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HYDROLOGICAL AND HYDROCHEMICAL CHARACTERISTICS OF THE URAL RIVER IN THE WESTERN KAZAKHSTAN REGION

Abstract

This article presents the results of a study of the current state of the ecological, hydrological and hydrochemical characteristics of the Ural River, which directly affect the efficiency of natural reproduction of the marketable fish species. The authors present the results of a study of the main hydrological indicators of the reservoir, such as the width, depth and speed of the river during the spring flood and summer low water. The features of the spring flood in 2018 are described in detail with an analysis of the spring rise, peak and decay of flood waters. It is noted that the volume of the annual flow of the Ural River for 2018 is significantly lower than the same indicator for 2017 and amounted to 5,06 km³. The article contains valuable data on the fluctuations in the annual water flow of the Ural River in the territory of West Kazakhstan Oblast over the past 17 years. A detailed hydrography of the Ural River basin within the West Kazakhstan region is given, with the hydrological characteristics of the river network consisting of 7 tributaries and 3 outflows. A hydrochemical analysis of research at five stations of the river on the content of biogenic compounds, the level of mineralization, pH and permanganate oxidation, as well as the gas regime of natural waters is presented.

Keywords: *Ural River, hydrology, hydrography, hydrochemistry, spawning areas.*

Introduction. The Ural river originating from the foothills of Ural Ridge in the Uchalinsky region of Bashkortostan proceeds across the territory of two countries: The Russian Federation (The Orenburg, Chelyabinsk areas and the Republic of Bashkortostan) and Kazakhstan (The West Kazakhstan, Aktyubinsk and Atyrau areas), flows into the Caspian Sea. The river has the status of interstate, cross-border water object. Sources of the Ural river are located at the height of 637 m above sea level at a foot of the mountain of Nazhimtau and the ridge Uytash in the Uchalinsky region of Bashkortostan. These are five constant keys which merge in a uniform stream. The Urals is the third longest river in Europe, yielding only to the Volga and the Danube. The total length is 2428 km, within the Republic of Kazakhstan the length is 1084 km, the total area of the basin is 231 thousand km² [1].

The river is unique natural object – the only natural spawning area of many species of fish of the Caspian Basin. In lower reaches of the river, and also rising to an middle current in borders of the West Kazakhstan Region of Kazakhstan (WKR) checkpoints and species of fish semi-through passage as here it is located more than one thousand hectares of spawning areas of sturgeon, and about 5 thousand hectares of ordinary fishes come on spawning.

Materials and methods. Materials for researches gathered in 2018, on five stations of sampling on the Ural river in borders of the WKR. The grid from 5 stations was established taking into

account possibility of fuller coverage of the studied site of the river. The geographical coordinates of the sampling stations are shown in table 1.

Table 1 – Coordinates of sampling stations

Numbers and names of stations	Width	Longitude
Station No. 1 Burlin settlement	51° 27'22"N.L.	52° 40'38"E.L.
Station No. 2 Kabył Tobe settlement	51° 18'43"N.L.	51° 52'33"E.L.
Station No. 3 Krugloozernoє settlement	51° 04'12"N.L.	52° 40'38"E.L.
Station No. 4 Chapayev settlement	50° 11'24"N.L.	51° 10'49"E.L.
Station No. 5 Taypak settlement	49° 02'51"N.L.	51° 53'41"E.L.

The sampling of water for the hydrochemical researches was made by means of a batometr. The chemical analysis of tests of water was carried out in the accredited laboratories of the West Kazakhstan branch of the RSE «Kazhydromet» and the SRI of biotechnology and environmental management of 2NPJSC «Zhangir khan West Kazakhstan Agrarian-Technical University». Hydrological data on the water mode of the Ural river were obtained from the West Kazakhstan regional center of hydrometeorology.

The depth of the water in the channel was measured by the Garmin Echo 150 echosounder, the flow rate of the hydrometric turntable GMCM-1. The water temperature and the content of the dissolved oxygen were defined by the Termo-oximeter «Samara 2».

Results of researches. According to the nature of the channel, the valley and the water content, the Ural river is divided into three parts (currents): upper, middle and lower. In the beginning the river flows directly to the south to the city of Orsk. This site is considered the upper course. Then it sharply turns on the West. Having passed in the width direction about 850 km to the city of Uralsk (a middle current), turns at right angle again on the South and keeps this direction to a confluence with the Caspian Sea (the lower current, distance of 840 kilometers). The Ural is pronounced type of the river of snow food. In the period of a spring high water (April-May) comes from 60 to 90 % of an annual drain here. During the post-flood period the water level is stabilized, with insignificant inter-seasonal fluctuations.

In 2018, the spring rise of flood waters began in the 2nd decade of April. In the 3rd decade of April the rise of the flood reaches a peak. However, already in the first decade of May, the water level decline continues until June, after which the period of summer low water begins. The duration of the spring flood in 2018 was only 30 days, whereas in 2017 the rise of flood waters began in the first decade of April and only in the second half of June did the decline in water level begin. Thus, the level and duration of the spring flood in 2018 were significantly lower than those of 2017.

The middle speed of a watercourse in April fluctuated from 0,82 to 0,97 m/s. In the summer low water period, the flow velocity decreased from 0,4 to 0,45 m/s. The content of dissolved oxygen in the water was in the flood from 8,2 to 9,1 mg/l, in the low-water area from 8,2 to 8,8 mg/l [2].

The distinctive feature of the water mode of the Ural river is instability of volumes of middle annual drains. So, at an middle annual drain, at the Kushumsky hydropost, 10,6 km³ in a year, this indicator made 14,0 km³ in 2002 and only 4,45 km³ in 2015 (figure 1). After 2007, optimum on water content, the annual decrease in volume of the annual drain reaching critically low point in 2015 is observed.

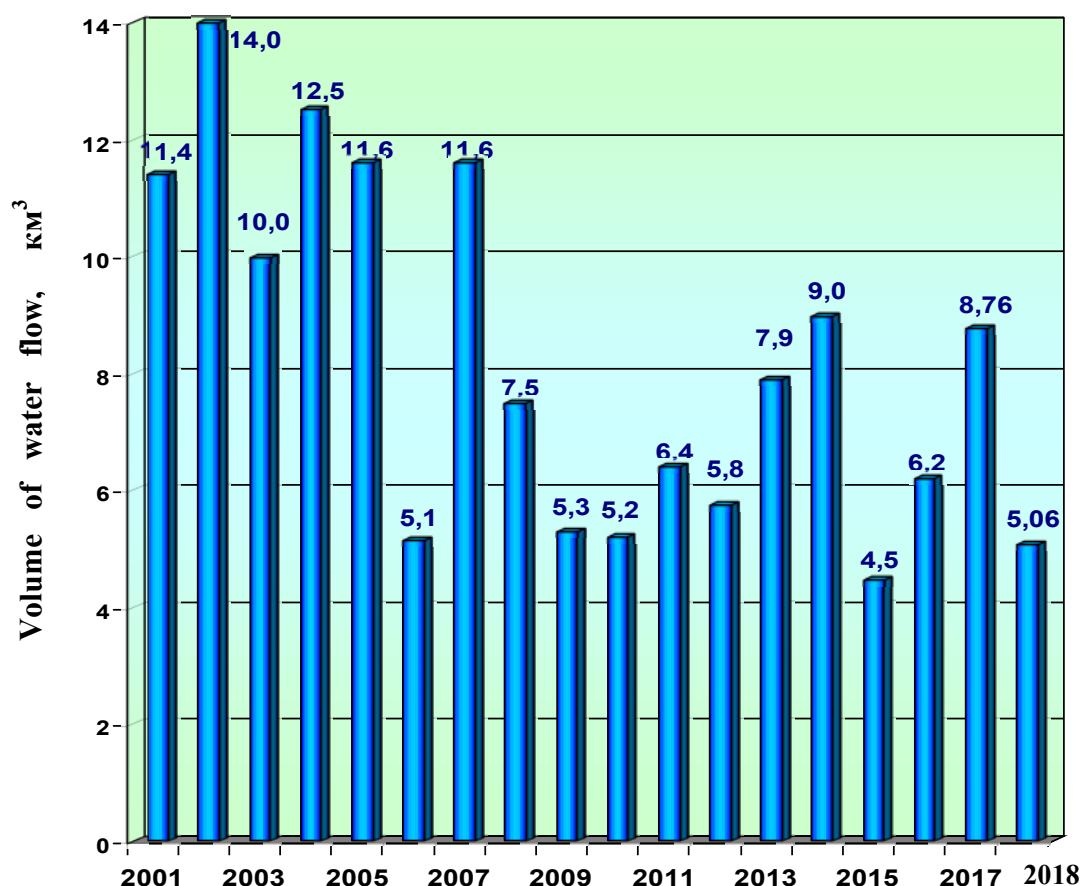


Figure 1 – Fluctuations of an annual water drain of the Ural river in the West Kazakhstan Region in 2001-2018, in км³

The volume of the annual flow of the Ural River was 5.06 км³, which makes it possible to characterize the year 2018 as low in the level and duration of the spring flood. It is obviously not enough this volume for creating favorable conditions on all hydrographic network of the Ural river for the natural reproduction of trade species of fish on inundated spawning areas. The full flood of these spawning areas during a flood and efficiency of spawning on them in many respects defines character of a natural reproduction of the commercial reserves of all Uralo-Caspian Basin.

The modern hydrographic network of the Ural river in the WKR is represented by a 761 km of long root channel. The width of the river is from 70 to 110 m in low water period and from 180 to 300 m during a flood. The middle depth is about 5 m in low water period, and to 15 m during a flood. The middle watercourse passes in the north of area and lasts from border of the Russian Federation at the village of Burlin and further on the West to Uralsk (figure 2). Here river to the course smoothly turns on the South and further flows on the flat plain of Caspian Depression. This is the lower watercourse.

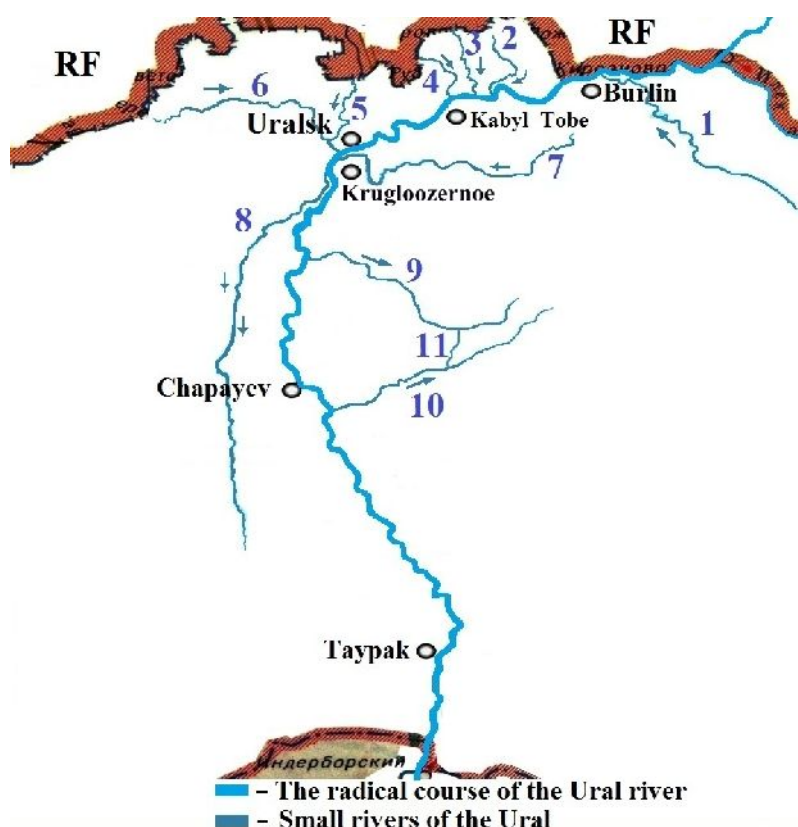


Figure 2 – Hydrographic network of Ural river within the West Kazakhstan region

In the middle reaches of the Urals the rivers Utva, Embulatovka, Bykovka, Rubezhka, Chagan and Derkul fall into the river. In the lower current there is only one inflow – river of Barbastau, and three outflows – the rivers Kushum, Ashchisay, Solyanka. Two last on middle a current are connected by the proto which Karabas. The list of the small rivers of a hydrographic network is presented in table 2.

Table 2 – The small rivers of a river basin the Urals within the West Kazakhstan Region

№	Name of the small river	Characteristic
1	Utva	Left-bank inflow in the middle current
2	Embulatovka	Right-bank inflow in the middle current
3	Bykovka	Right-bank inflow in the middle current
4	Rubezhka	Right-bank inflow in the middle current
5	Chagan	Right-bank inflow in the middle current
6	Derkul	Right-bank inflow in the middle current
7	Barbastau	Left-bank inflow in the lower current
8	Kushum	Left-bank outflow in the lower current
9	Ashysay	Left-bank outflow in the lower current
10	Solyanka	Left-bank outflow in the lower current
11	Karabas	The river channel between the rivers Ashysay and Solyanka

The left inflow of the middle current – the river Utva begins in the Chingirlausky Area of West Kazakhstan Region. Flowing further northwest the river passes through Burlinsky area and in vicinities of village Burlin runs into the Ural River. The water content of the tributary is uneven and depends on the flood. The bed is poorly washed, with excessive overgrowing by underwater soft vegetation. With the Ural, the reservoir is connected only during the spring high water. Total length is about 200 km. The width is from 20 to 30 m. The averages depths are 1,7-2 m.

The left inflow of the lower current – Barbastau's river originates in the Terektinsky area at the settlement of Fedorovka. Flowing further on the southwest the river flows into the Ural below the Uralsk city at the village Socialism. The water content of inflow is not great as a result of control of the course and formation of a number of reservoirs. The course which is badly washed out with considerable overgrowing. Barbastau's river is connected to the Ural all the year round, however inflow of water is observed only during a spring flood. The total length is about 70 km. The width is from 22 to 30 m. The middle depths are 1,8-2 m.

The right inflow of the middle current – Embulatovka's river stretches from the Russian Federation border in the North (the district of the Rozhkovo village) and further flows to the South, falling into the Ural river lower the village of Yanvartsevo. The weak water content of inflow is caused by control of the course and formation of a number of reservoirs and ponds. The bed of the river insufficiently profound, with the surface rigid and underwater soft vegetation raised by overgrowing of a reservoir.

With the Ural, the Embulatovka is connected only in deep-water years. Its total length is about 80 km. The width is from 20 to 25 m. The average depths are in limits of 1,1-1,5 m.

The right inflow of the middle current – Bykovka's river also goes north from border with the Russian Federation in the neighborhood of the Chesnokovo village and goes to the South, falling into Ural river above the village of Krasnoarmeyskoye. Owing to control of the course the water content of inflow is minimum. The bed of the river which is insufficiently washed out with intensive overgrowing of a reservoir. With the Ural River, this inflow is connected only at a sufficient level of spring flood. The total length is about 75 km. The width is from 18 to 20 m. The average depths are 1,1-1,2 m.

The right inflow in the middle current – Rubezhka's river goes from Russian Federation border in the North (the village Razdolnoye) and further flows to the South, falling into Ural river lower the village of Rubezhka. The water content of inflow is low as a result of control of the course and formation of a number of reservoirs and ponds. The course which is badly washed out the coastal and shipped water vegetation is plentifully developed. This inflow connects with the Ural river only at the sufficient level of a spring flood. The total length is about 72 km. The width is from 15 to 20 m. The average depths are 1,1-1,4 m.

The right inflow of the middle current – the river Chagan goes north from the Russian Federation border in the neighborhood of the village Red Zhayyk (Ural) and further flows to the South, falling into the Ural river in the western part of the Uralsk city. The river Chagan is connected to the Ural all the year round, however inflow of water on Chagan is observed only during a spring flood. The total length is about 78 km. The width is from 50 to 100 m. The average depths are 3-4 m.

The right inflow of the middle current – the Derkul river begins in the Tuskalinsky area near the village of Semiglavy Mar and then flows east, to the confluence with the Chagan river near the city of Uralsk. With Chagan, Derkul is connected all year round, but the flow of water along the river is observed only in spring flood. The total length is about 130 km. The width is from 30 to 50 m. The average depths are 3-4 m.

Above-mentioned channels play a certain positive role in the formation of bioresources of Ural river. They feed the river with waters from the catchment area, enrich the river ecosystem with planktonic fodder organisms.

The right outflow of the lower current – the river Kushum begins below the city of Uralsk near the village of Krugloozernoe and further flows on the southwest. The largest irrigation and watering system of the WKR – Ural-Kushumskaya irrigation and watering system was established on the river. The total length of Kushum is about 250 km. The width is from 30 to 50 m. The average depths are 2-3 m. Kushum ends in the lake floods of Zhangalinsky area.

The left outflow of the lower current – the river Ashysay begins near the village of Akzhaik and further flows on the southeast. This outflow connects to the Ural only in the years of a high spring flood. The river bed is poorly washed, heavily overgrown. The total length is about 60 km. The width is from 20 to 25 m. The average depths are 1,2-1,7 m.

From the neighborhoods of the Kamystykol village, another left outflow of the lower watercourse of the Ural river, the Solyanka river, begins and proceeds further to the northeast. This outflow connects with the Ural river only in the years of a high spring flood. The course is badly washed out, with the surface rigid and underwater soft vegetation raised by overgrowing of a reservoir. The total length is about 70 km, The width is from 18 to 23 m. The averages depths are 1,1-1,5 m.

The river Karabas is the sleeve going from the river Ashysay to the river Solyanka in the neighborhood of the village of Karabas. The bed of the river which is insufficiently washed out with intensive overgrowing of a reservoir. The total length is about 55 km, The width is from 20 to 25 m. The averages depths are 1,4-1,7 m.

Thus the drain of Ural river, is generally formed in an upper course where the river network numbering 7 inflows and 3 outflows is strongly developed. Below the Uralsk city, before flowing into the sea, the Ural river has no tributaries, except for the low-water river Barbastau.

As a result of hydrochemical researches at five stations it was established that the waters of the Ural river throughout the West Kazakhstan region are fresh (hypogaline), slightly alkaline. The concentrations of dissolved oxygen were at a sufficient level for the life of fish and varied within the range of 8,2-8,8 mg/dm³. Excess phosphate levels were noted for all the surveyed sections, which is most likely a consequence of pollution of the reservoir by domestic and agricultural wastewater (table 3).

Table 3 – Results of hydrochemical researches, summer post-flood period 2018

Station	rn (pH)	O ₂ mg/dm ³	Biogenous connections, mg/dm ³				Oxidability perman- ganatny mg/dm ³	Mineralization of water, mg/dm ³
			NH ₄	NO ₂	NO ₃	PO ₄		
Art. 1	7,43	8,8	0,05	0,022	2,3	0,15	3,32	440,0
Art. 2	7,45	8,4	0,05	0,013	2,6	0,02	3,08	440,0
Art. 3	7,48	8,6	0,05	0,012	2,3	0,76	3,08	450,0
Art. 4	7,41	8,5	0,05	0,010	1,8	0,22	2,72	440,0
Art. 5	7,50	8,2	0,05	0,015	1,8	0,12	3,2	450,0
MPC	6,5-8,5	not less than 6,0	0,5	0,08	40,0	0,05	15,0	1500

The total mineralization of water did not rise above 450,0 mg/dm³. Except for the concentration of ammonium ion, the maximum permissible concentrations were not exceeded for fishery reservoirs. According to the permanganate oxidation index characterizing the dissolved organic matter content, the waters of the Ural river in 2018 corresponded to the class "moderately polluted".

Thus, when studying the hydrological mode of Ural river the volume of an annual drain for 2018 made 5,06 km³, which is significantly lower than the same indicator for 2017. Full flood of all hydrographic network of Ural river is necessary for creating favorable conditions for natural reproduction of trade species of fish on inundated spawning areas. By results of the conducted hydrochemical researches of Ural river it is possible to draw a conclusion that conditions for dwelling of hydrobionts on the main hydrochemical indicators in 2018 were accepted. The presence of deviations from the MPC standards for phosphate content has reduced the quality of water, but the other hydrochemical parameters correspond to the fishery norms and the habitat conditions of the hydrobionts are quite satisfactory.

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vodoemah mezhdunarodnogo, respublikanskogo znachenij i vodoemah OOPT Uralo-Kaspijskogo bassejna, a takzhe ocenka sostoyaniya rybnyh resursov na rezervnyh vodoemah mestnogo znacheniya» razdel: reka Ural po Zapadno-Kazahstanskoj oblasti. – Ural'sk: ZKF KazNIIRH, 2017. – 59 s. (*in Russian*).

ТҮЙІН

Бұл мақалада Жайық өзенінде мекендейтін кәсіптік балықтардың табиғи көбеюіне тікелей ықпал ететін экологиялық, гидрологиялық және гидрохимиялық көрсеткіштердің қазіргі жағдайын зерттеудің нәтижелері көрсетілген. Мақала авторлары көктемгі тасқын және жаз мезгілдерінде өзеннің ені, тереңдігі және ағыстың жылдамдығы секілді негізгі гидрологиялық көрсеткіштерді қамтитын мәліметтерді келтірген. 2018 жылы көктемгі тасқын суының деңгейі, көтерілу шегі және қайтуы талданып, тереңрек сипатталған. Жайық өзенін дегі 2018 жылғы судың жылдық деңгейі 2017 жылға қарағанда айтарлықтай төмендеп, 5,06 км³ деңгейін көрсетті. Мақалада Батыс Қазақстан облысының аумағындағы Жайық өзенінде соңғы 17 жылдағы су көлемінің ауытқуын жылдар бойынша зерттеу мәліметтерінің нәтижелері берілген. Батыс Қазақстан облысының аумағындағы Жайық өзенінің алабына кіретін өзен тармақтарының гидрографиясын, 7 қосылатын тармағы мен 3 шығатын тармағының гидрологиялық ерекшеліктерін сипаттайтын мәліметтерді қамтиды. Өзен бойында бекітілген бес зерттеу бекеттерінде биогендер құрамы, минерализация деңгейі, сутектік көрсеткіш және перманганатты тотығу, сонымен қатар табиғи суының газ режимі бойынша гидрохимиялық талдаудың сараптамасы келтірілген.

РЕЗЮМЕ

В данной статье представлены результаты изучения современного состояния экологических, гидрологических и гидрохимических характеристик реки Урал, непосредственно влияющих на эффективность естественного воспроизводства промысловых видов рыб. Авторы приводят результаты изучения основных гидрологических показателей водоёма, таких как ширина, глубина и скорость течения реки в период весеннего паводка и летней межени. Подробно описаны особенности весеннего паводка 2018 года с анализом весеннего подъёма, пика и спада паводковых вод. Отмечается, что объём годового стока реки Урал за 2018 год значительно ниже аналогичного показателя за 2017 год и составил 5,06 км³. Материалы статьи содержат ценные данные по колебаниям годового водного стока реки Урал на территории Западно-Казакстанской области за последние 17 лет. Приводится развернутая гидрография бассейна реки Урал в пределах Западно-Казакстанской области, с гидрологическими характеристиками речной сети, состоящей из 7 притоков и 3 оттоков. Представлен гидрохимический анализ исследований на пяти станциях реки по содержанию биогенных соединений, уровню минерализации, водородного показателя и перманганатной окисляемости, а также газового режима природных вод.

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ОРЫС БЕКІРЕСІ МЕН ПІЛМАЙДЫҢ ҚАН ҚҰРАМЫНЫҢ МОРФОБИОХИМИЯЛЫҚ КӨРСЕТКІШТЕРІНЕ ҚОЛАЙСЫЗ ОРТАНЫҢ ӘСЕРІ

Аннотация

Мақалада орыс бекіресі мен пілмайдың қан құрамындағы көрсеткіштері әртүрлі қолайсыз жағдайларда салыстырмалы түрде зерттелген. Зерттеуге алынатын негізгі көрсеткіштерге негіздеделер, балықтардың қан құрамы, балық қанының физико – химиялық сипаттамасы және балықтардың қанын зерттеу туралы жалпылама түсініктер келтірілген.

Ғылыми зерттеу жұмыстарын жүргізу үшін тәжірибе бассейндері мен бақылау бассейндері құрылды. Зерттеу Жәңгір хан атындағы Батыс Қазақстан аграрлық - техникалық