CONTRACT TITLE: Study on the ecological status of the waters of Lake Vaya and providing trainers on environmental protection
REF: RD-02-29-71/ 20.03.2017-S-1

Final Report

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Rector (contractor)

Dec 14, 2018

According to the Technical offer the services provided by the tenderer on the basis of contracting authority's enquiry in the Part A, Point 2, the current Report covers the following components:

A. **Study on the quality of waters in Vaya lake**

- The activities include monthly water quality analysis at Lake Vaya at three sampling points to obtain data to compare regional differences in water quality in Vaya and Gala lakes.
- Study is aimed at detecting pollutants of a chemical and biological nature, identifying trends in water quality, and determining the degree of influence of nature of pollutants on biodiversity and the possible use of waters for recreational purposes.
- The impact of the waters of the Marine Lakes Channel on the ecological characteristics of the water should be studied.
- The study should be conducted on the basis of reliable data from the certified laboratory ensured by the Contractor.
- Monthly samples of water quality in Lake Vaya at three sampling points should be taken for at least 6 months; The water quality is tested for several physical, chemical and biological parameters, listed in the corresponding chapter;

B. ***Participation of two lecturers in two 3-days training one in Enez and one in Burgas***

- Two 3-day trainings on environmental protection, conservation of habitats and biodiversity will be held one in Burgas for exchange of information on preliminary results, methodologies used for the study in each lake, potential challenges faced by experts/sub-contractors and expectations reg. the final outputs and one in Enez for presenting the final results.
- In this regard the Contractor has to ensure the participation of two lecturers in each training one to present the interim and final study results,

and one who is going to present to opportunities for joined actions and cooperation.

- Elaboration of at least 12 presentations.

c. **Reporting**

Elaboration of interim/ final reports to acceptance protocols for elaborated research, conducted trainings, interpretations. Preparation of applications-presentations, agenda, lists of participants, photos and other supporting documents to the final report

Introduction

Burgas Lake Complex comprises 4 lakes and 3 protected areas. It is one of the most important wetlands on the Bulgarian Black Sea coast and a significant wetland for waterfowl. One of these 4 lakes is Burgas Lake or Vaya. It is the biggest natural lake in the country and it is a subject of the current study.

Vaya lake is a shallow coastal lake - an open lime with a weak connection to the sea through a canal. Its depth can reach about 1.3 m. The water of the lake is characterized by salinity with high seasonal fluctuations. The lake shores are overgrown with waterfowl vegetation, mainly reed. In the northwest part there are fishponds (currently nonfunctioning). The lake is surrounded with wet meadows, as well as agricultural lands and pastures.

Burgas lake (Vaya) have been listed as Ramsar site (2003) under the Ramsar Convention and it is of international importance, particularly as a waterfowl habitat. Due to a unique ornithological variety Vaya lake has been declared Ornithological important place (1989) by BirdLife International, Corine site, Protected zone within the meaning of the Biodiversity Act (NATURA 2000 site) and Protected area within the meaning of the Protected Areas Act - Protected Site "Vaya" (1997).

Part of the protected area is the largest natural reservoir in Bulgaria. Burgas Lake or Lake Vaya and its water is distributed between two residential areas of Burgas -

Upper and Lower Ezerovo. The Lake occupies 2,899.9ha, with salty waters of a depth of 1.5m due to its relationship with the Black Sea (it is linked to it via a canal). It not only provides a constant flow of saltwater, but it also provides a saltwater fish lake. The freshwater comes from the rivers of Aytoska, Sandardere and Chukarska that flow in the western part. The lake is separated from the sea with a sandbar where now the industrial zone of Burgas is. In the northeastern part of the lake, it is surrounded by small ponds (marshes that are overgrown with dense marsh vegetation and abandoned fishponds).

Burgas Lake sited at the western coast of Burgas Bay, Black Sea, Bulgaria. The lake is separated from the shore by wide strips of beaches. The wide and very shallow lagoon, into which the Aitoska River and small rivers Synyrdere and Chukarska flow. Length of 9.6 km and a width of 2.5 to 5 km. area—27 km“ the country's largest sea lake. Prior to construction of the canal linking the lake with the sea, in summer its salinity was very much like that of the sea and even exceeded it. After the control locks were built and fresh water from Mandra Lake Storage Reservoir was supplied, in summer, the water and chemical regime of B.L. improved. Carp is common in the lake. It is one of the most productive lakes.

There have been significant changes in lake condition during the last 50-60 years. It is located in close proximity to the Burgas refinery which leads to severe pollution of the lake’s waters in the first years after it was put into operation. The lake bottom is characterized by a very thick sludge layer which is a prerequisite for retaining a number of potentially dangerous substances (such as petroleum products). Shallowing and equalizing of the bottom has been reported which may lead to release of these accumulated in the sludge substances. Another important issue is the disturbed natural connection with the sea leading to a reduction in total and open water as well as a drastic reduction in salinity (from 18‰ in 1958 to 3‰ in 1968). These changes in water quality leads to a change in the type and quantity of fish stocks and thus in both the food base of many waterfowl and lake ecosystem generally.

Another major issue is the strong anthropogenic pressure due to the proximity of the lake to the city, large residential complexes and industrial zones. As a result, both purified and untreated water flow into the lake. On the east coast there is a major road which is another prerequisite for waste disposal. The intensive use of

mineral fertilizers and pesticides over the years in surrounding agricultural lands leads to water pollution and accelerated eutrophication.

Due to the international importance of Vaya Lake it is essential to maintain high water quality. The overall condition of the lake is of great significance to conservation and restoration of natural heritage. In order to fulfill this goal, the project sets activities related to detecting pollutants of a chemical and biological nature, identifying trends in water quality, and determining the degree of influence of nature of pollutants on biodiversity.

Reporting

I. Study on the quality of water in Vaya lake

Activities include monthly water quality analysis at Lake Vaya at three sampling points to obtain data to compare regional differences in water quality in Vaya and Gala lakes. Study is aimed at detecting pollutants of a chemical and biological nature, identifying trends in water quality, and determining the degree of influence of nature of pollutants on biodiversity and the possible use of waters for recreational purposes.

The impact of the waters of the Marine Lakes Channel on the ecological characteristics of the water was under study. The study is conducted on the basis of reliable data from laboratories ensured by the Contractor. Monthly samples of water quality in Lake Vaya at three sampling points are taken within 9 months; the water quality is tested for the following physical, chemical and biological parameters, as follows:

- Total Suspended Solids (TSS)
- Turbidity
- pH

- Dissolved Oxygen
- Electrical conductivity
- BOD_5
- COD
- P-PO4
- Total N
- NO_3 – N
- NH_3 – N
- NO_2 - N
- Phosphorus
- Oil products
- ICP to determine the content of heavy metals (in sediment and water column)
- GC to determine the content of specific organic pollutants (in sediment and water column)
- Chlorophyll A for the determination of phytoplankton
- Microbial number (count)

The sampling points are specifically selected in order to cover all kinds of potential pollution sources. Sampling point 1 (North) is located at the point of discharge of Burgas WWTP effluents. Sampling point 2 (Center) is in close proximity to the lake-sea channel and sampling point 3 (South) is chosen as an area with the lowest anthropogenic pressure. Monthly samples for determination of water quality in Lake Vaya are taken at the three sampling points for period of 9 months. The main results are given in Tables 1-4.

Table 1. Heavy metals, Point 1 - North

				Point 1 - North			
C, ppb	July.17	aug.17	sept.17	oct.17	Jan.18	feb.18	march.18
11 B		400,828	383,162		242,034	215,882	23,453
27 Al		9,473	319,086	*	105,719	187,997	40,724
28 Si		10856,036	15191,123		13690,729	13871,115	3551,817
31 P		158,361	260,142	74,267	133,033	83,919	57,696
52 Cr		*	20,952	1,089	104,069	33,026	*
55 Mn		2,967	25,722	8,642	17,612	13,298	3,364
57 Fe		141,793	506,681	219,875	1456,411	738,881	93,241
58 Ni		4,287	32,743	3,908	91,488	43,327	*
59 Co		*	1,941	0,964	4,302	1,594	*
60 Ni				4,233	155,940	52,335	*
63 Cu				6,785	23,252	16,308	20,683
64 Zn		11,258	52,634	2,419	21,129	18,141	30,356
65 Cu		3,390	39,499	1,464	20,097	14,083	18,385
75 As		13,453	25,041	5,887	3,437	3,683	2,606
78Se					0,983	0,758	0,618
82 Se				6,598	3,161	3,151	1,679
111 Cd				0,156	0,200	0,093	0,053
112 Cd		0,282	1,909	0,176	0,223	0,114	0,233
133 Cs				0,020	0,091	0,070	*
137 Ba				30,772	34,843	35,675	24,531
138 Ba		35,067	19,851	18,549	28,247	26,833	25,900
208 Pb		2,305	15,498	0,391	3,534	0,636	0,563

* below the limit of quantification

Table 2. Heavy metals, Point 2 Center

C, ppb	July.17	aug.17	sept.17	oct.17	Jan.18	feb.18	march.18
11 B	314,351	286,522	361,015		212,105	228,295	12,421
27 Al	8,126	25,977	313,351	*	111,629	279,497	92,966
28 Si	9800,397	7437,643	13991,310		14898,469	15537,019	3718,760
31 P	209,559	105,174	313,016	83,257	125,145	146,505	108,378
52 Cr	*	38,612	14,530	0,669	90,922	119,813	*
55 Mn	2,051	6,721	32,361	6,843	20,590	24,663	18,097
57 Fe	106,147	229,769	489,842	207,408	1340,119	1544,475	156,217
58 Ni	3,883	28,893	20,221	7,829	80,511	75,394	*
59 Co	*	*	1,749	0,966	3,864	4,731	0,017
60 Ni				8,251	137,201	166,037	*
63 Cu				7,485	24,526	17,320	16,043
64 Zn	18,989	15,623	36,964	5,243	19,044	10,250	26,228
65 Cu	6,115	5,420	31,343	2,662	21,467	14,228	14,411
75 As	8,702	8,558	19,844	6,180	3,946	3,662	2,648
78Se					0,863	1,578	0,995
82 Se				6,415	3,286	3,137	1,777
111 Cd				0,490	0,160	0,121	0,035
112 Cd	0,607	0,601	0,466	0,509	0,171	0,123	0,233
133 Cs				0,022	0,077	0,071	*
137 Ba				32,030	35,962	48,311	22,271
138 Ba	17,088	32,489	19,504	19,019	35,682	30,416	23,191
208 Pb	1,139	1,332	3,736	0,682	1,356	0,376	0,284

* below the limit of quantification

Table 3. Heavy metals, Point 3 - South

C, ppb	August 2018	February 2018	March 2018
11 B	388,811	235,925	34,081
27 Al	9,968	439,962	93,762
28 Si	10487,434	17213,109	3849,295
31 P	164,321	175,151	79,040
52 Cr	*	94,867	*
55 Mn	3,294	22,919	14,723
57 Fe	163,741	1338,987	170,005
58 Ni	6,017	74,679	*
59 Co	*	4,066	0,049
60 Ni		135,040	*
63 Cu		19,373	12,717
64 Zn	15,352	14,481	24,973
65 Cu	5,107	15,974	10,784
75 As	12,661	4,300	2,568
78Se		2,198	1,085
82 Se		3,117	1,599
111 Cd		0,127	0,069
112 Cd	0,410	0,133	0,253
133 Cs		0,087	*
137 Ba		51,971	21,741
138 Ba	37,620	33,105	22,253
208 Pb	3,463	0,459	0,347

* below the limit of quantification

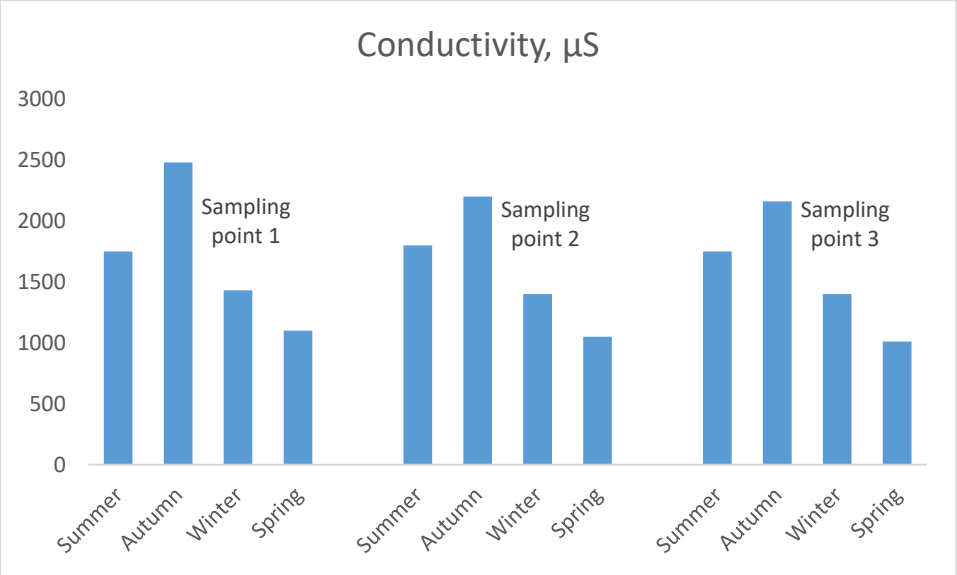
Table 4. pH, TSS, Conductivity, organic matter, nutrients, chlorophyll and microbialcells (CFU)

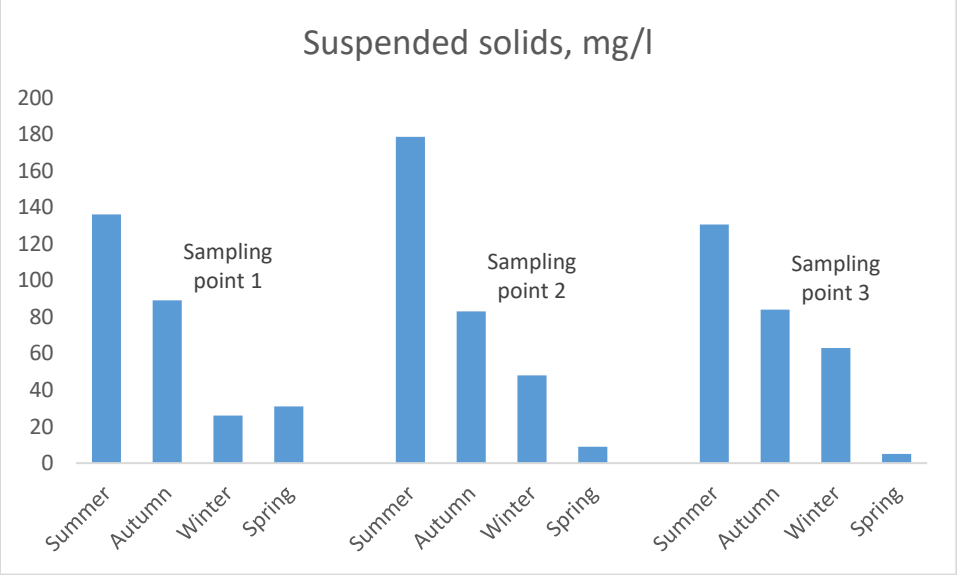
1 - North
2 - Center
3 -South

	July.17	aug.17			sept.17			oct.17
		1	2	3	1	2	3	1
TSS, mg/dm3	37	43	154	53	229	203	208	204
pH	8,15	8,24	8,28	8,31	7,43	7,45	7,47	8,81
Saturated oxyden, mg/dm3	6,24	6,72	5,92	5,85	4,77	5,81	5,11	11,07
Conductivity, µS	1453	1427	1573	1429	2087	2073	2076	2700
BOD, mg/dm3	8	43	49	44	23	22	24	15
COD, mg/dm3	73,8	98,3	111	106	152,4	154,8	156,2	123,2
P-PO4, mg/dm3	0,049	0,06	0,078	0,015	0,298	0,173	0,31	0,158
N-NO2, mg/dm3	0,112	0,127	0,143	0,138	0,192	0,179	0,198	0,149
N-NO3, mg/dm3	0,256	0,376	0,319	0,367	0,521	0,423	0,534	0,28
N-NH4, mg/dm3	0,532	0,574	0,957	0,739	2,066	2,239	1,98	0,68
Total N, mg/dm3	0,898	1,073	1,422	1,245	2,783	2,842	2,712	1,11
Concentration of microbial cells, CFU/cm3		1 103	4 103	6 103	3.2 103	2.5 103	5 103	1.4 103

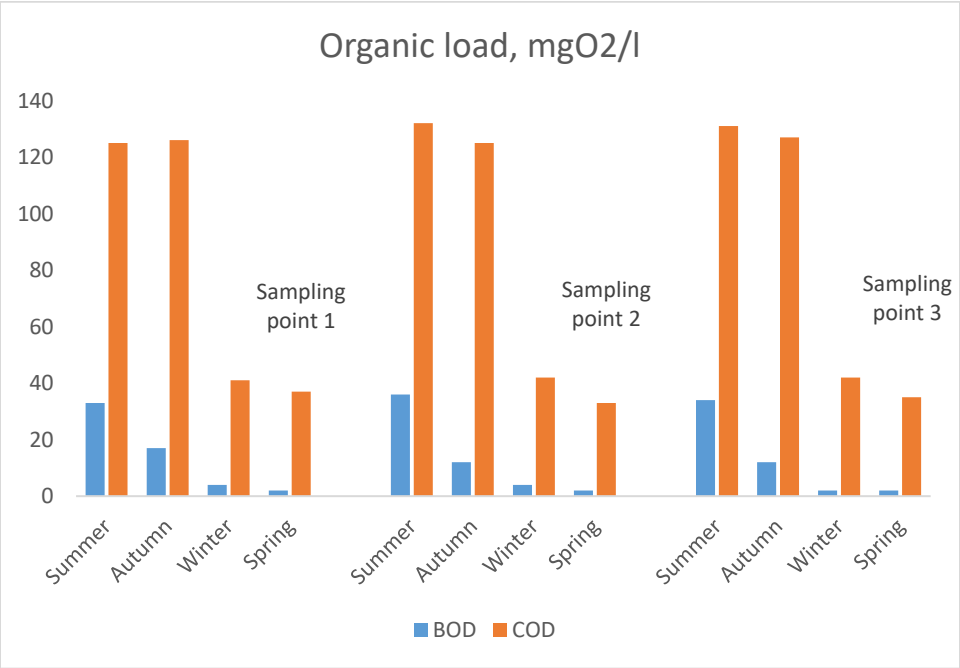
ное.17			дек.17			яну.18			фев.18			мар.18			апр.18		
1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
49	62	30	15	29	20	38	84	68	14	12	58	34	8	2	28	10	8
8,11	8,38	8,47	8,13	8,14	8,08	7,95	8,09	8,02	7,94	8,04	7,97	8,75	8,24	8,16	8,75	9,02	9
9,34	9,46	10	10,64	10,29	10,09	11,49	11,4	11,23	10,92	10,86	10,8	11,15	9,07	10,81	9,79	10,66	9,73
3110	2150	2170	1640	1649	1615	1496	1482	1487	1357	1372	1381	1182	1127	1053	1017	971	969
33	36	29	3	1	4	2	3	2	3	4	2						
224	228	224	32,2	28,8	36,8	45,2	44,7	45,8	38,2	39,4	38,7	42,1	37,2	36	33,5	29	34,7
0,173	0,244	0,155	0,140	0,131	0,193	0,167	0,176	0,169	0,104	0,131	0,104	0,070	0,099	0,092	0,038	0,008	0,031
0,226	0,223	0,086	0,075	0,064	0,082	0,057	0,059	0,062	0,044	0,065	0,094	0,037	0,063	0,044	0,054	0,03	0,043
0,595	0,582	0,611	1,25	1,05	1,35	0,385	0,331	0,394	1,09	1,12	1,16	1,09	1,01	1,06	0,176	0,141	0,153
1,114	0,963	0,854	1,242	0,947	1,034	1,501	1,501	1,426	1,077	1,060	1,129	1,008	0,549	0,558	0,523	0,238	0,333
1,935	1,768	1,551	2,565	2,064	2,462	1,942	1,89	1,882	2,211	2,245	2,383	2,135	1,622	1,622	0,753	0,409	0,529
$4.6\ 10^4$	$3.98\ 10^4$	$1.74\ 10^4$	$2.03\ 10^3$	$2.3\ 10^3$	$3.2\ 10^3$	$3.4\ 10^3$	$1.26\ 10^4$	$1.03\ 10^4$	$1.3\ 10^3$	$1.1\ 10^3$	$1\ 10^2$	$8.6\ 10^3$	$1\ 10^4$	$1.06\ 10^4$	$5\ 10^2$	$2.5\ 10^3$	$1.3\ 10^3$

Generally, there were no significant differences of the measured parameters of the three test points. As expected in summer and autumn there is a higher salt content of water (presented as conductivity) which decreases in winter and spring. This process can be explained by the concentration of suspended solids in the water (with the same profile).

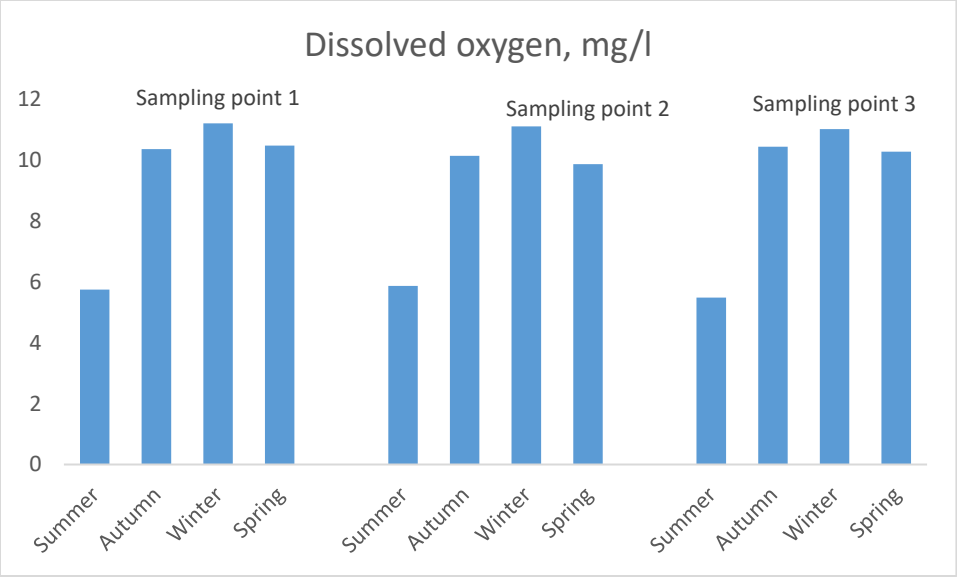


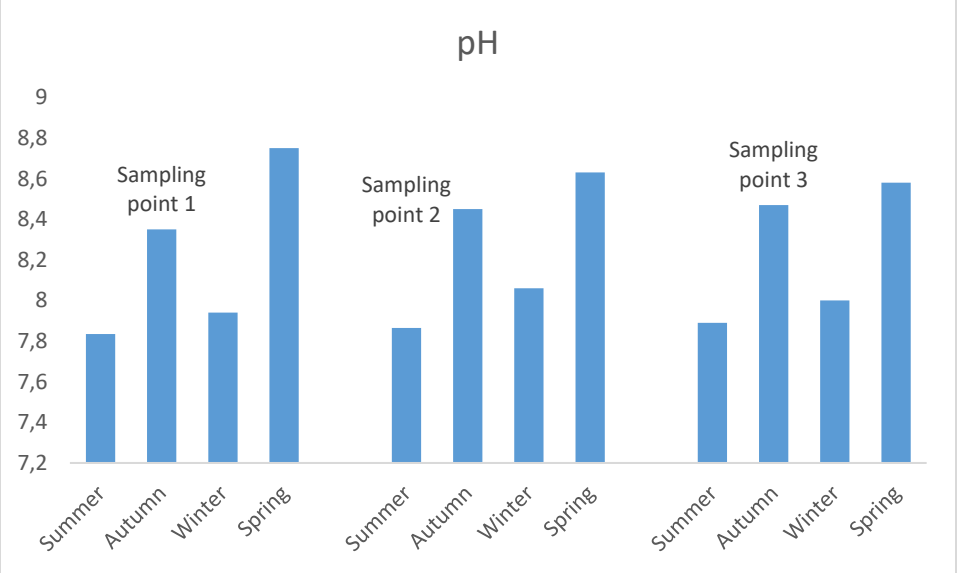


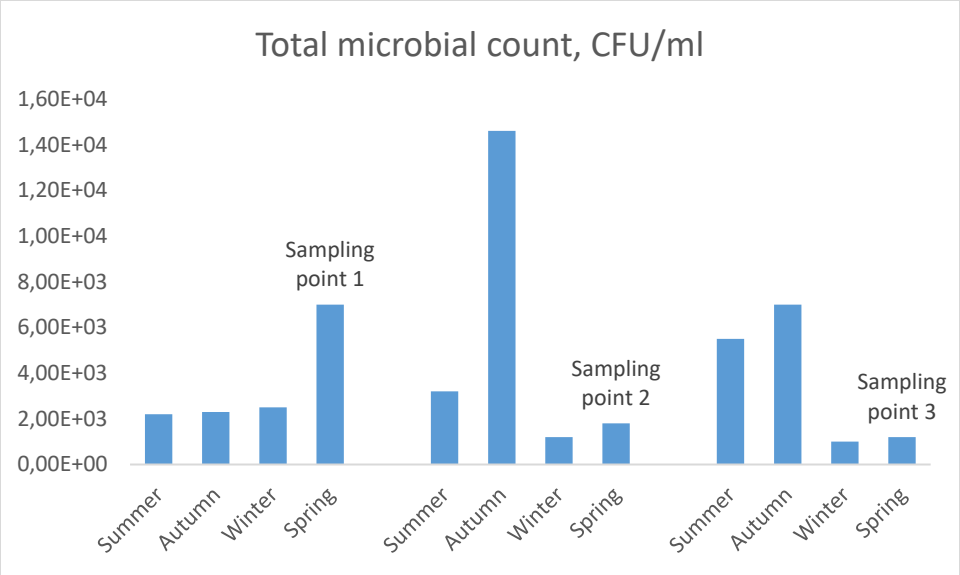
The decrease observed in the cold months is due to increased rainfall, reduction in sunshine, ion content and nutrients in the water, which is confirmed by the BOD and COD values (again higher in the summer and autumn and lower in winter and spring). These data are a clear indicator of the ability of lake to self-clean.



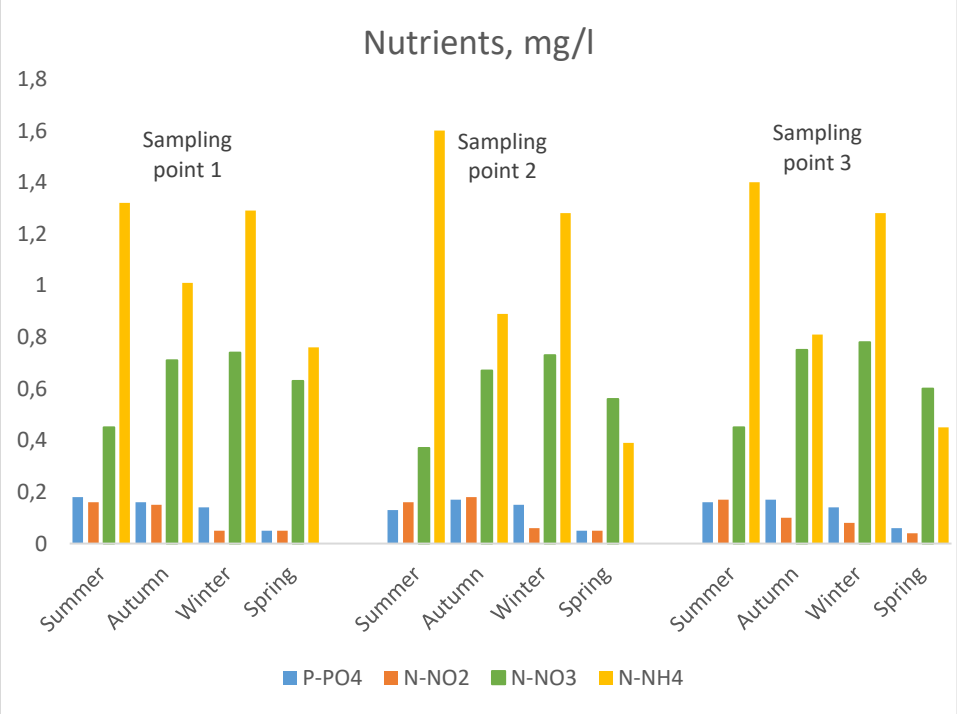
The same profile is observed with dissolved oxygen, which increases with lowering of temperature. The measured pH is within the optimum limit for water bodies. Increased local microbial concentration has been reported in late autumn. We tend to conclude that it is not a result from ongoing processes and it may be an analysis misdoing at this exact sampling point.


Dissolved oxygen, mg/l
12
10
8
6
4
2
0
Sampling point 1
Sampling point 2
Sampling point 3
Summer
Autumn
Winter
Spring


pH
9
8,8
8,6
8,4
8,2
8
7,8
7,6
7,4
7,2
Sampling point 1
Sampling point 2
Sampling point 3
Summer
Autumn
Winter
Spring



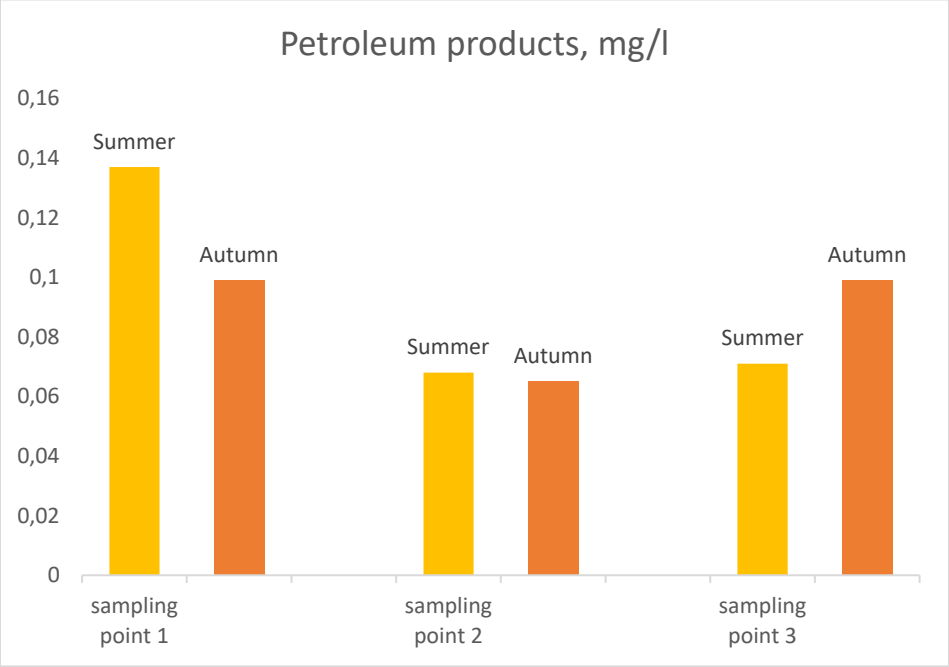
The ratio of the measured forms of nitrogen (nitrite, nitrate and ammonia) shows decaying and natural processes as well as complete nitrification of the water basin. The low nitrate values indicate limited anthropogenic pressure in regard to this indicator. This means that the fertilization of agricultural lands is not that intense and does not lead to environmental pollution.



The total nitrogen content varies depending on the season. The same applies to the amount of phosphorus reported which profile indicates human activity. Migrating birds also have a share in the high phosphorus values due to their rich in phosphorus guano (the migration period corresponds with an increase in the measured phosphorus contend).

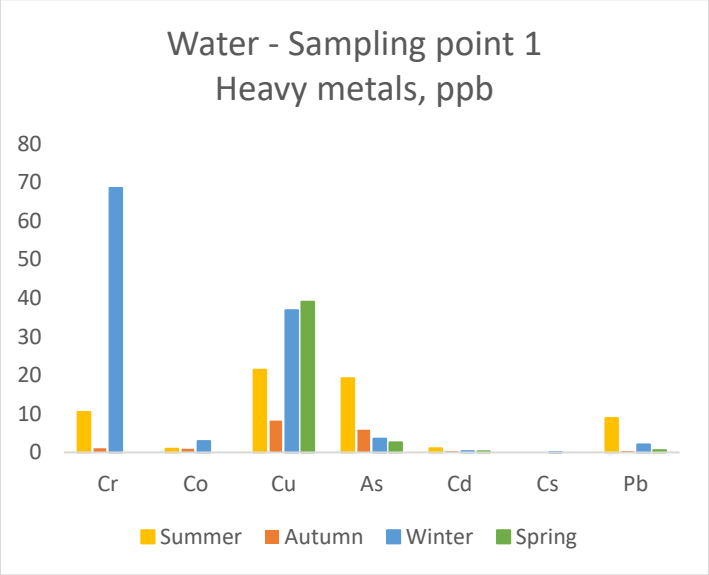
The measured chlorophyll values are within the upper limits, indicating a risk of eutrophication. Low concentrations of petroleum products were established and confirmed by an external accredited laboratory.

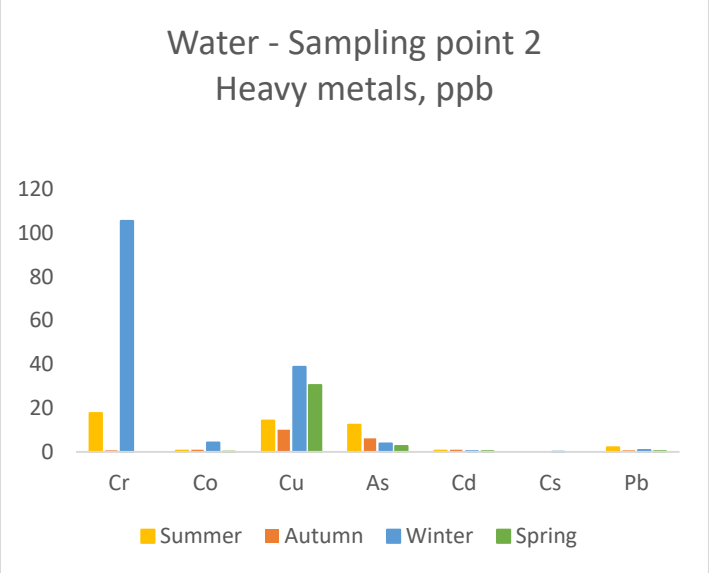
Surprisingly, because the closeness of the lake to the Petrochemical industry along Burgas, the concentrations of petroleum products were found to be very low in all seasons, 0.07 – 0.014 mg/l.

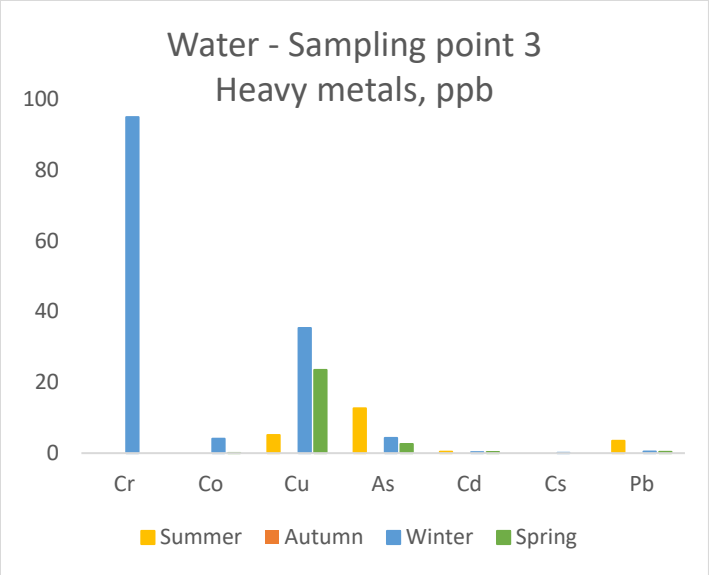


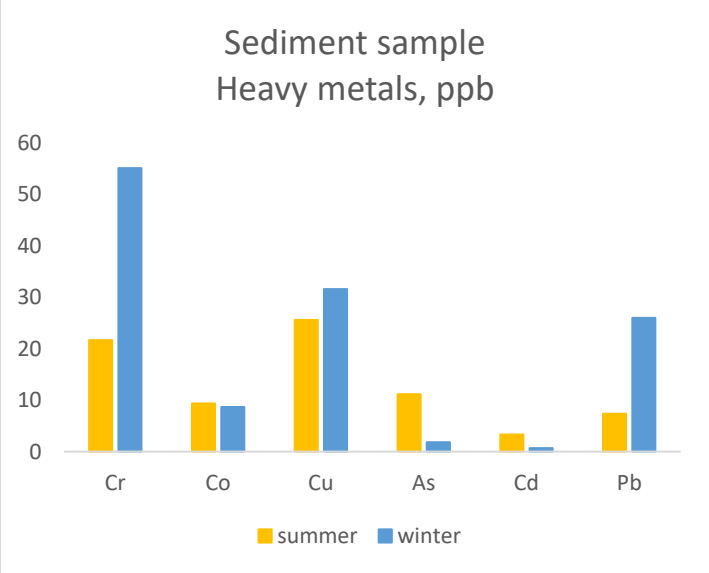
The content of heavy metals was determined both in liquid and sediment samples. As the heavy metals are toxic and at higher levels pose health risk, it is necessary to study their quantitative changes of their presence in Burgas lake water and sediments. Therefore, the purpose of the present work is to observe the changes of heavy metals content within the period of study. The data

obtained show an background concentration of all heavy metals studied within 5-40 ppb, with one exclusion for Chromium which reaches in levels above 100 ppb. In all samples the base line concentrations are below the permissible level.






Water - Sampling point 3
Heavy metals, ppb
100
80
60
40
20
0
Cr
Co
Cu
As
Cd
Cs
Pb
Summer
Autumn
Winter
Spring


Sediment sample
Heavy metals, ppb
60
50
40
30
20
10
0
Cr
Co
Cu
As
Cd
Pb
summer
winter

Discussion related to the results obtained

As it was mentioned in the chapter above the sampling points were selected in order to cover the potential pollution changes in all area of the lake and the main sources of pollution, namely Burgas WWTP (Sampling point 1 North); the sea channel (Sampling point 2 Center) and the area of lowest anthropogenic pressure , point 3 South). Based on the monthly samples for determination of water quality in Lake Vaya taken in a period of 9 months it was found that the measured parameters in the three points of sampling do not differ significantly, so, the water constituents are more or less equal in all lake's sites. This could be accepted as a proof that there is no momentum high ecological pressure from a single source of pollution.

Regarding the single water quality parameters, the following discussion can be made:

<u>Water salinity</u>

As it could be expected the salinity in summer and autumn is higher (shown by the conductivity measurements) and corresponding decrease in winter and spring base on the higher evaporation during the warm months. The decrease observed in the cold months is due to increased rainfall, reduction in sunshine, ion content and nutrients in the water, which is confirmed by the BOD and COD values (again higher in the summer and autumn and lower in winter and spring).

<u>Total suspended solids</u>

The data obtained for the fluctuation of TSS (total suspended solids) can be explained by the higher extent of diffusion during the summer/autumn time bringing some suspended solids of organic and inorganic nature from the bottom to the upper layer.

<u>Dissolved oxygen (DO)</u>

The view about DO is very typical as it increases with lowering of temperature. Besides the level in summer period, the DO observed is quite high with values exceeded 9 mg/l. Such results show that the processes as aerobic assimilation and

nitrification (O2 consuming processes) are not governing the whole self-cleaning process of Burgas Lake. The stable values for pH are also an evidence for a slow going biological nitrification.

Organic matter content

The measured values of BOD and COD show very high distinction for the cold and warm periods. In summer time the BOD and COD values are high which can be attributed to larger effects of diffusion and turbulence of the bottom sludge during this period. Obviously, higher TSS leads to high values of dissolved organic matter.

Nutrient content

The content of P is in the range of 0.1-0.2 mg/l without high deviation through the period of the study. The level of measured forms of nitrogen (nitrite, nitrate and ammonia) shows very low content of all species and almost complete nitrification of ammonia. As it was mentioned above the low level of nitrates is an indication of limited anthropogenic pressure both from human activities and fertilization of agricultural lands around Lake Burgas.

Heavy metals

The metal contend in both types of samples, in water and in sediments, correspond to the emission limits according to Ordinance №6/9.11.2000 for permissible standards for the permissible content of harmful and dangerous substances in waste waters discharged into water bodies. However, the values are close to the requirements set in Ordinance №4/14.09.2012 for the characterization of surface water. We tend to say that this may be a result from the massive lake pollution from the late ’60 to the early ’80. Despite the fact that the lake has not been fully recovered from that damage the measured values of metals and petroleum products, as said above, are within the emission limits according to Ordinance №6 and there is no immediate harm for the aquatic flora and fauna of the lake.

As a Lake, Vaya water quality is preset in Ordinance №4 by Bulgarian Ministry of Environment and Water. All measured values are interpreted according the respective regulation and in respect with the observed data a good condition of the lake is reported. The ongoing processes follow the natural circle and the processes of self-purification are sufficient to maintain its ecological state. (Data presented with a color code: yellow for summer, orange for autumn, blue for winter, green for spring).

Parameters/ Condition	Dis. O_2, mg/l	pH	Cond. µS/sm	N-NH_4, mg/l	N-NO_3, mg/l	N-NO_2, mg/l	Tot. N, mg/l	P-orto PO_4, mg/l	P-Tot, mg/l	BOD_5, mg/l
Excellent	9-7	-	650	<0.1	<0.8	<0.03	<0.7	0.01-0.025	<0.025	<2
Good	7-6	6.5-8.7	750	0.1-0.3	0.8-2	0.03-0.06	0.7-2.5	0.025-0.06	0.025-0.075	2-4
Moderate	<6	-	>750	>0.3	>2	>0.06	>2.5	>0.06	>0.075	>4

Parameters/ Condition	Dis. O_2, mg/l	pH	Cond. µS/sm	N-NH_4, mg/l	N-NO_3, mg/l	N-NO_2, mg/l	Tot. N, mg/l	P-orto PO_4, mg/l	P-Tot, mg/l	BOD_5, mg/l
Excellent	9-7	-	650	<0.1	<0.8	<0.03	<0.7	0.01-0.025	<0.025	<2
Good	7-6	6.5-8.7	750	0.1-0.3	0.8-2	0.03-0.06	0.7-2.5	0.025-0.06	0.025-0.075	2-4
Moderate	<6	-	>750	>0.3	>2	>0.06	>2.5	>0.06	>0.075	>4

Parameters/ Condition	Dis. O_2, mg/l	pH	Cond. µS/sm	N-NH_4, mg/l	N-NO_3, mg/l	N-NO_2, mg/l	Tot. N, mg/l	P-orto PO_4, mg/l	P-Tot, mg/l	BOD_5, mg/l
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Moderate	<6	-	>750	>0.3	>2	>0.06	>2.5	>0.06	>0.075	>4

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Moderate	<6	-	>750	>0.3	>2	>0.06	>2.5	>0.06	>0.075	>4

Conclusions

Vaya Lake as shallow brackish coastal lake has an open firth with a small connection to the sea and with fringe vegetation along the banks. It is connected to the sea through a channel with a sluice, whose cleaning in recent years has been one of the most important challenges for the normal functioning of the lake. The channel carries fresh water from the sea which is of vital importance and with it many nutrients and sea creatures into the otherwise largely freshwater lake.

The open water area predominates in the lake and in some places it is 1.3 m deep. The shores are covered with a strip of fringe vegetation, mainly reed and bulrush, which in the western and northwestern parts form large massifs.

Burgas Lake is a part of the Burgas lakes complex – one of the three most significant wetland complexes for the gathering water birds on the Bulgarian Black Sea coast. In the area of the lake there are 245 bird species, 71 of which are included in the Red Book of Bulgaria. 105 of all the species occurring here are of European conservation importance. 9 of them are globally endangered species. The area provides suitable habitats for 89 species included in Annex 2 of the Law on Biological Diversity which require special protection measures. Since the lake is on the migratory route Via Pontica, it is one of the most important stations in bird migration along the Bulgarian Black Sea coast. Particularly numerous are pelicans, geese, shorebirds and herons. The lake is particularly important as a resting place during passage for the Dalmatian pelicans and the pink pelicans, as well as for the pygmy cormorants. There are years when Vaya Lake hosts over 20 000 pelicans resting on their migration route. The globally endangered corncrake has also been seen as a migratory species in this area.

Burgas Lake is of international importance for the wintering of a significant number of water birds, mainly little cormorants, great cormorants, whooper swans, white-fronted geese, pochard duck and tufted ducks. Burgas Lake is the only place in Bulgaria where up to 7% of the Black Sea population of white-headed ducks gathers. In winter you can see here the globally endangered

Dalmatian pelican and red-breasted goose. The lake is one of the most important places in the European Union for the preservation of the little bittern which nests here.

The lake is subjected to high anthropogenic pressure due to its proximity to the densely populated city of Burgas, large industrial facilities and complexes, as well as the unrestricted and unsupervised access of people to areas outside the protected areas. Burgas Lake is affected by all human activities which may lead to a change of the water regime or water quality of the wetland. It is also affected by the accelerating development of the city. In former years the lake was contaminated with petroleum products, phenols and other chemicals from the nearby oil refinery. The intensive use of pesticides and fertilizers in the surrounding agricultural land lead to pollution and accelerated eutrophication of the water basin. In recent years there has been an increase in the amount of disposed waste and the cleaning activities in the city. Construction and domestic waste has illegally been disposed of in many places around the lake, especially on its northern shores. The water basins in the northeastern part of the lake are filled with dirt and at this stage 80% of them are almost entirely destroyed.

Wastewater from the northern and southern industrial areas of the city flows into the lake after passing through a treatment plant. Significant amounts of wastewater flow into the lake from the villages of Gorno and Dolno Ezerovo, as well as from some enterprises in Burgas. The changes in water quality lead to changes in the type and quantity of fish stocks and thus of the food base of a large number of water birds. The areas around the lake are being polluted and are continuously being built up. The channel connecting the lake with the sea is almost entirely silted and free passage of fish through it is very limited. The international road leading to the southern state border along the east coast contributes to the waste and causes noise pollution.

On the other hand, Vaya offers a good opportunity for the residents of Burgas, when leaving their homes to find themselves among, to some extent, wild nature, to be able to explore it, to use its resources and to enjoy it. Along the shores of the lake there are popular and well-established places for fishing, which attract

fishermen. Burgas Lake is a place of interest for photographers who are attracted by the rare and interesting species of birds. In the very near future, as part of the project "Life for Burgas Lakes" of the Bulgarian Society for the Protection of Birds, the pier near the former farm yard in Dolno Ezerovo will be rebuilt. This will provide an opportunity for boat trips and bird watching directly from the lake.

Vaya Lake is a liman and recently it is mixooligohaline with fluctuating halinity due to a siltated channel connection with the Black Sea. The lake is located on the 'Via Pontica' ornithological migratory route and is important for the conservation of rare and endangered species of national, European and global significance. The lake is a Ramsar site, a protected area and Natura 2000 site, included as critically endangered in the Red List of Bulgarian Wetlands. During the last decades Vaya has undergone significant changes due to different anthropogenic factors, which disturb the water balance of the lake and lead to introduction of biogenic elements in the wetland with a negative effect on the chemical composition of the water with impacts on the flora and fauna of the aquatic ecosystem.

Even the high anthropogenic pressure on the lake, the results obtained show an improved characteristic of lake water studied in respect of nutrients, organic matter content (BOD and COD) and petroleum products. It is a good prerequisite for further water quality improvement based on the opening the sea-lake channel, which cleaning in the last year has been one of the most important challenges for the normal functioning of Burgas Lake.

Still, there are efforts to be made and measures to be taken to minimize or even completely eliminate anthropogenic pressure in the future. Good indicator for going on this path is the obtained results after the cleaning of the lake-sea canal. In order to observe the effect of this action in full extent a longer period is needed – more than a year. Nevertheless, simultaneously with the process of cleaning of the canal were taken samples for analysis and there is significant change and progress in some water parameters. The results show (the Table below) that at the end of the summer of 2018 the concentration of dissolved is increased 1.9 times, i.e. the O2 consumption is considerably decreased. Evidently, it shows indirectly a low organic matter load of the lake. The later can be attributed to the

fresh sea water coming through the channel. In addition a decrease of measured values of nitrite-nitrogen by 3.2 times, nitrate-nitrogen by 31.4 times and total nitrogen by 2.21 times is observed. These results can be explained by the positive influence of cleaning/opening of the channel to the Burgas bay Black sea water.

Month / Parameter	March'18	August'18
Dissolved oxygen, mg/l	5.34	10.18
Nitrite nitrogen, mg/l	0.035	0.011
Nitrate nitrogen, mg/l	0.817	0.026
Total nitrogen, mg/l	0.925	0.418

Further Environmental Impact

The cleaning of the lake-sea canal and restoration of lake-sea connection is expected to have further beneficial impact on the environmental conditions of Lake Vaya. The above measures undertaken by the Burgas Governmental authorities could have favorable effects are expected to lead to the following effects:

- ✓ Normalization of the hydrological regime of the lake and gradual restoration of water salinity to the natural state of the lake as dated in 1960's;
- ✓ Restoration / improvement of the habitat of the inhabitants of the lake;
- ✓ A positive change of the species and quantity of the fish stocks resulting in enrichment of food base of many water fowls;
- ✓ Restoration of the usual fauna and respectively increasing and improving the lake biodiversity;
- ✓ Restoration of the natural state of the lake.

II. Participation in two trainings on environment protection

Two 3-day trainings on environmental protection, conservation of habitats and biodiversity were organised. The training held in Burgas (9-11. Oct. 2017) includes exchange of information on preliminary results, methodologies used for the study in each lake, potential challenges faced by experts/sub-contractors and stakeholders. The event Agenda is attached as an Annex. In addition a WORKSHOP was carried out on 7-8 Oct. 2017 about the activities related on environmental protection, conservation of habitats and biodiversity Vaya Lake, district Burgas, Bulgaria and Gala Lake District Enez, Turkey in the frames of project "Measures for conservation and restoration of natural heritage in Burgas and Enez" (*MoreCare*), CB005.12.1.115. The corresponding agenda is given in an Annex.

The following reports (12) have been presented at the training held in Burgas (9-11. Oct. 2017):

Доклади (Д)

Д1.Цели, обхват и теми на обучението - Проф. В. Ненов

Д2. Езерото ВАЯ и влажните зони в област Бургас – обща информация и характеристика – доц.д-р Х. Йеменджиев

Д3.Стратегии за мониторинг и оценка на качеството на водите – Проф.В. Ненов

Открита дискусия и представяне на специфични примери Open discussion and specific case studies - всички участници

Д4. Природен статус на ез. Вая. Отговорни ведомства и екологично състояние на езерото – инж.Т.Манолова, РИОСВ

Д5. Езеро Вая като част от екологичната мрежа Натура 2000 – инж.М. Ярмова, РИОСВ

Д6. Влияние на туризма върху състоянието на околната среда и водните екосистеми – Маг.С. Енилова, БРТА

Д7.Процеси на масопренасяне в езерата – г. ас д-р И. Чобанов

Д8. Оценка на екосистемните характеристики и биологичното разнообразие – доц.Х. Йеменджиев

Д8. Дейност, практики и резултати от мониторинга на околната среда в РИОСВ – Бургас – д-р Т. Михалев Изпълнителя Агенция, МОСВ

Д9. Доклад на резултати от мониторинг на езеро Вая в летния период на 2017-та година – Проф.В. Ненов

Открита дискусия и представяне на специфични примери - всички участници

Д10. Оценка и моделиране на поддържащия капацитет и потенциала за развитие на аквакултури – доц. Х. Йеменджиев

Д11. Методи за оценка на риска от наводнения. Източници на информация, обработка на данните и приложение на Географски информационни системи (ГИС) – доц. Х. Йеменджиев

Д12. Биогенно замърсяване на влажните зони и черноморско крайбрежие в регион Бургас – проблеми и превенция –Проф. В. Ненов

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