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SCIENTIFIC AND BIOLOGICAL SUBSTANTIATION

Assessment of the impact of hydrotechnical works on the state of fish stocks of the Danube River during the construction of a cargo berth with the operational water area of the river port in Izmail, Odesa Region

Responsible executor:
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The results of the work were reviewed
by the scientific council of IFME,
protocol No. 1 dated 17/05/2022

2022

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REPORT

Report on scientific and biological substantiation: 55 pages, 1 figure, 5 tables, 21 sources, 4 appendices.

The object of research is the aquatic environment, phytoplankton, zooplankton, zoobenthos, ichthyoplankton, ichthyofauna.

DANUBE RIVER, HYDROTECHNICAL WORKS, DREDGER, FLOATING CRANE, PHYTOPLANKTON, ZOOPLANKTON, ZOOBENTOS, ICHTHYOPLANKTON, ICHTHYOFAUNA, DAMAGE.

The purpose of the work is to develop a scientific and biological substantiation with an assessment of the impact of hydrotechnical works on the state of fish stocks of the Danube River during the construction of the cargo berth of the River Port (terminal) of NIBULON LLC within Izmail city of Odesa Region.

Research method - assessment of the state of benthic and pelagic communities, determination of the degree of influence of hydrotechnical works, calculation of the cost of compensatory measures for fisheries with the possibility of works during the period of the ban during spawning.

The works were performed in accordance with the Agreement and the "Technical task" to the Agreement (Appendix A).

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INTRODUCTION

The main document, which is taken as a basis in the nature protection legislative base of Ukraine, is the Bucharest Convention on the Protection of the Black Sea against Pollution (the Convention was ratified by Resolution of Ukrainian Parliament N 3939-XII (3939-12) dated 04.02.94. It entered into force for Ukraine on 14.04.1994. The Protocol on the Preservation of Biodiversity and Landscapes of the Black Sea to the Convention on the Protection of the Black Sea against Pollution (newsletter the Vidomosti of the Verkhovna Rada of Ukraine (VVR), 2007, N 50). The Protocol was ratified by Law N 685-V (685-16) dated 22.02.2007, and the presence of other international agreements, which provide for the creation of an ecological security system in the Black Sea basin, which should become a mandatory condition for the social and economic development of the country and the region as a whole.

Among the types of economic activities subject to mandatory regulation, considerable attention is paid to the control of hydrotechnical works. Hydrotecnical dredging works have certain negative impact on the aquatic environment and aquatic biocoenosis, since it is accompanied by the destruction of benthic groups of hydrobionts in the work areas and the death of pelagic and benthic organisms not only in the places of direct work, but also at some distance from the place of dredging (soil dumping, and, or due to siltation of adjacent water areas).

The development of scientific and biological substantiation is aimed at assessing the scale of hydrotechnical works (dredging) in the operational water area of the river port in Izmail, Odesa region.

Place of work: Izmail, Odesa region, Danube river from 91.09 to 91.55 km.

The place of storage of the extracted bottom soil: a coastal dump, the organization of which is provided for on the plot of land set aside for the construction of the River Port (terminal).

The following issues will be considered during the development of the scientific and biological substantiation:

- provided biological characteristics of the work performance area;
- calculation of the cost of compensatory measures for fisheries;
- provision of recommendations on minimizing the impact of dredging operations on the living conditions of ichthyofauna during the spawning period in the operational water area of the river port of Izmail, Odesa region.

For scientific and biological substantiation, the following will be used:

- the volume of bottom soil removed from the operational water area during the construction of the cargo berth of the River Port (terminal) of NIBULON LLC within the water area of the Izmail Sea Port, which is planned for 2022 - 112,000 m^3;
-information regarding the involvement of equipment that will perform dredging works (all

mechanisms are gradually engaged):

- dredging to the 4 m depths - the multifunctional diesel Watermaster Classic IV dredger in two regimes: an excavator using a bucket and a suction pump using a soil pump with a loosening cutter attachment and a slurry pipeline, through which bottom soil will be transported to the coastal dump with the help of water;

- dredging at depths from 4.0 m to 8.23 m will be carried out by a dredger of the SDS 15 project in suction mode using a soil pump with a loosening cutter attachment and a slurry pipeline, through which the bottom soil will be transported to the coastal dump using water;

-previous and current results of IFME research in the framework of scientific research works (2021), as well as data from list of references.

Works on the development of scientific and biological substantiation are carried out within the framework of the contract with the NIBULON Agricultural Limited Liability Company (NIBULON LLC). Contract No. NB-770-22 dated 07.05.2022.

Address on behalf of the "Customer": Kabotazhnyy spusk, 1, Mykolaiv, 54002, Ukraine.

Address of the "Perfomer": Konsulska street, 8, Berdiansk, Zaporizhzhya region, 71103, Ukraine.

1 SUBSTANTIATION FOR THE NEED TO PERFORM DEVELOPMENT

For the possibility of performing hydrotechnical works (dredging) in the water area of the Danube river which is located along the shipping channel Vylkove – Izmail Ceatal from 91.09 km to 91.55 km in order to build the River Port (terminal) of NIBULON LLC in Izmail city, Odesa Region (Fig. 1.1).

The total volume of bottom soil, which is removed as a result of hydrotechnical (dredging) works from the operational water area of the river port (terminal) of NIBULON LLC, Izmail - 112,000 m³, Appendix A.

The term of performance of works (excluding the period of preparatory works and possible repair works) is 52 days with the possibility of works during the period of the ban during spawning until 05.06.2022.

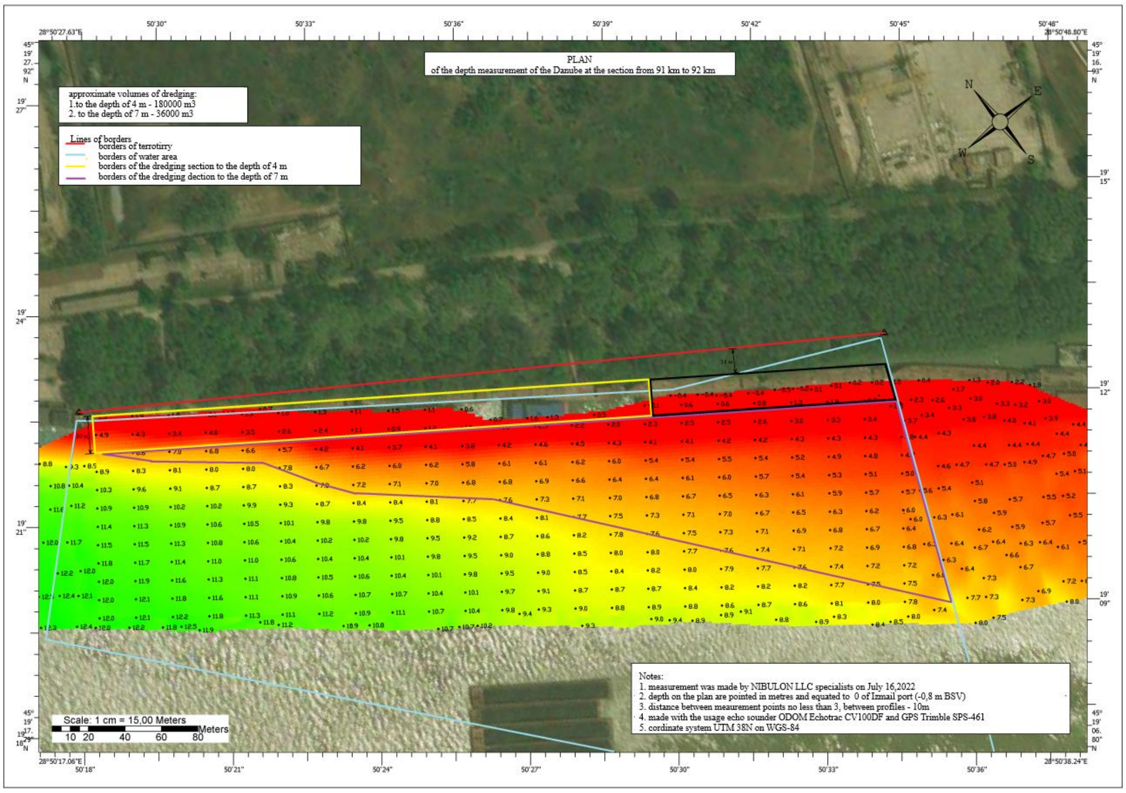


Figure 1.1 – Situational map-diagram of the river port of NIBULON LLC Izmail, Odesa Region

Design characteristics of the operational water area with an approach channel: length – 460 m, width – 115 m, area 5.29 ha, design depth – 8.23 m from “0” of Izmail seaport.

Stage of construction	Design characteristics	Involved dredger and working body	Volume of works, m3
I	Performance of work on the	Watermaster Classic IV,	22000

	area of 1.0 ha to the point of 4.0 m	bucket	
	Bottom cleaning on the area of 1.0 ha to the point of 4.0 m	Watermaster Classic IV, cutter, soil pump	10000
III	Dredging on the area of 2.2 ha to the point 7.32 m	Self-propelled vessel SDS-15, cutter, soil pump	53000
V	Dredging on the area of 2.32 ha to the point 8.23 m (if necessary)	Self-propelled vessel SDS-15, cutter, soil pump	27000

Dimensions of the work area: the largest length is 460.0 m (91.55 km - 91.06 km), the largest width is 30 m.

The dredging works are planned to be carried out by machinery in turn with the involvement of the following hydraulic engineering:

- **Watermaster Classic IV.** The pulp is pumped using a suction pump, through a pipeline with a diameter of 200 mm, with a pulp productivity of 600 m^3/h. The soil: water ratio is 1:5; the work of bucket by the volume of bucket is 1 m3

- **self-propelled dredging vessel (dredge) SDS - 15**. The pulp is pumped using a suction pump, through a pipeline with a diameter of 450 mm, with a productivity of pulp 2400 m^3/h. The soil:water ratio is 1:6;

The extracted soil (pulp) is transported through the pipeline and stored in a 1.24 ha coastal dump. The perimeter is surrounded by a dam with 2.5 m high, within its boundaries are formed alluvium maps with a discharge pipe Ø 200 m for the discharge of clarified water and a drainage ditch along the barrier dam with a depth of 0.5 m and a bottom width of 1.0 m for the discharge of water that filtered through the embankment dam (Appendix B).

Taking into account the location of planned activities, as well as being guided by the provision of the Resolution of the Cabinet of Ministers of Ukraine dated May 22, 1996 No 552 “On approval of the List of industrial sites of fishery water bodies (their parts)”, this territory, as a hydrotechnical structure and a place of intensive shipping (ports, shipping way) are not an industrial part of the Danube basin.

According to the Order of the State Agency of Melioration and Fisheries of Ukraine (Black Sea Fisheries Patrol) No. 132 dated April 14, 2022, industrial and amateur fishing is prohibited for the period of mass spawning in the Danube River from April 22 to June 05 (the ban does not apply on the directed fishing of herring), appendix C.

Taking into account the duration of the works (52 days) and the total volume of dredging of the operational water area of the River Port (terminal) of NIBULON LLC (112,000 m^3), the estimated amount of extracted soil will be equal to 2154 m^3 per day.

The dredging of the Danube river section will not have a negative impact on adult fish, as they are able to avoid dangerous areas. The negative impact (at the level of complete destruction) will be felt by eggs and young fish that get to the place of the production process, so the purpose of the work is to assess the degree of impact of the works on fish resources, due to the loss of fish products from eggs and early young fish. If dredging works will be carried out during the ban on specialized fishing, which will be associated with the period of their mass spawning, assessments and compensation must be obtained in accordance with the procedure established by the legislation of Ukraine.

According to the available cartographic materials, it has been established that there are no objects of the nature reserve fund and territories reserved for the creation of nature reserve fund objects on the territory of the planned activity and in the zone of its territorial impact (within a radius of 687 m from the centroid of the production site). Also, this territory is not a migratory eco-corridor for rare species of birds, does not belong to the territories of the "Emerald Network" project and Natura 2000.

Convention on the Protection and Sustainable Use of the Danube River (1994, ratified by Ukraine in 2002). Cooperation in the field of water management is aimed at sustainable water management, which means of the criteria of sustainable, ecologically sound development, which are simultaneously aimed at:

- maintaining the general quality of life;
- maintenance of long-term access to natural resources;
- avoidance of long-term environmental damage and protection of ecosystems;
- implementing a preventive approach.

The result of the biological substantiation will be an assessment of the impact of hydrotechnical works on the state of fish stocks of the Danube River with the provision of recommendations of a preventive approach for the implementation of hydraulic works.

2 PHYSICAL AND GEOGRAPHICAL CHARACTERISTICS OF THE REGION

The river port (terminal) of NIBULON LLC of the Izmail Sea Port is located in the Danube Delta and is located in the southwestern part of Ukraine and Eastern Romania, from the bifurcation of the Danube above Izmail to its flowing into the Black Sea. The Danube Delta occupies an area of 5,640 km², of which 1,200 km² is within the Odesa region [1]. The Danube delta zone is divided into two arms (mouths) - the left Kiliia (on the border with Romania) and Tulcea, the right one. Tulcea arm, in its turn, is divided on George and Sulina branches (both on the territory of Romania). The Kiliia arm is the most full-water, its length is 117 km. It is shipping to Izmail, ports: Izmail, Kiliia, Vylkove. Near Vylkove town, it splits into a series of waterways that form the young delta of the Kiliia mouth (area 1958 km²), which is in a state of dynamic development. On average, the area of the delta increases by 1.1 km² annually. There are numerous lakes and river branches in the Danube Delta. More than 85 % of its area is occupied by floodplains - marshy areas that are flooded for a long time or constantly. About 70% of the territory of the floodplains is covered by groups of southern reeds. In their composition, a large number of sedge, cattail, bulrush, as well as weeds grow in the most elevated areas of ridges near the riverbed. Among the flood plains are lakes connected by channels and often covered with thickets. Large, unvegetated channels have folded loamy levees.

The Danube delta ends with the front, seaward edge of the lower face of this river delta, which includes bays and mouths of arms, and the avandelta (in front of the delta), which is not part of the delta, is the water area from the coast of the sea to the zone of sea water overrepresentation; its length from the shore in the sea can be several kilometers. The river-sea geochemical border with the average values of the Danube flow is characterized by an isohaline of 6 ‰.

The Danube Delta is the largest in Europe and one of the largest in the world by area.

The river port (terminal) of NIBULON LLC is located in the water area of the Kiliia mouth of the Danube River, 93 km from the Black Sea. The water area of the SEA port of Izmail port includes the water space of the river from 81 km to 97 km, directly from the left bank to the conditional line of the state border of Ukraine, which passes along the fairway of the Danube, the river port (terminal) of NIBULON LLC occupies the river part of the port from km 91.09 to km 91.55.

The port can accept ships the length of which does not exceed 150 m, width - 30 m, draft - 7 m. The draft of ships entering the port is limited by the passing depths of the Sulina Channel and the Bystre Channel on the Ukrainian section of the Danube River.

In 2022, NIBULON LLC is building a cargo berth with the operational water area of a river port in Izmail, Odesa region, under the project "New construction of a transport infrastructure object - a river port (terminal) in Izmail, Izmail district, Odesa region". The working project envisages the execution of dredging works with the subsequent transportation of pulp through the pulp pipeline on the coastal bottom soil dump (see Appendix C).

Over 30 years of activity, NIBULON has created a modern, unique grain logistics infrastructure in Ukraine, which consists of transshipment terminals and complexes for receiving, storing and shipping grain and oil crops, powerful fleet and production units throughout Ukraine. Today, the company is represented in most regions of our country. [2].

2.1 Climate

The climate of the temperate zone is characterized by relatively mild and wet winter and hot, dry summer [3]. In winter, due to the spread of the branch of the Asian anticyclone in the east of Europe, persistent and strong winds from north-east to east arise on the Black Sea, which bring cold and relatively dry continental air of moderate latitudes. The weakening from the horn of the Asian anticyclone leads to the development of cyclonic activity in the Black Sea, which leads to an increase in air temperature and abundant precipitation. In summer, the northwestern part of the Black Sea is under the influence of a subtropical anticyclone. Individual areas of this anticyclone often produce long periods of weather with little wind activity and a large number of dry, clear days. During the arrival of the polar front, cyclones are formed, which contribute to precipitation. The following types of weather can be distinguished in the northwestern part of the Black Sea.

The anticyclonic type of weather is distinguished by its breeze-type winds with a speed of no more than 7 m/s, and in the spring also by fogs.

Cyclonic type of weather, which is characterized by winds with a speed of 7 - 15 m/s from the south, west and north-west directions. In winter, this type of weather contributes to gloom and prolonged precipitation. Cloudiness prevails in summer.

The type of weather characterized by strong cyclonic winds with a speed of 19 - 23 m/s, stormy and heavy precipitation. Thunderstorms are observed in summer and autumn, according to a similar type of weather, and in winter, a sharp cooling is possible.

The north-eastern type of weather is different, there is a significant drop in temperature and "hovering" is noted. In the summer, the air temperature is high, insignificant humidity and clear skies.

The western type of weather is characterized by strong westerly winds, significant or complete cloud cover, and prolonged precipitation. On the northwestern coast of the sea, for example, the average monthly temperature in the coldest months of the year (January and February) is - 1 - 4 °C. The absolute minimum air temperature in winter in the north west reaches - 30 °C. In March, the average temperature slightly changes to 2 - 3 °C, in May it is 14 - 17 °C. In summer, the air temperature is approximately equal. In the warmest months of the year (July and August), the average temperature on the coast is 22- 24 °C. The absolute maximum temperature reaches 40 - 41 °C. Autumn is warmer than spring. In mid-autumn - in October, the air temperature in the northwest is 13-14 °C.

The average annual number of days with frosts in the research area is approximately 100. It should be noted that frosts do not last long and are usually associated with strong winds from the northeast to north. The relative humidity of the air during the year in the described area varies on average from 60-70 to 80-88%, and in summer and early autumn it is lower than in other seasons.

In the greater northwestern part of the Black Sea, winds from the northwest, north, and northeast prevail in winter, the total recurrence of which reaches 50%; in certain points, winds from the east are also quite often observed. In the spring, winds from the northeast and northwest may prevail, but along with them, winds from the south, southeast and southwest receive a noticeable development. In summer, in most points, winds from the northwest (repeatability up to 20 - 35%); of the winds from other directions, the most likely winds are from the west and southwest, and in some points also from the north. In autumn, winds from the north, northeast and east are more often noted, and in some areas - winds from the northwest.

The average annual number of days with storms (wind speed ~> 15 m/s) can reach 112 days. Most often, they occur from October or from November 15 to March, when on average there are 4 - 7 days or more with storms per month. From April or from May to September, the average monthly number of days with them rarely exceeds 2.

Visibility of 5-10 miles or more prevails in the area. The best visibility conditions are noted from April to October - November. During the day, the highest visibility is observed in the afternoon, the lowest in the morning. When there is a repeat invasion of cold air masses, which is most likely from October to May, exceptional visibility is noted - at this time visibility can reach - 110 - 160 miles.

Thunderstorm activity is most developed from April - May to September, on a larger scale part of the area, when on average there are from 1 to 8 days with thunderstorms per month. From October to March thunderstorms are rare.

Hail, most likely from April to June. The number of days with it is small - 5: on average, it does not exceed 1 - 2 per year.

Clear ice is possible in the cold season, but the average number of days with it is no more than once a month. Blizzards occur only from December - January to March. The average number of days with them varies from 1 to 3 per month.

A moderately cold climate is observed in the work area with a large (as for the southern part of Ukraine) amount of precipitation, even in the driest month. It falls about 452 mm of precipitation per year.

The average annual air temperature is 9.9 °C. The largest amount of precipitation is in October, with an average of 24 mm. The highest amount of precipitation falls in July, with an average of 54 mm.

The hottest month of the year is July, the average temperature is 22.7 °C. The lowest average temperature of the year is recorded in January, when it is about - 3.3 °C.

Between the dry and rainy months, the difference in precipitation is 30 mm. The temperature change throughout the year is 26.0 ° C.

2.2 Hydrological conditions of the Danube River

The place of work is located in the Danube Delta. The speed of surface currents of the Danube from Reni to the seacoast increases in the section from Reni to Kiliia - Velyke Stolitti, where the maximum speed of 175 cm/s is registered [1]. The speed of water flow from the entrance to each arm and exit from it to the sea decreases.

The Novostambulsky arm is characterized by the most powerful removal on the coast, the speed in which reaches 55 cm/s. Divergence of surface and bottom currents was repeatedly recorded. In 55% of the cases of observations of individual arms of the delta, the difference in current directions is vertical. These features of the flow regime in the arms of the Danube delta affect the spatial distribution of hydrochemical characteristics and the processes of accumulation of suspended and polluting substances.

The characteristic connection of the river flow regime with the change in turbidity is expressed in the low transparency of the water and the high content of suspended substance. The minimum transparency (0.3 m) was noted in the Kiliia Delta, slightly higher in the lower current of the Danube River (0.6 m) and in the avandelta (0.7 m). Along the course of the river from Reni to Kiliia, the content of suspended substance increases. On average, the content of suspended substance in the delta is twice as high as in the river. The general mineralization of water naturally increases from the river to the sea.

The temperature value was distributed relatively evenly, both by area and vertically. Despite the high dynamics of waters and their intensive aeration, the content of dissolvable oxygen in water is almost everywhere below the saturation level, in the Kiliia delta it is slightly higher than in the river.

In general, the waters of the region are characterized by relatively low pH values. The reason for this phenomenon can be considered the presence of an excess of easily oxidizing organic substance, which is illustrated by high BOD_5 values (in 82% of cases they exceed the MPC by 2.5 times), as well as the MPC and the level of suspended organic carbon content. This, in turn, is due to the removal by the river from the upper and middle reaches a large amount of allochthonous (dead organic) matter, as well as the high trophic status of the region. BOD_5 values can be equal to 9.6 mg/l [4].

The Danube can carry an average of 205 km^3 of water to its estuary annually. Approximately 7.3% of this volume of flow (i.e. 15 km^3) is formed on the territory of Ukraine (Uzh, Tisza, Siret, Prut). The increase in flow in the river delta is insignificant - about 1.5 km^3. Irreversible water consumption directly within the estuary region of the Danube currently does not exceed 0.5

km³/year, which is less than a quarter of a percent of the total flow of the river. Due to the protrusion of the estuarine sections of the waterways of the Kiliia delta in the sea, as well as due to the artificial direction and deepening of the Sulina arm and the construction of a guide dam at the bifurcation node of these arms, the flow of the Kiliia arm has slightly decreased. Recently, the redistribution of flow in favor of the Tulcea branch has slowed down.

In the annual course of the water level in the Danube in modern conditions, the spring flood, autumn and winter floods, summer-autumn low and winter low baseflows are distinguished. The spring flood occurs, as a rule, in two waves: the first - from the melting of snow on the flat parts of the basins; the second - from the melting of snow in the mountains and the rains that fall during this period. The maximum level of the spring flood is usually the highest of the year. From September to the beginning of ice formation in the Danube, water level rises caused by autumn floods are observed. As a rule, they are not high, although in some cases they can exceed maximum spring flood levels. A large rise in the water level can also be caused by winter floods, which are accompanied by ice jams. In about 20% of cases, these rises become the highest for the year. The minimum annual water level is observed in the summer-autumn period, but in some years (20% of cases) it can also be in winter. The amplitude of water level fluctuations in the Danube decreases downstream and amounts to 620 cm in Reni, Kiliia - 305 cm and Vylkove - 261 cm.

The water temperature in the Danube River, averaged on an annual scale, is 12.7 °C. The warmest river waters are usually in July - August (up to 24.1 °C in general); during this period, the maximum temperature is observed - 27.6 ° C. The duration of the period with a water temperature exceeding 5 ° C is 265 days on average (16.03 - 6.12). The temperature is above 10°C, it is maintained from 10.04 to 9.11 (213 days), above 15°C - from 4.05 to 13.10 (162 days) and above 20° C - from 31.05 to 16.09 (108 days). Certain regularities in the distribution of water temperature along the length of the estuarine section of the river were not found.

An analysis of the wind regime of the Danube delta over a long period (1945-2000) showed that all hydrometeorological stations and posts in the delta are characterized by the dominance of winds from the north and south. The period of winds from the north-west, west, and north-east directions in total accounts for 40.75% every year, but the share of south, north, and north-west winds is 32.09%. The northerly wind is characterized by especially significant repeatability - 17.51%. A very high percentage of calms - 14.85%.

Ice phenomena on the Danube are not observed every year. Winters here are relatively mild - the average monthly air temperature of the coldest month (January) is -2° C. In colder winters, ice appears at the top of the river delta (on average 4 - 9.01), then spreads for 2 - 3 days in the entire estuarine region. The duration of the autumn ice movement, which is accompanied, most often, by the formation of ice jams, can be from one to 20 - 25 days. Ice formation lasting more than 5 days is formed only in 50% of cases. The ice thickness on the main branches of the delta does not exceed 25-35 cm. The destruction of the ice cover begins in February, at the beginning of March the river is cleared of ice. In recent years, in order to continue navigation and reduce traffic jams, the ice cover on the Danube and in the arms of the delta has been destroyed artificially, which leaves a noticeable mark on the ice regime of the river [3].

2.3 Hydrochemical mode

The hydrochemical regime of the Ukrainian section of the Danube is formed under the impact of its internal water flow, the vital activity of aquatic organisms and wastewater from industrial enterprises, agriculture and settlements. Many ingredients of the hydrochemical regime are inversely related to the amount of river flow.

The main factor in the formation of seasonal dynamics of water mineralization is the water flow of the river. According to the dominance of ions, the water of the Ukrainian section of the Danube belongs to the hydrocarbonate class of the calcium group. In the arms of the delta, the concentration of calcium fluctuates no more than 28 - 60 mg/l. The largest amount of magnesium is found in the mouth of the Prut, up to 23 mg/l, in the middle part of the river - 13 - 16, in the arms of the delta - 8 - 26 mg/l. Seasonal dynamics is characterized by a minimum content in spring and an increase towards winter.

Concentrations of carbonate ion are small: 3 - 24 mg/l. It occurs at pH 7.6 - 7.8 and is accompanied by a decrease in the amount of hydrocarbons to 160 - 180 mg/l [4].

The sulfate ion concentration also varies widely in the area with maximum values at the mouth of the Prut (up to 120 mg/l). Its content fluctuates significantly throughout the year within the limits of one point of observation. So, in the Vylkove area it was distributed as follows: in March – 92.2 mg/l, May – 55.2, June – 70.1, August – 46.4, October – 48.5 mg/l. Its maintenance is influenced, in addition to the water flow of the river, by the influx of phenomena from the Black Sea.

In the distribution of chlorides, there is an increasing trend from the Reni to the mouth of the river is observed, which is mainly due to the impact of the sea. Because of this, their seasonal dynamics are unstable.

The oxygen saturation of the water flow varies greatly down the river from the Reni to the Black Sea. Calculations of oxygen flows in the Reni, Izmail and Vylkove reservoirs showed that despite some qualitative differences caused by their transformation downstream, they directly depend on the change in the volume of the river flow.

Ecological observations of Ukrainian scientific center of Ecology of Sea (UkrSCES) in 2020 allow us to state that the content of total nitrogen in the water area ranged from 0.486 mg/dm^3 to 1.6280 mg/dm^3, total organic phosphorus – from 0.0141 mg/dm^3 to 0.0595 mg/dm^3 (Table 2.1).

Table. 2.1. Hydrochemical indicators in the water of the Danube estuary area [5]

Ingredient-indicator, mg/ dm³	Approach channel, fluctuations (average)
PO_4^{3-}	0.0 – 0.0526 (0.0173)
Porg	0.0141 – 0.0595 (0.0290)
NH_4^+	0.0 – 0.0142 (0.0042)
NO_2^-	0.0017 – 0.0242 (0.0099)
NO_3^-	0.0485 – 1.2110 (0.4579)
Norg	0.4860 – 1.6280 (1.0811)
SiO_3^{2-}	0.1520 – 2.7920 (1.1415)
Salinity, ‰	0.0 - 2.6
Oxygen mg/dm³	6.20 – 9.30
Biochemical oxygen demand5, mg O/ dm³	2.73 – 3.29
pH	8.19
Suspended substances	93 - 242

The materials of the Danube Hydrometeorological Observatory for a 20-year period show that the turbidity of water in the branches of the Kiliia delta is characterized by lower values: in the Kiliia arm in Vylkove it is 158 g/m³, in the Starostambulske arm — 161, in the Prorva arm - 172 g/m³. The average turbidity of the Danube water in the Vylkove area can vary from 93 to 242 g/m³; the highest monthly average value of turbidity in this body can reach 800 g/m³ (October), the lowest – 16.6 g/m² (November). The range of fluctuations in daily values of water turbidity in the Danube Delta is exceptionally wide - from a few grams to 2-3 kg/m of water.

The main hydrochemical parameters of water masses are given in table 2.1.

The analysis of the spatial distribution of hydrochemical parameters shows that the research water area can be classified as anthropogenic-eutrophic and characterized by a high content of biogenic substances with a predominance of their organic forms.

2.4. Hydrobiological conditions of the Danube River

Phytoplankton. In the waters of the Danube River, diatoms have the greatest species diversity, accounting for 64% of the floristic composition [6]. Among the most common diatoms with a duration of 48-78% are freshwater *Cyclolella kuetzingiana Thw., C. meneghniana Kutz.*, Melosira granulata (Ehr.) Ralfs., *M varians Ag., Synedra acus Kutz., S. acus van radians* (Kutz) Hust. The representatives of marine flora *Sceletonema costatum (Grev.) CI., Cerataulina pelagica Perag* are much less common.

Green algae are represented by widespread *Scenedesmus quadricauda* (Turp.) Brebsl., *Ankistrodesmus arcuatus* Korch., *Kirchneriella lunaris* (SchmicUe) Bohl., in terms of the number of species they rank second after diatoms. In total, up to 67 taxons were found in the Danube and its arms, and up to 48 intraspecific taxons of algae in the Danubian water bodies. In the Danube, the floristic spectrum of diatoms is up to 62%, in the Danubian water bodies - up to 58.3%, green algae - 29% and 25%, respectively, blue-green algae - 7.5% and 6.2%. The species diversity of the phytoplankton of the delta and the avandelta differ. *Fragillaria crotonensis Kitt., Fr. virescens Ralfs., Nitzschia lorenziana Gran, M. varians Ag* were found only in the delta.

Indicators of the quantitative development of phytoplankton in the Danube, in the Yalpug and Kugurluy lakes varied widely: the number - from 3.0 million cells/m^3 to 11.0 billion cells/m^3, biomass - from 4.2 to 3687.6 mg/m^3. The maximum number was achieved due to small cells of blue-green algae. In the upper part of the river at the Reni river crossing, as well as in the Yalpuh and Kuhurlui Danubian water bodies near the Romanian shore, the number (10.0 million cells/m^3) of phytoplankton was an order of magnitude lower, and the biomass was 4.5 times smaller than in other areas of the section. The average values of the number and biomass of diatoms (respectively, 92.6 and 93.3%) in the lakes were close and grew on the rush of the river.

An increase in the number of phytoplankton with the dominance of diatoms (98.7% of the number and 98.0% of the biomass) was noted on the Izmail crosspiece. Downstream of the Danube and in the estuaries of the Kiliia region, the number reached 410.0 million cells/m^3, biomass - 158.7 - 1055.8 mg/m^3. These values can vary widely. The increased amount of phytoplankton in these areas is associated with the intensive development of freshwater diatoms *Stephanodiscus hantzeshii Gran* (93.6 million cells/m^3 - number and 65.6 mg/m^3 - biomass) and brackish water *Diatoma elongatum* (Lyngb.) Ag. (86.4 million cells/m^3 and 121.0 mg/m^3, respectively).

In the greater part of the Kiliia section of the delta, where phytoplankton was distributed almost uniformly, the role of algae belonging to different systematic divisions is not the same. The spatial distribution of the number and biomass of diatoms and greens often acquired an inverse relationship.

In recent years, a decrease in the number of phytoplankton has been observed in the Danube Delta, which could be a consequence of a change in the hydrochemical regime of the Danube Delta and avandelta, which is associated with a significant decrease in the concentration of mineral forms of nitrogen [6].

According to research results, in 2000 [6] the average number of phytoplankton in the area of Izmail was 447.0 million cells/m^3, biomass - 524.4 mg/m^3.

The intensity of phytoplankton development is also directly dependent on the amount of water turbidity, since finely dispersed mineral suspension prevents penetration of solar energy to the water column. In addition, the suspension, having a mechanical effect on the pelagic cells, contributes to their sedimentation in the bottom layers. Degree of turbidity of Danube waters increases in the spring, during the flood period. In April, an extremely high content of suspended substance in river water is observed not only in connection with hydrodynamic factors, but also due to the removal of a large amount of allochthonous organic substance. In addition to this factor, the decrease in the number and biomass of phytoplankton, compared to previous years, can be explained by the high level of pollution. The high content of metals and allochthonous organic substance in the water can be attributed to the factors of suppression of phytoplankton, especially in the delta.

Zooplankton. Zooplankton of the Danube within Ukraine is characterized by significant diversity of species. Its structure can include more than 82 taxons [7]. The basis of structure of plankton group is represented by rotifers and cyclopedias. There are such species of calanoida as *Eurytemora vefox* Lilleborg and *Diaptomus gracilis* Sars. Harpacticoida are also available. Representatives of the epibiotic Ponto-Caspian fauna *Heterocope caspia* G.O. Sars and *Calanipeda aquae-dulcis* Kritshagiii are absent in this part.

Zooplankton of the Danube usually has copepodit character. The total number of zooplankton of the riverbed part in average is 44.3 ths. specimen/m³, biomass – 241.52 mg/m³, at the delta: number – 35.4 ths. specimen/m³, biomass– 193.2 mg/m³. Both in the riverbed part and in the delta, the rotifers prevail in number. At the riverbed part their share is 72.7%, at the delta – 70.0%. In both parts, the copepods prevail by biomass: riverbed part - 65.7%, delta – 66.2%. The average number of zooplankton of riverbed part and delta in average is 39.8 ths. specimen/m³, biomass – 217.36 mg/m³ [8]. Analysis of the development of zooplankton shows that the formation of river zooplankton is mainly influenced by water content. In years of abundant water, the development of zooplankton increases. However, despite the fact that in some years (spring 2000) high water content is observed, such a trend in the development of zooplankton was not noted. In the spring period in the early 1980s, both in terms of number and biomass, rotifers prevailed. From the dominant species of zooplankton the rotifers were mentioned such as *Brachionis calyciflorus* Pallas and *Asplanchna priodonta* Gosse, from the copepods - *Acanthocyclops robustus* (Sars). At the high development of *Br. calyciflorus* the dominant place was taken by rotifers of Keratella genus: *K. quadrata* (Muller), *K. q. dispersa* and *K. cochlearis* (Gosse). With a high diversity of rotifers in the structure of the river community in certain years (2000), the main role belonged to a few species: *Br. Calyciflorus* Pallas, *Br. canuroeiformis* Brehm, *A. priodonta* Gosse, *A. herricki de Guerne, K. quadrata* (Muller), *K q. dispersa*. Among the diplostraca the *Daphnia lonqispina* O.F.Muller, *Simocephalus vet*ulus O.F. Muller, *Chydorus sphaericu* O.F. Muller, *Bosmina longirostris* O.F. Muller dominated.

Together with the representatives of zooplankton syrton organisms are registered in the river: larvae of insects and molluscs, nematode etc. The total numbers and biomass of this group of hydrobionts are not very significant. They averaged no more than 1%.

The fact that the number of larvae of the Dreissena mollusk in plankton significantly decreased, which in abundant water period could be up to 13% of the total number is noteworthy, the presence in the plankton of the dead larvae of Ostracoda increased. They are found already dead with open valves. Thus, in the Izmail area, in some years, up to 100% of dead larvae were found.

Molluscs at an earlier stage of development (veliger) are found in small quantities and have a "non-viable" appearance.

The development of zooplankton in different parts of the river is not uniform. In the Izmail area, as a rule, indicators of numbers and biomass are at an average level. The development of zooplankton in the Danube can vary significantly. As for example, on May of low-water 1998, in the channel area the total amount of zooplankton was 4.5 ths. specimen/m^3, biomass – 70.24 mg/m^3 [8]. In that area in all cases, the tendency of dominance in the community of rotifers and copepods remains.

Therefore, taking into account the above, it should be assumed that the zooplankton of the Danube within the borders of Ukraine is characterized by a large species diversity, the increase in biomass occurs due to the development, mainly, of the copepodite complex.

Average number of zooplankton of riverbed part is 39.8 ths. specimen/m^3, biomass – 217.36 mg/m^3. A group change was noted in the development of the zooplankton of the river. In all areas of the riverbed part of the river and the delta, rotifers dominate in number, and copepods dominate in biomass.

Zoobenthos. Individual areas of the Danube River within Ukraine differ from each other in terms of flow speed, mineralization, depth, nature of bottom sediments, which are related to the sedimentation of suspended material, the level of pollution and other factors. As a result, the benthic fauna population differs in its qualitative composition, the ratio of numbers and biomass of the main systematic, ecological and trophic groups, the degree of dominance of the main species, the size composition of populations of dominant species of bivalve molluscs, and the spatial distribution of the quantitative characteristics of benthic invertebrates.

Up to 14 species of benthic invertebrates have been noted along the Izmail-Reni dam – one of worms and one of arachnids, molluscs – 4, crustacean - 2, insects (larvae and imago) - 6 The average number of benthos reaches 5000.0 specimen/m^2, biomass – 11.94 g/m^2. On the areas of river where the gastropods are found, the biomass can reach 20.08 g/m^2. Among the main systematic groups by the number of taxons (6) and density (65.6%) insects dominate, by the biomass (74.7%) – molluscs [9].

The amount of taxons of protoaquatic and secondary animals is almost the same, by number (65.6%) secondary organisms prevailed, by biomass (84.4%) – protoaquatic ones. The representatives of infauna in many times prevail over the animals of the epifauna, accounting for 75.0% of the number of species, 99.1% of the number and 83.6% of the biomass. The most wide-spread are mosquito larvae - 59.6% of the density of the entire benthos. At the same time, their biomass is only 9.7%, since the average mass of a specimen is small - about 0.0004 g. The highest biomass (64.3%) is noted in the gastropod molluscs *Bithynia tentaculata* L.

The number of taxons (85.7%) and biomass (88.6%) is dominated by representatives of the epifauna, and by the number (63.6%) - invertebrate of infauna.

Among the trophic groups detritivores dominate by density (64.4%), by biomass (78.7%) – plant-detritus forms.

The biomass of benthos significantly varies by years, seasons and areas of the river. In the recent years extreme decrease of number indicators of benthos is determined in the Kiliia area of the Danube more than of an order. If in the 80s the number of benthos reached 11.7 ths. specimen/m², biomass 36.7 g/m², then in 2000s these values decreased to 205.0 specimen/m² and 1.43 g/m² respectively [9]. The number of oligochaetes and molluscs reduced significantly, which have created the main biomass of the benthos and have determined high food capacity of river at the Kiliia area of the Danube.

Thus, the quality composition of the benthic fauna of the Danube river in the area of Izmail port is poor and is represented mainly by larvae of insects (chironomidaes), oligochaetes and benthic crustacean (gammaridaes, mysida and others) [10].

The average biomass of forage organisms living in the Danube River in the area of dredging works is shown in Table 2.2.

Table 2.2 – The average biomass of forage organisms in the Danube River in the area of dredging works

The name of water body	Biomass of forage organisms		
	Phytoplankton, g/m³	Zooplankton, g/m³	Zoobenthos, g/m²
Danube river	0.524	0.217	1.43

2.5 Ichthyofauna and fishery significance of the works area

One of the main factors that determine the conditions for fish reproduction is the river level regime. In connection with the construction of dams, not only a part of spawning grounds in the Danube was lost, but also the flood decreased, which led to the deterioration of spawning conditions. Currently, the spawning of ordinary fish mainly takes place in the Kiliia mouth of the delta. Shrubs of soft aquatic vegetation are concentrated here, which is a spawning substrate of phytophilous fish species [11]. Along the entire length of the Ukrainian section of the Danube River, there are small meadows flooded with water where carp, crucian carp, bream, zander and others spawn.

In addition to anthropogenic eutrophication and pollution of the Danube waters, the state of fishing in the delta was significantly affected by the regulation of the river's flow and the arrangement of the banks with dams, which significantly worsened the natural spawning conditions of many fish species.

The terms of fish spawning in the Danube River are similar to those in the Danubian water bodies. Their change occurs depending on the hydrometeorological conditions of the year. The success of spawning largely depends on the water content of the year. The biology of species living in the Danube River is described in the handbook [12]. Usually on February-March the northern pike *Esox luceus* (Linnaeus, 1758) already spawns. On the third decade of March - second decade of April at the temperature of water 10 – 11 °C, the highest intensity of spawning of European perch *Perca fluviatilis* (Linnaeus, 1758) is observed. Later the reproduction of common roach *Rutilus rutilus* (Linnaeus, 1758) and zander *Sander licioperca* (Linnaeus, 1758) occurs. Common bream *Abramis brama* (Linnaeus, 1758) spawns at the higher indicators of temperature of water – from 14 to 17 °C. After its heating to the 16 - 17 °C the spawning of crucian carp, golden or silver crucian carp *Carassius carassius* (Linnaeus, 1758), *C. gibelio* (Bloch, 1782) and European carp *Cyprinus carpio* (Linnaeus, 1758) begins. These species have a very extended, portioned spawning, which often continues throughout the summer.

In the aboriginal fauna of the Danube River, there are three main groups of fish with different types of reproduction:

- pelagophils (Black Sea and Azov Sea herring, sabrefish);
- litophils (sturgeon, starry sturgeon, sterlet, vimba, aspius etc.);
- phytophils (roach, bream, carp, crucian carp etc.).

In response to the change in reproduction conditions due to the construction of dams, many populations of phytophils fish showed ecological flexibility and adapted to spawning in the river bed on new substrates.

Spawning grounds of crucian carp usually is situated on areas or river with slow current and in the backwater with a ditch water. For spawning, it chooses shallow coastal areas with a depth of about 0.5 m, with a more or less muddy bottom and shrubs of aquatic vegetation - arrowhead, typha, pondweed etc., or flooded areas with ground vegetation of reedbed.

Spawning of common bream largely depends on the spring flood, spawning duration and size depend on it. In conditions of significant fluctuation of the river level, the *bream* has mastered new spawning areas at the greatest depths of the river. At the same time, a small part of the spawning herd of common bream spawns in the riverbed part of the Danube delta, and a significant part - in the reedbed system.

For European carp, spawning sites are usually shallow, well-warmed areas of water bodies, characterized by a weak current, with a hard or slightly muddy bottom, which is covered with soft or hard aquatic vegetation, or flooded with meadow vegetation. At the lower part of the Danube river spawning grounds for European carp are flooded with meltwater areas of reedbed with well-developed vegetation namely grass, sedge, pondweed etc.

Sabrefish Pelecus cultratus (Linnaeus, 1758) spawns at the temperature of water 11 - 12°C. The spawning conditions of sabrefish are very peculiar. It can spawn both in the riverbed part and in the reedbed, laying eggs on vegetation. This species uses the so-called spawning grounds of the first and second type. Spawning sites of the first type are used with a high water level, when there are available flooded areas of reedbed at a depth of 20 - 50 cm. The second type - spawning in the riverbed of the river at a depth of up to 3 - 4 m - takes place at a low water level.

Zander spawns near the shores, in shallow water places where there are tree roots, flooded fragments of branches, dead but not rotted vegetation.

Spawning of the perch occurs in places with a weak current, or, in the absence of a current, in those places where there are hard aquatic vegetation, roots, branches of flooded bushes. Vegetation is not only a substrate for spawning, but also contributes to the spawning process of *perch*.

The northern pike spawns in shallow water and in flooded sections of reedbed, spaces with meadow vegetation. Northern pike eggs is laid into the bottom layer, on river and flooded meadow vegetation.

White bream *Blicca bjoerkna* (Linnaeus, 1758) spawns on May – the beginning of June. The spawning grounds of white bream - small bays with flooded or soft underwater vegetation.

Rudd spawns in late May and in June in bays, lakes or areas with a weak current. Spawning takes place in reed bushes.

Common roach spawns from early April to early May. Spawning takes place near the shore. Substrates for spawning can be different - aquatic vegetation, roots, flooded trees, in the absence of plant substrates - stones.

Gobiidae (round goby – *Neogobius melanostomus*, monkey goby – *N. fluviatilis*). The biggest length of body 25 cm, usually up to 20 cm, weight 140 g, usually 90 - 100 g; monkey goby - 20 cm, usually up to 15 cm, weight 70 g, usually up to 40 - 50 g, duration of life 5 - 6 years. During reproduction, the color of the males round goby turns black, and the fins also darken, which have a light border on the edges.

Adheres to areas with muddy shelly, sandy, or pebbly soil, but generally avoids clean rocky or muddy soils and thickets of underwater vegetation. Lives at depths from 1 - 2 m to 10 - 15 (17) m, sometimes up to 30 m; usually migrates to greater depths after spawning and in the cold season. Spawning is portioned, begins at a water temperature of 9-10ºC, its peak falls on a water temperature of 15-16ºC.

Youngstock feed on plankton with a gradual transition to consumption of benthos (worms, crustaceans, insect larvae, small molluscs, etc.). Large individuals feed mainly on molluscs, which make up 90% of their diet, other benthic invertebrates and young fish. In the area, the works are not of industrial importance.

Roach - *Rutilus heckelii* (Linnaeus, 1758). Spawns from early April to early May. Spawning takes place near the shore. Substrates for spawning can be different - aquatic vegetation, roots, flooded trees, in the absence of plant substrates - stones.

Herring. Danube river herring *Alosa caspia nordmanni* Antipa, 1904. A pelagic schooling migratory fish that lives in the sea and enters fresh water to reproduce. Spring migration from March, at a water temperature of 6º C, most intensively at 13-17º C, until the end of April, when it enters the estuaries of rivers. It reaches sexual maturity at the age of one year with a length of 11-13 cm and a weight of 25-30 g. Spawning is from the end of April - the beginning of May to the end of June, at a water temperature of 13 - 22º C, on the area with weak flowing or ditch water, but clear water and sandy, or sandy and muddy soil. Egg is spawned on the surface layers of water.

Sturgeon family – Acipenseridae Bonaparti, 1831. Migratory demersal fish which constantly live in the sea and for spawning moves into rivers except the starlet which is freshwater fish and does not perform huge migrations.

The sturgeon family of the lower reaches of the Danube (within Ukraine) includes: beluga sturgeon - *Huso huso* (Linnaeus, 1758); freshwater sterlet - *Acipenser ruthenus* Linnaeus, 1758; russian sturgeon – *Acipenser gueldenstaedtii* Brandt et Ratzeburg, 1833; starry sturgeon – *A. stellatus* Pallas, 1771 [11].

Beluga sturgeon. Migratory demersal fish which constantly live in the sea and for spawning moves into rivers. Spawning migrations twice a year: fish which enters the rivers in spring (the second half of March-April at the temperature of water 4 – 5° C), reproduces at the same year, and wich enters the rivers in autumn (Spetember-November) – reproduces only in spring of the next year. Males become mature at the age of 12-14 years at length of more 120 and cm, females at the age of 16-18 years at the length of more 150 cm. Spawning from the end of April to the beginning of June occurs at the deep places with fast current and stone, sand-gravel ground. Fertility on sizes and age variates from 360 thousand to 7.7. million eggs. Egg is bottom, sticky at the temperature of water 12-14° C, its development lasts for 8-9 days, larvaes start to feed after one and hal of wek after outlet from egg. After the spawning adult, and then young fish move to the sea. The length of body of adult fish can reach 5 m, mass – 1000 kg.

The quantative of beluga is extremely low. The speice is enlisted to the Red Book of Ukraine, 1994, lists of Bern convention, IUCN, and European Red List.

Freshwater starlet. Freshwater demersal residential fish, which don`t do huge migrations. It keeps alone or in small groups in deep areas of rivers with clean, cool running water in places with sandy or sandy-pebble soil. Males become sexually mature at the age of 3, mostly 4-6 years, with a length of more than 35 cm, females, respectively, at 5-9 years with a length of more than 45 cm. Spawning occurs in April-May at a water temperature above 10°C (usually at 12-17°C). Fertility up to 110-140 thousand eggs. Eggs are bottom, sticky, are deposited at a depth of 10 m or more in riverbed areas with a fast current and pebble or stony soil. A week or more after fertilization, larvae emerge from the eggs. After spawning, breeders and young move to places of permanent residence. The largest body length is up to 1.0 - 1.2 m, weight is up to 16 kg.

In recent decades, its number has sharply decreased. The speice is enlisted to the Red Book of Ukraine, 1994, lists of Bern convention, IUCN, and European Red List.

Russian sturgeon. Migratory demersal fish which constantly live in the sea and for spawning moves into rivers. Spawning migrations twice a year: in autumn, depending on weather conditions, from August to January (reproduces the following spring) and in spring, usually from March to the beginning of April, sometimes from February to May to the beginning of June, at a water temperature of 6-11° C, en masse at 15° C (reproduction of the same year). Males reach sexual maturity at the age of 8 - 14 years with a length of more than 90 - 100 cm, females respectively at 10 - 17 years with a length of more than 105 - 110 cm. Spawning is from the end of April - the beginning of May to the middle of June at a water temperature of 11 - 22° C, at depths up to 16 m, at sections of the fundamental riverbed with a current speed (up to 1.5 m/s) and sandy-pebble, shelly, or stony soil. Fertility up to 800,000 eggs. Eggs are bottom, sticky, the development of the embryo in the eggs lasts up to 12 days. After reproduction, broodstock, and in general the young, move into salty waters to feed. The largest body length is more than 2 m, weight is more than 100 kg, life expectancy is more than 50 years.

In recent years, the number of the specie has been declining. The speice is enlisted to the third edition of the Red Book of Ukraine, 2004, IUCN, and, European Red List.

Starry sturgeon. A migratory demersal fish that constantly lives in the sea and enters the river twice a year to reproduce: in the autumn from the end of September to the end of November (it reproduces in the spring of the following year), and in the spring, from March to the end of April to the beginning of May (it reproduces in the same year). It keeps alone or in small groups. Puberty of males occurs at the age of 5-14, mostly 9-12 years, females 7-17, mostly 7-14 years (when the body length of both sexes is more than 95-100 cm). Spawning from the end of April to the middle of June at a water temperature of 8 - 15 ° C and above, in deep areas of the fundamental riverbed with a fast current on hard, usually sandy-pebble, sandy-clay or stony soil. Fertility can exceed 360,000 eggs. Eggs are bottom, sticky, larvae emerge from it 1.8-4 days after fertilization. After the end of reproduction, broodstock, and later the young, move into the sea to feed. The largest body length is 220 cm, weight up to 80 kg.

In recent years, the number of the starry srurgeon has been declining. The speice is enlisted to the third edition of the Red Book of Ukraine, 2004, IUCN, and, European Red List.

Despite the low number of sturgeon species, the Danube remains a river where natural sturgeon spawning is observed.

3 ASSESSMENT OF THE ACTUAL IMPACT OF HYDROTECHNICAL WORKS

3.1.Impact on aquatic biological resources

When conducting dredging works in the operational water area of the river port (terminal) of NIBULON LLC within the water area of the Izmail sea port, the impact on the biotic and abiotic environment of the Danube River will be temporary.

The impact of dredging operations on mature individuals of fish is insignificant, as they can avoid areas with increased turbidity, chemical pollution, noise disturbances, etc. The planned works can have the most significant negative effect on hydrobionts, which serve as food objects for fish. The temporary effect of dredging will be manifested directly in the process of exavation soil during the operation of hydrotechnical means (Watermaster Classic IV and the self-propelled dredging vessel (dredge) SDS-15, the formation of suspension in the water column during the operation of the bucket (Watermaster Classic IV) near the berth. Increased man-made turbidity can lead to changes in thermal conductivity, optical properties of water, deterioration of the breathing conditions of hydrobionts, mechanical damage to their coverings, and can lead to the complete or partial death of pelagic and benthic forms of invertebrates. The damage caused to living water resources during the works will be due to the death of forage organisms for fish. As a result of complete destruction of benthic biocenoses in the area of dredging, partial silting of benthic communities in adjacent water areas, death of zooplankton in the zone of increased man-made turbidity, which is formed in the process of soil development.

An analysis of the mode of operational dredging of the Danube River in recent years has shown that the benthic communities affected areas remain sufficiently high. Previous studies have shown that dredging does not have a negative effect on bottom biocenoses of adjacent areas and their plankton complexes. The negative effect is expressed in the removal of benthic organisms together with the soil, but the species composition and partly the biomass of the zoobenthos in the areas, after the completion of the works, are restored after some time. The registered recovery rate of benthos communities after dredging works, according to foreign researchers [13], is: riverbed muddy soil – 6 months; lagoon muddy soil – up to 11 months; muddy soil-sand – 18 months; sand-gravel – 2 - 3 years. In the area with high variability of bottom precipitation, the effect of dredging operations was observed for a relatively short period of time. For example, full recovery of benthic communities in the channel and delta of the Wadden Sea near the coast of Holland occurred within one year of removal of bottom sediments in this movable sand area [14]. One of the indicators that has a direct impact on the state of fish stocks in the Danube section (within the river port (terminal) in Izmail) is dredging in the operational water area of the water body.

Carrying out dredging works with a further assessment of the impact on the state of fish stocks in the Danube River during the construction of a cargo berth will be considered from the destruction of forage organisms (plankton and benthos), as well as eggs and young fish in areas of the operational water area and areas of the spread of mud flow in the zone of increased turbidity.

3.1.1 Methodology for calculating damage due to the death of forage organisms

Dredging works are carried out according to the planned procedure, after obtaining appropriate permits and in compliance with the requirements of environmental protection legislation. In our case, dredging works are being considered with the possibility of working during the period of special ban during spawning on fishing in the Danube River (until June 5, 2022).

The "Temporary damage assessment method" will be used to assess fishery damage [15]. In connection with the fact that during the works the object of negative action is the forage base of fish, the amount of damage in natural value is calculated according to the formula:

$$N = n_o \times P/B \times 1/K_2 \times K_3/100 \times F \times 10^{-6}, \quad (3.1)$$

where: N – value of damage due to the death of forage organisms, t;

F - volume, affected area, m^2, m^3;

P/B - coefficient for the conversion of the biomass of forage organisms into the products of forage organisms;

n_o – average concentration of forage organisms, g/m^3 of water;

K_2 - forage coefficient for the conversion of products of forage organisms into fish products;

K_3 – indicator of limited use of forage base by fish, %;

10^{-6} - multiplier for converting grams to tons.

According to the point 4 of the «Temporary damage assessment method» [15] cost value of damage at capital construction can be determined using calculation of capital investment on implementation of measures compensating for damage to fish stocks. The amount of the compensation payment for the damage is determined by the formula:

$$Ki = \sum_{i=1}^{n} (Mi \times Ki) \times En \times ti ,) , \quad (3.2)$$

where: Ki – specific capital investment to the objects of this type, ths. UAH;

Mi – capacity of its industrial return, in tons;

En – normative coefficient of economic efficiency of capital investments; the value of the normative coefficient of economic efficiency of capital investments for this object, determined volumes of necessary capital investments.

i – type of measure or object;

t_i – time of negative action on fish stocks.

Calculation of damage caused to aquatic biological resources.

Soil development in the water area of the river port (terminal) of NIBULON LLC on the Danube River is planned to be carried out using the dredging vessel Watermaster Classic IV(I stage) and self-propelled dredging vessel (dredge) SDS-15 (III, V stages) and with the transportation of excavated soil (pulp) using slurry pipelines to the coastal dump (see Appendix B).

During the dredging works, 112 000.00 m^3 of soil will be removed at the operating water area of the river port of the NIBULON LLC on the Danube River for the construction of a cargo berth.

Work is carried out on an area of 1 ha up to the 4.0 m mark using a Watermaster Classic IV dredger with a pulp productivity of 600 m^3/h. The ratio of soil: water is 1:5, so the amount of water that will be used for pulp formation is 50,000 m^3. When performing work with a self-propelled vessel of the SDS 15 project with a pulp productivity of 2400 m^3/h, the ratio of soil: water is 1: 6 on an area of 2.2 ha up to the mark 7.32, the amount of water that will go to the formation of pulp is 318,000 m^3, and on an area of 2.32 ha up to the mark 8.23 is 162,000 m^3.

Thus, the total amount of water that will be used to form the pulp is equal to:

$$50000\ m^3 + 318000\ m^3 + 162000\ m^3 = 530000\ m^3$$

Dredging of the operational water area near the transshipment floating complex of the port will be carried out using a Watermaster Classic dredger with a bucket volume of 1 m^3. The rise of the soil to the surface will cause increased turbidity in the water volume of 1840.0 m^3 (shoreline length - 460 m, bottom mark - 4.0 m, bucket width - 1 m). In this volume of water, 100% death of planktonic forage organisms will occur.

During soil removal (dredging), work is performed on areas with an area of **23200.0 m^2** (until the design depth of 8.23 m is reached). During the development of the soil on the area of 23200.0 m^2, 100% of the zoobenthos will die.

The duration of the works (not including the period of preparatory works and possible repair works) is 52 days, with the possibility of works during the ban during spawning until 05.06.2022 (estimated 18 days).

For creating calculation of damage, we use data from table 3.1.

Setting numerical values to the formula, we will get the value of the damage in natural value (52 days).

1. In water and oil mixture and on dredging area (operation of dredges).

Table 3.1 – Parameters of damage calculation, which affects the aquatic biological resources (fishery) by the development of soil of operational water area of river port (terminal) of NIBULON LLC, the Danube river, 2022

Groups of forage organisms	Average biomass, g/m^3 , g/m^2	P/B	K_3, %	K_2	Volume, affected area, m^2 , m^3
phytoplankton; 100% damage	0.524	2.0	30	30	530000
zooplankton; 100% damage	0.217	2.0	30	10	530000
zoobenthos; 100% damage	1.430	4.0	45	10	23200

N_1 (phytoplankton) = 0.524 x 2.0 x 1/30 x 30/100 x 530000,0 x 52/240 x 10^{-6} = 0.0012 t;

N_1 (zooplankton) = 0.217 x 2.0 x 1/10 x 30/100 x 530000.0 x 52/240 x 10^{-6} = 0.00150 t;

N_1 (benthos) = 1.430 x 4.0 x 1/10 x 45/100 x 1 x 23200.0 x 52/240 x 10-6 = 0.00129 t;

2. Turbidity near the berths (operation of bucket).

N_1 (phytoplankton) = 0.524 x 2.0 x 1/30 x 30/100 x 1840.0 x 52/240 x 10^{-6} = 0.000004t;

N_1 (zooplankton) = 0.217 x 2.0 x 1/10 x 30/100 x 1840.0 x 52/240 x 10^{-6} = 0.000005 t;

The damage in natural value, taking into account the period of restoration of planktonic and benthic communities, will be:

N_1 plankton = (0.0012 t + 0.00150 t + 0.000004 t + 0.000005 t) x 1.0 = 0.002709 t.

N_1 benthos = 0.00129 t x 2.0 = 0.00258 t.

Total N_1 development = 0.002709 t + 0.00258 t = 0.00529 t

At the *spawning period* (18 days). The estimated volume of extracted soil is 232632.0 m^3 (takin into account 2154 m^3/day and ratio of soil and water 1:6). Setting numerical values to the formula, we will get the value of the damage in natural value:

N_1 (phytoplankton) = 0.524 x 2.0 x 1/30 x 30/100 x 232632.0 x 18/240 x 10^{-6} = 0.00018 t;

N_1 (zooplankton) = 0.217 x 2.0 x 1/10 x 30/100 x 232632.0 x 18/240 x 10-6 = 0.00023 t;

N_1 (benthos) = 1.430 x 4.0 x 1/10 x 45/100 x 1 x 16200.0 x 18/240 x 10^{-6} = 0.00031 t;

2. Turbidity near the berths (operation of bucket).

N_1 (phytoplankton) = 0.524 x 2.0 x 1/30 x 30/100 x 3786.0 x 18/240 x 10^{-6} = 0.000003 t;

N_1 (zooplankton) = 0.217 x 2.0 x 1/10 x 30/100 x 3786.0 x 18/240 x 10^{-6} = 0.000004 t;

The damage in natural value, taking into account the period of restoration of planktonic and benthic communities, will be:

N_1 plankton = (0.00018 t + 0.00023 t + 0.000003 t + 0.000004 t) x 1.0 = 0.000417 t.

N_1 benthos = 0.00031 t x 2.0 = 0.00062 t.

Total N_1 development = 0.000417 t + 0.00062 t = 0.001037 t

During the operation of the bucket the integrity of the river soil is disturbed, the amount of which will enter a suspended state and will begin to spread downstream and deposit to the adjacent areas of the bottom of the water body.

As a result of the deposition of small particles, siltation will appear - an unfavorable factor for the life of forage organisms, which leads to the death of phytoplankton, zooplankton and zoobenthos.

The siltation area is calculated based on the size of the particles up to 0.05 mm, because their removal during the work will be maximum.

The distance of removal of suspended substance or the distance at which suspended solids will deposit to the bottom (the length of the turbidity plume) is determined by the formula:

$$L_p = \frac{h_{max} \cdot V_{av}}{\omega_{av}}, \text{ m}$$

where: h_{max} – 4.0 m – the depth of dredging;

V_{av} = 0.50 m/s – average speed of current of the Danube river;

ω_{av} – 0.02889 m / s – the average hydraulic size of suspended substances that is determined according to the Building code B.2.4 - 1-99 (Appendix P recommended).

$$L_p = \frac{4.0 * 0.5}{0.02889} = 69.23\ m$$

Thus, the length of the turbidity plume is 69.23 m

The time of deposition of suspended substances is determined by relation:

$$T = \frac{L_p}{\omega_{av} * 3600}, hours$$

where: L_p -69.23 m – the length of the turbidity plume from the place of discharge of wastewater

ω_{av} – 0.02889 m/s – the average hydraulic size of suspended substances.

$$T = \frac{69.23}{0.02889 * 3600} = 1\ h$$

Thus, the time of deposition of the turbidity plume is 1 h

Calculation of the siltation area is carried out by formula:

$$F = \frac{B1 + B2}{2} * L\ (1)$$

(Typical technological scheme of extraction of sand, gravel, sand and gravel mixtures of the shipping rivers and other water bodies, M, Transport, 1980)

where: B_1 - initial flow width equal to the length of the initial mixing zone;

B_2 - the width of the water flow at a distance from the zone of initial mixing downstream to the calculated cross section;

L - the distance over which the particles will move.

The width of flow B_1 in the area of works is 1.0 m (bucket width). The estimated width of the flow B_2 is:

$B_2 = B_1 + 2 \text{ x } L \text{ x } tg13° = 1.0 + 2 \text{ x } 69.23 \text{ x } 0.23 = 32.84$ m

Actually, the width of flow B_2 will be smaller because from the left side the water flow with increased turbidity is limited by left bank curtailment. The siltation area is an isosceles trapezoid with height of 69.23 m. The width of upper (smaller) base of the trapezoid is 1.0 m, lower one – 32.84 m. While the length of reduction of flow B_2 will be:

$B_{reduction}$ = (32.84 m - 1.0 m) : 2 = 15.92 m

Thus, from the total area of siltation it is necessary to subtract area that is:

$S = 15.92$ m x 69.23 m : 2 = 551.07 m²

By substituting numerous values into formula 1, we will get the estimated siltation area:

$F = (1.0$ m + 32.84 m) : 2 x 69.23 m = 1171.37 m².

From the obtained value we need to subtract area which is limited by water curtailment and we will get the actual siltation area:

F_2 = 1171.37 m² – 551.07 m²= 620.3 m²

At the average depth of 4.0 m, the area of increased turbidity is 2481.2 m³(620.3 m² x 4.0 m).

N_2 (phytoplankton) = 0.524 x 2.0 x 1/30 x 0.3 x 2481.2 m³ x 52/240 x 10-6 = 0.000006t

N_2 (zooplankton) = 0.217 x 2.0 x 1/10 x 0.3 x 2481.2 m³ x 52/240 x 10-6 = 0.000007 t

N_2 (benthos) = 1.43g/m² x 4.0 x 1/10 x 45/100 x 620.3 m² x 52/240 x 10-6 = 0.000035 t

N_2 plankton = (0.00006 t + 0.00007 t) x 1.0 = 0.00013 t.

N_2 benthos = 0.00035 t x 2.0 = 0.00007 t.

Total N_2 siltation = 0.00013 t + 0.00007 t = 0.000083 t

During spawning period (18 days):

N_2 (phytoplankton) = 0.524 x 2.0 x 1/30 x 0.3 x 2481.2 m³ x 18/240 x 10^{-6} = 0.00002t

N_2 (zooplankton) = 0.217 x 2.0 x 1/10 x 0.3 x 2481.2 m³ x 18/240 x 10^{-6} = 0.00002 t

N_2 (benthos) = 1.43г/m² x 4.0 x 1/10 x 45/100 x 620.3 m² x 18/240 x 10^{-6} = 0.000012 t

N_2 plankton = (0.00002 t + 0.00002 t) x 1.0 = 0.00004 t.

N_2 benthos = 0.000012 t x 2.0 = 0.000024 t.

Total N_2 siltation = 0.00004 t + 0.000024 t = 0.000028 t

The total damage on the death of forage organisms during dredging works will be:

$\sum_N$ 52 days (benthos + plankton): 0.00529 t + 0.000083 t = 0.005373 t

$\sum_N$ 18 days (benthos + plankton): 0.001037 t + 0.000028 t = 0.001065 t

It is necessary to mention that this damage will be temporary.

3.1.2 Calculation of capital investments for the implementation of measures to prevent damage as a result of the death of forage organisms

According to point 4.2. [15], the adverse impact on fish stocks is not permanent, and its duration is shorter than the regulatory term for the total of capital investments. In this case, the amount of capital investments (K) is determined by formula:

$$K = \sum_{i=1}^{n} (M_i \times K_i) \times E_n \times t_i,$$ where:

M_i – capacity of industrial return, tones;

K_i – specific capital investments to the objects of this type (UAH per ton of industrial return);

E_n – normative coefficient of economic effectiveness of capital investments;

t_i – time of the negative impact on fish stocks (year).

The final damage assessment will be based on the death of forage organisms: 0.005373 t (total) and 0.001065 t (in the spawning period).

According to point 4 [15], the cost value of damage can be determined using calculation of capital investments for the implementation of measures that compensate the damage to fish stocks.

According to the calculations of the State institute of Ukraine for design of fisheries enterprises and industry Ukrrybproekt (point 6) the specific capital investments on 1 ton of raw fish reproduction of industrial returns at fish-farming objects-analogs are taken as "Fish farm of herbivorous fish of fish factory the 3-d determinative" of the VI zone of fishing – 548.73 ths. UAH. The coefficient of economic effectiveness – 0.18. As of 2022, specific capital investments per 1 ton of raw fish remained at the level of 2018. (Appendix D).

The expected amounts of compensation payments for the death of forage organisms in terms of cost value will amount to:

$К_1$ = 548.73 ths. UAH/t x 0.005373 t x 0.18 = 530.70UAH without VAT (total period of work).

$К_2$ = 548.73 ths. UAH/t x 0.001065 t x 0.18 = 105.19 UAH without VAT (during the spawning period of work).

Thus, during the implementation of hydrotechnical works (dredging) in the operational water area of the river port in Izmail, Odesa Region, on the Danube River in 2022 the compensation payments will be equal to:

- At the general period of work (52 days) – **530.70** UAH;
- At the spawning period of work (18 days - until 05.06.2022) – **105.19** UAH.

3.2 Deterioration of fish reproduction conditions

The operational water area of the river port (terminal) of NIBULON LLC in the city of Izmail (where dredging works will be carried out according to the plan) is a plot with a total area of 5.29 hectares and depths from 4.0 m to 8.23 m. In this section, the river's current speed is recorded up to 175 cm /s, which is the maximum for the lower Danube. In addition, the section of the water area of the river port is included in the territory with rich navigation and depths of 8.0 m and more.

If we consider the operational water area from the point of view of suitability for the reproduction of fish with a phytophilous type of reproduction (ram, bream, carp, crucian carp, etc.), then it is obvious that it (the dredging area) does not meet the requirements for spawning biotopes due to the presence of fast currents, depths, beyond the required limits, and the lack of sufficient aquatic vegetation. Spawning of phytophilic fish species takes place in warmed shallow water areas, in bays and creeks with a slow current and soft aquatic vegetation, which is a spawning substrate (eggs are deposited on aquatic vegetation and roots).

For fish that belong to the lithophilic type of reproduction, such as beluga, starry sturgeon, sturgeon, sterlet, etc., the hydrological conditions, which are formed in the areas of hydrotechnical works, are also not favorable. According to scientists, after feeding in the waters of the Black Sea, sturgeon species of fish enter the Danube, and pass through the territory of five countries during the period of spawning migration, going up far the river and ending their journey in the area of the Derdap hydroelectric power station dam - 2 (864 km of the Danube), below which the main spawning areas of these species are located on a short section of the river [16].

After spawning, adults of anadromous species (sturgeon) together with the young stay for some time in the spawning grounds, where they are fattened. After that, the breeders, together with this year's adult young, migrate to the Lower Danube, and then to the sea, where they continue to fatten near the mouth of the Danube [17, 18].

In the period of the predicted slide (gathering) (July - October) in the mouths of the Kiliya delta, there are 4 species of young sturgeon (sturgeon, starry sturgeon, beluga, sterlet, cocklefish, there are isolated cases of catching hybrids). In the catches of fry and small drift nets, juveniles of linear sizes from 13.0 cm to 29.0 cm are recorded: in bycatch of industrial fishing gear (32-50 mm mesh) - from 15 cm to 112 cm [19]. The ratio of the species composition and the number of juveniles of various species of sturgeon in the Ukrainian section of the Danube varies from year to year: sterlet - from 2% to 23%; belugas - from 3% to 83%, starry sturgeon - from 10% to 84%, sturgeon - from 3 to 33%.

According to the observations of Romanian scientists, young sturgeon species of fish during migration to feeding places stay close to the surface of the water, with a maximum depth limit of 3.2 m. This makes it possible to speed up and at the same time preserve or reduce the energy costs of movement as much as possible [18]. In this way, young sturgeons preserve the viability of the species, avoiding unnecessary possible injuries as much as possible.

The section of the river where hydrotechnical works are planned (91 km of the Danube) is at a great distance from the traditional natural spawning grounds of the sturgeon (864 km of the Danube), which were laid down by the ancestors of the sturgeon (864 km of the Danube), so the dredging water area and adjacent water areas are not suitable for spawning of wild species.

The area of hydrotechnical works is located on the migration path of young sturgeons. On this section of the Danube, the way to the sea is overcome by already viable individuals (linear dimensions from 13 cm and above), which are able to avoid places with unfavorable conditions. The work of dredging equipment will take place at a depth of 4 m, which, based on observations, is no longer used by modern fish to overcome regular movements to the sea coast.

Spawning of the herring (Danube Alosa) takes place in areas with weakly flowing or still but clean water and sandy or sandy-muddy soil. Eggs are deposited in the surface layers of water, its development takes place at the bottom, and lasts more than two days after fertilization. Juveniles are in estuarine areas in the summer and often stay there for the winter. The work area does not meet the hydrological conditions for the natural reproduction of Danube herring.

The hydrological conditions of the operating water area of the river port (terminal) of NIBULON LLC in the city of Izmail are unfavorable for the reproduction of fish of the Danube ichthyofauna (damages from the deterioration of reproduction conditions are not calculated), and the method of soil extraction (stacking in a coastal dump) minimizes the spread of silt flows and reduces the risk of negative impact on aquatic biota and spawning areas located outside the works.

3.2.1 Damage calculation method

According to the plan, the estimated volume of hydrotechnical works (dredging) on the Danube river will be 112000.0 m³.

According to the point 3.b of the «Temporary methods...»[15] the calculation of damage from the local deterioration of spawning, fish-growing or wintering conditions of fish is carried out according to the area method, by equating the affected areas to the area of complete loss of fish productivity according to the formula:

$N = n_o \times W_o \times (100 - K_o)/100 \times K_1/100 \times p \times 10^{-3}$ [15], where:

n_o – the average for the period in which this stage or weight category of the concentration of pelagic eggs, larvae, or early young fish occurs in the area affected by the works, in specimens per cubic meter;

W_o – volume of water affected by the negative impact during this period, m^3;

K_o – coefficient (percentage of death of the organisms), %;

K_1 – coefficient of industrial return, %;

p – average weight of specimen in the industrial takes, kg;

10^{-3} – multiplier for conversion kilograms into tones.

Based on the peculiarities of the hydrological and hydrochemical conditions of the southern part of the Danube in the water area of the river port of Izmail, Odesa region, the basis of ichthyoplankton is carp and herbivorous fish species, as well as herring [11, 18].

In the zone of influence of dredging works, the death rate of fish fry will be 100%, both for eggs and for early juveniles, in the area of increased turbidity, the death rate of fish eggs and fry will be 25%.

The following data were used when calculating the losses caused to the fishery from the death of ichthyoplankton organisms:

Coefficient of industrial return from eggs, %: carp and herbivorous – 0.01; the Black Sea migratory herring (Danube) – 0.001.

Coefficient of industrial return from larvae, %: carp and the Black Sea migratory herring (Danube) – 0.05; herbivorous – 0.01.

Coefficient of industrial return from juveniles, %: carp and herbivorous – 10.0; the Black Sea migratory herring (Danube) – 3.0.

Estimated volume – 531840.0 m³ (water and soil mixture - 530000.0 m³ and volume of turbidity - 1840 m³), where death of 100% of eggs and larvae will occur.

The daily production capacity of dredges will be about 2154 m³, during the spawning period (18 days) - 38772 m³. The total volume of the pulp will be equal to 232632m³ (1:6), the volume of turbidity - 1840 m³, the estimated volume - 234472.0 m³, where 100% death of fish eggs and larvae will occur.

The zone of increased turbidity is 2481.2 m³. In this volume, 25% of fish eggs and larvae will die.

By substituting the numerical values into the modified formula, we will get the value of the damage from the work carried out in natural calculation in terms of adult fish individuals (tables 3.2 and 3.3).

Table 3.2 – Expected losses of eggs and juveniles of fish during the general dredging of river port (terminal) of NIBULON LLC, Danube river, 2022

Fish species	Stage of development	Dead, %	Density, specimen/m³	Industrial return, %	Volume of affection, m³	N of dead fish, specimen	P Adult individuals, kg	Losses of fish products,t
Adding sand								
Carp	Larvae	100	0.01	0.0005	530000	0.027	4.000	0.00011
Bream	Larvae	100	0.1	0.002	530000	1.06	1.330	0.00141
Crucian carp	Larvae	100	23.0	0.004	530000	487.6	0.480	0.23405
Other	Larvae	100	0.3	0.0076	530000	12.084	0.300	0.00363
Perch	Larvae	100	0.01	0.001	530000	0.053	1.400	0.00007
Herring	egg	100	0.02	0.001	530000	0.106	0.200	0.00002
							Total	0.23929
Turbidity zone								
Carp	Larvae	25	0.01	0.0005	2481.2	0.00003	4.000	0.00000012
Bream	Larvae	25	0.1	0.002	2481.2	0.0012	1.330	0.00000160
Crucian carp	Larvae	25	23.0	0.004	2481.2	0.5707	0.480	0.00027394
Other	Larvae	25	0.3	0.0076	2481.2	0.0141	0.300	0.00000423
Perch	Larvae	25	0.01	0.001	2481.2	0.0001	1.400	0.00000014
Herring	egg	25	0.02	0.001	2481.2	0.0001	0.200	0.00000002
							Total	0.0002801
Total								0.2395701

Table 3.3 – Expected losses of eggs and juveniles of fish at the spawning period with dredging of river port (terminal) of NIBULON LLC, Danube river, 2022.

Fish species	Stage of development	Dead, %	Density, specimen /m^3	Industrial return, %	Volume of affection, m^3	N of dead fish, specimen	P Adult individuals, kg	Losses of fish products,t
Adding sand								
Carp	Larvae	100	0.01	0.0005	232632	0.012	4.000	0.00005
Bream	Larvae	100	0.1	0.002	232632	0.465	1.330	0.00062
Crucian carp	Larvae	100	23.0	0.004	232632	214.021	0.480	0.10273
Other	Larvae	100	0.3	0.0076	232632	5.304	0.300	0.00159
Perch	Larvae	100	0.01	0.001	232632	0.023	1.400	0.00003
Herring	egg	100	0.02	0.001	232632	0.047	0.200	0.00001
							Total	0.10503
Turbidity zone								
Carp	larvae	25	0.01	0.0005	2481.2	0.00003	4.000	0.00000012
Bream	larvae	25	0.1	0.002	2481.2	0.0012	1.330	0.0000016
Crucian carp	larvae	25	23.0	0.004	2481.2	0.5707	0.480	0.0002739
Other	larvae	25	0.3	0.0076	2481.2	0.0141	0.300	0.00000423
Perch	larvae	25	0.01	0.001	2481.2	0.0001	1.400	0.00000014
Herring	egg	25	0.02	0.001	2481.2	0.0001	0.200	0.00000002
							Total	0.0002801
Total								0.10531

3.2.2 Calculation of capital investments for the implementation of measures to prevent damage

According to point 4.2. [15], the adverse impact on fish stocks is not permanent, and its duration is less than the regulatory payback period for capital investments. In this case, the amount of capital investments (K) is determined by formula:

$$K = \sum_{i=1}^{n} (M_i \times K_i) \times E_n \times t_i,$$ where:

M_i – capacity of industrial return, tones;

K_i – specific capital investments to the objects of this type (UAH per ton of industrial return);

E_n – normative coefficient of economic effectiveness of capital investments;

t_i – time of the negative impact on fish stocks (year).

The final assessment of damage from the death of young fish is in the sum:

Σ_1 damage from deterioration of reproduction conditions during the *period of work* - 0.2395701 t

Σ_2 damage from deterioration of reproduction conditions during the *period of ban during spawning* - 0.10531 t

According to the calculations of the State institute of Ukraine for design of fisheries enterprises and industry Ukrrybproekt, the specific capital investments on 1 ton of raw fish reproduction of industrial returns at fish-farming objects-analogs are taken as "Fish farm of herbivorous fish of fish factory the 3-d determinative" of the VI zone of fishing – 548.73 ths. UAH at prices in 2022. The coefficient of economic effectiveness – 0.18.

Expected values of compensatory payments for the deterioration of reproduction conditions during the period of works in the form of cost value will be:

- at the general period K_1 = 548.73 ths. UAH/t x 0.2395701 t x 0.18 = 23662.67 UAH without VAT;
- At the spawning period K_1 = 548.73 ths. UAH/t x 0.10531 t x 0.18 = 10401.62 UAH without VAT

When hydrotechnical works are performed in the operational water area of the river port (terminal) of NIBULON LLC in Izmail on the Danube River in the spawning period of 2022 (until June 5, 2022), the compensation payment will be equal to UAH **105.19.** (due to the death of the forage base) and UAH **10401.62** (from the death of eggs and young fish), which will amount to UAH **10506.81**.

During the dredging operations, which are carried out *outside the ban during spawning period*, the final assessment of the loss is accepted according to the maximum amount from the estimated value [15] and will be carried out from the death of eggs and young fish - 0.2395701 t (death of forage organisms - 0.005373 t) and will be **23662.67** UAH.

Thus, if the works take over the period of the ban during spawning (until 05.06.2022), the amount of the compensation payment will consist of the loss from the death of eggs, larvae and forage organisms:

23662.67 UAH + 105.19 UAH = **23767.86** UAH.

4 RECOMMENDATIONS ON MINIMIZING WORK ACTIONS

The analysis of man-made impact on biological resources during the implementation of hydrotechnical works (dredging) in the operational water area of the river port in Izmail, Odesa region, on the Danube river and putting the soil to the coastal dump with the help of a suction pump through the pipeline shows the presence negative of effects on the water ecosystems of the Danube delta. The development of dredging soils, of course, have an impact on water ecosystems. First of all, the quality of river water is changed, albeit short-term, as a result of an increase in the content of suspended substances in the water, transferred from the bottom sediments into the water environment in the process of soil excavation. Therefore, the main parameters for the state of the changing water environment during dredging are the hydrochemical regime,conditions of living of aquatic organisms and redistribution of bottom sediments. The effect of dredging on the hydrochemical regime is determined by the chemical composition of the soils, the soil volume, which is developed. As a result of these processes, there can be secondary pollution of water masses with toxic pollutants, leading to a deterioration in water quality. Analysis of soil pollution level of dredging has shown that deterioration of water quality in the process of hydrotechnical works (dredging of water area during the construction of cargo berth), as a result of the introduction of toxicants into the river environment (heavy metals, oil products, chlor-organic compounds) will not be significant, in particular because the soils that are excavated, according to the Azov-Black Sea basin dredging soil classification, belong mainly to classes A - II.

Excessive slurry entering the water as a result of dredging is one of the main factors of negative impact on hydrobionts and the condition of recreational areas. The influence of slurry on hydrobionts is caused by purely mechanical reasons - clogging of fish gills, destruction of benthic animals and by other causes that lead to changes in the natural normal living conditions of biocenoses. The decrease transparency of water as a result of the turbidity of water leads to a decrease in the level of primary products. The introduction of suspensions into water objects at insignificant distances from recreational areas can lead to a decrease in water quality and natural bottom sediments (silting of sandy beaches). The shape of the suspension cloud, its size and the period of viability mainly depend on the hydrological regime of the researched water body.

Hydrodynamic conditions, in turn, depend on wind activity, shoreline ruggedness and bottom topography. Rapid change of synoptic situations, can several times change the speed of the current during the period of dredging. Therefore, the spread of the suspension cloud from working suction pumps is probable at any distance.

The impact of operational dredging on biological resources occurs both directly through the destruction of the biocenosis in the dredged area and indirectly through an increase in the turbidity of bottom sediments in the area adjacent to the dredged territory in the water area. As a result, there is a siltation of benthic organisms, simultaneously with decrease of transparency and increase of content of suspended substances in the water environment, there is death of forage organisms for fish, and also for a short period of time, the development of phytoplankton in the area of carrying out works is stopped. Certainly, the effects of dredging on benthic organisms can be felt for more than a year.

For benthos and plankton in the siltation area, the negative impact is limited to the timing of the works. Studies have shown that during the observance of technological regulations of dredging, intensive restoration processes of the benthic community are taking place within a year.

Thus, realization of dredging leads to change of place of existence of hydrobionts, violation of conditions of reproduction of ichthyofauna, occurrence of barriers on ways of migration of organisms, elimination or restriction of their forage base. A set of measures to ensure the regulatory state of the environment during the process of development of dredging of water areas should include preparatory, protective, compensation and security measures.

Preparatory measures:

– the optimal choice of technical means for carrying out dredging;

– It is recommended to carry out works in water areas where soils belong mainly to the first, second or third group of soil development difficulty, involving the shore dump for the collection of extracted soil, which reduces the siltation of the water area and undoubtedly reduces the pressure on the ecosystem of the water body;

The protective measures include the following organizational and technical measures provided for at the design stage:

– conducting of dredging works in strict accordance with safety rules in construction. Rules of safety and industrial sanitation during the implementation of dredging works performed by the technical fleet;

– before the implementation of dredging works, carrying out of trawling or diving examination of the deep areas, with the purpose of revealing explosive objects, interference, which can cause damage of technical means and as a result, threat to life and health of personnel;

– during detection of explosive objects on the site of dredging works, the emission from the soil of harmful gases to the human body, works are immediately stopped to eliminate sources of danger and obtain permission of the relevant bodies;

– the strict implementation of measures on environmental protection, to prevent pollution of the water surface with fuel and oil materials;

– to reduce soil erosion and expansion of the area of spreading suspension, the dredging work are immediately stopped in the period of adverse weather conditions.

Compensatory measures include monetary compensation for the environmental damage caused to aquatic living resources, as a result of the deterioration of the conditions of fish-growing period and reproduction.

Security measures.

In order to reduce the negative impact of dredging works on the state of biological resources on the operational water area of the river port in Izmail, the Danube, and taking into account the biology of the main industrial objects, ways and terms of their migration to places of spawning, in order to minimize the negative impact of economic activity on the state of the biological resources of the Danube basin - to limit the performance of hydrotechnical works during the period of mass spawning of the main industrial fish to the necessary minimum.

In case of urgent need to carry out hydrotechnical works during prohibited spawning periods the works are carried out in accordance with the Scientific and Biological Substantiation "Assessment of the impact of hydrotechnical works on the state of fish stocks of the Danube River during construction of the cargo berth with operational water area of the river port in Izmail, Odesa region (during spawning)" after agreement with the State Agency of Meliorations and Fisheries of Ukraine. Final impact of the dredging action on the ecosystem state is determined by the implementation of the integrated monitoring of the hydrotechnical works.

CONCLUSIONS

The cargo berth of the River port (terminal) of NIBULON LLC is building within the water area of the SEAPORT of Izmail.

Considering the location of the planned activities and following the provisions of Resolution № 552 of the Cabinet of Ministers of Ukraine dated 22 May 1996 "On Approval of the List of Industrial Areas of Fishery water objects (their parts)", this territory, as a hydrotechnical facility and a place of intensive navigation (ports, navigable waterway) is not an industrial area of the Danube basin.

Scientific and biological substantiation for the solving the issue regarding implementation of hydrotechnical (dredging) works in the operational water area of the river port (terminal) of NIBULON LLC in Izmail on the Danube River with the possibility to work during the ban during spawning up to 05.06.2022 is developing under the Contract № 243-V-FDL-21 dated 17.09.2021 by order of NIBULON LLC. The estimated dredging volume to a depth of 8.23 m in 2022 will be 112000.00 m^3.

The removed soil will be transported by slurry pumping using suction pump through pipelines to the coastal dump. The coastal dump area is 1.24 ha, the perimeter is surrounded by a dam with 2.5 m high, within its boundaries are formed alluvium maps with a discharge pipe Ø 200 m for the discharge of clarified water and a drainage ditch along the barrier dam with a depth of 0.5 m and a bottom width of 1.0 m for the discharge of water that was filtered through the embankment dam. The soil dumping technology excludes the negative impact on the biological resources of the Danube river.

The total term of the dredging is 52 days, the possible period of work in the period of ban during spawning until 05.06.2022 is about 18 days.

The expected dredging volumes during the state ban on fishing in the Danube during the spawning season of 2022 will be about 2154.00 m^3 per day (works of suction pumps and the floating grab crane which will be used for soil cleaning).

There are bans on industrial and amateur fishing of water bioresources in connection with spawning in the Danube from 22 April to 05 June (the ban does not apply to the special herring fishery).

The purpose of this development is to assess the impact of hydrotechnical works on the state of fishery stocks in the Danube during the construction of a cargo berth with a river port operational water area in Izmail, Odesa region and with calculation the cost of compensatory measures to the fishing industry.

The impact of hydrotechnical works (dredging) on the water environment can be seen in the direct destruction of the biocoenosis in the deep waters. In nearby (silted) water areas expected to partially death of zoobenthos from siltation, decrease of biomass of phytoplankton and zooplankton from increased turbidity of water and decrease of transparency of water. Probability of getting in the water environment of polluting substances as a result of desorption of them from the surface layer of bottom sediments being developed.

The damage caused to the living water resources of the Danube River during the works (with the possibility of works during the period of the ban during spawning until 05.06.2022) will be caused by death of forage organisms as a result of complete destruction of bottom biocoenosis in the dredged area; partial siltation of benthic communities on adjacent water areas; death of phyto- and zooplankton in the zone of increased technogenic turbidity, which is formed in the process of soil development and deterioration of reproduction conditions for some spawning fish populations.

Research conducted earlier showed that along with the dredging works (on adjacent and neighboring areas) benthic and pelagic biocenoses do not have a negative impact. The death of the bottom invertebrates occurs on the areas of deepening from their damage as a result of mechanical influence. However, after completion of dredging works, benthic biocenoses are restored depending on the quality formation of biocenoses at the sites.

The damage affecting the aquatic living resources during operational dredging was calculated according to the "Temporary damage assessment method.... [15], which is recommended for use by the Ministry of Environmental Protection and Natural Resources of Ukraine.

Preliminary calculation value of compensation payment for influence on the aquatic biological resources of the Danube river at carrying out of hydrotechnical works (dredging works) during construction of cargo berth on the river port water area in Izmail of Odesa region will be **23662.67** UAH (outside of ban during spawning – after 05.06.2022).

If dredging works are carried out during the period of ban during spawning (until 05.06.2022), the cost of the compensation payment will be **23767.86** UAH (deterioration of fish reproduction and fish-growing conditions).

Hydrotechnical works (dredging) can be carried out only in accordance with the requirements envisaged by measures for preservation of the normative state of the environment.

Carrying out of hydrotechnical works (dredging) leads to change of living conditions of hydrobionts, violation of conditions of reproduction of ichthyofauna, occurrence of interference on ways of migration of organisms, elimination or restriction of their forage base and conditions of reproduction. In order to preserve the normative state of the environment, in particular the plant and animal world, it is envisaged a set of measures, which are listed above.

The sound pressure level during operation of the self-propelled dredging vessel and or a floating crane at the dredging section of the river port in Izmail on the Danube river meets the standard for settlement zones in the daytime (38.0 dBA), and in the evening - much lower.

Thus, in compliance with the requirements provided by this scientific-biological substantiation, the planned activities, considering the expected impacts on the water biological resources, are designed with an acceptable level of environmental risk, taking into account a set of measures respecting the normative state of the natural environment and fishery protection measures.

To assess the actual impact and determine the residual effect of the work it is advisable to accompany with specialized scientific ecological monitoring with compensation of the corrected losses in accordance with the current legislation of Ukraine.

LIST OF REFERENCES

1. Riasyntseva N.I. Area of work, program and materials of research / Kiliia part of the Danube Delta in the spring of 2000: the state of ecosystems and consequences of man-made disasters in the basin // edited by B.G.Alexandrova; NAS of Ukraine, Odesa Branch of the Institute of Biology of the Southern Seas. - Odesa, 2001. - pp. 9 - 12.
2. https://www.nibulon.com/data/pro-kompaniyu/zberigannya-dorobka-ta-perevalka-zerna-torgovelna-diyalnist.html
3. North-western part of the Black Sea: biology and ecology /Edited by Zaitsev Y.P., Aleksandrov B.G., Minicheva G.G. - K.: Naukova dumka, 2006. – p 701 .
4. Bohatova Y.I. Hydrochemical regime of the Ukrainian section of the Danube coast // Water resources. - 2013. - vol. . 40. - no.3. - pp. 295 - 305.
5. Assessment and diagnosis of the state of biocenoses and biodiversity of the marine ecosystems of Ukraine in 2020: Report on scientific and research work / SRI"The Ukrainian Scientific Center of Ecology of the Sea (UkrSCES); author: Kovalyshyna S.P. – Odesa, 2020. – p.110 - № of state registration 011903494.
6. Berlinskyi M.A., Ivanov O.I., Karpezo Y.G. To the specification of phytoplankton and microphytobenthos of the water bodies of Sulina and George arm of the Danube // Science notes of Ternopil State Pedagogical University. Series: Biology, No. 3(14) Special edition: Hydroecology. – 2001. – pp. 30 – 31.
7. Polishchuk L.N. Qualitative variety of zooplankton of Danubian lakes of the Danube Delta in Ukraine //Science notes of Ternopil State Pedagogical University. Series: Biology, No. 3(14) Special edition: Hydroecology. – 2001. – pp. . 86 – 88.
8. Kharchenko T.A., Tymchenko V.M., Kovalchuk A.A. and others. Hydroecology of the Ukrainian section of the Danube and adjacent water bodies. - K.: Naukova dumka, 1993. – p. 328
9. Volikov Y.N. Anthropogenic changes in the composition of the bottom fauna of the «Caspian» complex of macrozoobenthos of Danubiam water bodies // Science notes of Ternopil State Pedagogical University. Series: Biology, No. 3(14) Special edition: Hydroecology. – 2001. – pp.. 33 – 34.
10. Voloshkevych E.V. Current state of macrozoobenthos of the delta of the Kiliia Arm of the Danube // Science notes of Ternopil State Pedagogical University. Series: Biology, No. 3(14) Special edition: Hydroecology. – 2001. – pp.34 – 35.
11. Tkachenko V.O., Andriychenko K.S., Volkova O.M. and others. The state of ichthyofauna and fish capacity at the lower reaches of the Danube within Ukraine // Uzhhorod National University Herald. Series: Biology.– 2004. – No. 15. – pp. 129 – 133.
12. Movchan Y.V. Fish of Ukraine (guidebook). – K.: "Golden Gate", 2011. – p.420.
13. Nedwell, S. and Elliot, M. (1998). Intertidal mudflats and sandbanks and subtidal

mobile sandbanks. Institute of estuarine and Coastal Studies, University of Hull. Newell, R.C; Seiderer, L. J. and Hitshsosk, D.R. (1998). The impact of dredging works in coastal waters: A review of the sensitivity to disturbance and 18 subsequent recovery of biological resources on the sea bed. Oceanography and marine Biology: an Annual Review 1998. - 36.- p.127-178.

14. Van der Veer, H.W., Bergman, M.J.N. and Beukema, J.J. (1985) Dredging activities in the Dutch Wadden sea: effects on macro - benthic fauna. Neth. J. sea Res., 19 (2), pp. – .183 – 190.

15. Temporary damage assessment method to fish stocks caused by the construction, reconstruction and expansion of enterprises, structures and other facilities and implementation of various types of work on fisheries water bodies. Approved by the Ministry of Finance of the USSR in December 1989, approved by the State Committee for the Protection of Nature of the USSR, the Ministry of Fisheries of the USSR and recommended for use by the Ministry of Environmental Protection of Ukraine. - M., 1990. - p 62.

16. Balatskyi K.L., Voloshkevych A.N. Gathering of sturgeon youth on the Ukrainian sector of the Danube river // Modern problems of theoretical and practical ichthyology : summaries of International Ichthyology and practical conference (Odesa, September 7-11, 2011) – Odesa: Fenix, 2011 – p. 21-24

17. Antipa G. 1909. Fauna ihtiologica a Romaniei. Institutul De Arte Grafice “Carol Göbl” Bucuresti.

18. EVALUAREA SUPRAVIEȚUIRII ȘI RĂSPÂNDIRII ÎN MAREA NEAGRĂ A PUILOR DE STURIONI DIN SPECII AMENINȚATE CRITIC, LANSAȚI ÎN DUNĂREA INFERIOARĂ ROMÂNIA (2013 – 2015) Proiect pilot, măsura 3.5 . Contract nr. 18 /22.042013 Finanțat din Fondul European de Pescuit prin Autoritatea de Management pentru Programul Operațional pentru Pescuit Universitatea “Dunărea de Jos” din Galaţi Galați, 2016. 121 pages.

19. Bushuev S.H., Balatskyi K.L., Kudriashov S.S. Accounts of young sturgeon fish in the Kiliya Delta of the Danube River in 2007-2010. // summaries of International Ichthyology and practical conference (Odesa, September 7-11, 2011) – Odesa: Fenix, 2011 – p. 48-51

20. Kiliia part of Danube delta in spring 2000: Ecosystem state and consequences of technogenic catastrophes in the basin / Edited by. B.G. Aleksandrova. - Odesa, 2001. –p. 128

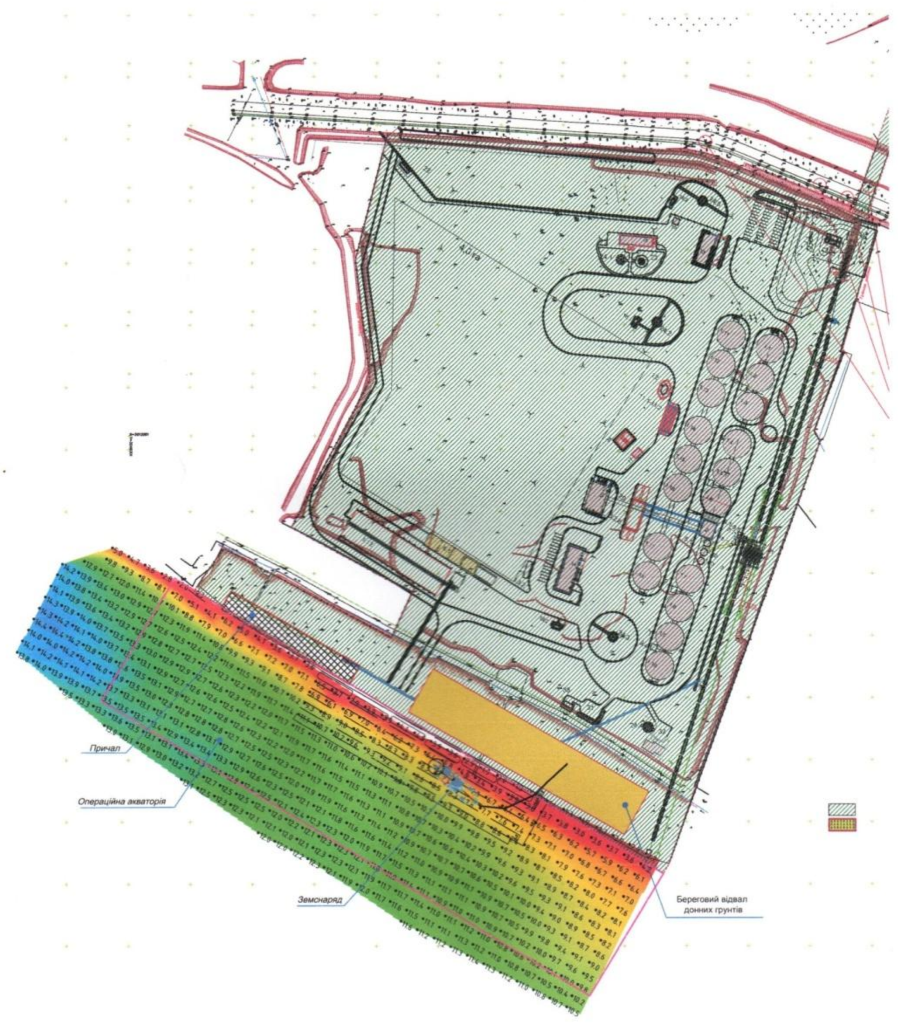
21. Shekk P. V. Retrospective analysis and the current state of ichthyofauna and fisheries of the Danube Delta // Odesa National University herald. - 2003. - vol. 8, no 11. Ecology. - P. 55-83.

Appendix A

Data for performance of work:

The planned activity involves the new construction of hydrotechnical structures of the Port (operational water area with an approach channel) on an area of 5.29 hectares in the developed part of the water area of the Danube River, which is located along the shipping channel "Vylkove - Izmail Ceatal" from 91.09 to 91.55 km and belongs to the water area of the Izmail seaport (Resolution of the CMU dated October 07, 2009 No. 1208 "Boundaries of the water area of the Izmail seaport").

Appendix B



Appendix C

ДЕРЖАВНЕ АГЕНТСТВО
МЕЛІОРАЦІЇ ТА РИБНОГО ГОСПОДАРСТВА УКРАЇНИ

ЧОРНОМОРСЬКЕ БАСЕЙНОВЕ УПРАВЛІННЯ ДЕРЖАВНОГО АГЕНТСТВА МЕЛІОРАЦІЇ ТА РИБНОГО ГОСПОДАРСТВА (ЧОРНОМОРСЬКИЙ РИБООХОРОННИЙ ПАТРУЛЬ)

НАКАЗ

від 14. 04 2022р. Одеса № 132

Про встановлення заборони вилову водних біоресурсів у зв'язку з їх нерестом на водних об'єктах підконтрольних Чорноморському рибоохоронному патрулю у 2022 році

На підставі статті 10 Закону України «Про рибне господарство, промислове рибальство та охорону водних біоресурсів», статті 38 Закону України «Про тваринний світ», відповідно до пунктів 8.1, 11.1.6, 11.2.3, 11.2.5, 11.2.6, 11.5, 14.7.6 та 14.7.8 Правил промислового рибальства в басейні Чорного моря, пунктів 3.14, 4.4, 4.14.1 Правил любительського і спортивного рибальства, Положення про Чорноморське басейнове управління Державного агентства меліорації та рибного господарства, затвердженого наказом Державного агентства рибного господарства України від 15.07.2016 №229 (зі змінами), враховуючи рекомендації ДП «ОдЦ ПівденНІРО» від 30.03.2022 №20/3 та від 05.04.2022 №23/3, з метою створення оптимальних умов відтворення водних біоресурсів,

НАКАЗУЮ:

1. Встановити заборону на промисловий та любительський вилов водних біоресурсів у зв'язку з їх нерестом на водних об'єктах підконтрольних Чорноморському басейновому управлінню Державного агентства меліорації та рибного господарства (далі - Чорноморський рибоохоронний патруль) в наступні терміни:

- у Дністровському лимані - **з 15 квітня по 31 липня** (заборона не поширюється на спеціалізований промисел оселедця);
- у Шаболатському лимані (відносно срібного карася, який мігрує з Дністровського лиману) – **з 15 квітня по 15 червня;**
- у Кучурганському водосховищі - **з 15 квітня по 15 червня**;

- у р. Дунай - **з 22 квітня по 05 червня** (заборона не поширюється на спеціалізований промисел оселедця);

- у придунайських озерах: оз. Ялпуг - Кугурлуй, оз. Кагул та озері Сасик **- з 15 квітня по 15 червня**;

- у Хаджибейському лимані **- з 15 квітня по 15 червня;**

- у верхній частині Каланчацького лиману відносно прісноводних видів риб з 15 квітня по 14 липня.

2. На період нересту риби заборонити:

- пересування будь-яких плавзасобів у заборонених для рибальства зонах (за винятком установлених судових ходів), а на ділянках, які оголошені нерестовищами - усіх плавзасобів, крім суден спеціально уповноважених органів, які здійснюють охорону водних біоресурсів;

- проводити у рибогосподарських водних об'єктах та в прибережних захисних смугах днопоглиблювальні, вибухові, бурові, сейсмологічні роботи, видобуток гравію та піщано - ракушкової суміші, проводити забір води без ефективних рибозахисних пристроїв.

- організацію змагань з рибальства та підводного полювання.

3. В нерестовий забороненний період, дозволити любительське рибальство з берега однією поплавковою або донною вудкою з одним гачком і спінінгом, на ділянках водойм зазначених у Переліку місць, визначених для любительського рибальства у період заборони вилову водних біоресурсів у зв'язку з їх нерестом на водних об'єктах підконтрольних Чорноморському рибоохоронному патрулю у 2022 році (додаток 1).

4. Користувачам водних біоресурсів, які здійснюють промисловий вилов водних біоресурсів в зоні контролю Чорноморського рибоохоронного патруля зняти з промислу знаряддя лову, заборонені для використання в місцях та у терміни, визначені пунктом 1 цього наказу.

5. Відділу іхтіології та регулювання рибальства Чорноморського рибоохоронного патруля:

- надавати щомісячну інформацію до 1 числа місяця наступного за звітним до Держрибагентства про хід нересту водних біоресурсів;

- довести зазначений наказ до відома користувачів водних біоресурсів, населення, підприємства, установи, організації, а також місцеві адміністрації про встановлення заборони на вилов водних біоресурсів шляхом розміщення інформації в засобах масової інформації та на офіційному сайті Чорноморського рибоохоронного патруля.

6. Керівникам відділів рибоохоронних патрулів №1,2,3,4 посилити охорону ділянок нерестовищ та контроль за ходом нересту риби шляхом проведення спільних рибоохоронних рейдів із залученням контролюючих органів, згідно планів спільних заходів.

7. Контроль за виконанням цього наказу залишаю за собою.

Т.в.о. начальника Чорноморського
рибоохоронного патруля — Сергій ЧЕРНЯВСЬКИЙ

Додаток 1
до наказу Чорноморського рибоохоронного патруля
від «14» 04 2022 № 132

Перелік
місць, визначених для любительського рибальства у період заборони вилову водних біоресурсів у зв'язку з їх нерестом на водних об'єктах підконтрольних Чорноморському басейновому управлінню Державного агентства меліорації та рибного господарства у 2022 році

№ з/п	Назва водойми	Місце розташування ділянки
1	Дністровський лиман	Ділянка в межах м. Овідіополь – від пасажирського причалу в сторону с. Роксолани протяжністю 1,5 км
2		Ділянка в м. Білгород-Дністровський – розташована на правому березі Дністровського лиману з 1-го міського причалу в сторону с. Заливне довжиною 4 км по берегу
3	Річка Дунай	Затон Базарчук
4		Піщаний канал (ПМК-овський канал)
5		Білгородський канал в межах міста Вилкове
6		30-метрова прибережна смуга річки Дунай в межах м. Вилкове
7		75-77 км
8		96-97 км
9		103-105 км
10	Хаджибейський лиман	Від трамвайної зупинки в сторону очисних споруд протяжністю 200 м (для пільгової категорії громадян)
11		По лівій стороні лиману від північного краю с. Черняховське на протязі 1 км в сторону с. Маринівка

Appendix D

1 3

ДЕРЖАВНЕ АГЕНТСТВО РИБНОГО ГОСПОДАРСТВА УКРАЇНИ
УКРАЇНСЬКИЙ ДЕРЖАВНИЙ ІНСТИТУТ
ПО ПРОЕКТУВАННЮ ПІДПРИЄМСТВ РИБНОГО ГОСПОДАРСТВА ТА ПРОМИСЛОВОСТІ
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18.12.2018 № 01/232

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Тел./факс: (044) 272 20 32

Щодо надання інформації

Повідомляємо, що питомі капіталовкладення на 1 т риби-сирцю промповернення в цінах станом на 01.10.2018 року (без ПДВ) за проектами-аналогами становлять:

1. «Выростное хозяйство по выращиванию молоди частиковых рыб в Голопристанском районе Херсонской области» VI зона рибництва становлять – 467,30 тис. грн.;

2. «Рыбопитомник озерно-товарного хазяйства на водохранилище Днепро-Брагинском в Лоевском районе Гомельской области» III зона рибництва становлять – 636,30 тис. грн. Коефіцієнт економічної ефективності капіталовкладень – 0,06;

3. «Каневский рыбопитомник Черкасской области» IV зона рибництва становлять – 310,88 тис. грн. Коефіцієнт економічної ефективності капіталовкладень – 0,12;

4. «Рыбопитомник для зарыбления водохранилища им. Ленина в Новомосковском районе» V зона рибництва становлять – 806,39 тис. грн. Коефіцієнт економічної ефективності капіталовкладень – 0,12;

5. «Рыбопитомник для зарыбления Каховского водохранилища» VI зона рибництва становлять – 879,76 тис. грн. Коефіцієнт економічної ефективності капіталовкладень – 0,2;

6. «Рыбопитомник растительноядных риб рыбозавода «3й Решающий» VI зона рибництва становлять – 548,73 тис. грн. Коефіцієнт економічної ефективності

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капіталовкладень – 0,48 (0,18 з обліком благозасвоєння);

7. «Рыбопитомник по воспроизводству растительнроядных рыб и карпа в Очаковском районе Николаевской области» VI зона рибництва становлять – 644,02 тис. грн. Коефіцієнт економічної ефективності капіталовкладень – 0,22;

8. «Морской нефтеперевалочный комплекс в районе г. Одессы» V зона рибництва становлять – 938,18 тис. грн. Коефіцієнт економічної ефективності – 0,16;

9. «Рыбоводный комплекс по выращиванию кефали-пелегаса» V зона рибництва становлять – 550,51 тис. грн. Коефіцієнт економічної ефективності – 0,18.

Питомі капіталовкладення на 1 т риби-сирцю промповернення станом на 01.10.2018 р. визначені з урахуванням додатку до листа Мінрегіонбуду України від 17.10.2018 № 7/15.3/10900-18 (відповідно до збірника "Ціноутворення в будівництві" Інституту "Інпроект, Київ, 2018, випуск 11).

Директор М. Д. Левченко