methods. That is why international standards should be applied. Germany is known for being a driving force during the development and implementation of European standards and legal regulations about the monitoring of the environment.

The transfer of these experiences to the territory of the World Heritage Site Lake Baikal is of utmost interest for the Russian side. Since the Baikal Law is a framework legislation, many regional laws still have to be developed. The mature legal structure of the German federal system might serve as a model for the Baikal region. Given the possibility that Russia will become a full participant of the European economy, such a legal system, if it is developed and implemented, will be of great interest for the German and European economy and industry. Investors and business partners in the Baikal region will be able to work effectively in a familiar legal sphere.

Only 50000 people inhabit the territory which was declared World Heritage Site. But many more live in the larger region including the large cities of Ulan-Ude and Irkutsk. This region addressed in the Baikal Law because of its significant effects on the lake. The duty to preserve Lake Baikal can only be fulfilled if solutions have positive effects on the standard of living of these people. We believe that the main task of the development of cooperation is the stimulation of economic activities in the Baikal region. Especially people who directly depend on the lake as a source of income should have a chance to increase the standard of living. For those people Lake Baikal, its biological richness, its surrounding landscapes and its natural resources, is a source of wealth and social respect.

People in the Baikal region need to have access to information about their natural and social environment so they can participate in the decision making

processes which concerns their villages, towns and regions. Information management via modern communication technologies a possible approach to meet this challenge. Since the beginning of the political and economic transformation of Russia to a free market economy many people in the Baikal region have proved to be successful in making their living, creating employment and finding investors. Their economic success has been inextricably linked to the use and the protection of the unique values of Lake Baikal. There are, for example, private businesses which are successful in the tourism and recreation sector, in diving schools or in the management of museums. As they are forced to work under the most difficult economic conditions, they have proved to be reliable partners for German enterprises.

The interest of Germans for Lake Baikal and for Siberia as a whole can be explained by the fact that there is little undisturbed nature left in Europe which can be experienced. This experience is a need shared by millions of Europeans, though. Russian partners in the tourism business who are interested in establishing contacts should try to point out the unique characteristics of Lake Baikal. This certainly requires an active involvement of the scientific community. Assuring reliability and safety is the most important precondition for success.

Last but not least, mass media have an important role in spreading information about Lake Baikal. They familiarize the German public with the uniqueness of Lake Baikal , with the daily life and the problems of the local population in the World Heritage Site and with the history and culture of the peoples of Siberia.

The Baikal Conference

From November 14 – 17, 1999 the Alfred Toepfer Academy for Nature Conservation (NNA) and the German Federal Agency for Nature Conservation (BfN) organize an international conference about the future Russian-German cooperation in Siberia. The meeting focuses on the protection and the sustainable development of the Lake Baikal region.

This conference is applying the concept of information management. We have to understand that cooperation can only be effective and lasting if areas of mutual interest can be defined. In other words, German partners can be attracted if discussions focus on the unique characteristics of Lake Baikal which do not exist anywhere else on the globe. This also includes, of course, a clear definition of the goals of the Russian party.

The conference aims to bring together existing initiatives and projects, arranges new contacts, mediates conflicts and intensifies the exchange and cooperation between Russian institutions and German participants in general. Representatives of key social groups join to not only exchange their latest experiences and intentions for interdisciplinary approaches but also to plan and prepare innovative projects. This will help to create synergies. Target groups are the interested public of the environmental sector, decision makers in politics and administration, sciences and media and concerned branches of the economic sector (e.g. fishery, agriculture, forestry, tourism). The establishment of contacts dealing with the standardization of monitoring and the development of the relevant legal regulations will be a major purpose of the conference. It is also necessary to invite representatives of enterprises which have been successfully working in the Baikal region. They should have an opportunity to develop firm and lasting contacts to German partners. Popular journalists and TV reporters who have worked about Lake Baikal, should also be invited to the conference to successfully support the publication and marketing of the results.

As result of the conference a catalogue will be published which explains the main areas of action and lists relevant projects and institutions. Potential financiers, for instance, can get access to information effectively. Ideally this will be the foundation of a lasting, international information network which offers new perspectives for nature conservation in the Baikal region.

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