ANNOTATED REPORT
ON SCIENTIFIC RESEARCH

Complex environmental monitoring program for the Danube-Black Sea Deep-Water Navigation Canal operation in 2017-2018. The Sea Approach Canal zone.

Introduction

In 2017-2018 monitoring works were implemented in accordance with the Terms of Reference to the contract number 600/ 1.1 /99-В-ФДЛ- 17 dated 02.06.2017 and "Complex environmental monitoring program for the Danube-Black Sea Deep-Water Navigation Canal operation in 2017-2018. The Sea Approach Canal zone".

For work performance the main executor (USRIEP Ministry of Ecology and Natural Resources of Ukraine) have been involved the following organizations: Danube Hydrometeorological Observatory (DHMO), Odessa Centre of State Enterprise South Scientific Institute of Fisheries and Oceanography (SSIFO), State Enterprise "CHERNOMORNIIPROEKT", Danube Biosphere Reserve National Academy of Sciences of Ukraine (DBR), Governmental Institution "Institute of Marine Biology, National Academy of Sciences of Ukraine" (IMB).

1. Regular hydrological and hydrochemical studies (DHMO, USRIEP)

Implementation of the Program and scope of works

The hydrological monitoring program included daily monitoring of the level and temperature of water. These observations were carried out on eleven stationary posts in five of which, moreover was carried out daily monitoring on turbidity. During reporting period, expedition on m/s "Tymophiy Bohatyr" have been taken expedition to study the spatial and temporal variability of water flow and sediment of the Danube and its delta arms.

Hydrochemical observation were conducting according to the TOR in the Danube river and Kiliya delta arms. The number of posts on the Danube and delta arms amounted 17.

Short hydrometeorological description

Weather conditions: the monthly average temperature in April-November of 2017 was close to normative. Only in September the monthly average temperature was +19,7ºC thus exceeded the norm by 2,4º.

Water levels: In April and May of 2017 the monthly average water levels in the Danube (in Ukrainian part) were lower than average long-term. The decline in water levels continued in June and July. In September-October there was a slight increase in water levels. In November, due to rains in the Danube basin, water levels increased during the month. In general, in the autumn, the average monthly water levels were close to the average long-term values, but did not exceed them (Fig.1.1).

Water and sediment runoff. In April - November 2017, the average monthly water flow in the outlet of the Danube (54 miles) varied from 3680 to 7370 m^3/sec. The maximum average daily water runoff during this period at the top of the Danube Delta (8400 m^3/sec) was observed in the second decade of May. The average water runoff at the top of the Danube

Delta for April - November 2017 amounted to 4860 m^3/sec, i.e. during this time 102 km^3 of water arrived to the delta: 50.4 km^3 (49.4%) passed along the Kiliya arm, corresponding to an average water runoff of 2390 m^3/s; the average water runoff of the Bystriy arm for this period amounted to 936 m^3/sec. Thus, in April-November, along the route of the DWNC through the Bystry arm 19.7 km^3 of water were taken to the sea, or 19.3% of the total inflow into the delta at the Danube outlet (Table 1.1).

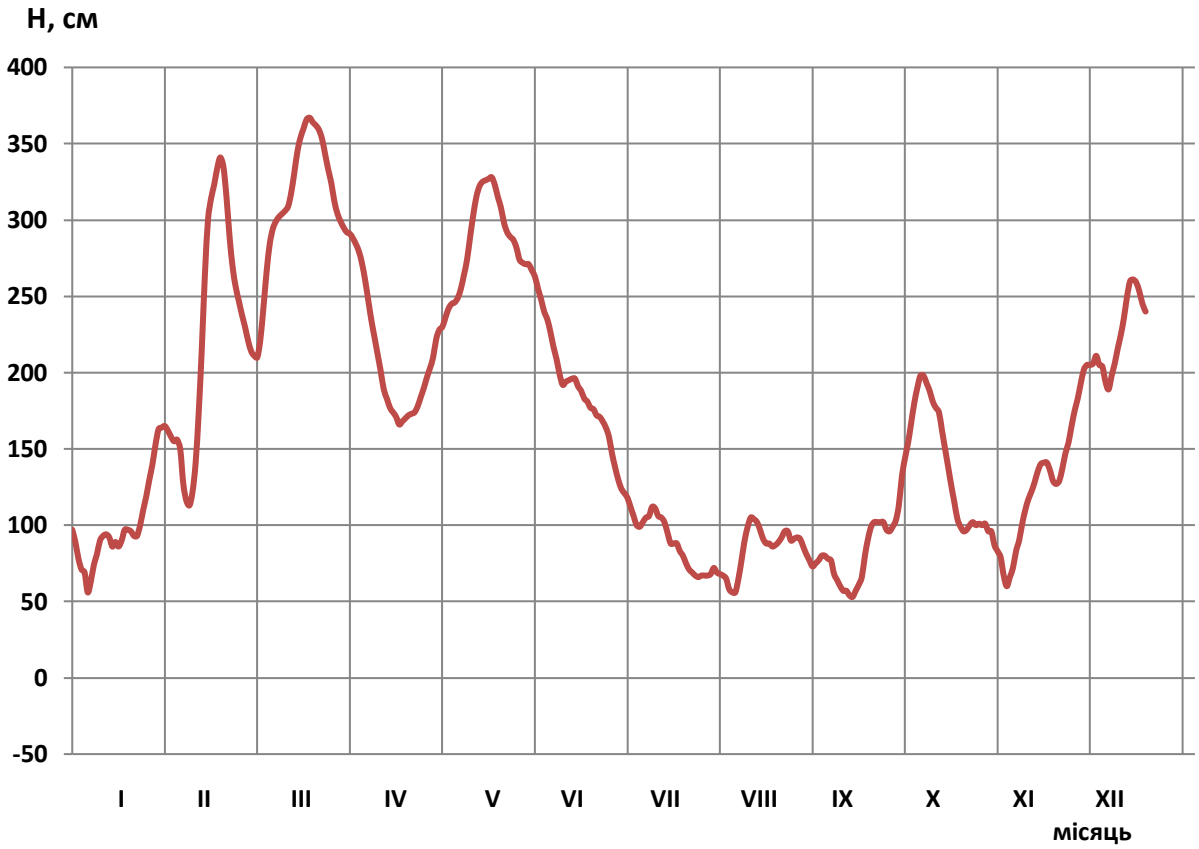


Figure 1 – Diagram of daily water levels of the Danube river, ГП-I Reni

Table 1.1 – Water runoff (km^3) during April-November 2017

IV	V	VI	VII	VIII	IX	X	XI	Сума	%
The Danube river, 54 miles									
15,3	19,7	13,9	9,94	9,86	9,75	11,8	12,2	102	100
The Danube river, Bystry arm									
2,90	3,64	2,72	2,00	1,96	1,90	2,33	2,27	19,7	19,3

The maximum daily average sediments runoff at the mouth of the Bystry arm for April-November (400 kg/sec) was recorded on May 16.

In total, in April-November, the Black Sea received 6.25 million tons of suspended sediments of the Danube, 1.45 million tons of which or 23.2% of the total went through the Bystry arm (Table 1.2).

Table 1.2 – Suspended sediments runoff (millions of tons) in April-November 2017

IV	V	VI	VII	VIII	IX	X	XI	Сума	%
The Danube river, 54 miles									
1,19	1,96	0,70	0,35	0,23	0,39	0,78	0,65	6,25	100
The Danube river, Bystry arm									
0,29	0,48	0,18	0,05	0,07	0,05	0,17	0,16	1,45	23,2

Analysis of hidrochemical monitoring results

Changes of the hydrochemical regime of delta part of the Danube mostly depended on the parameters of the hydrological regime: water content and temperature, and amount of suspended solids. Significant current speed and turbulence of water flow caused to homogeneity of chemical parameters and their relatively limited amplitude. An anthropogenic factor significantly impacts the chemical composition of water as well.

The water temperature is one of the most important hydrophysical indicators that determines the speed of chemical and biochemical processes, the concentration of dissolved gases, organic compounds, oxygen consumption, etc. Average water temperature during expeditionary work in January-December 2017 gradually increased from January to August, reaching extreme values from 0.2 to 26.9 ^{o}C.

Concentrations of suspended substances in the Danube water during the observation varied from 0.50 mg/dm^3 in January to 206 mg/dm^3 in February. Extreme values were registered on the Kilia section of the Danube River (32 km). The average value was 38.3 mg/dm^3 and was insignificantly lower than last year's value.

The content of organic substances in the Danube water was characterized by permanganate and bichromatic oxidation values. Their ratio (0.18) indicates the predominance of substances that are difficult to oxidize over substances that are easily oxidized. This characteristic is stable for the Danube water for many years. The average value of permanganate oxidation was 3.58 with extreme values of 3.20 and 4.08 mgO/dm^3, registered in March and November correspondingly. The average value of bichromate oxidation of the Danube water in the reporting period was 19.2 with fluctuations of concentrations from 15.4 to 23.1 mg O/dm^3, respectively, in April and May.

Danube water has a stable composition of the main ions. Hydrocarbons, calcium and sulphates dominate in the Danube water. Chlorides, the sum of alkali metals, magnesium are placed further, decreasing.

The content of hydrocarbons in the Danube water was 178 mg/dm^3 with an amplitude of fluctuations of 147 mg/dm^3 (July) and 220 mg/dm^3 (January).

The content of calcium in the Danube water varied from 36.4 to 66.1 mg/dm^3, the average concentration was 51.3 mg/dm^3, which is slightly higher than last year's value. Extreme values were registered in August and January, respectively.

In addition, the concentration of sulfates, chlorides, magnesium, phenols, surfactants, petroleum products, hexavalent chromium and the sum of sodium and potassium ions was determined.

The samples of the Danube water for further identification of organochlorine pesticides were taken in March - November. In all samples, HCFCs, HCBs, DDDs and DDTs were not found. In the analyzed samples, DDE was found in single samples taken in March - April and August

- October in the amount of 0.005-0.022 mg/dm^3.

Determination of metal content in surface waters and bottom sediments by results of expeditionary researches (USRIEP)

In accordance with the rules of expeditionary researches, the content of iron, manganese, zinc, copper and nickel was determined in November 2017 in terms of monitoring of the content of metals in river water and bottom sediments.

Each sample was studied in three parallels. In total 50 element-determination were done to study the content of iron, manganese, zinc, copper and nickel, including 25 in water and 25 in the bottom sediments (excluding the parallel).

2. Hydrobiological studies (USRIEP)

During the period of expeditionary research, 66 samples of water and bottom sediments were taken for biological and chemical analysis. The samples at 0 km of the Bystryi's arm were not taken due to weather conditions.

Table 2.1 – Sampling points of the USRIEP (November 2017)

# of point	Code, name of sampling point	Distance to the mouth	Geodetic connection	Date	Sample kinds
1	R01, 2 km above Reni	71 mile	Left bank	13.11.17	hydrochemical, hydrobiological
2	R06, 1 km км below Izmail	89 km	Midstream	13.11.17	hydrochemical, hydrobiological
3	R07, above Kiliya	49	Left bank	16.11.17	hydrochemical, hydrobiological
4	R09, below Kiliya	32 km	Left bank	16.11.17	hydrochemical, hydrobiological
5	R10, 1 km above Vylkove	21 km	Left bank	17.11.17	hydrochemical, hydrobiological
6	R11, Ochakivskyi arm	17 km	Midstream	14.11.17	hydrochemical, hydrobiological
7	R14, Ochakivskyi arm	6 km	Midstream	14.11.17	hydrochemical, hydrobiological
8	R12, Starostambulskyi arm	11 km	Midstream	14.11.17	hydrochemical, hydrobiological
9	R15, Starostambulskyi arm	Below Bystre mouth	Midstream	15.11.17	hydrochemical, hydrobiological
10	R13/9, Bystryi arm	9 km	Midstream	15.11.17	hydrochemical, hydrobiological
11	R13/1, Bystryi arm	1 km	Midstream	15.11.17	hydrochemical, hydrobiological
12	R13/0, Bystryi arm	0 km	-	-	-

Sampling and analysis were provided according to standard hydrobiological methodic.

Results of phytoplankton studies

During the preliminary analysis of the algological samples taken in November 2017 in the studied areas of the Danube River, there were detected about 70 taxonomic units of algae from 8 divisions of freshwater phytoplankton, most of which belonged to freshwater and saltish water phytoplankton.

Thus, in November 2017, there was registered some improvement in the water quality by the indicator of biomass of phytoplankton, on the section from the sampling point above the Kiliya to the section above Vylkove, and especially in the Bystryi's arm, 9.5 km.

Zooplankton

Zooplankton samples were taken in 10 sections of the investigated area of the river. In the points R-14 and R-13/0 zooplankton samples were not taken due to the storm.

Important in determining the ecological status of water bodies are indicators of the development of hydrobionts - their qualitative and quantitative development. Mainly they depend on many factors: the hydrochemical, hydrological state of the water body, and others.

Indicators of the total number of zooplankton groups at the study points were ranged from 100 ind./m^3 at point R-09 (below the Kiliya), where only *Arcella vulgaris* was detected, to 2000 ind./m^3 at point R-07 (above the Kiliya), where vesicular crayfish dominated (the *Nauplii* number was 700 ind./m^3 and *Copepoditii cuclops* 300 ind./m^3, and *Copepoditii counts* - 100 ind./m^3. In the rest of surveyed points, the total numbers varied from 400 ind./m^3 at R-12 (Starostambulskyi arm, 11 km) to 900 ind./m^3 at R-06 (below Izmail) (Table 2.2).

According to the trophic features, quantitative (average) indicators allow to indicate zooplankton by number up to low gradation (with fluctuations from “extremely low” and “low” and oligo-mesotrophic category of trophy; by biomass - to extremely low gradation and oligotrophic category of trophy, the similar to the previous years of research.

Table 2.2 - Indicators of the number (ind./m^3) and biomass (mg/m^3) of the main taxonomic groups of the zooplankton communities of the Danube River and its arms by the materials of the study in November 2017

#	Taxonomic groups	Indicators of	Points of research					
			R 01	R 06	R 07	R 09	R 10	R 11
1	Sarcomastigophora	number	300	200	700	100	0	0
		biomass	0.228	0.0414	0.35	0.076	0	0
2	Rotatoria	number	300	400	200	0	0	0
		biomass	0.13	0.156	0.083	0	0	0
3	Cladocera	number	0	0	0	0	0	0
		biomass	0	0	0	0	0	0
4	Copepoda	number	0	300	1100	0	0	0
		biomass	0	0.66	17.54	0		0
In total		number	600	900	2000	100	0	0
		biomass	0.358	0.8574	17.97	0.076	0	0

#	Taxonomic groups	Indicators of	Points of research					
			R14*	R 12	R 15	R 13/9	R 13/1	R 13/0*
1	Sarcomastigophora	number		400	200	0	0	
		biomass		0.236	0.152	0	0	
2	Rotatoria	number		0	0	0	0	

		biomass		0	0	0	0	
3	Cladocera	number		0	100	0	0	
		biomass		0	1.7	0	0	
4	Copepoda	number		0	200	0	0	
		biomass		0	2.0	0	0	
In total		number		400	500	0	0	
		biomass		0.236	3.852	0	0	

* - samples were not taken

Pigmented characteristics of the phytoplankton of the Ukrainian part of the Danube Delta

In 2017, the experts of USRIEP during the special monitoring of the Ukrainian part of the Danube Delta and the control of work on the Danube-Black Sea DWNC continued the definition of pigmentary indices of phytoplankton and bottom sediments. The obtained values of pigmentary indices of phytoplankton are presented in Table. 2.3.

Table 2.3 - Pigmentary indices of phytoplankton

Month	Code	Point	Chlorophyll "a", mkg/dm^3	Index D_{430}:D_{665}, ind.$^{-1}$	Index D_{480}:D_{665}, ind.$^{-1}$	Index TSI	Water trophicity assessment
April	R01	Above Reni. 72mile	1.35	2.43	1.43	33,48	1к, oligotrophic
	R06	Below Izmail, 89km	0.52	4.00	2,33	24,22	1к, oligotrophic
	R07	Above Kiliya, 49km	3.86	3.67	2,62	43,81	1к, oligo-mesotrophic
	R09	Below Kiliya, 39km	1.10	3.67	2,33	31,52	1к, oligotrophic
	R10	Above Vylkove, 21km	5.82	3.94	3,06	47,85	1к, oligo-mesotrophic
	R11	Ochakivskyi arm, 17km	3.98	3.38	2,05	44,13	1к, oligo-mesotrophic
	R12	Starostamb. arm, 11km	2.54	2.46	1,31	39,71	1к, oligotrophic
	R12/1	Bystryi arm, 9km	0.68	5.75	4,50	26,74	1к, oligotrophic
	R14	Ochakivskyi arm, 6km	0.73	5.25	3,75	27,47	1к, oligotrophic
	R15	Starostamb. arm, 4km	0.89	4.40	3,20	29,43	1к, oligotrophic
	R13/1	Bystryi arm, 1km	4.48	4.20	3,24	45,27	1к, oligo-mesotrophic
	R13/0	Bystryi arm, 0km	0.37	4.50	3,00	20,73	1к, oligotrophic
August	R01	Above Reni, 72mile	2.51	4.78	2,78	39,60	1к, oligotrophic
	R06	Below Izmail, 89km	2.30	3.08	2,77	38,75	1к, oligotrophic
	R07	Above Kiliya, 49km	4.42	2.17	1,17	45,14	1к, oligo-mesotrophic
	R09	Below Kiliya, 39km	2.59	3.40	2,40	39,89	1к, oligotrophic
	R10	Above Vylkove, 21km	1.96	2.00	1,13	37,18	1к, oligotrophic
	R11	Ochakivskyi arm, 17km	1.41	3.25	3,13	33,95	1к, oligotrophic
	R12	Starostamb. arm, 11km	1.96	2.83	2,67	37,20	1к, oligotrophic
	R12/1	Bystryi arm, 9km	3.07	2.15	1,46	41,56	1к, oligotrophic
	R14	Ochakivskyi arm, 6km	1.79	1.75	1,25	36,26	1к, oligotrophic
	R15	Starostamb. arm, 4km	1.56	2.13	1,38	34,95	1к, oligotrophic
	R13/1	Bystryi arm, 1km	2.83	2.81	2,56	40,76	1к, oligotrophic
	R13/0	Bystryi arm, 0km	3.57	2.13	1,13	43,05	1к, oligo-mesotrophic
November	R01	Above Reni, 72mile	1.89	2.00	1,67	36,80	1к, oligotrophic
	R06	Below Izmail, 89km	3.42	2.55	2,00	42,63	1к, oligotrophic
	R07	Above Kiliya, 49km	2.33	2.80	1,90	38,88	1к, oligotrophic
	R09	Below Kiliya, 39km	2.94	2.50	1,33	41,16	1к, oligotrophic
	R10	Above Vylkove, 21km	2.24	2.57	1,57	38,49	1к, oligotrophic
	R11	Ochakivskyi arm, 17km	4.16	2.24	1,35	44,56	1к, oligo-mesotrophic
	R12	Starostamb. arm, 11km	4.80	2.27	1,40	45,95	1к, oligo-mesotrophic
	R14	Ochakivskyi arm, 10km	2.60	3.00	1,63	39,93	1к, oligotrophic
	R12/1	Bystryi arm, 9km	2.91	2.44	1,33	41,04	1к, oligotrophic
	R15	Starostamb. arm, 4km	2.87	2.42	1,00	40,91	1к, oligotrophic
	R13/1	Bystryi arm, 1km	4.16	2.35	1,35	44,56	1к, oligo-mesotrophic
Average in April			*2.19*	*3.97*	*2.74*	*34.53*	*1к, oligotrophic*
Average in August			*2.50*	*2.71*	*1.98*	*39.02*	*1к, oligotrophic*

Month	Code	Point	Chlorophyll "a", mkg/dm^3	Index D_{430}:D_{665}, ind.$^{-1}$	Index D_{480}:D_{665}, ind.$^{-1}$	Index TSI	Water trophicity assessment
Average in November			*3.12*	*2.47*	*1.50*	*41.36*	*1к, oligotrophic*
Average			***2.59***	***3.06***	***2.09***	***38.22***	***1к, oligotrophic***

3. Field studies of the ecological state of the Danube coastal area in the DWNC zone (IMB)

Two expeditions were conducted on the marine part of the Danube Delta in the second half of 2017. On August 22-25 a marine complex ecological expedition was carried out in the area of exploitation of the Danube-Black Sea DWNC; and a coastal expedition to the area of the dam of the Bystre mouth and the Ust Dunaiskyi port was completed on August 22, 2017.

As the result of the samples analysis, there was obtained the data for the calculation of compensatory payments for the impact on the components of the environment during operational dredging works at the SAC in the 3rd quarter of 2017 (fish feed base, granulometric composition of soils, content of pollutants in bottom sediments).

In the fourth quarter of 2017 there were carried out a complex expeditionary work on the topic "Control observations in the process of exploitation of the Danube-Black Sea DWNC (Marine part)". On November 6-10, 2017 the complex marine expedition and coastal expedition to the area of the dam at the Bystre mouth exit and to the Ust Dunaiskyi port (10.11.2017) were conducted.

The purpose of the marine expedition was to estimate the soil contamination and the status of the fish feed base on the Danube seaside. The main task of the coastal research was to monitor the indicators of phytoperithellon development at the areas of the Bystre and Ust-Dunajskyi mouths, using the parameters of the morpho-functional and structural organization of plant communities. In November 2017, works were carried out at 12 complex stations (Fig. 3.1).

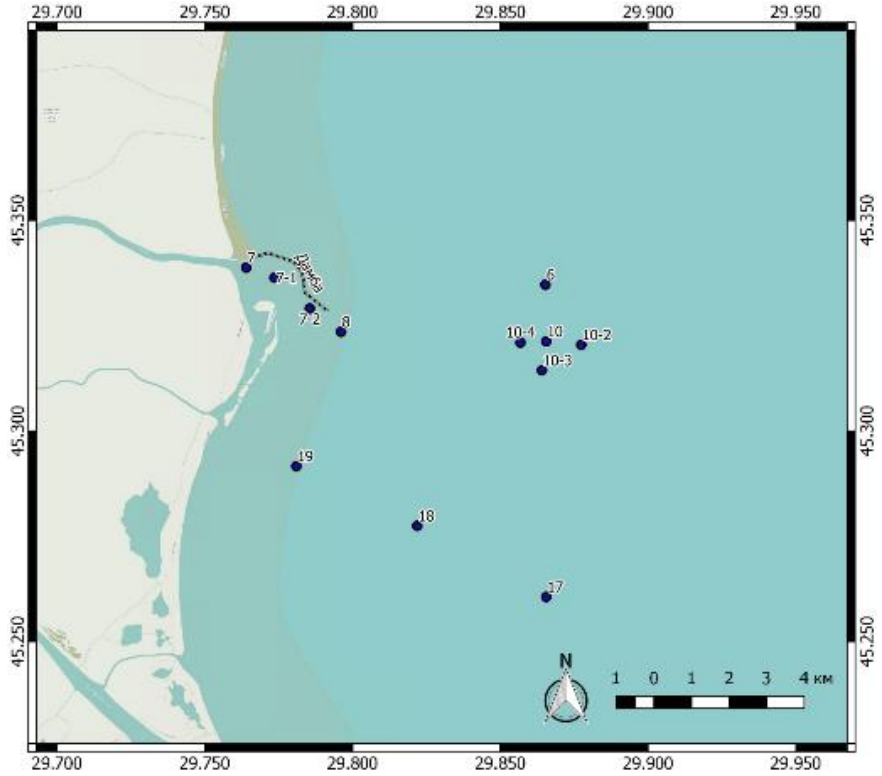


Figure 3.1 – Scheme of location of complex stations in November 2017

The complex of hydrological, hydrochemical and hydrobiological works was conducted at every station according to the standard methods. Samples of zoobenthos and soil samples for hyrdochemical and granulometric analysis were taken at the stations, as well as samples for salinity, phytoplankton and hydrochemical analysis. The determination of water temperature and salinity in surface and bottom water layers was conducted directly from the boat.

Meteorological observations were carried out at every station, the transparency of the water (if the sea was calm) and parameters of waving were determined. The location of the stations was determined using the GPS-12 "Garmin".

In addition to the commonly used indicators, which are used in the study of fixed aquatic vegetation (species composition, projective coverage, biomass), the methods of morpho-functional evaluation will be used in the analysis of the data (Minichova, 1989).

For conducting of the monitoring observations on the aquatic environment quality, based on changes in the parameters of the morpho-functional organization of the phytoperiphery groups, the coefficients of the surface area (S / W) and surface indexes (SI) are calculated in accordance with the methodic algorithms (Minichova, Zotov and others, 2003).

Study of the bottom sediments state

The sampling of modern sediments was carried out using the bottom scoop ДЧ-0.1 with a capture area of 0.1 m^2. After the lifting of the bottom scoop on board the Orlik boat, the description of bottom sediments was done, indicating the type, color, consistency, presence of fauna, odor, etc. The bottom sediments were analyzed for pollutants content (toxic metals, phenols and the sum of petroleum hydrocarbons), as well as the granulometric composition of soils was studied.

Fish feed base

The fish feed base in November 2017 will be determined by the analysis of data of phyto-, zooplankton and zoobenthos samples, including fodder organisms.

The avendelta of the Ukrainian part of the Danube is conditionally divided into three areas: dredging on the route of the canal from the Bystre mouth, soil dumping area and background stations (based on averaged data). Taking into account the peculiarities of the extensive distribution of pelagic and benthic organisms, averaging for fodder phyto- and zooplankton is performed using an arithmetic mean, for zoobenthos - a geometric mean values.

4. Ichthyological monitoring (SSIFO)

The work is carried out in the framework of complex monitoring of the operation of the Danube-Black Sea DWNC along the Bystre mouth. The main tasks of ichthyological monitoring are the analysis of the water bioresources development state and the assessment of the negative impact on the ichthyofauna with the calculation of compensatory payments. Scientific research works are carried out according to the standard methods of hydrobiological and ichthyological research, adopted by the system of the State Agency of Fish Resources and National Academy of Sciences of Ukraine.

The previous studies showed that the dredging does not negatively affect the bottom biocenoses of adjacent areas and their planktonic complexes. Negative impact is appeared when bottom dwelling organisms are excavated with the soil and when are covered with stored soil; but the species composition and the biomass of the zoobenthos, after a certain time, are restored.

Of course, the effects of dredging and damping on benthic organisms can be felt more than a year in the immediate area of dredging and in the place of soil dumping. The negative impact for benthos and plankton in the zone of silting is limited by the timing of the work. As the research has shown, following the technological dump regulations within the established area of soil dumping, intensive restorative processes of the bottom communities occur within a year.

The main impact of dredging and storing of soils during the support of passport characteristics of the SAC DWNC is exerted on the feed base of fish, and less impact - on the conditions for their reproduction and early fish young. However, studies conducted in the framework of ecological monitoring of dredging sites on the DWNC indicate that this impact is mainly limited by local sites during the period of work. Dredging works cause a short-term increase of suspended solids concentrations in water.

There was fulfilled the scientific and biological substantiation of the possibility of dredging works during the prohibition period for fishing and catch of other aquatic biological resources, including preliminary calculation of losses incurred by biological resources during the performance of work on the operational dredging at the SAC DNWNC and the storage of soil on the marine soil dump; the recommendations for limiting economic activity during the works implementation in 2018 have been developed.

5. Monitoring of terrestrial and coastal ecosystems on the territory of the Danube Biosphere Reserve (DBR)

Monitoring of plant and animal communities of the coastline and wetlands of the Danube Biosphere Reserve (DBR) during the exploitation of the Danube - Black Sea DWNC was provided in accordance with the terms of reference and time schedule.

During the reporting period there was conducted the analysis of changes in the plant and animal communities of the DBR and has assessed the possible impact of WDNC on DBR's ecosystems (using the obtained and archival data).

Flora of the DBR

The assessment of the flora changes dynamics on the area of the Danube Biosphere Reserve due to natural and anthropogenic factors in the second half of the 2017 was provided by field observations of the territories, which are located in the DWNC zone.

In the second half of 2017 there was an extraordinary summer heat, which led to a decrease in water levels and drying out of many territories. The main factors influencing the vegetation of the reserve were climatic, hydrological and anthropogenic.

In the coastal part of the Stambulskyi island, morphological changes along with changes in vegetation cover continue. Among the shrubs and trees, the most projective cover is amorphous shrub (*Amorpha fruticosa*) - approximately 30%, salt cedar (*Tamarix ramosissima*) - up to 25%, silver berry (*Elaeagnus angustifolia*) - up to 25%, sea buckthorn (*Hippophae rhamnoides L*) - about 15%, willows - about 5%.

Some of the lower sites the Stambulskyi island coastal part are almost devoid of plant cover, or it is extremely depleted in comparison with previous years because of sea waves influence.

The formation on a large area of saline meadows of the European solonetz and Sueda is continuing, the spot areas of Sálsola are sparsely found. All this indicates the increase of the soil salinity. In a few hundred meters from the water cut, the low area became a saltish water body, surrounded by reeds and plants of the solonetz type. Among them are *Aster tripolium, Salicornia européea, Suaeda prostrata, Spergularia marina (L.), Cakile euxina*, *Lactuca tatarica (L.)* and other species in smaller amount.

In the sand covered area near the dam edge, vegetation of the loboda family species is formed, which is characteristic for areas with saline soils, as well as vegetation of the true psamophytes. In addition to alluvial-sandy vegetation, the overgrown species of saline soils are found: tamarix branched, isthorium solonetzous, loboda, etc.

The road to the dam on the Stambulskyi island is overgrowing with bush and herbaceous vegetation. The projective cover of the vegetation at the road sections varies from 60 to 100%.

In the so-called scoop behind the dam it is formed a strip of sandy-misty soil; there are formed shoal with real water and air-water vegetation (*Scirpus tabernaemontani, Bolboschoenus maritimus and B. compactus*, *Cyperus* and other airborne and water species of plants, spots of *Amorpha fruticosa* and *Tamarix ramosissima Ledeb*.

The dam, which was previously filled up with sand, now stands with deep debris between stones, which is the result of storms, and therefore there is almost no plant cover. In the area next to the dam, a vegetation band is formed from the saltish-water aliuviofites and air-water vegetation.

The Ptashina spit is significantly influenced by storms, which erode the coastal zone in the southern part of the spit, which leads to the destruction of the vegetation, even shrubs. Almost the entire area of the spit is covered with vegetation with varying degrees of projective coverage, which consists predominantly of perennials; there is a process of the rapid formation of vegetation cover.

The depth of the Bystriy Gulf has not changed and ranges from 0.1 to 0.4 meters. Visual inspection showed the slow development of immersed macrophytes in comparison with previous years. The most significant overgrowing is registered in the part of the corner near the Eastern mouth, and the smallest - near Bystryi mouth.

The water drain in the Ochakivskyi mouth is being continued at a very fast pace. This led to its narrowing, shallowing, overgrowing of shoal areas and to the formation of islands in the middle of the arm, which had already begun to overgrown with woody vegetation (willows). The lower parts and submerged plots on the sides are densely overgrown with *Typha angustifolia L., Typha latifolia, Scyrpus lacustris, Phragmites australis, Scyrpus litoralis*, and *Bútomus umbellátus*, which has been very widespread in the reserve last year.

Macrozoobenthos, phytophilic fauna

The hydrobiological study on the monitoring of macrozoobenthos and phytophilic fauna groups of the Danube Biosphere Reserve during the operation of the Danube-Black Sea DWNC in 2017 was carried out during expeditions in September 2017.

The research was conducted on the territories located in the Danube-Black Sea DWNC zone in the secondary delta (Bystry, Eastern, Starostambulskyi, their bars parts, the remains of the Bistryi and Eastern bays).

50 benthic samples and 22 samples of phytophylline fauna were taken in the different vegetation groups.

Study of rare ichthyofauna

During the reporting period of 2017, the study of the rare ichthyofauna was continued as a part of the monitoring work on the operation of the Danube-Black Sea DWNC. Scientific research catches with driftnets were conducted at the same stations as in the past year, and according to established methods, which allow to let the fish youth back to the river after the studying of biometric parameters. Also, observations were made during industrial fishing in the area of the DWNC and adjacent parts of the coastal area, where the catches of rare species were conducted. This results in significant ichthyological material and important ichthyofaunistic data.

As a result of fishing with driftnets conducted during the reporting period, youth of following rare fish species were registered: beluga sturgeon with length of 38-45 cm, stellate sturgeon - 34-36 cm, sterlet - 32-39 cm, large asproon - 17-33 cm, small asproon - 10-12 cm, striped ruff - 10-18 cm, gobio - 10-12 cm, stellate tadpole-goby - 3-8 cm, morey - 20-28 cm. Among the common types of fish in catches driftnet mesh there were young of sheatfish, bream, white bream, sazan and pike perch.

In addition to industrial fishing along the river, during September-October 2017, in the seashores of the mouths of Beastra and East, specialized fishing was conducted by seamless seagrass fish for the family of kefals - singhila, loban and pilengasa. Observation during such catches allows to obtain the data on the species composition and state of the populations of the Ichthyofauna, including rare ones, which actively use the shallow waterland with a rich fodder base for feeding in this season.

Due to the low water level in the Danube River during the second half of 2017 there was a penetration of a wedge of salty sea water in the river stream. For the first time in 2017, this phenomenon was registered at the Bystre mouth in late June, and during August-December a wedge of salt water was observed from the mouth to 6 km.

During the reporting period of 2017 there was no impact of the Danube - Black Sea DWNC operation on the representatives of the rare ichthyofauna at the area of research.

Amphibio- and herpetofauna

During the 2017, the monitoring program continued the study of the species composition, number and distribution of herpeto- and amphibiofauna of the Danube Biosphere Reserve.

Studies, conducted within the framework of the monitoring program during the reporting period, have confirmed the presence of amphibians and reptiles species described in previous years, their biotope distribution and population at the area of Bystre mouth and Ermak island.

The spring-summer period of 2017 in the Danube Delta was characterized by a relatively low level of water during the spring flood; as a result of this process some areas that are usually flooded were dry. The same situation was registered in the end of summer - the beginning of autumn. Significant raising of the water level in the Danube River delta were not observed in the autumn period.

Despite the low level of water, the reproduction of the herpeto- and amphibiofauna species was mainly successful.

The autumn period of 2017 was quite warm. Until the beginning of December there were no frosts. The background species of herpeto and amphibiofauna were registered on the territory of the DBR during the entire third decade of October, and the transition of amphibians and reptiles to the winter anabiosis was registered from the beginning to the middle of November.

During the conducted research, the direct impact of the operation of the Danube-Black Sea DWNC on the state of populations of amphibians and reptiles was not detected.

Avifauna

The traditional August records were not conducted in the coastal part in 2017 in full volume, because of prolonged storms. Instead, the full registration of the birds of the wetland complex was held on September 22, 2017. In the seaside part of the Bystre mouth, including the granite dam, the Ptashina spit and the adjoining areas, 628 specimens of 11 wetlands bird species were registered, which was 2% of the total number of specimens and 22% of the number of species registered in the seaside part of the Danube Delta on specified day. The largest bird clusters have traditionally been registered in the southern part of the DBR – on the New World spit, on the Kuril Meadows. The reason for such a distribution is the availability of food and large areas.

In the area of the seaside part of the Bystre mouth, the greatest number of birds was registered in the inlet between the Ptshina spit and the Kubaskyi island. Dominantes were presented by phytophagous (swan, mallard, big garganey) and ichthyofagy (pink pelican, small cormorant).

To understand the significance of a granite dam that was built in the bars part of the Bystre mouth, hiking registers were carried out on October, 10 from 10:30 a.m. to 1:30 p.m. and the distribution of birds on the dam was analyzed, depending on the distance from the Stambullskyi island.

Dredging works during the fourth quarter of 2017 were carried out in the bars of Bistre, but due to the fact that their intensity was rather low, it can be assumed that they did not affect the number of migratory and wintering birds in the territory of the Danube Biosphere Reserve. The ornithofauna of the specified region during this period was influenced by climatic conditions, first of all, mild weather conditions in the autumn and early winter periods, due to which the number and species composition were significantly poorer than the average annual figures.

Theriofauna

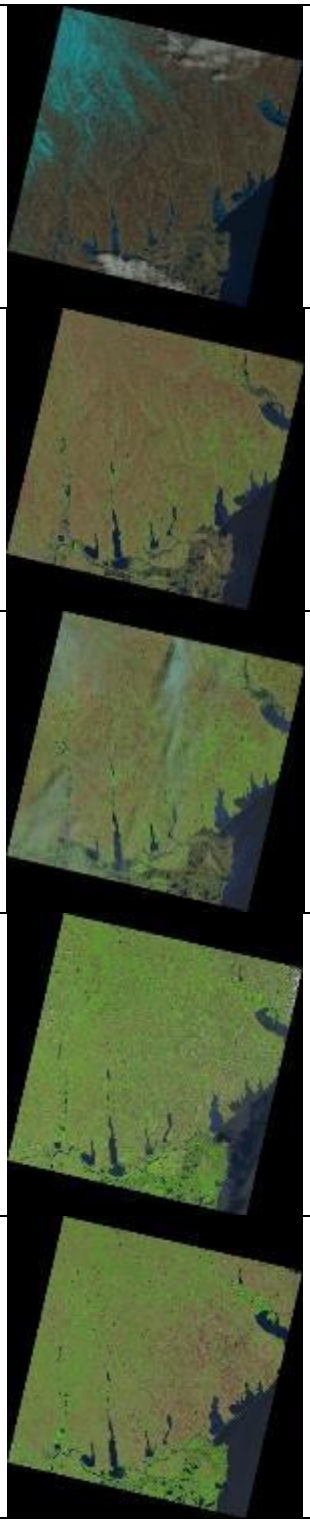
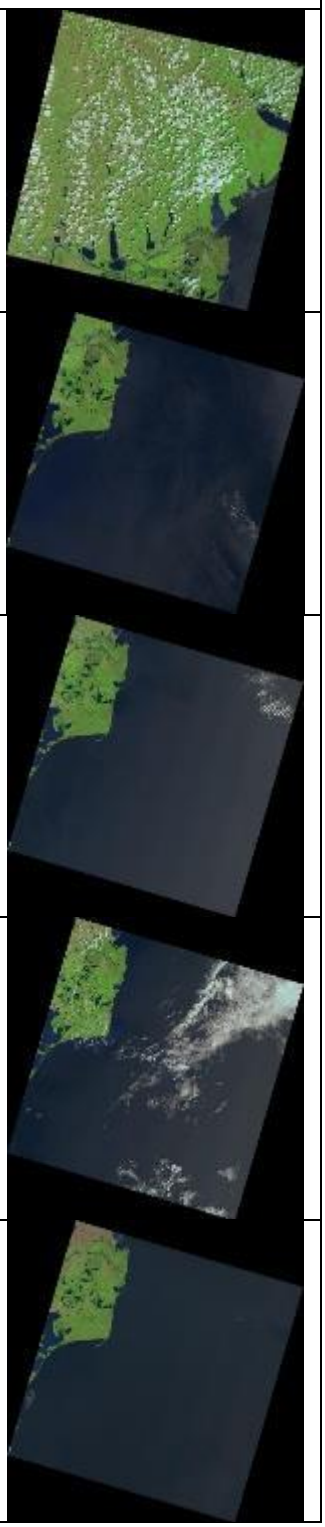
During 2017, the monitoring program continued the study of the species composition, number and distribution of the theriofauna under the impact of natural and anthropogenic factors, as well as the impact of the Danube-Black Sea DWNC on the species composition and number of mammals in the Danube Biosphere Reserve.

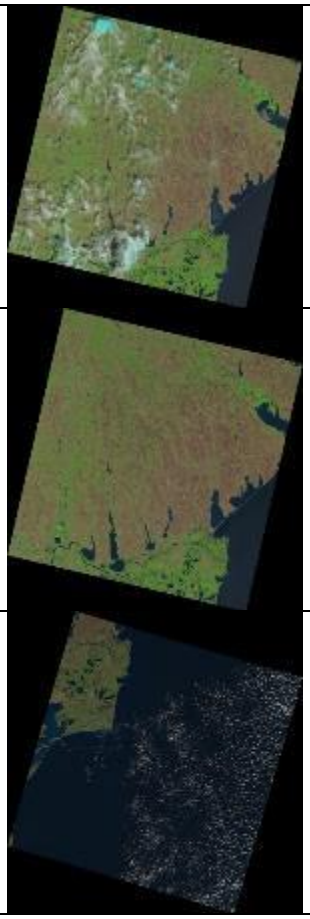
6. Analysis of the ecological processes in the Daube Delta and in the coastal area based on satellite images

Materials selection

During the works, the current availability of images and was analyzed and images base was enlarged (Table 6.1).

Table 6.1 - Landsat 8 images available for analysis of the state of the Danube Delta delta in January-December 2017

Path 181 Raw 028			Path 180 Raw 029	
Date			Date	
22.02.2017			29.05.2017	
11.04.2017			07.06.2017	
27.04.2017			23.06.2017	
30.06.2017			09.07.2017	
01.08.2017			10.08.2017	

Path 181 Raw 028			Path 180 Raw 029	
Date			Date	
17.08.2017			26.08.2017	
02.09.2017			13.10.2017	
29.10.2017			21.11.2017	

Dynamics of suspended solids distribution

In 2017, photos of the Landsat 8 spacecraft were used to analyze the dynamics of suspended solids distribution. To analyze the dynamics of the coastline and the distribution of suspended sediments in the Danube Delta, a database of space images was created in 2017, images are processed and decoded.

The visual analysis of the suspended sediments distribution in the western part of the Black Sea area in the Danube Delta region showed the following dynamics (Fig. 6.1, 6.2, 6.3, 6.4):

- in the area of the main stream of each of the Danube's mouths there are zones of maximum degree of turbidity. The turbidity field structure has a whirlwind appearance with seaward clarification;
- the general direction of the suspended sediments removal is the southern one, but in some periods the coastal flow and wind stream move them in the north-easterly direction.

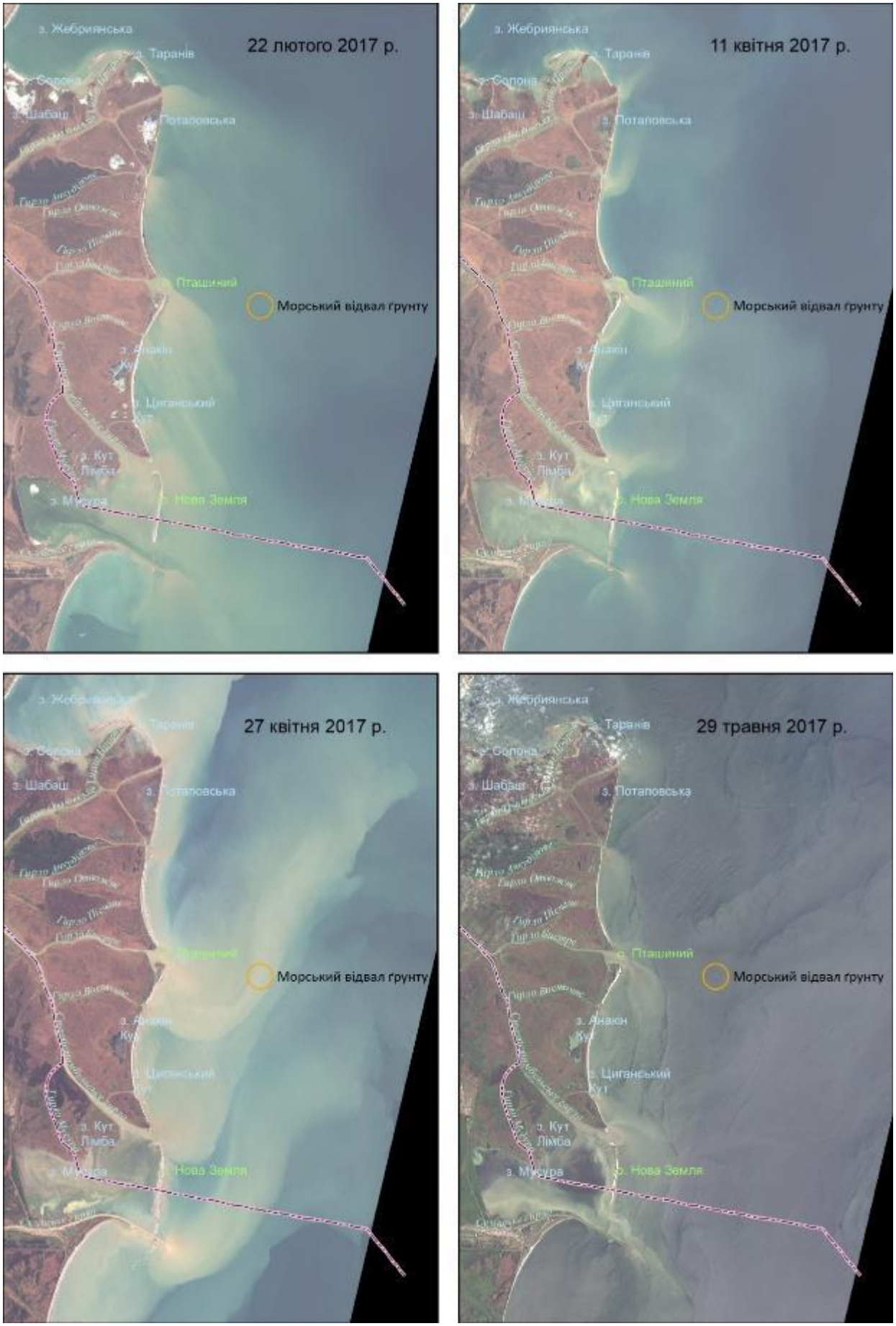


Figure 6.1 - Dynamics of channel processes and suspended solids distribution in the delta of the Danube and at the coastal part of the Black Sea in 2017

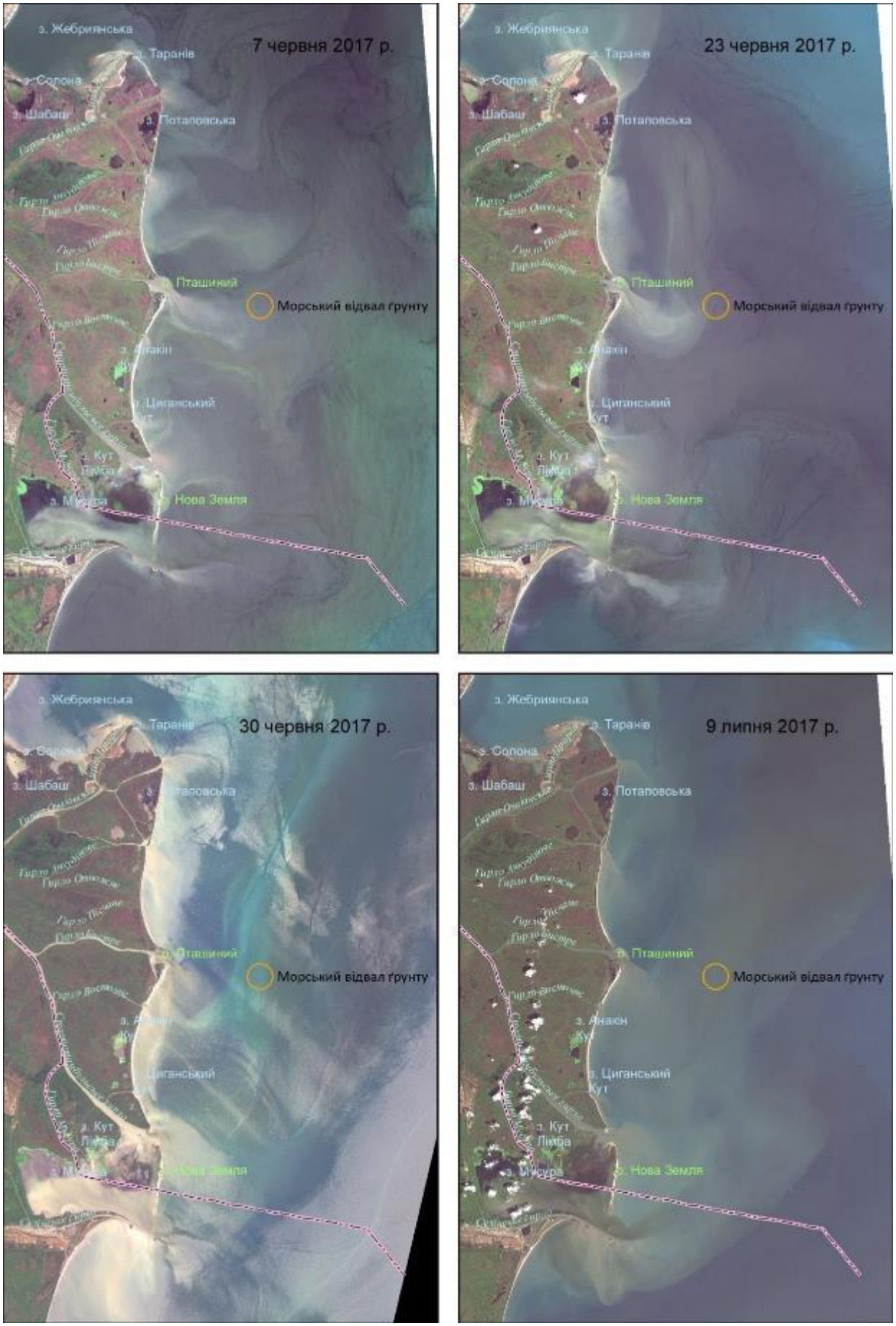


Figure 6.2 - Dynamics of channel processes and suspended solids distribution in the delta of the Danube and at the coastal part of the Black Sea in 2017

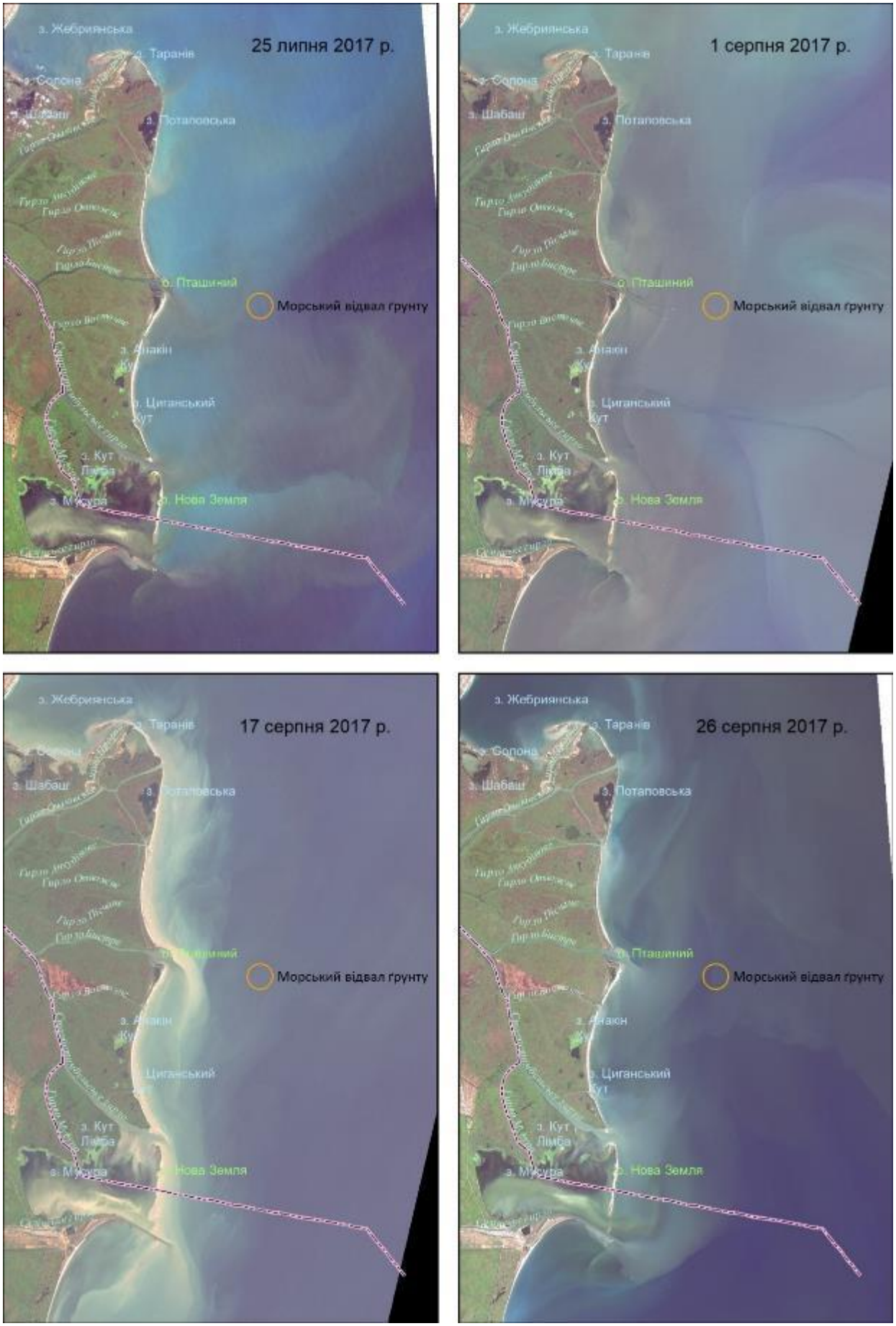


Figure 6.3 - Dynamics of channel processes and suspended solids distribution in the delta of the Danube and at the coastal part of the Black Sea in 2017

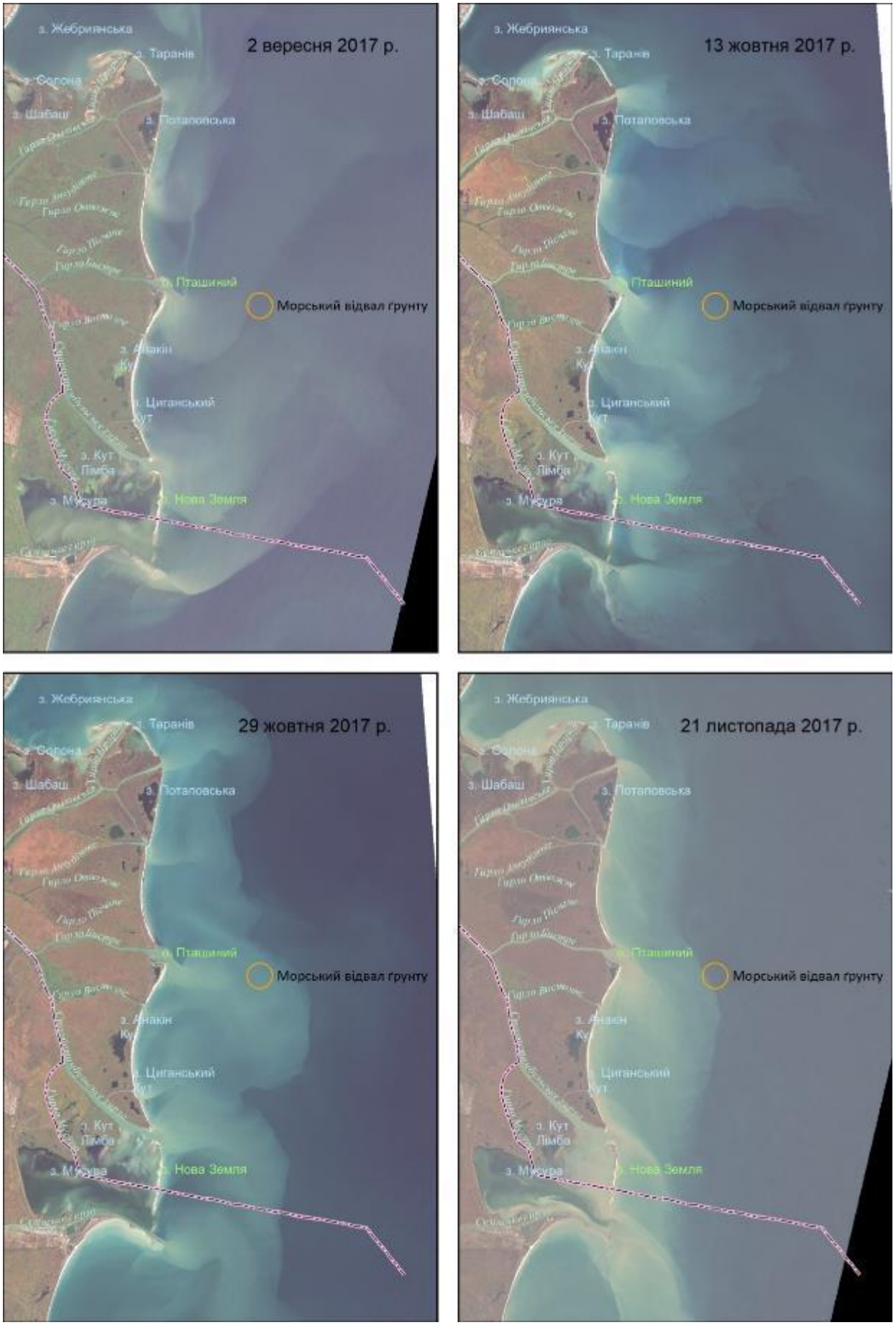


Figure 6.4 - Dynamics of channel processes and suspended solids distribution in the delta of the Danube and at the coastal part of the Black Sea in 2017

7. Monitoring of the marine soil dump under the conditions of operation of the Danube - Black Sea DWNC (CHERNOMORNDIPROEKT)

In the reporting period, specialists of the CHERNOMORNIIPROEKT calculated the compensation payments for the water environment pollution in the 3rd quarter of 2017.

Sandy-muddy soils, which are being excavated along the route of the DWNC in the marine area, according to research materials of 2016-2017 years, can be considered as mainly the A-II class by their chemical properties.

To calculate the losses, there were used the averaged data of 2017 that were received by the IMB during the field monitoring surveys in the area of DWNC dredging.

For calculating of the losses incurred by the aquatic environment, the averaged indicators are used: the content of the suspension-forming fraction is 13.09% and the density is 1.6 t/m^3.

Calculation of the loss for the estimated planned volume

For the convenience of calculating of the aquatic environment losses, the assessment of the work is carried out for the planned volume of work.

CONCLUSIONS

"Complex environmental monitoring program for the Danube-Black Sea Deep-Water Navigation Canal operation in 2017-2018. The Sea Approach Canal zone" has been fully implemented in all directions.

The program of hydrological monitoring in the reporting period is fully implemented, planned series of sampling and measurements were carried out. Data is processed. A detailed analysis will be presented in the final report.

Monitoring of plant and animal communities of the coastline and flowing of the Danube Biosphere Reserve (DBR) during exploitation of the Danube - Black Sea DWNC was conducted in accordance with the terms of reference and programs. In 2017, according to generally accepted methods, field expeditionary surveys were conducted and botanical, ichthyological, herpetological and ornithological materials on the territory of the DBR (district of Bystre, coastal area, Ermakov Island) were collected. Climatic features of the year were the most significant factor that influenced the development of plant and animal groups of DBR. A detailed description of the biosphere reserve ecosystems will be provided in the final report.

The Danube herring, as in previous years, was the most important of the Danube fishery objects. The catch of other fish species in its background is negligible. As a result of fishing conducted during the reporting period by drift nets, there were identified a young growth of such rare fish species as the beluga, sevruga and sterlet.

Studies have shown that the area of the northwestern part of the Black Sea, adjacent to the area of the marine soil dump, remains highly productive. The state of the industrial fish stocks in the north-western part of the Black Sea depends on the preserving the existing ichthiocomplex.

To assess the present state of the marine soil dump area and the possibility of its further use, an analysis of the depths and the calculation of the residual soil content on the loading blocks and on all dump, as well as a comparative analysis of the depths and residual soil was carried, based on measurements conducted 02.08.2016 and 04.08.2017.

The calculation results showed that the residual soil content in general for the soil dump decreased from 7,075,810 m^3 in 2016 to 6,823,643 m^3 in 2017, i.e. by 252,167 m^3. During this time, 339,131.14 m^3 of dredging soil was stored. The final soil content of the soil dump mainly depends on volumes of stored dredging soil and soil consolidation processes. The first lead to the decrease and the second - to the increase of the final soil content. As a result of the soil consolidation an additional soil content of the marine soil sump growing up be 92,700.5 m^3 (the area of negative deformation multiplied by the thickness of the consolidated soil).

According to results of geomorphological conditions analysis of marine soil dump area, we can make a conclusion about further use of loading blocks №№ I, II, III, IV and the expediency of temporary cessation of the use of the central part of block V, northeastern part of block VI and the southern part of block VII.

The experience of the operation of the dump during the implementation of the "Complex environmental monitoring for the Danube-Black Sea Deep-Water Navigation Canal resumption and operation" shows the absence of environmental impacts outside the predicted scope.

Calculations of compensatory payments were made based on the data of the field observations carried out in the framework of environmental monitoring at sections of conducting hydraulic engineering works on the SAC and marine soil dump. In the third quarter of 2017, the amount of the aquatic environment pollution charge was UAH 23,753.97, and the amount of compensatory payments for the impact on fish resources was UAH 5,770, in total - UAH 29,523.97.

According to preliminary results of monitoring work, there have been identified no significant impact of the Danube - Black Sea DWNC exploitation and the work on supporting of the SAC passport characteristics to the Ukrainian part of the Danube Delta, as well as no transboundary impact of the marine soil dump, the excavation and storage of bottom sediments.

Thus, monitoring studies conducted in 2017 indicate that there is no significant transboundary impact.