APRIL 2012 DRAFT

**UNECE Convention of the Protection and Use of Transboundary Watercourses and International Lakes**

# ПРОБЛЕМЫ АДАПТАЦИИ К ИЗМЕНЕНИЮ КЛИМАТА В БАССЕЙНАХ РЕК ДАУРИИ: ЭКОЛОГИЧЕСКИЕ И ВОДОХОЗЯЙСТВЕННЫЕ АСПЕКТЫ

# ADAPTATION TO CLIMATE CHANGE IN RIVER BASINS OF DAURIA: ECOLOGY AND WATER MANAGEMENT

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**List of authors**

## EXTENDED SUMMARY

(***WHEN REPORT TRANSLATED SUMMARY WILL BE REPLACED BY INTRODUCTION)***

This report presents first outcomes of "Dauria Going Dry" project initiated by DIPA and WWF under auspices of UNECE Convention on Transboundary Waters.
The key question that the Project addresses is how to prevent destruction of Daurian natural ecosystems, enhance their resilience and save globally endangered species in circumstances of intensive economic development and climatically caused periodical water deficit at the region. The project collects and analyses scientific information on natural climate-dependent ecosystems processes, their actual conditions and dynamics and anthropogenic influence on them. These data is the scientific basis for environmental-friendly social and economic development at the Dauria Ecoregion.

The project was initiated by Daursky Biosphere Reserve (Russian part of DIPA) and then in 2010 the project formed partnerships with WWF, Administration of Zabaikalsky Province, International Crane Foundation, East Asian-Australasian flyway Partnership, Rivers without Boundaries Coalition, Institute of Natural Resources and Cryology of Russian Academy of Sciences, and a number of Mongolian and Chinese NGOs and researchers. DIPA and WWF provided most funding for multi-year work, while some activities were supported in 2011 from UNDP\GEF "Russian Steppe Conservation" Project.

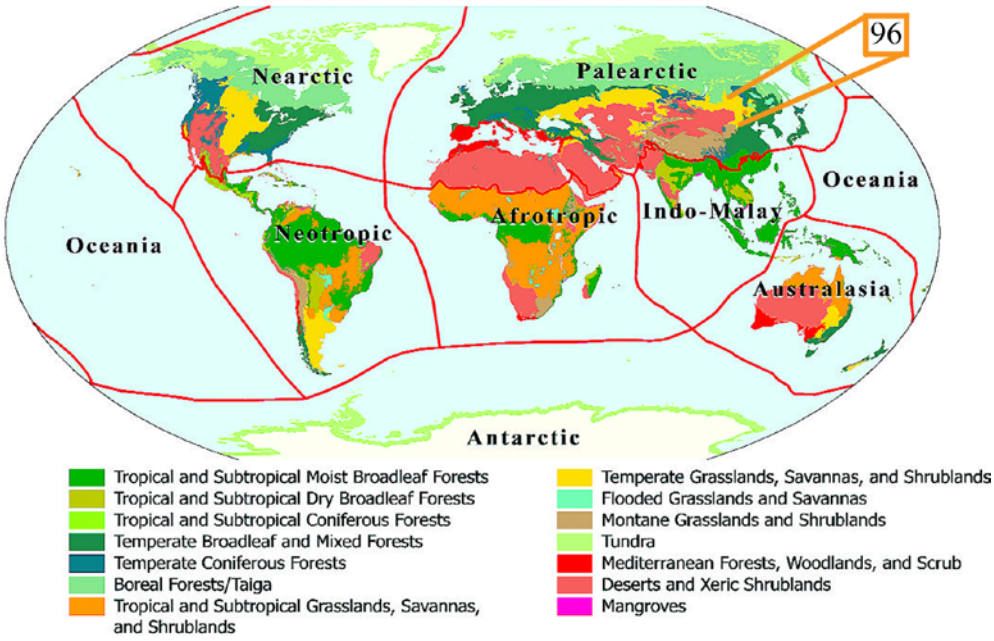


*Fig. 1. "Daurian Steppe» Global 200 Ecoregion (№ 96) on the world map (by Olson et all, 2001)*

### Dauria Ecoregion: ecosystems and climate

In the last decades considerable climate changes of a global character are taking place. However, at the regional level they differ much from the general global pattern, and have peculiar features in each region. Even greater differences between regions are observed in the ecosystems's reactions to climatic variability, which to a great extent depend on the natural and economic conditions of the regions.

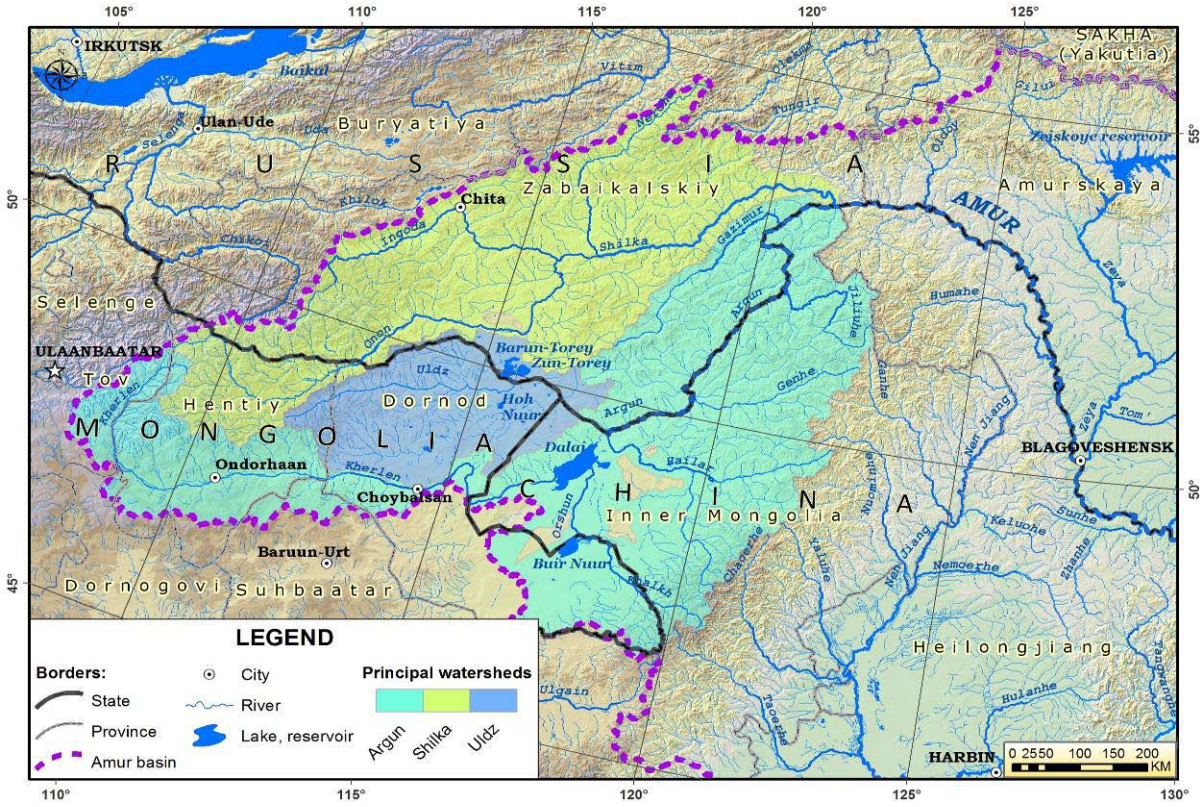


*Fig.2. Principal transboundary river basins of Dauria*

One of the regions that is ecologically strongly dependent on climate changes is the Daurian steppe (Dauria). Dauria lies in the northern part of Central Asia. Most of the Daurian steppe area is situated in North-East China and East Mongolia; the Russian part is confined to Zabaikalsky Province and Buryat Republic. In terms of the WWF Terrestrial Ecoregions of the World the Daurian Forest-Steppe covers the Nenjiang River grassland, the Daurian forest-steppe, the Mongolian-Manchurian steppe, and the Selenge-Orkhon forest-steppe eco-regions (Olson & Dinerstein 1998). These grassland areas are united by geographic location, annual and multi-year rhythms in ecological factors, and structure and composition of communities (Tkachuk et al. 2008). In terms of freshwater ecosystems Dauria is divided into 3 principal freshwater ecoregions: Shilka River, Argun River and Endorheic Basins (Abel et al. 2008) of which Torey Lakes\Uldz River Basin is the most prominent (see Fig.1.2.). Daurian steppes were included by WWF into the list of 200 globally important eco-regions since they possess very high level of biodiversity for a steppe zone.

Most of the region lies at 600-800 meters above sea level, comprises mainly plains and rolling relief, and has an ultra-continental climate. Low winter temperatures (in the Russian part the average January temperature is –25° C) result in deep freezing of the soils and the formation of permafrost pockets. This favors the cryophytic character of the Daurian steppes. The spring is cold, windy and dry, while most of the rainfall coincides with the highest annual temperatures during the second half of the summer. This leads to a highly intensive cycling of nutrients in the short summer period and, as a result, to the formation of primarily poor, shallow soils.

The Central Asian Steppe Sub-Region of the Eurasian Steppe Region (Lavrenko 1970) has a flora that is notably different from that of the steppes to the west. The most typical steppe communities are dominated by *Stipa krylovii, S. baicalensis, Leymus chinensis, Artemisia frigida,* etc. Shallow salt lakes with halophytic vegetation around them are also characteristic of

the region. Grass-dominated grassland communities are intermingled with other vegetation types (wetlands, saline vegetation, forest groves, bush, etc.) and should be described and preserved only in a broader landscape context.

The animal world of Dauria is diverse. There are species here whose main distribution area is much farther to the east, west or south (Japanese or Red-crowned crane (*Grus japonensis)*, Manchurian tsokor (*Myospalax psilurus epsilanus*), Mongolian gerbil (*Meriones unguiculatus*), Common crane (*Grus grus*), etc.). Among the endemics of Dauria are the Mongolian gazelle (*Procapra gutturosa*) (up to 90 % of the world population of the species lives here), Daurian hedgehog (*Mesechinus dauuricus*), Daurian souslik (*Spermophilus dauricus*), Mongolian lark (*Melanocorypha mongolica*) and others. Fish fauna, adapted to climate cycles, has more than 60 species, three of which are believed to be endemic to Dauria, and giant Kaluga Sturgeon (*Huso davhuricus*) is likely migrating to Mongolian border all the way from Pacific Ocean. A peculiar feature of the animal world is its variety of bird species determined by the narrowing of the global migration routes of birds in the Dalainor-Torey depression (Goroshko 2009). The number of transitory migrants in the region's bird fauna is not less than 45 %. More than 40 bird species registered here are listed both in the Red List of IUCN and the national Red Data Books of Russia, Mongolia, and China.

*Fig3. Red-crowned Crane in reeds of Argun River floodplain.*

On the whole an important peculiarity of the region is that the amount of endemic natural communities in Dauria, which have been formed with participation of different floras and faunas under conditions of permanent climate changes, is much higher than the amount of endemic species.Under the conditions of global warming and the cyclical changes in moisture availability characteristic for the region, appreciable changes in species composition, abundance and spatial distribution of wildlife take place.

We discuss the direct and indirect impacts of the main consequences of climate changes on communities of wildlife and vegetation, and give examples. Most of them are the result of research conducted within the framework of the international cooperation of Russian-Mongolian-Chinese Dauria International Protected Area.

Some of most important conclusions of our project research are the following:

-Due to clear cyclic changes in humidity habitats in the Daurian eco-region change. During dry phases habitats with tall plants, which provide much foraging capacity and good protection, reduce in area, and most of the wetlands vanish completely, while in wet phases they appear again and provide a sharp rise in biological productivity.

-The vegetation of Dauria is adapted to cyclical climate changes and resiliently reacts with fluctuations and cyclical succession.

-In dry phases the steppe border in the south gives way to the desert, and in the north it shifts the forest limit; in wet phases the reverse processes take place. Most of the species, both aquatic and terrestrial, survive drought using different adaptation strategies. The most important are: surviving in few refuge habitats; persisting in the dormant phase of the life cycle; survival of non-reproductive adult individuals. The distribution areas of many ground vertebrates pulsate in concord with the cyclic changes in humidity. But the continuing warming gradually destroys the complete reversibility of these processes and leads to aridization.

-On the whole, in Dauria the dry phase of the 30-years humidity climate cycle, which occurs against the background of global warming, causes remarkably strong changes in nature, in which has mostly negative consequences: the level of biological diversity falls, as well as the sustainability and productivity of natural ecosystem complexes, the biomass of living organisms decreases, the borders of the ranges and the migration routes of mammals and birds shift. Many vertebrate species find themselves on the brink of survival.

*Fig. 4. Dead fish on the Torey lakes shore in the dry period of climate cycle.*

**Action-oriented Ecosystem Monitoring**

Multi-year research conducted by DIPA staff resulted in accumulation of considerable body of knowledge on ecosystems and species of Dauria and spurred development of new comprehensive ecological monitoring system that is oriented towards integration of science and development of sound science-based policies in conservation and natural resource management.

Now all activities are integrated into one program of research and nature conservation called **"Impact of climate change on ecosystems of Daurian ecoregion and ecosystem-based adaptations to them".**

The key element of the Program is a system of long-term on the ground and remote-sensing monitoring of wetlands in transboundary upper Amur-river basin. Main tasks of the monitoring system are

1) to study influence of climate variability on upper Amur basin wetlands;
2) develop scientific basis for sustainable adaptation of national and international politics of nature resources management to climate change and biodiversity conservation.
3) use monitoring results to guide development of specific adaptation measures.

The monitoring network includes more than 200 plots at floodplains and at lake shores at territory about 200000 sq.km. (most are designed for monitoring both vegetation and animal populations). This wide network allows the Project to get data on spatial and temporal dynamics of ecosystems.

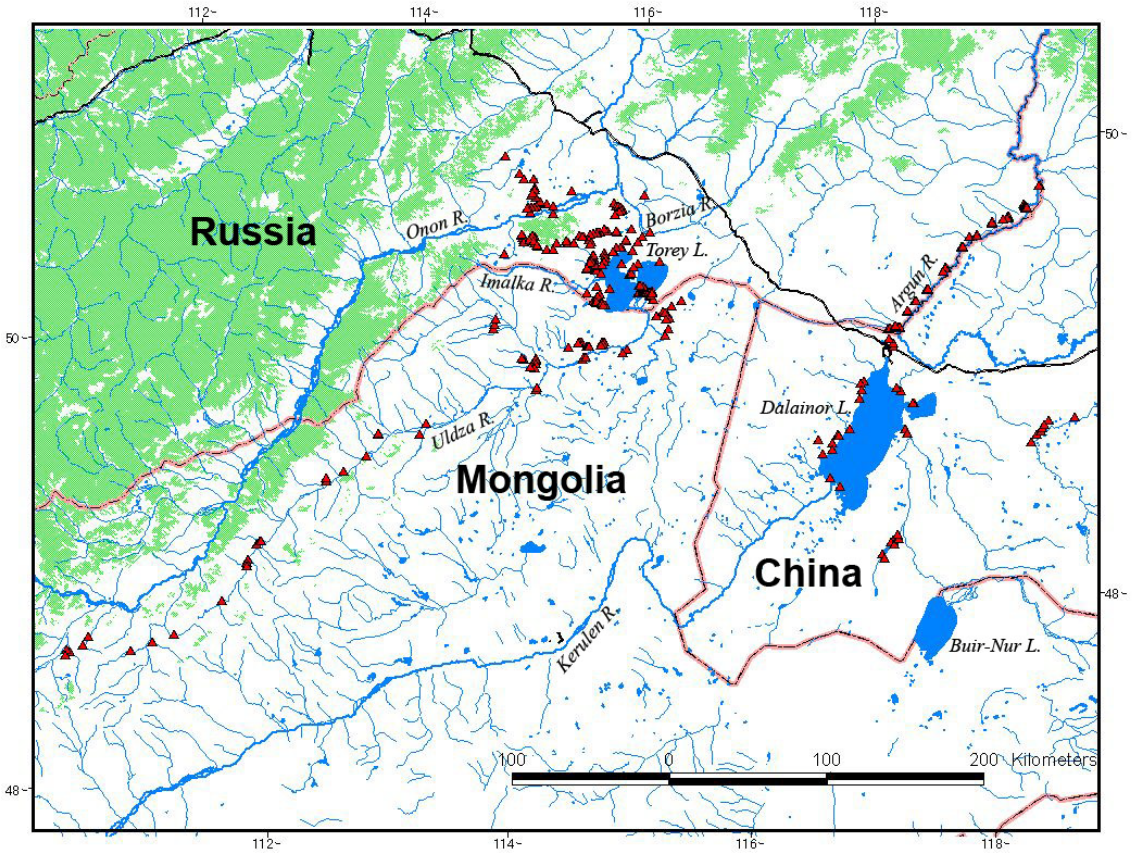


*Fig.5. Location of the monitoring stations network in wetlands of the Dauria Ecoregion*

The key outputs of the Project are the policy-relevant knowledge on the natural dynamics of ecosystems which can be put in the basis of sustainable development of the region including sustaining of globally valuable biodiversity in the face of climate change. Now we have already knew some general principles of climate cycles at the region and connected to them spatial and temporal differentiation of biota, main factors and adaptations that help species to survive during

critical multi-year periods. Monitoring results wil guide development of specific adaptation measures such as:

1. new protected areas planning and region-wide spatial planning to secure refugia and corridors for species movements
2. prediction of possible adverse impacts of water infrastructure and adjustment of water infrastructure schemes
3. development of allowable limits of anthropogenic impacts improve environmental flow requirements in changing climate conditions
4. better planning of land-use and water consumption
5. development of other climate adaptation measures increasing resilience of traditional activities of local communities

**Climate adaptation and Water management**

This longest part of the report starts with general overview of climate adaptation principles and challenges in Dauria, using water sector as its focus. Argun River basin example is used to exemplify and analyze potentially unsustainable water resource use at basin-scale. Besides basin –wide Argun River example case-studies are presented for interbasin water-transfers, hydropower, gold mining and border demarcation. Short conclusions are drawn on international policy and technical approaches to solving environmental problems in water sector in Dauria.

*Fig. 6. Herders' camp at Huihe, Inner Mongolia*

Climate adaptation is not a new theme for people of Dauria- Mongolian nomadic tribes were adapted to temporal and spatial change in availability of water and other resources due to climate cycle. However, the current mode of development, associated with stationary settlements/production facilities and linear growth in economic output is inevitably leading to severe competition for water and other resources at the time of drought. Human induced "Climate Change" may make cycles even more pronounced and affect duration of phases, but is likely to bring problems similar to those already experienced by society poorly adapted to periodic drought. Meanwhile drought is nowadays perceived as "climate change scarecrow" and very questionable water engineering solutions are proposed to "protect environment and society"

from climate change. Poorly planned human activities initiated in anticipation of climate change (including some adaptation measures) may drastically hurt ecosystem much earlier and more severe than consequences of actual global climate change.

Recent rapid socio-economic changes and loss of nomadic heritage in Dauria Steppe makes ecosystems and local communities less resilient to naturally fluctuating resources and to droughts and floods made more extreme through climate change. Drastically different cultures, population density and unsustainable mode of economic development and water use in Russia, China and Mongolia, make it very difficult to build transboundary mechanism to protect common water resources. Meanwhile risks for wetland ecosystems and dependent population are further exacerbated by recent proposals for several inter-basin water transfer projects and other infrasture in the Argun River Basin. Water management crisis is actively developing in all three countries –China, Mongolia and Russia. Argun-Hailaer, Khalkh, Kherlen, Uldz, Onon, Imalka rivers– virtually all notable watercourses of the Dauria are transboundary. Greatest potential threat is unfolding when competition for water among countries is made the implicit goal of national policies to store waters on national territories and this leads to demolition of transboundary wetlands of global importance.

Therefore any adaptation to climate change in Dauria must first of all occur through the prevention and removal of maladaptive water management practices that do not succeed in reducing vulnerability but increase it instead. Adaptation may be achieved through the use of best water-saving technologies and appropriate resource-use practices. Here countries have different comparative advantages and have a lot to share. Mining seems to be one of most fast-growing water-consumer among growing economy sectors in all 3 countries.

*Fig.7. New coal mining operation in Moergol River valley, Hulunbeier, Inner Mongolia*

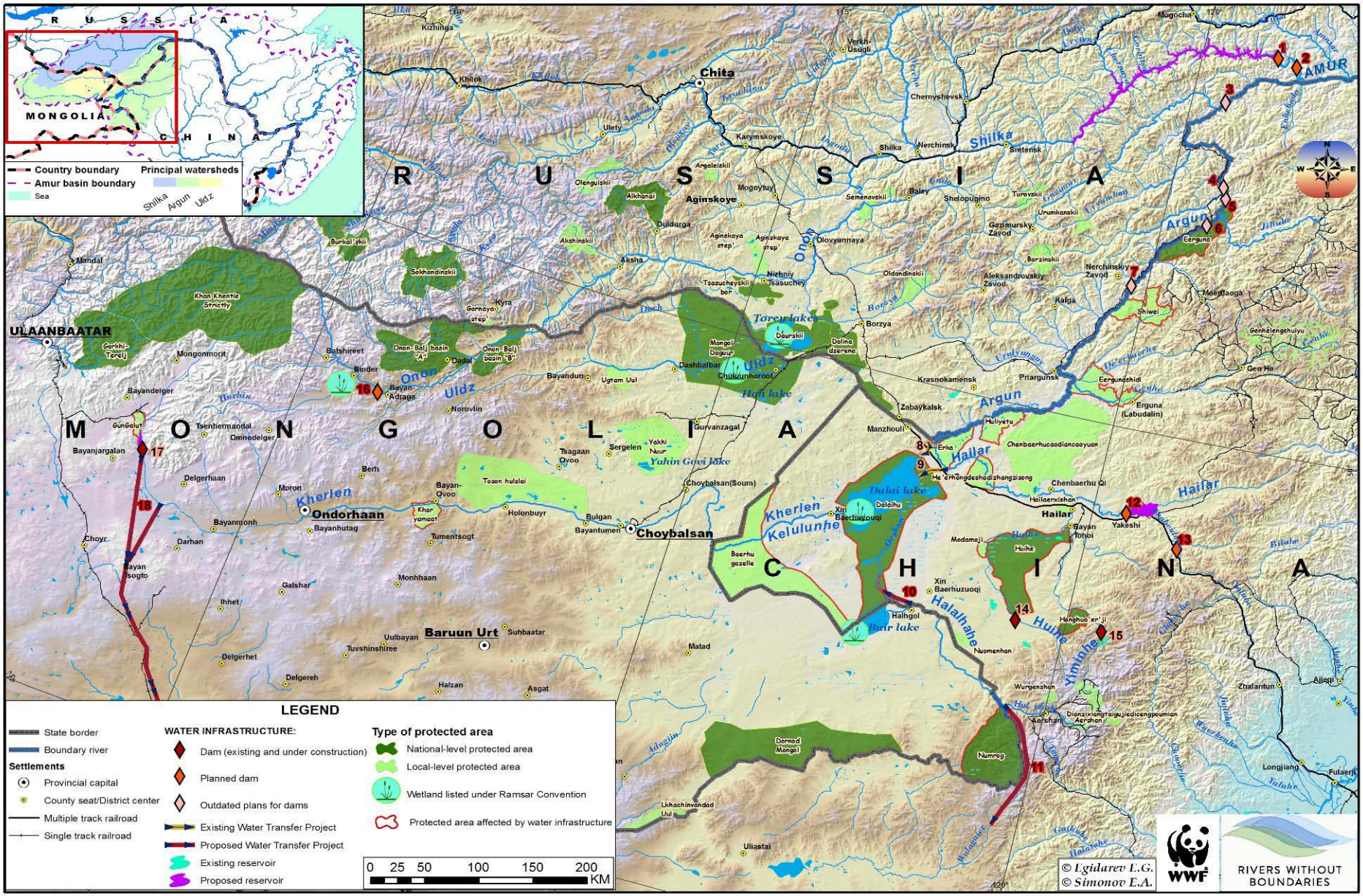


*Figure 8. Water infrastructure projects and principal protected areas in transboundary of Dauria*

Argun River basin spans all three countries of Dauria and includes 3 large transboundary watercourses: Argun-Halaer, Khalkh and Kherlen rivers as well as transboundary Buir Lake. While water use pattern in each of 3 countries is unsustainable and has its peculiarities, China due to greater population and economic activity has the key role in this basin.

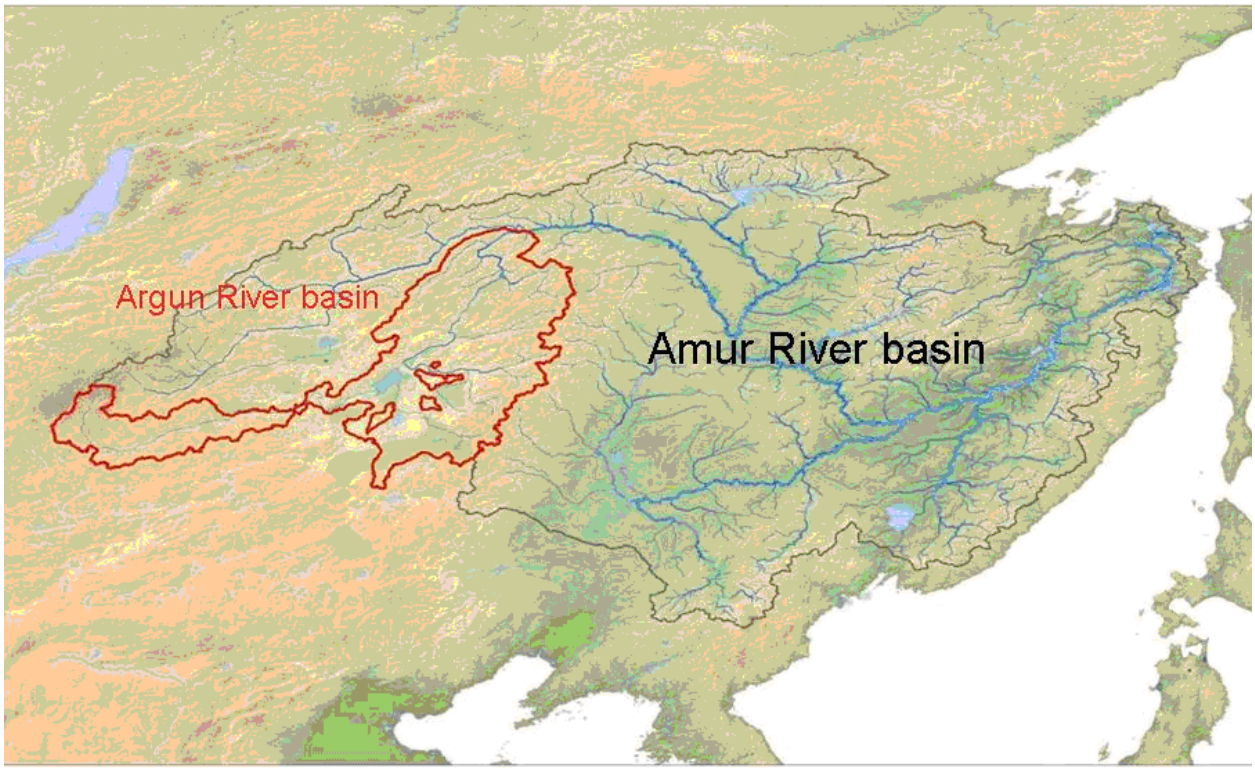


*Fig.9..Amur and Argun river basins.*

Water management component of the program "Revival of Old Industrial Bases in the Northeast China" in Inner Mongolia (2003-2030contains detailed justification for the rapid water diversion and flow regulation in the Argun (Hailar in the upper reaches) River basin, including construction of two large canals for water diversion and 10 reservoirs (*Honghuaerji, Zhaluomude, Daqiao, Zhashuhe* and others – see the table). This will ensure water supply for growing cities (Hailar, Yakeshi, Manzhouli), development of irrigated agriculture, building of thermal power plants that use local coal (Dayankuangqu deposit and coal-fired power plants in the valley of Imin River) and others (*China Engineering Academy, 2007*). Simultaneously China also develops programs for "water-conserving irrigation", air cooling systems and circulating water supply systems in industry etc. Nevertheless from 2003 to 2015 in four prefectures in eastern Inner Mongolia 10-fold increase in industrial water use was planned, mainly through the creation of coal energy complexes, as well as substantial growth of water consumption in agriculture and for the "environmental" purposes like tree planting in grsslands and converting lakes into reservoirs. (arrangement of green spaces and "environmental transfer"into Dalai Lake). Planned increase in the average long-term water consumption by only already constructed or approved for construction reservoirs in Hailar River basin will be up to 1-1,5 $km^3$ of water per year. In addition, the canal Hailar-Dalai is designed to transfer more than 1 $km^3$ / year. In total this will make more than 60% of the average long-term run-off of Hailar -Argun River.

In depopulated Russian part of the basin consumption water is minimal and most conserns arise in conjunction with mineral extraction and processing, with large uranium mine being of most concern.

In Mongolia National Water Program is sound approved, that along waer-management measures includes excessive amount of planned reservoirs for “adaptation”, hydropower, irrigation, supply to mining sites, etc.

*Fig.10. Wastewater discharge from Zhalainor town into Mutnaya watercourse 15 kilometers upstream from Molokanka water sampling station. Hulunbeier*

Water quality in transboundary Argun River deteriorated sharply after 2000. This is partly connected with advance of long-term dry period (reduced volume of water in the river resulted in increased concentrations of dissolved pollutants), and partially - with the rapid development of industry in China. Approximately during last ten years there have been continuing discussions of this problem between the Government of the Zabaikalsky Province and Inner Mongolia . These discussions did not yield any tangible results, as Russian side has no effective tools to influence the Chinese side. In connection with development plans for water use, industry and irrigation as well as with population growth, the situation in Argun River basin should be expected to worsen in the near future.

Hulun Buir Prefecture (Inner Mongolia, China) has completed construction of a canal to divert water from Hailar River (upper reaches of Argun River) to Lake Dalai for the "environmental purposes”. The project has passed the necessary approvals in the Ministry of Water Resources, Ministry of Environmental Protection and other relevant departments in China.

Average long-term run-off of Argun River in the place where Argun-Hailaer River reaches the Russian-Chinese border is about 3.5 $km^3$ per year, and in dry period the runoff is hardly exceeding 1.5 $km^3$ per year. The projected average long-term water transfer is 1,05 $km^3$ without use of pumping and regulation by reservors upstream. If the flow is regulated by water reservoirs and/ or installed pumping equipment, water allocation can be increased. At a length of 200-300 km downstream from the planned water intake, Hailar River is the only significant source of water for Argun River.

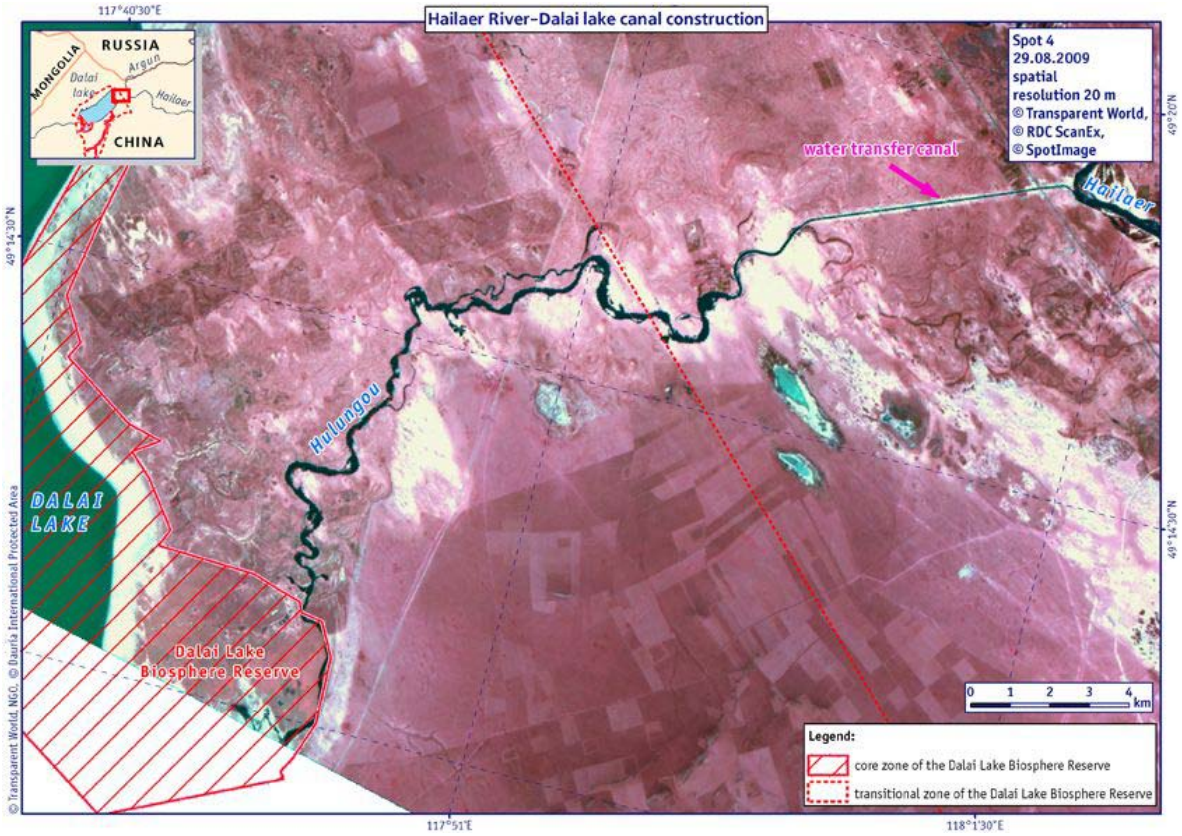


*Fig.11. Water started flowing through Hailar-Dalai Canal in August 2009.*

The water transfer project was suspended in summer 2007, after expression of concern from the Russian side at the official negotiations of heads of two states. The matter was passed for discussion at the meetings of relevant water authorities, at which Chinese Ministry of Water Resources has expressed unambiguous opinion that canal construction is a purely internal matter of China, and it is not to be discussed at bilateral meeting.

Obvious purpose of canal construction is to provide water for fish farming, tourist facilities, municipalities and mining industry. The threat to Dalai Lake Ramsar site from mining was even mentioned in the Resolution X.13 of the COP10 of the Ramsar Convention in 2008. Construction of the canal diverting water from Hailar River will become a new justification for the water allocation from Dalai Lake to many mines and factories around.

He canal was built and started operation in August 2009. It is expected that by 2012-2015 water diversion through the canal will cut floods feeding the Argun River floodplain and in general substantially change the volume of river runoff.

The following consequences are possible as a result of water regime alterations in the transboundary part of the Argun River valley due to upstream reservoirs and canal:
• Regulation of river flow will disturb existing flood cycle, leading to drainage of wetlands;
• River meandering will stop, natural braided channel will degrade, leading to degradation of wetland habitats structure;
• Reduction of wetland areas threatens populations of migrating and nesting birds, including 19 globally threatened species listed the International Red List;
• migration routes will be disrupted in the entire area of Dauria steppes;

• Flood control will disturb flooding and replenishment of soil with nutrients in floodplains, and thus will reduce the pastures and hayfields on which people's survival depends during droughts;
• Aridization of climate in the Argun River valley will occur, which will worsen conditions for growing crops and cause desertification;

• Concentrations of pollutants in the waters of Argun River will increase;
• There will be worsened water supply conditions for Zabaikalsk settlement with the largest customs checkpoint, Priargunsky mining chemical factory, settlements along the river, etc.;
• The deteriorating conditions will force inhabitants of settlements located in the border areas of China and Russia to move to other places.

Consequences of the water transfer for Dalai Lake in China may also be negative:
• Increase of the inflow from Hailar-Argun River will lead to concentration of pollution in the lake, posing a threat to public health, fisheries and tourism;
• Disturbance of the natural cycle of water level fluctuation will affect diversity and productivity of the lake that has been converted into human-made reservoir.

*Fig.12. Gun-Galuut Nature Reserve on Kherlen River to be destroyed by Kherlen-Gobi water transfer*

There are other water diversion projects planned in the region:

-from Kherlen River (Kerulen, Kelulunhe) to Gobi in Mongolia to supply South Gobi mining industry and exports of added-value products (washed coal).

-from Halhin Gol River (Halahahe) to Xilingol coal mining areas in China to support development of coal-burning thermal power plants.

All water infrastructure projects are interrelated and implementation of one of them increases probability of implementation of other projects to deal with negative consequences.

Dauria has very poor and risky conditions for hydropower development due to highly variable flow with dramatic climate cycles, remoteness from large industrial consumers and other limitations. Despite several dozen perspective dam locations suggested here during last century not a single hydropower plant has been built.

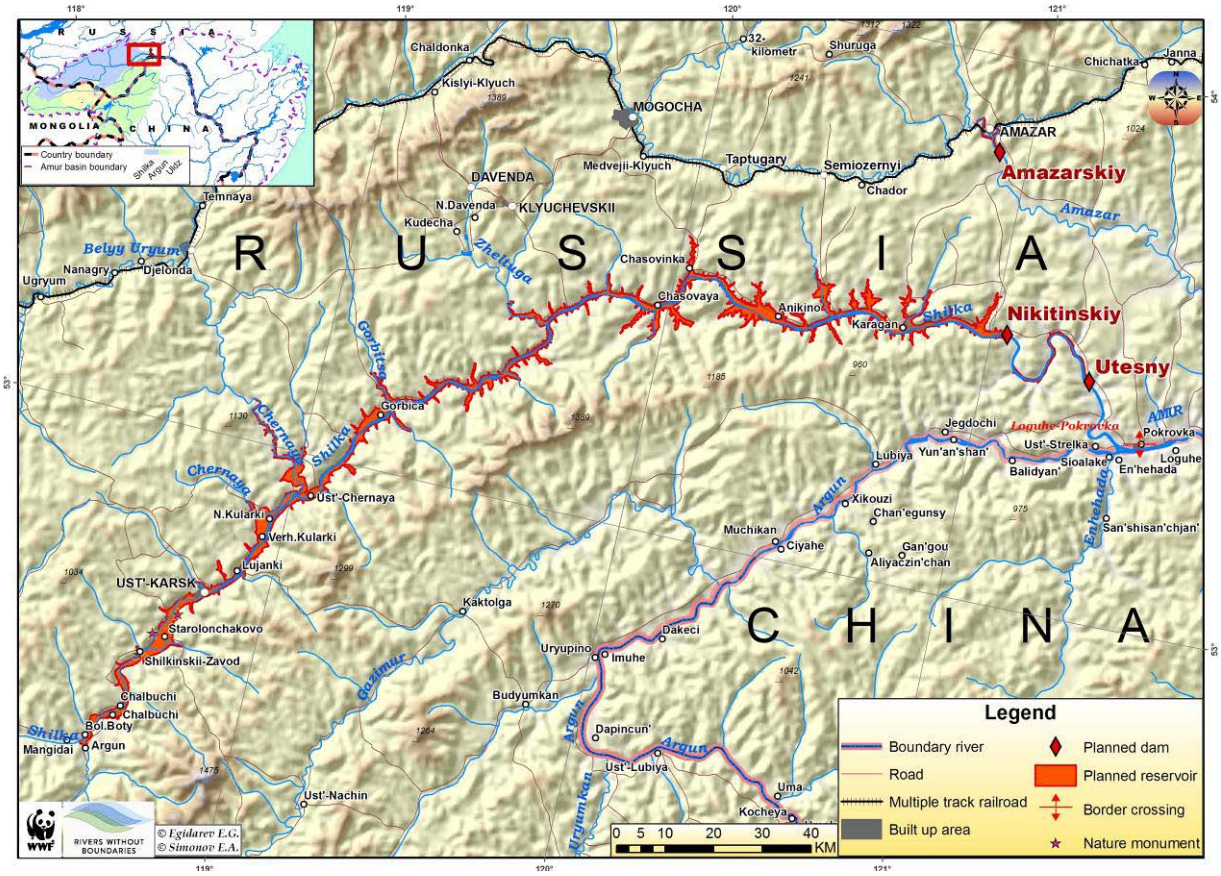


*Fig.13. Planned reservoirs of Transsibirsky hydropower cascade on Shilka River*

However a new hydropower initiative is targeting the largest river in Dauria right now. "EuroSibEnergo-En+", the largest independent power producer in Russia, and China Yangtze Power Co. ("CYPC"), the largest Chinese listed hydroelectricity producer, now prepare for joint investment into power plant construction projects in Eastern Siberia. The owner of "EuroSibEnergo-En+", Russian billionarie Deripaska claims that China and Russia could jointly develop large hydropower in Siberia to reduce Chinese dependence on coal. "EuroSibEnergo-En+", proposed Trans-Sibirskaya Hydro in Zabaikalsky Province **,** on Shilka River –the source of Amur River with 450 kilometer long reservoir, that in length will occupy roughly a half of Shilka River proper. It will fully block Shilka River watershed, disrupt important migration corridor between Amur river and northern Dauria, exterminate floodplain communities unique

for Dauria, drown 130 important historic sites and 20 settlements. Reservoir will be contaminated with rotting wood and toxic substances from mining complexes upstream, it will exterminate local fish including giant Kaluga Sturgeon–endemic of Amur. CYPC and Three gorges Co. eye this project on the source of Amur as a first step to build dams on Amur River main transboundary channel. Right now “EuroSibEnergo”(En+) develops feasibility study to obtain investment from EXIM Bank of China and other sources.

This project was continuously questioned by regional scientists and environmentalists. In March 2012 a wave of actions in defense of the Shilka River initiated by WWF and local NGOs rolled through the Amur River basin from headwaters to the ocean and it impressed hydropower company. On World Water Day En + Group and WWF Russia have signed agreement to hold a joint comprehensive study to assess the impact of hydroelectric plants on the ecosystem of the Amur River Basin. The purpose of the study is to produce balanced account of all the key factors, including environmental and socio-economic, that should be considered when deciding on the possible development of hydro potential of the Amur basin and construction of new hydroelectric plants.Such a comprehensive strategic basin-wide environmental assessment will be conducted for the first time in the history of hydropower in Russia and the Soviet Union. Prior to the completion of studies and discussing its conclusions with the public En + EuroSibEnergo promised to suspend work and negotiations on the Trans-Siberian hydroelectric project on the Shilka River.The decision on the future of the Trans-Siberian hydroelectric project company should be based on the conclusions of a comprehensive environmental assessment.

If such an assessment would be conducted in Dauria river basins only it would not make much sense, since much better conditions for hydropower development exist in adjacent basins to the North (Lena River), West (Yenisey River),East (Zeya and Bureya tributaries of Amur River).

*Fig.14.Gold-mining vessel at work*

*Fig.15. Kirkun River valley at confluence with Vereya River devastated by gold mining*

Mining industry is on the rise in Dauria and its impacts on rivers are very obvious. Extraction of placer gold has the longest history and widest distribution among mined minerals. Placer gold mining transforms relief, hydrological regime, destroys plant and animal communities. It is also known to induce decease and abnormal development in humans and animals. Besides, devastation of key element of the habitat - stream valleys, mining process may bring mercury and other pollution. In China this mining has resulted in degradation of significant part of

wetland and riverine habitat that requires science-based ecosystem management and restoration measures, while in Russia and Mongolia it is also on-going destruction in previously pristine river valleys. This publication presents findings of assessments of gold mining impacts on river valley ecosystems, assessment of potential pollution in streams, and essence of mining policies in Russia, China and Mongolia. China somehow has already stopped “gold rash” but has to deal with profound consequences and bear costs of habitat restoration and developing alternative livelihood opportunities for local people. Mongolian society just realized tremendous threats to nature and people and government under strong pressure from expert community and civil movements started implementing measures to limit mining in valuable areas.Russia is boasting greatest amount of rivers already destroyed by mining and is on the verge of starting new mining operations which will lead to massive destruction of most valuable remote wilderness areas of Dauria. Gold mining on transboundary rivers has already lead to official complaints by Mongolia authorities and civil society towards Russian officials in 2010-2011.

*Fig.16. Embankment built on China side of Mutnaya and Prorva watercourses’ confluence*

*Fig.17. Erosion of the Argun River Bank in Russia provoked by embankment of the opposite riverbank. Starotsurukhaitui*

Embankements on transboundary river. Relation between the state border line and natural changes of the riverbed (erosion and sedimentation processes) is a hot issue in Sino-Russian negotiations. In the present situation the agreed border follows “the center of transboundary  ever , each party independently decides the issue of preserving stability of demarcated state border, including undertaking artificial bank protection which may lead to erosion of the opposite bank, destruction of the natural floodplain dynamic at this section, loss of natural retention areas in floodplain reservoirs that reduce the risk of catastrophic floods, loss of spawning grounds, etc. This issue is most relevant for Argun River, where negative environmental impacts of bank protection have never been formally evaluated by governments. Natural riverbed processes (meandering) are cyclical in time and are limited by floodplain areas (i.e., they may cause only local and temporary loss of limited areas). A sound common regime for the protection and use of floodplains and for demarcation of state border should be elaborated, that preserves the natural floodplain processes. Coordinated establishment of the system of protected wetlands on transboundary rivers in the long term may also help to resolve the problem. Resolving this problem has enormous long-term environmental, economic and political effects, because

ecological integrity of the river will be maintained, enormous costs to control riverbed processes will be reduced, the damage to fisheries will be eliminated, ability to self-purification will be maintained, and damage from floods to downstream areas will be prevented (not increased). Obviously, there will be eliminated mutual claims of both parties that regularly arise under the present regime of border demarcation.

International cooperation on water and climate. Uncoordinated water resource development aimed to secure water on the individual national territories would have devastating effects on the transboundary wetlands. While conflict is possible, the countries have different comparative advantages and have a lot to share. There are hopeful developments in each country: China has strong National Wetlands Protection Policy and Action Plan that prescribes water allocation to important wetlands(2003). Russia adopted new Water Code prescribing development of "Standards of acceptable impact" (SAI) for environmental flows, as well as chemical, thermal, radioactive and microbial pollution)(2007), Mongolia adopted a new law "On prohibition of mining in water protection zones"(2009).

From many multilateral conventions the Ramsar Convention is one of the most relevant policy tools in the Amur-Heilong River basin with 15 wetlands already listed under convention. The Ramsar Convention Regional Initiative approach provides a suitable framework for multilateral cooperation on transboundary water management and transboundary environmental flows for wetland conservation, but three countries are slow to realize it.

All three countries also have bilateral agreements on Use and Protection of Transboundary Waters, which lack clear mutual obligations and their implementation so far has not led to appropriate integration of water management across the borders.

It is necessary to initiate establishment of Chinese-Russian-Mongolian intergovernmental commission on economic and ecological adaptation of nature resource management policies in Dauria to changing climate conditions with the aim to ensure favorable environmental and political situation. The Commission is needed primarily for the development and implementation of water management regimes, mutual endorsement of economic projects that might have a significant impact on transboundary ecosystems, as well as for the joint application of best technologies and management practices.

One of the most needed international tools is the Agreement on environmental flow norms for transboundary rivers of Dauria river basins and provisions for sustaining natural dynamics when planning water allocation to wetlands. Several other specific recommendations conclude this chapter.

*Fig.18.Inner Mongolian Hulietu Nature Reserve spans floodplain of transboundary Argun River*

**Protected areas network: challenges and opportunities**

Dauria International Protected Area **(DIPA)** was created by Mongolia, China and Russia in 1994 to protect and study ecosystems of the region. Further development of ecological network requires estab lishement of new protected areas, improvements and adjustments in protection regime and management of existing protected areas and development of explicit transboundary forms of protected areas.

Development of nature reserve network should provide for migration and breeding of species in all phases of region-wide drought cycle and preserve key hydrological features and all important refugia. (fragmentation avoidance, promoting connectivity, and protection of climate refuge with especially resistant habitats. Riverine wetland conservation is an essential component in any basin-wide adaptation Progamme and should first of all focus on protecting natural refugia during most unfavorable climate conditions and sustaining environmental flows.
Network design also requires understanding interplay of permafrost, fire regime, drought cycles, agriculture, infrastructure development in changing landscapes, with special attention to forest-steppe transition zone and freshwater ecosystems.

Specific suggestions are made in this part for estab lishement of new protected areas, improvements and adjustments in protection regime and management of existing protected areas and development of ceertain transboundary protected areas.

**(Extensive list of literature is at the end of Russian report, that also contains 50 bi-ligual illistrations.)**