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CHARACTERISTIC ASPECTS OF THE DANUBE DELTA LAKES

Daniela PLEȘOIANU, Ștefana VEDEA

Ovidius University, 1, University Avenue, Campus, Building B, Constanta, Romania,
Email: plesoianudaniela@hotmail.com

Corresponding author: plesoianudaniela@hotmail.com

Abstract

The study area is a unique zone called the Danube Delta. The name "delta" derives from the Greek "delta" because of its equilateral triangle shape. Inside this triangle there is a positive relief represented by beams and islands, as well as a negative relief such as canals, marshes, ponds, lakes or Danube arms. The research methods used the statistical data provided by the competent bodies, which were processed and analyzed. It used the computerized processing that generated tables and graphs.The delta hydrography is represented by the Danube's arms, lakes, ponds, marshes, lakes, ponds, canals and sahale. The lakes are distributed throughout the delta, and, as mentioned by P. Gâtestescu in 1969, are concentrated in several lacustral complexes: Sireasa, Storm, Pardina, Matiţa-Merhei, Dranov, Gorgova-Isac and Roşu-Puiu and Zătoanele. The 2005-2010 interval captures the lakes in the Danube Delta in a predominantly good ecological state for almost all chemical compounds, from oxygen, to copper, zinc, iron, nickel.

Key words**:** *delta, lake, vegetation, ecology, environment*

INTRODUCTION

The total Delta area is 4,152 km^2, of which 3,318 km^2 representing 82% of the delta surface are found in the territory of our country. However, this area of 3,218 km^2 is the actual delta surface (2,491 km^2) and the area of Lagunar Razim-Sinoe (827 km^2). [2]
The Danube Delta is an alluvial plain, which is in a continuous process of formation, dominated by marshy areas. It has the shape of an equilateral triangle, where 20.5% of the delta territory is under 0 meters, and 79.5% above this level.
Most of the areas have altitudes between 0 and 1 m. The highest "altitudes" are located on the marine beams (Letea grunt 12.4 m and Caraorman grunt 7 m), and the highest depths are found on the Danube arms (-39 m on the Chilia branch, - 34 m on the Tulcea arm, -26 m on the Sf. Gheorghe arm, -18 m on the St. George's arm). The average altitude of the Danube Delta is 0.52 m, and the relief is composed of a variety of positive and negative microforms at whose formation the Danube, the Black Sea contributed, and last but not least, the aeolian processes, the vegetation, the eustathic and epigenetic movements and especially the anthropic factor. These forms of relief are divided into two types of relief: major and medium and minor.

MATERIALS AND METHODS

In order to write the paper I have consulted several specialized bibliographic sources and used data from research institutions such as Constanta Meteorological Station or Tulcea Environmental Protection Agency.
The statistical data provided on the characteristic aspects of the lakes, data that were processed, analyzed and interpreted graphically were used.

RESULTS AND DISCUSSIONS

The major relief includes three subtypes: the fluvial delta, the maritime delta and the submerged delta (belonging to the continental platform).
The medium and minor relief includes beams, fluvial arms, secondary deltas, marshy fields, beaches, dunes, etc (Figure 1).
"The Danube Delta falls within the temperate climate zone and the coastal climate, and is subjected to three external influences, such as: continental, pontic influences and those of the advective air that pervade to the west or east, depending on the direction of travel air masses; as a result of the delta position of the

delta between the continental drylands surrounding it, which surrounds it in the north, west and south, and the Black Sea to the east". [2]

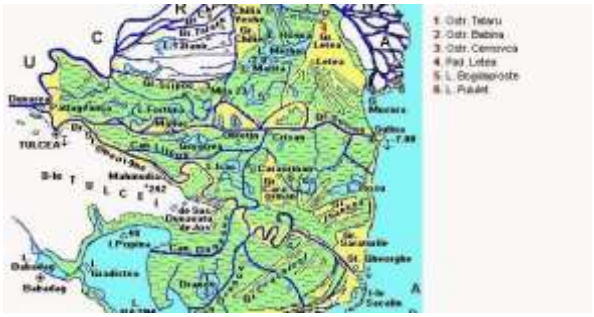

Fig.1 The Danube Delta
Source: http://www.info-delta.ro/delta-dunarii-17/

Hydrography

"The hydrographic network within the Danube Delta is very complex and has one of the most important roles in the delta, having both an economic role, attracting tourists in these areas, and its navigable potential, a landscaping landscape, and that of feeding the lakes with water". [1]

"Also, hydrographic network is one of the determining factors in the emergence, and then in ensuring the evolution and functioning of the Danube Delta.

The hydrography of the delta is represented primarily by the Danube's arms, ponds, marshes, lakes, ponds, canals and sahals". [3]

The arms of the Danube are the most important hydrographic element in the Danube Delta, namely Chilia, Sulina and Sfântu Gheorghe that flow directly into the Black Sea.

The Chilia arm transports 60% of the water and alluviums, the Sulina arm transports 18% And St. George's arm carries 22% of the volume of water.

Lakes are one of the most important morphohydrographic elements in the Delta, which occupies an area of about 25,666 hectares today.

Over time, there has been a dramatic decrease in the number of lakes in the delta, due to the numerous landscaping works that have been considered as desulphurization, the most important being the Sireasa and Pardina, in which 40 and 120 lakes were drained respectively; or the restriction of the hydrographic arteries, which ensured the connection with the Danube arms. In this respect, it is noticed that, from 661 lakes (only lakes with an area of more than 1 hectare were considered), which occupied 31,493 ha (9.49% of the Danube Delta area), - registered in 1964, following inventory by the State Water Committee, the number of lakes has now been reduced to 479, which occupies an area of 25,794 ha, only 8.06% of the total deltaic space. [8]

Table 1. Number, surface and volume of lakes in the Danube Delta

Unity	Number	Surface		Volume	
		m^3	%	m^3	%
Letea	214	9,463.50	36.69	128,593,375	39.41
Caraorman	175	12,802.50	49.63	159,124,000	49.12
Dranov	90	3,528.50	13.68	31,640,250	11.47
Total Delta	479	25,794.25	100	319,357,625	100.0

Source: Driga (2004) [2].

The deltaic lakes are outlined by vegetation such as reed and poplar, as well as several emitting or submerged beams. These lakes keep permanently, or only temporarily, with the Danube's arms, through the intersection of the canal network and the lakes, or even underground, beneath the plaque, thus making a continuous exchange of waters; making it difficult to accurately assess the water balance of a single lacquer. [6]

Under these conditions, the water balance of the whole depression lake complex is usually determined and calculated. [8]

Lakes are distributed throughout the delta, but there is a clear difference in the number and size of the lakes between the western and eastern parts. This differentiation resulted from much more intense alluvial processes in the western part, but also from the higher degree of antropic intervention compared to the eastern part. Thus, the western part is characterized by a larger number of lakes, but with smaller areas, while the eastern part of the delta is characterized by a smaller number of lakes, but with larger surfaces. [9]

Another significant difference between the two extremes lies in the depth of the lakes, reduced in the west, below 1 m, unlike the eastern one, where the average depth is 1-3 m, or even much larger if we take into account and the category of meander lakes, which

have depths of over 7 m. The aspect of the shore is another differentiating element, well defined and outlined by the fluvial banks in the west, compared to those in the eastern delta, where we meet rather a pseudo-shore, the shore line being contoured by reed and plum. [9]

Varnishes with areas of less than 0.5 km^2 are treated differently due to their specific character and are located mainly in the delta area between the main Danubian arms. These lakes also have the name "”ghioluri”" and have a depth of -0.5 m, which makes it impossible to wipe them even with the smallest waters.

Specific issues

Lacustrian complexes are complex depression areas, made up of lakes, bounded by high tides, bushes and plains, and which are interconnected by a network of hedges and canals, which also ensures their water connection with the Danube arms. Thus, the entire area can be considered a unitary lake system, often outlined by vegetation and rarely by girders. [5]

The Danube Delta, as mentioned by P. Gâtestescu in 1969, is composed of several lacustral complexes such as Sireasa, Sturuna, Pardina, Matiţa-Merhei, Dranov, Gorgova-Isac (corresponding to the fluvial delta), and Rosu-Puiu and Zătoanele included in the maritime delta).[7]

We will then look at some detailed aspects of the water balance of the Matița-Merhei Complex.

Given that the Danube level variation regime directly determines that of the Matiţa-Merhei complex, the maximum quantities of water stored in this complex are produced between April and June, while the minimum values are recorded in the season autumn, and even winter.

Based on the morphohydrographic map of the Danube Delta, with a scale of 1:50,000, conducted by the Institute of Geography in 1963, it follows that the level observations at the center of the Matita-Merhei complex highlight two thresholds at 105 and 200 cm, which determines: the volumes, levels, water-covered areas and the changes recorded in the process of water exchanges between the lake area and the Danube arms.[4]

Thus, raising the water level, even by 1 cm at the threshold of up to 105 cm, increases the volume of water throughout the depression area and lake. [10]

Given the variation of the level of the Danube River, which inevitably determines the variation of the level within the Matiţa-Merhei complex; the largest quantities of water stored in the latter occur in the period April to July, with maxims in May and June, while the minimum values occur in the autumn and winter seasons.

For a more explicit analysis, an interval of 22 years (1964-1985), which was the highest level, was considered. Under these conditions it is noted:

- the interval from May 27 to May 31, 1970, when there were high levels at Matiacherhana, namely 244 cm, which means that the daily volume of cantonated water was about 803 million m^3;
- April 7-9, 1981, the largest volume of water cantonated daily from the analyzed period (1964-1985), ie 834.8 million m^3, which led to the reaching of a level of 252 cm in the Matiţa-cherhana
- February 9-12, 1964, when the lowest daily water volume, namely 139.8 million m^3, was registered.

In order to determine the water balance for the Matiţa-Merhei complex, the years were selected:1964 (the year with the lowest levels),1970 (the year with the highest levels), 1975 and 1980, these being the years with the most accessible data.[2]

For these years the quantities of atmospheric precipitation were recorded and analyzed at the meteorological stations in Gorgova, Chilia Veche and Vâlcov (belonging to Ukraine), the largest quantities being received at Gorgova (325.2 mm in 1970 and 546.1 mm in year 1980). (Driga, 2004) [2].

Table 2. Volume of water stored in Matiţa-Merhei lake depression in 1964 (million m^3)

YEAR	1964											
Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Mediate	178	180	234	312	382	360	288	240	188	208	310	362
Maximum	208	201	251	366	388	385	315	276	211	266	334	379
Date	1-2	29	31	31	11-16	1	1	1-2	3-4	30-31	22-26	24-27
Minimum	155	140	201	256	366	321	276	206	170	185	271	334
Date	23-29	9-12	1	1	1-2	29-30	31	29-31	24-26	15-21	1	1

Source: Driga (2004) [2].

Table 3. Water volume stored in Matiţa-Merhei lake depression in 1970 (million m^3)

YEAR	1970											
Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Mediate	346	460	682	762	796	766	666	498	422	298	244	282
Maximum	430	515	778	799	803	803	729	60	455	350	266	289
Date	30-31	28	31	30	27-31	1	1	1	1	1	28-30	18-22
Minimum	302	430	522	749	790	712	614	430	366	256	233	266
Date	7-10	1	1	8-13	7-9	30	31	23-25	30	31	9-13	1

Source: Driga (2004) [2].

Table 4. Water volumes stored in the Matiţa-Merhei Lagoon Depression in 1975 (million m^3)

YEAR	1975											
Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Mediate	502	351	262	344	466	554	636	519	348	256	256	244
Maxi Mum	525	433	297	414	496	601	696	679	363	299	287	287
Date	4-6	1	31	30	31	19-21	16-21	1	1	1	4-6	8-9
Mini Mum	436	292	241	302	420	477	566	363	304	226	226	208
Date	31	28	13-15	1	1	6	1	31	30	22-23	20-21	31

Source: Driga (2004) [2].

Table 5. Water volumes stored in Matiţa-Merhei lake depression in 1980 (million m^3)

YEAR	1980											
Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Mediate	370	444	446	459	548	570	524	446	344	308	430	470
Maxi Mum	404	518	525	499	720	720	554	550	410	385	455	525
Date	1	25-27	1	23-25	30-31	1	10	1	1	31	17-18	31
Minimum	344	337	391	407	464	487	487	401	271	236	401	410
Date	31	1	27-29	1	4	29-30	4-5	27-31	30	5	3	1

Source: Driga (2004) [2].

Based on the direct observations made on the cork on Lake Gorgova, which only functioned until 1975, it was possible to estimate the evaporation of the water, which was correlated with the evaporation from the surface of the soil, as well as with the moisture deficit, from the same station, for the years 1975, 1980 and 1982. [2]
Water evaporation ranged from 1,126.2 mm in 1975 to only 947.6 mm in 1980, meaning that if we report the precipitation evaporation, it would result in an aridity index of 0.36 in 1964; 0.34 in 1970; 0.40 in 1975 and the maximum of 0.58 in 1980. [2]
Under these circumstances, the Matiţa-Merhei complex receives an average of 80.9 million m^3 of rainfall and releases 301.9 million m^3 of evapotranspiration, resulting in an average annual deficit of 221 million m^3, a deficit which normally, without the water supply by the Danube, would make it impossible for this complex, and hence the entire deltaic territory.
The 2005-2010 interval captures the lakes in the Danube Delta in a predominantly good ecological state for almost all chemical compounds, from oxygen, to copper, zinc, iron, nickel, and so on. [2]

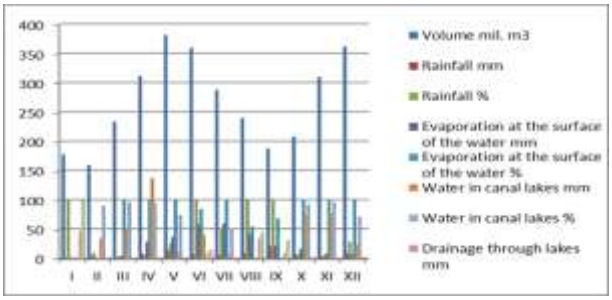

Fig.2. The water balance of the Lake Matita-Merhei Lake Complex in the years 1964, 1970, 1975 and 1980
Source: Own determination.

The best concentrations, which have provided a very good environmental status, are pH, oxygen, phosphorus, sulfate, chromium, calcium and zinc, which suggests a very low acidity and an optimal level for fish multiplication and development, and of the lacustrine vegetation, while at the opposite end, with very harmful concentrations for the deltaic lakes, there were nickel, iron and copper, chemical compounds resulting from the processes of dyke development, river transport, and spills and not only by the local population and / or industrial plants in the Delta area, which are very dangerous to the life of the fish, leading to the reduction or even disappearance of one or more species of fish and / or plant species.

CONCLUSIONS

The Danube Delta is the second largest wetland in Europe but also the lowest and the newest plains region, located on the territory of two countries: Romania and Ukraine.
The total delta area is 4 152 km^2, of which 3 318 km^2, are located on the territory of our country.
The Danube Delta is an alluvial plain, in a continuous process of formation, dominated by marshy areas, with the shape of an equilateral triangle, in which a relief consisting of a variety of positive and negative microforms is carried out, showing a medium altitude of 0.52 m.
The delta hydrography is represented by the Danube's arms, lakes, ponds, marshes, lakes, yaks, canals and sahals. Of all these hydrographic elements, an important place is occupied by the lakes, which have drastically

reduced their number from 661 lakes in 1964 to just 479 lakes today.

The lakes are distributed throughout the delta, and as P. Gâștescu mentioned in 1969, they are concentrated in several lacustral complexes such as: Sireasa, Fortuna, Pardina, Matiţa-Merhei, Dranov, Gorgova-Isac, Rosu-Puiu and Zătoanele.

Delta Lakes take up the need for precipitation water as well as channels, channels that act as water regulators, helping either to feed the lakes with water or to drain water from the lakes to the arms. Another particularly important process in the water circulation process in the Danube Delta is evapora- tion, a process that causes the loss of a large quantity of water.

The 2005-2010 interval captures the lakes in the Danube Delta in a predominantly good ecological state for almost all chemical compounds, from oxygen, to copper, zinc, iron, nickel, and so on. The best concentrations, which have provided a very good environmental status, are pH, oxygen, phosphorus, sulfate, chromium, calcium and zinc, which suggests a very low acidity and an optimal level for fish multiplication and development, and of lacustrine vegetation, while at the opposite pole, with very harmful concentrations for the animals the deltaic lakes were nickel, iron and copper, chemical compounds resulting from the process of dyke, river transport and wastewater discharges, and not only by the local population and / or industrial plants the area of the Delta, and which are very dangerous for the life of the fish, leading to the diminution or even disappearance of one or more species of fish and / or plant species.

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