ECOLOGICAL STATE OF THE AMUR RIVER

VORONOV BORIS.A.
Institute of Water and Ecology Problems, FEB RAS, Khabarovsk, Russia

The Amur basin is an enormous and unique natural and territorial unit with exclusively diverse natural conditions, landscape and biotopic specifics and highly varied biotic representation. The basin stretches from north to south for 1600 km, east to west for 2500 km. It has area of 1850 thousand km^2, shared by Russian (1003 thousand km^2), China (820 thousand km^2), Mongolia (32 thousand km^2) and the North Korea (just several dozens km^2). The basin is situated within several geographical regions, which have a wide spectrum of natural and climatic conditions: from typical north-taiga specifics in the north of Priamurye to sub-tropical humid forests in its south, from dry steppes and forest-steppes in the west and monsoon dark-coniferous and pine-broad-leaved taiga in the east.

A wide variety of natural and climatic features, a well-developed hydrographic system, interchange of plain and mountain relief in the Amur basin predetermined the formation of genetically rich species and ecosystem biological diversity, a unique merge of components, belonging to different floras and faunas, within the same natural ecosystems. Local flora is rich in 9000 vascular plants. There are about 700 species of land vertebrates and 135 fish species, including the kaluga, the biggest fresh-water fish in the world. The Amur basin is a home for Beringian, Angarian, Manchzhurian (with elements of Indo-Malayan), Mongol-Daurian and high-mountain floras and faunas, as well as fauna of open cenoses of Priamurye [4, 5]. Quite often small areas serve a habitat for some species or whole communities, which usually inhabit not only different geomorphological ground levels and mountain belts, but also different geographical regions with specific natural condition. As usual, centers of species adaptive irradiation are quite distant from each other, but in the Amur basin such species inhabit the same natural complexes. This natural phenomenon can be explained with Amur basin specific geographical situation and high communication importance of mountain systems and valleys of the Amur and its tributaries for the exchange of genetic materials both within a singly ecosystem and between various ecosystems.

Rich genetic, species and ecosystem biological diversity provide originally high biological productivity of natural water and land ecosystems, whereas numerous natural ecological corridors and boundaries make the Amur basin biogeographically important both inter-regionally and inter-continentally. Ecological corridors in the Amur valley serve seasonal migration routes for dozens of thousands wild ungulates and large beasts of pray, for millions water fowl species, etc. Less than 80 years ago the entire basin, including the Shilka and Argun rivers, was a spawning area for salmon, and had hundreds of fishing grounds. The annual catch only of Nickolaevskaya fishing ground in the Amur lower reaches exceeded several thousands tons of salmon. Rich fish resources, abundance of game, huge natural berry fields and variety of edible and medicinal plants provided conditions for comfortable and successful leaving of Priamurye indigenous people. Their traditional activities were and remain fishing, hunting, harvesting berries, mushrooms, pine nuts and other forest products.

However, biological diversity in Priamurye is ecologically fragile and subjected to natural and especially anthropogenic impact and its qualitative and quantitative characteristics are rather unstable. To some extent it can be explained with a fact that a large number of species in local biota are at the boundaries of their areals (e.g. over 40% of bird and over 50% of fish species, etc.) and there are also lots of ecologically conservative, small in number, rare, endangered plants and animals, enlisted in the

Red Data Books of various levels. Over 50% of the total number of species and ecosystems are ranked as fragile, only 30% are assessed as stable and a little over 10% are considered doing well.

Moreover in recent decades Priamurye became the arena of large-scale anthropogenic transformations of natural ecosystems. Chaotic natural resource use, illegal timber felling, hunting and fishing and concomitant negative effects caused significant changes of the natural resource and ecological potential of the territory, stably negative tendencies in its dynamics and deterioration of a general state of the environment and living conditions of the people. Exhaustion of a natural resource base, reduction of natural ecosystem productivity and quality of nature and living conditions as a whole make the region less attractive for population and cause population outflow and even closing of some settlements.

The situation is aggravated not only because of extensive and deep negative transformations, but also due to long recovery processes in disturbed natural complexes. For example, in conditions of north Priamurye burnt or cut forest regenerate in 300-350-years time [4], provided reforestation processes are not interfered. At present long-lasting pyrogenic zones are being formed in Priamurye. Repeated fires often happen there. If in general catastrophic fires in the region happen once in 22-23 years and excessive fires happen once in 10-15 years, in pyrogenic zones they repeat every 4-5 years. Fires cause transformations of ground waters, their chemical composition and thermal regime. Ecosystems lose up to 30% of their total nutrition elements. At average 10 kg of phosphorus (18%), 51 kg of potassium (17%), 100 kg of calcium (12%), 37 kg of manganese (29%) volatilize from 1 hectare of a burnt ground. Due to a full-scale or creeping fire forest litter losses from 27 to 64% of nitrogen. After the fire mineral concentrations in soil significantly increase: calcium – 20 times, manganese – 10 times, potassium, natrium, nitrogen and phosphorous [6]. In several years after the fire lots of minerals are washed out from the burnt areas and with surface runoff get into rivers, lakes and bogs (total amount of calcium, manganese, potassium, natrium, nitrogen and phosphorous may reach 300 kg from a hectare) [1]. Increased concentrations of these minerals in water cause eutrophication of water ecosystems, shortage of spawning grounds [3] and fish kill. In rivers of pyrogenic areas summer water temperature is usually several degrees higher that in forest areas. Salmon spawning run becomes difficult or impossible and mass fish mortality is observed in some years [2]. Many Amur tributaries are polluted with insufficiently-treated household, agricultural and industrial sewage and mining wastes, which contain arsenic, heavy metals (lead, copper, zinc, etc.), and.

The Amur is most heavily polluted in its lower reaches. It becomes a collector, storage and transmitter of pollutants, which are discharged from the upper basin areas, especially from the middle transboundary part of the Amur. Most pollutants in Middle-Amur water come from the Sungari River basin, which entirely belongs to China and from the Ussuri River basin, which is shared by Russia and China. The spectrum of pollutants is shocking: heavy metals, phosphorus, nitrogen, nitrates, nitrites, benzene, nitrobenzene (and their derivatives xylol, toluol, etc.), chlorine-containing and polyaromatic compounds just to name a few [3,7]. They contaminate Amur water and water organisms, accumulate in bottom sediments and are further discharged into the Tatar Strait and the Okhotsk and Japan seas. Quite often primary pollution causes secondary pollution, and fish, caught here in winter is dangerous to eat.

Hydropower constructions also have a significant impact on Amur basin ecosystems, especially on its water ecosystems. Four hydropower stations, built in the Sungari basin and Russian Zeya and Bureya stations not only changed the Amur runoff in winter and summer, but disturbed common fresh water fish spawning grounds, affected river temperature regime and water quality. Nowadays, the situation is becoming even worth because of the Chinese works on transferring a part

of Argun River water in the other direction.

Processes and phenomena, described above, cause changes and reduction of biodiversity of the Lower Priamurye. In recent decades several dozens of plant species become extinct and over 20% of local flora are adventive plants. Such vertebrates as Amur goral, red wolf, Japanese crested ibis, crested shelduck are now extinct. Such game species as moose, musk deer, lynx, Indian marten, wolverine, grey goose, bean goose, stone wood-grouse and many others used to be numerous, but nowadays are few in number and rare because of their habitat and feeding base changes, poorly regulated hunting and poaching. Dozens of species, including tiger, forest cat, fish owl, fish hawk, erne, Far Eastern turtle and some others are on the verge of becoming extinct. In the last 115 years resources of salmon and sturgeon species in the Amur decreased 50-80 times because of excessive catch (mainly illegal fishing) and changes of natural and economic situations in the Amur basin. Water pollution with pyrogenic, industrial household and agricultural wastes cause most damage.

Priamurye landscapes not only lost their productivity, but their attractiveness as well. Huge areas (over 50% of the basin territory) of burnt or cut wood or widely-spaced new growths are unattractive and even psychologically depressive. Moreover, fires in Priamurye are becoming more frequent and cause lots of smoke. Heavy smoke in the cities is health-damaging. Medical research data showed that fire smoke affects even a child in his mother's womb and 70% of such children are born unhealthy or abnormal. Over 90% of fires are caused by men. They are the results of agricultural and other burnings (most often not controlled) and low environmental awareness of natural resource users.

Priamurye by now has lost the most part of its natural and resource potential (productive and suited for wood-felling and non-timber forest product harvesting, fishing, hunting, tourism, rest and recreation). Attractive landscapes, natural fresh water and mining resources are reduced. Priamurye ecological capacity decreased and its ecological tension increased. At the same time natural and mineral resource damans are high and have a tendency to increase. It is quite understandable as the regional economy is mainly resource-oriented. However, even now there is a shortage of a great number of resources. The need for the transition to new regional economy management to provide ecologically sustainable and endless regional development becomes evident and rather vital.

However, sustainable development of any territory is possible only if a territory has a scientifically proven balance of man-managed and self-managed systems in its natural and economic structure. A heavy anthropogenic load can be mitigated only with new relations in the "man - nature" system and a new perspective of natural resource use management. Only they can save ecosystems and a resource and ecological potential necessary for today and future generations. Up to now activities focused on regeneration, conservation and ecologically adapted use of a natural resource potential of the Amur Basin are of local character, whereas the region needs a full-scale and complex strategy of sustainable ecological and economic development and environment conservation.

The problem of sustainable development, conservation and rational use of the natural-resource potential in regions with dominating "resource economy" is extremely many-sided and not less complicated than in industrial regions. It may be solved only if there is a deep interrelation of different aspects of activity and management and advanced methods of social, ecological and economic sustainable development of the region. Main efforts should be focused on the balance of social and economic interests of the region, its population with resource and environmental capacity of its territory, ecosystems and their elements. Several other scientifically proven aspects should also serve as guidelines for the formation of regional and ecologically adapted natural resource use and facilitate both rational use of Priamurje resource potential and general progressive development of this region. The first steps have already been taken in planning the Strategy of Social and Economic Development of the Russian Far Eastern and Baikal region for the period up to 2025.

REFERENCES

1. Baburin A.A. Dynamics of forest vegetation conditions of Amur-Komsomolsk Energy and Industry Complex // Geography and Natural Resources. 1980. №1. P. 151-158.
2. Voronov B.A. Ecological damage of environment in the Amur basin caused with transboundary pollution and economical transformations of its natural systems // Changes of environmental conditions in CIS countries under the recent climate changes (Ex. Ed. Academisian V.M. Kotlyakov. – M.: Media-Press, 2008. .- 232 p.
3. Kondratyeva L.M. Ecological risks of water ecosystem pollution. Vladivostok: Dalnauka, 2005. – 299 p.
4. Kurentsov A.I. Zoogeography of Priamurje.-M.-L.: Nauka, 1965. – 155 p.
5. Sochava V.B. Botanic-geographic correlations in the Amur basin //Amur taiga (Complex botanical studies). L.: Nauka, 1969. P.5-15.
6. Furyaev V.V., Zlobina L.P. Global changes of ecological functions of Eurasia boreal forests due to fire damage // Sib. ecol. J. 2001. №6. P. 661-665
7. Shesterkin V.P., Sjhesterkina N.M. Main problems of surface water quality in the Amur basin // Regions of new developments: state, potential, perspectives at the beginning of the third millennium. (Int. Sci. Conf. Proc. Vol. 2. Vladivostok-Khabarovsk: FEB RAS, 2002. P. 158-160