CARTOGRAPHY AND GIS

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THE USE OF THE CARTOGRAPHIC METHOD IN ANALYZING THE LAKE ECOSYSTEMS ON THE TERRITORY OF THE WETLANDS IN TOBOL–ISHYM FOREST-STEPPE

SUMMARY. The dynamics of some hydrochemical indexes of the lakes on the territory of the wetlands of Tobol–Ishym forest-steppe is considered in this article. The wetlands of Tobol–Ishym forest-steppe are entered in the list of wetlands having an international value. The characteristic feature of the territory is plenty of lakes. The area of the majority of lakes is less than 1 square kilometer. The analized data cover the inspections conducted in 1961 and 2004–2005. The basic research presents the analysis of hydrochemical composition of lake water due to three generalized indexes of quality: permanganate value, pH-value, and mineralization. The most lakes under study proved the considerable increase of mineralization and pH-value. There is a decline in the permanganate value. For the considered period there was a change in the mineral structure of some lakes. The authors try to apply a cartographic method to estimate the changes and to deduce spatial conformities in hydrochemical indexes of the lakes. As a result of the research of spatial distribution of the lakes, it has been found that the closely located lakes can considerably differentiate in mineralization. Consequently it is necessary to consider the genesis of lakes under the analysis.

KEY WORDS. Wetlands, lake, hydrochemical parameters, dynamics, cartographic method.

Nowadays wetlands play an important role in natural processes and human lives that is why the issue of their preserving and studying becomes increasingly interesting. The area of 1,217,000 ha covering Armizon, Berduzhye, Ishym, Kazanka and Sladkovo Districts was considered to have an international value as the waterfowl habitat, and was approved and regulated by No.628-p Tyumen Region Administration Order of 2 September 1996, *On the Tobol–Ishym Forest-steppe Wetlands, Drawn under No.1050 Russian Federation Government Resolution of 14 September 1994.*

The entry of Tobol–Ishym forest-steppe wetlands into the list of internationally significant wetlands proves the importance of their preservation. Tobol–Ishym forest-

steppe lakes play a positive environmental role. Their value for economic activities and environment makes their study and ecological estimation necessary.

Experimental part. The object in question is the environment of Tobol–Ishym forest-steppe lakes. The territory under study is located in the middle reaches of the Ishym River, its borders are 55°55' N 67°05' E, 55°50' N 70°30' E, 55°00' N 70°25' E and 55°15' N 69°00' E (Figure 1).

Tobol–Ishym forest-steppe lakes were studied by HydroRybProject Institute and SibRybNIIproject Institute during 1961 and 1983–1985 expeditions [1–3], as well as by the Tyumen State University experts during 2004–2005 expeditions [4–7], where the authors of this article took part. The expeditions performed the water chemical and hydrobiological analysis [8]. Bottom and surface water samples as well as zooplankton and zoobenthos were collected for the water chemical analysis at several points of each lake.

Results and discussion. The territory under study is characterized by a high degree of roughness, it is a plain with lakes and elevations of 120–140 m max. The climate is typically continental with low humidity. The annual average is +0.5°C...+0.7°C, July average temperature is +18.6°C, January average is -18.9°C. Most fallout is during the warm season–80% of the annual amount (260–290 mm), during the cold season—only 20% (about 70 mm). Heavy rains during the warm season may bring about 80 mm per day [9].

The hydrographic net is characterized by small rivers and lakes, and a high swampiness of their sheds. The biggest rivers are the Ishym and the Yemets. Closed basins are bad for river drainage. Most fresh water lakes get overgrown gradually; their banks are partly swamped [9]. The genesis of the lake basins under consideration is diverse: residual (ancient draining hollows), paleothermokarstic (sink-sagged) and plain lakes.

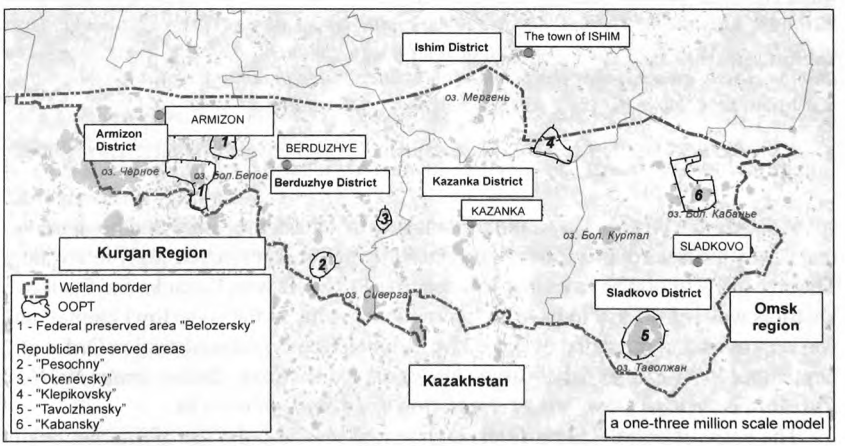

Figure 1: The territory of Tobol–Ishym forest-steppe wetlands.

Most lakes under the study have the area of less than 1 km^2 (small and very small lakes). The largest lakes with the area of over 20 km^2 are the Chornoye (125 km^2), the Tavolzhan (72 km^2), the Siverga (41 km^2), the Mergen (27 km^2), the Bolshoye Beloye (24 km^2), the Bolshoy Kurtal (24 km^2), the Bolshoye Kabanye (22 km^2) (Figure 1).

The analysis performed during the expeditions showed that from 1961 to 2004 the total mineralization rose and the mineral composition of the lake changed: the share of hydrogen carbonates increased, some lakes turned from chloride sodium into hydrogen carbonate sodium (the Mergen, the Starichnoye, etc.) [4–5].

The pH indicator is one of the most significant for the water quality because it is important for chemical and biological processes: water plant life and evolution, different elements migration stability, water attack on metals and cement; it changes pollutant toxicity. The 1961 and 2004–2005 data comparative analysis showed that pH of the most lakes increased (Figure 2). For example, in 1961 pH was about 7.8. In 2004–2005 pH was normal for the most lakes except for the Maloye Kabanye, the Steganets and the Travnoye (Dalneye Travnoye village) with their pH of 9.17, 9.18, and 9.27 respectively.

Oxidability is a good complex indicator which allows estimating the general organic pollution. The permanganate value (compared to the 1961 study results) decreased in the most lakes (Figure 2) except for the Steganets which showed a little increase from 32.4 to 33 O_2mg/dm^3. Though the permanganate value decreased, the 5 mg/md^3 MAC excess is characteristic for all the lakes in the territory except for the Bezymyannoye, the Savino, the Vlasovo, and the Kudryavtsevo.

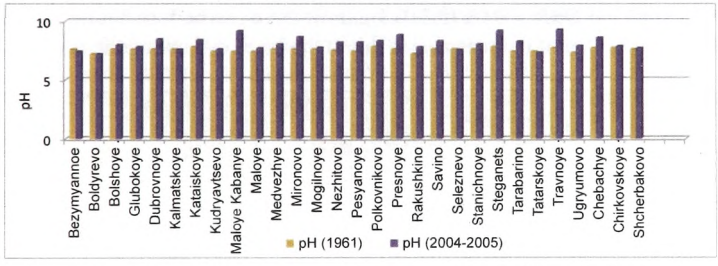

Figure 2: The Tobol–Ishym forest-steppe lakes pH dynamics.

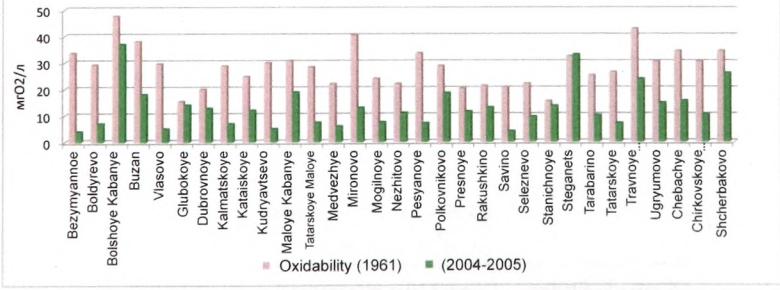

Figure 3: The Tobol–Ishym forest-steppe lakes oxidability dynamics.

The studied period showed a considerable change in water mineralization of the lakes in Tobol–Ishym forest-steppe wetlands (Figure 4), the increase is 80%.

However, the concentration comparative analysis alone will not give a whole picture of the mineralization increase. It is worthwhile using a cartographic method to show the lake with different hydrochemical properties, to identify the impact facors.

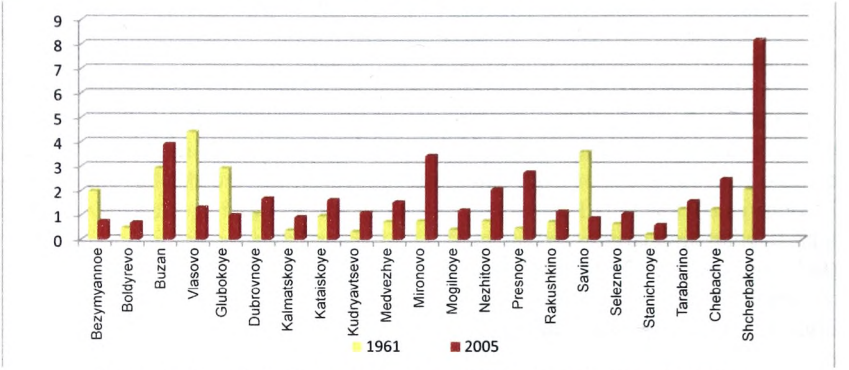

Figure 4: The Tobol–Ishym forest-steppe lakes mineralization dynamics.

The spatial distribution of the lakes accoding to their mineral properties in Sladkovo District (Figure 5) proved that the water composition of the closely located lakes differs greatly. Next to soft fresh waters (0.3–0.5 g/dm^3) there can be found mild saltish lakes (1–3 g/dm^3) [10]. One of the reasons for this is the lakes different genesis.

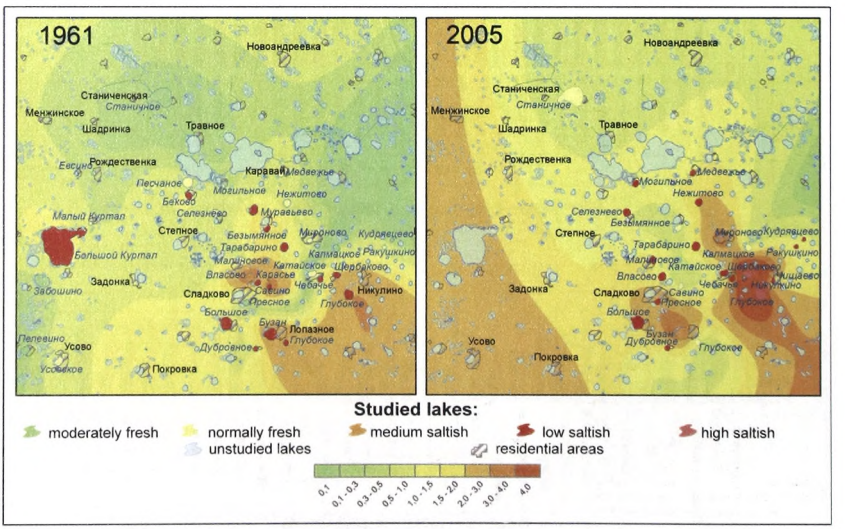

Figure 5: Sladkovo District lake mineralization characteristics.

The survey proved that a cartographic method for dynamics estimation of the lake hydrochemical composition can help to analyze the changes in the lake mineral properties.

REFERENCES

1. Actions to Develop Lakes and Ponds in the South of Tyumen Region. Lakes. *VSNKh Fund. HydroRybProject Institute, Object No. 608*. Moscow (1962): 140.

2. SibRybNIIproject: Report on Scientific Research *Hydrochemical and Hydrobiological Condition in the Lakes of Armizon, Sladkovo, Kazanska, Berduzhye Districts*. Tyumen (1990): 61.

3. *Specifications for Water and Fish Resources in Large, Medium and Small Lakes in Western Siberia, and Recommendation for Their Rational Use Scientific Research Report*. V.M. Sudakov. SibRybNIIproject. Tyumen (1983).

4. Katanayeva, V.G., Larin, S.I., Selyanin, A.V. Changes in Ion Constitution of Water, and General Features of Hydrochemical Condition in Ishym Forest-Steppe Lakes. *Tyumen State University Herald. № 1.* (2005): 146–159.

5. Katanayeva, V.G., Selyanin, A.V. Hydrochemical Indexes of Water on the Right Bank of Ishym Forest-Steppe. *Tyumen State University Herald. № 7.* (2010): 202–209.

6. Larina, N.S., Larin S.I., Maslennikova S.S. Estimated Condition of Ishym Brackish Lakes. *Tyumen State University Herald. № 4.* (2011): 81–90.

7. Katanayeva, V.G., Selyanin, A.V. Estimated Content and Pollution of Heavy Metals on the Right Bank of Ishym Forest-Steppe Salt Lakes. *Tyumen State University Herald. № 5.* (2011): 39–48.

8. Aleshyna, O.A., Katanayeva, V.G. Macrozoobenthos Distribution and Organization in Ishym Brackish Lakes. *Tyumen State University Herald. № 7.* (2010): 66–75.

9. Russian Wetlands. Vol. 1. *Internationally Important Wetlands*. Ed. V.G. Krivenko. Moscow: Wetlands International Publication No. 47. (1998): 256.

10. Posokhov, E.V., Nikanorov, A.M. Guide to Hydrochemistry. Leningrad: HydroMeteoIzdat (1989): 391.