IMPORTANT ENVIRONMENTAL PROCESSES IN THE SULYNSKA BAY OF THE KREMENCHUK RESERVOIR

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Contemporary changes in environmental state of landscapes of the Sulynska Gulf under anthropogenic pressure are investigated. Seasonal and long-term fluctuations in Kremenchuk reservoir and economic activity in the Sula river basin recognized as the factors of such pressure. Field studies, chemical analysis of water of the Sula River and Kremenchug reservoir and materials of remote sensing by Landsat 5, 7 and Terra satellites were used to substantiate these findings.

Keywords: reservoir, river basin, runoff, water pollution, satellite imagery, environmental state, oil and gas wells

The purpose of research. Study of the environmental state of the Sulynska Bay remains valid, since it plays an important role in biodiversity enhancing of the region, fish farming, and also participates in the processes of eutrophication and water pollution around the Kremenchuk reservoir. That is why our task was to identify the significant processes that positively or negatively affect the formation of the environmental situation in the region. At the same time we took into account the important processes that affect both the quantitative parameters and qualitative characteristics for all water resources of the Sula River basin, of which the state of Sulynska Bay depends largely on.

Materials and methods of research. Studies were conducted mainly in the Sulynska Gulf, on top of which a new delta of the Sula River is forming, and in the river basin and the Kremenchug reservoir aquatorium as well. Materials of this area remote sensing by satellites Landsat 5 and 7, Terra and Aqua, obtained from the archives of NASA, were used for the analysis of important environmental processes. Quantitative and qualitative characteristics of the Sula river flow were studied according to the Dnieper Basin Water Management Administration and chemical laboratory of the Poltava regional branch of this organization. Terrestrial reconnaissance route from the Sula River mouth to its headwaters was conducted as well.

Results and discussion. Our previous studies [1, 2, 4] found that the hydro-morphological processes in this gulf led to landscape changes in time and space and to environmental degradation. Among the factors of these processes the role of climate change (strong heating water in summer and deep freezing in winter) and anthropogenic deterioration of water quality in the Sula River and reservoir were marked. In the future, the main focus was on the mutual impact of water masses of

this gulf and the main reservoir (Kremenchug reservoir) and the strengthening of human pressure on the ecosystem of the region.

Monitoring of "bloom" and water pollution in the Kremenchug reservoir in summer and autumn 2012, using a series of images of Terra and Aqua satellites, showed that these processes were the strongest in the Sulynska Bay and at the mouth of the Tyasmin River (Fig. 1). As a result, the water was low dissolved oxygen, high - manganese and unpleasant taste near the reservoir dam, where the water intakes for drinking water supply of the city Kremenchuk.

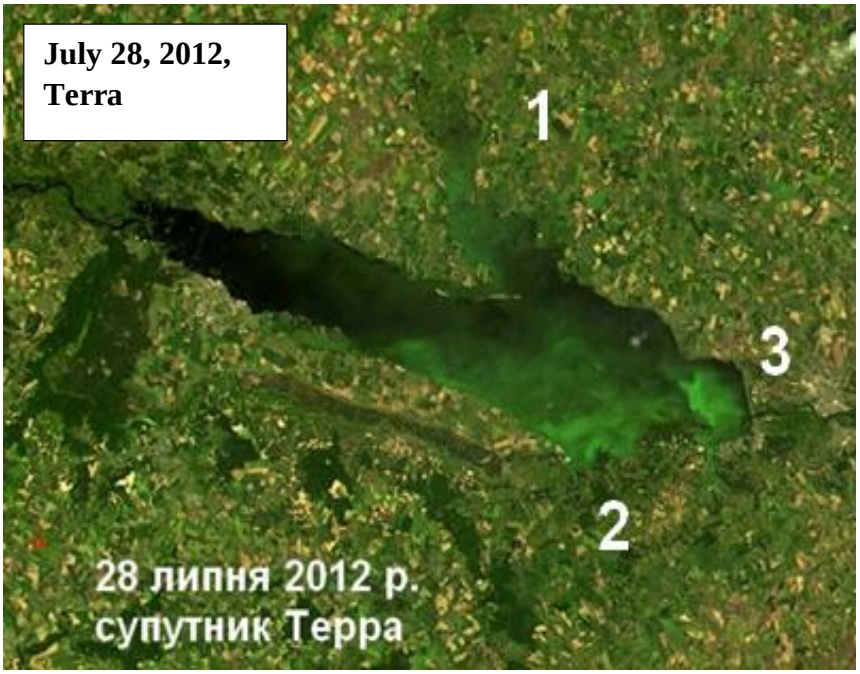

Figure 1. "Blooming" water in the Kremenchug reservoir (1 - Sulynska Bay, 2 - estuary of the Tyasmyn River, 3 - Dam of the Reservoir).

This situation lasted until October 2012, when the "bloom" weakened due to lower water temperature. At the same time there was reduction in the Sula River flow, so the better water from Kremenchug reservoir flowed into the bay. And at the top of the bay, where river water is dominated, environmental situation continued to deteriorate. The fact has drawn attention that the Sula flow decreased dramatically to small quantities - 5% of the average annual (20 times less). This reduced flow cannot be explained only by meteorological factors. That is why we examined the entire Sula basin, and results showed us that the water content in lower and middle parts of the river basin is very weak, landscapes are undergoing significant dehumidification. The flow of medium and small tributaries of the Sula River decreased significantly as well (Fig. 2, 3, 4).

Figure 2. The Minoha River (tributary of the Sula River) at October 30, 2012 (Photo of V.M. Starodubtsev).

Figure3. The Sliporid River (tributary of the Sula River) at October 30, 2012 (Photo of V.M. Starodubtsev).

Figure 4. The Sula River near the Romny town at October 30, 2012. The flow is 1-2 m^3/s. (Photo of V.M. Starodubtsev).

Further observations of the water content in the Sula River showed that it remained very low all the fall 2012 and winter 2013 (Fig. 5). Only in the second half of February 2013 discharge rates increased due to strong thaw and snow melt.

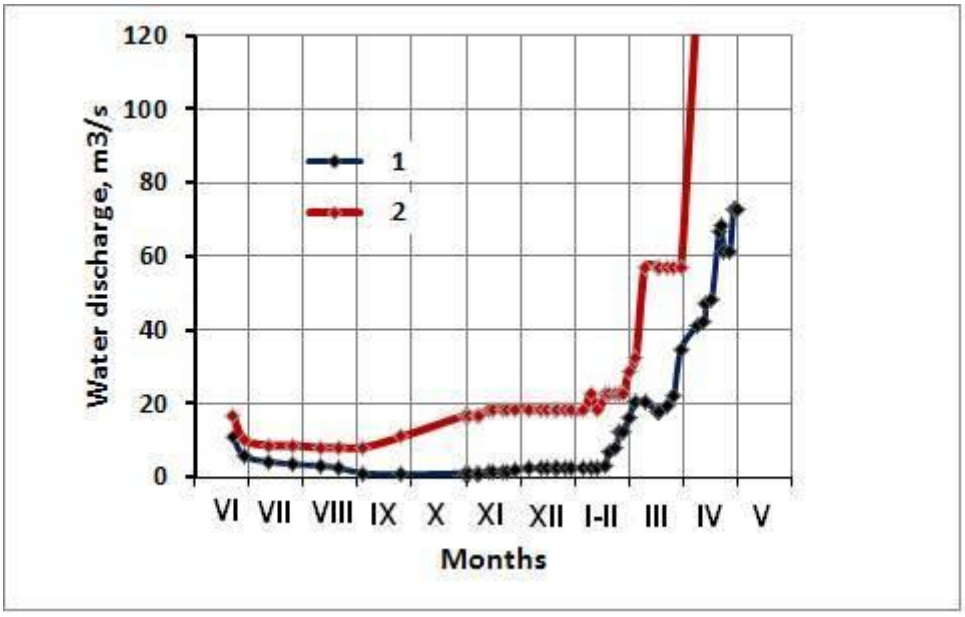

Figure 5. Water discharge of the Sula River in the 2012-2013, h/p Lubny (number 1) and average annual value (number 2).

In April, the flood began in the Sula basin (Fig. 6), during which water discharge was significantly below average. This trend manifested itself in the adjacent river basins of Poltava region - Psyol and Vorskla Rivers.

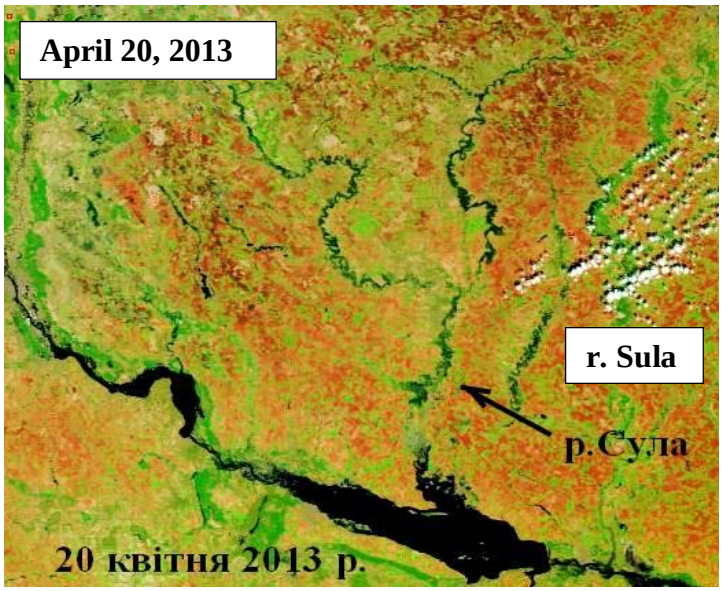

Figure 6. Floods in the Sula River basin (Terra satellite image).

These facts cause the assumption that the extremely low water content in the Sula River in autumn and winter due to the impact of network of gas and oil wells

by weakening the delivery of water from soil into the river. I fact in the Sula River basin are developed Anastasivske, Hnidyntsivske, Lelyakivske, Talalaevske, Udayske and Yablunivske oil and gas fields, Glinsko-Rozbyshivske gas field, Nynivske oil field. It is developed new - Runovschynska - area of energy resources. Further monitoring of hydrological regime of the Sula River will confirm (or deny) this conclusion. However, the likelihood of such human impacts on river flow of Poltava region is great, and it is of particular importance in connection with plans to produce regional shale gas by drilling of large number of deep wells [3].

It is importantly, that the strong decrease of the Sula River runoff in autumn and winter led to a marked deterioration of environmental situation in the Sulynska gulf of the Kremenchuk reservoir. Figure 7 clearly shows that a practical absence of the river water inflow into the mouth causes much worse watering of landscapes in the upper part of the bay than normal [1].

Figure 7. Watering of Sulynska Bay' landscapes in April 17, 2013 (Landsat-7).

A link of fish-wintering pits in the bay with the main water area of the reservoir in March was significantly impaired, although power "alarm" drawdown of water level in the reservoir did not reach the critical range of 78.5 mBS (the lowest level seen briefly in March - 78.8 m).

Hydrochemical analyzes, performed by laboratories of Dnieper Basin Water Management Administration, show that due to a runoff decrease the water salinity of the Sula River already in the autumn at the mouth of the river reached 0.6-0.7 g / l, pH -8,0-8,5 and chemical oxygen demand - 25-38 mhO/dm3, that is 1,7-2,5 times more the permissible value. In winter there was significant decrease in the concentration of dissolved oxygen in shallow and separated from the main water area gulfs - even to values 1,64-1,80 mhO/dm3. In these places an indicator of chemical oxygen demand exceeded the norm by 2-5 times.

Conclusions. 1. The Sula River runoff dramatically decreased during the 2012-2013, especially in autumn and winter (by 20 times), due apparently influenced by exploitation of oil and gas wells in the basin.

2. Reducing of the river water inflow into the Sulynska gulf of the Kremenchuk reservoir downgraded its environmental condition, especially in the upper part (from the Goroshyne village to the Sula River mouth).

3. Changes in hydrological and hydrochemical regimes of the Sula River adversely affected fish-wintering conditions in the gulf, primarily because of the shallow water separation from the main water area (Kremenchug reservoir) and the reduction of dissolved oxygen in the water.

References:

1. Starodubsev V.M., Dremlyuga I.M., Struk V.S.,at all. Landscapes changes in the Sulynska gulf of the Kremenchuk reservoir according to remote sensing and terrestrial observations / Scientific reports of NUBiP of Ukraine. -2012. - 13 p. - Http://nd.nubip.edu.ua/2012_4/12svm.pdf. (In Ukrainian).

2. Starodubsev V.M., Dremlyuga I.M., Struk V.S., Urban B.V. Environmental problems in the Sulynska gulf of the Kremenchuk reservoir / / 4th International Ecological Forum "Clean City. Clean River. Clean Planet". September 13-14,2012. Kherson. - 2012. - P. 207-211. (In Russian).

3. Starodubsev V.M. "Black Hole" in Poltava region. http://www.eco-live.com.ua/content/blogs/chorna-dira-na-poltavshchini. - 2013. - 2 p. (In Ukrainian).

4. Starodubtsev V.M., Bogdanets V.A. Dynamics of hydromorphic landscapes formation in upper part of Dnieper river reservoirs / Water Resources, v.39, # 2. - 2012. - P. 165-168. (In English).

АКТУАЛЬНІ ЕКОЛОГІЧНІ ПРОЦЕСИ В СУЛИНСЬКІЙ ЗАТОЦІ КРЕМЕНЧУЦЬКОГО ВОДОСХОВИЩА

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Досліджено сучасні зміни екологічного стану ландшафтів Сулинської затоки під впливом антропогенного тиску. Чинниками його визнані як сезонні та багаторічні коливання рівня Кременчуцького водосховища, так і господарська діяльність у басейні річки Сули. Для обґрунтування цих висновків проведено польові дослідження, хімічні аналізи води річки Сула й Кременчуцького водосховища, а також використані матеріали дистанційного зондування Землі супутниками Ландсат 5, 7, а також Терра.

Ключові слова: *водосховище, басейн річки, стік, забруднення води, космічні знімки, екологічний стан, нафтогазові свердловини*

АКТУАЛЬНЫЕ ЭКОЛОГИЧЕСКИЕ ПРОЦЕССЫ В СУЛИНСКОМ ЗАЛИВЕ КРЕМЕНЧУГСКОГО ВОДОХРАНИЛИЩА

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Исследованы современные изменения экологического состояния ландшафтов Сулинского залива под влиянием антропогенного прессинга. Их факторами признаны как сезонные, так и многолетние колебания уровня Кременчугского водохранилища, так и хозяйственная деятельность в бассейне реки Сулы. Для обоснования этих выводов проведены полевые исследования, химические анализы воды реки Сулы и Кременчугского водохранилища, а также использованы материалы дистанционного зондирования Земли спутниками Ландсат 5, 7, а также Терра.

Ключевые слова: *водохранилище, бассейн реки, сток, загрязнение воды, космические снимки, экологическое состояние, нефтегазовые скважины*