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«____» _____ 2019 p.

RESEARCH REPORT

"Analysis of the impact of the environment of Danube River Delta which follows from the already implemented work related to the project "Danube-Black Sea Deep-Water Navigation Channel on the Ukrainian section of the Delta " (stage 1 and on full development) with the development of compensatory measures and measures to mitigate the likely impact based on the materials of integrated environmental monitoring 2004-2017 and the results of field monitoring observations (at least in a transboundary context) "

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INTRODUCTION

On the basis of the Law of Ukraine "On Environmental Protection" dated

06.06.1991 No. 1264-XII, the Law of Ukraine "On Environmental Impact Assessment" dated 05.23.2017 No. 2059-VIII, Resolution of the Cabinet of Ministers of Ukraine dated 20.07.1996 No. 815 " On approval of the Procedure for the implementation of state water monitoring ", Decree of the Cabinet of Ministers of Ukraine dated 10.07.1998 No. 1057" on approval of the "Concept for the protection and reproduction of the environment of the Azov and Black Seas" and Decision of the Interdepartmental Coordinating Council (hereinafter referred to as the ICC) on the implementation in Ukraine of Convention on Environmental Impact Assessment in a Transboundary Context, Protocol dated 05.21.2018 by the by the Ukrainian Scientific and Research Institute of Ecological Problems (USRIEP) carried out the work "Analysis of the impact of the environment of Danube River Delta which follows from the already implemented work related to the project "Danube-Black Sea Deep-Water Navigation Channel on the Ukrainian section of the Delta " (stage 1 and on full development) with the development of compensatory measures and measures to mitigate the likely impact based on the materials of integrated environmental monitoring 2004-2017 and the results of field monitoring observations (at least in a transboundary context) "

In carrying out the work, the results of the research work "Integrated environmental monitoring of the environment during the operation of the Danube-Black Sea Deep-Water Navigation Canal (DWNC) in 2017. The area of the sea accesse channel with the development of the project "Implementation of operational dredging" and taking into account the materials:

- Report "On the likely significant adverse transboundary impacts of the Danube - Black sea navigation route at the border of Romania and the Ukraine", Espoo inquiry commission, July, 2006, UN Economic Commission for Europe (UNECE);

- "Assessment of the possible transboundary environmental impacts of the Danube - Black Sea DWNC in the Ukrainian section of the delta. The second edition of the annex to the EIA as part of the working draft "Creating a deep-water navigation channel Danube-Black Sea in the Ukrainian section of the Delta. Full development "; as well as the results of full-scale control observations during the stoppage of work on the implementation of the project of the Danube - Black Sea DWNC.

Studies on the environmental impact assessment of the Deep-Water Navigation Canal in the Ukrainian section of the Danube Delta (project of the Danube-Black Sea DWNC), conducted by the Ukrainian Scientific and Research Institute of Ecological Problems (USRIEP) and co-contractors, since 2002 confirm the absence of possible significant negative environmental impacts of the project. In addition, these works confirmed the environmental safety of the construction and operation of the Danube-Black Sea DWNC and the feasibility of the implementation of the route variant on the Bystriy branch, as the most environmentally safe by a set of criteria.

In the course of the work, a strategy for managing the environmental safety of DWNC was proposed, which is aimed on improvement of design solutions according to the criteria of the state of the Delta biota; recommendations on environmentally friendly dredging technology have been developed. Based on the results of the work, a program of integrated environmental monitoring (further Program) was developed and implemented, that is aimed at eliminating uncertainties in environmental impact assessments. Environmental monitoring was founded in 2004.

The analysis of the results of the studies allows us to conclude that there are no possible significant negative transboundary environmental impacts as a result of the project and confirms the environmental safety of the construction and, in the future, the

operation of the Danube-Black Sea DWNC.

The DWNC environmental safety management strategy has the priority of improving design decisions according to criteria for the state of Delta biota; development of recommendations on environmentally friendly technology for dredging work and operation of the shipway.

Based on the results of the work, a program of integrated environmental monitoring (further Program) was developed and implemented, that is aimed at eliminating uncertainties in environmental impact assessments [annex].

The main attention during the monitoring work was aimed at tracking the actions (direct and indirect) of the operational dredging of the route of the sea accesse channel and shipping on the ecological state of water bodies, as well as other factors of a natural and anthropogenic nature, form the situation in the studied region (hydrological regime, volumes of water and sediment flow, hydrochemical regime of the Danube flow, dynamics of the Delta marine region, the development of nutritive base organisms groups of fish, etc.). Monitoring was also required by the state of the adjacent water and coastal ecosystems of the Danube Biosphere Reserve, as well as obtaining the necessary information on possible transboundary impacts in accordance with the requirements of the Espoo Convention, in particular identified by the Commission upon request as "probably significant negative transboundary impacts", which taken into account when adjusting the Program.

In different years, leading scientific institutions have been involved as co-contractors in the implementation of the program: the Danube Hydrometeorological Observatory (DGMO), Odessa Center of the Southern Institute of Marine Fisheries and Oceanography (ODC YuzhnNIRO), State Project Development & Research Institute of Marine Transport CHORNOMORNDIPROEKT State Enterprise, Odessa branch of the Institute of Biology of Southern Seas of NASU (OB IBSS), Danube Biosphere Reserve of NASU (DBR), Institute of Hydrobiology of NASU (IGB), Institute of Zoology of NASU, Ukrainian Center for Land and Resources Management, Ukrainian scientific center of Ecology of Sea (UkrSCES), etc.

Detailed substantiated materials to the made conclusions and proposals are given in the reference materials.

1. Analysis of the scale of the impact on the environment, which arose as a result of the construction and operation of objects of the Danube-Black Sea Deep-Water Navigation Canal according to the results of integrated environmental monitoring that accompanied the work in accordance with the project of Phase I and the project for full development (At least in a transboundary context)

Monitoring of the surface and sea waters of the Ukrainian section of the Danube Delta and assessment of the impact of dredging and soil dumping were carried out by a number of organizations during 2004-2019. Fig. 1.1 shows the location of the main points of quality control of surface waters of the river part of the Ukrainian section of the Danube Delta. A seawater quality monitoring station on the seashore near the Ukrainian section of the Danube Delta is shown in Fig. 1.2.

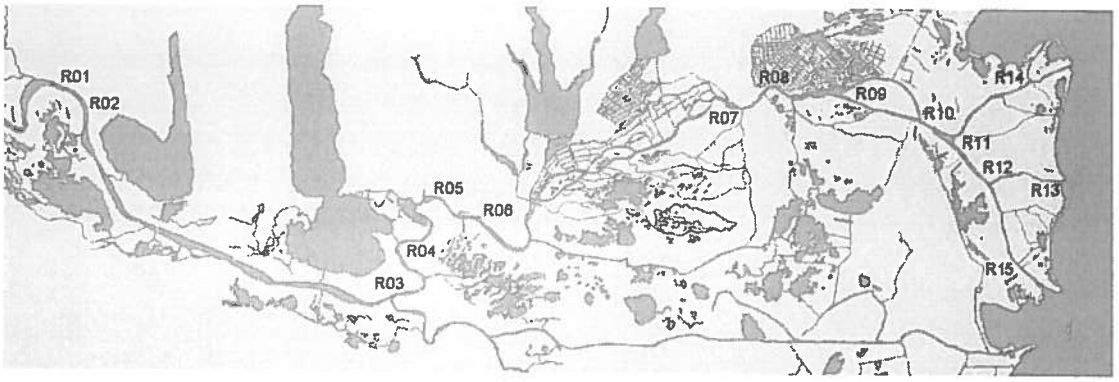

Fig. 1.1 Main monitoring points of the river part of the Ukrainian section of the Danube Delta

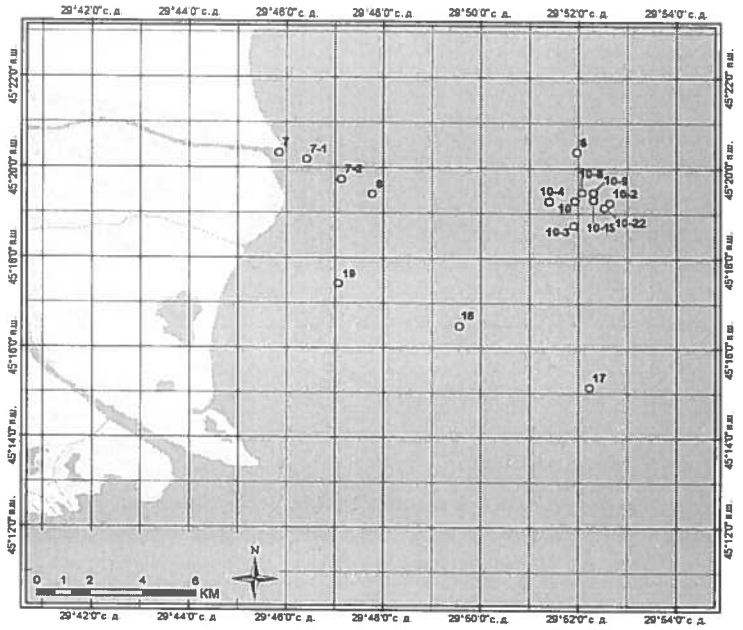

Fig. 1.2 Location of monitoring stations on the seashore of the Ukrainian section of the Danube Delta

1.1. Impact on the redistribution of water flow between the branches of the Danube and the branches of the Chilia Delta.

The development of the marine Chilia Delta is influenced by the constant decrease in water flow at the source of the Chilia branch. The modern evolution of the Bystriy branch is defined as a decrease in runoff in the upper part of the Chilia Danube Delta, and the conduct of hydrotechnical work to deepen this branch during the restoration and operation of the DWNC. These changes mainly compensate each other as the analysis of the measurement data shows. In general, the water flow of the Bystriy branch (removal of water and sediment) has slightly changed in recent years. The same applies to the Starostambulsky branch. The decrease in the water flow of the Chilia system mainly affects the water content of the Ochakov branch. It is likely that in the future, with the support of navigable conditions in the Bystry and the shallows of the Chilia branch in the headwaters of the Danube Delta (Izmail Chatal) and on the large watercourses of the Chilia branch a relative equilibrium will be established in the redistribution of the flow.

Conducting hydrotechnical works on the Bystriy branch bar did not cause changes in the flow redistribution trends at the apex of the Delta when the Danube divided into Kiliysky and Tulchinsky branches. The restoration of the DWNC has also not changed the current trends in the development of the water flow of the Chilia Delta. Long-term hydrological studies in the Delta and on the Danube coast showed that the Bystriy branch continues to increase runoff. This process has been observed in the branch over the past 50 years and has been slightly enhanced thanks to hydraulic engineering works on its bar since 2004. However, hydrotechnical work on the bar of Bystriy branch did not affect the trend of increasing / decreasing part of the flow with an increase in the Danube water content, did not cause changes in the flow redistribution trends in the forks of the main Delta branches: Chilia , Tulchinsky, Sulinsky and Georgievsky, and also did not change the natural development trends of the Kilia Delta's branches: branchs that reduced the flow (Ochakov and its branches system; Starostambulsky, below the source of the Bystroi branchs and its watercourse systems) is continued its decline. All this also confirms the lack of transboundary impact of DWNC on the hydrological regime of the Danube Delta.

The discharge flow of the Chilia branch in the section from Izmail Chatal (the top of the Danube Delta) to Vilkovo is on average 100-120 m3 / s and associated with the filling of the Danube lakes and water intake for domestic and economy needs. Thus, the proportion of runoff of the Chilia branch in the Vilkovo region (stream gauge 20 km) decreased by 2015 to 47.1%.

1.2. Impact on the quality of the aquatic environment in places of dredging and dumping of soil (suspended substances, biogenic substances, pollutants, etc.)

According to the analysis of data obtained within special monitoring of the Danube Delta carried out over period of 2004-2018, as well as during control observations directly in the course of dredging and dumping, the following should be noted.

The impact of dredging on the quality of the Danube and the coast waters had a local character.

In general, according to average levels of indicators of 2004-2018 years, the

waters of the Ukrainian section of the Danube Delta were grade II of Environmental Assessment, between 2 and 3 categories ("very good - good" for the ecological state, "clean - relatively clean" in terms of purity); and according to the average of the worst levels of indicators of class - III, 4 categories with a transition to 5 ("satisfactory with a transition to mediocre" by ecological state, "slightly polluted with transition to moderately polluted" by degree of purity).

The largest contribution to the level of indices of the overall environmental assessment at all points and in all seasons was given by a block of indicators of the trophic-saprobiological state of waters. Especially in this sense, It can be noted the suspended substances, the content of nitrite and nitrate nitrogen.

According to the classification recommended by TNMN, poor water quality was noted in terms of COD, phosphate content, nitrate and nitrite nitrogen. The average index of water quality for the observation period for this classification was 1.5 (between classes I and II), and the average index of the worst over seasonal dynamics is 2.8 (class III with the transition to II).

A slight excess of household MPC is noted for average COD levels, concentrations of phenols and total iron. The greatest exceedances of fishery MACs were observed in terms of metal content.

The average ratio of mineral nitrogen to mineral phosphorus did not fall below 16, so the development of organisms that need mineral compounds of nutrients (plants, microorganisms) was limited by phosphorus. The highest average phosphate content was observed in 2005. However, since the phosphate content was also maximum separately at the point above Reni (R01) in 2005, this does not prove the effect of dredging on the phosphate content.

The content of suspended solids fluctuated in quite considerable limits both in the interannual and in seasonal measurement. The highest average annual concentration of suspended solids in the region as a whole was recorded in 2005, however, since the highest average annual concentration of suspended solids was also noted separately in the points above that year it is doubtful that the main reason for this was the impact of dredging in the Ukrainian sector.

In the marine area, there have been periodic cases of oxygen deficiency, but not only in the dumping area, but also in other areas (sometimes at most of the deep points).

In sea waters off the coast of the Danube Delta, both the content of nutrient element compounds and the ratio of the concentrations of mineral forms of nitrogen and phosphorus varied in a very wide range (up to analytical zero for the content of ammonium phosphates and nitrogen). In a rather significant part of cases, the development of groups that consume mineral forms of nutrients (bacteria, plants) was limited by nitrogen. In some cases (for example, in the autumn period of 2017), the maximum content of mineral nitrogen was observed in the zone of probably significant influence of fresh water (stations of group 7); in the dumping area (station of group 10), the content of mineral nitrogen was significantly lower.

According to the subjects of monitoring, dredging in the bar area only on a small area contributed to an increase in the concentration of suspended solids. Also, obviously, by dumping. For example, in November 2004, in the dumping area (station 10), an increased (although not maximum at that time) content of suspended solids was observed; however, in the points located nearby (stations 6 and 13), the content of suspended solids was significantly lower.

The MPC excess for sea water was noted in terms of pH, BOD5, oxygen content,

ammonium and nitrite nitrogen.

The influence of the geochemical boundary of seawater and river waters has played a significant role in determining the quality of the seawater quality of the Danube Delta.

1.3. Impact on the dynamics of the Delta seaside, coastal neoplasms

Analysis of observational data on the dynamics of spatio-temporal changes in the coastline of the Danube estuary in the period 1972-2017. Indicates seasonal fluctuations while preserving the overall shape of structural elements. In particular, the general tendency is to extend the sea edge of the Chilia Delta in the section from the mouth of the Potapovsky branch to the mouth of the Tsiganskiy branch, at the southern end of the Ptichaya bay its shift towards the coast within the limits of natural evolution is observed. The influence of operational dredging works on morphodynamic processes is limited only by the coastal section adjacent to the mouth of the Bystry branches. The impact, as well as on this site is not significant, and the effect of soil dumping, as well as dredging works in the channel part, is local.

1.4. Impact of operation of sea soil dump in the adjacent areas

During the construction and operation of the sea bar part of the DWNC, from 2004 to 2017, 8 km from the bar of the Bystry mouth accumulated bottom sediments developed during dredging on the DWNC Danube-Black Sea access channel.

According to the results of specialized observations and mathematical modeling (State Project Development & Research Institute of Marine Transport CHORNOMORNDIPROEKT State Enterprise), it was not possible to record the effects of soil excavation on the sea access channel and soil dumping in the dumping area on the increase in the content of pollutants in the water column. This is due to the fact that dredging works on the sea access channel took place in the immediate vicinity of the mouth of the branches Bystriy and the impact of dredging was leveled by a solid Danube drain even at average water consumption. In the area of dumping, the scattering of the cloud of turbidity occurred fairly quickly, possibly due to the high water content of the soil, which is discharged, and the hydrodynamic activity of the region's waters.

It has been established that, at a seasonal average flow velocity in this area, from 0.10 to 0.15 m / s, the suspension fraction with a hydraulic particle size of F 0.32 cm / s cannot be outside the control range. All material whose concentration (self-purification) decreases in the aquatic environment due to subsidence to the bottom will not be carried further 900–950 m from the discharge point with a radius of the ground shaft equal to 925 m but will not reach the natural reserve areas. After 10:00 after discharge, the concentration of the polydisperse suspension in the center of the spot of increased turbidity will decrease by about 100 times and will be 2 to 12 mg / dm^3 with an average concentration of 4 mg / dm^3. The spot radius will be approximately 60-70m. The maximum spot radius (75-85 m) will be observed in about 25-30 hours, and the maximum suspension concentration in it will be 3-4 mg / dm^3, and the average - 1-2 mg / dm^3.

The amount of suspension that crosses the control target will be in the range of 45-50% of its total amount, got into the aquatic environment at the discharge points. This suspension will be represented by fractions with a hydraulic size of not more than 0.05

cm / s. Calculations showed that within the dump, these soil particles will drift under the influence of waves and wind-wave currents (will be 1417.00-1771.25 m. That is, it does not exceed 2 km with different wind directions.

1.5. Effect on ichthyofauna, its composition, spawning conditions, industrial stocks

Fish are the most important element of the fauna of the estuary zone of the Danube. The significant size of freshwater and brackish water areas, favorable trophic conditions of the delta led to a high biological diversity and density of ichthyofauna. The fish stocks of the mouth of the Danube are one of the main natural resources of this region, an important object of economic activity is fishing and processing.

One of the reasons for the decrease in the fishery value of water bodies may be an increase in alien species of aquatic organisms, the variety and number of which, in turn, depend, among other things, on the intensity of shipping.

The available data shows that an increase in the water area of the Black Sea of invasive species of aquatic organisms (including fish) was observed long before the construction and commissioning of the DWNC Danube-Black Sea.

The most valuable fish species in this region are sturgeons. For this group of fish, poaching and by-catch in approved fishing gear are considered the most important threat. At the same time, in modern conditions poaching acquires a hidden form under the guise of legal fishing with nets with an approved eye.

Downstream migration of sturgeon young from the Danube to the Black Sea in the Ukrainian part of the river during 1963-2013. Significantly decreased. In this case, the most significant reduction occurred before the start of work on the creation and operation of the DWNC Danube-Black Sea.

The main effect of dredging and storage of soils with the support of the passport characteristics of the sea access channel of the DWNC, , is manifested primarily in the impact on fish feed, to a lesser extent on conditions of their reproduction and young juveniles as the long-term studies of many scientific organizations (including Odessa Center of the Southern Institute of Marine Fisheries and Oceanography (ODC YuzhnNIRO)) show. Moreover, this action is mainly limited to local areas during the period of work, which is determined by a short-term increase in the concentration of suspended solids in water.

The direct impact of soil development and dumping on ichthyofauna is negligible. The relationship between the scale of navigation on the river, the volume of dredging on the sea access channel at the Bystriy branch and the magnitude of both the total commercial fish catches and herring has not been established.

In general, the results of ichthyological monitoring indicate that work associated with DWNC does not significantly affect the bioproductivity of their area. This is confirmed, in particular, by the data of the inter-annual dynamics of fish catch, which indicate the absence of effects on fish resources during the period of operation of the DWNC.

The sea access channel is located in the mixing zone of fresh river and sea waters, where unfavorable conditions are created for the spawning of most native fish species. In this regard, dredging works that occur here do not entail a significant impact on the reproduction of fish stocks. Minor damage (given the small area, is affected) can be caused only in the area of the dumping of the soil and is not of a transboundary nature.

Thus, a significant impact of work related to the activities of DWNC on the state of populations of migratory and aquatic fish species has not been established.

Annually, based on the results of monitoring studies and taking into account the actual volumes of operational dredging, the values of losses that were caused to aquatic biological resources (fisheries) during dredging were determined.

Compensation funds for the performed work (for losses to fisheries) are most expediently directed to the acquisition and installation of a plant for breeding valuable species of fish (sturgeon, cyprinidae). The operational experience of such plants proved their feasibility and economic efficiency in restoring the population of rare fish species.

1.6. Impact of shipping and dredging works on biodiversity, in particular aquatic and coastal ecosystems of the Danube Biosphere Reserve

The wetlands of the Danube Delta are very important in preserving the biodiversity of the region, the country and the world and are of extreme ecological importance in the conditions of deterioration of the natural environment in Ukraine and the world as a result of anthropogenic impact.

In general, the results of integrated environmental monitoring provide an opportunity to assert about the absence of a direct effect on the restoration and operation of the Danube-Black Sea DWNC on biotic groups. The most significant violations of the structure of biotic communities were recorded in the places of direct dredging and, in general, had a local character and a short period. Studies have shown that the actual changes in the components of the natural environment, which occur under the influence of the activities on the restoration of DWNC, do not exceed the predicted, and often less significant. Changes that were noted in the state of the Danube Delta ecosystem, mainly due to the traditional complex of factors of natural impact; The development of plant and animal communities in the Delta was primarily associated with climatic and seasonal hydrological changes. In all areas of monitoring, the significant transboundary impact of the activities for the restoration and operation of the DWNC Danube-Black Sea has not been established.

The results of a set of studies carried out since the beginning of work to restore navigation in the Ukrainian part of the Danube Delta indicate a lack of significant transboundary impacts on fish fauna and avifauna caused by construction activities, and a low probability of such impacts occurring in the future, given the established seasonal and spatial restrictions on such work.

After normalization of the hydrological regime of Ermakov island in 2009. There is a rapid restoration of natural wetland ecosystems and the enrichment of the biodiversity of the island and the Danube Biosphere Reserve as a whole, which is of particular relevance at the present time, when many ecosystems of Ukraine require an access to the natural state.

It can be predicted that strengthening the movement of vessels in connection with the restoration of DWNC will contribute to enhancing the migration of invasive species, since the Danube is considered a large invasive corridor from Ukraine to Europe, as well as one of the powerful migration routes for invasive species to Ukraine. In total, during the integrated environmental monitoring of the restoration and operation of the DWNC Danube - Black Sea in the period 2004-2018. Individual new species of plants, hydrobionts, avifauna, reptiles, whose quantitative development was generally characterized as insignificant and such that it does not have a significant effect on the

Delta ecosystems, were discovered.

During the research, certain changes and patterns were noted at the level of groups and ecosystems, in particular:

- construction of a protective dam in the bar area of the mouth of the Bystry leads to changes in the composition of sand and littoral vegetation in the coastal part of Stambulsky Island with an increase in the proportion of meadow species and common reed, and on the coast - the formation of detritus-sandy vegetation with a predominance of ruderal species;
- during periods of low water level and low flow in the Danube observed the presence of a wedge of salty seawater in the lower reaches of the Bystry estuary, from the barom to 5–6 km. Together with sea water, marine species of aquatic organisms penetrated into the estuary;
- desalination of the zones adjacent to the estuarine zone led to changes in the macrozoobenthos species composition: the salt-water fauna was replaced by freshwater, but in general the quantitative characteristics of the macrozoobenthos did not undergo significant changes.
- favorable conditions are created in the bar part of the Bystry branch (especially in shallow bodies of water that warm up well) for the development of the Ponte-Caspian fauna (mainly small crustaceans), which is notable for its high productivity. During the study period, the number of these species in the branchs and reservoirs of the lower Delta of changes in very insignificant limits, indirectly indicates minor changes in the environmental conditions of the studied water bodies.

The *set of mitigating measures* provided for by the project allows preventing significant cross-border cumulative effects of DWNC Danube - Black Sea during the operation period on the life of fish and birds of the Danube Delta in the context of the adjustment of this complex at the stage of post-project analysis based on the results of systematic studies of manifestations of cumulative effects.

In general, an analysis of the results of integrated environmental monitoring in 2004-2019. It indicates the absence of a significant impact of shipping and dredging on biodiversity, in particular, aquatic and coastal ecosystems of the Danube Biosphere Reserve. Noticeable disturbances in the state of the Danube ecosystem, as well as a significant transboundary impact on biological indicators were not detected. To maintain the normal functioning of the natural complex of the delta of the river. The Danube is generally directed at environmental protection measures provided for by the GHA project for full development.

1.7. The environmental impact of the construction of the dam of the sea access channel

To the main consequences of the construction of the dam of the sea access channel on the environment in the period 2004-2018, should be attributed below:

- the construction of the dam did not significantly affect the quality of the aquatic environment, the formation of new biotopes not characteristic of the Chilia Danube Delta was observed;
- the influence of the dam as new biotope - substrate, was to resettle organisms of various taxonomic groups, including invasive species, attached organisms of filter feeders, sedimentators, carrying out a certain influence on the dam not on the formation of water quality and the transformation of substances and energy;

- the dam had a local impact on macrozoobenthos in the bar part of the Bystry branch and began to play the role of an artificial reef
- the construction of a protective dam led to biotopes change, to the disappearance of typical sand-littoral vegetation in the coastal part of the Stambulsky island, where the formation of a new type of flora vegetation is determined;
- the siltation of shallow waters in the mouth part of the left mouth of the Bystry after the construction of the dam led to changes in the qualities composition of the fish fauna.

1.8. Other types of environmental impacts, if they were identified according to the results of integrated environmental monitoring or control observations when performing work on this task

An additional impact on the status of the terrestrial and river ecosystems of the Danube River is increasing of recreation.

The effect of operational dredging works using new technologies within the sea access channel through the Bystriy Bar is local and does not worsen the environmental situation.

In conditions of usually high turbidity of the Danube water, an additional increase in the concentration of suspended matter in the places of the dougle destructive work is local.

Supplementing of still insufficient information for assessing some possible negative impacts of DWNC Danube - Black Sea, not referred by the Commission at the request to the likely significant transboundary impacts including long-term influence on the morphology of the Romanian coast between the Chilia and Sulina branches as a result of the construction of a protective dam and operational dredging at the Bystriy branches bar, which needs further research.

During the in-depth studies, additional information was obtained on the part that the Commission did not assess at the request of the likely negative transboundary impacts, which testifies to their local and limited, in addition, studies of these impacts will be continued as a result of further monitoring studies.

Existing influences at this time on the hydrological regime, the Delta morphodynamics, the quality of river and sea water, and feed water. fish base, place of residence, population of birds and the biodiversity of birds, including especially valuable and vulnerable species are local and limited, that is, those that will not lead to significant changes in the main environmental parameters and biodiversity losses of the Danube Delta.

2. Control observations during the stoppage of work on the implementation of the DWNC Danube - Black Sea project.

Ship expeditions

During the stoppage of work on the project of the DWNC Danube - Black Sea on July 11 and additionally July 21-22, 2019 the studies of the chemical composition of water and the main groups of aquatic organisms to assess the impact of stopping dredging were carried out. The studies were carried out in the access channel and the place of dumping of the soil at the points at which samples of groups of hydrobionts were studied before stopping the work on DWNC. The work was carried out according to the scheme, which included 8 stations (Fig. 2.1.).

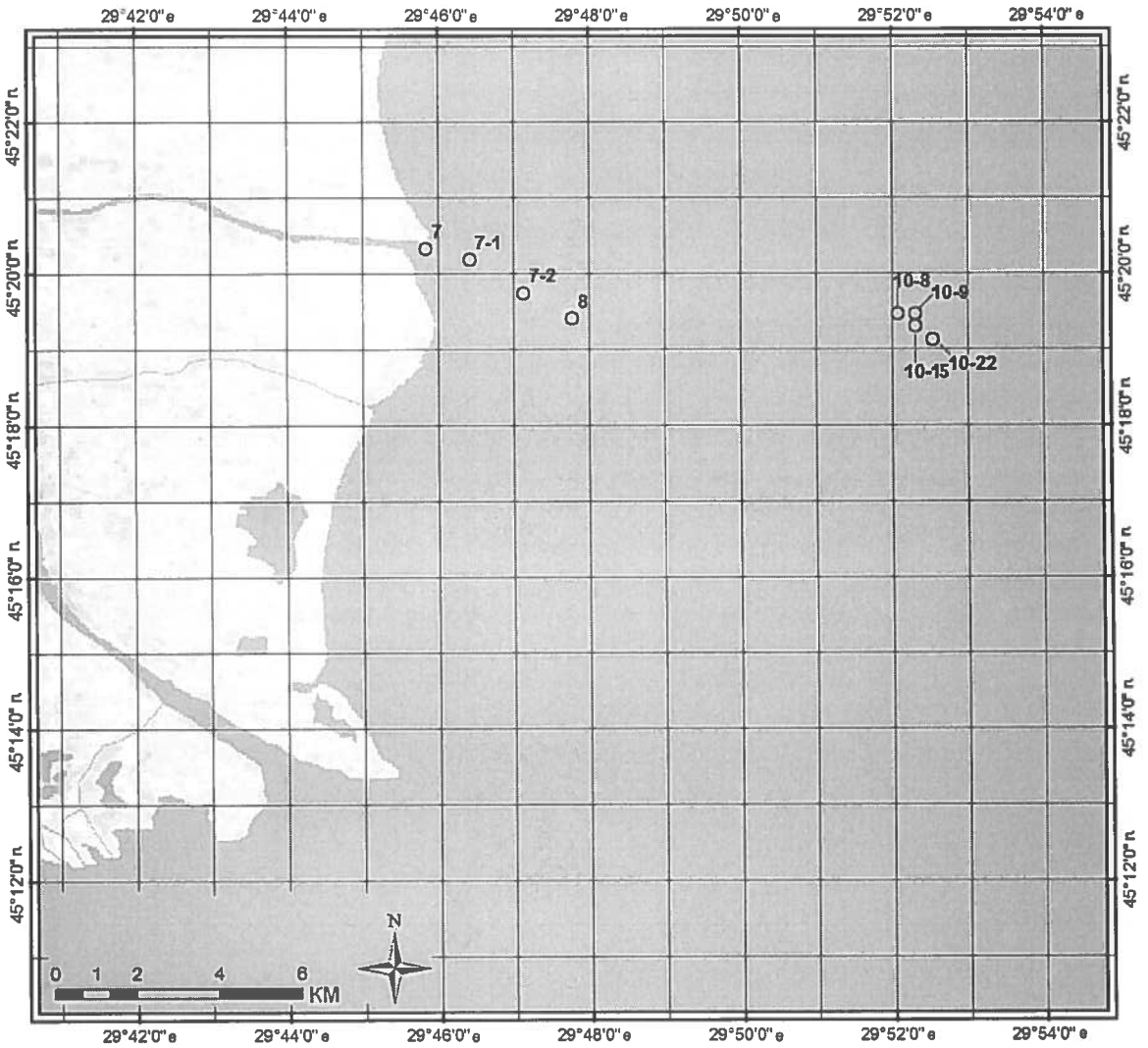

Fig. 2.1– Scheme of control observations stations

At each station, a complex of hydrological, hydrochemical and hydrobiological works was performed by standard methods. At all stations to determine salinity, phytoplankton, zooplankton and hydrochemical analyzes the water samples were taken. The temperature in the surface and bottom layers of water was measured directly on board. Samples were analyzed in the laboratories of USRIEP.

The coordinates of the sampling points are presented in Table 2.1

At all stations the meteorological observations were performed, water transparency was determined, and the parameters of excitement were observed. Exit to the station and location were determined using a GPS-12 Garmin. Water sampling was performed with a 2-liter plastic bathymeter. Wind speed was measured by the induction anemometer ARE-49, depth was determined using an echo sounder.

A total of 8 integrated stations were completed (Table 2.1.).

The taken samples:

Hydrology – 16 (8),

Hydrochemistry - 16,

Phytoplankton - 8,

Zooplankton - 4.

Table 2.1. Danube Seaside Stations completed in July 2019

Sampling point	* Latitude, 0	* Longitude, 0	Depth m	Transparency, Secki disk, m	Temperature C°	
					surface	botto m
The route of the marine part of the deep water navigation channel (accesse channel)						
7	450 20*310**	29045*838**	5,3	0,4	25,0	15,0
7-1	450 20*171**	29045*405**	5,2	0,5	25,0	15,0
7-2	450 19*701**	29047*201**	5,1	0,7	25,0	14,9
8	450 19*383**	29047*830**	9,3	0,8	25,0	14,9
The dumping area						
10-8	450 19*415**	29052*101**	20,2	3,0	21,0	12,3
10-9	450 19*477**	29052*323**	20,0	2,8	21,0	12,5
10-15	450 19*330**	29052*308**	20,3	2,9	20,9,0	13,1
10-22	450 19*151**	29052*509**	20,4	2,9	20,7	13,7

The results of analyzes of the selected samples and the assessment of changes in the values of the indicators studied after stopping dredging are presented below.

2.1. Hydrochemical characteristics of sea and surface water during the stop dredging

2.1.1. Hydrochemical characteristics of sea waters in the areas of the navigation course and the sea dump after stopping dredging

During the implementation of the program of studies of the impact on the Danube Delta ecosystem of dredging on the DWNC Danube-Black Sea route, as well as soil dumping at the sea dump, the indicators of water quality and bottom sediments in these areas were determined after the cessation of work.

Water sampling was carried out using a Ruttner bathometer from the near-bottom and near-surface horizons. Using the Van Wien ladle the bottom sediment sampling was carried out.

The state of the seaside waters of the Danube Delta during the period of cessation of dredging.

The Danube Delta is an ecotonic system. The conditions of such systems are usually characterized by instability and pulsating dynamics. This also applies to the nature of changes in hydrological and hydrochemical characteristics. The seasonal variation of the parameters and the influence of changing climatic and weather factors, the effects of which are often different not only in different seasons, but also in the same seasons of different years, also join the fluctuations caused by the mixing of the waters of the Danube and the Black Sea.

During the July selection in 2019, the surface layers of water in the area of the accesse channel was characterized by low salinity typical for fresh water (from 0.32 to 0.35 g / dm3), with the exception of station 8, where salinity began to increase (2.42 g / dm3). At the same time, the bottom layers of water, starting from station 7 (2), had a fairly high salinity (15 g / dm3). In the area of the sea landfill, there was also a significant influence of fresh water on the surface water layer, which was highly desalinated (from 4.44 to 4.48 g / dm3, against 15.21-18.70 g / dm3 in the bottom layers). Such cases in this water area were described in previous years, although this phenomenon was not noted in one of the 2017-2019 selections. Thus, at the time of selection in a significant part of the water area, water stratification was observed due to mineralization. It can also be assumed that not only meteorological factors, but also the processes of accumulation of bottom sediments when stopping dredging could influence the distribution of fresh water. The change in water mineralization is a significant factor that affects the loss of salts and the formation of additional suspended solids from fresh water when they reach the sea, in addition to suspended solids already present in river water. Thus, the distribution of desalinated water can affect the suspended matter content.

The suspended matter content was quite high. In the area of the canal, on average, it is 20.79 mg / dm3 in the surface layers and 50.92 mg / dm3 in the bottom layers, and in the area of the soil dump, respectively, 32.55 and 67.40 mg / dm3. During previous selections of 2017-2019, usually low values (about 8-10 mg / dm3) were observed in the area of the soil dump, although they were often noted higher in the area of the canal (more than 100 mg / dm3). But noticeable patterns in the spatial distribution of suspended solids during the July selection were not found. It should be specially noted, however, that in the near-bottom horizons at most stations the content of suspended solids was significantly higher than in near-surface ones; during previous selections of 2017-2019, such stratification was not observed. This could be attributed to the action of the factors associated with the cessation of dredging, if in the area of the sea dump there were no concentrations higher than when storing the soil, which indicates the effect of other, obviously, more powerful factors. In particular, associated with the spread of river water.

In the bottom layer of water in the channel area (station 8), an oxygen deficiency (1.94 mg / dm3) was noted, although in most cases the oxygen content was sufficient. The average oxygen saturation was below 100%. In previous years, in the studied water area during the summer period there were frequent cases of oxygen deficiency in the bottom layers, not only in the areas of work, but also in the background stations. The occurrence of oxygen deficiency in the summer is usually associated with the "bloom" of water, which, as a rule, causes a number of concomitant changes in the levels of hydrochemical parameters (oxygen regime, organic matter content and compounds of nutrients). In addition, the planktonic algae responsible for the "blooming", as a rule, are defined as one of the components of the complex of suspended substances. In the adjacent waters of the Black Sea during the period of research, cases of "blooming" of water were observed. Oxygen deficiency during the July selection may have been

exacerbated by stratification due to halocline. However, neither in May nor in 2017-2018, this was observed. Redox conditions very significantly affect all hydrochemical parameters and processes, including the ratio of the mineral forms of nitrogen.

In some samples, increased (including above MAC) ammonium nitrogen concentrations (maximum value 3.40 mgN / dm3) and phosphorus phosphates (maximum value 1.25 mg / dm3); significantly higher than during the previous selections 2017-2019. It should be noted that during previous selections of 2017-2019, the average content of nitrates and phosphates in the area of the approach channel was higher than in the area of the dump; but in the July selection of this was not observed. Based on the average ratio of the content of mineral forms of nitrogen and phosphorus, an excess of phosphorus was observed in the system; the development of biota groups that consume mineral forms of nutrients was limited by nitrogen.

At the same time, both in May and during the 2017-2018 selections, the situation was reversed. It can be assumed that these phenomena are also the result of "blooming".

The pH level of water in some cases slightly exceeded the maximum permissible concentration: the maximum pH value is 8.73 (station 10 (22), surface layer); the minimum was 6.41 (station 7, surface layer) with a MPC from 6.5 to 8.5. For the Danube waters, higher pH levels are more characteristic, as repeatedly indicated in past years. The fact that a low pH was observed "at the entrance" to the control area may indicate the influence of external factors.

Bottom sediments in the dumping area were represented by heavily silted sand, and in the area of the approach channel, sandy silt (or a transitional state between these types of sediments). The moisture content and fraction of fractions up to 65 μm in the area of the soil dump were significantly lower than in the area of the channel; the soil was more dense. A similar situation was observed in May. Therefore, in general, there were no fundamental differences in the composition and distribution of the characteristics of bottom sediments compared to May sediments.

It should be noted that large fractions of sediments in the canal area and in the dump area had a different nature. So, if large fractions of sediments in the dumping area consisted mainly of mineral inclusions, the remains of mollusk shells, small shells and individual plant residues, then in the area of the approach channel they were mainly light small peat-like plant residues with a small fraction of mineral inclusions and / or heavily crushed shells . Based on the fact that the bottom soil of the dump is formed from the bottom soil removed in the area of the canal, it can be assumed that sedimentation continues in the area of the canal, while light fractions were washed out in the area of the dump.

In the area of the dump, metal concentrations were slightly lower than in the area of the canal, however, this may be a consequence not only of a lower level of contamination, but also of a lower sorption capacity of sands compared to mules. As with metals, large concentrations of compounds of nutrients in bottom sediments in the canal area can be caused not only by their greater pollution (or by the consumption and / or leaching of nutrients in the dump area), but also by the greater sorption ability of mules compared to the sands.

Thus, analyzing the results of hydrochemical observations, the following can be noted.

In some cases, the pH level was slightly higher than the MPC for seawater.

In some samples, elevated (including above the MPC) concentrations of ammonium nitrogen and phosphorus phosphate were observed. In the bottom layer of

water in the area of the channel, oxygen deficiency was noted.

A comparison of the May and July hydrochemical characteristics of the studied water area for assessing the impact on the quality of the water of the cessation of dredging should be considered rather problematic due to the masking of this effect by the action of powerful external factors, both natural (seasonal variation, changes in hydrological conditions) and natural-anthropogenic (water blooming) character.

It can be assumed that the effect of dredging as a whole did not exceed the limits of fluctuations associated with the action of other factors in the formation of water quality in these areas.

2.1.2. Hydrochemical characteristics of the Danube water during the period of dredging work stop

Danube water has a constant composition of the main ions, among which hydrocarbonates, sulfates and calcium predominate.

Concentrations of bicarbonates ranged from 157 to 210 mg / dm3; the average concentration was 182 mg / dm3. The sulfate concentration ranged from 14.4 to 43.2 mg / dm3; the average concentration is 27.8 mg / dm3, being within the 1st category of environmental assessment (very pure water). Chloride concentrations varied from 21.3 mg / dm3 (category 2 environmental assessment, clean water) to 48.4 mg / dm3 (category 3 environmental assessment, fairly pure water); the average chloride concentration was 33.7 mg / dm3 (category 3 environmental assessment).

Calcium content varied from 46.5 to 63.3 mg / dm3; the average value was 55.8 mg / dm3. The concentration of magnesium ranged from 9.7 to 17.2 mg / dm3; the average value was 13.6 mg / dm3. The total content of sodium and potassium ions varied from 5.8 to 32.8 mg / dm3; the average value was 15.3 mg / dm3.

The silicon content ranged from 1.61 to 3.10 mg / dm3; the average value was 2.29 mg / dm3, which is almost at the level of long-term average concentration.

The content of suspended solids varied widely, from 8.3 mg / dm3 (category 2 environmental assessment) to 98.3 mg / dm3 (category 6 environmental assessment).

The transparency of the water was low and varied from 5 to 16 cm. The average transparency was 10 cm, which is close to the long-term average.

The concentration of dissolved oxygen averaged 10.0 mg / dm3, with a maximum of 12.5 mg / dm3 and a minimum of 7.07 mg / dm3. The minimum value of oxygen content corresponded to 3 categories of environmental assessment (fairly clean waters, 1 class according to TNMN).

The concentration of carbon dioxide varied from 1.96 mg / dm3 to 10.1 mg / dm3; on average, it was 5.07 mg / dm3.

The pH value varied from 7.70 to 8.20; the average value is 7.91, which is close to the average annual value, which is about 8.00, due to the natural characteristics of the Danube.

BOD5 values varied from 1.30 mgO2 / dm3 (category 2 environmental assessment, pure water, class 1 according to TNMN) to 4.13 mgO2 / dm3 (category 5 environmental assessment, moderately polluted water, 1.38 fishery use MPC, Grade 2 according to TNMN).

The size of permanganate oxidation ranged from 3.19 MGO / dmz to 4.42 MGO / dmz; on average, it was 3.88 MGO / DMZ, which corresponds to 2 categories of environmental assessment (clean water), 1 class according to TNMN.

The size of bichromate oxidizability (COD) varied from 13.3 MGO / dmz to 23.8 MGO / dmz; the average value was 19.4 MGO / DMZ (category 3 environmental assessment, fairly clean water, 1.29 household use MPC, Grade 2 according to TNMN).

The ratio of oxidation values indicates the predominance of hardly oxidizable organic compounds.

The average ammonium nitrogen content was 0.12 mgN / dm3 (environmental assessment category 2, Grade 1 according to TNMN). The amplitude of concentration fluctuations ranged from 0.03 to 0.28 mgN / dm3.

The average concentration of nitrite nitrogen was 0.025 mgN / dm3 (category 5 environmental assessment, moderately polluted water, 1.25 fishery use MPC, Grade 2 according to TNMN). An excess of the MPC level in 50% of the samples was noted.

The average concentration of nitrate nitrogen was at the level of 1.20 mgN / dm3 (environmental assessment category 6, dirty water, Grade 2 according to TNMN classification) with concentration changes from 0.53 mgN / dm3 to 1.59 mgN / dm3.

Mineral phosphorus was present in amounts from 0.020 mGy / dm3 to 0.056 mGy / dm3; an average of about 0.040 mGy / dm3 (category 3 environmental assessment, Grade 1 according to TNMN).

The ratio of the average concentrations of the mineral forms of nitrogen: phosphorus (over 67) indicates an excess of nitrogen in the system and a limitation of the development of biotic communities that consume mineral compounds of nutrients in phosphorus.

The average concentration of total phosphorus was 0.114 mGy / dm3 with an amplitude of concentration fluctuations from 0.080 to 0.162 mGy / dm3.

The concentrations of surfactants did not exceed the maximum allowable, varying from the level of analytical zero to 0.03 mg / dm3 (4th category of environmental assessment, slightly polluted water).

The phenol concentration reached 0.003 mg / dm3 (3 MAC, category 5 environmental assessment); minimum concentrations were at the level of analytical zero; the average concentration is 0.001 mg / dmz (1 MPC, category 3 environmental assessment), which is close to the level of long-term average concentrations.

The average concentration of petroleum products was the level of analytical zero. The maximum concentration reached 0.04 mg / dm3 (category 3 environmental assessment).

The concentration of hexavalent chromium averaged 3 μg / dm3 (3 fishery use MPC.), Varying from the level of analytical zero to 6 μg / dm3 (6 fishery use MPC.).

Thus, according to the analysis of the monitoring results, no significant changes in the hydrochemical status were recorded, which indirectly indicates that there is no negative impact of the operation of the DWNC Danube-Black Sea on the hydrological and hydrochemical regime of the Danube delta, incl. in the cross-border aspect.

2.2 The state of the main groups of hydrobionts that form the forage base of fish of the Ukrainian section of the Danube Delta

Samples for hydrobiological studies were taken during the period of cessation of the dredging operations on the riverbed of the Ukrainian section of the Danube River and the coast part of the Chilia delta. Sampling and treatment were performed according to standard hydrobiological methods.

2.2.1. Status of hydrobiont groups in the areas of the access channel and dumping

Phytoplankton

When analyzing 8 algologic samples taken in July 2019 at 4 stations along the coast of the Chilia Delta of the river. Danube - 7-1, 7-2, 10-15, 10-22 - in the surface and bottom layers of water, 100 species and intraspecific taxa from 8 groups of algae were found. In general, the phytoplankton of this site was represented by a diatom-chlorococcal complex of freshwater and brackish water species. The greatest species diversity was observed in the Diatoms (Bacillariophyta) - 37 species and varieties (37% of the total number of species) - and Green (Chlorophyta) - 31 taxa (31% of the total number of species).

When analyzing the algologic material, 47 types of water quality indicators were identified, determined by standard hydrobiological methods, almost half of which were indicators of β-mesosaprobic zones ("moderately polluted waters") - 22 species

The saprobity index calculated by the Pantle and Bucca method among the studied stations did not fluctuate significantly - from 1.62 (7-1 bottom) to 1.67 (7-2 floor, 10-15 floor). And in accordance with β ' - mesosaprobic zone, II class of surface water quality, 3 categories (value of saprobity index 1.6-2.0): "good" in terms of water quality, "fairly clean" in terms of purity / contamination, overwhelmingly approaching more clean border.

The obtained values of the species diversity and quantitative development of phytoplankton biomass of the studied stations of the Danube Delta in most of the analyzed samples were within the parameters of the corresponding season of the previous years or higher, especially in the surface horizons, which indicates the relative stability of the aquatic ecosystem of the study area and a short period of time for significant changes after the cessation of the dredging operations of the Danube - Black Sea DWNC and soil dumping in early July 2019.

Macrozoobenthos

In July 2019, as a part of the macrozoobenthos of the approach channel and the dumping zone, 35 taxa of bottom macro fauna were recorded: worms - 8, mollusks - 16, crustaceans - 9, representatives of other groups - 1.

The polychaete worms Heteromastus filiformis, Nephtys hombergii, Polydora cornuta, Melinna palmata, and mollusks Mya arenaria and Spisula subtruncata were constantly found.

The maximum abundance reached 4800 ind · m 2, and the minimum value was 160 ind · m-2. The total biomass ranged from 4.12 to 144.40 g · m-2. The biomass of forage zoobenthos had minimum values on the approach channel (4.12 g · m-2 - point 7-1), its maximum value was also noted on the approach channel (60.20 g · m-2 - point 7).

Comparison of our data with the research results of the Institute of Marine Biology of the National Academy of Sciences of Ukraine, which carried out an expedition on the Danube coast in the area of the Danube-Black Sea DWNC before stopping dredging (from 05/12/19 to 05/14/19.) showed that the abundance and biomass of macrozoobenthos 1.5-2 weeks after the dredging was almost unchanged. The restoration

of bottom communities after dumping soil takes time and can be refined as part of general monitoring.

2.2.2. Status of hydrobiont groups of freshwater ecosystems of the Danube Delta watercourse

Phytoplankton

When analyzing algological samples taken during the period of termination of the operational dredging work in the 5 main of the studied sections of the channel part of the Danube within Ukraine (R01 - above the city of Reni, R06 - below the city of Ishmael, R07 - above the Chilia, R10 - above the Vilkovo, R13 / 9 - Bystriy 9 km) was discovered 88 taxonomic units of planktonic algae from 8 divisions.

Floristic spectrum of phytoplankton of the studied sections of the Danube was represented by a chlorococo-diatom complex; most of the species belonged to freshwater-brackish-water. The dynamics of the number of phytoplankton species in the sections positively correlated with the dynamics of biomass, except for a decrease in the number of species in the section from Ishmael to Chilia.

In general, a rather noticeable quantitative development of phytoplankton was noted - both in biomass (1.19 - 4.71 mg / dm3) and in abundance (21.51 - 48550000. C / dm3). According to the biomass of phytoplankton, diatoms prevailed in all analyzed samples (within 0.544–2.674 mg / dm3), the development of which mainly reflected the dynamics of the total biomass. The second place in this indicator at three points (below Ishmael, above Chilia, above Vilkovo) was occupied by blue-green algae, above Reni - blue-green and green, in the Bystriy arm, 9 km - green.

According to the Methodology for the Environmental Assessment of Surface Water Quality (the Methodology for the Environmental Assessment of Surface Water Quality in the corresponding categories / V.D. Romanenko, V.M. Zhukinsky, A.P., Oksiyuk et al., 1998) by the values of phytoplankton biomass, the water quality in the gauge is higher Reni answered class II, 3 categories: "good", "fairly clean", β'-mesosaprobic zone (biomass in the range 1.1 - 2.0 mg / dm3), in the other four sections - class III, category 4 "satisfactory" "," Slightly polluted ", β '- mesosaprobic zone (phytoplankton biomass in at 2.1 - 5.0 mg / dm3), and the development of biomass from the upper to lower sections varied from a cleaner border to a more contaminated one.

Zooplankton

Organisms belonging to 9 taxa were found in the composition of the zooplankton of the DWNC river section. In July, copepods dominated, in particular, Cyclops vicinus J., which were present at almost all observation sites. Among the branched crustaceans, the subdominant taxon was Daphnia longispina O. (in sections above Chilia and higher Vilkovo).

The average abundance and biomass of zooplankton ranged between 230-1400 ind · m3 and 0.007-0.0140 mg · m3. The maximum quantitative indicators of zooplankton communities were observed in the Ochakov arm and sections above Chilia and higher than Vilkovo, and the minimum in the Bystry arm. Rotifers prevailed in numbers, cladocerans and copepods in biomass.

The species composition and quantitative development of zooplankton in the river part of the DWNC during the stoppage of work on the implementation of the DWNC river project. The Danube - Black Sea was similar to the same periods of previous years

of research.

The number of species at the observation points ranged from complete absence (at 4 points) to 3 (maximum value) at point R 06 — lower than Izmail.

Macrozoobenthos

The species composition of macrozoobenthos in July 2019 totaled 6 species of bottom invertebrates, which belonged to 2 systematic groups. In the species composition, representatives of the mollusk type dominated. As in previous studies, there was a poverty of species diversity and quantitative indicators of the development of benthic organisms, both as a whole in the channel part and in points of the coastal zone. Among the research points, significant fluctuations in the macrozoobenthos grouping by the number of species, species composition and quantitative development indicators, as in previous years, were noted.

In general, the species diversity and quantitative development of the phytoplankton, zooplankton and macrozoobenthos studied created the channel part of the Ukrainian section of the Danube during the termination of operations for operational dredging corresponded to the summer season and the type of water bodies studied, as well as similar to the same period of the previous years of observations.

Thus, the results of hydrobiological analysis - the species composition and quantitative development of phytoplankton, zooplankton, macrozoobenthos - studied selection points during the termination operational dredging operations were within the parameters of the corresponding seasons of previous years of observations (2004 - 2018) both on the riverbed of the Ukrainian section of the Danube River and on the seashore of the Chilia Delta. This indicates the stability of the aquatic ecosystem of the studied section of the Ukrainian part of the Danube Delta, as well as a short period of time for noticeable changes after the termination of work on operational dredging.

2.3. Assessment of water quality by toxicity level

The toxicity of water samples (7-1; 7-2; 10 (8) 8) of the marine part of the DWNC Danube-Black Sea in August 2019 was determined by a biotesting method using Artemia salina L. marine crustacean larvae as test objects.

Based on the results of biotesting to determine the acute lethal toxicity of seawater samples, it was found that the level of acute lethal toxicity of seawater samples is zero; water is non-toxic, belongs to the 1st class of toxicity.

2.4. Analysis of the dynamics of channel processes and suspended solids in the Danube Delta and in the coastal part of the Black Sea based on satellite imagery

Space imagery selection

To analyze the state of Ermakov Island, images were taken from Landsat 5, 7, 8 spacecraft. The choice of Landsat images is due to their availability and the ability to use the entire set of spectral channels both for reliable visual identification of objects and for automatic processing with specialized software (a combination of infrared (far, middle and near) and red channels is most effective for identifying water surfaces, and for Estimated quantities of suspended solids using red and blue and channels). Landsat spacecraft images also have optimal spatial resolution, which provides the necessary detail of studies.

2.4.1. The influence of ground storage of dredging soils on the ecosystem of the Island of Ermakov

Ermakov Island state

Analysis of satellite images of the Island of Ermakov for the summer months of the period from 2000 to 2019 (Fig. 2.2 - 2.6) made it possible to reflect the dynamics of the state of the Island. The figures show the synthesized space images sequentially after several years in a combination of spectral channels 7, 5, 2. The purple color reflects areas of bare ground, green - areas with vegetation. Pictures before the storage of soil are given for comparative analysis.

Fig. 2.2 – The state of. Ermakov Island on May 31, 2003

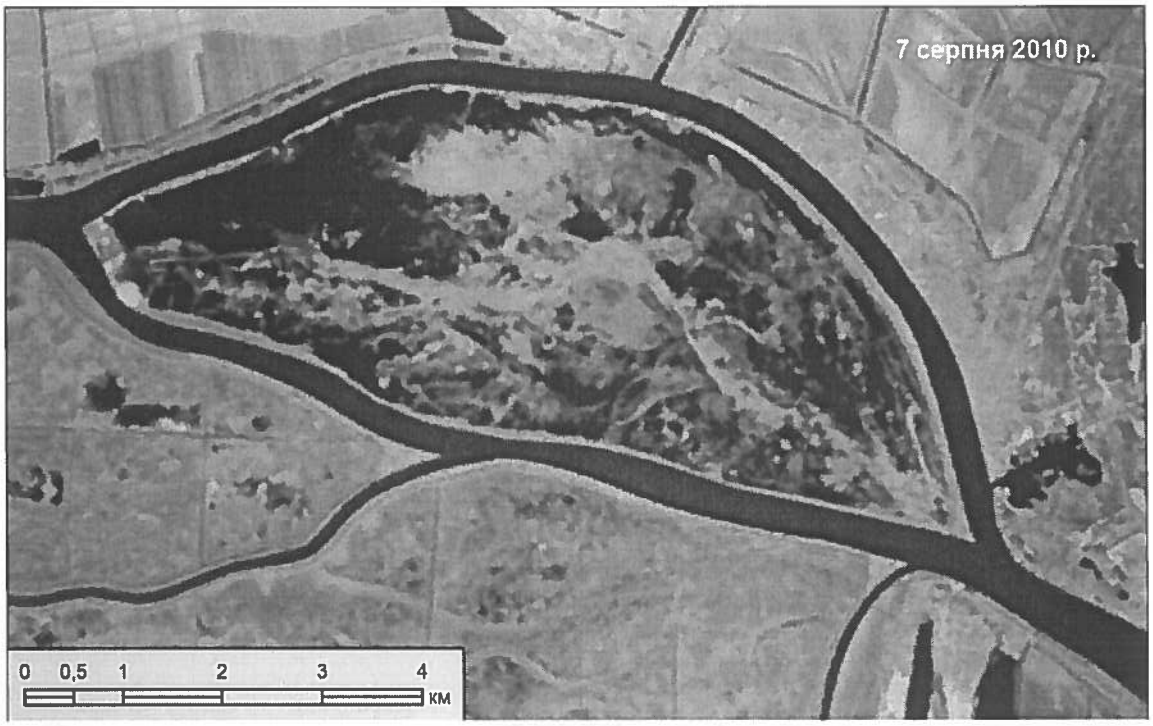

Fig. 2.3 – The state of. Ermakov Island on August 7, 2010

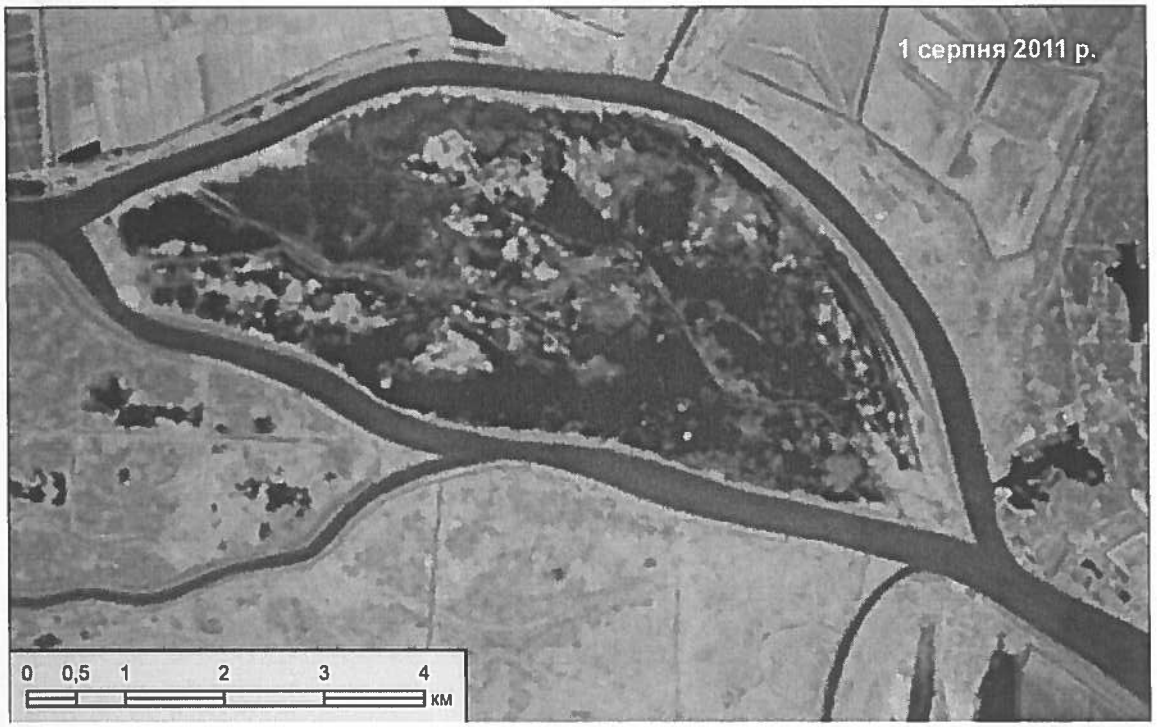

Fig. 2.4 - The state of. Ermakov Island on August 1, 2011

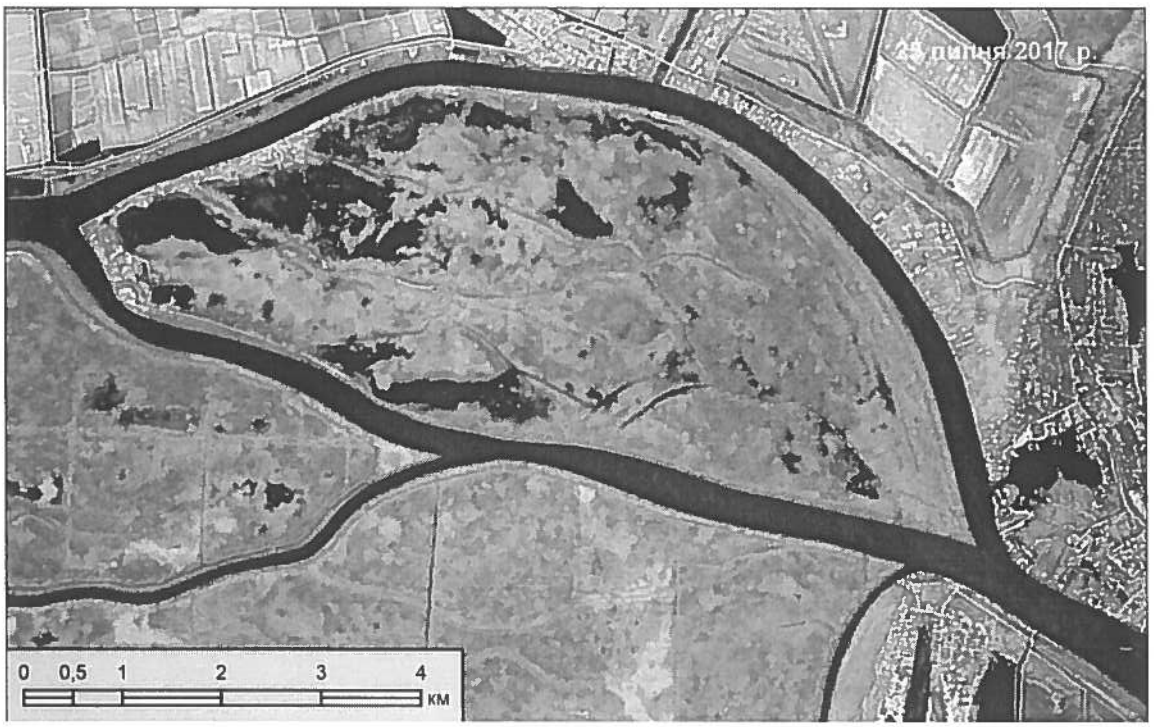

Fig. 2.5 – The state of. Ermakov Island on July 25, 2017

Fig. 2.6 – The state of. Ermakov Island on July 31, 2019

Analysis of satellite images of Ermakov Island during the summer months of the period from 2000 to 2019, as well as analysis of the collected information shows that the alluvial soil 2004 had local and short-term influence on Ermakov ecosystem. Long-term studies of the Danube Biosphere Reserve indicate that the island's ecosystem is largely dependent on natural factors.

2.4.2. The dynamics of the distribution of suspended solids in the area of the mouth of the Bystry

Analysis of satellite images of the distribution of suspended matter (turbidity) in the marine part (in the areas of dumping and dredging of the Bystrye estuary) for the period from May to August 2019 allowed us to reflect the dynamics of suspended solids (pollutants) in the western part of the Black Sea in the region of the Delta. Danube. The model is presented in pseudo colors, the scale of the concentration of suspended solids is relative and requires comparison with the data of contact observations. Figures 2.7 – 2.12 show the synthesized space images sequentially after several months from May to August 2019 According to satellite imagery, the intensive removal of suspended matter from the Bystrye mouth was observed on May 3, 28 and June 13, 22 in a southeastern direction over considerable distances. On July 2, the outflow direction is northeastern, the suspension of suspended solids is intense. On July 22nd and 31st, the drift direction is east-south, insignificant. July 27 and August 7, the east-west drift direction is insignificant. The structure of the turbidity field has a swirling appearance with lighting towards the sea. It should be noted that an unequivocal relationship between dredging and removal of suspended solids for this period was not found. Removal in the area of each of the mouths of the Danube is observed.

No phototon anomalies observed in the landfill zone; only on August 7 are there any changes in the photon.

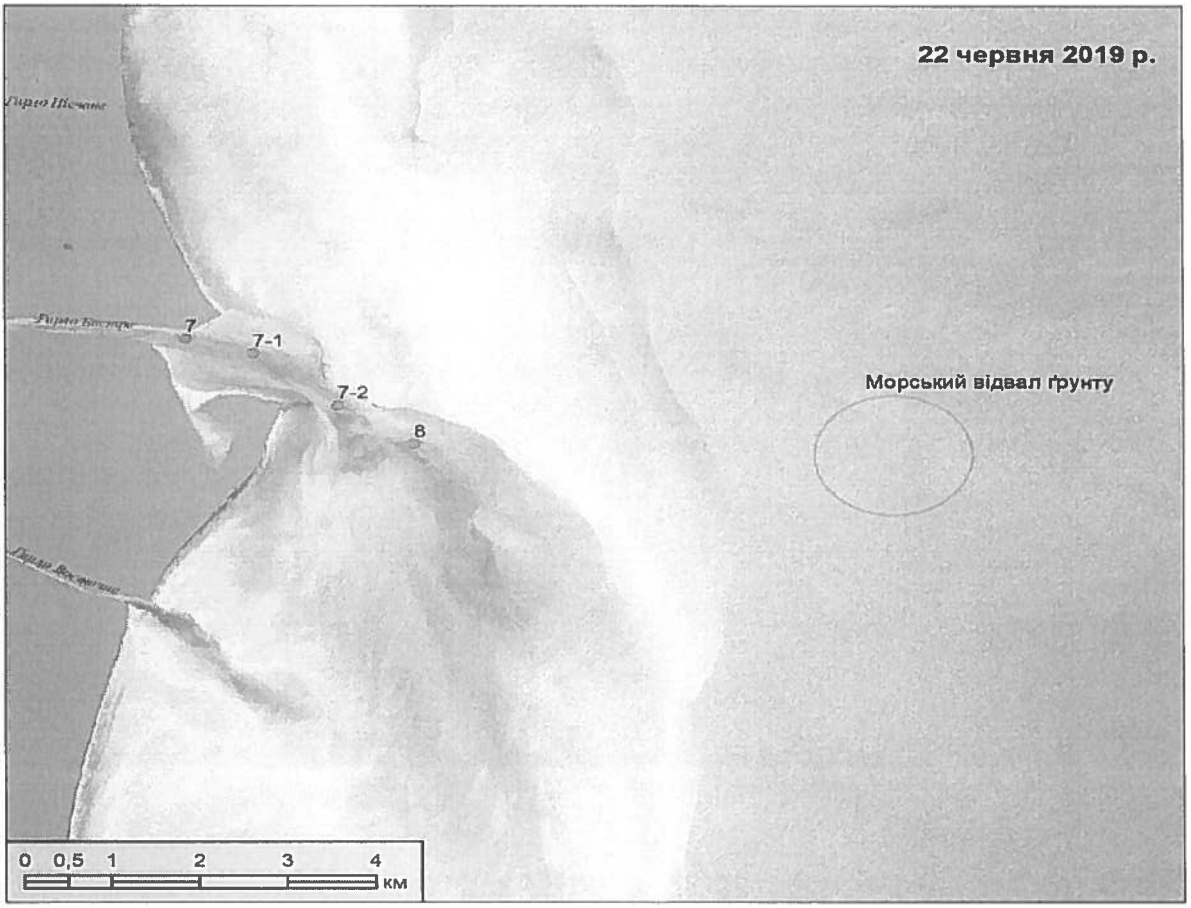

Fig. 2.7

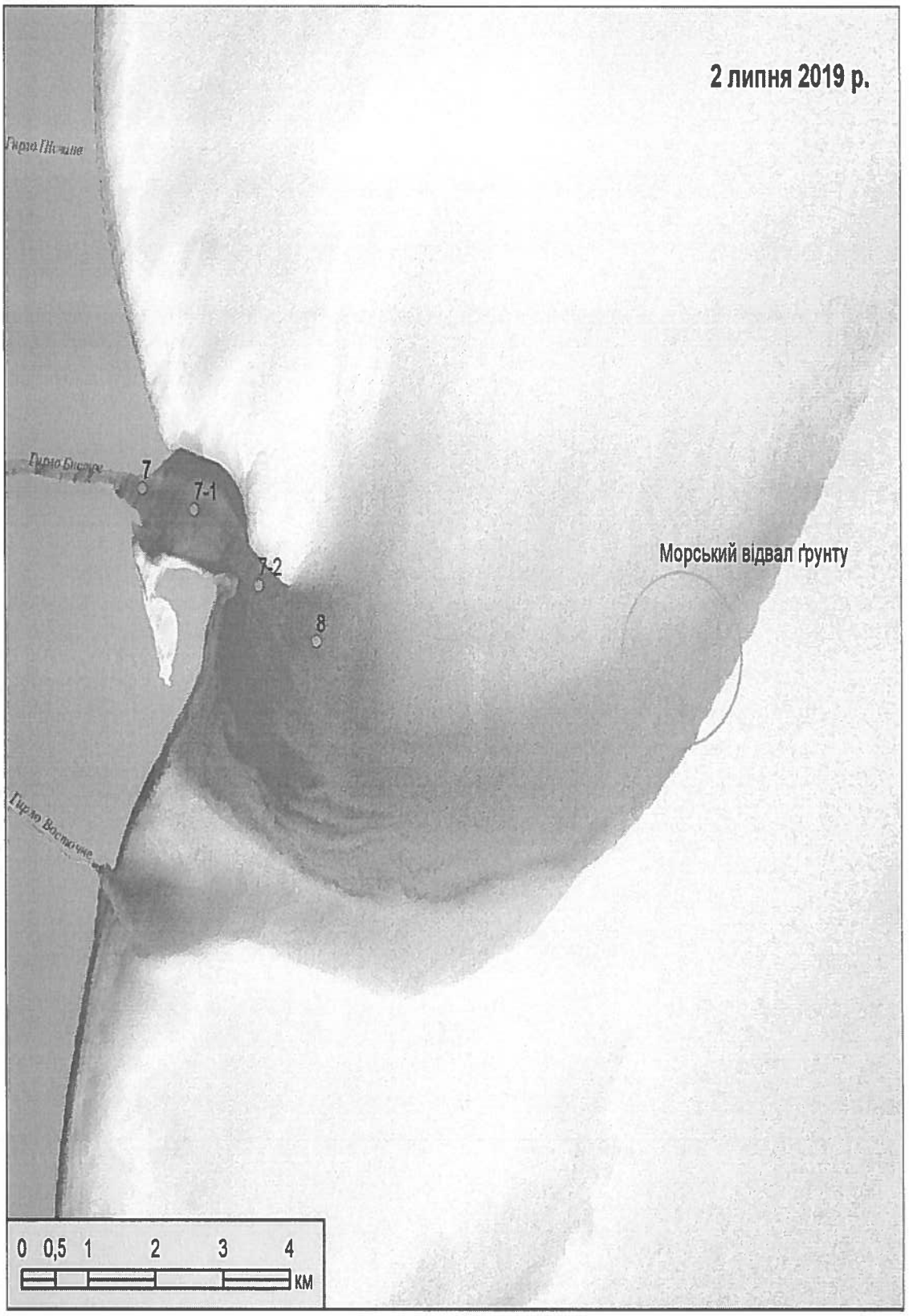
2 липня 2019 р.
Гирло Північне
Гирло Бистре
7
7-1
7-2
8
Морський відвал ґрунту
Гирло Восточне
0 0,5 1 2 3 4
км

Fig. 2.8

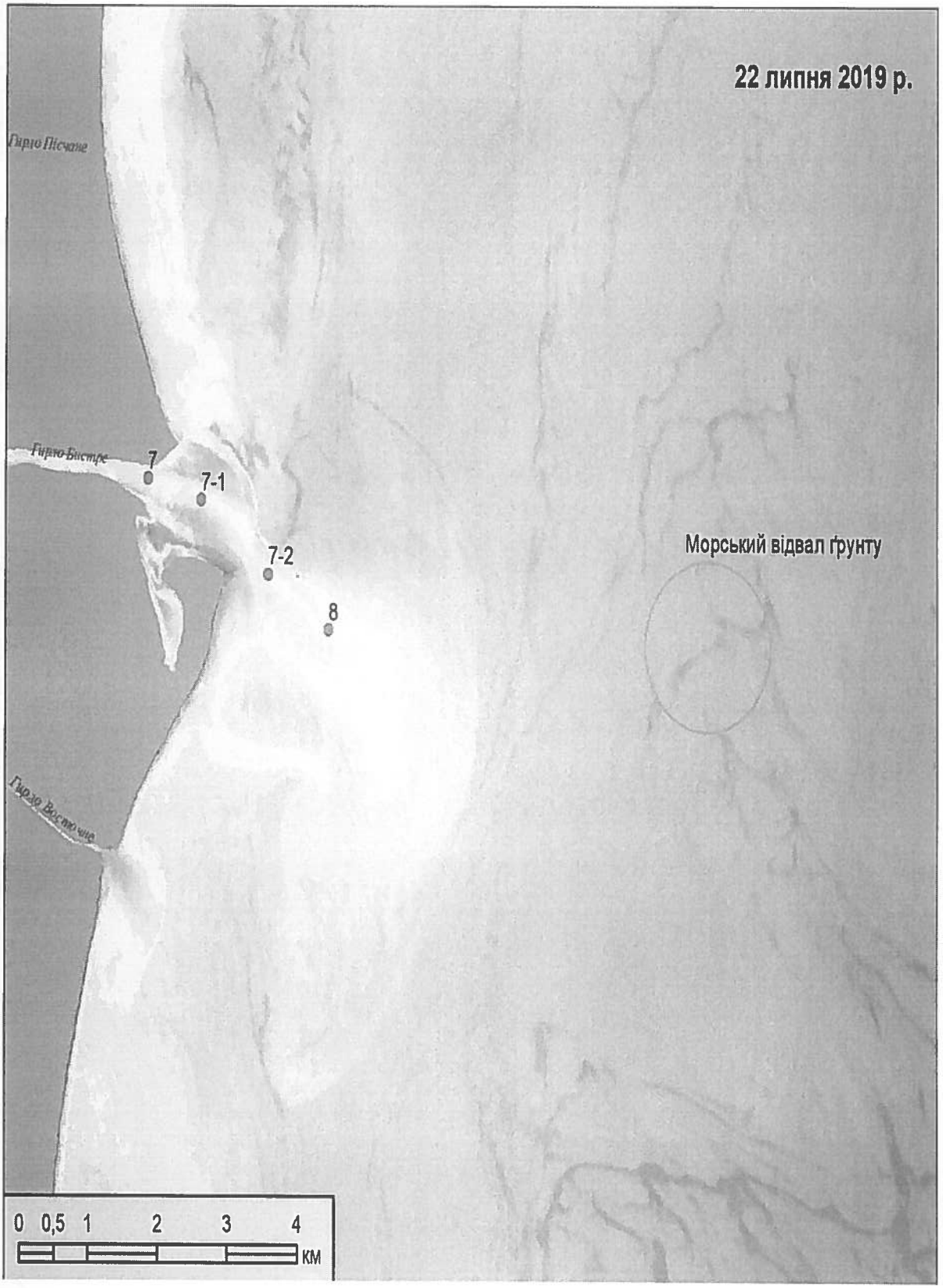
22 липня 2019 р.
Гирло Пісчане
Гирло Бистре
7
7-1
7-2
8
Морський відвал ґрунту
Гирло Восточне
0 0,5 1 2 3 4
км

Fig. 2.9

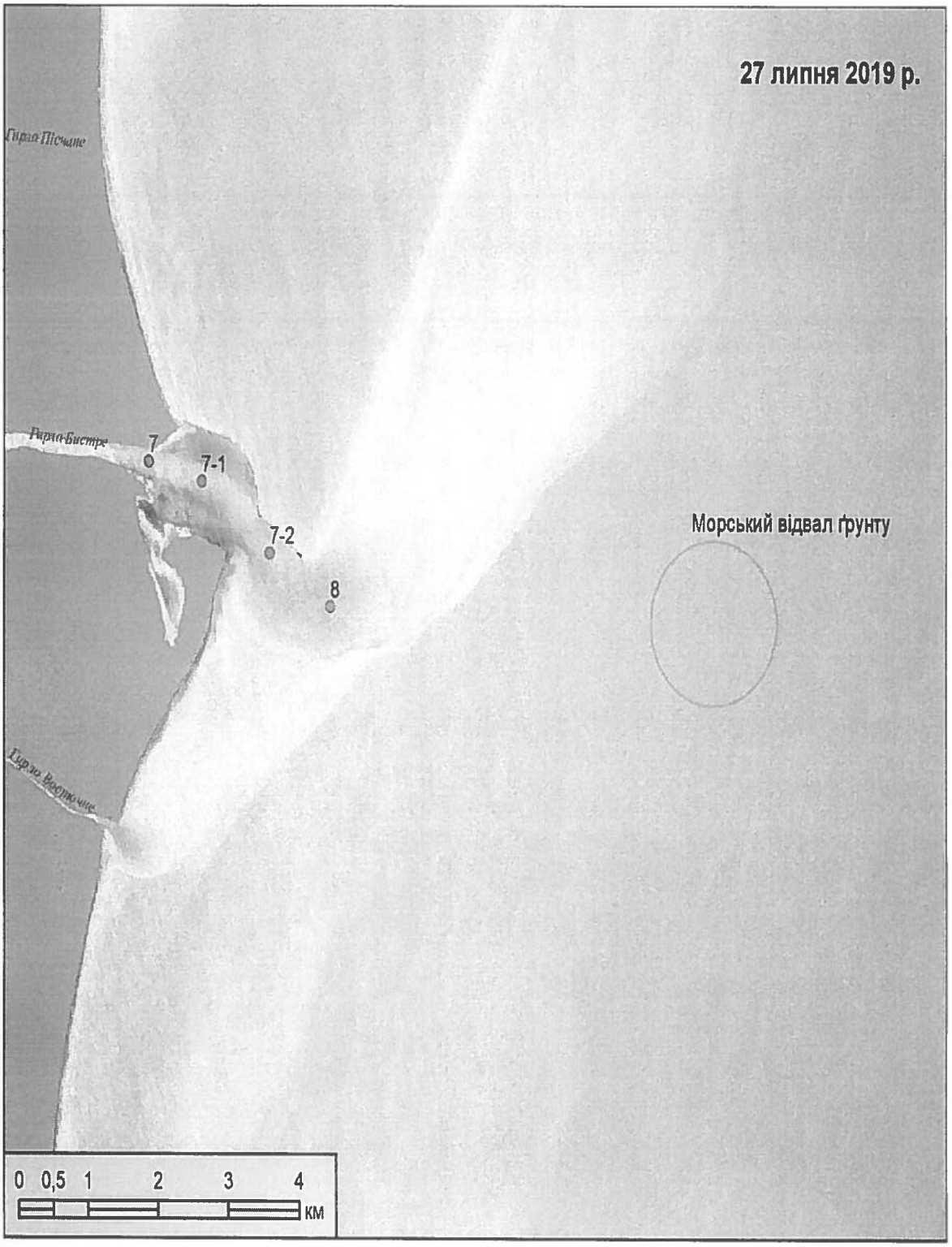
27 липня 2019 р.
Гирло Пісчане
Гирло Бистре
7
7-1
7-2
8
Морський відвал ґрунту
Гирло Восточне
0 0,5 1 2 3 4
км

Fig. 2.10

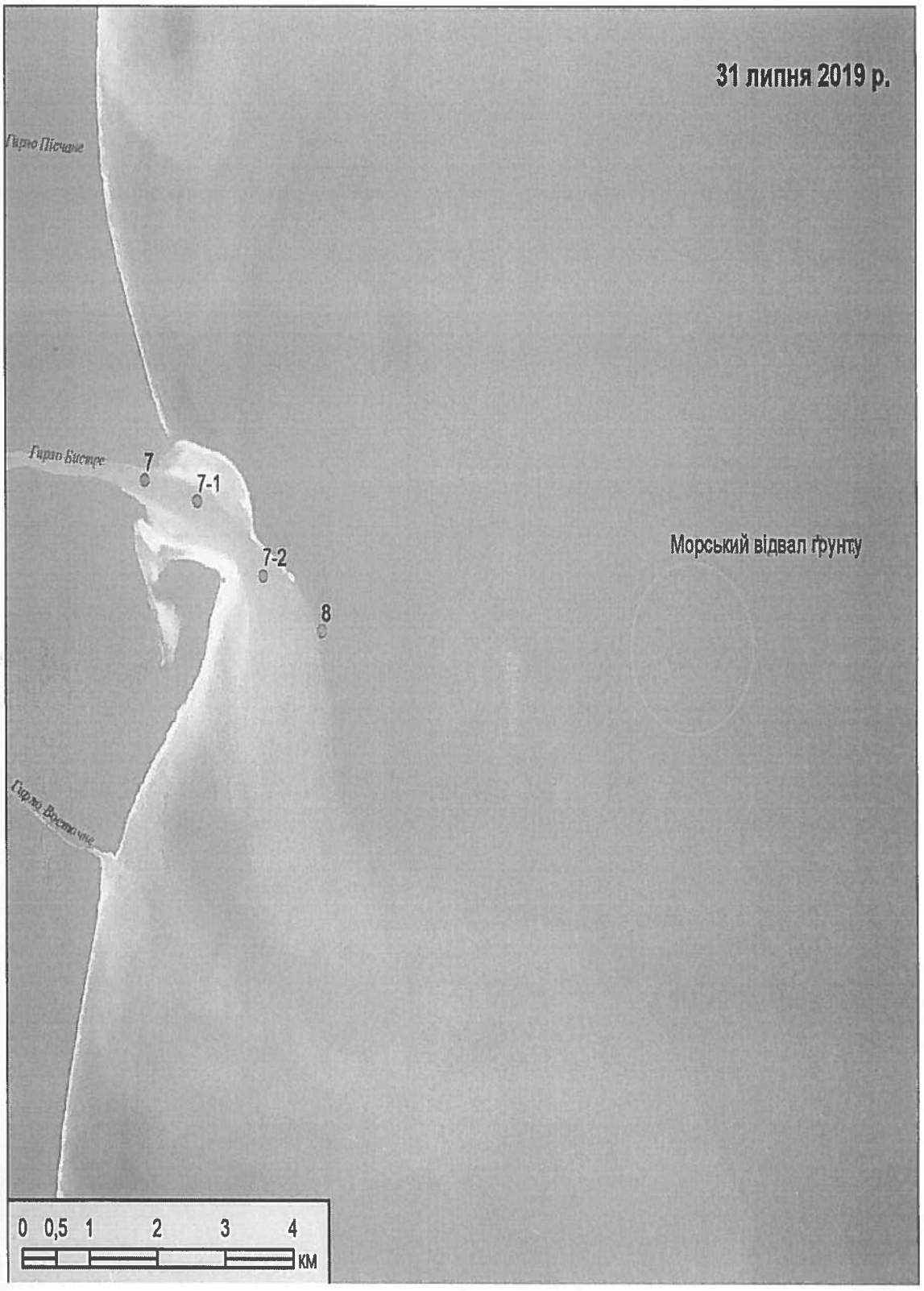
31 липня 2019 р.
Гирло Пісчане
Гирло Бистре
7
7-1
7-2
8
Морський відвал ґрунту
Гирло Восточне
0 0,5 1 2 3 4
КМ

Fig. 2.11

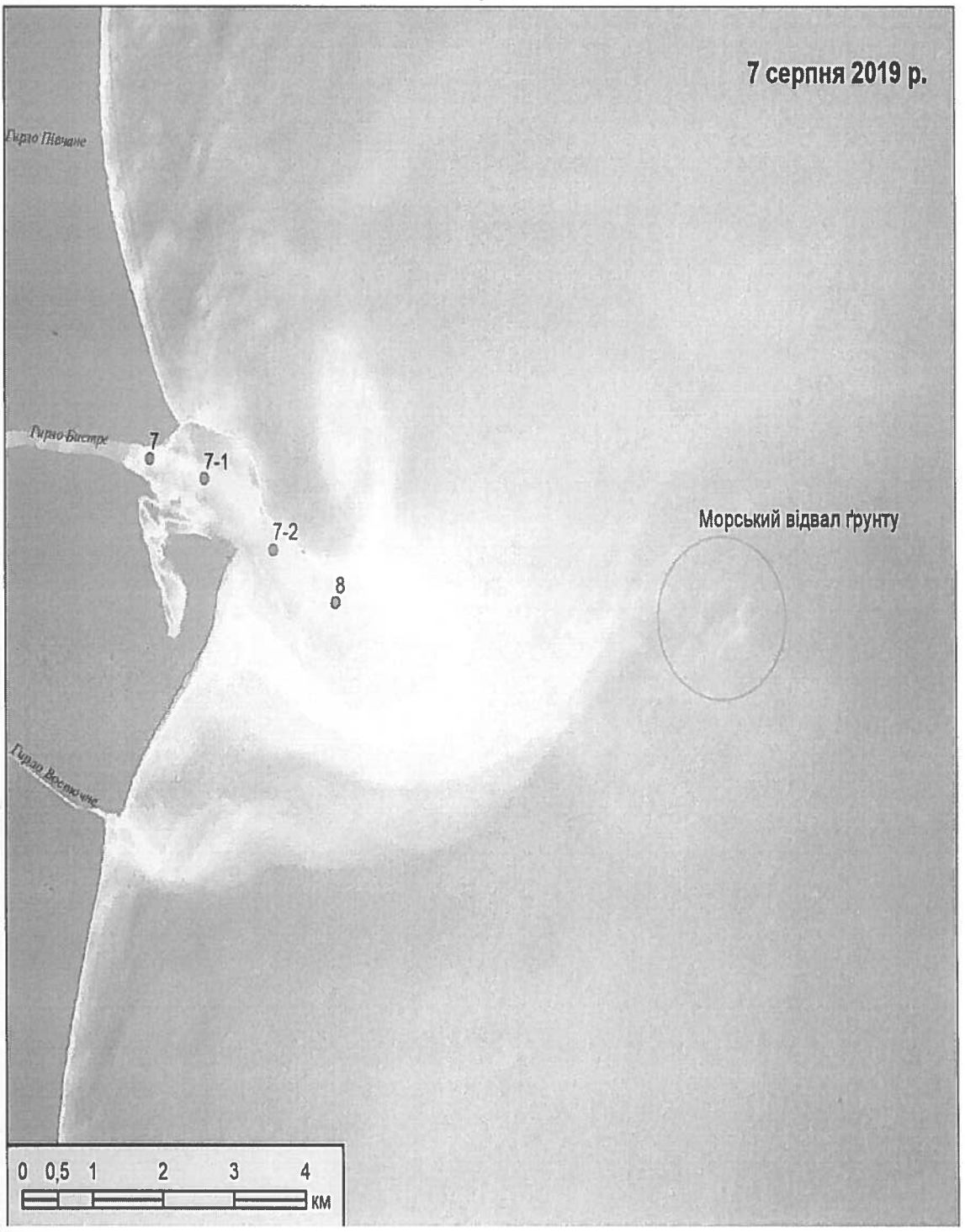

Fig. 2.12

Fig. 2.7 - 2.12– Dynamics of channel processes and suspended solids in the Danube Delta and in the coastal part of the Black Sea in 2019 (May-August)

3. Development of recommendations on compensatory measures or measures to minimize possible negative impacts during the implementation of a new project of Danube-Black Sea DWNC (at least in a transboundary context).

Recommendations on countervailing measures or measures to minimize possible negative impacts during the implementation of a new DWNC project Danube - Black Sea are given below.

To assess the impact of recreational activities in the Danube Delta (Ukrainian and Romanian parts) on the state of ecosystems of the Danube and coastal part of Black Sea.

The deepening of the channel of the DWNC sleeves as an event that allows partially restoring the water regime of the delta is disrupted as a result of previous anthropogenic influences - the straightening of the channels of the sleeves and the construction of a flow dam on the branching of the Chilia and Tulchinsky arms conducted by Romania.

To provide monetary compensation for irreparable losses with the allocation of funds for an equivalent improvement in the state of the environment (for example, compensation for losses to fish resources through the construction of a breeding facility.

Compensate for losses associated with the disturbance factor for birds by implementing measures to increase the ornithological capacity of adjacent areas of the territory. Implement a comprehensive environmental monitoring program in order to timely identify trends in the manifestation of possible negative consequences of the operation of DWNC.

In order to reduce the negative impact on the conditions of fish reproduction, it is advisable during the period of the ban on fishing for flounder-Kalkan (May) and the Azov-Black Sea mullet (late August - early September) to conduct dredging on the sea part of the approach channel, which is adjacent to the Bystry mouth (the most identified site).

It is necessary to maintain and modernize the existing system of hydrological and hydrochemical monitoring in the Ukrainian section of the Danube Delta. The dynamic delta system requires an increase in the frequency of measurements and the opening of additional stationary observation points, and first of all, the marine hydrometeorological station at the Bystry mouth.

When conducting environmental monitoring of the aquatic environment, a modern methodology based on the approaches of the EU Water Framework Directive should be used.

In order to reduce the negative impact on fish reproduction conditions, it is advisable:

- to operate the dump in accordance with design decisions that are aimed at uniformly filling the underwater dump at the recommended loading areas, taking into account the schedule for filling cards;
- limit the volume of dredging during spawning and slope periods juvenile fish, which are agreed in the justification, for each specific species that is affected by the minimum required production quantities, which are necessary to ensure the safety of navigation and, if possible, to ensure a complete interruption of work during the days of the most intensive spawning of herring.

On the territory of the DBR there is an overwhelming number of new invasive species for Ukraine (for example, about 60% of new flora over the past 20 years) , which is largely due, in particular, to significant traffic flows. In this regard, it is necessary to

create a regional center for monitoring new species here and introduce measures to limit the spread of dangerous species.

To compensate for the influence of the DWNC on the Bystry mouth on nesting settlements of land nesting bird species, it is advisable to build artificial floating islands, for example, in the Anankin corner and Potapovsky corner.

Monitoring of the storage of soils in an offshore dump should be carried out by performing regular (once every six months) depth measurements with the following parameters: the distance between the measuring profiles is 100 m; the distance between the points on the survey tack is 10 m. Based on the measurements performed, an operational soil laying pattern is developed.

Obtaining hydrometeorological and hydrochemical information is an important component of integrated environmental monitoring of the Danube Delta, which allows to optimize nature management in the Ukrainian delta section, as well as to track anthropogenic impact on natural evolutionary processes.

Therefore, preservation of the existing network of hydrometeorological and hydrochemical observations and its modernization is required.

In order to create a highly effective system for preventing and protecting the population, infrastructure and nature of the Danube from the negative effects of man-made and natural phenomena, as well as for information support of navigation along the DWNC Danube-Black Sea, the following is necessary:

1. Modernization of the hydrometeorological monitoring system of the Danube Delta and Seaside.
2. Modernization of the hydrochemical monitoring system.
3. Creation of a permanent mathematical model for predicting the expected changes in the morphology, hydrological and hydrochemical regime of the Danube delta and seaside, taking into account possible scenarios of climate change, runoff of Danube water and sediment, Black Sea level and various options for water management and hydraulic engineering measures.

For the Ukrainian part of the Danube Delta, the most significant negative factor now is the large-scale redistribution of river flow in favor of the Romanian Tulchinsky mouth.

It is necessary to expedite the completion of the creation of a joint Ukrainian-Romanian-Moldovan monitoring of the entire Danube Delta and the organization of the joint Ukrainian-Romanian-Moldovan working group on cooperation on the transboundary impacts of economic activity on the environmental status of the Danube Delta.

For a coordinated assessment of the transboundary impact of anthropogenic activities in the Danube Delta, it is advisable, within the framework of the united Ukraine-Romanian-Moldavian environmental monitoring, to accelerate the development of regulations and a joint methodology for transboundary assessment of possible environmental impacts.

Synchronization of observations is a prerequisite for a common Ukraine-Romanian-Moldavian environmental monitoring of the estuary of the Danube.

One of the main directions of future modernization of hydrometeorological monitoring is the opening of a marine hydrological station at the mouth of the Bystry arm.

During the implementation of the second stage of the construction of the Danube - Black Sea DWNC and the implementation of large-scale up-and-down operations already

in the riverbed, the problem of finding places for dumping of land will become an acute problem. To drastically reduce environmental damage, it is necessary to store the excavated soil on landfills, and not on underwater landfills in the river. Joint storage or discharge locations should be agreed with the Romanian side.

Given the importance of the issue of penetration of a salt wedge in the Bystry. Quick for an objective assessment of the impact of the operation of the DWNC, it is advisable to organize and conduct additional in-depth studies of the problem according to a special program by the forces of hydrologists, oceanologists, chemists and biologists.

It is necessary to periodically clear the silt from the silt in the dams on about. Ermakov to ensure the washing of the island and the restoration of its ecosystem, as well as the shallow channel in the Ukrainian part of the delta.

Conclusions

Assessment of the state of the environment is necessary in terms of compliance with environmental laws and state policy in the field of environmental safety and environmental management, and is also the basis for assessing the impact of human activities on the environment from an environmental perspective. From a political point of view, environmental assessment is necessary based on the transboundary nature of environmental problems and the need to comply with international agreements.

As a result of the analysis of the impact of the environment of Danube River Delta which follows from the already implemented work related to the project "Danube-Black Sea Deep-Water Navigation Channel on the Ukrainian section of the Delta " (stage 1 and on full development) based on the materials of complex ecological monitoring 2004-2018 and the results of field control observations (July 2019), the following was established:The results of the work on the Program showed the following.

Hydrotechnical works on the Bystriy bar did not cause changes in the flow redistribution trends in the forks of the main Delta branches: Chilia , Tulchinsky, Sulinsky and Georgiyevsky. The restoration of the DWNC has not changed the natural tendencies of the development of the water flow of the Chilia Delta; branches that reduced the flow (the system of watercourses of the Ochakov branch; Starostambulsky, below the leakage of hands. The Bystriy and the system of its watercourses, except the Tsiganskiy branch) continued its decline. Active branches (Bystriy and Tsiganskiy) increased the flow, and dredging at the bar led to the fact that the process of natural growth of the flow was slightly enhanced. The reduction in the flow of the Ochakov branch is mainly due to the natural tendency of the development of the watercourse, and the cessation of dredging in the Prorva branch and the access channel. Tendencies of increasing / decreasing part of the runoff of branches with the growth of the Danube's water content have been preserved.

Predictive calculations show that the development of the Sf. Gheoghe Branch will remain the decisive factor determining the water content of the main branches in the Danube Delta during any construction work. The reduction of its length in 1981-1992. From 109 to 76 km (30%), by building channels with a loose channel, it still leads to an increase in the cross-section of the channels-straightened and activation of the whole Sf. Gheoghe and Tulchinsky branches.

Maintaining the passage depths at the mouth of the Bystry branch at the level of 5-7 m can change the dynamics of the main branches of the Delta, however, the deepening of shoals and the Chilia branch bar will somewhat slow down the redistribution of the flow in favor of the Tulchinsky system of branches.

Integrated environmental assessment of water quality of the Danube indicates a satisfactory and fairly stable condition of the ecosystem by chemical indicators. The deterioration of water quality with the introduction of DWNC into operation was not fixed.

Monitoring showed that compared with the Danube's eutrophication influence (transboundary pressure), the impact of maintenance operations on the coast was exclusively local and manifested directly in the dredging zone and in the marine dumping zone ground.

The transboundary impact of dredging and dumping of the soil on the sea dump, located 8 km from the sea edge of the Delta was not recorded in the Romanian waters. This is confirmed by the results of determining the concentrations of suspended and

polluting substances at baseline monitoring stations, including July 2019.

The results of the analysis of bottom sediments of dredging and soil dumping areas showed that the concentrations of pollutants in these sediments do not exceed the permissible values for dumping in the Black Sea.

Analysis of materials for observing the dynamics of spatio-temporal changes in the coastal line of the Danube estuary in the period 1972-2018. Indicates seasonal fluctuations while maintaining the general form of structural elements. In particular, the general trend of extension of the sea edge of the Chilia delta in the area from the mouth of the Potapovsky arm to the mouth of the Tsiganskiy arm remains. At the southern tip of the Ptichaya bay, its shift towards the coast within the limits of natural evolution is observed. The influence of dredging on morphodynamic processes is limited only to the coastal section adjacent to the mouth of the Bystry arm, and also on this section is not significant, and the effect of soil dumping, as well as dredging in the channel part, is local.

On the whole, the results of comprehensive environmental monitoring and field control examinations make it possible to assert the absence of both direct and indirect effects of restoration and operation of the Danube - Black Sea DWNC on biotic groups. The most significant violations of the structure of biotic communities were recorded in the areas of direct dredging and, on the whole, were local in nature and had a short period. Studies have DWNC that changes in the components of the environment that occur under the influence of DWNC restoration activities do not exceed predicted, and often less significant.

The results of a series of studies carried out since the start of restoration of shipping in the Ukrainian part of the Danube Delta indicate the absence of significant transboundary impacts on the ichthyofauna and avifauna. An assessment of the impacts of operational dredging and dumping on the forage base of fish of the Danube Seaside also indicates their locality, which cannot affect the general bio-productivity of the region and have a transboundary character. The results of ichthyological monitoring indicate that the impact of the restoration of DWNC directly on juvenile fish is less than on the feed base. Moreover, as noted above, these works do not significantly affect the bio-productivity of the area where they are held. An assessment of such a local effect is confirmed, in particular, by data on interannual dynamics of fish catch, which indicate the absence of cumulative effects on fish resources during the period of operation of the DWNC. The marine approach channel is located in the mixing zone of fresh river and sea waters, where unfavorable conditions are created for spawning of most native fish species. In this regard, the dredging that takes place here does not affect the reproduction of fish stocks. Insignificant damage (given the small area it is exposed to) can be caused by the reproduction of kalkan and Black Sea mullet only in the area of soil dumping and has no transboundary character.

In general, no significant effect of works related to the recovery of DWNC on the status of populations of passable and tuvodnyh fish species has been established.

The results of many years of hydrobiological studies and studies conducted in July 2019 suggest that there is no direct impact of the restoration and exploitation of the Danube - Black Sea DWNC on the phytoplankton, zooplankton and benthos groups, except for local disturbances of community structures in the areas of direct hydraulic works.

According to the results of the monitoring, there is a tendency of relatively fast restoration of bottom biocenoses at separate sites upon completion of works. The local

and short-term increase in the concentration of suspended matter in dredging and dumping sites does not significantly affect the state of planktonic communities.

Monitoring observations on the territory of the DBR showed that as a result of the shallowing of the bay, the Ptichaya bay of Bystriy gulf became accessible to land-based predators and boars. In this regard, the colonial settlements of land-nesting birds moved to the neighboring bay - Taranova and Novaya Zemlya.

Analysis of the retrospective data showed that over the past three decades in the Ukrainian part of the Danube Delta, the main places of the perennial colonial bird settlements have changed several times. These data indicate the passage of the processes of adaptation of avifauna to impact factors and changing environmental factors.

In general, according to the results of the monitoring conducted during the restoration and operation of the Danube - Black Sea DWNC, including in July 2019, there was no evidence of a decrease in the species diversity of the flora and fauna of the protected areas.

Strengthening the movement of ships in connection with the restoration of the DWNC contribute to the activation of migration of invasive species. In total, during the integrated environmental monitoring of the restoration and operation of the DWNC Danube - Black Sea in the period 2004 - 2018. Isolated new species of plants, aquatic organisms, avifauna, reptiles were found, the quantitative development of which was generally characterized as insignificant and such that it does not have a significant effect on the delta ecosystems.

The set of mitigation measures provided for by the project prevented a significant transboundary cumulative impact of the Danube - Black Sea DWNC during exploitation of fish and birds of the Danube Delta during the adjustment of this complex at the post-project analysis stage according to the results of systematic studies of the effects of cumulation of impacts.

According to the results of the Commission's findings on the implementation of the complex of in-depth studies carried out within the framework of the implementation, the probable transboundary environmental impacts from the implementation of the Danube – Black Sea DWNC project for full development, namely: on the hydrological regime, delta morphodynamics, river and sea water quality, and food supply fish, places of feeding and spawning, migratory flows of sturgeon and Danube herring, places of residence, number of populations and biodiversity of birds, including especially valuable and vulnerable species, were evaluated as locally limited, that is, those that do not lead to significant changes in the major parameters of the environment and biodiversity of the Danube Delta.

In order to establish and limit the transboundary impact of economic activities in this part of the Danube Delta (both on the territory of Ukraine and on the territory of Romania), it was proposed to create a single (international) integrated monitoring system involving specialists from Ukraine and Romania as well as experts from European countries to its creation, implementation.

According to the results of control field observations during the stoppage of work on the implementation of the project of the DWNC of the river. Danube - Black Sea in July 2019, the following conclusions were drawn:

1. Based on the analysis of the monitoring results, which we have carried out since 2004. It can be argued that the environmental situation in the zone of creation of the DWNC Danube-Black Sea has stabilized, and the results of expeditionary work during a stop on the bar part only confirmed the absence of transboundary impact, as well as the

absence of significant negative impacts on the ecological state of the Danube Delta and in places of soil dumping.

2. Comparison of the May and July hydrochemical characteristics of the studied water area for assessing the impact on the quality of water of the cessation of dredging should be considered rather problematic due to the masking of this effect by the action of powerful external factors, both natural (seasonal variation, changes in hydrological conditions) and natural anthropogenic ("bloom" of water) nature.

3. Between the studied stations, a significant fluctuation in abundance and less distinct changes in the biomass of phytoplankton were observed. The minimum quantitative development of planktonic algae was noted at the station 10-22 bottom (number 1,45 million cells / dm 3;; biomass 0.46 mg / dm^3), the maximum - in paragraph 10-15 et. (Abundance 70,19 million cells / dm 3;; biomass 8.602 mg / dm^3). In general, higher abundance and biomass of phytoplankton were observed in the surface water layers of stations 10-15 and 10-22, the lowest - in the bottom layers of these stations. In stations 7-1 and 7-2, the indicators of the quantitative development of planktonic algae of the surface and bottom had closer values.

4. The saprobity index calculated by the Pantle and Bucca method among the studied stations did not fluctuate significantly - from 1.62 (7-1 bottom) to 1.67 (7-2 floor, 10-15 floor) And answered β'- mesosaprobic zones, II class of surface water quality, 3 categories (saprobity index value 1.6-2.0): "good" in terms of water quality, "fairly clean" in terms of purity / contamination, overwhelmingly approaching cleaner borders.

5. The obtained biomass values of phytoplankton in most of the analyzed samples were within the limits of the corresponding season of previous years or were higher, especially in the surface horizons.

6. The abundance and biomass of macrozoobenthos 1.5–2 weeks after dredging is almost unchanged. The restoration of bottom communities after dumping soil takes time and can be refined as part of general monitoring.

7. Based on the results of biotesting to determine the acute lethal toxicity of seawater samples, it was found that the level of acute lethal toxicity of seawater samples is zero; water is non-toxic, belongs to the 1st class of toxicity.

8. An analysis of satellite images of the Ermakov island during the summer months of the period from 2000. In 2019, as well as an analysis of the collected information, it shows that the Soil Flushing in 2004 had on ecosystem c. Ermakov local and short-term influence. Long-term studies carried out by the Danube Biosphere Reserve indicate that the island's ecosystem is largely dependent on natural factors.

9. According to satellite imagery, the intensive removal of suspended matter from the Bystroe mouth was observed on May 3, 28 and June 13, 22 in a southeastern direction over significant distances. On July 2, the discharge direction is northeastern; suspended matter removal is intense. July 22 and 31, the drift direction is east-south-, insignificant. July 27 and August 7, the drift direction is east-west, insignificant. The structure of the turbidity field has a swirling appearance with illumination towards the sea. It should be noted that an unequivocal relationship between dredging and removal of suspended solids for this period was not found. Removal is observed in the area of each of the mouths of the Danube. In the area of the landfill, phototone anomalies are not observed, only on August 7th There should be some changes in the photon of uncertain origin.

The main conclusions from the observations indicate that for all indicators monitored as of July 2019, changes under the influence of the restoration and operation of the DWNC exceed predicted values, and often less significant.