«Ecological researches of water and wetlands in the national nature park "Burabay" for detection of the sustainable development ways»

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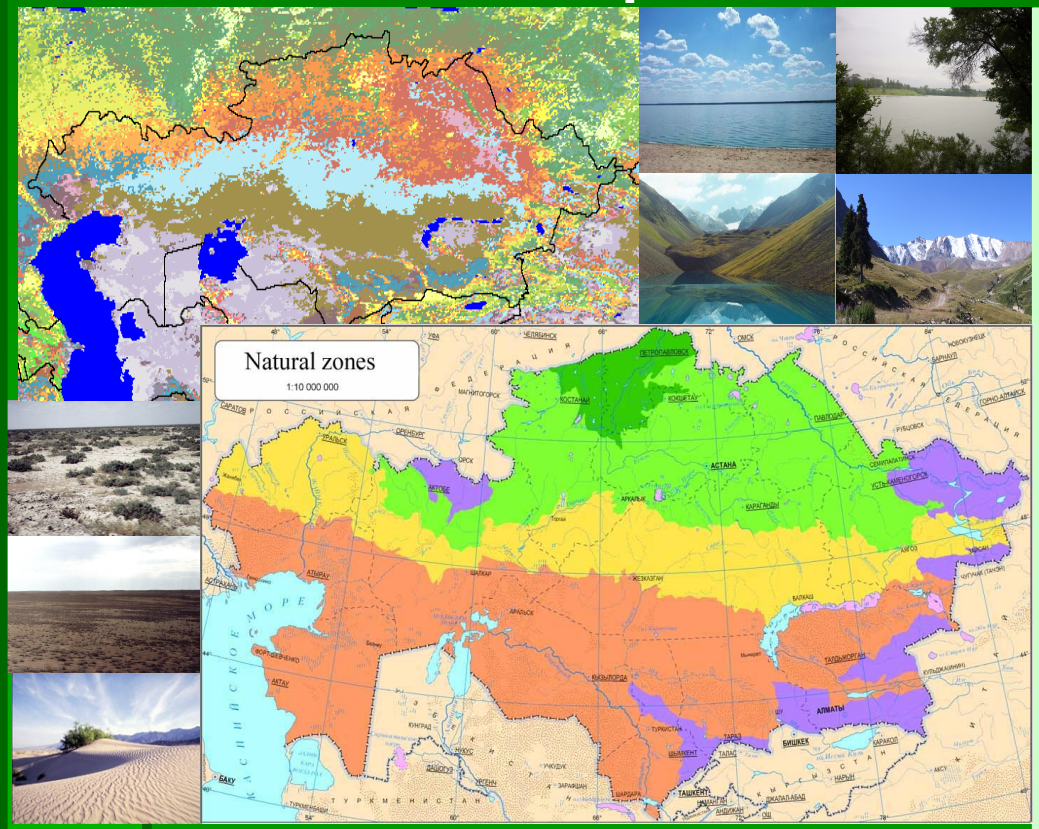


Area of Kazakhstan - 2724900 sq. km

Population - 16.5 mln.

Steppe, semi-desert and **desert landscapes** - about 88% of territory, **Mountains** and **forest-steppe landscapes** - about 10% of territory

Total area of water surface - about 50,000 sq. km (1.8% from all area)

Number of large and small lakes - 48,262

Percentage of lakes in North Kazakhstan – 2.36-4.38%

Important lake systems - Caspian, Aral, Balkhash, Alakol-Sasykol, Zaysan, Tengiz-Korgalgin, Kusmurun, Sarykopa, Shalkar

Important rivers: Ural, Syrdarya, Irtysh, Ishim, Ili, Tentek, Emba, Chu

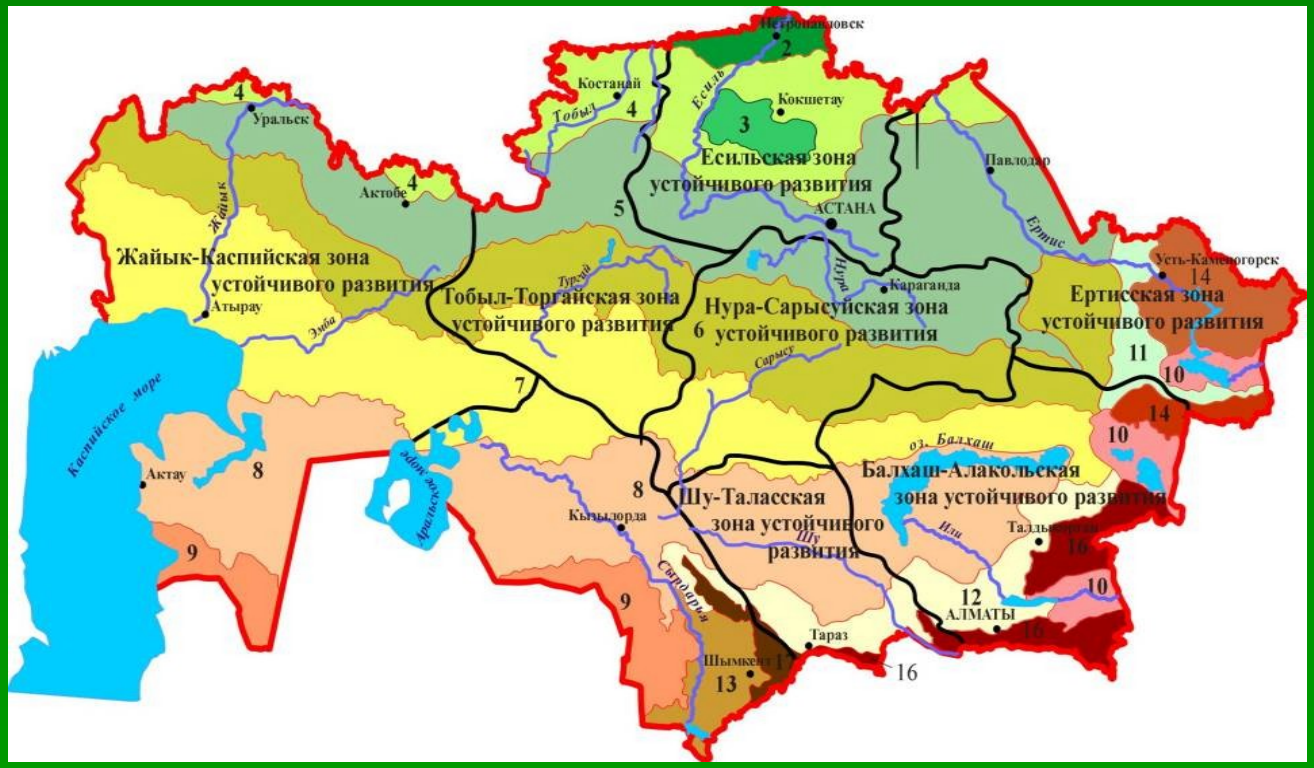
Flora

- Over 6,000 species of higher vascular plants
- about 5,000 species of mushrooms
- 485 species of lichens
- over 2,000 species of sea weeds
- about 500 species of bryophytes

Fauna

- 835 vertebrate species inhabit
- 178 species of mammal
- 489 species of mammal
- Birds (396 species actually nest within the territory)
- 49 species of Rhynchocephalia
- 12 amphibia species
- 104 fish species
- 3 species of Cyclostomata

Zones of sustainable ecosystem development of main river basins



Long-term irrational land use has lead to disturbance of ecological situation in the republic.

In some regions (Aral sea, Semipalatinsk nuclear test ground and others) ecological problems are becoming of global catastrophic character.

Study and rational use of water and wetlands in Kazakhstan became the important priority of protection of the environment.

One of objects of ecological researches is national nature park "Burabay" in North Kazakhstan (Akmola oblast).

Goals of research:

Analysis and estimation of natural and anthropogenic factors of formation of a modern ecological situation, development of principles and methods of an ecological estimation and mapping, development of conservation measures of landscape-ecological and aesthetic value of object .

Tasks:

(a) **to develop the principles and methods of an ecological estimation and mapping,**

(b) **to develop principles and methods of landscape-ecological zoning and identification of stress zones,**

(c) **to assess the leading natural and anthropogenic factors of formation of an ecological situation,**

(d) **to estimate the violation of landscapes from different kinds of anthropogenic influence,**

(e) **to create the database of the main sources of destabilization of water and coastal and land ecological systems,**

(f) **to identify the ecological capacity of nature-recreational systems of lakes,**

(g) **to develop the landscape-ecological requirements to sustainable development of region,**

(h) **to draw the cartographical models of sustainable development of nature-recreational systems of lakes.**

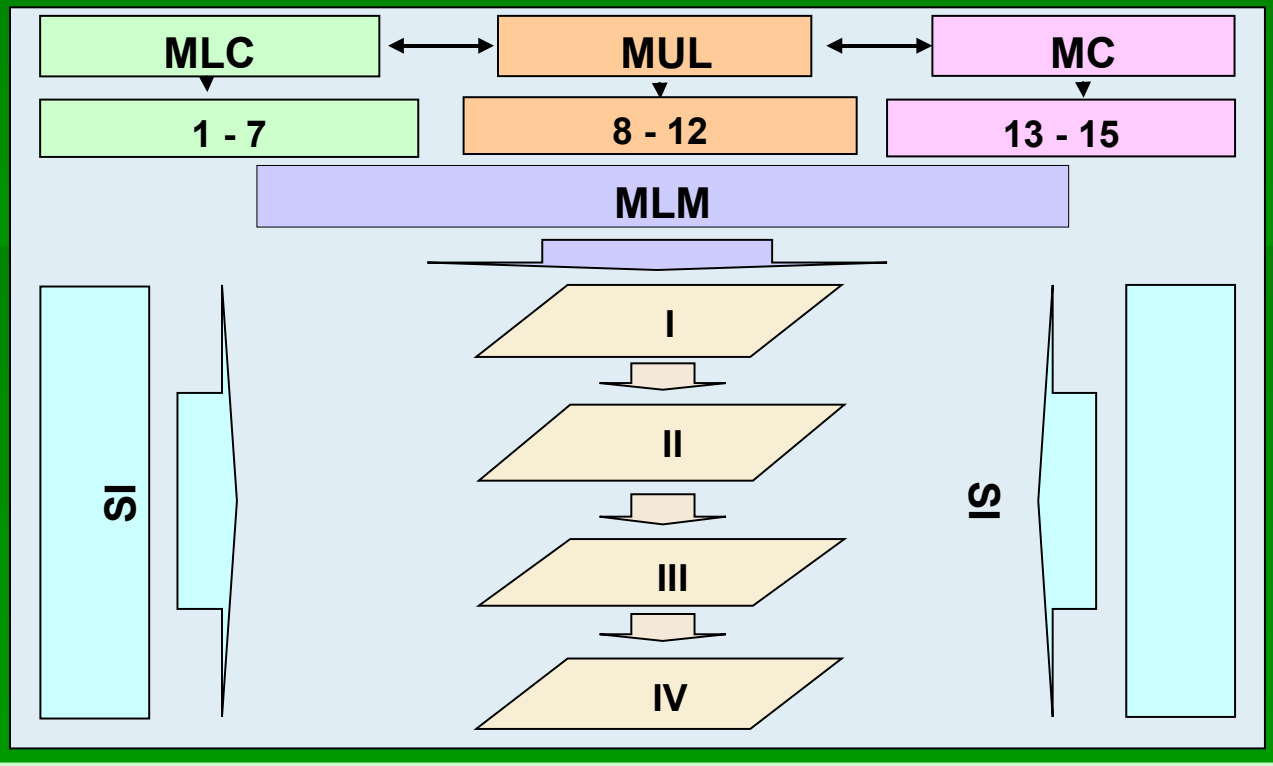
Methodology, methods and technologies:

Researches of water and wetlands in NNP "Byrabay" have interdisciplinary and transdisciplinary scientific character.

***Principles, approaches and technologies*:**
Interdisciplinary approach, landscape-ecological approach, system principle, regional-typological principle, historical-genetic principle, ecological zoning, GIS-technologies, computer technologies of processing and representation of the information.

***Methods*:**
(a) processing of the statistical information,
(b) mapping and regionalization,
(c) decoding remote sensing data and using GIS,
(d) comparison, detection of analogies, descriptions,
(e) filling and studying of typical forms and questionnaires,
(f) landscape analysis,
(g) use of the integrated and individual indicators of an ecological status,
(h) analysis of ecological-economic risks,
(i) extrapolation of results of research,
(j) methods of optimization of regional programs of development.

Cartographical base of ecological researches of water and wetlands in NNP "Burabay"



Maps of landscape components (MLC): 1 – Map of hypsometry; 2 – Hydrographic and и hydrologic maps; 3 - Geomorphologic map; 4 – Geological and hydro-geological maps; 5 – Soil map; 6 – Map of botanical zoning; 7 – Map of forests.

Maps of use of landscapes (MUL): 8 – Land use maps for the past and present situation; 9 - Maps of hydraulic structure; 10 – Perspective plan of architectural building in the Shuchinsk-Borovoe resort zone; 11 – Map of infrastructure network; 12 – Map of recreational objects.

Maps of human-induced impact and changes (MC): 13 **–** Map of violation of landscapes from different kinds of anthropogenic influence; 14 – Map of ecological zoning; 15 – Map of ecological capacity of nature-recreational systems of lakes.

MLM – Modern landscape map. **SI** – Processed satellite images.

(MC): I – Map of nature and human-induced processes. **II** – Map of susceptibility of landscapes to degradation. **III** – Map of requirements for sustainable development of nature-economic system. **IV** - Map of nature protection.

Study area

Study area is the central part of Kokshetay hills.

Altitude ranges between 300 m and 800 m above sea level.

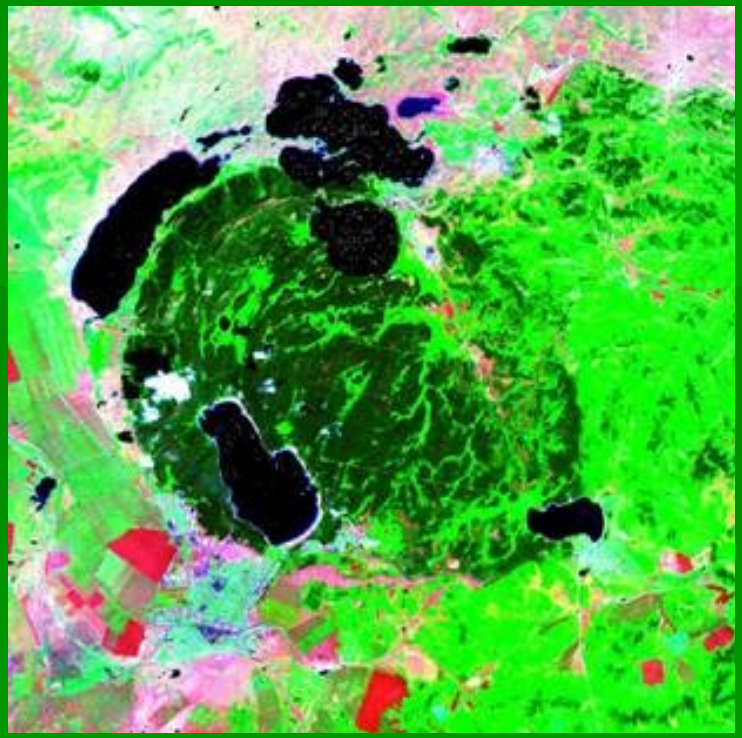
Latitudinal and altitudinal climatic parameters are atypical for North Kazakhstan.

Territory is characterized by high diversity of ecologically contrast ecosystems: hydrosystems, steppes, forest-steppe, forests, meadows, etc.

The territory can serve as unique model test area since it has unique environmental conditions.

In various years in NNP "Burabay" researches of a climate, subsurface geology, vegetative and fauna, superficial and underground waters were carried out but they had narrowly specialized character.

At present time comprehensive studying of a modern ecological state of forest, lakes and rivers, soil, air is conducted and the system of ecological monitoring on the basis of it can be created.



Name - National nature park "Burabay" (NNP)
Location - Shuchinskij and Enbekshilderskij regions, Akmola oblast, Republic of Kazakhstan.
Area – 159,932 hectares.

Brief description. It is created according to the Decision #1246 of the Government of Republic of Kazakhstan in 2000 (August, 12) for conservation of unique landscapes.

Zones and subzones:

(1) zone of a reserved regime;
(2) zone of a wildlife-refuge regime with subzones:
(3) subzone of regulable recreational use;
(4) subzone of administrative-productive destination;
(5) subzone of service of visitors and tourists;
(6) subzone of the limited productive activities.

There are 6 forestry "Akulbayskoe", "Borovskoe", "Katarkolskoe", "Zolotoborskoe", "Mirnoe", "Barmashinskoe", "Museum of the nature", a subsidiary agriculture, guild on processing wood and manufacturing of souvenir products, objects of service of visitors and tourists.

There are a set of the fresh and feebly-salted lakes. The largest lakes: Big and Small Chebachie, Borovoe, Shuchie, Katyrkol. Small lakes (water fresh, rich water vegetation, boggy coast): Telekol, Akkol, Gaynak, Chebekkol, Mountain, Lebaygie, Big and Small Karasie, Svetloe.

There are 16 settlements with a population more than 40,000. Settlements Shuchinsk, Borovoe, Vorobievka and others are located in a subzone of the limited productive activities. There are 46 rest zones and sanatoriums in a subzone of regulable recreational use.

In NNP function 158 little enterprises.
Total average annual emission of polluting substances are 2209.3 tons.
698.4 tons of polluting substances with sewage are dumped.
23021.9 tons waste products of a various origin are formed.

Types of water bodies - lake and river with fresh or feebly-salted water.

Biodiversity

Flora:
(a) number of families - 89, sorts - 332, kinds - 757,
(b) number of families of mosses - 19, sorts - 24, kinds - 40,
(c) number of rare and disappearing kinds - 6.

Fauna:
(a) Mammal - 47 kinds,
(b) Birds - 216 kinds (148 kinds build its nest),
(c) Reptile - 6 kinds,
(d) Amphibians - 1 kind,
(e) Fishes - 12 kinds.

- swimming birds and wader - 54 kinds
- disappeared 9 kinds birds which nested 50-100 years ago
- 1 kind is anthropogenic introducted (Lyrurus tetrix L.)
- number of Charadriformes and Anseriformes (20%) are evidence of great importance of the water and wetlands

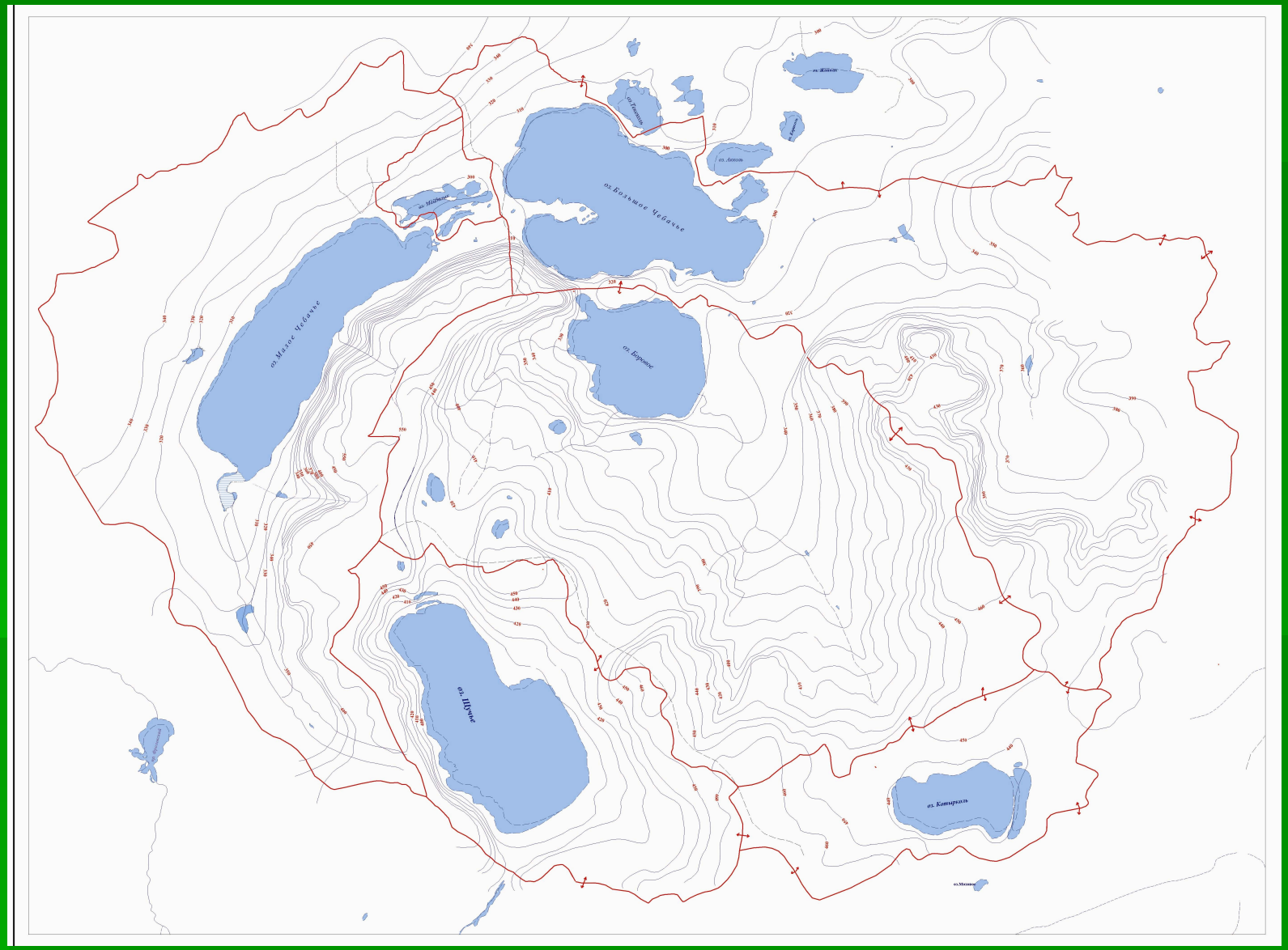
Preferable habitat of birds

Type of habitats	Number of kinds	Specific weight, %
Ponds	48,0	30,8
Forest-steppe landscapes	35,0	22,4
Forest landscapes	33,0	21,2
Steppe landscapes	15,0	9,6
Ruderal landscapes	12.0	7,7
Bog landscapes	8,0	5,1
Meadow landscapes	5,0	3,2

Rare and disappearing kinds of animals (10 kinds)

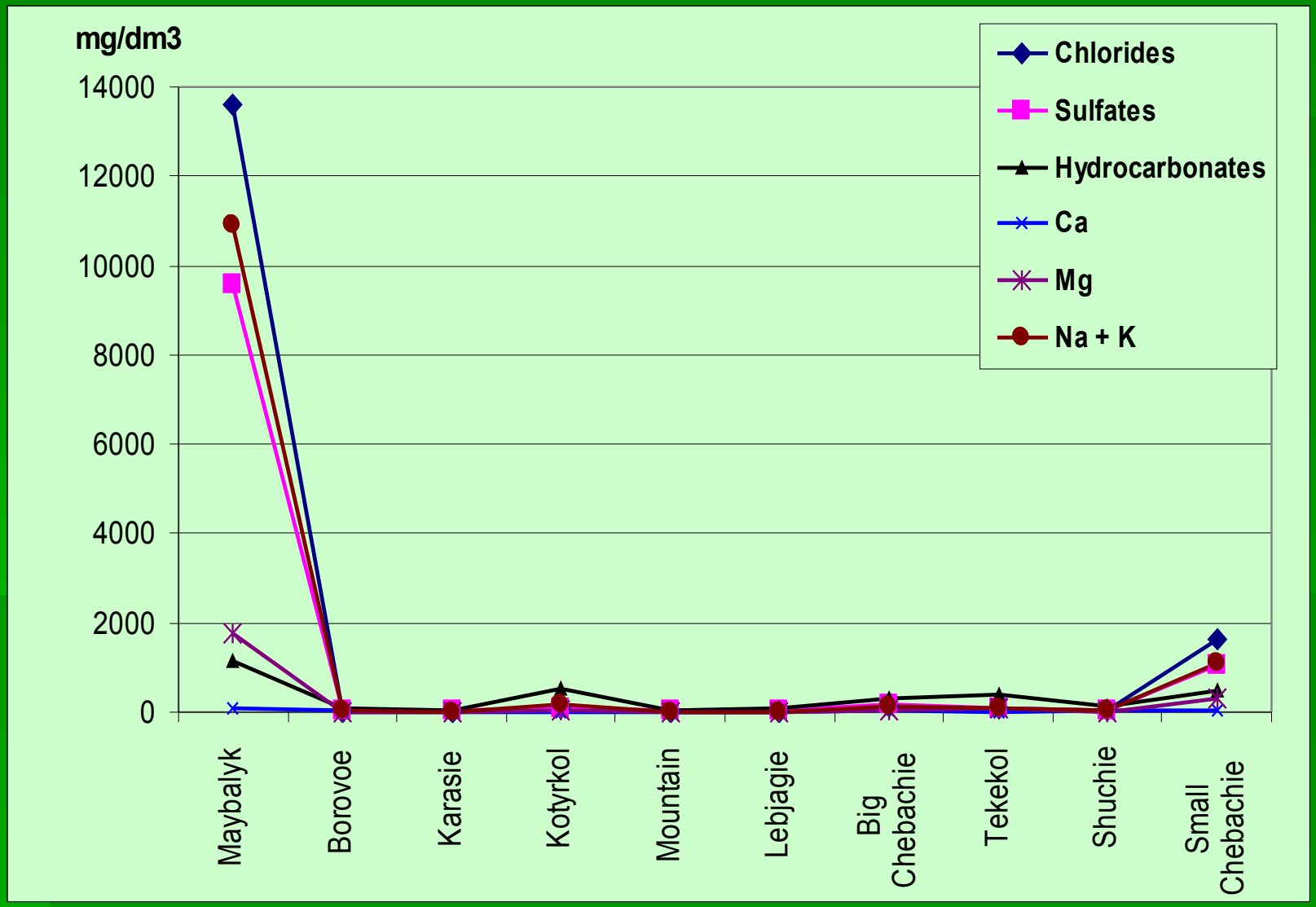
- ☹ Rufibrenta ruficollis Pall.
- ☹ Anser anser L.
- ☹ Cygnus alop Gm.
- ☹ Cygnus cygnus L.
- ☹ Tadorus Faruginea Pall.
- ☹ Phoenicopterus roseus Pall.
- ☹ Pelecanus crispus Bruch.
- ☹ Anthoropoides virgo L.
- ☹ Aquila clanga Pall.
- ☹ Falco cherrug Gray.

Catchment basins



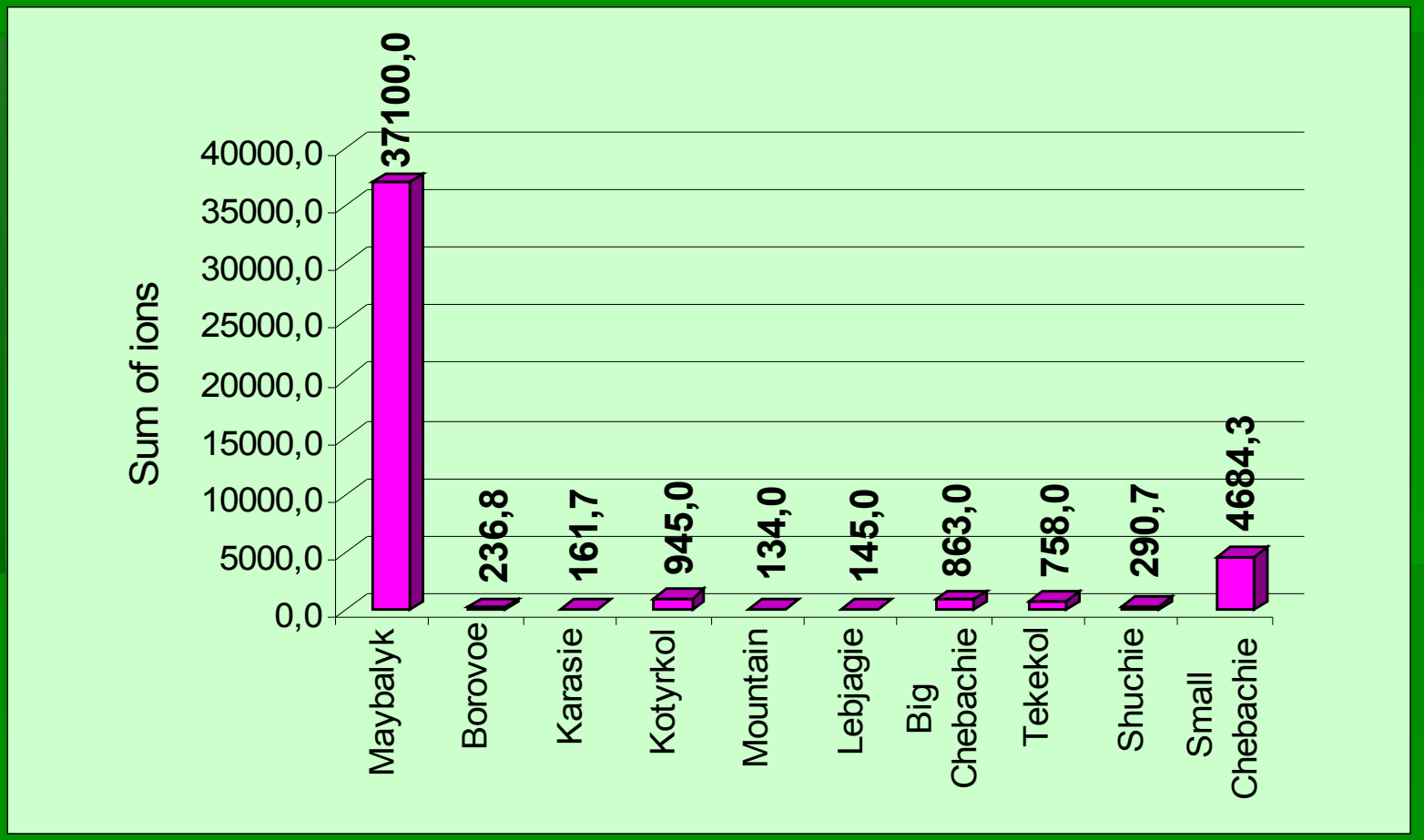
Hydrochemical parameters of condition of lakes

Main ions in lake water

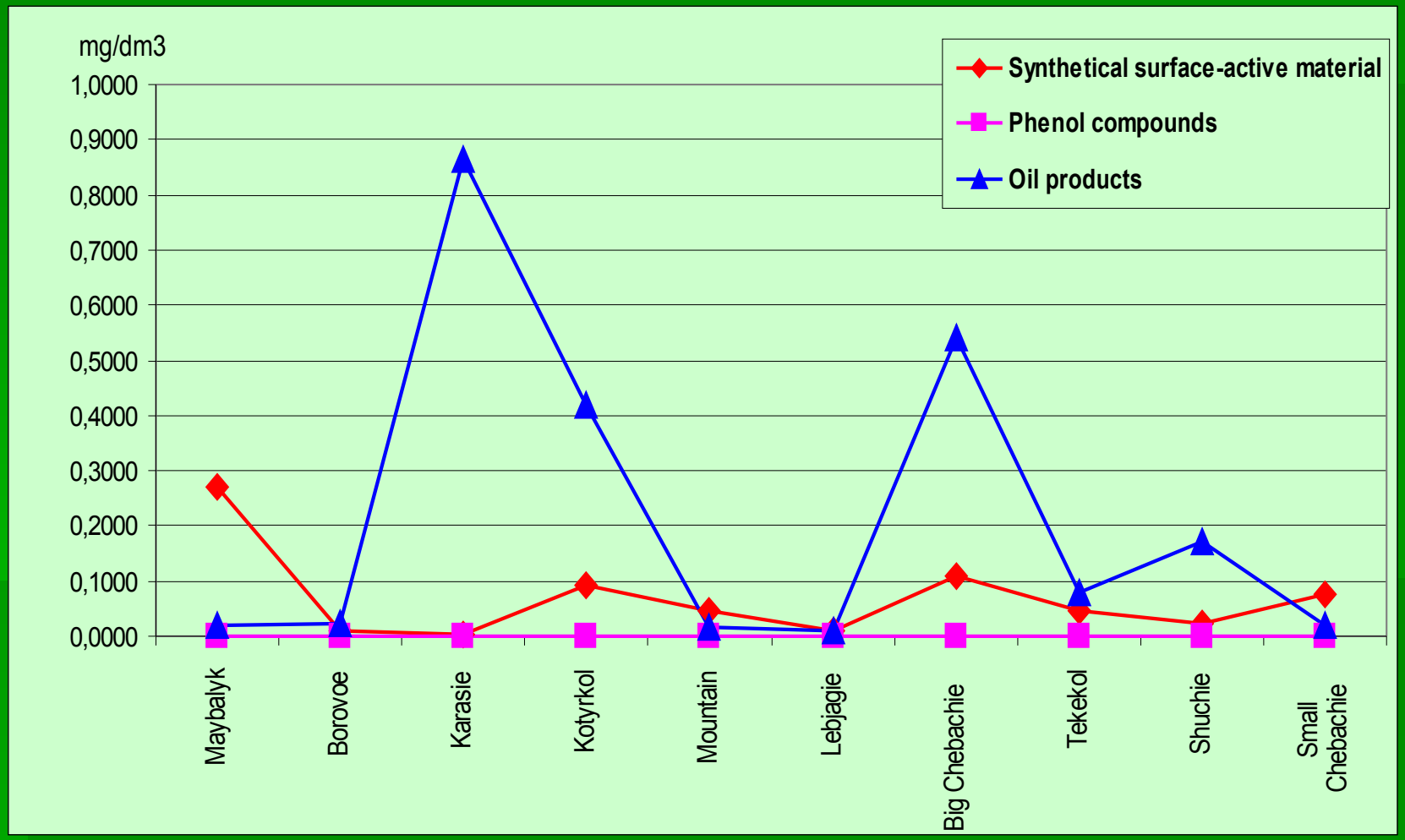


Hydrochemical parameters of condition of lakes

Mineralization of lake water



Content of organic substances in lake water

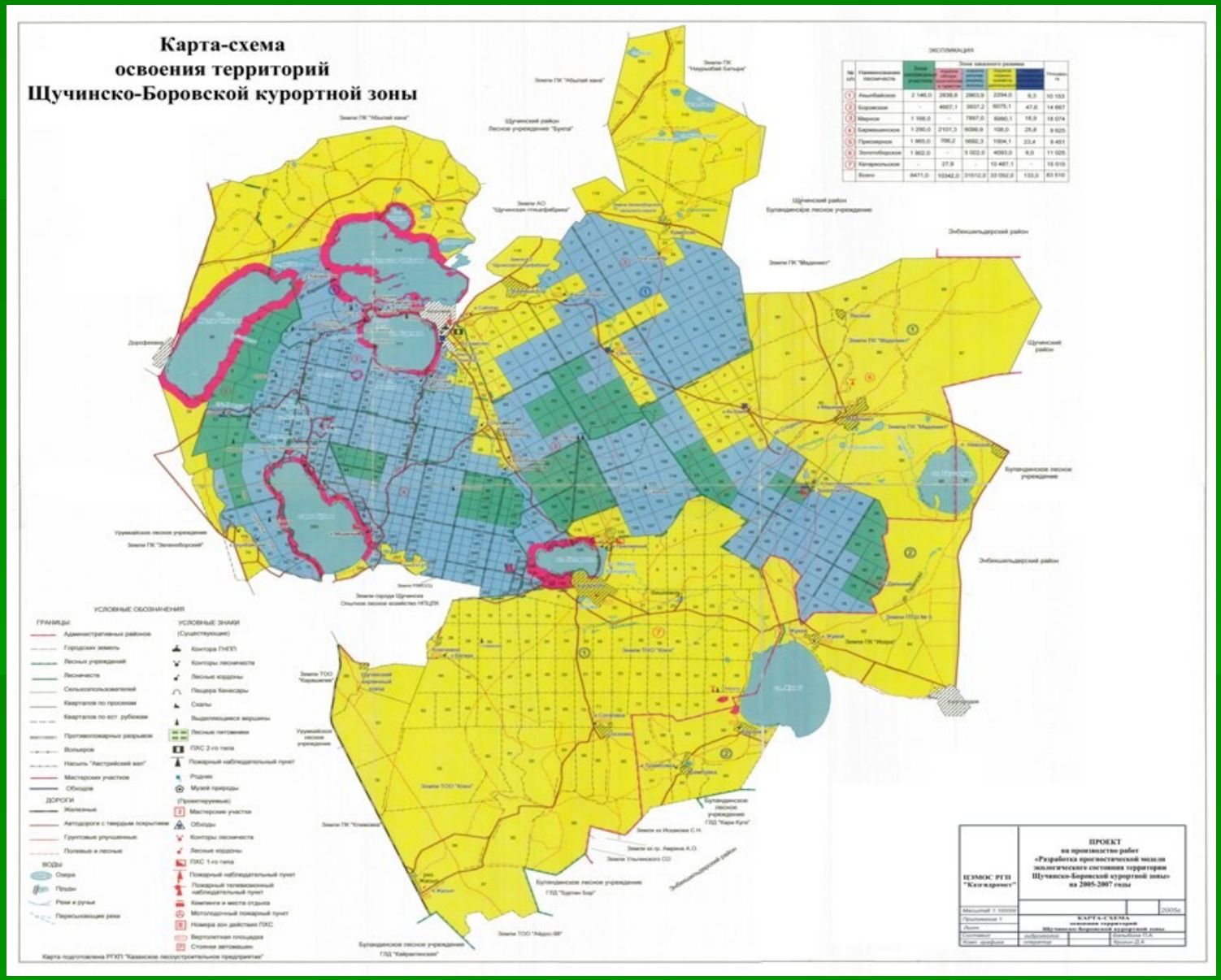


Relative number of various kinds of fishes in lakes, %

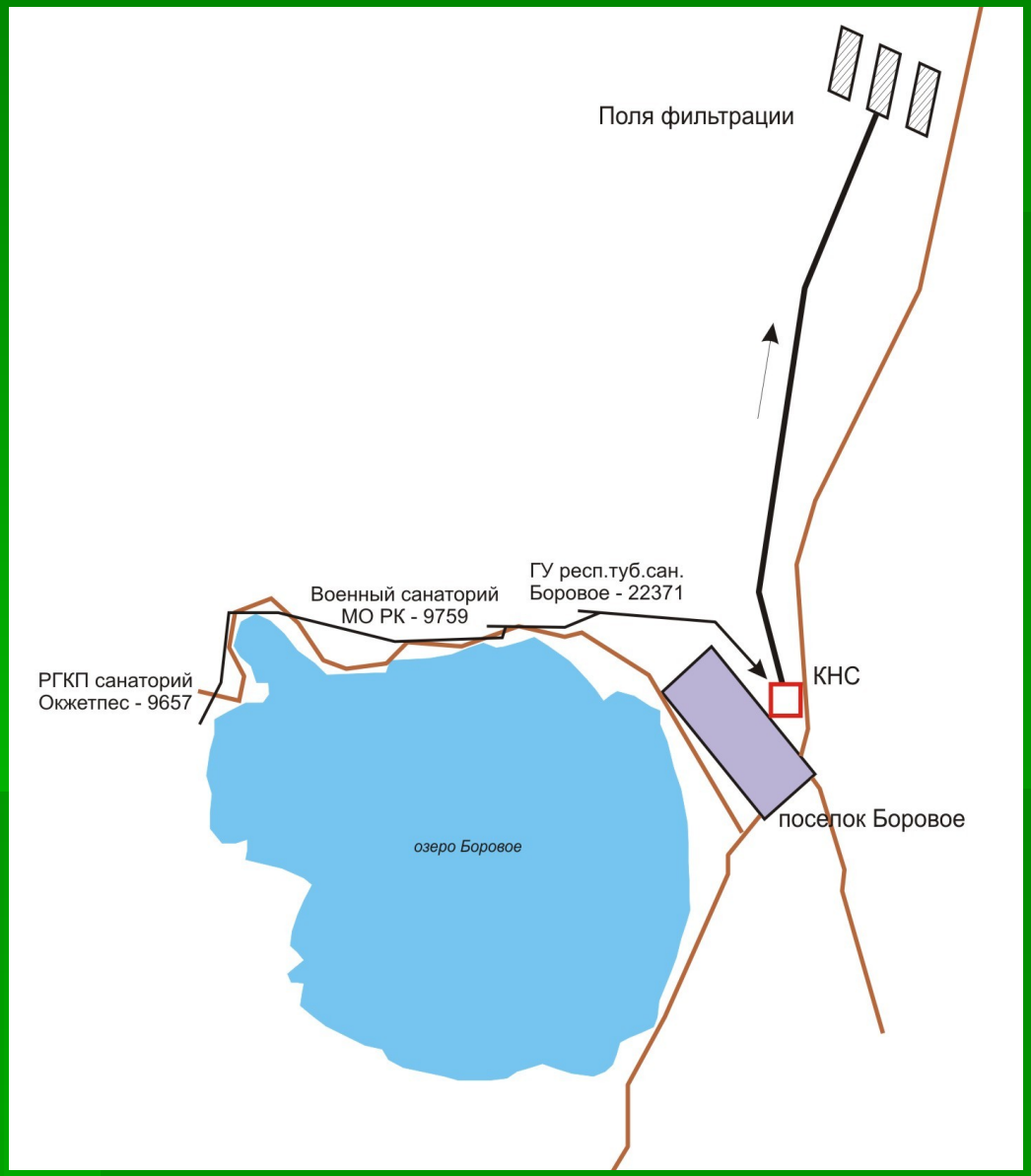
Kinds	Lakes					Status
	Small Chebachie	Big Chebachie	Borovoe	Shuchie	Kotyrkol	
Coregonus peled G.	-	20.9	-	-	-	A, FR
Coregonus albula L.	-	20.5	0.4	8.4	-	A, FR
Esox lucius L.	-	+	-	7.9	-	N, FN
Rutilus rutilus lacustris Pall.	-	0.2	42,5	28.6	-	N, FN
Leuciscus idus L.	-	-	-	-	-	N, FR
Tinca tinca L.	-	+	42.9	1.0	-	N, FR
Carassius carassius L.	-	+	-	-	-	N, FN
Carassius auratus gibelio Bloch.	-	+	-	-	-	N, FN
Abramis brama L.	10.4	0.2	-	-	81.2	A, FN
Cyprinus carpio L.	-	+	+	-	0.6	A, FR
Persa fluviatilis L.	-	58.2	13.8	54.1	18.2	N, FN
Lucioperoa lucioperoa L.	89.6	-	-	-	-	A, FR
Nemachilius strauchi Kessler	-	+	0.4	-	-	A, NF
Sum total, %	100	100	100	100	100	

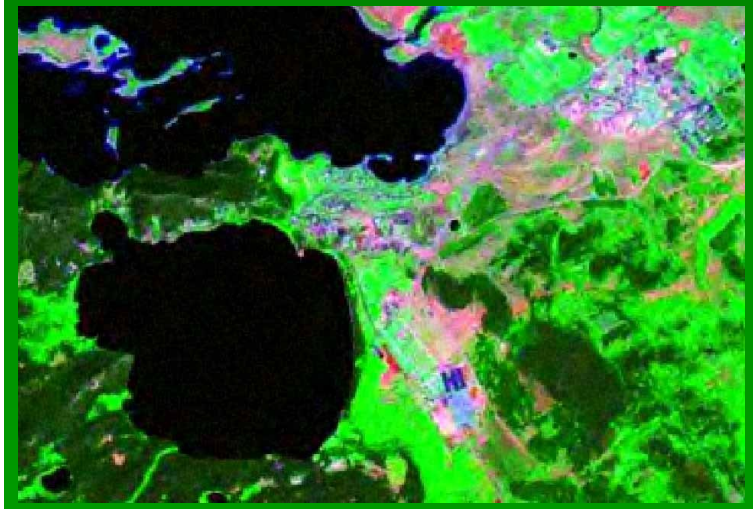
Note: FR - food rare kind, FN - food numerous kind, NF - not food kind, N - native kind, A - acclimatized kind, '+' is present, '-' Isn't present

Development of territory

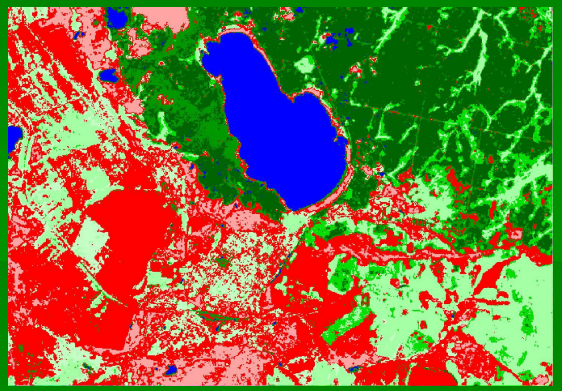


Drainage facility of economic subjects in lake Borovoe

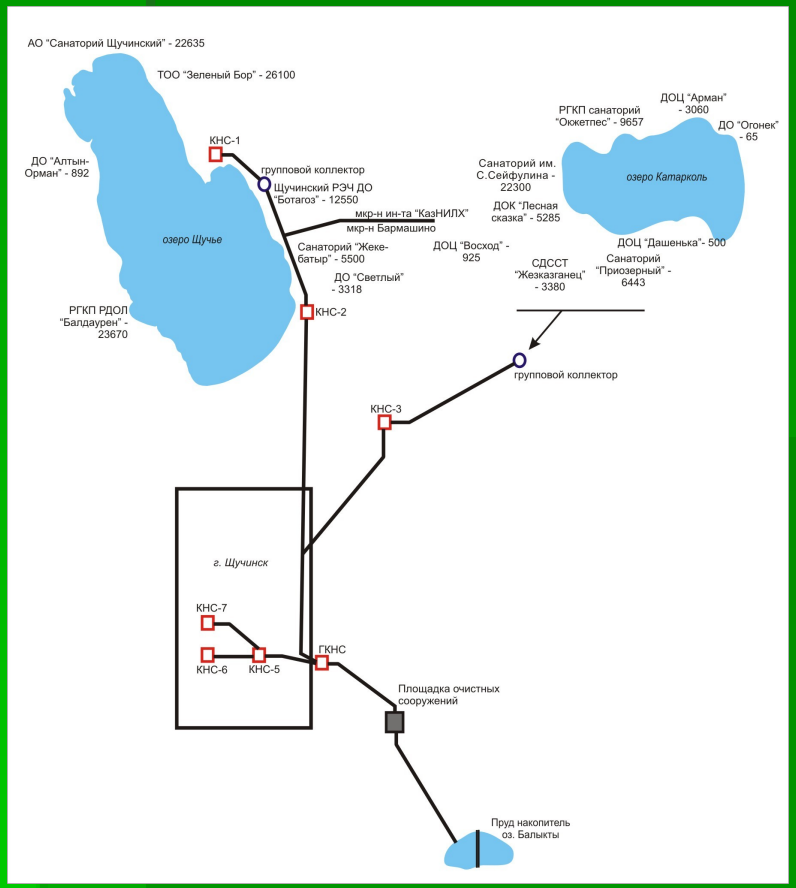




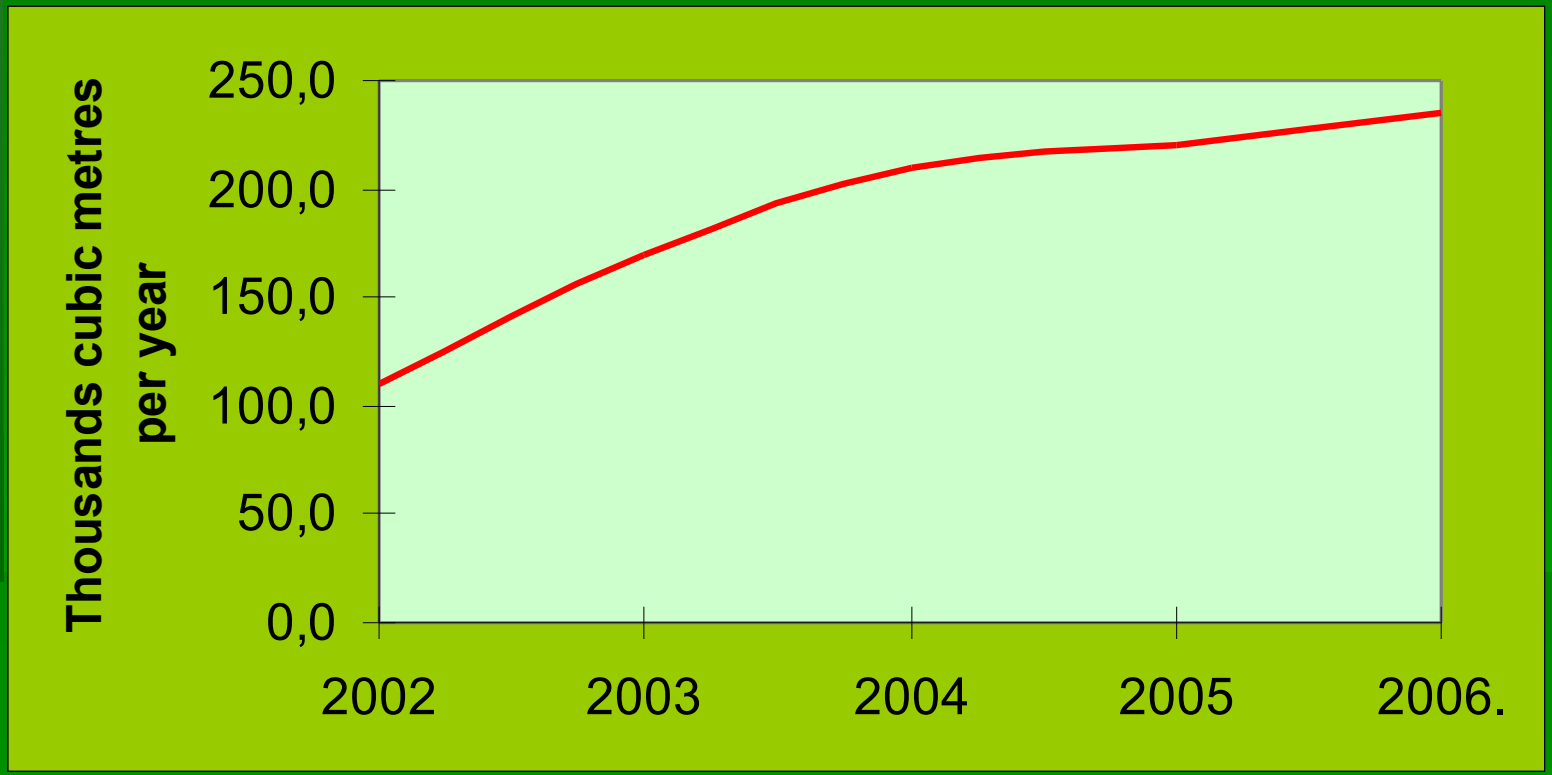
Drainage facility of economic subjects in lake Shuchie



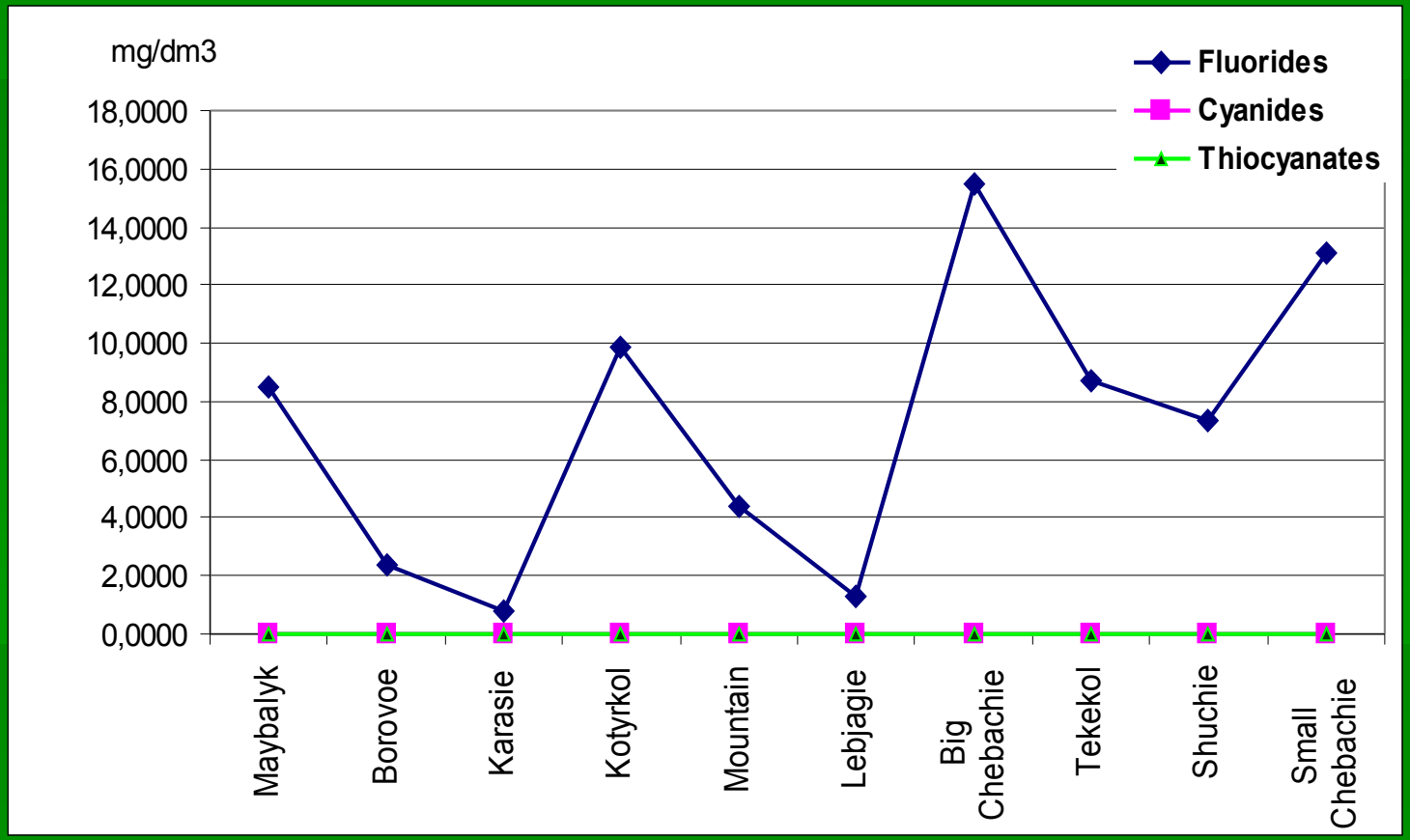
Intensive anthropogenic influence



Dynamics of sewage disposal from economic subjects in NNP "Burabay"

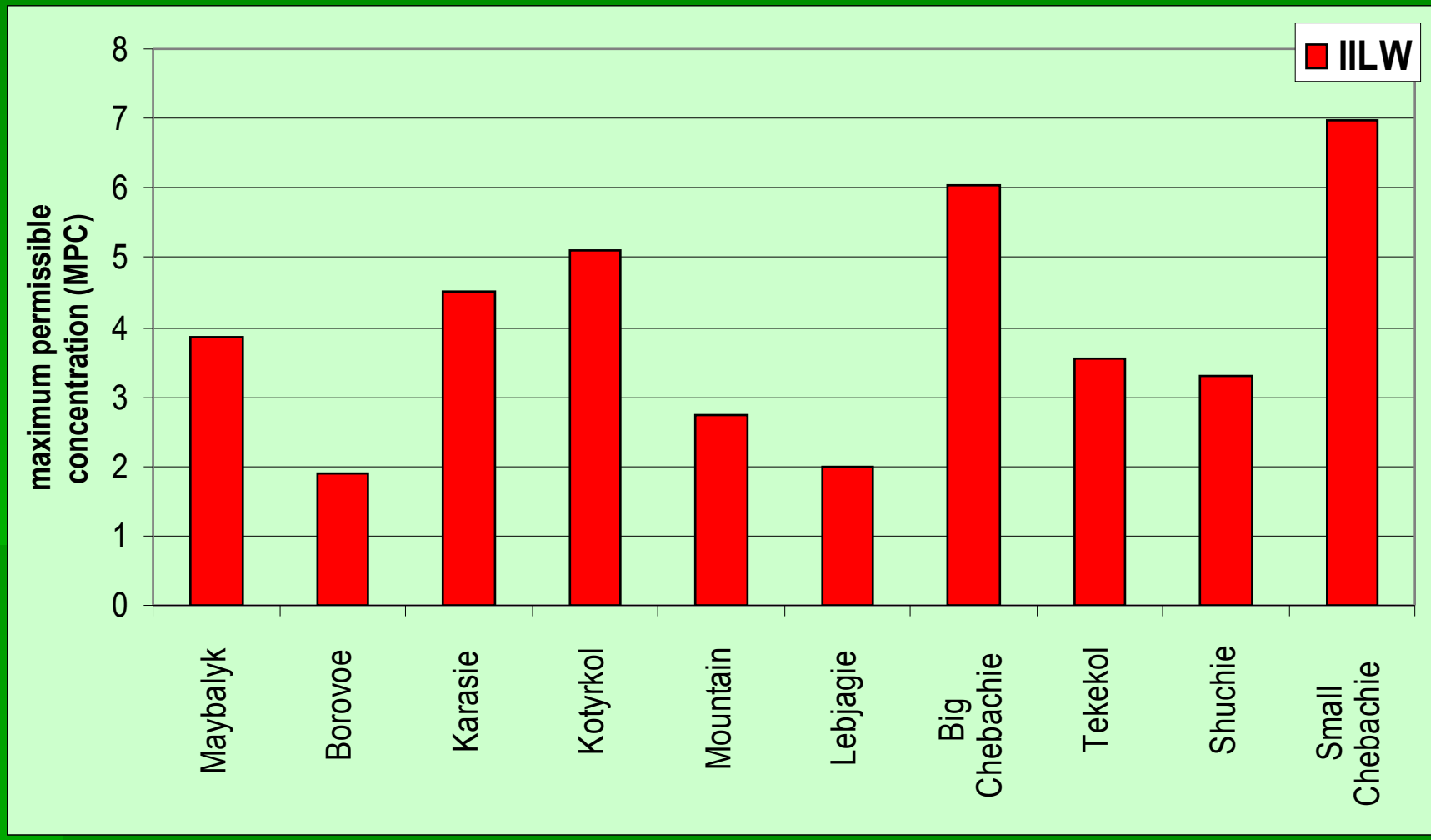


Content of polluting substances in lake water



Hydrochemical parameters

Impurity index of lake water (IILW)



Analysis and assessment of an ecological state

Units of territory (Taxon) for definition of ***an ecological status of an environment*** are ***landscapes***.

For estimation the ecological status of an environment we use ***a five-score scale*** - favorable, satisfactory, adverse, strained, critical (**individual ratings on 19 parameters**).

Natural factors of formation of an ecological status:
1 climatic,
2 hydrological,
3 soil,
4 orographical,
5 spontaneous natural processes.

Anthropogenic factors of changes of an ecological status:
6 intended for building,
7 industry,
8 power engineering and hydraulic engineering,
9 transport and communications,
10 agriculture,
11 forestry and recreation.

Changes of an environment:
12 quality of atmospheric air,
13 quality of water resources;
14 transformation of a vegetative cover,
15 state of fauna,
16 violation of lithogene cover,
17 pollution and violation of a soil cover,
18 hazardous wastes and garbage,
19 radioecological situation.

Problems and threats

Natural character

(1) long-term (duration about 30 years) climatic cycles; alternation of the droughty and damp periods is the reason of cyclic fluctuations of level of a water in lakes,

(2) entry into the droughty period,

(3) deterioration of feeding properties of habitats,

(4) reduction of the area of reeds which are the major bird's-nests, feeding and protective biotop of natatorial and peri-water birds,

(5) high dynamics of quantity of a nest water birds and parameters of success of their nesting as a result of the big amplitude of fluctuation of water,

(6) reduction of quantity of stopping on rest during seasonal migrations of natatorial and peri-water birds,

(7) decrease of stability of the forest landscapes which are carrying out a role of "protective umbrellas",

(8) influence of predators on a egg laying and broods of rare kinds of birds has increased,

Problems and threats

Anthropogenic character

(1) close adjacency of natural park and resort zone,

(2) uncontrolled visiting of territory and close location of the railway (factor of disturbance),

(3) distribution of polluting substances and storage of waste products in bordering territory,

(4) summer and autumn fires, reed fires,

(5) overgrazing in bordering territory,

(6) bad control over movement of domestic animal that stimulate of vegetative communities degradation and death of wild animals from unattached dogs,

(7) annual increase of recreational activity,

(8) infringement of rules of natural resources use (poaching) which include not licenced fishing, felling of trees for firewood, hunting,

(9) amateur fishing in places of a egg laying and congestions of birds,

(10) intensive early mowing,

(11) it is necessary to do new functional zoning territory and updating of plans of its use and expansion of monitoring network,

(12) it is necessary to control the construction works in the water areas of lakes which transform of a natural hydrological regime,

(13) there are incidents of birds death from collisions with transmission lines,

(14) protection of moist meadows from overgrown of the frutex and forest,

(15) overgrown some coastal beaches,

(16) problem of management is limitation of staff,

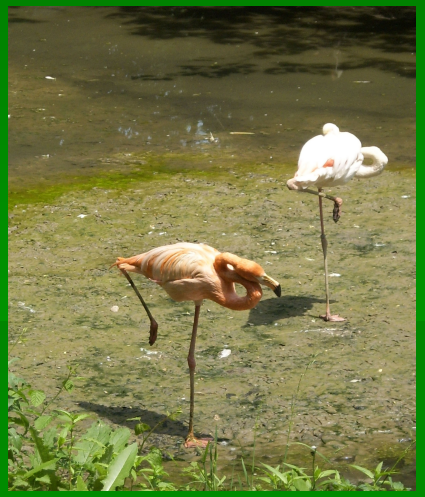
(17) problem of interaction between various supervising services at realization of control-inspection activity,

(18) low value of ecology in public consciousness owing to social and economic difficulties and a unsatisfactory standard of living,

(19) removal of local inhabitants from the decision of nature protection problems.

Top-priority measures for sustainable development support

(1) liquidation of disturbance factors for natatorial and peri-water birds on spring transit,
(2) preservation of a landscape variety, keeping of rare kinds and optimum condition of water and coastal vegetation, monitoring of a state of landscapes,
(3) monitoring of populations of natatorial and peri-water birds,
(4) reduction of use of pesticides, mineral and organic fertilizers in bordering territory, the strict control over polluting substances and waste products in bordering territory,
(5) temporary interdiction of all kinds of hunting,
(6) to intensify realization of fire-prevention actions and reafforestation,
(7) studying and regulation of recreational capacity,
(8) basic directions of activity of forestry are protection and effective regulation of forest resources use for satisfaction of local population needs (not just in wood),
(9) on a regular basis to carry out scientific researches of the reasons of negative trends in dynamics of landscapes and prognosis of consequences,
(10) it is necessary to realize of schools - seminars, improvement of ecological-educational activity among local population, propagation of nature protection knowledge, popularization of data on value of water and wetlands,
(11) preparation of the program of training on inventory, monitoring, ecological management and restoration of landscapes,
(12) formation of specialized scientific and advisory groups,
(13) publication of information materials,
(14) implementation of sustainable forms of nature management, including demonstration farms of environmentally appropriate technology,
(15) economic mechanisms of animal protection: estimation of fauna state, definition of territory of influence and its zoning on intensity of anthropogenic influence, definition of duration of influence, estimation of changes of a condition of fauna as a result of anthropogenic influences, calculation of natural (ecological) damage, calculation of damage to a biodiversity, price of fauna objects, price estimation of natural (ecological) damage,
(16) management of long-term dynamics of the lakes which allow to support the most valuable stages or to interrupt not valuable stages,
(17) development and realization of the program of artificial reservoirs creation as the elements of a landscape promoting preservation of a biodiversity and support of a level of subsoil waters,
(18) development of strategy and plan of action on conservation of water and wetlands,
(19) perfection of ecological examination at construction of economic objects; at construction to provide a superficial drain in lakes and preservation of a natural hydrological regime,
(20) constant instead of the periodic control over managing subjects,
(21) monitoring of influence of economic and habitable objects and communications,
(22) to put a temporary veto of ploughing up soil and new construction in subzone of the limited productive activities,
(23) increase of inspectors number,
(24) development and ratification of the new plan of management.



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