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INCDDD

Joint Operational Programme "BLACK SEA BASIN 2007-2013"

Project: **INNOVATIVE INSTRUMENTS FOR ENVIRONMENTAL ANALYSIS IN NORTH WESTERN BLACK SEA BASIN (BLACK SEA e-EYE)**
Cod proiect: **MIS-ETC No 1475**

GA1: Monitoring physical-chemical and biological parameters of surface aquatic systems in North-Western Black Sea Basin

Research initiative 3

Results (historic data and actual data) (Danube delta)

Danube Delta National Institute for research and Development (DDNITL Partner 1)

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Tulcea, Romania
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CONTENT

Introduction

Historically water quality was usually assessed on the basis of physical-chemical parameters but since 1990 much greater emphasis has been placed on biological criteria of quality. The EU Water Framework Directive requires principally an ecological assessment of water quality. According to EU Water Framework Directive ecological status is an expression of the quality of the structure and functioning of aquatic ecosystems associated with surface waters. Furthermore, the WFD provides a selection of the most relevant quality elements for the classification of ecological status.

Notwithstanding, the zooplankton are not included in the WFD as a biological quality elements the authors believes that a good picture of the current conditions of ecological status of the Danube Delta lakes can be also derived by looking at zooplankton indicators such as their biomass, abundance and species diversity. One the other hand, has been proved that in the Danube Delta Biosphere Reserve there is a high diversity of the zooplankton species, and the abundance of zooplankton has been responsible to the bottom up and top down control of phytoplankton in Danube Delta lakes (Moss et al. 2003, Török et al. 2008).

Ecological status is defined as an expression of the quality of the structure and functioning of aquatic ecosystems based on the assessment of a series of biological quality elements (BQEs-macroinvertebrats, fish, phytoplankton, macrophytes and phytobentos) and supported by a set of chemical and hydromorphological quality data (Annex V, 2000/60/EC), and efforts are demanded to restore (if needed) the natural waterbodies to at least "good ecological status" within a limited time period. Zooplankton are mentioned in the WFD CIS Monitoring guidance (CIS 2003) as a 'supportive/interpretative parameter' of fish 'often/typically measured or sampled at the same time'.

During the 1950-1970s monitoring of West European lakes mainly focussed on a number of chemical variables, chlorophyll-a (as an indicator of phytoplankton) and sometimes phytoplankton biomass, phytoplankton production and benthic invertebrates (Jeppesen et al. 2011).

In Danube Delta, zooplankton have been routinely sampled since the 1975s (Zinevici and Parpala 2007), and now it is monitored on a regular basis in different Danube Delta National Institute (DDNI) projects.

Zooplankton is considered a good indicator of changes in water quality because the community is strongly influenced by and has a fast response to changes in environmental conditions. The species diversity is strongly dependent on the season (Premazzi and Chiaudani 1992, Tudor 2008).

3. Results (historic data and actual data)

3.1 Physical - chemical indicators

In this chapter are presented the historic and actual data obtained between 2009 – 2013 in 9 representative sampling points.

All the concentrations values are reported to the Romanian Order 161/ 2006 which is the transposed of Water Framework Directive into Romanian Legislation.

The classification into the quality classes was made in accordance with Romanian Order 161/2006, regarding the classification of surface water quality to determine the ecological status of water bodies, Table no. 6, Elements and biological quality standards, chemical and physico-chemical for setting ecological status of surface waters, Annex C, Elements and chemical, physico-chemical quality standards in water.

The results represent the annual average concentrations values, and the variation ranges, between 2009 – 2013, of the indicators took into consideration from 9 sampling points in Danube Delta Biosphere Reserve (Ceatal Chilia, Ceatal Sf. Gheorghe, Periprava, Sulina, Sf. Gheorghe, Fortuna lake, Isac lake, Merhei lake, Rosu lake).

3.1.1. General physical-chemical quality elements (thermal, salinity, oxygenation)

This part of the study summarizes the results of general physical-chemical quality elements in the period 2009-2013. The annual average concentrations values of the general indicators (pH, chloride, calcium and magnesium, sodium, sulphates, filterable residue, anionic surfactants) varied within the normal range and comply with the target values for I (very good ecological status) and II quality class (good ecological status) in all nine sampling points (**Figures 3.1.1.1-3.1.1.8**).

In 2013, values of pH, chloride, magnesium, sulphates and anionic surfactants concentrations show similar slightly decreasing trend; in the same year a slightly increasing values concentrations of calcium, sodium and filterable residue were observed in all nine sampling points.

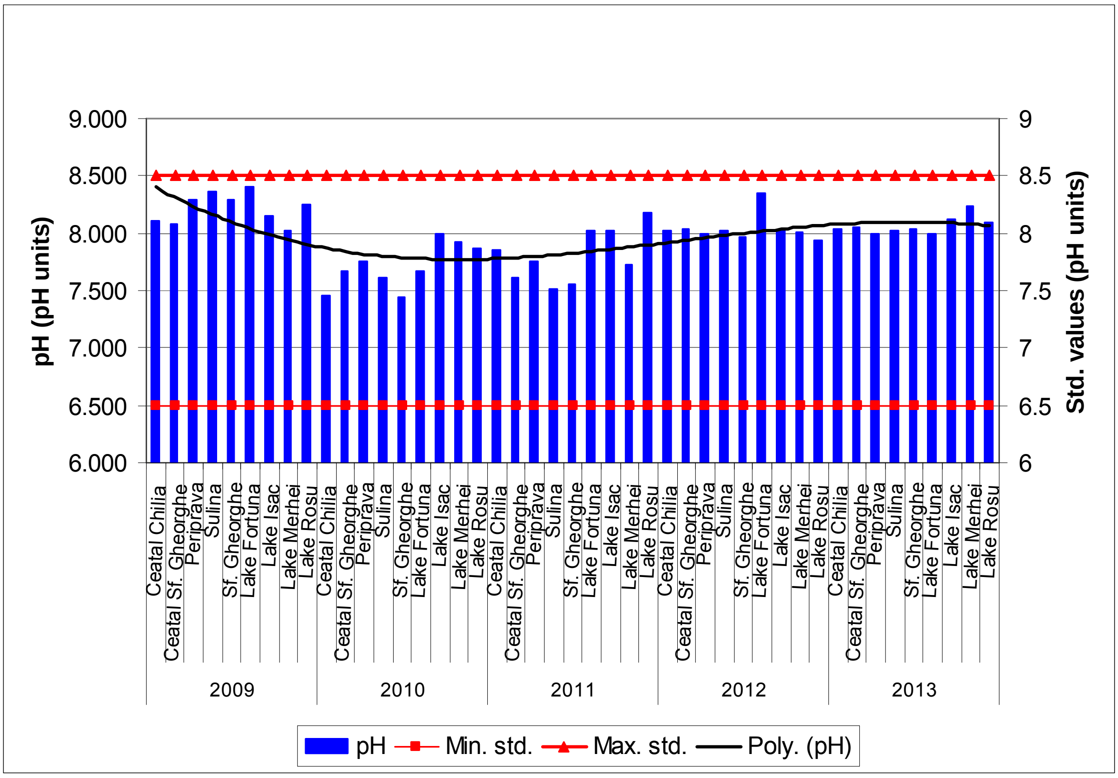

Figure 3.1.1.1 Annual average concentrations values of pH between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

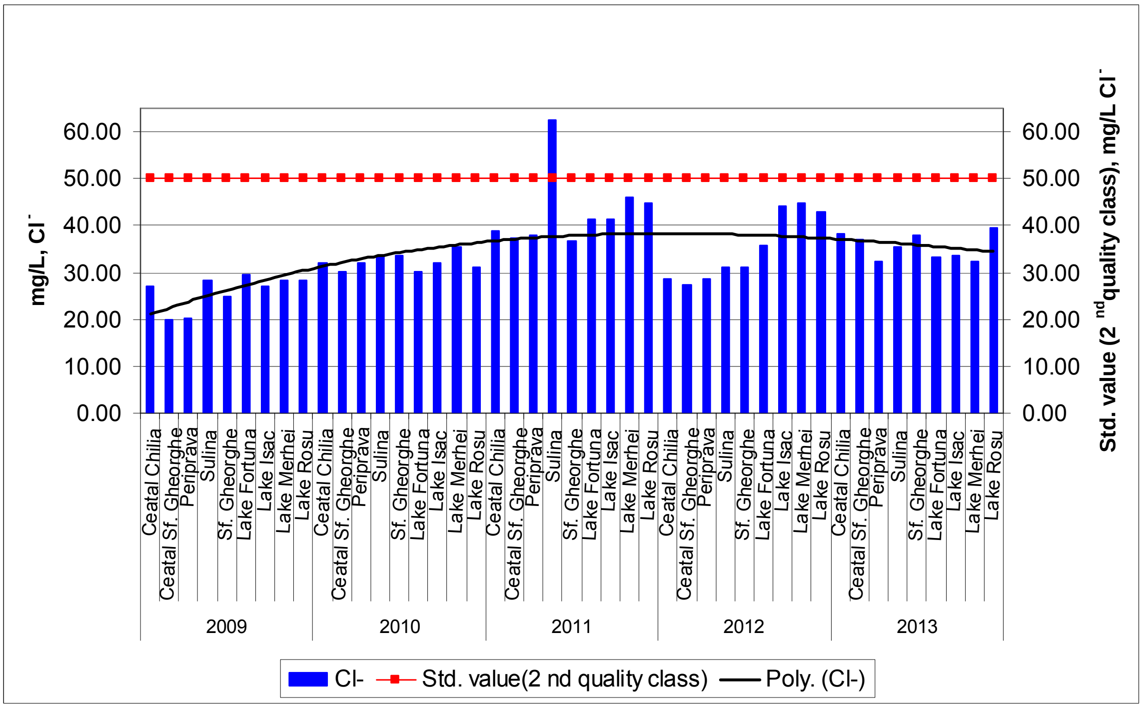

Figure 3.1.1.2 Annual average concentrations values of chloride between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

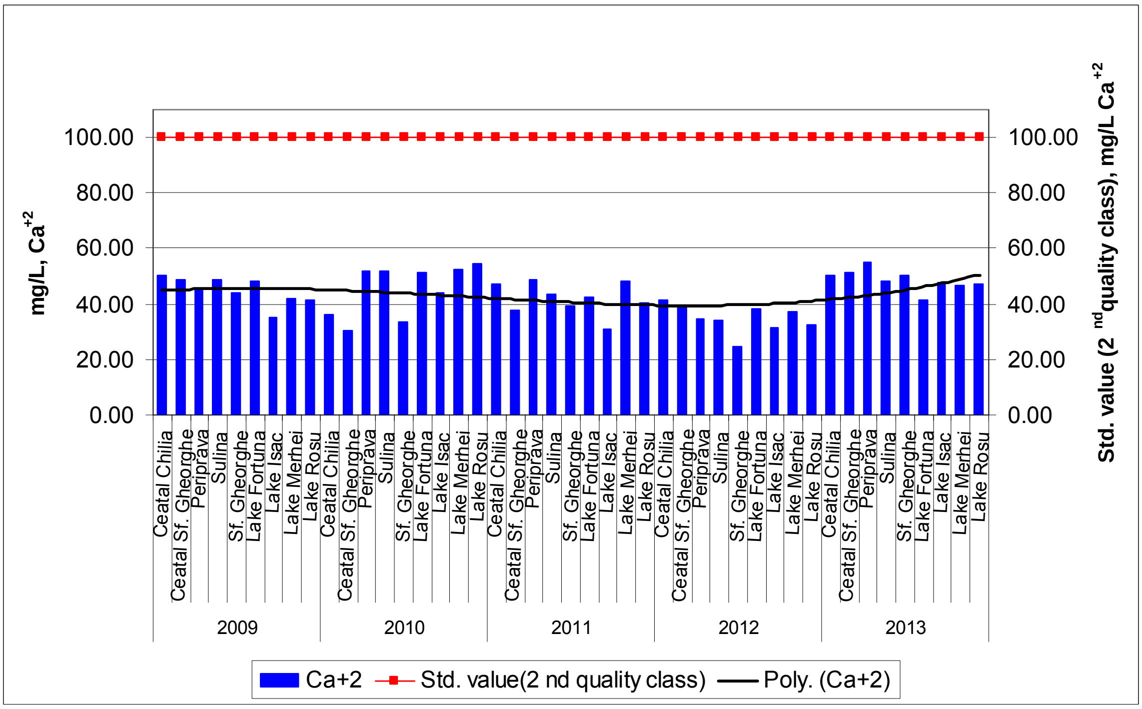

Figure 3.1.1.3 Annual average concentrations values of calcium between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

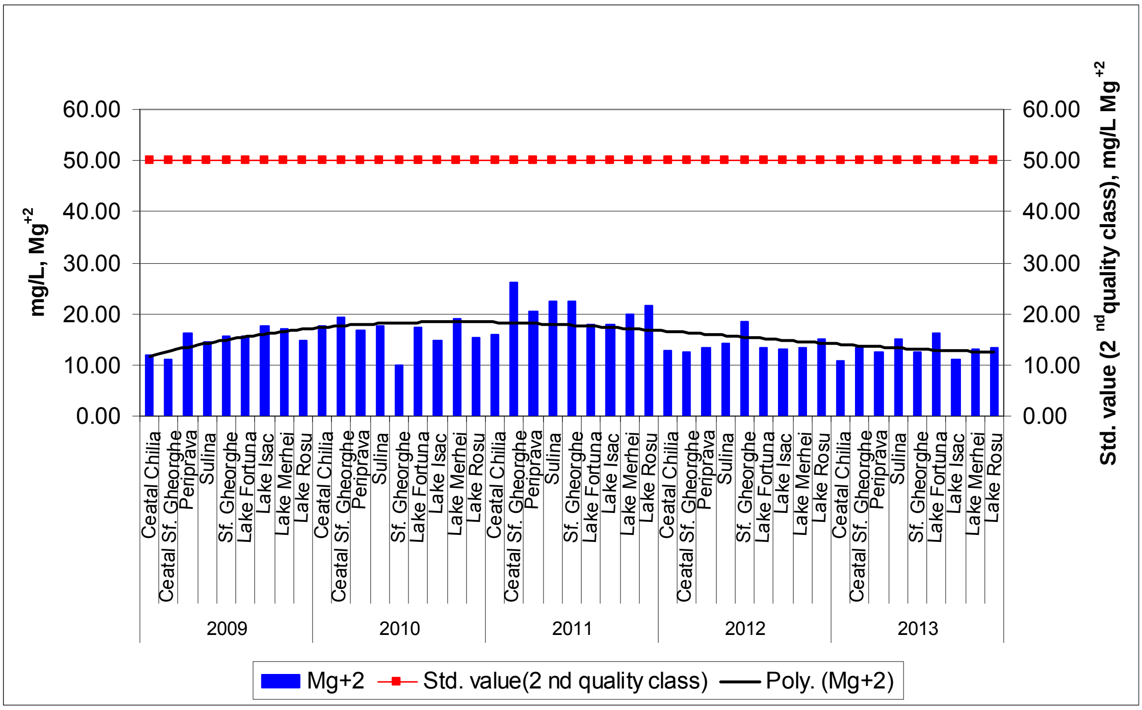

Figure 3.1.1.4 Annual average concentrations values of magnesium between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

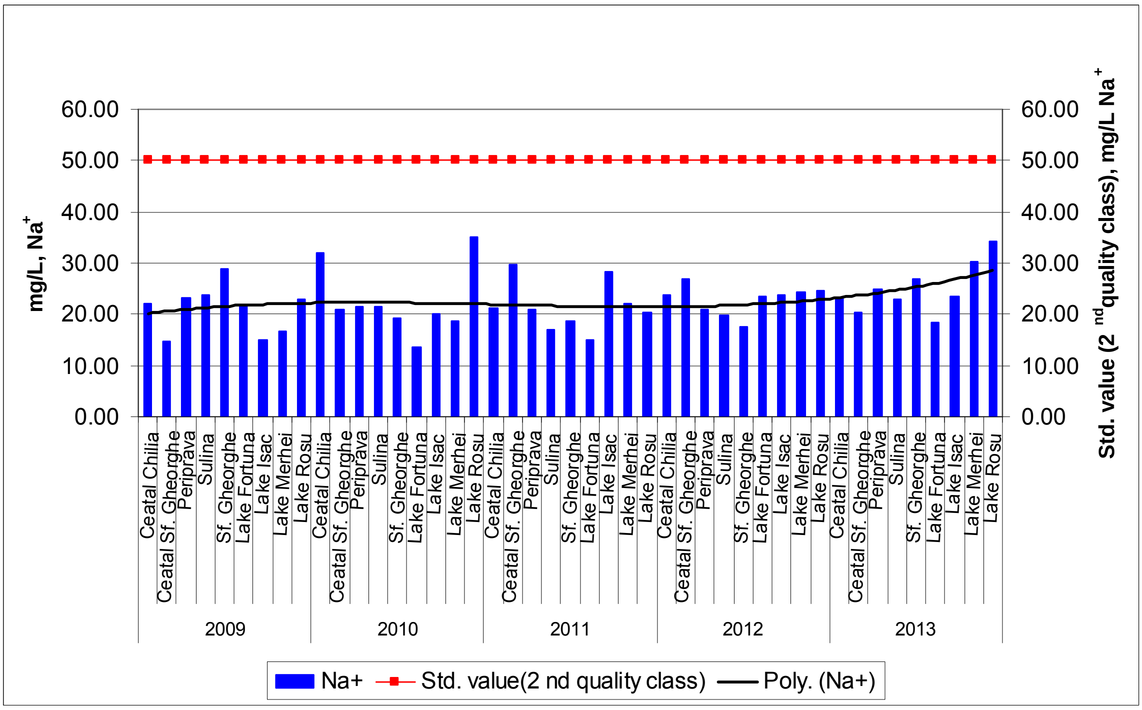

Figure 3.1.1.5 Annual average concentrations values of natrium between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

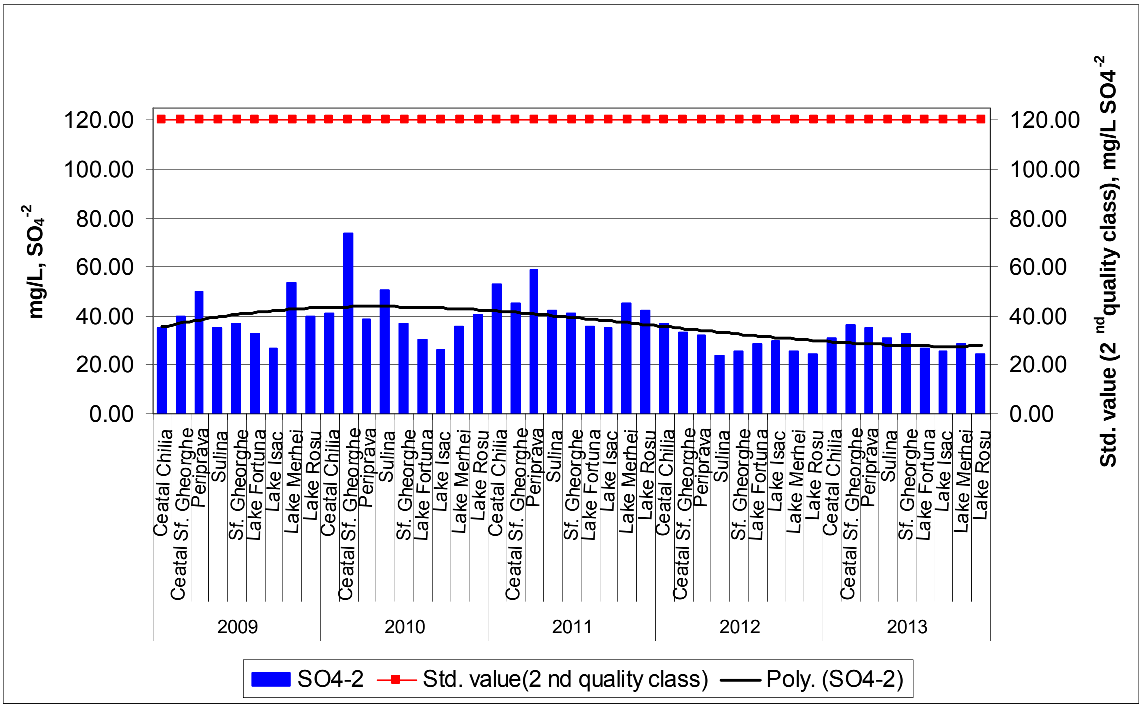

Figure 3.1.1.6 Annual average concentrations values of sulphates between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

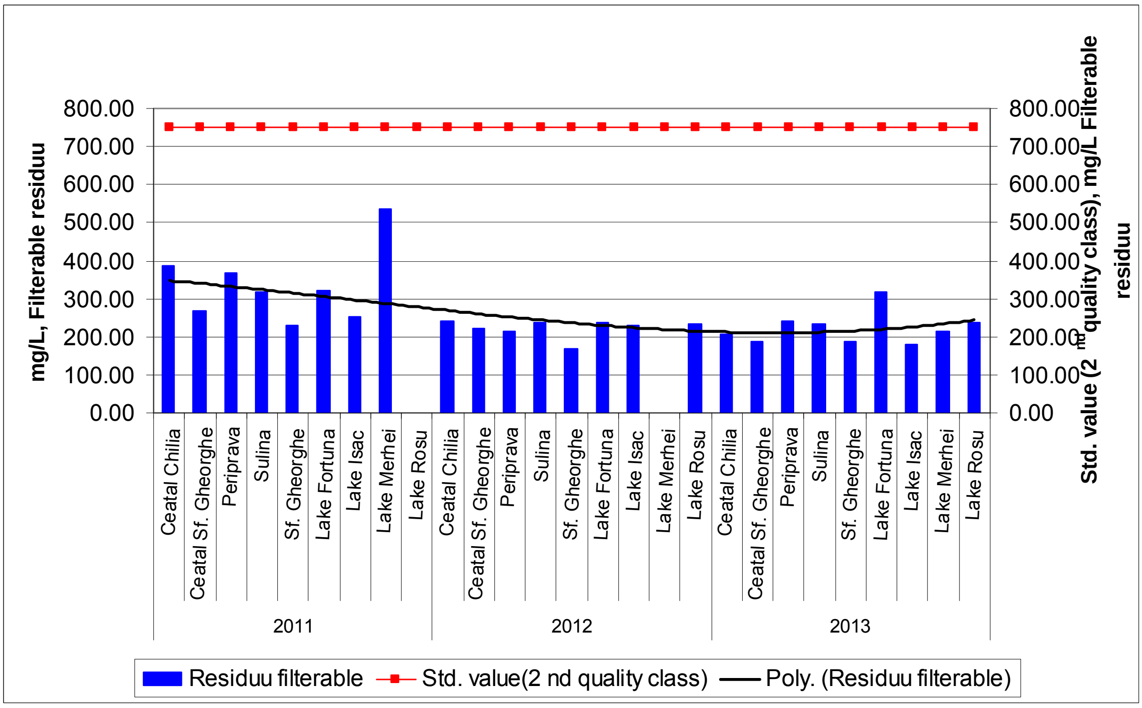

Figure 3.1.1.7 Annual average concentrations values of filterable residue between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

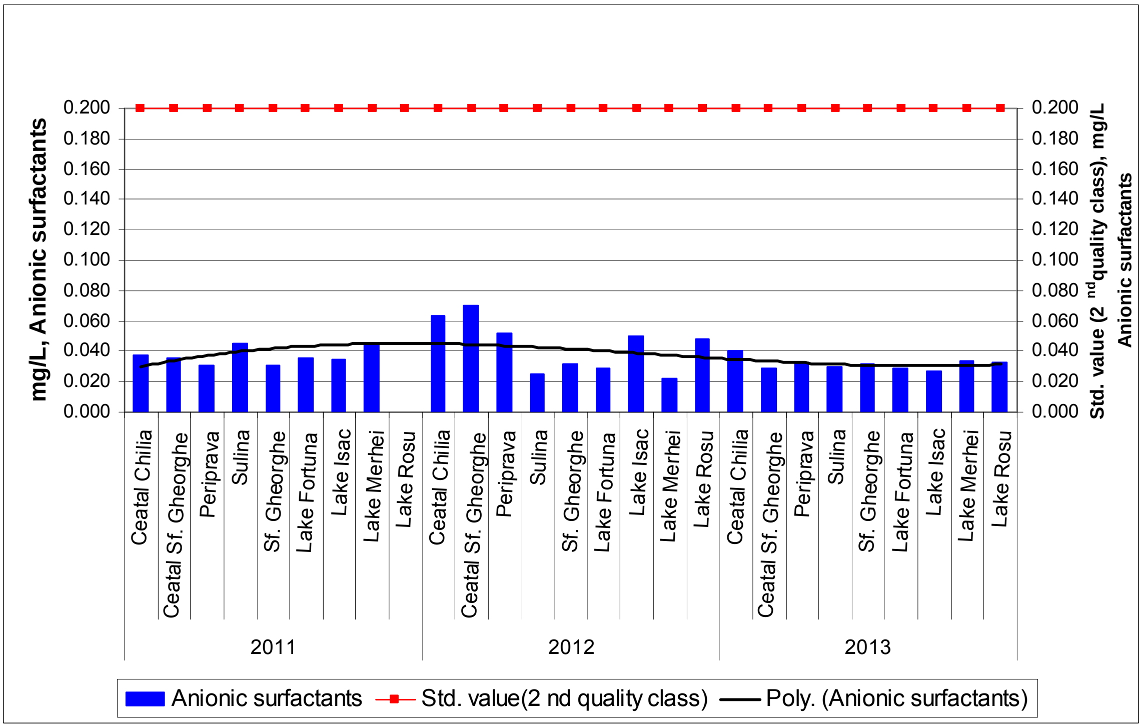

Figure 3.1.1.8 Annual average concentrations values of anionic surfactants between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

Oxygen regime

For dissolved oxygen, the results, show that the water of all nine sampling points frame into the first (very good ecological status) and second quality class (good ecological status) (**Figure 3.1.1.9**). Maximum values were obtained in 2010 and minimum values were observed in 2009. In 2013 a slight increasing tendency was observed.

The concentrations of biochemical oxygen demand obtained in the period 2009-2013, show a decreasing general trend, with a maximum in 2010 (**Figure 3.1.1.10**). Average concentrations values of biochemical oxygen demand for the nine sampling points, between 2009–2013, generally frame into the second quality class (good ecological status), with some exceptions, when the average concentrations of biochemical oxygen demand frame this waters in the third (moderate ecological status) and the fourth quality class (poor ecological status).

Chemical oxygen demand average concentrations at most of the sampling sites, in the period 2009-2013, correspond to the first (very good ecological status) and the second quality class (good ecological status) (**Figure 3.1.1.11**). Only, lake Merhei in 2009, belongs to third quality class (moderate ecological status). A slightly increasing tendency was observed in 2013.

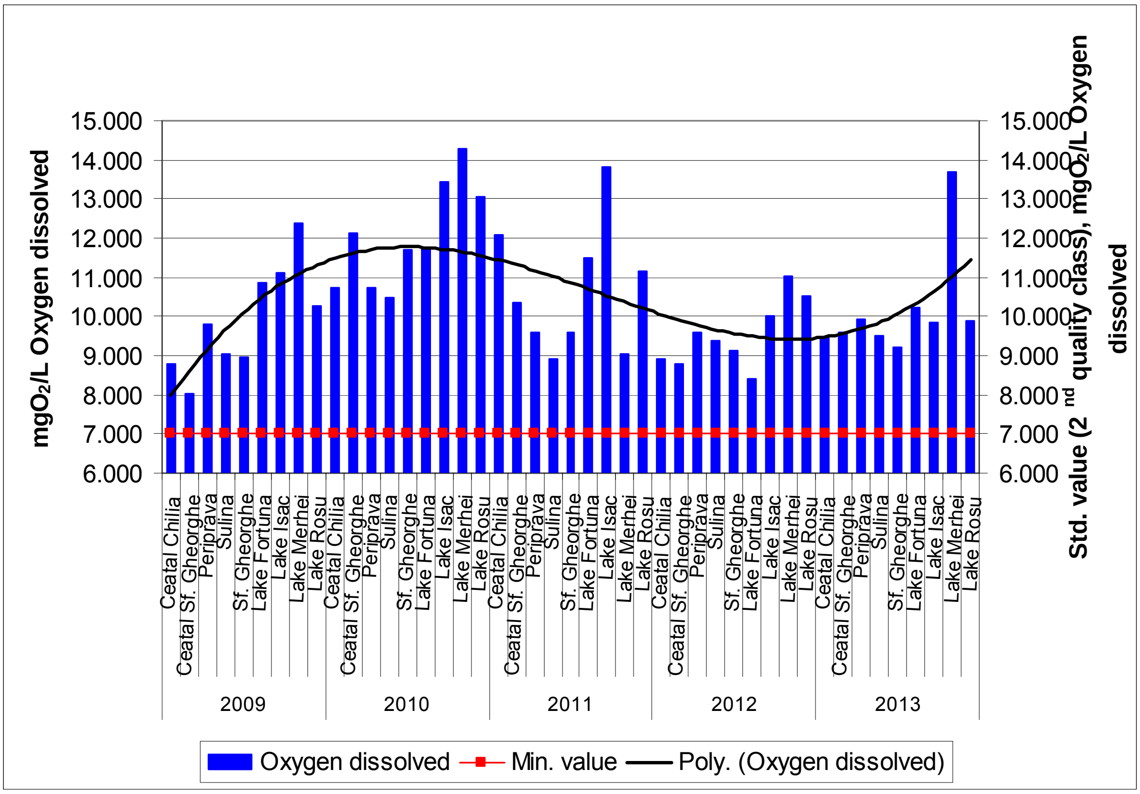

Figure 3.1.1.9 Annual average concentrations values of dissolved oxygen between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

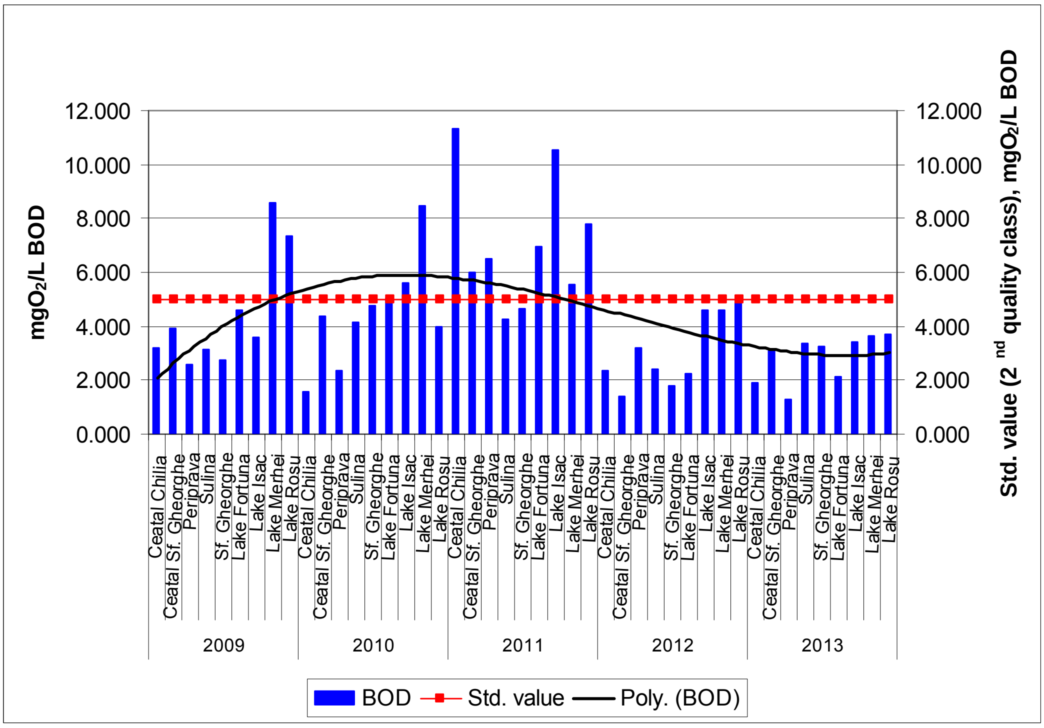

Figure 3.1.1.10 Annual average concentrations values of biochemical oxygen demand between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

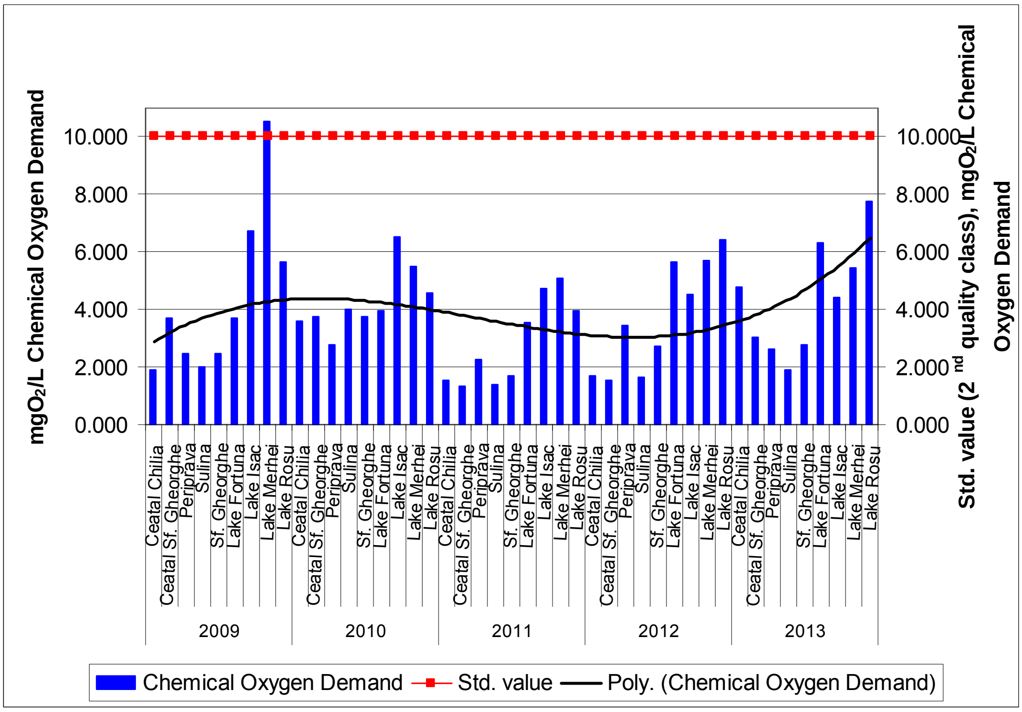

Figure 3.1.1.11 Annual average concentrations values of chemical oxygen demand between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

3.1.2. Nutrients

This part of the study continues the analysis of physical-chemical quality elements, focusing on the various nitrogen and phosphorus compounds, as well as chlorophyll “a”; nutrients are the elements which influence biological and biochemical processes in aquatic ecosystems.

Average concentrations values for nutrients forms (nitrogen from ammonium, nitrogen from nitrite, nitrogen from nitrate, total nitrogen, orthophosphates, total phosphorus, chlorophyll ‘a”) analyzed in the water samples during 2009-2013 are presented in the **Figures 3.1.2.1 – 3.1.2.7**.

Based on Romanian Order 161/2006, regarding the classification of surface water quality to determine the ecological status of water bodies, from nutrients point of view, in the period 2009-2013, the sampling sites from Danube Delta Biosphere Reserve are either in the „very good” (first quality class) or „good” ecological status (second quality class); three sampling sites do not comply with „good ecological status” only for nitrite as it follows: Periprava (2009) and Merhei lake (2010) – moderate ecological status (third quality class), Sf. Gheorghe (2009) – bad ecological status (forth quality class).
All nine selected sampling sites were characterised by a high content of organic nitrogen in water samples, which was followed by an increase of total nitrogen content, with values above the maximum concentration limit for second quality class (7 mgN/L).
Nutrients concentrations showed a decreasing trend in 2013.

Regarding chlorophyll “a“ concentrations, only a few had values framed into the first and second quality classes, the others can be framed into third, forth and fifth quality classes, as it follows: first class – Merhei lake (2009, 2012), Rosu lake (2009, 2013), Fortuna lake (2010); second quality class – Fortuna lake (2009, 2013), Merhei lake (2011); third quality class – Isac lake (2009, 2012, 2013), Rosu lake (2010) and Fortuna lake (2012); forth quality class – Merhei lake (2010, 2013), Fortuna lake (2011), Isac lake (2011) and Rosu lake (2011, 2012); fifth quality class – Isac lake (2010) (**Figure 3.1.2.7**).

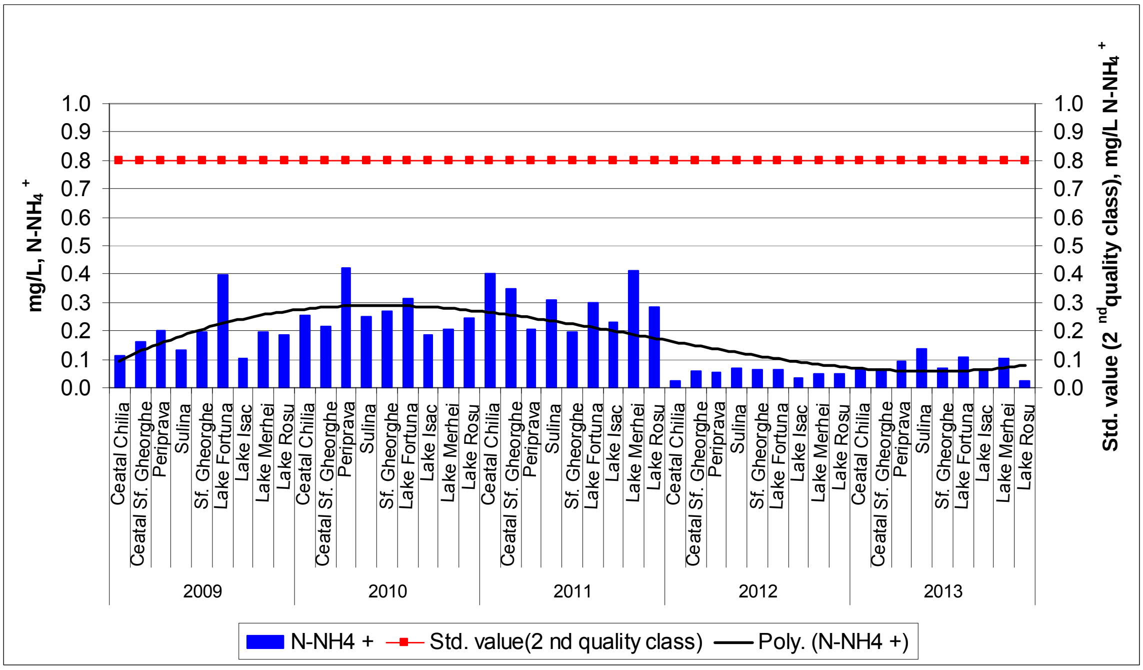

Figure 3.1.2.1 Annual average concentrations values of nitrogen from ammonium between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

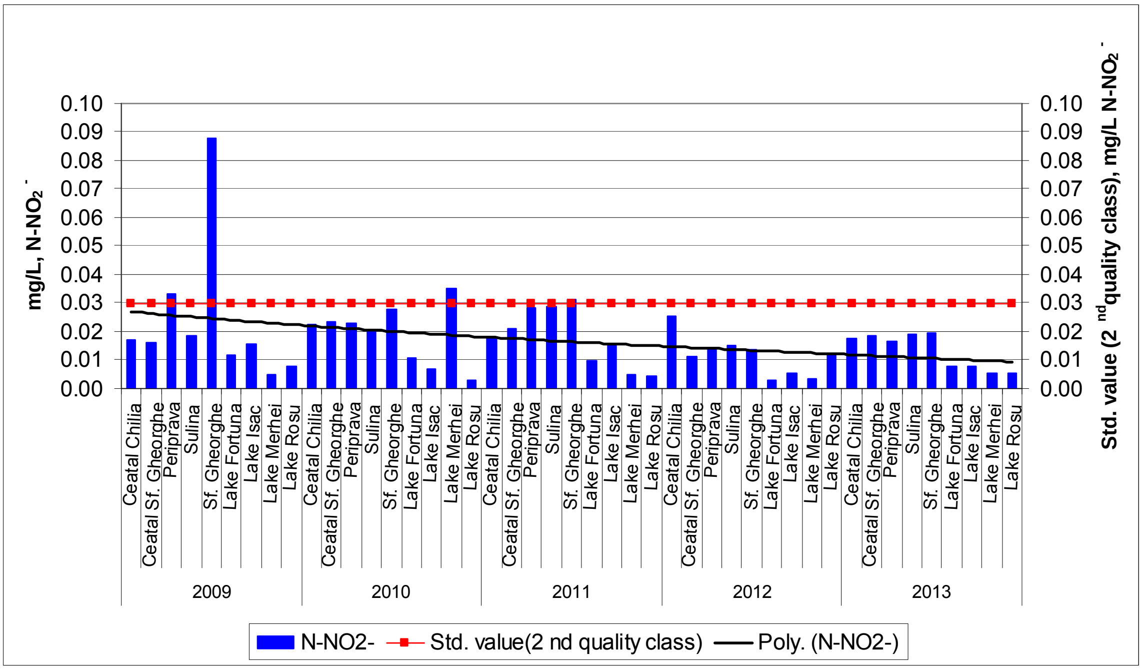

Figure 3.1.2.2 Annual average concentrations values of nitrogen from nitrite between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

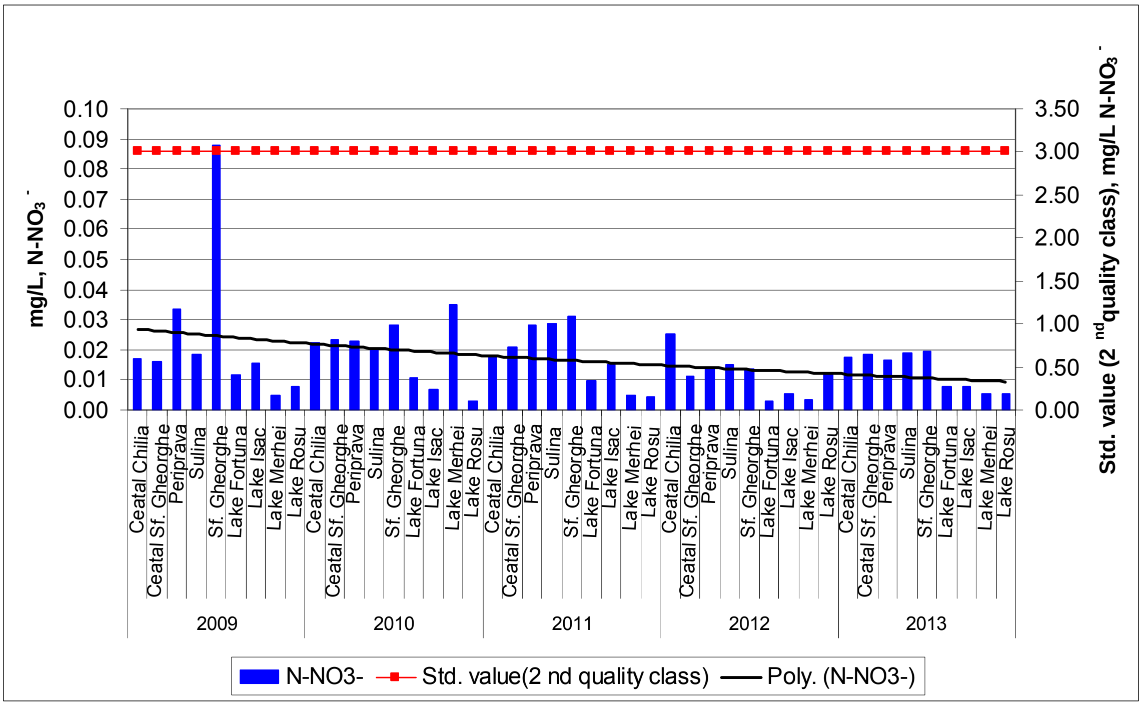

Figure 3.1.2.3 Annual average concentrations values of nitrogen from nitrate between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

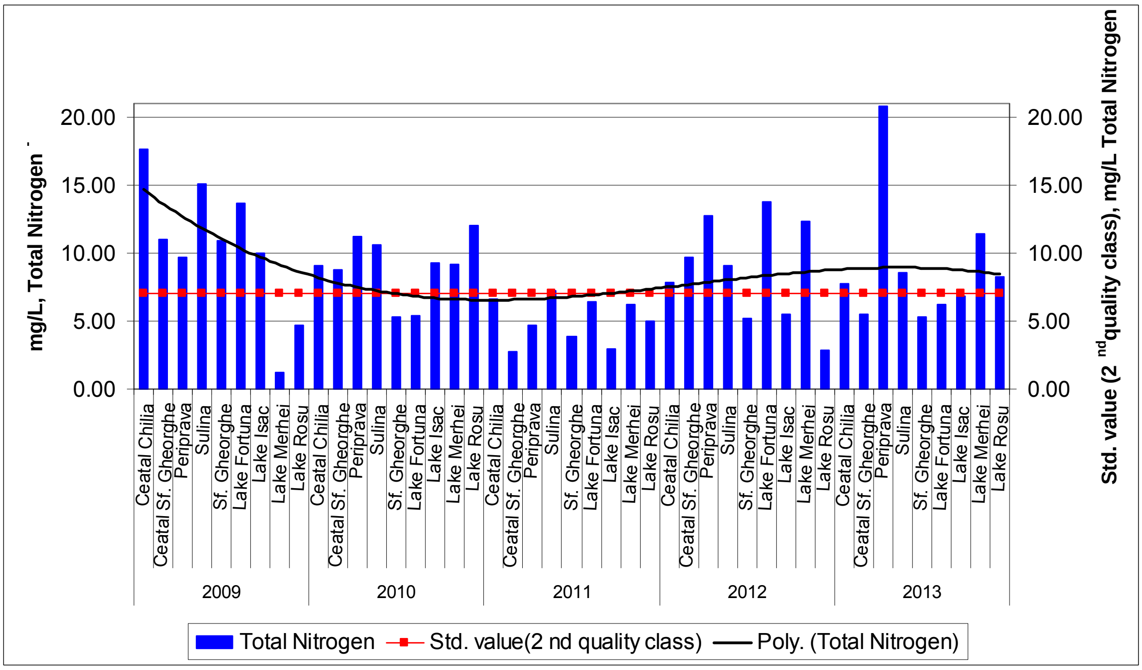

Figure 3.1.2.4 Annual average concentrations values of total nitrogen between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

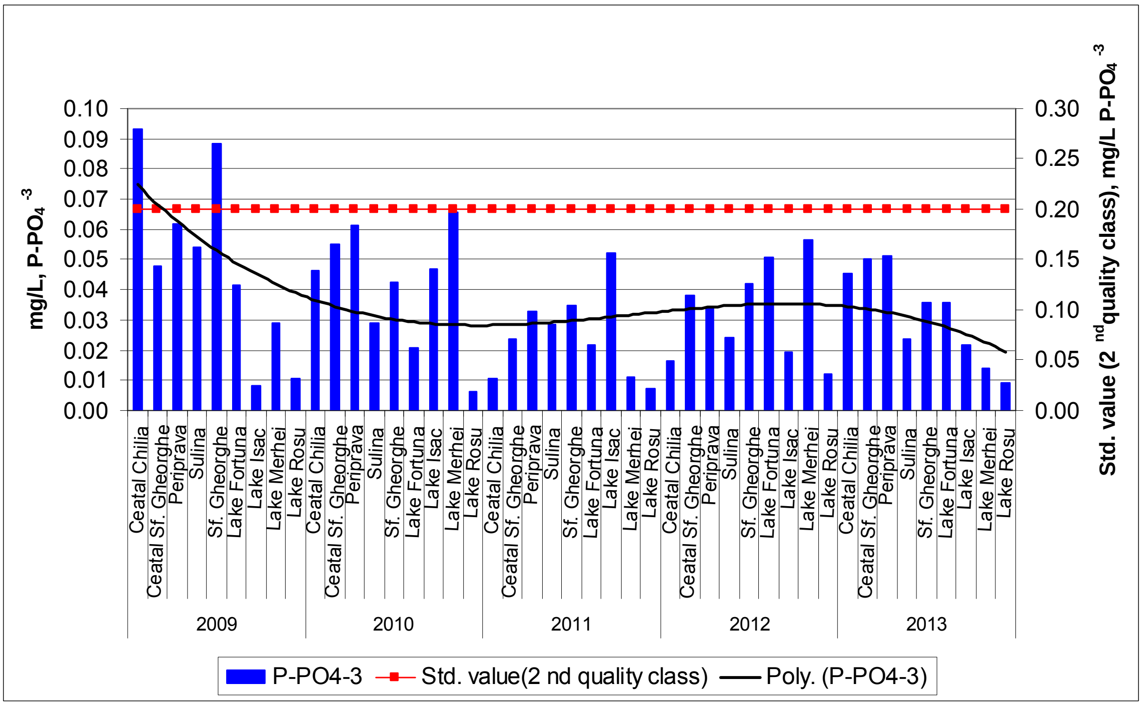

Figure 3.1.2.5 Annual average concentrations values of phosphorus from orthophosphates between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

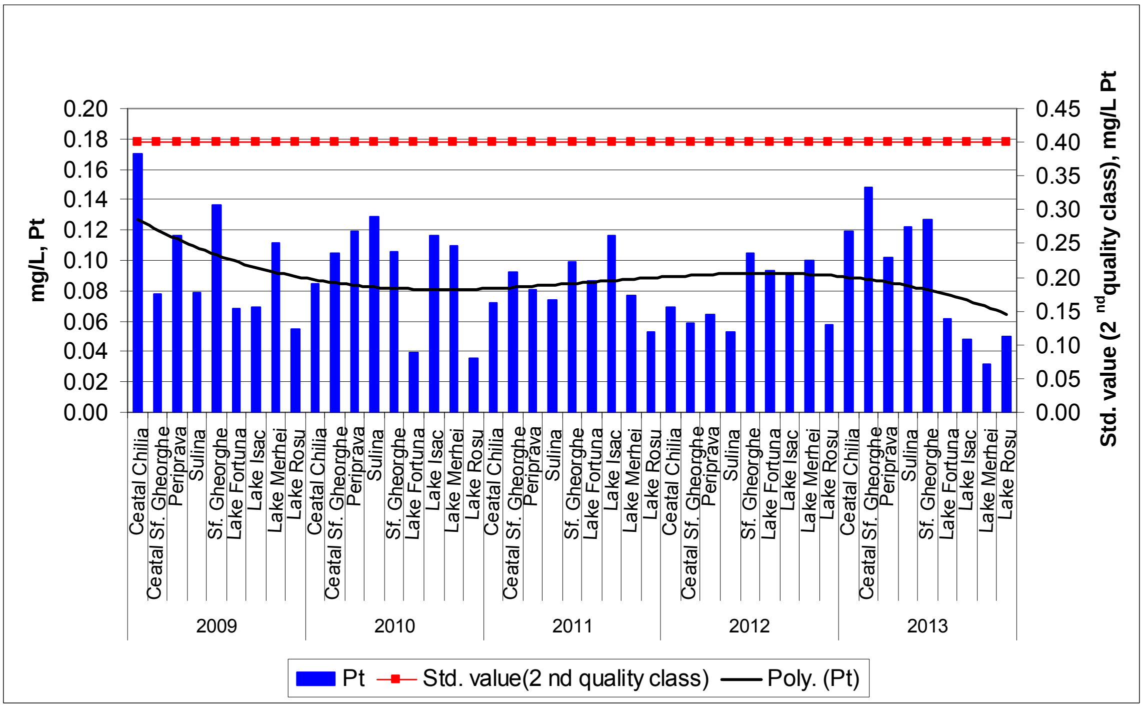

Figure 3.1.2.6 Annual average concentrations values of total phosphorus between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

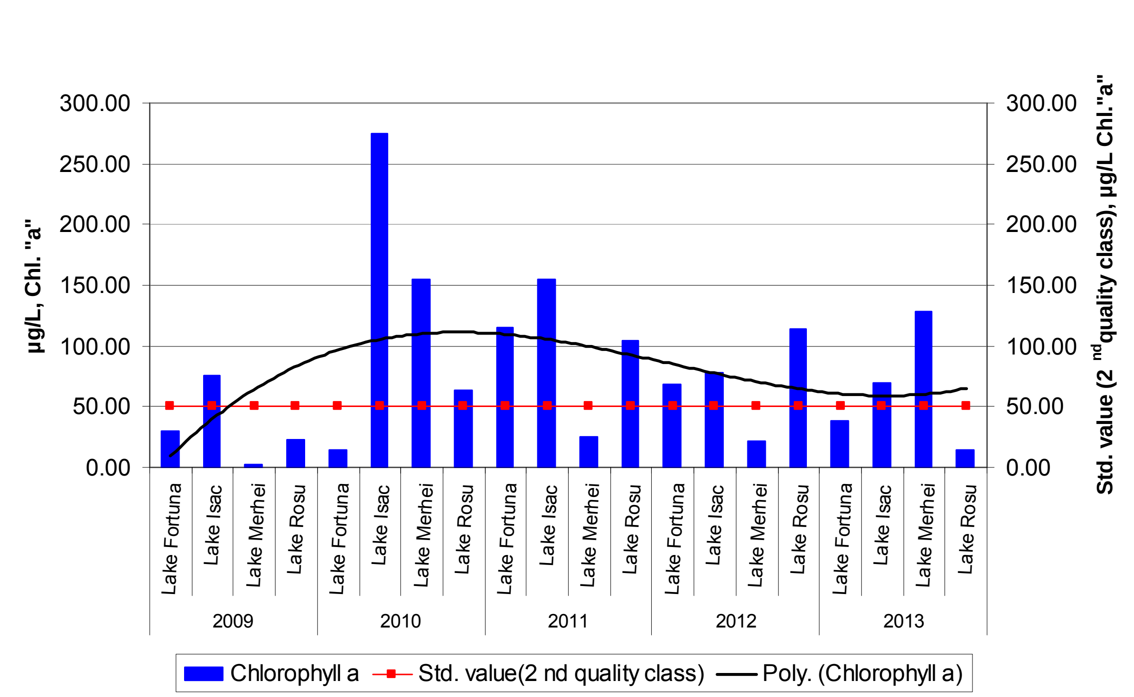

Figure 3.1.2.7 Annual average concentrations values of chlorophyll "a" between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

3.1.3. Metals

As a general trend, concerning heavy metals concentrations, in all nine sampling points from Danube Delta Biosphere Reserve, in the period 2009-2013, maximum values can be observed in 2010 and minimum values can be seen in 2009 for the majority of the studied metals.

Most of the heavy metals (cadmium, chromium, copper, nickel, manganese) have values which exceed (in 2010, in special) the limit for second quality class (good ecological status), framing into third, forth and fifth quality classes.

In case of arsenic, lead and iron, the exceedance of the limit for good ecological status (second quality class), was observed in special in 2010, the rest of the values framing, with a few exceptions, into the first (good ecological status) and the second quality classes (very good ecological status).

Zinc and mercury were present in all stations, in all period, in concentrations below the limit for second quality class (good ecological status).

In the figures below there are presented the average concentrations values for the studied heavy metals in all nine sampling points and a general trend for this metals between 2009-2013 (**Figures 3.1.3.1-3.1.3.10**).

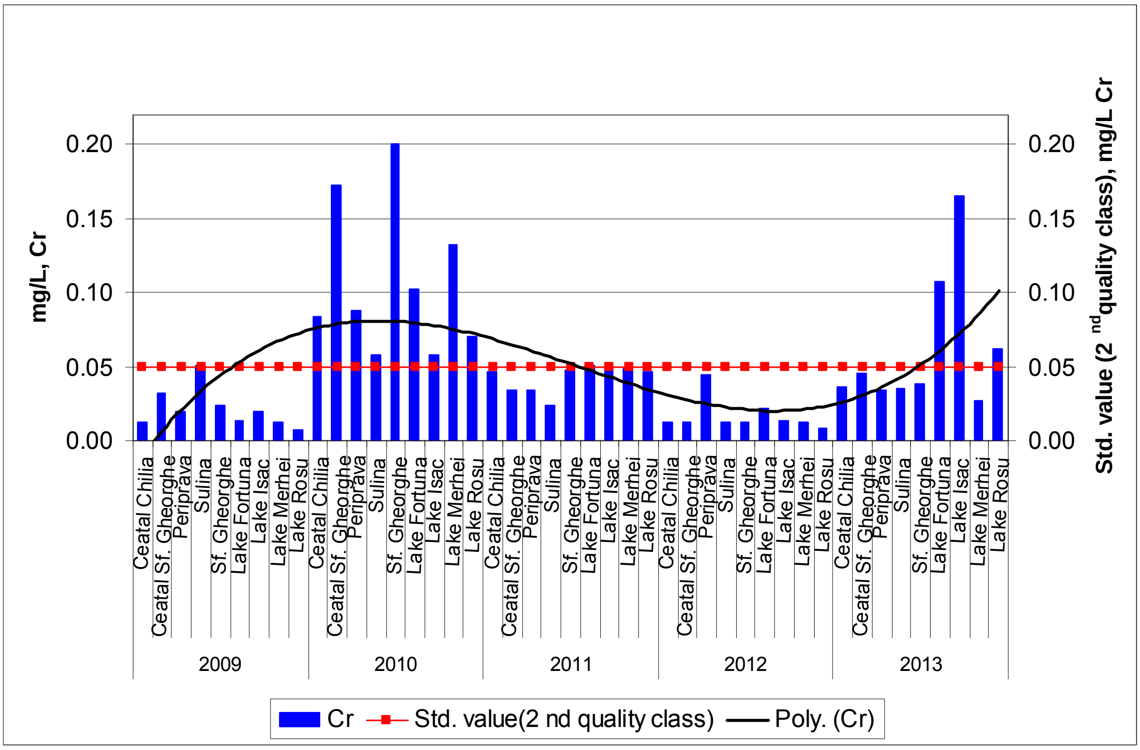

Figure 3.1.3.1 Annual average concentrations values of total chromium between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

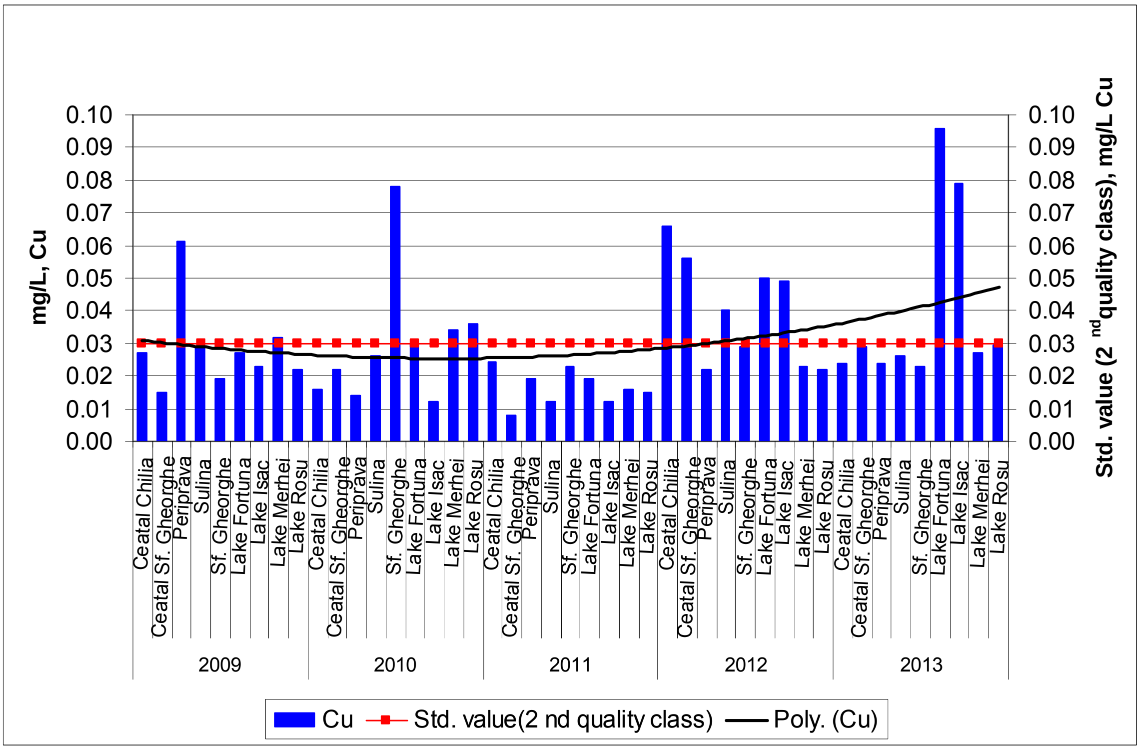

Figure 3.1.3.2 Annual average concentrations values of copper between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

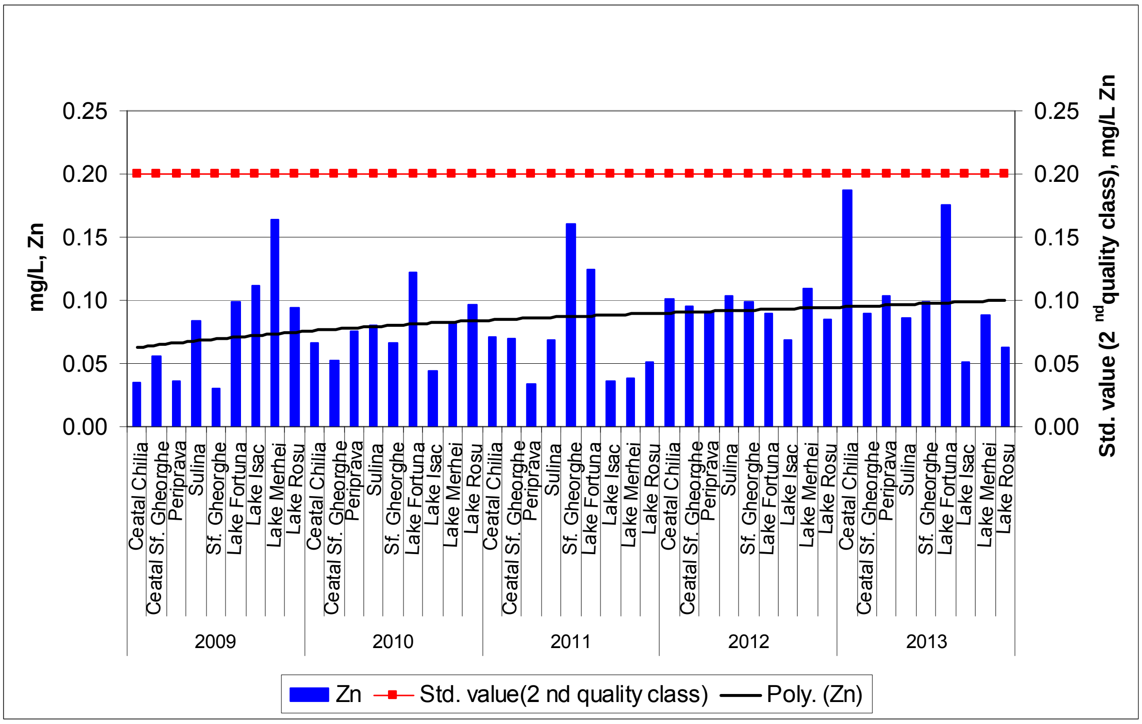

Figure 3.1.3.3 Annual average concentrations values of zinc between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

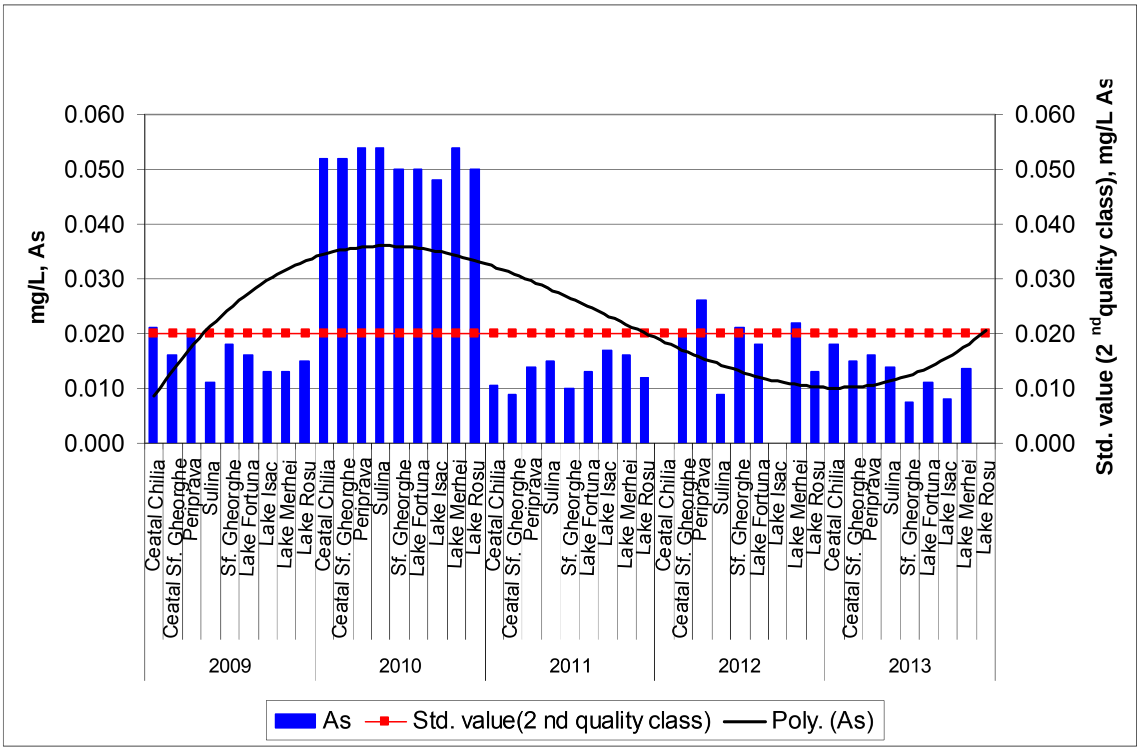

Figure 3.1. 3.4 Annual average concentrations values of arsenic between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

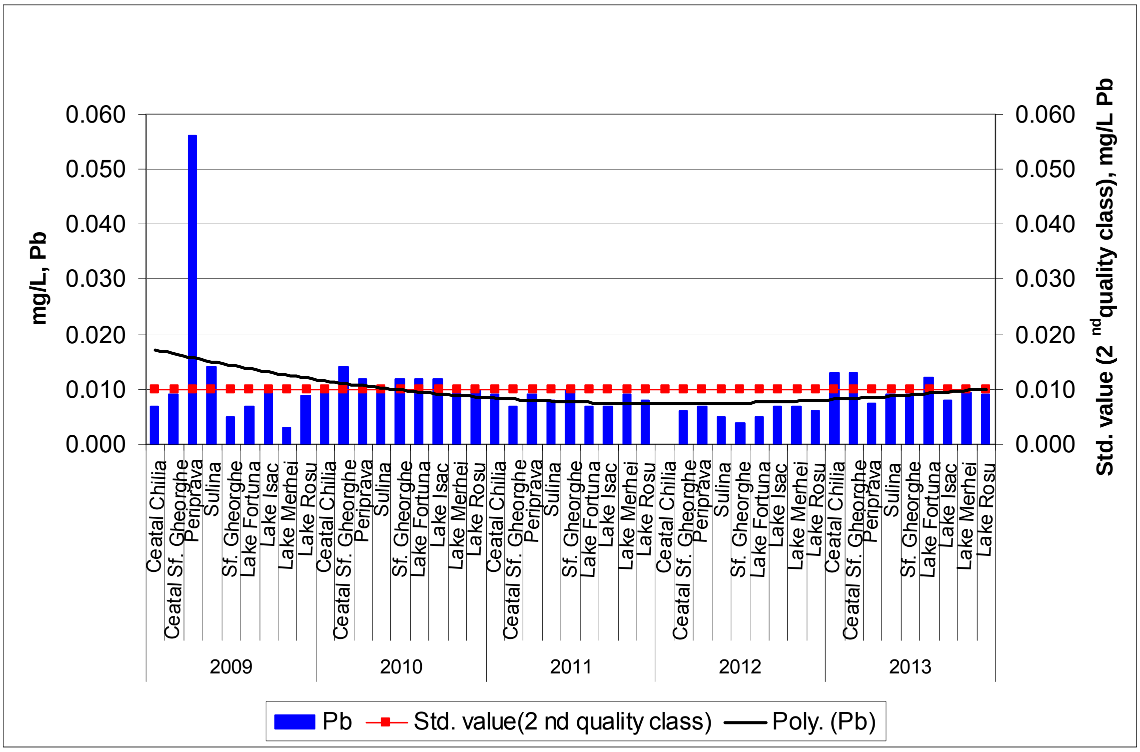

Figure 3.1.3.5 Annual average concentrations values of lead between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

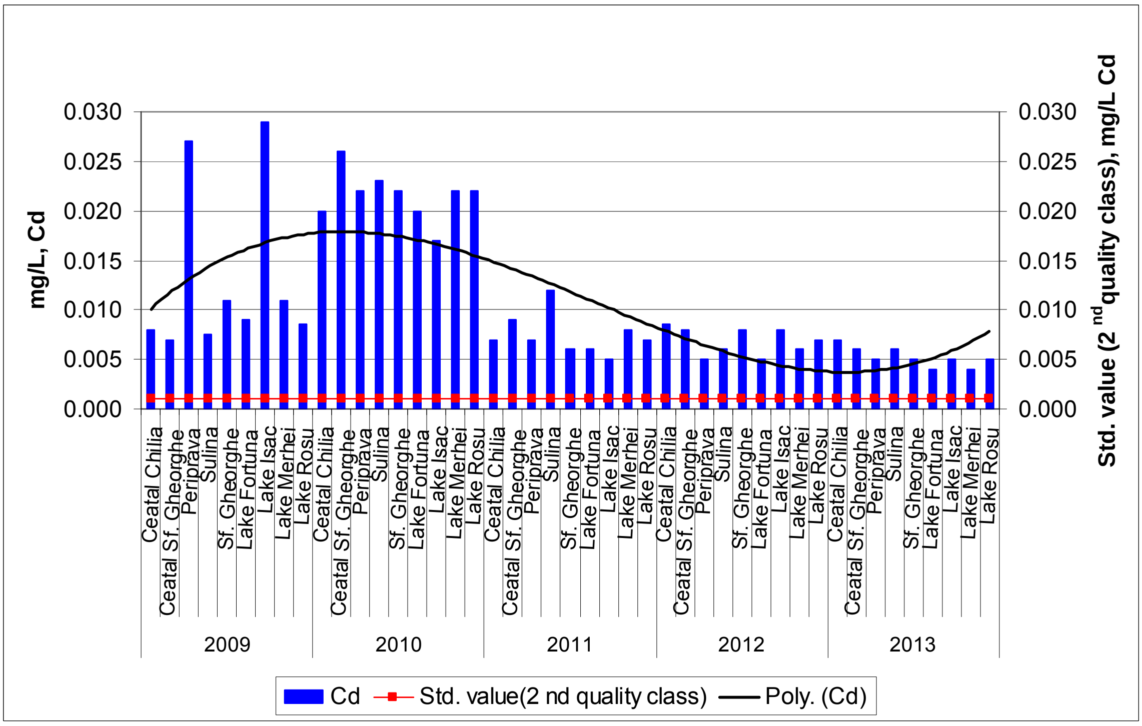

Figure 3.1.3.6 Annual average concentrations values of cadmium between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

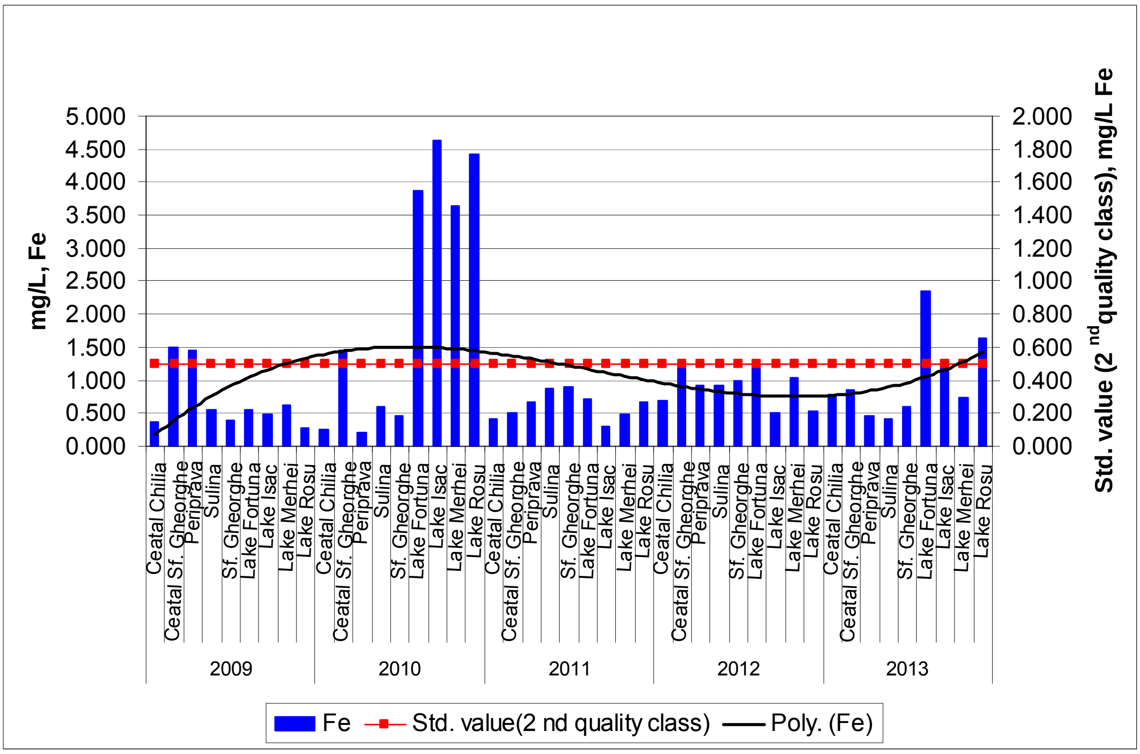

Figure 3.1.6.7 Annual average concentrations values of total iron between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

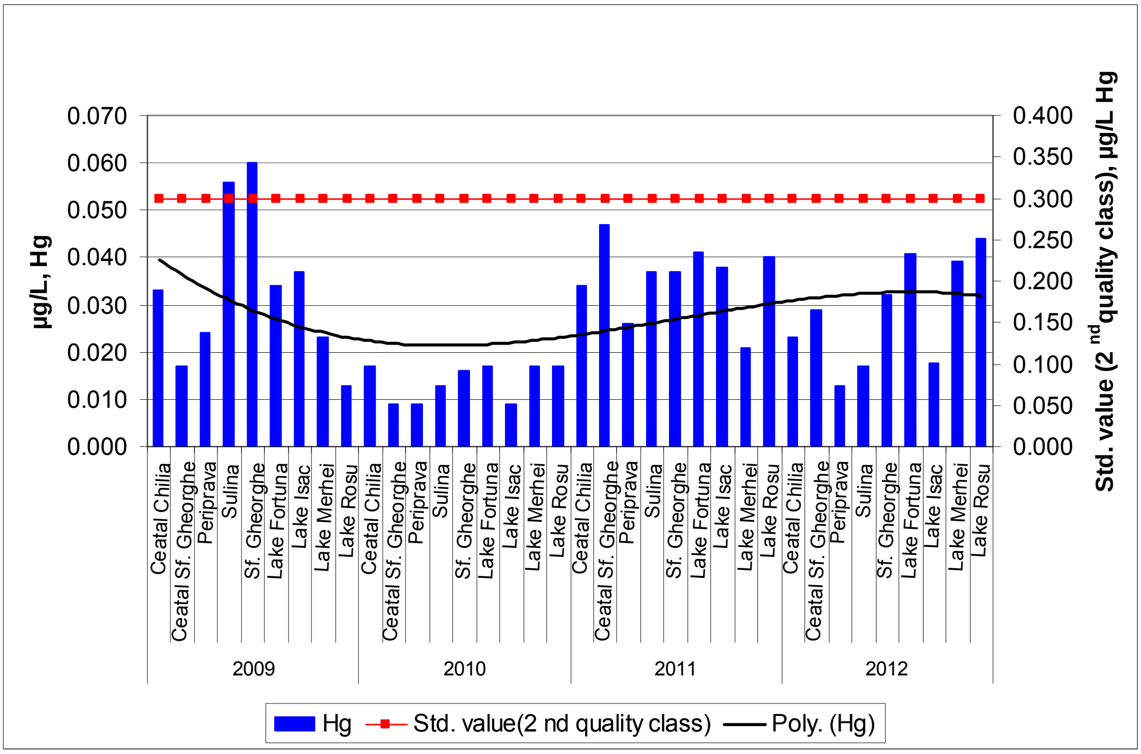

Figure 3.1.3.8 Annual average concentrations values of mercury between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

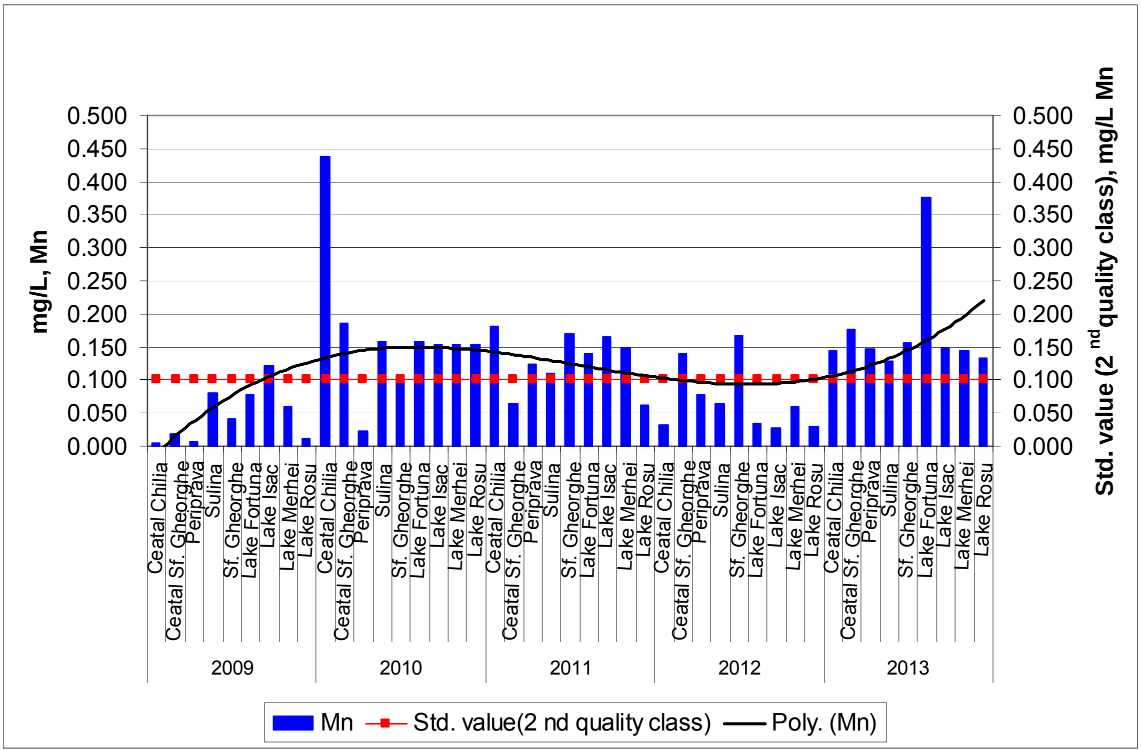

Figure 3.1.3.9 Annual average concentrations values of total manganese between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

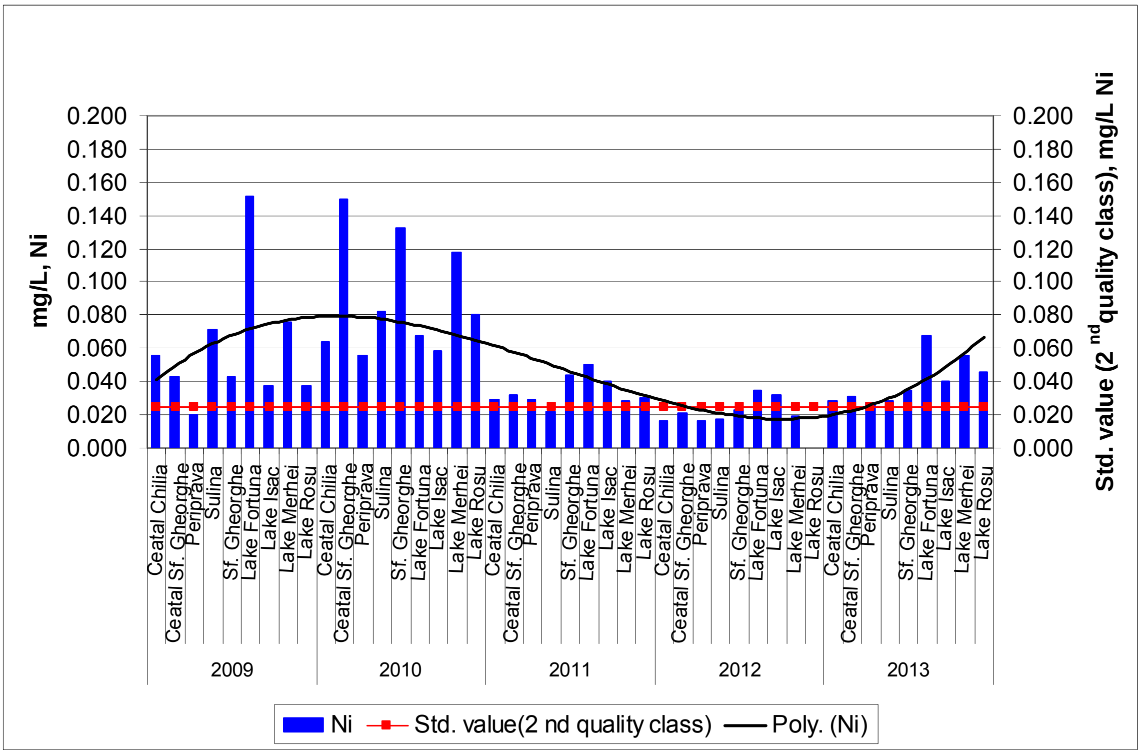

Figure 3.1.3.10 Annual average concentrations values of nickel between 2009 – 2013 in nine sampling points from Danube Delta Biosphere Reserve

3.2 Phytoplankton

Abundance varied between 424446.5 ind/l and 2044444 ind/l in station Aval Izmail, between 437878.6 ind/l and 3070875 ind/l in station Periprava, between 265279.1 ind/l and 1622992 ind/l in station Ceatal Chilia, between 41195.1 ind/l and 1307916 ind/l in station Sulina, between 270360.1 ind/l and 2148897 ind/l in station Ceatal Sfantu Gheorghe and between 319112 ind/l and 1915571 ind/l in station Sfantu Gheorghe.

The maximum number of individuals per litre was found in Periprava in XI.2013 (3070875 ind/l) and the minimum number of individuals per liter in Ceatal Chilia in IX.2013 (265279.1 ind/l) (**Table 3.2.1**).

Tabel 3.2.1. Abundance of phytoplankton in studied aquatic ecosystem

Date	Ceatal Chilia	Aval Izmail	Periprava	Ceatal Sf. Gheorghe	Sulina	Sf. Gheorghe
III.2013	445647.6	424446.5	437878.6	270360.1	411951.1	-
VI.2013	1622992	2044444	821156.9	2148897	1307916	1915571
IX.2013	265279.1	-	-	547759.2	451409.6	392147.5
XI.2013	-	-	3070875	576559.5	-	319112

Biomass varied between 4.36 µg/l and 9.75 µg/l in station Aval Izmail, between 4.63 µg/l and 8.93 µg/l in station Periprava, between 4.46 µg/l and 10.5 µg/l in station Ceatal Chilia, between 5.01 µg/l and 6.26 µg/l in station Sulina, between 5.44 µg/l and 8.81 µg/l in station Ceatal Sfantu Gheorghe and between 5.06 µg/l and 8.53 µg/l in station Sfantu Gheorghe (**Figure 3.2.1**).

The chlorophyll-a values in sample stations on Danube branches are however due to Romanian standards and according to TransNational Monitoring Network (TNMN) in water quality class I (<25 µg/l). (**** 2006)

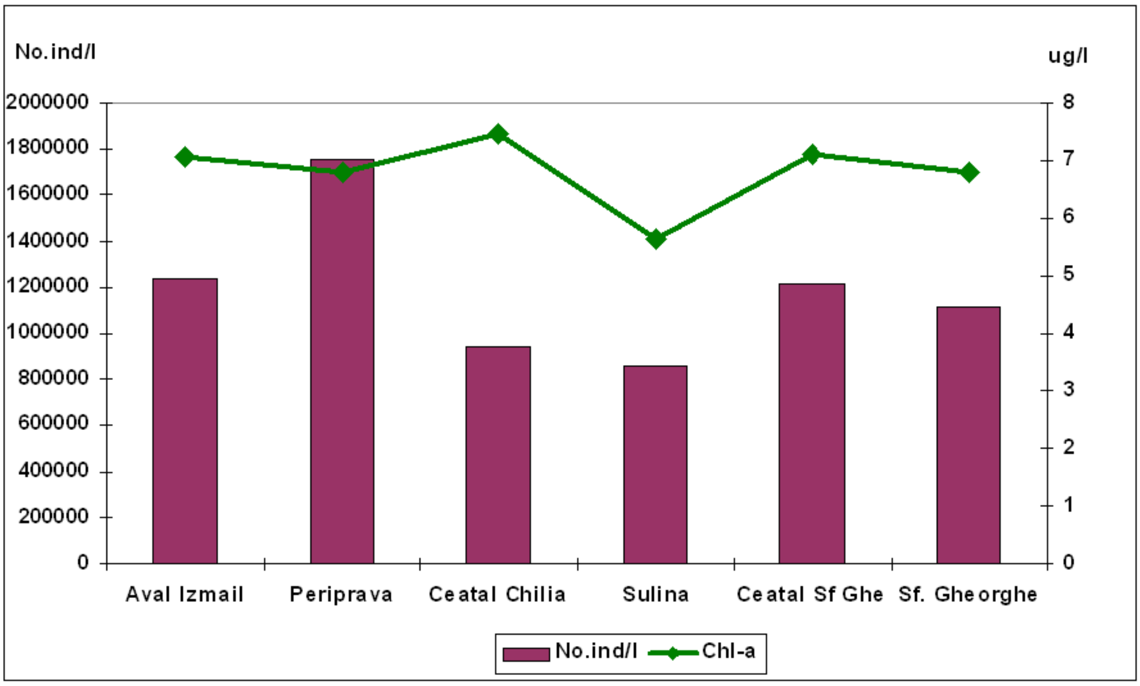

Figure 3.2.1 Abundance and biomass averages in studied aquatic ecosystem.

The chlorophyll "a" concentration recorded in Sulina branch in year 2008 within the transect between Dunărea Veche towards Crisan – Caraorman canal range between 5,04 – 7,67 µg/l and the chlorophyll – a concentration recorded in Sf. Gheorghe branch section between Perivolovca canal and Ceatal Sfântu Gheorghe range between 6,43 to 9,57 µg/l (Torok 2009).

Number of species varied between 13 species in sample from Periprava in 11.2013 and 36 species in sample from Aval Izmail in 06.2013.
Species list identified in samples from 2013 include 120 species from which 46 chloroficee (CHLO), 59 diatoms (DIAT), 6 cyanobacteria (CYAN), 4 cryptophyta (CRYP), 3 euglenophyta (EUGL) and 2 dinophyta (DINO) (**Table 3.2.2**).

Table 3.2.2 List of species in studied aquatic ecosystem
(chloroficee= CHLO, diatoms=DIAT, cyanobacteria=CYAN, cryptophyta=CRYP, euglenophyta=EUGL, dinophyta=DINO, X=presence, 0=absence)

Taxonomic group	Gen	Specie	Aval Izmail	Periprava	Ceatal Chilia	Sulina	Ceatal Sf. Gheorghe	Sf. Gheorghe
CHLO	Actinastrum	aciculare	0	0	0	0	x	0
CHLO	Actinastrum	gracillimum	0	0	x	0	x	x
CHLO	Ankyra	ancora	0	0	0	0	0	x
CHLO	Characium	lanceolatum	0	0	0	0	x	0
CHLO	Chlamydomonas	reinhardi	0	0	0	x	0	0
CHLO	Chlocococcum	llipsoideum	0	0	0	0	0	x
CHLO	Chlorella	vulgaris	x	x	x	x	x	x
CHLO	Chodatella	quadriseta	0	0	0	0	x	0
CHLO	Closteriopsis	acicularis	0	0	0	0	x	0
CHLO	Coelastrum	microporum	x	0	0	x	0	x

CHLO	Coelastrum	sphaericum	0	x	0	0	x	x
CHLO	Cosmarium	bioculatum	0	0	0	0	0	x
CHLO	Cosmarium	formosulum	0	0	x	0	0	0
CHLO	Crucigenia	tetrapedia	x	x	0	0	0	0
CHLO	Dictyosphaerium	pulchellum	x	x	x	x	x	x
CHLO	Eremosphaera	viridis	x	0	x	x	x	x
CHLO	Kirchneriella	lunaris	0	0	0	x	0	x
CHLO	Kirchneriella	subcapitata	0	x	0	0	0	0
CHLO	Lagerheimia	genevensis	0	0	x	0	x	x
CHLO	Monoraphidium	arcuatum	0	x	0	0	0	0
CHLO	Monoraphidium	contortum	0	x	0	x	0	x
CHLO	Monoraphidium	convolutum	0	0	x	0	0	x
CHLO	Monoraphidium	graffithii	0	0	0	0	x	x
CHLO	Monoraphidium	irregulare	0	0	0	0	0	x
CHLO	Monoraphidium	komarkovae	0	0	0	0	x	x
CHLO	Oocystis	lacustris	0	0	x	0	x	0
CHLO	Scenedesmus	armatus	0	0	x	x	0	0
CHLO	Scenedesmus	bellospinosus	x	0	x	0	x	0
CHLO	Scenedesmus	ecornis	x	x	0	0	x	0
CHLO	Scenedesmus	gutwinskii	0	0	0	x	0	0
CHLO	Scenedesmus	obliquus	0	0	0	0	x	0
CHLO	Scenedesmus	opoliensis	0	0	x	0	0	0
CHLO	Scenedesmus	quadricauda	x	x	x	x	x	x
CHLO	Scenedesmus	sempervirens	0	0	0	0	0	x
CHLO	Scenedesmus	spinosus	0	x	x	0	0	x
CHLO	Schroederia	robusta	0	0	0	0	0	x
CHLO	Schroederia	setigera	0	0	0	x	0	0
CHLO	Siderocelis	ornata	x	x	0	x	0	0
CHLO	Staurastrum	enorme	0	0	0	0	x	0
CHLO	Stauroneis	anceps	0	0	x	0	0	x
CHLO	Tetracystis	aggregata	0	0	0	0	0	x
CHLO	Tetraedron	minimum	x	0	0	x	x	0
CHLO	Tetrastrum	elegans	x	0	0	0	x	x
CHLO	Tetrastrum	taurogeniaeforme	0	0	0	0	x	0
CHLO	**TOTAL**		**11**	**11**	**15**	**13**	**21**	**23**
CHRY	Dinobryon	sertularia	0	x	0	0	x	x
CHRY	**TOTAL**		**0**	**1**	**0**	**0**	**1**	**1**
CRYP	Crypyomonas	erosa	0	0	x	0	x	0
CRYP	Crypyomonas	ovata	x	x	0	x	x	x
CRYP	Rhodomonas	lacustris	0	0	0	0	0	x
CRYP	Rhodomonas	lens	x	0	x	x	x	x
CRYP	Rhodomonas	tenius	0	0	x	0	0	0
CRYP	**TOTAL**		**2**	**1**	**3**	**2**	**3**	**3**
CYAN	Aphanizomenon	flos-aquae	0	0	0	0	0	x
CYAN	Merismopedia	glauca	0	0	x	0	0	0
CYAN	Oscillatoria	lacustris	0	0	0	x	0	0
CYAN	Oscillatoria	tenius	0	0	0	0	0	x
CYAN	Phormidium	retzii	0	0	x	0	0	0
CYAN	**TOTAL**		**0**	**0**	**2**	**1**	**0**	**2**
DIAT	Achnanthes	clevei	0	0	0	x	0	x

DIAT	Asterionella	formosa	x	x	x	x	x	0
DIAT	Aulacoseira	ambigua	0	0	0	0	x	0
DIAT	Aulacoseira	granulata	x	x	x	x	x	x
DIAT	Aulacoseira	italica	x	0	x	x	0	x
DIAT	Caloneis	amphisbaena	x	0	0	0	0	0
DIAT	Closterium	kutzingii	0	0	0	x	0	0
DIAT	Cyclotella	kutzingiana	0	0	0	0	0	x
DIAT	Cyclotella	meneghiniana	x	x	x	x	x	x
DIAT	Cymatopleura	elliptica	x	0	0	0	0	0
DIAT	Cymatopleura	solea	x	0	0	0	0	0
DIAT	Cymbella	prostata	x	x	x	x	0	0
DIAT	Diatoma	hiemale	0	0	0	x	x	0
DIAT	Diatoma	mesodon	x	x	x	x	x	x
DIAT	Diatoma	vulgare	x	0	x	x	x	0
DIAT	Fragilaria	capucina	0	0	0	0	x	0
DIAT	Fragilaria	construens	0	0	0	0	x	0
DIAT	Fragilaria	crotonensis	x	0	0	0	x	x
DIAT	Gomphonema	olivaceum	0	0	x	x	x	0
DIAT	Gomphonema	parvulum	x	0	0	x	0	0
DIAT	Gomphonema	truncatum	0	0	0	x	0	0
DIAT	Melosira	dickiei	0	0	x	0	0	0
DIAT	Melosira	varians	0	0	0	x	0	x
DIAT	Navicula	capitata	0	0	0	0	0	x
DIAT	Navicula	cryptocephala	x	0	x	0	x	0
DIAT	Navicula	cuspidata	0	0	x	0	0	0
DIAT	Navicula	hungarica	0	0	0	x	0	0
DIAT	Navicula	radiosa	0	x	0	0	0	0
DIAT	Neidium	iridis	0	0	x	0	x	0
DIAT	Nitzschia	acicularis	0	x	0	0	x	x
DIAT	Nitzschia	amphibia	0	0	0	0	x	x
DIAT	Nitzschia	bacillum	0	0	x	0	x	x
DIAT	Nitzschia	capitellata	0	0	0	x	x	0
DIAT	Nitzschia	dissipata	x	x	x	x	0	x
DIAT	Nitzschia	dubia	0	0	0	0	0	x
DIAT	Nitzschia	fonticola	0	0	0	x	x	0
DIAT	Nitzschia	graciliformis	x	x	0	0	0	0
DIAT	Nitzschia	gracilis	0	x	0	0	0	0
DIAT	Nitzschia	intermedia	0	0	0	0	0	x
DIAT	Nitzschia	lacuum	0	x	0	0	0	x
DIAT	Nitzschia	linearis	x	x	x	x	x	x
DIAT	Nitzschia	palea	x	0	0	x	x	x
DIAT	Nitzschia	pura	x	0	0	0	0	0
DIAT	Nitzschia	pusilla	0	0	x	0	0	0
DIAT	Nitzschia	recta	x	0	0	0	x	0
DIAT	Nitzschia	sigmoidea	0	0	x	x	x	0
DIAT	Nitzschia	sociabilis	x	x	0	0	x	0
DIAT	Nitzschia	solita	x	0	0	x	x	0
DIAT	Nitzschia	subacicularis	x	0	0	x	0	x
DIAT	Nitzschia	sublinearis	0	0	0	0	x	0
DIAT	Pinnularia	gibba	0	x	0	0	0	0

DIAT	Pinnularia	lundii	0	0	0	0	x	0
DIAT	Pinnularia	viridis	0	0	x	0	0	0
DIAT	Stephanodiscus	astraea	x	x	x	x	x	x
DIAT	Stephanodiscus	binderanus	x	0	x	0	0	0
DIAT	Surirella	ovata	x	0	x	x	x	0
DIAT	Surirella	robusta	x	x	x	x	x	x
DIAT	Synedra	capitata	0	0	0	0	0	x
DIAT	Synedra	ulna	x	0	x	0	0	0
DIAT	Tabellaria	fenestrata	0	x	0	0	0	0
DIAT	Tabellaria	flocculosa	x	0	x	x	x	x
DIAT	Tryblionella	hungarica	x	0	0	0	0	0
DIAT	**TOTAL**		**29**	**17**	**24**	**27**	**30**	**23**
DINO	Dinobryon	cylindricum	0	x	0	0	0	0
DINO	**TOTAL**		**0**	**1**	**0**	**0**	**0**	**0**
EUGL	Euglena	acus	0	0	0	0	0	x
EUGL	Phacus	torta	0	0	0	x	x	0
EUGL	Trachelomonas	volvocina	x	x	x	x	x	x
EUGL	**TOTAL**		**1**	**1**	**1**	**2**	**2**	**2**

Shannon-Wiener index of phytoplankton from Danube River and its delta braches varied in year 2013 between 0.37 and 2.49. (**Table 3.3.3**)

Table 3.3.3 Shannon-Wiener index variation in studied aquatic ecosystem

Data	Ceatal Chilia	Aval Izmail	Periprava	Ceatal Sf. Ghe.	Sulina	Sf. Gheorghe
3.2013	2.18	2.28	2.31	2.21	2.45	-
6.2013	1.43	1.72	1.81	1.53	1.96	1.83
9.2013	2.31	-	-	2.38	2.49	2.36
11.2013	-	-	0.37	2.47	-	2.47

3.3 *Zooplankton*

From 160 analyzed samples collected during 2009-2013 in four shalow lakes and five station in channels a total of 96 species of rotifers, 1 specie of harpacticoid copepods, 5 species of calanoid copepods, 21 species of cyclopoid copepod and 33 species of cladocerans were recorded.

In shallow permanent lakes, the most representative species were *Bosmina longirostris* (Müller, 1785), *Chydorus sphaericus* (Müller, 1776), *Daphnia galeata* (Sars, 1864), *Diaphanosoma brachyurum* (Liévin, 1848), *Simocephalus* sp., *Acanthocyclops viridis* (Kiefer, 1927), *Eucyclops serrulatus* (Claus 1893), *Macrocyclops albidus* (Claus 1893), *Thermocyclops crassus* (Sars, 1914), *T. oithonoides* (Sars, 1914), Brachionus (Pallas, 1766), *Trichocerca sp.* (Voigt, 1957), Asplanchna (Gosse, 1850) (**Table 3.3.1**).

In the river- branch the most representative species were *Bosmina longirostris* (Müller, 1785), Acanthocyclops (Kiefer, 1927)*, Thermocyclops oithonoides* (Sars, 1914), *Brachionus calyciflorus* (Pallas, 1766), *Keratella tecta* (Gosse, 1850), Asplanchna (Gosse, 1850) (**Table 3.3.1**).

Chydorus sphaericus has been commonly utilized as an indicator of eutrophic conditions in Danube Delta shallow lakes. Bosminid cladocerans have been utilized as indicators of trophic conditions for many decades. The classical species shift during eutrophication as determined primarily from paleolimnological studies, is from oligotrophic “species” *Bosmina longispina*, to the eutrophic species *Bosmina longirostris* (Gannon and Stemberger 1978).

Rotifers, therefore, respond more quickly to environmental changes than crustacean plankton and appear to be more sensitive indicators of changes in water quality.

Our investigation observed a different response in species richness and biodiversity for the various taxonomic groups.

Predominant species may have more functional importance than total species numbers in the zooplankton community. In our research only one to three copepods and two to four cladocerans were normally predominant.

Table 3.3.1 Zooplankton taxa found in the lakes and branchs studied (2009-2013).

Zooplankton species	Isac	Merhei	Rosu	Furtuna	Ceatal Sf. Gh.	Sf. Gh.	Ceatal Chilia	Sulina	Periprava
Branchiopoda, Cladocera									
Acroperus harpae	x								
Alona costata	x		x	x					
Alona rectangula coronata			x						
Alona quadrangularis	x					x			
Alonella exigua				x					
Alonella nana		x							

Biapertura affinis ornata							x		
Bosmina coregoni			x		x	x		x	
Bosmina longirostris	x	x	x	x	x	x	x	x	x
Camptocercus rectirostris				x					
Ceriodaphnia pulchella	x								
Ceriodaphnia reticulata	x								
Ceriodaphnia sp.	x								
Chydorus sphaericus	x	x	x	x	x			x	x
Pseudochydorus globossus				x					
Daphnia curvirostris								x	
Daphnia galeata	x		x			x		x	
Daphnia longispina	x			x	x			x	x
Diaphanosoma brachyurum	x	x	x	x		x	x	x	x
Graptoleberis testudinaria	x	x	x	x					x
Ilyocryptus agilis		x						x	
Latona setifera	x		x					x	
Leydigia acanthocercoides		x							
Leptodora kindti	x					x			
Moina macrocopa								x	
Moina brachiata	x								
Moina micrura	x		x		x			x	
Pleuroxus uncinatus	x	x							
Polyphemus pediculus		x							
Sida crystallina	x								
Simocephalus espinosus	x								
Simocephalus vetulus	x		x	x					
Simocephalus serrulatus	x								
Copeoda									
nauplius larva	x	x	x	x	x	x	x	x	x
copepodid stages	x	x	x	x	x	x	x	x	x
Copepoda, Calanoida									
Calanipeda aquae dulcis	x		x						
Eudiaptomus gracilis	x							x	
Eudiaptomus graciloides	x								
Euritemora velox		x							
Heterocope sp.	x								
Heterocope caspia							x		
Copepoda, Cyclopoida									
Acanthocyclops vernalis	x		x				x		
Acanthocyclops viridis	x						x	x	
Achantocyclops sp.	x		x						
Cyclops furcifer	x								
Cyclops insignis	x								
Cyclops rubens	x								
Cyclops strenus		x							
Cyclops vicinus	x		x						
Diacyclops bicuspidatus							x		
Eucyclops macruroides	x					x			
Eucyclops serrulatus	x	x			x	x	x	x	
Eucyclops sp.									
Ectocyclops phareratus		x					x		
Halicyclops sp	x							x	
Macrocyclops albidus	x		x	x		x		x	
Macrocyclops fuscus	x	x	x						
Mesocyclops leuckarti					x				
Microcyclops bicolor				x					
Paracyclops fimbriatus	x		x				x	x	
Thermocyclops crassus	x	x			x		x	x	
Thermocyclops oithonoides	x	x	x	x			x	x	
Unidentified cyclopoida	x		x	x	x			x	x
Copepoda, Harpacticoida									
Atheyella sp.		x		x	x		x		
Unidentified harpacticoida	x	x						x	
Rotifera									
Adineta oculata	x								
Anuaeropsis fissa	x	x	x	x			x		
Ascomorpha ecaudis	x	x		x					
Ascomorpha ovalis		x	x						
Ascomorpha saltans	x		x						
Ascomorpha volvocicola			x						
Asplanchna brightwellii							x		
Asplanchna herricki			x	x					

Asplanchna priodonta	x	x	x	x	x	x	x	x	x
Asplanchna sp.	x	x	x						
Asplanchnopus multiceps	x	x	x						
Brachionus angularis	x		x	x	x			x	
Brachionus angularis bidens	x	x	x			x	x		
Brachionus calyciflorus	x			x					x
Brachionus calyciflorus amphiceros	x	x	x	x		x	x	x	
Brachionus calyciflorus pala	x	x	x	x		x		x	
Brachionus diversicornis	x		x	x	x	x	x	x	
Brachionus diversicornis homoceras	x		x						
Brachionus falcatus	x								
Brachionus forficula	x								
Brachionus leydigi	x			x					
Brachionus leydigi rotundatus		x	x					x	
Brachionus quadridentatus	x		x	x		x		x	
Brachionus quadridentatus brevispinus			x					x	
Brachionus rubens	x								
Brachionus urceolaris		x	x					x	
Cephalodella forficula				x					
Cephalodella gibbba		x	x						
Cephalodella sp			x						
Colurella colurus		x	x						
Colurella obtusa			x						
Colurella sp.	x								
Conochilus unicornis			x						
Cyrtonia tuba	x		x						
Dissotrocha aculeata	x								
Enteroplea lacustris	x								
Epiphanes brachionus	x		x						
Epiphanes macrourus	x								
Epiphanes senta	x	x	x						
Euchlanis dilatata	x	x	x	x				x	
Euchlanis incisa	x								
Filinia dolicoptera	x								
Filinia longiseta	x	x	x				x		
Filinia limnetica									
Gastropus hyptopus	x		x						
Gastropus stilyfer	x	x	x						
Habrotrocha gracilis			x						
Habrotrocha sp.	x								
Harringia eupoda			x						
Hexarthra sp.	x		x						
Keratella cochlearis	x	x	x	x				x	
Keratella quadrata	x	x	x	x	x		x	x	x
Keratella tecta	x		x			x	x		
Keratella valga heterospina	x								
Lecane cornuta	x								
Lecane luna	x		x				x		
Lecane sp.	x					x			
Lepadella quadricarinata	x								
Lindia sp.	x								
Macrotrachela sp.	x								
Microcodides chlaena	x	x							
Mytilinia mucronata	x	x	x	x				x	
Mytilinia trigona	x								
Notholca acuminata	x	x	x	x					
Notholca foliacea		x	x	x					
Notholca labis	x	x	x	x					
Notholca squamula				x					
Notommata sp.	x		x						
Philodina sp.	x								
Platyias polyacanthus	x	x		x					
Platyias quadricornis	x		x						
Pleurotrocha (Proales) petromyzon			x						
Ploesoma hudsoni			x						
Polyarthra dolichoptera		x	x						
Polyarthra euryptera	x		x						

Polyarthra major	x						x		
Polyarthra remata	x	x	x	x		x			
Polyarthra vulgaris	x	x	x	x				x	
Pompholyx sulcata	x	x	x	x	x			x	
Rhinoglena frontalis	x	x	x						
Rotaria rotatoria								x	
Rotaria elongata	x								
Squatinella leydigi	x								
Synchaeta longipes	x	x	x						
Synchaeta oblonga			x						
Synchaeta pectinata			x						
Synchaeta sp.	x	x	x						
Testudinella mucronata	x								
Testudinella patina	x	x							
Trichocerca bicristata					x				
Trichocerca capucina		x							
Trichocerca cylindrica	x								
Trichocerca elongata	x								
Trichocerca longiseta	x							x	
Trichocerca porcellus	x								
Trichocerca pussilla	x								
Trichocerca rattus	x								
Trichocerca similis	x								
Trichocerca sp.	x				x	x		x	
Trichotria pocillum	x	x	x				x		
Nematoda		x	x						
Chironomidae st I	x	x	x	x					

One hundred fifty species were identified from collections made in 2009-2013 at lake stations and sixty-one were captured in branch stations. The zooplankton community was numerically dominated by small-sized specimens (mostly nauplii and rotifers) (**Figure 3.3.1**).

The maximum total abundance occurred in Merhei lake (196 ind./l) and the minimum in Sulina arm (4 ind/l) (whole system averages) were found here *Bosmina* sp., *Trichocerca* sp., *Brachionus* sp., sporadically and usually in small numbers. Zooplankton taxa was also dominant in terms of total biomass (average values), accounting for 0.08mg/l ww (minimum, Ceata Sf Gheorghe) and 3.4mg/l ww (maximum, Rosu lake) (**Figure 3.3.1**).

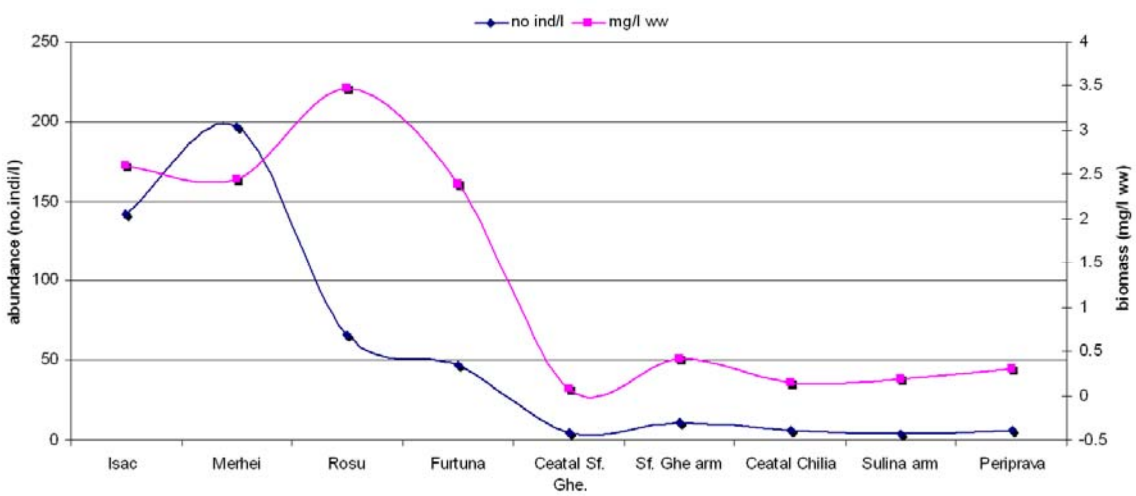

Figure 3.3.1 Zooplankton distributions of abundance and biomass whet substances during the study period

Rotifers were the dominant group on all sampling dates and accounted for 64% in Lakes to 50% in Danube branches, of the total zooplankton density (**Figure 3.3.2**; **Figure 3.3.3**).

Cladocerans were found in all zones; the group was second to the Copepoda in terms of density (average value 20%) and in terms of total biomass, accounting for 2.44 mg/l (maximum, Isac lake) and 0.04mg/l wet weight in Chilia arm (minimum).

The most frequent species (*Bosmina longirostris* and *Chydorus sphaericus*), displayed their higher densities usually in March and September. The predaceous cladoceran *Leptodora kindtii* was a minor component of the group in terms of both numbers and biomass and was found in Isac lake and Sf. Gheorghe.

The zooplankton taxonomic groups of the Danube Delta lakes are essentially represented by Rotifers (64 %) with a predominance of the family Brachionidae (35.41 %) (**Figure 3.3.2**). All data on zooplankton indicate that lakes have features typical of shallow lakes with moderate productivity, due to the predominantly species which have more functional importance than total species numbers in the zooplankton community.
Predators are thought to be the main factor controlling the spatial distribution, abundance and body size of zooplankton in shallow lakes. The small size of the dominant cladocerans and the dominance by copepods and rotifers likely reflect the extremely high abundance of the potential predators, particularly the planktivorous fish.

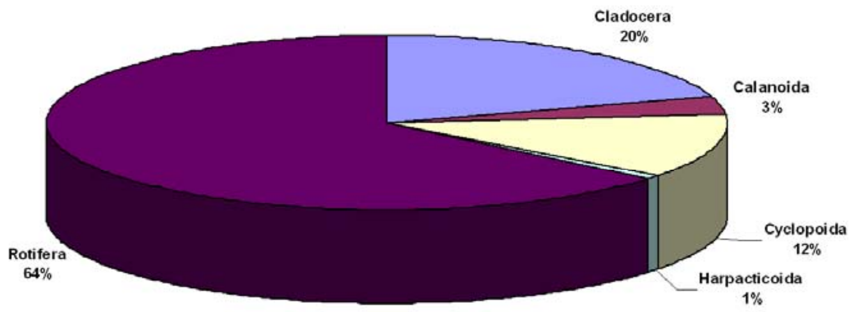

Figure 3.3.2 Percentage of taxonomic groups in studied lakes (2009-2013)

The rotifers dominate with 50% in arms, followed by small cladocerans (**Figure 3.3.3**). Some species, especially among the cladocerans, occurred irregularly, usually in a small numbers and were not present in all branch stations.

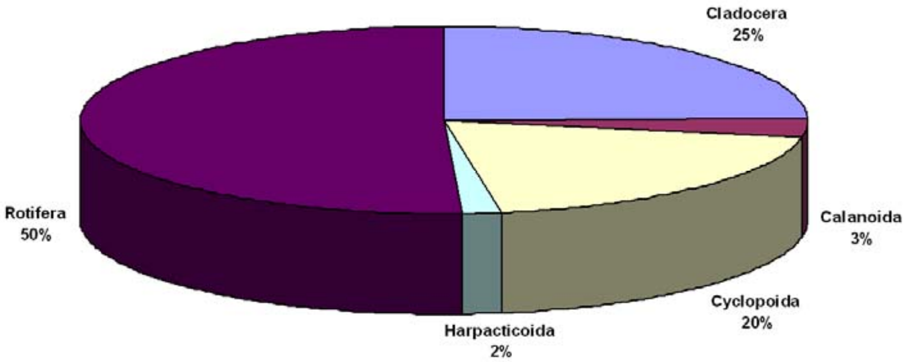

Figure 3.3.3 Percentage of taxonomic groups in channel and arms (2009-2013)

Our results confirm those of other studies indicating that rotifers and cladocera are the most dominant species in the communities of lakes. In the branch stations, zooplankton population, are generally low, rotifers are present in all analyzed sites. The species identified show a wide ecological valence and are commonly distributed in the eutrophic aquatic ecosystems of Danube Delta Biosphere Reserve.

3.4. Macroinvertebrates

This report includes an assessment of temporal and spatial variation of macroinvertebrates community in 4 lakes from Danube Delta between 2009 and 2013. Macroinvertebrate communities and measures of these communities were evaluated and a baseline characterization of assemblages was determined for the analyzed sites.

Metrics are commonly used to characterize the community structure or biological condition of an aquatic ecosystem. Overall, metrics related to taxonomic composition and abundance can be indicative of the general condition of the invertebrate community. The two metrics selected (taxa richness, abundance,) are not calibrated to a reference or control site, but relative comparisons among the sites were made to provide assessment of the macroinvertebrate communities and measures of these communities.

Taxa richness (total taxa) can be useful in describing the biological condition of lake. It generally increases with improving water quality and/or habitat diversity. Total abundance of the macroinvertebrates across taxa decreases when communities are exposed to stress such as degraded water quality or habitat alteration that can result from natural or manmade influences.

The highest number of taxons are recorded in Fortuna lake in 2011 and Merhei in 2010. In general Fortuna lake has higher taxa richeness in all investigated years with the exception of 2012. Most constant among lakes regarding the number of taxon is Isac. Here, in the entire time interval the values of richness was between 21 and 26 taxon. Other lakes are characterized by a greater difference between different years (**Figure 3.4.1**).

Total abundance followed a pattern similar to taxa diversity with Fortuna and Isac having the highest yearly values and Rosu and Merhei having just 1 year with high total abundance (**Figure 3.4.2**) (the exception is due to high number of oligochaeta).

All lakes had a consistent high relative abundance of chironomids (**Figure 3.4.3**).

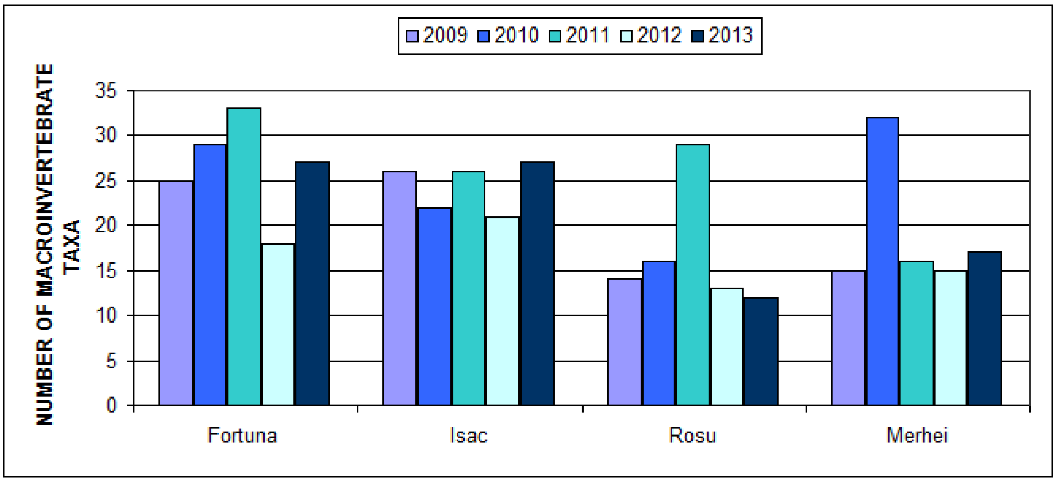

Figure 3.4.1 Number of macroinvertebrate taxa collected during 2009-2013 in analyzed lakes

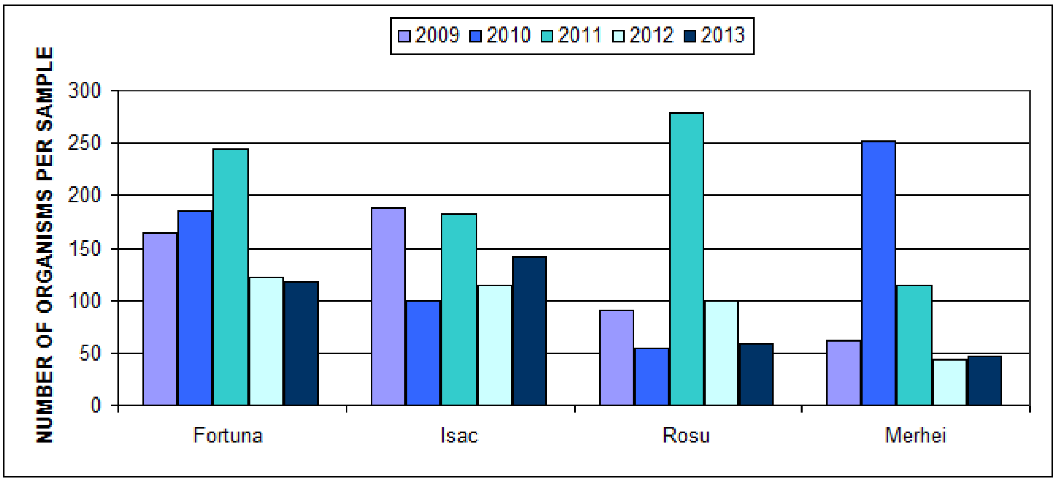

Figure 3.4.2 Abundance of macroinvertebrate taxa collected during 2009-2013 in analyzed lakes

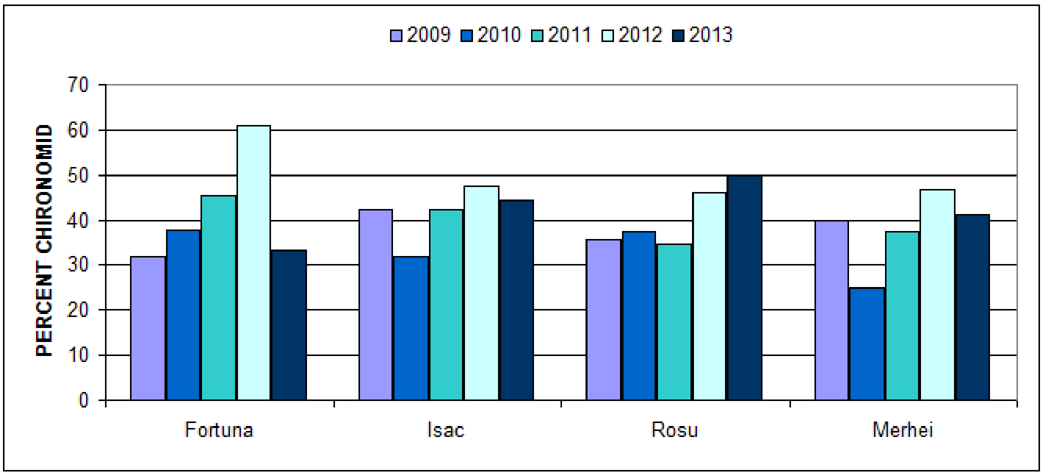

Figure 3.4.3 Relative abundance of chironomid collected during 2009-2013 in analyzed lakes

Benthic macroinvertebrate taxa collected from selected sites in the Danube Delta (Fortuna, Isac, Rosu and Merhei lakes) are listed (**Table 3.4.1**). Kick net/hand net and dredge sampling yielded the identification of 89 macroinvertebrate taxa. As a percentage of taxa richness Dipterans (Chironomidae) accounted for 52% of the taxa.

Table 3.4.1 Macroinvertebrate taxa in Fortuna, Isac, Rosu and Merhei lakes collected between 2009-2013

Species/ Lakes	Fortuna_2013	Isac_2013	Rosu_2013	Merhei_2013	Fortuna_2012	Isac_2012	Rosu_2012	Merhei_2012	Fortuna_2011	Isac_2011	Rosu_2011	Merhei_2011	Fortuna_2010	Isac_2010	Rosu_2010	Merhei_2010	Fortuna_2009	Isac_2009	Rosu_2009	Merhei_2009
Ablabesmyia longistyla	x			x							x									
Ablabesnyia monilis		x	x					x			x	x	x							
Ablabesmyia phatta	x								x			x					x			
Procladius choreus	x	x	x	x	x	x				x	x		x	x	x	x	x	x	x	x
Tanypus kraatzi									x	x			x							
Tanypus punctipennis		x							x					x				x		
Tanypus vilipennis	x	x											x	x	x		x	x		
Cricotopus algarum													x							
Cricotopus bicinctus									x											
Cricotopus	x	x				x			x	x	x		x			x	x	x		

Species/ Lakes	Fortuna_2013	Isac_2013	Rosu_2013	Merhei_2013	Fortuna_2012	Isac_2012	Rosu_2012	Merhei_2012	Fortuna_2011	Isac_2011	Rosu_2011	Merhei_2011	Fortuna_2010	Isac_2010	Rosu_2010	Merhei_2010	Fortuna_2009	Isac_2009	Rosu_2009	Merhei_2009
flavocinctus																				
Cricotopus fuscus									x											
Cricotopus sylvestris		x			x				x	x								x		
Metriocnemus scirpi										x				x		x				
Nanocladius dichromus			x				x												x	
Psectrocladius psilopterus	x																x			
Chironomus pallidivittatus															x	x				
Chironomus plumosus		x				x				x	x		x	x		x		x		
Chironomus annularius	x			x	x							x				x	x			x
Chironomus anthracinus				x				x	x											x
Chironomus riparius		x				x			x									x		
Chironomus dorsalis																				
Cryptochironomus albofasciatus		x				x							x					x		
Cryptochironomus defectus				x							x									x
Dicrotendipes nervosus											x	x	x		x	x				
Dicrotendipes tritomus															x					
Einfeldia pagana			x				x				x			x					x	
Endochironomus tendens											x									
Endochironomus dispar						x			x											
Glyptotendipes barbipes					x	x	x	x	x	x		x								
Glyptotendipes gripekoveni					x		x		x	x		x	x							
Harnischia curtilamellata					x									x						
Harnischia fuscimana					x															
Kiefferulus tendipediformis							x	x	x	x			x							
Microchironomus tener	x	x	x		x				x	x							x	x	x	
Parachironomus				x				x												x

Species/ Lakes	Fortuna_2013	Isac_2013	Rosu_2013	Merhei_2013	Fortuna_2012	Isac_2012	Rosu_2012	Merhei_2012	Fortuna_2011	Isac_2011	Rosu_2011	Merhei_2011	Fortuna_2010	Isac_2010	Rosu_2010	Merhei_2010	Fortuna_2009	Isac_2009	Rosu_2009	Merhei_2009
arcuatus																				
Parachironomus vitiosus																				
Paracladopelma camptolabis		x	x				x								x			x	x	
Paratendipes albimanus																x				
Paratendipes intermedius					x															
Polypedilum exsectum								x			x									
Polypedilum sordens	x					x											x			
Polypedilum nubeculosum					x															
Polypedilum pedestre					x	x														
Polypedilum convictum									x											
Micropsectra radialis		x		x		x		x		x								x		x
Paratanytarsus sp.																				
Caenis horaria	x	x		x	x	x		x	x	x	x	x	x	x	x	x	x			x
Cloeon dipterum	x	x	x		x		x		x	x	x	x	x	x		x				
Ferrissia clessiniana	x	x				x			x	x				x		x		x		
Valvata piscinalis piscinalis		x			x	x				x				x		x	x			
Anisus spirorbis										x										
Viviparus viviparus	x																			
Viviparus sp.													x		x	x	x			x
Lithoglyphus naticoides				x				x												
Bithynia leachii leachii		x			x	x					x									
Bithynia tentaculata	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x		
Lymnaea stagnalis	x			x					x	x	x		x			x				
Radix auricularia									x	x	x		x			x	x			
Planorbis carinatus		x	x				x													
Planorbis planorbis						x			x											
Gyraulus albus		x												x		x				
Planorbarius	x			x					x				x		x		x	x		x	

Species/ Lakes	Fortuna_2013	Isac_2013	Rosu_2013	Merhei_2013	Fortuna_2012	Isac_2012	Rosu_2012	Merhei_2012	Fortuna_2011	Isac_2011	Rosu_2011	Merhei_2011	Fortuna_2010	Isac_2010	Rosu_2010	Merhei_2010	Fortuna_2009	Isac_2009	Rosu_2009	Merhei_2009
corneus																				
Physa fontinalis	x												x	x	x	x				
Stagnicola sp.											x							x		
Notonecta sp.				x		x		x	x		x									
Heteroptera Gen. sp.				x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	
Ranatra linearis	x	x	x			x	x			x		x						x		
Veliidae Gen. sp.	x	x	x				x		x		x	x	x		x	x	x	x	x	x
Noterus clavicornis									x											
Dytiscus sp.		x								x			x			x	x			
Laccophilus poecilus										x								x		
Laccophilus sp.																	x			
Cybister lateralimarginalis Lv.	x																x		x	
Haliplus sp.	x										x									
Lepidoptera Gen. sp.											x			x		x		x		
Cyrnus sp.											x		x			x				
Ecnomus tenellus	x								x	x	x		x			x	x		x	
Oecetis furva		x				x			x				x			x		x		
Coenagrionidae Gen. sp.	x			x					x		x		x	x	x	x	x	x	x	x
Gammaroidea Gen. sp.	x	x					x	x			x	x		x	x	x	x	x	x	x
Asellus aquaticus	x	x	x	x					x		x	x	x	x	x	x	x	x	x	x
Corophium curvispinum																				x
Piscicolidae Gen. sp.																				
Glossiphonia complanata	x					x						x	x			x	x	x		
Helobdella stagnalis										x										
Hemiclepsis marginata								x												x
Erpobdella octoculata	x			x	x													x		
Hirudo medicinalis		x							x		x			x		x				
Oligochaeta Gen. sp.					x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

3.5. Macrophytes

General considerations on water quality state as defined according to Water Framework Directive by using aquatic macrophytes (**Table 3.5.1**). Very good state - The taxonomic composition completely or almost completely corresponds to unmodified conditions. There are no detectable changes in the macrophytes average abundance. Good state – There are slight changes in taxonomic composition and macrophyte abundance compared to the communities characteristic for that type. Such changes do not indicate an accelerated increase of macrophyte or some superior forms, which should lead to undesirable disturbances with regard to either the organisms present within the water body or water physic-chemical quality or sediments. Moderate state – Macrophyte taxonomic composition differs moderately from the characteristic composition of the type and is significantly disturbed as compared to the good- state conditions. Moderate changes are spotlighted in macrophyte medium abundance (**Table 3.5.2)**.

Table 3.5.1 Reference conditions for Danube Delta Biosphere Reserve

Macrophytes	
For lakes	
Community type lake close to lake shore	*Charetum tomentosae*, *Nytellopsidetum obtusae* *Myriophillo-Potametum*, *Ceratophillo-Utricularietum*, *Nymphaeetum albo-lutae*
diversity (no. and species type)	> 10 species, without invasive species
abundance	Significant number of species, without mono-dominant macrophytes species

Table 3.5.2 Macrophyte surveillance 2009-2013

Lake name	**Qai**	**Qbi**	**Qci**	**Qgi**	**RI**	**Macrophyte community**	Ecological state	**Species richness (number of species)**	Ecological state	**Abundance**	Ecological state
2009											
Furtuna	0	3	48	77	-62.34	Cer	P	<7	B	2	P
Isac	0	42	48	378	-12.70	CerNit	VG	<3	P	1	P
Merheiu Mar	0	18	63	243	-25.93	CerNym	M	<3	P	1	P
Rosu	0	0	18	66	-27.27	CerPot	M	<3	P	1	P
2010											
Furtuna	4	3	48	77	-57.14	Cer	P	<7	B	2	P
Isac	2	45	39	378	-9.79	CerNit	VG	<3	P	3	M
Merheiu Mar	4	20	65	243	-25.10	CerNym	M	<3	P	1	P
Rosu	0	2	20	66	-30.30	CerPot	M	<3	P	1	P
2011											

Furtuna	3	4	46	77	-55.84	Cer	P	<6	M	2	P
Isac	3	47	53	378	-13.23	CerNit	VG	<10	B	3	M
Merheiu Mar	12	37	69	243	-23.46	CerNym	B	<8	M	1	P
Rosu	2	5	35	66	-50.00	CerPot	P	<3	P	1	P
2012											
Furtuna	10	6	49	90	-43.33	Cer	M	<6	M	3	M
Isac	2	37	47	378	-11.90	CerNit	VG	<3	P	1	P
Merheiu Mar	4	17	67	243	-25.93	CerNym	M	<3	P	1	P
Rosu	2	3	19	66	-25.76	CerPot	M	<3	P	0	FP
2013											
Furtuna	4	4	45	77	-53.25	Cer	P	<3	P	2	P
Isac	2	2	44	378	-11.11	CerNit	VG	<6	M	1	P
Merheiu Mar	1	13	59	243	-23.87	CerNym	B	<6	M	1	P
Rosu	2	2	20	66	-27.27	CerPot	M	<3	P	1	P

Qai - sensitive species index
Qbi - indifferent species index
Qci - tolerant species index
Qgi - total index (Qai, Qbi, Qci) - TRS = Trophic Ranking Score
RI - TMI - trophic macrophyte index RS = Ranking Score (VG=1-15; G=15-25; M=25-50; P=50-75; VP=75-100);
abundance (1=<1-15%;2=15-25%;3=25=50%;4=50-75%;5=75-100%)

In the **Figure 3.5.1** the trophic macrophyte index in relation with lake connectivity it is shown. The aquatic vegetation of the lakes in the Danube Delta is depending both spatially and temporally on complex biogeochemical gradients. These gradients strongly represent the degree of connectivity. Lakes where river water loaded with silt has direct access are characterized by dominance of vegetation of the *Trapa natans*-type (Fortuna Lake). The type of substrate is a major influence. In the large open lakes with mineral sediment, the *Potamogeton* type growth form is characteristic. In such lakes the light climate may be determined strongly by algal biomass, which in turn may be positively affected by the increased residence time of nutrient-rich water in early summer, as well as increased suspension due to wind action and the presence of benthic fish species. This group of lakes (Isac, Fortuna, Merheiu Mare and Rosu) showed clear water in the June samples. However, the clearness of the water seemed to be a temporary phenomenon in the falling water stage as filamentous algae beds overgrow the aquatic vegetation in a later stage. Observations in late summer indicate an absence of dense aquatic plant beds. On the other hand, Fortuna and Rosu lakes only showed sparse vegetation cover throughout the season.

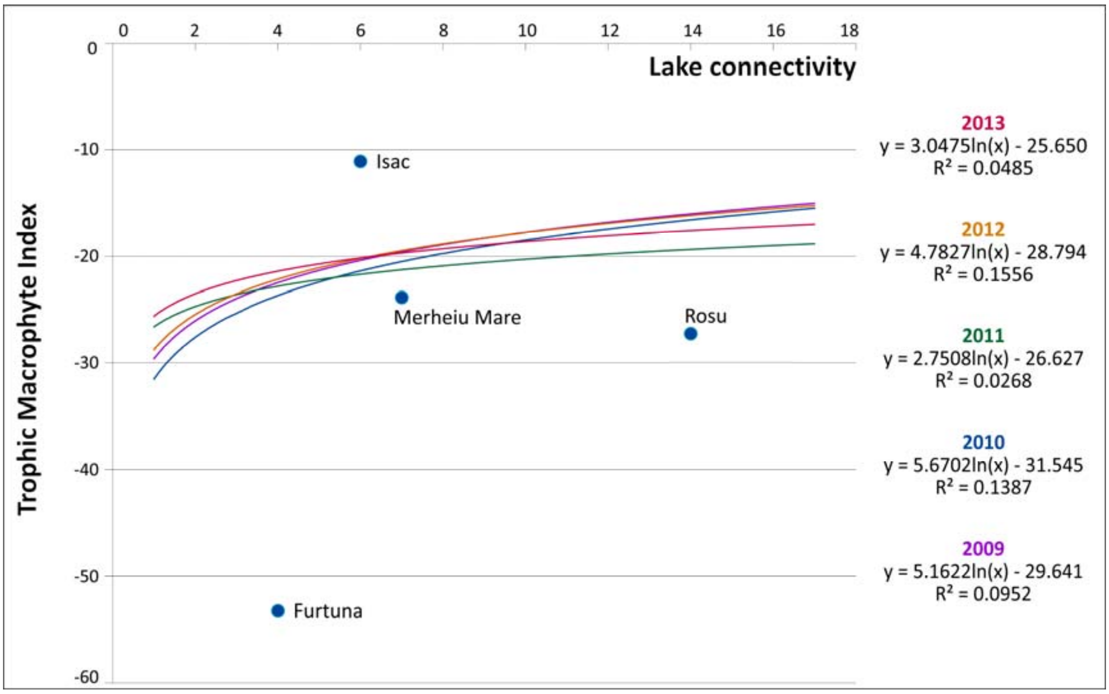

Fig. 3.5.1 Trophic macrophyte evaluation

According to literature, in DDBR water bodies there were identified 50 aquatic macrophyte species from which 1 is included in Habitats Directive, annex 2, 11 are considered rare or vulnerable according to the national red list and 4 are alien species.

List of aquatic species from Danube Delta Biosphere Reserve (DDBR)
Abbreviations used in the list: B – European taxon, E – endangered, b – subendemic, DH2 – Habitat Directive; EN – endangered, CR – critically endangered, LR – low risk, R – rare.

1. *Aldrovanda vesiculosa* L.; *Droseraceae;* Cosmopolite; Obretinul Mare; E (B), DH2; CR
2. *Ceratophyllum demersum* L.; *Ceratophyllaceae*; Cosmopolite; Danube Delta.
3. *Ceratophyllum demersum* L. subsp. *platyacanthum* (Cham.) Nyman; *Ceratophyllaceae*; (*Ceratophyllum pentacanthum* Haynald; *Ceratophyllum platyacanthum* Cham.; *Ceratophyllum komarovii* Kuzen.); Europe; Gorgova, Obretinul Mare; R.
4. *Ceratophyllum submersum* L.; *Ceratophyllaceae*; Europe; Erenciuc, Gorgova, Letea, Periprava, Somova – Parches.
5. *Elodea canadensis* Michx.; *Hydrocharitaceae*; (*Anacharis canadensis* Planch.; *Anacharis alsinastrum* Bab.); *North America; Obretinul Mare, Fortuna, Uzlina and Isac lakes.
6. *Elodea nuttallii* (Planch.) H. St. John; *Hydrocharitaceae*; (*Anacharis nuttallii* Planch.); *North America; Danube Delta.

7. *Lemna gibba* L.; *Lemnaceae*; (*Telmatophace gibba* (L.) Schleid.); Cosmopolite; Crisan, Rusca., Sahalin, Sontea-Fortuna.
8. *Lemna minor* L.; *Lemnaceae*; Cosmopolite; Danube Delta.
9. *Lemna minuta* H. B. K.; *Lemnaceae*; (*Lemna minuscula* Herter); *North America; Danube Delta (Nebunu, Răducu lakes, Ciamurlia fishing arrangement).
10. *Lemna trisulca* L.; *Lemnaceae*; Cosmopolite; Danube Delta.
11. *Myriophyllum spicatum* L.; *Haloragaceae*; (*Myriophyllum montanum* Martrin-Donos); Circumpolar; Danube Delta.
12. *Myriophyllum verticillatum* L.; *Haloragaceae*; Circumpolar; Gorgova, Șontea-Fortuna, Răducu lake.
13. *Najas marina* L.; *Najadaceae*; (*Najas major* All.); Cosmopolite; Dranov, Dunăvăț, Obretinul Mare, Sf. Gheorghe, Răducu lake.
14. *Najas minor* All.; *Najadaceae*; Sub-Mediterranean; R; Dranov, Sahalin, Sf. Gheorghe., Sulina.
15. *Nuphar lutea* Sm.; *Nymphaeaceae*; (*Nymphosanthus luteus* (L.) Fernald; *Nymphaea lutea* L.); Eurasia; Danube Delta.
16. *Nymphaea alba* L.; *Nymphaeaceae*; (*Nymphaea minoriflora* (Simonk.) E. D. Wissjul.; *Nymphaea occidentalis* (Ostenf.) Moss; *Castalia alba* (L.) Wood); Europe; Danube Delta.
17. *Nymphaea candida* C. Presl; *Nymphaeaceae*; (*Nymphaea fennica* Mela; *Castalia candida* (C. Presl) Schinz & Thell.); Eurasia; Erenciuc, Lopatna, Matiţa and Merhei lakes; R.
18. *Nymphoides peltata* (S. G. Gmel.) Kuntze; *Menyanthaceae*; (*Limnanthemum nymphoides* (L.) Hoffmanns. & Link; *Nymphoides orbiculata* Druce; *Limnanthemum peltatum* S. G. Gmel.; *Nymphoides flava* Druce); Eurasia; Danube Delta.
19. *Potamogeton acutifolius* Link; *Potamogetonaceae*; Europe; Gorgova, Obretinul Mare, Șontea-Fortuna.
20. *Potamogeton berchtoldii* Fieber *Potamogetonaceae*; (*Potamogeton pusillus* auct., non L.; *Potamogeton pusillus* L. subsp. *typicus* Dostál); Eurasia; Răducu lake.
21. *Potamogeton compressus* L.; *Potamogetonaceae*; (*Potamogeton zosterifolius* A. Schumach.); Circumpolar; Gorgova, Letea, Răducu lake; R.
22. *Potamogeton crispus* L.; *Potamogetonaceae*; Cosmopolite; Danube Delta.
23. *Potamogeton gramineus* L.; *Potamogetonaceae*; (*Potamogeton lonchites* Tuck.; *Potamogeton rufescens* Schrad. subsp. *nigrescens* (Fr.) Nyman; *Potamogeton heterophyllus* Schreb.); Circumpolar; Danube Delta.
24. *Potamogeton lucens* L.; *Potamogetonaceae*; Eurasia; Danube Delta.
25. *Potamogeton natans* L.; *Potamogetonaceae*; Circumpolar; Danube Delta.
26. *Potamogeton nodosus* Poir.; *Potamogetonaceae*; (*Potamogeton leschenaultii* Cham. & Schltdl.); Circumpolar; Danube Delta.

27. *Potamogeton obtusifolius* Mert. & W.D.J.Koch; *Potamogetonaceae*; Circumpolar; Danube Delta.
28. *Potamogeton pectinatus* L.; *Potamogetonaceae*; (*Potamogeton balatonicus* (Gams) Soó; *Potamogeton helveticus* (G. Fisch.) W. Koch; *Potamogeton zosteraceus* Fr.; *Potamogeton vaginatus* Turcz. subsp. *helveticus* (G. Fisch.) W. Koch); Cosmopolite; Danube Delta.
29. *Potamogeton perfoliatus* L.; *Potamogetonaceae*; Cosmopolite; Gorgova, Șontea-Fortuna, Goloviţa, Sinoe and Razelm lakes.
30. *Potamogeton pusillus* L.; *Potamogetonaceae*; (*Potamogeton panormitanus* Biv.; *Potamogeton gracilis* Fr., non Wolfg.); Circumpolar; Caraorman, Gorgova, Letea, Roşu, Puiu lakes.
31. *Potamogeton trichoides* Cham. & Schltdl.; *Potamogetonaceae*; Eurasia; Danube Delta, R.
32. *Ranunculus aquatilis* L.; *Ranunculaceae*; (*Ranunculus heterophyllus* Weber; *Batrachium radians* (Revel) Dumort.; *Batrachium aquatilis* (L.) Dumort.; *Ranunculus diversifolius* Gilib.; *Ranunculus capillaceus* Thuill.; *Batrachium gilibertii* V. I. Krecz.; *Ranunculus godronii* Gren.; *Ranunculus radians* Revel); Cosmopolite; Danube Delta.
33. *Ranunculus circinatus* Sibth.; *Ranunculaceae*; (*Ranunculus divaricatus* sensu Histria J. Coste, non Schrank; *Batrachium foeniculaceum* auct., non (Gilib.) V. I. Krecz.; *Ranunculus capillaceus* Thuill.; *Batrachium circinatum* (Sibth.) Fr.); Eurasia; Gorgova, Șontea-Fortuna, R.
34. *Ranunculus rionii* Lagger; *Ranunculaceae*; (*Batrachium rionii* (Lagger) Nyman); Eurasia; Letea, Sulina.
35. *Ranunculus trichophyllus* Chaix; *Ranunculaceae*; (*Ranunculus paucistamineus* Tausch; *Ranunculus brattius* Beck; *Batrachium confervoides* Fr.; *Ranunculus drouetii* F. W. Schultz ex Godr.; *Ranunculus flaccidus* Pers.; *Batrachium drouetii* (F. W. Schultz ex Godr.) Bosch; *Batrachium divaricatum* (Schrank) Wimm.; *Batrachium paucistamineum* (Tausch) F. W. Schultz; *Ranunculus divaricatus* Schrank; *Batrachium trichophyllum* (Chaix) Bosch); Europe; Danube Delta.
36. *Ruppia cirrhosa* (Petagna) Grande; *Ruppiaceae*; (*Ruppia spiralis* L. ex Dumort.; *Ruppia spiralis* L. ex Dumort. subsp. *spiralis*; *Ruppia drepanensis* Tineo; *Ruppia maritima* L. subsp. *spiralis* (L. ex Dumort.) Asch. & Graebn.; *Ruppia maritima* auct., non L.); Cosmopolite; Sinoe lake near to Grindul Lupilor and Portița; vulnerable.
37. *Ruppia maritima* L.; *Ruppiaceae*; (*Ruppia rostellata* W. D. J. Koch; *Ruppia spiralis* L. ex Dumort. subsp. *transsilvanica* (Schur) Nyman; *Ruppia aragonensis* Loscos; *Ruppia brachypus* J. Gay); Cosmopolite; Letea, Sulina; vulnerable/R.
38. *Spirodela polyrhiza* (L.) Schleid.; *Lemnaceae*; (*Lemna polyrhiza* L.); Cosmopolite; Danube Delta.

39. *Stratiotes aloides* L.; *Hydrocharitaceae*; Eurasia; Danube Delta. vulnerable.
40. *Trapa natans* L.; *Trapaceae*; (*Trapa astrachanica* (Flerow) N. A. Winter; *Trapa carinthiaca* (Beck) V. N. Vassil.; *Trapa rossica* V. N. Vassil.; *Trapa maeotica* Woronow; *Trapa colchica* Albov; *Trapa conocarpa* (F. Aresch.) Flerow; *Trapa septentrionalis* V. N. Vassil.; *Trapa sprygini* V. N. Vassil.; *Trapa hungarica* Opiz; *Trapa cruciata* (Glück) V. N. Vassil.; *Trapa europaea* Flerow); Eurasia; Danube Delta, vulnerable.
41. *Trapa natans* L. subsp. *muzzanensis* (Jäggi) Schinz; *Trapaceae*; Europe; Nebunu and Băclăneşti lakes.
42. *Utricularia australis* R.Br.; *Lentibulariaceae*; (*Utricularia neglecta* Lehm.; *Utricularia jankae* Velen.; *Utricularia major* auct.); Europe; Sulina; vulnerable/R..
43. *Utricularia bremii* Heer; *Lentibulariaceae*; Central Europe; Danube Delta; vulnerable/R.
44. *Utricularia vulgaris* L.; *Lentibulariaceae*; (*Utricularia dubia* Rosell.); Circumpolar; Danube Delta; R.
45. *Vallisneria spiralis* L.; *Hydrocharitaceae*; *Tropics; Danube Delta; vulnerable/R.
46. *Veronica anagallis-aquatica* L.; *Scrophulariaceae*; (*Veronica maresii* Sennen; *Veronica lysimachioides* Boiss.; *Veronica minniana* Merino; *Veronica espadamae* Pau; *Veronica anagallis* auct.; *Veronica reyesana* Pau & Merino; *Veronica anagallidiformis* Boreau); Circumpolar; Danube Delta.
47. *Wolffia arrhiza* (L.) Horkel ex Wimm.; *Lemnaceae*; (*Lemna arrhiza* L.; *Wolffia michelii* Schleid.); Cosmopolite; Somova – Parcheș, Cernovca island; vulnerable; EN.
48. *Zannichellia palustris* L. subsp. *pedicellata* (Wahlenb.& Rosén) Arcang.; *Zannichelliaceae*; (*Zannichellia polycarpa* Nolte ex Rchb.; *Zannichellia pedicellata* (Wahlenb. & Rosén) Fr.; *Zannichellia pedunculata* Rchb.; *Zannichellia peltata* Bertol.; *Zannichellia repens* Boenn.; *Zannichellia major* (Hartm.) Boenn. ex Rchb.; *Zannichellia macrostemon* J. Gay ex Willk.; *Zannichellia dentata* Willd.); Cosmopolite; Perisor, Goloviţa and Sinoe lakes near to Grindul Lupilor and Portița; Sea Side area; R.
49. *Zostera marina* L.; *Zosteraceae*; Circumpolar; Histria, and Sinoe lake; R ., vulnerable. Sea Side area.
50. *Zostera noltii* Hornem.; *Zosteraceae*; (*Zostera nana* pro parte); Atlantic - mediterranean; Sea Side area, Sinoe, Razelm and Goloviţa lakes; R.; vulnerable.

The enlisted species provided a check list for the field monitoring within the studied lakes. Also any macrophyte species with a certain conservation status that was identified in the field can determine additional management measures via ecological status.

3.6 Fish

In lake-complexes from DDBR was captured 37 fish species (**Table 3.6.1**) in 2005-2011 period (Nastase and Navodaru 2006, Nastase 2007, Nastase and Navodaru 2008, Nastase 2009, Nastase et. al. 2009, Nastase and Navodaru 2010, Navodaru et. al. 2004, Nastase and Navodaru 2011).

Table 3.6.1 Fish species richness from RBDD lake-complexes captured in the past (2005-2013)

No.	Species (scientific name, old name and author)	Importance		Ecological classification				
		Commercial value	Origin	Preference for current	Salinity	Adult feed	Tolerance to habitat degradation	Tolerance to low oxygen
1	*Abramis brama* L. 1758	**	n	stag-reo	dulc	omni	tole	tole
2	*Alburnus alburnus* L. 1758	*	n	reo-stag	dulc	omni	tole	tole
3	*Alosa tanaica (A. caspia nordmanni)* Antipa 1906	*	n	migr	euri	omni	into	inter
4	*Hypophthalmichthys (Aristichthys) nobilis* Richardson, 1845	**	e	stag-reo	dulc	zoopl	tole	tole
5	*Aspius aspius* L. 1758	**	n	reo-stag	dulc	ihtio	into	into
6	*Atherina boyeri* Risso, 1810	*	n	stag	euri	bent	tole	tole
7	*Blicca bjoerkna* L. 1758	*	n	stag-reo	dulc	omni	tole	tole
8	*Carassius carassius* L.1758	**	n	limn	dulc	omni	tole	tole
9	*Carassus gibelio* L. 1758	**	n	eury	dulc	omni	tole	tole
10	*Cobitis sp.* L. 1758		n	eury	dulc	bent	inter	inter
11	*Cyprinus carpio* L. 1758	***	n	stag-reo	dulc	omni	tole	tole
12	*Clupeonella cultriventris* Nordmann, 1840	*	n	migr	euri	zoopl	tole	tole
13	*Esox lucius* L. 1758	***	n	limn	dulc	ihtio	into	tole
14	*Gymnocephalus cernuus* (*Acerina cernua*)L. 1758		n	limn	dulc	bent	tole	tole
15	*Hypophthalmichthys molitrix* Valenciennes, 1844	***	e	stag-reo	dulc	fito	tole	tole
16	*Knipowitschia caucasica Berg,1916*		n	limn	euri	bent	into	into
17	*Lepomis gibbosus* L.1758		e	limn	dulc	omni	tole	tole
18	*Leucaspuis delineatus* Heckel, 1843		n	limn	dulc	omni	into	into
19	*Leuciscus idus* L. 1758	**	n	reo	dulc	omni	inter	inter
20	*Misgurnus fossilis* L. 1758		n	limn	dulc	bent	tole	tole
21	*Neogobius fluviatilis* Pallas, 1814		n	stag-reo	dulc	omni	tole	tole
22	*Babka (Neogobius) gymnotrachelus* Kessler, 1857		n	limn	euri	bent	into	into
23	*Neogobius melanostomus* Kessler, 1857		n	stag-reo	euri	bent	into	into
24	*Perca fluviatilis* L. 1758	**	n	stag-reo	dulc	ihtio	tole	tole
25	*Perccottus glenii* Dybowski, 1877		e	limn	dulc	ihtio	tole	tole
26	*Petroleuciscus borysthenicus* Kessler 1859		n	limn	dulc	omni	into	into
27	*Proterorhinus semilunaris (marmoratus)* Pallas 1811		n	limn	euri	bent	into	into
28	*Pseudorasbora parva* Temmink & Schlegel, 1842		e	stag-reo	dulc	omni	tole	tole
29	*Pungitius platygaster* Kessler, 1859		n	limn	dulc	omni	into	into
30	*Rhodeus amarus* Bloch 1782		n	limn	dulc	erbi	into	tole
31	*Rutilus rutilus* L. 1758	**	n	eury	dulc	omni	tole	tole
32	*Sander lucioperca (Stizosteidon lucioperca)* L. 1758	***	n	stag-reo	euri	ihtio	tole	tole
33	*Scardinius erythrophthalmus* L. 1758	**	n	stag-reo	euri	omni	tole	tole
34	*Silurus glanis* L. 1758	***	n	stag-reo	dulc	ihtio	tole	tole
35	*Syngnathus abaster* Risso, 1826		n	limn	euri	zoopl	tole	tole
36	*Tinca tinca* L. 1758	**	n	limn	dulc	omni	into	inter
37	*Umbra krameri* Walbaun, 1792		n	limn	dulc	omni	into	into
	TOTAL	**20**	**5**					

Note. Symbol used: 1 = presence, Food values; * = reduced food value, ** = second food value, *** = high food value; Origin: n
= native, e = exotic; Preference for current: eury = eurytope, migr = migratory, limn = limnophilic, reo = rheophilic, stag = stagnant; Adult feed: omni = omnivores, ihti = piscivorous, zoopl = zooplanctivorous, bent = bentivorous, herbi = herbivore, plankton = planctonophagous; Salinity: dulc = freshwater, euri = euryhaline; Tolerance of habitat degradation and low oxygen: tole = tolerant, into = intolerant, inter = intermediary.

In all 4 studied lakes in last 5 years (2009-2013) generally ecological status is moderate, with high from fish communities and poor for predatory/prey relationship, in accordance with Moss et.al., (2002) (**Table 3.6.2**).

Table 3.6.2 Ecological status in accordance with Moss et. al. (2002) (Pi=piscivorous present, Abex=Exotic and aggressive absent, Altd=other situation beside piscivorous present or exotic and aggressive absent; Ecological status: H=high, G=good, M=moderate, P=poor, B=bad)

Lake	Year	Fish community	Ecological status	Biomass (CPUE) g/100m²	Biomass (CPUE) g/1m²	Ecological status	Predatory Biomass / Prey biomass	% Predatory biomass	Ecological status
Isac	2010	Pi + Abex	H	6712.963	67.12963	M	0.29	22.63415	P
Furtuna	2010	Pi + Abex	H	3258.778	32.58778	M	0.35	25.94511	P
Merhei	2011	Pi + Abex	H	6745.216	67.45216	M	0.22	17.82379	P
Rosu	2011	Pi + Abex	H	10731.96	107.3196	P	0.15	13.13355	P
Rosu	2012	Pi + Abex	H	6188.194	61.88194	M	0.28	21.79492	P
Furtuna	2013	Pi + Abex	H	4571.296	45.71296	M			
Merhei	2013	Pi + Abex	H	2994.059	29.94059	M			
Isac	2013	Pi + Abex	H	5241.667	52.41667	M			

Conclusions

In the third research initiative it has been presented historic data and actual data of the selected indicators, in the period 2009-2013, in all nine sampling points took into consideration from Danube Delta Biosphere Reserve (Ceatal Chilia, Ceatal Sf. Gheorghe, Periprava, Sulina, Sf. Gheorghe, Fortuna lake, Isac lake, Merhei lake, Rosu lake).

The water quality, for all nine sampling points, was mainly characterized by general physico-chemical indicators and nutrients levels of first quality class (reference) second quality class (target value) in all analyzed period.
Due to high organic nitrogen levels in water samples, an increase of total nitrogen concentrations (above the maximum concentration limit for second quality class (7 mgN/L)) was observed.
As a general trend, both general indicators concentrations and nutrients concentrations showed a decreasing trend in 2013.
As a general trend, concerning heavy metals concentrations, in all nine sampling points from Danube Delta Biosphere Reserve, in the period 2009-2013, maximum values can be observed in 2010 and minimum values can be seen in 2009 for the majority of the studied metals.

Results of phytoplankton show a stable quality of waters along year 2013, according to Romanian laws.
The chlorophyll-a values in sample stations on Danube branches are according to Romanian standards in water quality class I (<25 µg/l).

Zooplankton was dominated by small-bodied organisms during 2009-2013 in shallow lakes and branch stations.

A total of 89 macroinvertebrate taxa was identified in Fortuna, Isac, Rosu and Merhei lake between 2019-2013.In general the samples were dominated by chironomidae larvae accounting for 52 % of all taxa.

The aquatic vegetation of the lakes in the Danube Delta is depending both spatially and temporally on complex biogeochemical gradients. These gradients strongly represent the degree of connectivity. The type of substrate is a major influence. In the large open lakes with mineral sediment, the *Potamogeton* type growth form is characteristic. This group of lakes (Isac, Fortuna, Merheiu Mare and Rosu) showed clear water in the June samples. On the other hand, Fortuna and Rosu lakes only showed sparse vegetation cover throughout the season.

37 fish species have been identified in DDBR those 4 study lakes, more than half are commercial species, but 5 are exotic fish species, mostly are limnophilous (stagnophilous), freshwater and omnivores species.
Fish relationships predatory/prey include fish to poor ecological status class for all studied lakes. Fish community in 4 studied lakes show high ecological status in all studied years. Relative abundance and biomass in CPUE include fish in moderate to poor ecological status class.

References

CIS (2003). "Monitoring under the Water Framework Directive. Common Implementation Strategy for the Water Framework Directive (2000/60/EC). Guidance Document No 7. Working Group 2.7 - Monitoring. European Communities, Luxembourg."

Gannon, J. E. and Stemberger, R. S. (1978). "Zooplankton (especially crustaceans and rotifers) as indicators of water quality." Transactions of the American Microscopical Society: 16-35.

Jeppesen, E., P. Nõges, Davidson T.A., Haberman J., Nõges T., Blank K., Lauridsen T.L., Søndergaard M., Sayer C., (2011). "Zooplankton as indicators in lakes: a scientific-based plea for including zooplankton in the ecological quality assessment of lakes according to the European Water Framework Directive (WFD)." Hydrobiologia 676(1): 279-297.

Moss B., Stephen D., Alvarez C., Becares E., Van De Bund W., Collings S.E., Van Donk E., De Eyto E., Feldmann T., Fernandez-Alaez C., Fernandez-Alaez M., Franken R., Garcia-Criado F., Gros E., Gyllstrom M., Hansson L-A., Irvine K., Jarvalt A., Jensen J-P., Jeppesen E., Kairesalo T., Kornijow R., Krause T., Kunnap H., Laas A., Lill E., Lorens B., Luup H., Miracle M.R., Noges P., Noges T., Nykaanen M., Ott I., Peczula W., Peeters E., Phillip G., Romo S., Russell V., Salujoe J., Scheffer M., Siewertsen H.S., Smal H., Tesch C., Timm H., Tuvikene L., Tonno I., Virro T., Vicente E., Wilson D., 2002.The determination of ecological status in shallow lakes - a tested system (ECOFRAME) for implementation of the European Water Framework Directive. Aquatic Conserv: Mar. Freshw. Ecosyst.

Năstase A., Năvodaru I., 2006 - Study of ichthyodiversity from Gorgova-Uzlina complex lakes. IN: Scientific Annals of the Danube Delta Institute, vol. 12, pp. 91 - 96. Editura Dobrogea, Constanta.

Năstase A., 2007 - First record of Amur sleeper Perccottus glenii (Perciformes, Odontobutidae) in the Danube delta (Dobrogea, Romania). IN: Acta Ichtiologica Romanica (Romanian Ichthyological Society Publication), vol. II, pp. 167 - 174. Sibiu, Romania.

Năstase A., Năvodaru I., 2008 - Ichthyofauna of Danube delta lakes. IN: Scientific Annals of the Danube Delta Institute, vol. 14, pp. 37 - 46. Editura Centrul de Informare Tehnologică Delta Dunării. Tulcea, Romania.

Năstase A., 2009 - Cercetări asupra diversitătii ihtiofaunei din Delta Dunării pentru exploatarea durabilă a resurselor piscicole [Researches of ichthyofauna diversity in the Danube delta for sustainable management of fish resources]. 269 p. PhD thesis, Universitatea „Dunărea de Jos" - Galaţi. [in Romanian]

Năstase A., Năvodaru I., Cernişencu I., 2009 - Fish community studies from riverine Danube Delta (Romania) area in 2007: Şontea-Furtuna and

Gorgova-Uzlina lake-complexes. IN: Scientific Annals of the Danube Delta Institute, vol. 15, pp. 115 - 124. Tulcea, Romania.

Năstase A., Năvodaru I., 2010. Cercetări asupra diversităţii ihtiofaunei din R.B.D.D. pentru conservarea speciilor. Faza 3/2010 Studiu de teren a speciilor de peşti din Delta fluvială (complexele lacustre Gorgova-Uzlina şi Şontea-Furtuna), 36 pag. Report to contract No. 26/2009 closed by INCDDD-Tulcea and the Romanian Ministry for Education, research, Youth and Sports.

Năvodaru I., Cernişencu I., Năstase A., 2004. Cercetări asupra biologiei şi pescăriei principalelor specii de peşti de importanţă economică din RBDD, în vederea fundamentării gestionării durabile a stocurilor. Faza 2/2004 Cercetarea speciilor comerciale de peşti din Delta fluvială (complexele Şontea-Furtuna şi Gorgova-Uzlina). 36 p. Report for the project PN 03-020304, developed by the Danube Delta National Institute for Research and Development (beneficiary: Romanian Ministry of Education and Research). Tulcea, Romania [in Romanian]

Năvodaru I. (ed.), 2008 - Estimarea stocurilor de peşti şi pescăriilor. 296 p. Editura Dobrogea, Constanţa. [in Romanian]

Năvodaru I., Năstase A., 2011. What fish and how many there are in Danube Delta? IN: Scientific Annals of the Danube Delta Institute, vol. 17, pp. 71 - 82. Editura Centrul de Informare Tehnologică Delta Dunării. Tulcea, Romania.

Premazzi G. and Chiaudani G. (1992). Ecological quality of surface waters. Quality assessment schemes for European community lakes. EUR 14563 EN. European Commission, Joint Research Centre, Ispra, Italy.

Török, L., O. Ibram, M. Tudir, M. Doroftei, A. Nastase, M. Staras, L. Teodorof, and R. Dumitru. 2008. “Contribution to the assessment of ecological status in some of the lakes of the Danube Delta according to the European Water Framework Directive”. Scientific Annals of Danube Delta Institute, Tulcea 14, 93-98 pp.

Török L. 2009. A new approach to assess the phytoplankton biomass in Danube Delta Biosphere Reserve, Sc. Annals of DDI, vol 15, pp 93-98, 2009

Tudor, I. M. (2008). "Evolution of Zooplankton Diversity; Schneider E., Tudor M., Staraş M. (ed), Evolution of Babina polder after restoration works." Kraft-Druck Ettlingen Germany: 31-36.

Zinevici, V. and L. Parpala (2007). "Zooplanktonul din Delta Dunarii si avandelta. Diversitate, structura, productivitate si relatii trofice." Universitatea din Bucuresti, Edit. Ars Docendi: 381.

**** (2006). Ordinul nr. 161 din 16 februarie 2006 al ministrului mediului şi gospodăririi apelor pentru aprobarea Normativului privind clasificarea calităţii apelor de suprafaţă în vederea stabilirii stării ecologice a corpurilor de apă. ÎN: Monitorul Oficial al României – Partea I, an 174 (XVIII), nr. 51, Bucuresti.

****Water Framework Directive (2000/60/EC). European Communities Official Journal L327 22.12.2000.