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Natural And Anthropogenic Factors Influencing Evolution Of Lakes (On Example Of The Lake Glubokoe)

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Abstract- With increase in the city territory anthropogenic loading and influence on development of lakes increases. It is necessary to take measures for these natural aquatic complexes preservation in due time. Developers of the Kazan General plan offer preservation and development of the existing forest parks, including Lebyazhsky, with establishment of the protection along natural water objects mode. Within this forest park, among other, there are lakes Big Glubokoe and Small Glubokoe which formed a uniform hollow of the lake Glubokoe earlier. Studying of natural and anthropogenic processes variability regularities for the purpose of possible damage to the water objects prevention, which are close (within) the city, is part of the practice-focused approach when training geographers. The research of lakes including the published data analysis, instrumental measurements, visual observation, polls of locals allows to establish the reasons for water surface level fluctuation. The lakes Big Glubokoe and Small Glubokoe are located in the karst and erosive valley stretched from the village of Osinovo to Yagodnaya Sloboda in Kirovsky district of Kazan among the pine woods on the second above-flood-plane (pine-forest) terrace of the Volga River.
Keywords: lake, hollow, evolution, factor.

Introduction

In aged pre-war scientific literature Small Glubokoe is still called as New Glubokoe [1], which confirms its recent nature. Studying of lakes Big and Small Glubokoe (our characteristic observation fall into 1958, 1975-76 and are continuously conducted since 1982 till this day) showed that since 1960ththey began to shallow quickly. Level of Big Glubokoe since 1961 fell to 7,5 m, and of Small Glubokoe - to 4,2 m (it is relative to the level of 1996) or on 7,8 m and to 4,5 m respectively (it is relative to the level of 2000). Levels falling is reflected in terraces and vegetable ranks, deposits of ground tape clays and swing moor oddments. Eye-witnesses testimonies giving the Tatar writers who specified still water levels of Small Glubokoe during a pre-war era remained. Research of lakes, instrumental measurements, data processing by means of geo-informational technologies, visual observation, polls of locals, allows to establish the reasons for water surface level fluctuation.

Main part

The terrace surface in places has the dune relief fixed by the pine wood and is crossed by a number of ravines and hollows reaching for Volga. The made mention karst and erosive valley, apparently, is secondary, imposed on more ancient erosive forms of relief, which it crosses almost at straight angle; it is not at all common to erosive forms of relief [2]. Under 50-60-meter thickness of terrace dolomite sand of the Kazan circle which form residual ridge under the valley, there are two ancient cuttings dividing r. Volga. Near

the outlier in cuttings the Perm system solids depth increases to 80 meters, in which gypsiferous thicknesses of Sakmarian strata are opened. Karst processes in the Sakmarian strata and anhydrites as it is now recognized [3], are responsible for the downwrapings reaching a day surface, karst and collapsible and underwashing in sand and loams of the Volga terrace, that is they also led to formation of the imposed valley and lake hollows on its surface, over ancient dune and younger ravine and girder relief.

When level of the Big Glubokoe lake fell to 5-6 m, from under water aged pine stubs with wide year rings (up to 1 cm thick) on peripheral part of trunks were bared. The main information on levels is stored by year rings of stubs and some modern coastal pines. It is clear, that these stubs remained from an era of lower standing of the lake level. The increase in thickness of the last 3-4 rings to 1-1,5 cm a year on stub edges, in comparison with the routine size of wood growth (0,2-0,3 cm/year), says that these trees were lost from flood at rise in the lake level, and, thus, except a problem of lakes shallowing, there was a problem of mysterious rise in their level in the past. On a mark of the maximal standing of the lake level in the 50-60th of the last century one unique stub bearing 23 rings 1,5-2 cm wide remained. On them it is possible to claim unambiguously that lake level since the end of the XIX century and till 1935-41 intensively grew and only after 1961 started falling.

Our dendro-chronological and geo-morphological researches show that increase of the water line in the lake, most likely, is bound to filling of the lake hollow with the growing cone efflux from the ravine which broke into a hollow from the North, from the modern plant "Orgsintez". This efflux cone led to fast water rising, division of uniform hollow and emergence of two lakes - Big Glubokoe and Small Glubokoe. The ravine arose along the drying ditch going from buckwheat fields on which spring thawed snow stood. On memoirs of old residents, in the twenties of the XX century winter snow drifts exceeded human height, and the spring drain from fields was so intensive that it led to emergence of new ravines and deepened the old. And now still it is visible that the ravine goes precisely along a glade, and its straightforwardness, unusual for routine ravines on the plain, clearly testifies that it has a man-maid origin (in article by B.B. Batyr [4] creating of such drying ditch from fields in 1914 is mentioned). Ravine volume, on our instrumental shootings and its slopes leveling made across its bed in eight places without inflows and ravine tributary was equal to 1,6 million cubic meters. Also the sandy crossing point (efflux cone) between Larger Glubokoe and Small Glubokoe lakes has the same volume. Invasion of such huge volume of sand into the lake hollow led to replacement of water and its level raising approximately on 10 m, that is to the level of 1953-61. Process of flooding happened quickly, and pines were continuously cut by team of foresters in process of level rising. These stubs are also bared from under water now, it is possible to see that all of them are cut absolutely monotonously: by hand saw, also there are no broken trees. Unfortunately, the stubs which appeared on air in some years start decaying, get drilled and destroyed by ants and other insects, and only very resinous and thin stubs still remained standing in water. The set of stubs imprinted on a film, now either decayed, or are burned and any more cannot be studied repeatedly by the latest methods (for example, the C14 method), except for exemplars from which saw cuts were collected [5].

Other hypothesis of the flooded stubs emergence at the bottom of the lake, bound to the speed of karst and collapsible process in sandy thickness is quite possible. Over caverns in the thickness of Kazan and the Sacmarian strata hollows, funnels in sand, in which our lakes are located, were formed. [6] To estimate the speed of similar processes in a lake hollow, for many years we carry out repeated levelings of the railway bridge through a hollow of the lake Big Glubokoe. For the last 13-15 years of observation and annual levelings we received sag figure about 7 mm/year, whereas for other territory of the Kazan Volga

region figure of collapsible process speed makes 4 mm/year. From here it is possible to estimate approximate age of the lake Big Glubokoe hollow. The only thing that contradicts this collapsible hypothesis, is a lack of tree trunks and stubs inclinations during their slipping into a hollow, though on the bathymetric map of the lake we made in 1990, the slipped blocks are visible. The same landslide blocks can be observed on the lake coast, in its wide part, by the beach.

To era of cone break efflux in a hollow of the lake corresponds to the particular hydrological mode of the Big Glubokoe lake. Its turbidity in the 1930-50th years was so high that sunshine warmed only the high layer of water (a transparency of water on Sekka's disk did not exceed 30 cm). Other water column in the lake was very cold, nobody bathed in it, and in its depths was great (then about 20 m), villagers used it for storing vegetables in the cold. Levchenko stored barrels with cabbage, the lake was used as the refrigerator as water temperature did not exceed 6 °C in the summer. In the thin surface layer of superheated water (temperature in it sometimes reached 35-40 °C) the plentiful phytoplankton and other water vegetation which formed a potent vegetable layer for some years - a so-called "splavina" (swing moor) expanded in summer. On this swing moor trees, which acted as sails, managed to grow, and the floating island moved on the water area of the lake under the influence of wind. Only in 1969 the swing moor was chained to pines in the southernmost tip of the lake about the railroad where it also settled on coast at the followed level falling. Oddments of this swing moor in the form of fungate caps remained on saw cuts of pines in the southern wooded part of the lake. The pressed swing moor on these stubs and ashore forms a peat-like layer 15-20 cm thick under which tape clays in the form of 10-15 cm thick layer preserved well. The part of swing moor is at the bottom of the lake, during rotting amplifying in the summer, vials of methane cause emerging of swing moor in the form of domes. The bottom relief is very maleficiated due to peat weight and tape clays. Three deep funnels, known on old literature, are not found now at the bottom of the lake. Apparently, two funnels in a northern extremity of the lake are filled completely up with sandy deposits with a crossing point growth, and only the single funnel is found in its mid-range in the form of 12,8 m depth hollow.

Since 1961 the the lake level began to go down, tree rings located at the maximum level (where now the border between the aged pine and young deciduous wood lies) which grew on the bared lake bottom confirm that. In 1963 level began to fall more intensively because the pumpings of underground waters begun due to water intake of Orgsintez plant which uses this water for the technological needs. Besides, in the same years in forest park "Lebyazhye" a number of summer camps and sanatoria, for which about 18 water wells with violation of technology, that is without grouting of annular space, were drilled; that led to overflow of underground waters from the top water bearing horizons on the lower..

The drought of 1972 seriously affected falling of the lake level. At this time the woods and peat bogs burned. Under conditions of water deficiency in Kazan (the Volga water intake did not cope with providing the city with water because of low Volga level standing) the water intake of Orgsintez plant was connected to supply of the city with water. According to hydro-geologists, the level of underground waters fell approximately by 40 m [7]

Long-term observation for lakes Big and Small Glubokoe water levels shows that since 80th they go down on average by 10-15 cm a year, though in droughty years level fell by 20-25 cm. Now, apparently, there came the equilibrium phase between a drain and inflow into the lake, and the last 7-9 years the water line barely changes.

Comparison of bathymetric maps and the map drawn on 1430 depths measurements of 1990 gives the chance to trace the course of the lake depths and sizes change. According to these maps and other literary data Big Glubokoe Square decreased from 12 hectares

(1964) to 10,4 hectares (1990), length (1963) decreased from 1100 m to 760 m (1990), depths changed from 21 m (1963) to 19,4 m (1964) and to 13,0 m (1990). Now water volume in the lake Big Glubokoe is about 980 thousand m^3, and the maximal depth in 2010 was 12,4 m. Underwater slopes in the lake repeat bias of coastal slopes, i.e. steep western slope, and the flat eastern one (fig. 1, 2). The bottom of the lake at depths over 10 m is almost absolutely flat, we connect this fact with adjournment of peat masses and tape clays.

Formation of tape clays in the Glubokoe lake accurately corresponds to efflux cone formation time and allows to estimate its formation duration. All sand formed an 800-meter crossing point of efflux cone between Big and Small lakes and a brow of 7,5-meter terrace on Big Glubokoe where the beach is now situated [8].

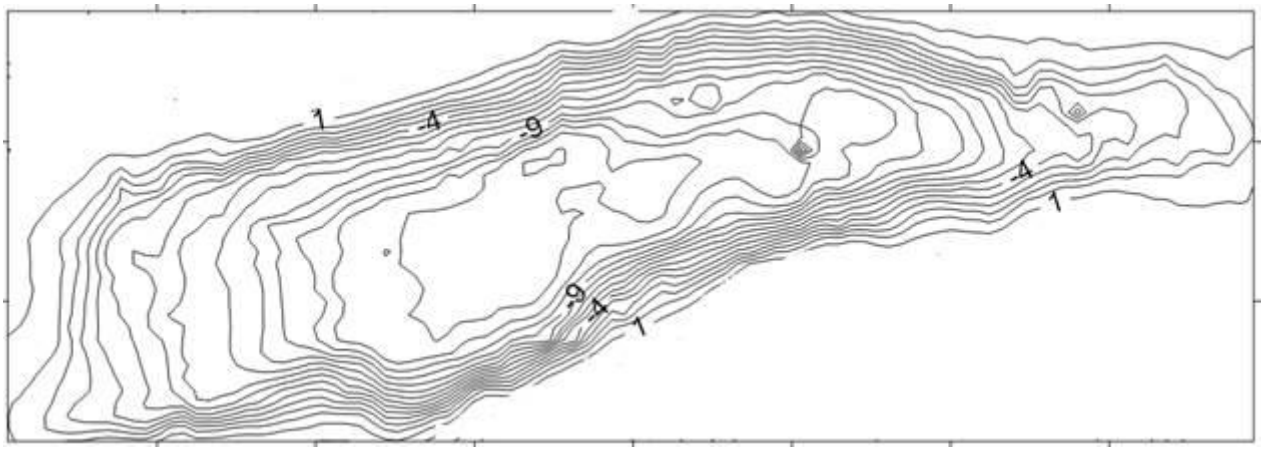

Fig. 1 Bathymetric plan of the lake. Glubokoe

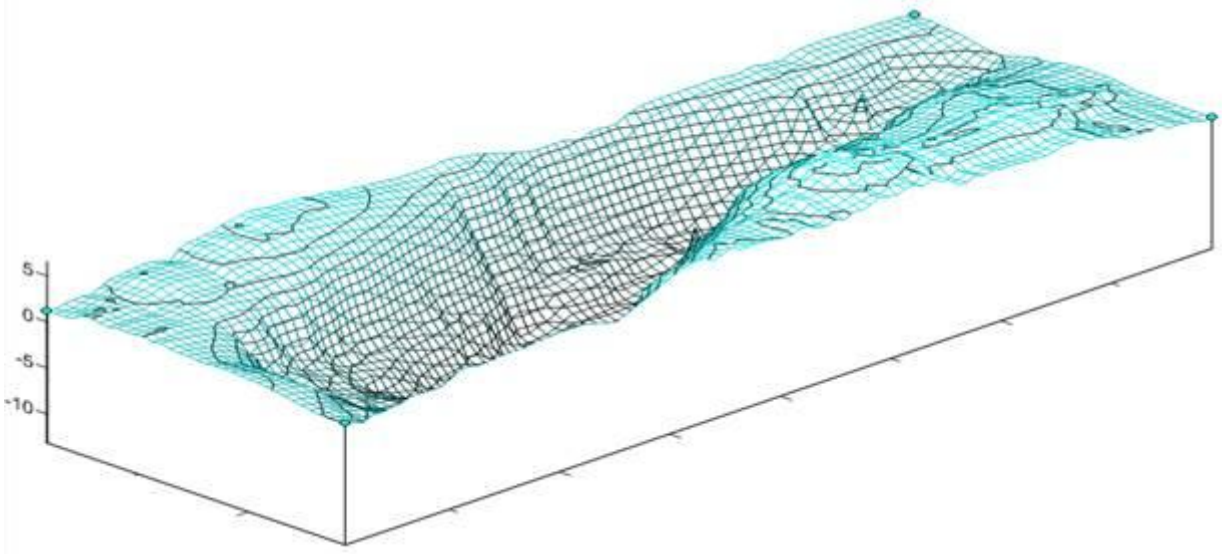

Fig. 2 Hollow model of l. Glubokoe

All dregs consisting of clay fractions deposited in a Big Glubokoe hollow in the form of various power layers (from several mm to 3-4 cm). In spring and in summer aleuritic fractions deposited, and in winter under ice thin clay dregs, forming glacial lakes varves-like year tapes deposited. By means of ground tube we managed to pass all this column of tape clays to a sandy substratum. It appeared that formation of efflux cone

happened exactly 86 years, the last 20-25 years there is an adjournment of organic sludges. It is impossible to specify number of years in organic sludges, in connection with frequency of bacteriemic processes in the oozes described by Perfilyev, and creating the own lamination which is not coinciding with the seasonal. Thickness of such clays at the bottom of the lake is about 90 cm, and on hollow boards it decreases to 10 cm. The higher level, where we recorded finds of tape clays, corresponds to the level of a 7,5-meter terrace. Currently it is possible to see them in a new gully on a crossing point near beach locker rooms, directly under peat layer. Here the layer thickness of tape clays equals to about 3-5 cm, and about 8-13 years their accumulation lasted.

Now tape clays formed a new local aquaclude, in which lake as in a bowl, it is now suspended in the column of dry sand. If to pierce this aquaclude, the lake Glubokoe can disappear, its waters will flow on the lower level of ground waters, which mirror lies, as it was already told, on some tens meters lower and corresponds to the level of depression funnel created by water intake of Orgsintez plant and the water line of the Yudinsky pit. Such phenomenon of the lake disappearance as a result of ground clays layer wholeness violation is colourfully described in Andrey Platonov's story about the attempt of construction of Volga-Don Canal at Peter I "Epifanovsky locks" published during "an era of Khruschev's warming".

We tried to estimate filtration rate through the layer of tape clays covering the bottom of the lake. In winter, when the water area of the lake is hermetically closed by ice and no atmospheric precipitation gets to the lake, it is possible to receive the clear amount of filtration through aquaclude. On lowering of radical ice border level on the water area of the lake in comparison with its situation on coastal stubs we received filtration size - 70-82 cm/year (data for 1995-96). For this purpose we carried out snow-measuring shootings and the corresponding leveling works within six years. Such idea of filtration rate determination is credible as in other cases it is very difficult to separate water from atmospheric precipitation from characteristic water of the lake and the more so it is difficult to consider evaporation losses.

Summary

It is established that threat of the lake shallowing proceeds: from possible violation of clay layer on coast and at the bottom of the lake; because of ground waters drain through not plugged annular spaces of water wells in the environmental sanatoria and camps, which pierced local waterproof layers of the Volga River second pine-forest terrace; because of intensive lowering of the underground waters level due to water wells of Orgsintez plants, silicate brick and the Yudinsky pit; because of the amplified slope erosion of the lake hollow and coast under the influence of vacationers crowds invasion and their cars destroying layer of tape clays, and, as a result, decreasing the reservoir area.

Conclusion

As a result of the conducted researches we provide the following recommendations for preservation of the lake: it is desirable that the Orgsintez plant and other enterprises working in vicinities of the lake implement a closed circuit water supply and limited selection intake of underground waters to wells; it is necessary to make immediately grouting of annular space of the water wells located in forest park "Lebyazhye" as it is provided by state standard specification and the Gosgeoltekhnadzor for such wells; to arrange lake slopes and coast restoration by means of herbs and bushes to exclude washout of coastal tape clays and infiltration of rain and thawed snow through sandy soils and to increase or, at least, to keep the existing water-collecting area of the lake.

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