

==== **METHODS OF MAINTENANCE AND PRESERVATION OF ECOSYSTEMS** ====
AND THEIR COMPONENTS

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**THE INTERNATIONAL SCIENTIFIC PROJECT ON ENVIRONMENTAL FLOW
AS THE BASIS FOR ECOSYSTEM CONSERVATION**

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The article provides information about the international project “Environmental Flow as the Basis for Ecosystem Conservation”. The project was implemented with the support of the Government of Kazakhstan, in cooperation with the Secretariat of the UN Water Convention and participation of the Central Asian countries. The article overviews the management features of the transboundary water bodies of Central Asia and focuses on the problem of accounting for environmental flow, which is important for ecosystem conservation. It describes the methodological approaches to determining the volume of acceptable irretrievable water withdrawal and establishing the environmental flow (discharge), formulated by the Russian and Kazakh participants. It also describes the studies that were carried out by the project participants on the transboundary rivers of their countries. Based on the results, the recommendations for the conservation and restoration of freshwater ecosystems of transboundary rivers are given.

Keywords: intergovernmental agreements, transboundary rivers, water sharing, environmental flow, acceptable irretrievable water withdrawal, freshwater ecosystem conservation.

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V.G. Dubinina, the author of this article, was a national expert from the Russian Federation in the project “Environmental Flow as the Basis for Ecosystem Conservation”. The project was implemented in 2019-2020 and supported by the government of Kazakhstan, in cooperation with the Secretariat of the UN Transboundary Water Convention, which develops propositions to prepare the “Guidelines for the Fair and Sustainable Distribution of Water Resources in a Transboundary Context”. The counties of Central Asian, such as Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan participated in the project, as well as Afghanistan, Iran, the People’s Republic of China, Mongolia and the Russian Federation. Kazakhstan, having the chairmanship in the Convention on Transboundary Watercourses and Water Bodies of the United Nations Economic Commission for Europe, intended to submit for further discussion two methods to substantiate the environmental flow and acceptable volumes of irretrievable withdrawal of river flow, a Russian and a Kazakhstani one (Burlibaev, Burlibaeva, 2020).

Modern Approaches to Transboundary Water Cooperation in the Russian Federation

Optimization and efficient distribution of river flow is especially important during a shortage of water resources, when the contradictions increase between economic and environmental requirements of the river and the water body that receives its flow. Water sharing between different countries is even more difficult. The legal basis for regional water relations is bilateral and multilateral agreements that consider the norms of international water law and the specifics of interstate relations in the given region, as well as national legal requirements, countries’ needs and interests.

The land border of the Russian Federation adjoins 14 other states. Its total length is 60,933 km, of which 7,141 km are rivers, 475 km are lakes, and 38,807 km are seas. The total number of transboundary water bodies in the region is more than a thousand, including 70 large and medium-sized rivers (State Report, 2018).

Currently, Russia has 10 on-going international agreements on the use and protection of transboundary waters with neighboring countries: bilateral relations with Finland, Estonia, Ukraine, Belarus, Azerbaijan, Abkhazia, Kazakhstan, Mongolia and China; trilateral with Norway and Finland. To organize the work and implement these agreements, the countries created joint commissions; however, the standards for environmental flow are not specified in the said agreements. At the same time, all parties recognize the commonality and unity of the transboundary water bodies' resources, therefore, cooperating on the principles of equality and partnership in order to conserve, protect and restore these resources. Aside from the international agreements, Russia has no other regulatory and methodological documents and economic mechanisms for the distribution of water resources in a transboundary context.

In 1992, the Russian Federation signed the UN Eurasian Economic Commission Convention on the Protection and Use of Transboundary Watercourses and International Lakes.

State of the Regulatory Basis to Determine and Implement the Environmental Flow (Discharge) in the Russian Federation

The standards for acceptable impact on water bodies are the basis for the regulation of anthropogenic impact on water bodies. Their aim is to maintain the state of surface water and groundwater that meets the requirements of Russian legal system.

The standards for acceptable impact, including the standards for acceptable irretrievable withdrawal of water resources, were calculated for transboundary basins of such rivers, as the Western Dvina, Neman, Pregolya, Dnipro, Terek, Ural, Selenga, Irtysh and Amur. The analysis showed the standards that are valid until the end of 2029 and 2030, were calculated exclusively for the Russian part of transboundary river basins and do not provide the total acceptable withdrawal of river flow from the entire river basin in total, which makes it difficult to determine if the calculations are adequate. At the same time, according to the "Guidelines for the Regulation ..." (Dubinina et al., 2008), the amount of irretrievable withdrawal of water resources should be calculated up to the outlet, regardless of its location, even if it is set in the territory of another country. This work should be continued within the international agreements and the development of joint "Schemes for the Use and Protection of Water Resources of Water Bodies", which make the basis for the water management plan.

The sharing of transboundary water resources should be based on the Scheme, developed and approved by the responsible authorities of the neighboring countries that work on it. First of all, the guidelines for the development of schemes for the complex use and protection of transboundary water bodies should be written and approved by the governments.

The Schemes allow coordination of plans for the use and protection of water resources, the needs of water users, while taking into account sanitary and environmental flows and water shortage between the participants of the water management complex, as well as the operating mode of water reservoirs and other aspects of water management. The indices of sectoral and territorial water management that are established in the Schemes become the basis for preparation of water use agreements and decisions that allow provision of water bodies for the further use. They are also needed for development of rules for the water resources use in reservoirs.

The water management balance is calculated as part of the Scheme. It is the result of water management calculations that determine the ratio of available resources and estimated water consumption at the current and predicted levels of economics. This calculation is carried out while

the environmental flow in the unregulated parts of the river is kept undisturbed. The value of the flow is established by the standards for the acceptable irretrievable withdrawal (discharge) of river flow.

The calculation of the water management balance and water resources sharing has to take into account two groups of consumers: first, the health care and protection of natural resources; then, water consumption and use by economics (Guidelines for Water Management Balance, 1974). Preservation and restoration of water ecosystems should be a key part of water resources management, while biological productivity should be an indicator of the water ecosystems condition. Therefore, the first group is prioritized for water use. When the groups are being divided, the acceptable volume of irretrievable withdrawal of river flow and environmental flows (discharge) is taken into account as well.

The Article 26 of the current federal law “On Environmental Protection” No. 7-FZ, issued on 10/01/2002, refers to “the standards for acceptable withdrawal of the environmental components”, which are “the standards that were established in accordance with restricted volume of withdrawal, in order to preserve natural and natural-anthropogenic objects, ensure the sustainable functioning of natural ecosystems and prevent their degradation”. At the same time the text emphasizes that the procedure for their establishment is determined by the subsoil legislation, as well as land, water and forest legislation, legislation on wildlife and other legislations of environmental protection. However, the current Water Code of the Russian Federation No. 74-FZ, issued on 03/06/2006, has no requirements for establishing an environmental flow and the volume of acceptable water withdrawal, while the Article 110 of its previous version, issued in 1995, contains the “Requirements for Environmental Discharge and Rationing of the Maximum Acceptable Irretrievable Withdrawal of Surface Water”:

“To maintain water bodies in a state that meets ecological requirements, water is discharged from reservoirs (environmental release), and the volume of irretrievable withdrawal of surface water is established.”

“Environmental releases and volumes of irretrievable withdrawal of surface water for every water body are determined by the federal executive authority responsible for the management, use and protection of the water fund, together with the federal authority responsible for environmental protection, according to the order of the government of the Russian Federation.”

“It is not allowed to satisfy the need for water resources of water users at the expense of ecological release.”

The main document for the reservoirs management is the “Rules for the Use of Reservoirs”, which include the “Rules for the Use of Reservoirs Water Resources” and “Rules for the Technical Maintenance and Improvement of Reservoirs”. They were developed according to the “Guidelines for the Rules Development for the Use of Reservoirs”, approved by order No. 17 of the Ministry of Nature of Russia, on 01/26/2011. The use of reservoirs also includes implementation of ecological requirements for the flow rate condition and water levels in the downstream and upstream pools of the hydroelectric complex that belongs to the reservoir under consideration. However, the “Rules for the Use of Reservoirs Water Resources” do not state the need for establishment of environmental releases.

In order to improve state management of the use and protection of water bodies, it is necessary to change the Water Code of the Russian Federation, namely, that part which refers to the inclusion of provisions on the necessary determination of the volume of acceptable irretrievable withdrawal of river flow (withdrawal of water resources) and environmental flow (discharge), as well as the methods that help to establish them.

Methodology for Determining the Environmental Flow (Discharge)

The current recommendations on reserving the environmental rivers flow in the Russian

Federation and other countries are based on different principles and cannot guarantee the ecological welfare of river systems. An analysis of various materials from those countries showed there are no unified terms and no unified approach to assessing the acceptable volumes of flow withdrawal from water bodies and the establishment of environmental flows. Therefore, it is necessary to develop a scientifically based strategy for the use and protection of water resources, for which the limits of the environmentally acceptable irretrievable withdrawal of surface runoff should be established for the rivers basins, while taking into account the requirements for water flow of the closing water bodies which act as the final parts of the hydrographic basin network.

There are numerous publications on the problem of withdrawing water resources to establish environmental flow, the most thorough review of which was done by B.V. Fashchevsky (1989, 1996) and V.G. Dubinina (2001). Those authors also proposed the most complete methodological approaches for determining the acceptable withdrawal of river flow, based on the functioning of water ecosystems.

The method of runoff calculation, created by B.V. Fashchevsky (1989, 1996), is based on the so-called homeostatic curves (of dynamics of plankton and benthos organisms abundance, reproduction of fish, abundance of near-water mammals and birds, yield curves of floodplain meadows, etc.). The curves were obtained for the main Russian rivers. The analysis of the curves of river flow availability made it possible to conclude that the number of aquatic and semi-aquatic organisms increases and reaches its maximum, when approaching the year of the average water content. Thus, the upper limit of the environmental flow (water availability is 25%) can be described by the hydrograph of the natural river flow with a water availability of 50%. The lower limit of the environmental discharge (water availability is 95%) is described by the hydrograph of the natural river flow with a water availability of 99%, i.e. the century-old stocks of water resources in the river system. The curves limit the range of calculated values for the environmental river flow.

Nevertheless, we believe that the assumption about the increasing amount of organisms that B.V. Fashchevsky's method is based on is not sufficiently substantiated. The results of other studies (Dubinina 1973; Bronfman et al., 1979; Pavlov et al., 1989; Kozlitina et al., 1998; Katunin et al., 2013) showed that for rivers of significant fishery importance the optimum reproduction of fish occurs during the years with their water availability of 25-40%. On practice, when this method is applied, the irretrievable withdrawal of river flow is often 30% or higher. Such a significant value can hardly ensure the system stability, because it can be critical for most rivers, rather than environmentally acceptable. B.V. Fashchevsky's method can be recommended only for an expert assessment for those parts of rivers that has a low biological productivity, as well as for small rivers, when the actual observation data, reliable dependencies and ecologically significant hydrological and biological data, needed for other methods, are not available.

The work that was carried out together with Kazakhstan as part of the "Environmental Flow as the Basis for Ecosystem Conservation" project indicates that in Kazakhstan there is a valid method to help determine the environmental flow below hydroelectric facilities and water intakes. It is entirely based on B.V. Fashchevsky's methodology. However, for the reasons stated above, we believe that it needs some improvements. According to calculations obtained from Kazakhstan, when the proposed methodology was used for the Ural River (called Zhaiyk in its lower reaches), the acceptable value of the irretrievable withdrawal of the river flow in its mouth was more than 30% of the average long-term value of the natural flow, which is unacceptable for conservation of water ecosystems. The latest version of this methodology was published in the "Water Management" journal (Burlibaev, Burlibaeva, 2020).

According to the project materials, the People's Republic of China uses the term "environmental flow" since 2015 in the "Water Pollution Prevention and Control Action Plan". By the end of 2020 China plans to establish an environmental flow monitoring system and implement the management measures by 2025. However, this plan only applies to the inland water

bodies and does not include the transboundary rivers, the flows of which are considered to be determined by the coastal countries. The main objective of the environmental flows of the main rivers and lakes, as shown on the example of the Huai River basin, is to maintain their base flow. The ecological base flow is the minimum of the lower limit flow (amount of water, water level and depth) that must be maintained for the successful existence of river and lake ecosystems. It is proposed to maintain about 5-10% of the average annual flow, which ensures the required width of the river, its depth and flow rate, satisfying the general requirements “for fishing, tourism and landscape”.

Other countries did not provide any methods for determining the amount of irretrievable withdrawal of surface and environmental flows. The characteristics of the runoff, left in the rivers, are not regulated in the countries of the Commonwealth of Independent States, but some republics made departmental restrictions, which, however, have no ecological justification. The basic conditions and procedures for the distribution of water resources within the republics are also used, but they were in effect only before 1991, when the USSR collapsed.

In Russia, in accordance with the Decree No. 881 of the Government of the Russian Federation “On the Procedure for Approving the Standards for Acceptable Impact on Water Bodies”, issued on 30/10/2006 (Collected Legislation of the Russian Federation No. 4, 2007, p. 510), and in order to improve the “Guidelines for the Development of Standards for Acceptable Impact on Water Bodies” (approved by the Order No. 328 of the Ministry of Natural Resources of Russia, on 12/12/2007; registered by the Ministry of Justice of Russia, No. 10974, on 23/01/2008), the “Methodological Guidelines for the Regulation of the Acceptable Irretrievable Withdrawal of River Flow and the Establishment of Environmental Flow (Discharge)” was developed (Dubinina et al., 2008) and published in the “Water Management of Russia” journal (Dubinina et al., 2009).

The accepted and unified methodological basis for determining the irretrievable withdrawal of river flow and establishing environmental flow and discharge in Russia is a scientifically founded principle of sustainable functioning of water and near-water ecosystems and preservation of the conditions for the natural organisms’ reproduction, meaning that the changes in the structure and functioning lie within the tolerance of the natural stage of hydrogenesis, and the ability of natural complexes for self-regulation (i.e. self-purification, self-renewal) is not disturbed (Dubinina, 2001; Pastukhova et al., 1991).

1. To determine the volume of acceptable irretrievable withdrawal of water resources, the calculation should be applied first for the entire basin along the outlet of the main river, and only then for the individual parts of the river, in accordance with hydrographic and/or water management zones. This applies to all water bodies, including transboundary rivers.

2. The volume of irretrievable withdrawal of environmental flow (discharge) should be determined according to the hydrological conditions that are critical for the organisms’ reproduction and the ecosystems’ functioning. When the flow rates and water volumes are close to the critical level or below it, the natural reproduction of valuable, commercial and other species of fish and hydrobionts, near-water animals and plants deteriorates severely, and the process of channel formation is disrupted. Critical hydrological conditions in nature are registered mainly during the dry years and periods.

3. Water volume and flow that indicate a critical state of water ecosystems should be determined after an analysis of the relationship between the natural (restored) hydrological characteristics of a river and the water ecosystems productivity or the indirect indicators that characterize the said river. For small rivers and tributaries of the main one with no data that is necessary to understand the influence the hydrological regime has on the state of water and near-water ecosystems, the critical flow is considered the volume of the restored flow for the years with water availability of 97%, which preserves the minimum acceptable conditions for the river ecosystem functioning.

4. Water and near-water ecosystems may function when the flow volume occasionally drops under its critical value. However, frequent drops and disruption of the natural hydrological regime of the rivers may cause degradation of ecosystems. Therefore, the calculated value of the acceptable flow withdrawal should guarantee to preserve flow fluctuations close to the ones under the natural conditions, i.e. those that do not outstep the limits of natural long-term fluctuations.

5. Acceptable withdrawal of the surface water resources should never exceed 20% its volume.

The “Guidelines for the Regulation ...” (Dubinina et al., 2008) provide a general calculation algorithm and examples that show how to determine the volumes of acceptable irretrievable withdrawal of river flow, environmental flow and ecological release.

In January 2021, when the “Guidelines for the Development of Standards for Acceptable Impact on Water Bodies” were under revision, the Federal Water Resources Agency of Russia ordered the Central Directorate for Fisheries Expertise and Standards for the Conservation, Reproduction of Aquatic Biological Resources and Acclimatization proposed to update the “Guidelines for the Regulation of the Acceptable Irretrievable Withdrawal of River Flow and Establishment of Ecological Flow (Discharge)” (Dubinina et al., 2021).

The methodological approaches to establish environmental flow in Kazakhstan, China and Russia were reported at the “Regional Meeting on the Distribution of Water Resources and the Assessment of Environmental Flow in a Transboundary Context” in Kazakhstan, September 2020. However, no assessments and proposals for the development of general positions for the further development were made during that meeting.

Main recommendations of the National Expert of the Russian Federation on the Conservation and Restoration of Water Ecosystems of Transboundary Rivers

1. The international agreements on the use and protection of transboundary waters should include the establishment of the volumes of acceptable irretrievable withdrawal of river flow and environmental flow (discharge) in accordance with the long-term natural (restored) rows of water flow, with its yearly distribution for the years with the flow of different availability.

2. The sharing of water resources sharing and the establishment of an environmental flow (discharge) in a transboundary context should be based on the Schemes, developed and approved by the responsible authorities of the neighboring countries that work on it. However, it is necessary to establish the methodological guidelines for the development of the Schemes for the complex use and protection of the transboundary water bodies beforehand and approve them on the governmental level. The quick decisions on the water sharing always take into account the current water management state in the river basin, the forecasts for the upcoming floods or high water, the hydrological and meteorological regime of transboundary rivers.

3. The methods offered by the Republic of Kazakhstan and the Russian Federation to justify the environmental flow and acceptable volumes of irretrievable withdrawal of river flow should be discussed at a joint meeting on the federal level.

4. The environmental flow (discharge) in most river basins is not implemented, therefore, causing deterioration of the water ecosystems. The main reasons for it are the lack of legal requirements, difficulty in assessing the damage to biological water resources, as well as insufficient concernment of interested parties.

5. Необходимо законодательно закрепить установление допустимого безвозвратного изъятия поверхностного стока и экологических стоков (попусков), а также контроль за их реализацией.

6. It is necessary to legally establish an acceptable irretrievable withdrawal of surface and environmental flows (discharges) and to control their implementation.

Conclusions

It is extremely important that the Secretariat of the Water Convention of the United Nations Economic Commission for Europe supports the introduction of a system to ration the acceptable irretrievable withdrawal of river flow and to establish certain parameters of environmental flow (discharge) under different water regime in order to preserve and restore water and floodplain ecosystems of transboundary rivers.

Therefore, it is necessary to develop a general opinion and coordinated approaches for the uniform methods of establishing the volumes of acceptable irretrievable withdrawal of river flow and environmental flow (discharge).

The joint development of schemes for the integrated use and protection of water bodies for transboundary river basins should be one of the methods for coordinated planning of the integrated use of water resources (objects).

In the future, the potential communication between countries should be improved to refine the legal framework, as well as the coordinated scientific and methodological principles of water resources distribution and assessment of transboundary environmental flow.

REFERENCES

1. Bronfman AM, Dubinina VG, Makarova GD. Hydrological and hydrochemical foundations of the productivity of the Sea of Azov [*Gidrologicheskiye i gidrokhimicheskiye osnovy produktivnosti Azovskogo morya*]. Moscow: Pishchevaya promyshlennost'. 1979:288.
2. Burlibaev MZh, Burlibaeva DM. Conceptual bases to regulate the ecological and free flow of Kazakhstan rivers [Kontseptual'nyye osnovy normirovaniya ekologicheskogo i svobodnogo stoka rek Kazakhstana]. *Water Management of Russia*. 2020;5:52-73.
3. Water Code of the Russian Federation [*Vodnyy kodeks Rossiyskoy Federatsii*]. Issued on 16.11.1995, No. 167-FZ (VK RF), with amendments and additions (no longer valid).
4. Water Code of the Russian Federation [*Vodnyy kodeks Rossiyskoy Federatsii*]. Issued on 03.06.2006, No. 74-FZ.
5. State report "On the State and Use of Water Resources of the Russian Federation in 2017". [*Gosudarstvennyy doklad "O sostoyanii i ispol'zovanii vodnykh resursov Rossiyskoy Federatsii v 2017 godu"*]. Moscow: NIA-Priroda, 2018:298.
6. Dubinina VG. Hydrological regime of the floodplain spawning grounds in the Lower Don and some prospects for their fishery use [*Gidrologicheskiy rezhim poymennykh nerestilishch Nizhnego Dona i nekotoryye perspektivy ikh*

REFERENCES

1. Бронфман А.М., Дубинина В.Г., Макарова Г.Д. 1979. Гидрологические и гидрохимические основы продуктивности Азовского моря. М: Пищевая промышленность. 288 с.
2. Бурлибаев М.Ж., Бурлибаева Д.М. 2020. Концептуальные основы нормирования экологического и свободного стока рек Казахстана // Водное хозяйство России. № 5. С. 52-73.
3. Водный кодекс Российской Федерации от 16 ноября 1995 г. № 167-ФЗ (ВК РФ) с изменениями и дополнениями. (утратил силу)
4. Водный кодекс Российской Федерации от 03.06.2006 № 74-ФЗ.
5. Государственный доклад «О состоянии и использовании водных ресурсов Российской Федерации в 2017 году». 2018. М.: НИА-Природа. 298 с.
6. Дубинина В.Г. 1973. Гидрологический режим пойменных нерестилищ Нижнего Дона и некоторые перспективы их рыбохозяйственного

- rybokhozyaystvennogo ispol'zovaniya]. *News of the North Caucasian Scientific Center of Higher Education [Izvestiya SKNTsVSH]*. Series "Natural Sciences" [Seriya "Yestestvennyye nauki"]. 1973;1:84-88.
7. Dubinina VG. Methodological bases of ecological regulation of the irretrievable withdrawal of river flow and establishment of ecological flow (discharge) [Metodicheskiye osnovy ekologicheskogo normirovaniya bezvozvratnogo iz'yatiya rechnogo stoka i ustanovleniya ekologicheskogo stoka (popuska)]. Moscow: Ekonomika i informatika, 2001:118.
 8. Dubinina VG, Kosolapov AE, Koronkevich NI, Chebanov MS. Guidelines for the regulation of the permissible irretrievable withdrawal of river flow and establishment of ecological flow (discharge), issued under the State Contract No. M-08-18, on May 16, 2008 [Metodicheskiye ukazaniya po normirovaniyu dopustimogo bezvozvratnogo iz'yatiya rechnogo stoka i ustanovleniyu ekologicheskogo stoka (popuska)]. Moscow: Federal'noye gosudarstvennoye uchrezhdeniye "Mezhvedomstvennaya ikhtiologicheskaya komissiya", 2008:40.
 9. Dubinina VG, Kosolapov AE, Koronkevich NI, Chebanov MS, Skachedub EA. Methodological approaches to ecological regulation of the irretrievable withdrawal of river flow and establishment of ecological flow (discharge) [Metodicheskiye podkhody k ekologicheskomu normirovaniyu bezvozvratnogo iz'yatiya rechnogo stoka i ustanovleniyu ekologicheskogo stoka (popuska)]. *Water Economy of Russia [Vodnoye khozyaystvo Rossii]*. 2009;3:26-61.
 10. Dubinina VG, Kosolapov AE, Koronkevich NI, Chebanov MS, Nikitina OI. On the methodological guidelines for the regulation of the permissible irretrievable withdrawal of river flow and establishment of ecological flow (discharge) and their update [O metodicheskikh ukazaniyakh po normirovaniyu dopustimogo bezvozvratnogo iz'yatiya rechnogo i ustanovleniyu ekologicheskogo stoka (popuska) i ikh aktualizatsii]. *Transboundary water bodies: use, management, protection [Transgranichnyye vodnyye ob'yekty: ispol'zovaniye, upravleniye, okhrana]*. Collection of materials of the All-Russian Research and Practice Conference with International Participation, Sochi, использования // Известия СКНЦВШ. Серия «Естественные науки». Вып. 1. С. 84-88.
 7. Дубинина В.Г. 2001. Методические основы экологического нормирования безвозвратного изъятия речного стока и установления экологического стока (попуска). М.: Экономика и информатика. 118 с.
 8. Дубинина В.Г., Косолапов А.Е., Коронкевич Н.И., Чебанов М.С. 2008. Методические указания по нормированию допустимого безвозвратного изъятия речного стока и установлению экологического стока (попуска) по Государственному контракту № М-08-18 от 16 мая 2008 г. М.: Федеральное государственное учреждение «Межведомственная ихтиологическая комиссия». 40 с.
 9. Дубинина В.Г., Косолапов А.Е., Коронкевич Н.И., Чебанов М.С., Скачедуб Е.А. 2009. Методические подходы к экологическому нормированию безвозвратного изъятия речного стока и установлению экологического стока (попуска) // Водное хозяйство России. № 3. С. 26-61.
 10. Дубинина В.Г., Косолапов А.Е., Коронкевич Н.И., Чебанов М.С., Никитина О.И. 2021. О методических указаниях по нормированию допустимого безвозвратного изъятия речного и установлению экологического стока (попуска) и их актуализации // Трансграничные водные объекты: использование, управление, охрана: сборник материалов Всероссийской научно-практической конференции с международным участием, г. Сочи, 20-25 сентября 2021 г. Новочеркасск: Лик.

- September 20-25, 2021 [*Sbornik materialov Vserossiyskoy nauchno-prakticheskoy konferentsii s mezhdunarodnym uchastiyem*]. Novocherkassk: Lik, 2021:109-114.
11. Dubinina VG, Kosolapov AE, Koronkevich NI, Nikitina OI, Chebanov MS. Updating the guidelines on the regulation of the permissible irretrievable withdrawal of river water and the establishment of ecological flow for the conservation of aquatic ecosystems [Aktualizatsiya metodicheskikh ukazaniy po normirovaniyu dopustimogo bezvozvratnogo iz'yatiya rechnogo i ustanovleniyu ekologicheskogo stoka dlya sokhraneniya vodnykh ekosistem]. *Water Economy of Russia: Problems, Technologies, Management [Vodnoye khozyaystvo Rossii: problemy, tekhnologii, upravleniye]*. 2022;2:16-26.
 12. Katunin DN, Bechetnova TS, Dubinina VG. On the issue of economic assessment of damage to the fish stocks of the Volga-Caspian Region under different levels of water availability for the spawning fish cycle [K voprosu ob ekonomicheskoy otsenke ushcherba rybnym zapasam Volgo-Kaspiya pri razlichnoy vodoobespechennosti nerestovogo tsikla ryb]. *Fishery [Rybnoe khozyaystvo]*. 2013;2:47-52.
 13. Kozlitina SV, Volovik SP, Dubinina VG, Nечepurenko IG, Volovik GS. Modeling the fish industry requirements for the water regime of the River Don [*Modelirovaniye trebovaniy rybnogo khozyaystva k vodnomu rezhimu r. Don*]. *Collection of scientific papers (1996-1997): The main problems of fishery and protection of fishery reservoirs of the Azov-Black Sea basin) [Sbornik nauchnykh rabot (1996-1997 gg.): Osnovnyye problemy rybnogo khozyaystva i okhrany rybokhozyaystvennykh vodoyemov Azovo-Chernomorskogo basseyna. Rostov-na-Donu]*. Rostov-on-Don, 1998:357-370.
 14. Pavlov DS, Katunin DN, Alekhina RP, Vlasenko AD, Dubinina VG, Sidorova MA. The requirements of fish industry for the volume of spring discharge into the Volga River delta [Trebovaniya rybnogo khozyaystva k ob'yemu vesennykh popuskov v del'tu Volgi]. *Fishery [Rybnoe khozyaystvo]*. 1989;9:29-32.
 15. Pastukhova EV, Dubinina VG, Epishin NB, Prokhorov VG. The concept of ecological risk for aquatic ecosystems [*Kontseptsiya ekologicheskogo riska vodnykh ekosistem*]. *Abstracts of the II All-*
 11. Дубинина В.Г., Косолапов А.Е., Коронкевич Н.И., Никитина О.И., Чебанов М.С. 2022. Актуализация методических указаний по нормированию допустимого безвозвратного изъятия речного и установлению экологического стока для сохранения водных экосистем // *Водное хозяйство России: проблемы, технологии, управление*. №2. С. 16-26.
 12. Катунин Д.Н., Бесчетнова Т.С., Дубинина В.Г. 2013. К вопросу об экономической оценке ущерба рыбным запасам Волго-Каспия при различной водообеспеченности нерестового цикла рыб // *Рыбное хозяйство*. № 2. С. 47-52.
 13. Козлитина С.В., Воловик С.П., Дубинина В.Г., Нечепуренко И.Г., Воловик Г.С. 1998. Моделирование требований рыбного хозяйства к водному режиму р. Дон // *Сборник научных работ (1996-1997 гг.): Основные проблемы рыбного хозяйства и охраны рыбохозяйственных водоемов Азово-Черноморского бассейна*. Ростов-на-Дону. С. 357-370.
 14. Павлов Д.С., Катунин Д.Н., Алехина Р.П., Власенко А.Д., Дубинина В.Г., Сидорова М.А. 1989. Требования рыбного хозяйства к объему весенних попусков в дельту Волги // *Рыбное хозяйство*. № 9. С. 29-32.
 15. Пастухова Е.В., Дубинина В.Г., Епишин Н.Б., Прохоров В.Г. 1991. Концепция экологического риска водных экосистем // *Тезисы докладов II Всероссийской конференции по рыбохозяйственной токсикологии*. СПб. С. 89-91.
 16. Руководство по составлению

- Russian Conference on the Fishery Toxicology [Tezisy dokladov II Vserossiyskoy konferentsii po rybokhozyaystvennoy toksikologii].* Saint-Petersburg, 1991:89-91.
16. Guidelines for water management balance [Rukovodstvo po sostavleniyu vodokhozyaystvennykh balansov]. New York, 1974:89.
17. Fashchevsky BV. Ecological substantiations of the permissible degree of river flow regulation – an overview [Ekologicheskiye obosnovaniya dopustimoy stepeni regulirovaniya rechnogo stoka – obzornaya informatsiya]. Series 87.19.91, Environmental protection [Seriya 87.19.91, Okhrana okruzhayushchey sredy]. Minsk: Tsentral'nyy NII kompleksnogo ispol'zovaniya vodnykh resursov, 1989:52.
18. Fashchevsky BV. Fundamentals of Ecological Hydrology [Osnovy ekologicheskoy gidrologii]. Minsk: Ecoinvest, 1996:240.
19. Federal law “On Environmental Protection” [Federal'nyy zakon “Ob okhrane okruzhayushchey sredy”]. No. 7-FZ, issued on 10.01.2002.
- водохозяйственных балансов. 1974. Нью-Йорк. 89 с.
17. Фащевский Б.В. 1989. Экологические обоснования допустимой степени регулирования речного стока. Обзорная информация. Серия 87.19.91, Охрана окружающей среды. Минск: Центральный НИИ комплексного использования водных ресурсов. 52 с.
18. Фащевский Б.В. 1996. Основы экологической гидрологии. Минск: Экоинвест. 240 с.
19. Федеральный закон «Об охране окружающей среды» № 7-ФЗ от 10.01.2002.

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МЕЖДУНАРОДНЫЙ НАУЧНЫЙ ПРОЕКТ ПО ТРАНСГРАНИЧНЫМ РЕКАМ «ЭКОЛОГИЧЕСКИЙ СТОК – ОСНОВА СОХРАНЕНИЯ ЭКОЛОГИЧЕСКОЙ СИСТЕМЫ»

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Работа выполнена в рамках проекта «Аналитическое исследование на тему «Экологический сток – основа сохранения экологической системы» по линии Конвенции по охране и использованию трансграничных водотоков и международных озер (1992 г), принятой под эгидой Европейской экономической комиссии Организации Объединенных Наций (ЕЭК ООН). Исполнителем данного Проекта является ТОО «Казахстанское Агентство Прикладной Экологии» (далее – КАПЭ) при взаимодействии с Секретариатом Конвенции по трансграничным водам. В Проекте участвовали страны Центральной Азии. Статья посвящена обзору особенностей управления трансграничными водными объектами Центральной Азии и фокусируется на рассмотрении проблемы учета экологического стока, важного для сохранения их экосистем. Описаны методические подходы определения объема допустимого безвозвратного изъятия и установления экологического стока (попуска), сформулированные российскими и казахстанскими участниками и охарактеризованы исследования, выполненные участниками проекта на трансграничных реках в их странах. На основе полученных

результатов сформулированы рекомендации по сохранению и восстановлению водных экосистем трансграничных рек.

Ключевые слова: межправительственные соглашения, трансграничные реки, деление водных ресурсов, экологический сток, допустимое безвозвратное изъятие стока. сохранение водных экосистем.

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