

PRELIMINARY DATA REGARDING THE ASSESSMENT OF WATER QUALITY FROM THE BASINS OF THE MUSEUM COMPLEX OF NATURE SCIENCES OF CONSTANȚA – DOLPHINARIUM SECTION

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Abstract. The quality of water from the basins containing the live patrimony of the Dolphinarium represents an essential factor in keeping them in captivity. Following the analyses of the samples collected from the above mentioned stations, 19 taxons have been identified so far among which 4 up to the genus. Out of the 19 species of ciliates in the covered basin of the Dolphinarium, only 15 were identified; the analyses of the filtering material did not highlight any difference regarding the qualitative composition of the ciliates, all the forms identified in the basin being present also in filters.

Keywords: ciliates, sediments, water quality.

Rezumat. Date preliminare privind evaluarea calității apei din bazinele Complexului Muzeal de Științe ale Naturii Constanța – secția Delfinariu. Calitatea apei din bazinele în care sunt menținute exemplarele patrimoniului viu ale Delfinariului reprezintă un factor esențial în menținerea acestora în captivitate. În urma analizei probelor colectate din stațiile menționate au fost identificate până în prezent 19 specii, dintre care 4 doar până la gen. Din cele 19 specii de ciliate în bazinul acoperit de la Delfinariu au fost regăsite doar 15. Analiza materialului filtrant nu a evidențiat diferențe în privința compoziției calitative a ciliatelor, toate formele identificate în bazin fiind regăsite și în filtre.

Cuvinte cheie: ciliate, sedimente, calitatea apei.

INTRODUCTION

The quality of water from the basins containing the live patrimony of the Dolphinarium represents an essential factor in keeping them in captivity. In order to grant these optimal conditions there is involved a complex team made up of biologists, veterinary doctors, trainers, food assistants etc.

The quality of water from the basins is carefully controlled by the agency of some current activities consisting on the one hand in the registration of the values of the main abiotic factors, such as temperature and salinity. Salinity is maintained in its relatively constant limits, the volume of water being renewed totally or partially any time it is required. A recently materialized initiative focused on the regular execution of certain physical-chemical analyses of the water from the basin as well as on the bacteriological analyses.

Our preoccupations in the field of quality assessment and control of water from the basins of the Dolphinarium are older, yet we started up a systematic study of the theme in March 2009 focusing on the quality of ciliates of indicators related to saprobic level of any ecosystem. The current study supports all procedures performed in the scope of maintaining the quality of water from the basins.

MATERIAL AND METHODS

In the period between March and December 2009 we collected 90 samples from both the middle seaside of the bay from the North Coast in the vicinity of the water capture plant for the Dolphinarium and from its covered basin; those from the North Coast contained sand and water.

Samples resulted from the covered basin within the Museum Complex of Nature Sciences (3 metres depth, 500 m³ capacity of captured water through a pipe directly in the sea North Coast station) contained both epibiosis resulted from the walls and a sedimentary mixture from the bottom (fragments of macrophytic algae fauna and of various animal origin sand marks) collected by the diver with every regular hygienic activity.

Two samples of sand and water were collected from the middle seaside station of the North Coast in the scope of performing the granulometric analysis of sediments. They were performed by means of mechanical screen method; the used granulometric scale was Udden – Wentworth; the cumulative curves were drawn up on probabilistic logic paper. For the interpretation of the results we received the support of a specialised expert.

Samples from the filtering material from the Dolphinarium were examined at its renewal.

Samples were transferred from collection recipients to Petri plates undergoing the first examination with the binocular loop; this stage has been followed by the second examination with the binocular loop.

The examination stage has been followed by that of sediment separation by different means (Webb Uhlig) according to the degree of fragility of species from the sample composition and aimed scope (DRAGESCO & DRAGESCO-KERNEIS, 1986).

Reduction of speed of the ciliates has been executed with the help of several anaesthetic mixtures, some of which containing tablets blend with the role of causing the sleep for human utility. A considerable number of tests have been performed in order to establish the optimal concentration taking into account the special fragility of some species.

The use of blends with anaesthetic role has been required for the study of some ciliates “in vivo” as well as for biometrical analyses (with the help of ocular micrometer), pictures and taxon sketches. The biometrical results have been processed by means of the computer and pictures were made with digital camera Canon A 410.

The diagnosis has been established for some species on fresh sampled material; in other cases vital colorants were used, such as acetic methyl green and some species required the application of techniques for the receipt of permanent preparations Chatton-Lwoff and Bodian (Wilbert version) (DRAGESCO & DRAGESCO-KERNÉIS, 1986).

The results obtained following the analysis of collected samples from the psamoma of the North Coast station and covered basin from the Dolphinarium were associated in the scope of interpreting the data related to the values of the main abiotic factors of both ecosystems obtained by current determinations (temperature salinity PH), as well as complex physical- chemical and bacteriological analyses. Both types of results have been performed within CMSN and INCDM Constanța being noted in the protocol books belonging to Dolphinarium section.

RESULTS AND DISCUSSIONS

a. Some considerations related to the values of abiotic factors of water from the two ecosystems (natural and artificial) as well as the bacteriological analyses.

The temperature of the sea water from the North Coast area had different values so that in March the average was of 9.4°C increasing its value until August when values of 27°C were registered; in September, the registered values started to decrease to 23.5°C so that in October reached the value of 13.3°C. The enclosure of the Dolphinarium (supplied with heat carrier in winter time) favours high values of the water temperature.

The majority of the pH values of the sea water from the North Coast were included in the alkaline field. Considering the optimal values for the majority of life forms (7.5 – 8.2) one can state that the pH values of the sea water from the basin complies with the limits for maintaining the safety conditions of the exemplars of the live patrimony.

The salinity of the sea water from the North Coast station oscillated between the minimum of 10.2 g/l (04.07.09) respectively the maximum of 17.9 g/l (June 17, 2009) (protocol books of the Dolphinarium section). The water salinity from the basins of the Dolphinarium has been artificially maintained between the limits of 15.4 g/l (May 25, 2009) respectively 19.03 g/l (March 22, 2009).

The bacteriological analyses of the samples resulted from the water of the covered basin highlighted a good quality characterised by the absence of coliform and faecal streptococcus (Analysis report no. 5/September 5, 2009).

b. The results of the granulometric analyses performed on sediments resulted from the middle seaside of the North Cliff beach.

Both samples collected and processed in a granulometric manner contained considerable quantities of gravel (11.52%), as well as coarse sand. Therefore, in case of sample 1, the percentage variation of this fraction stands between 2.14 respectively 5.4%. The sand of average granulation has a considerable contribution to samples up to 14.50% from sample 1, respectively 12.83% in the composition of sample 2.

As it was foreseeable, in case of these samples with lot of gravel and coarse sand, the quantity of fine sand of the analysed samples was minimum, up to 0.025% for sample 1, respectively 0.022% in case of sample 2 (Fig. 1).

To sum up the granulometric analyses of the two samples by sieving there is used a mesh system disposed to an interval of 1Ø. The analysed material is represented by carbon mainly organogenetic sand, the source of which is represented by mollusc shells (*Mytilus*, *Mytilaster*, *Nassarius* etc.).

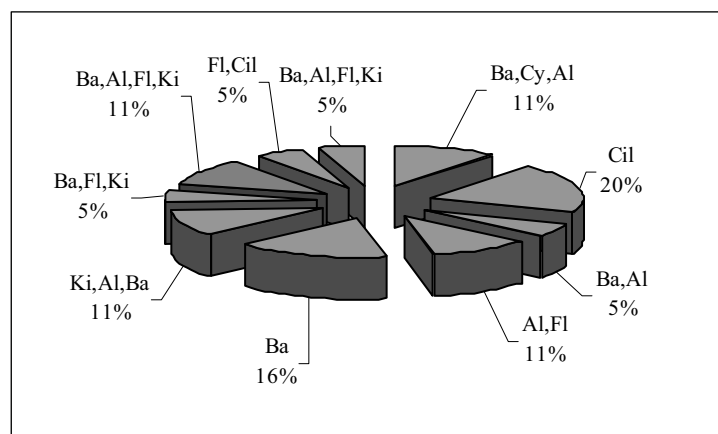


Figure 1. Preferred food of ciliates from the sand of north coast beach and covered basin of the Dolphinarium.

Figura 1. Hrana preferata a ciliatelor din nisipurile plajei Faleza Nord si bazinul acoperit de la Delfinariu.

c. Preliminary data related to qualitative composition of the ciliate fauna from the sand of the North Coast station and covered basin of the Dolphinarium.

Following the analyses of the samples collected from the above mentioned stations 19 species have been identified so far, among which 4 up to the genus (Table 1).

Table 1. Composition of ciliates fauna in the sands of Faleză Nord Beach and in Dolfinarium's basin.
Tabel 1. Compoziția faunei de ciliate în nisipurile plajei Faleză Nord și în bazinul de la Dolfinariu.

No.	SPECIES	Sands of Faleză Nord Beach	Covered pool of the Dolfinarium	Samples collected from the filters of the Dolfinarium basin	TS	HP	GS
1	<i>Holophrya atra</i> (SCHEWIAKOFF 1897)	+	-	-	oms	BaCy Al	a-p
2	<i>Holophrya simplex</i> (SCHEWIAKOFF 1893)	+	+	+	oms	BaCy Al	a-p
3	<i>Prorodon marinus</i> (CLAPAREDE & LACHMANN 1858)	+	+	+	he?	Cil	-
4	<i>Prorodon teres</i> (EHRENBERG 1838)	+	+	+	he	Cil	-
5	<i>Urotricha globosa</i> (SCHEWIAKOFF 1893) KAHL 1930	+	+	+	he?	Ba Al	b
6	<i>Lacrymaria coronata</i> (CLAPAREDE & LACHMANN 1858)	+	+	+	he	Cil	b
7	<i>Lionotus (Lithonotus) lamella</i> (EHRENBERG 1838)	+	+	+	he	Cil	a
8	<i>Trachelocerca</i> sp.	+	-	-	ome	Al Fl	-
9	<i>Uronema marinum</i> (DUJARDIN 1841)	+	+	+	he	Ba	a
10	<i>Pleuronema marinum</i> (DUJARDIN 1841)	+	+	+	he	Ba	a
11	<i>Condylostoma remanei</i> (SPIEGEL 1928)	+	+	+	he	FICil	-
12	<i>Strombidium arenicola</i> (DRAGESCO 1960)	+	+	+	oe	KiAlBa	b
13	<i>Strombidium faurei</i> (DRAGESCO 1960)	+	+	+	oe	KiAlBa	b
14	<i>Oxytricha gibba</i> (STEIN 1859)	+	+	+	he	BaFlKi	-
15	<i>Euplotes</i> sp. 1	+	+	+	he?	Ba Al Ki Fl	-
16	<i>Euplotes</i> sp. 2	+	-	-	he?	Ba Al Ki Fl	-
17	<i>Diophrys scutum</i> (DUJARDIN 1841)	+	+	+	os?	AlFl	-
18	<i>Uronychia transfuga</i> (MÜLLER 1786) STEIN 1859	+	+	+	os?	BaAlFl	-
19	<i>Aspidisca</i> sp.	+	-	-	he?	Ba	a-b

Legend of Table 1 and Figure 1

A = alphamesosaprobic
 Al = algae (except for diatomales but including autotrophic flagellates)
 a-b = alphamesosaprobic - betamesosaprobic
 a-p = alphamesosaprobic - polysaprobic
 b = betamesosaprobic
 b-a = betamesosaprobic - alphamesosaprobic
 Ba = bacteria
 Cil = ciliates
 Cy = cyanobacteria
 Fl = heterotrophic flagellates
 GS = degree of saprobity
 he = holo-euryhaline
 Ki = diatomales
 HP = preferred food
 i = isosaprobic
 m = metasaprobic
 MH = modality of feeding
 o = oligosaprobic
 oe = oligo-euryhaline
 ome = oligo or meso-euryhaline
 os = oligo-stenohaline
 p = polysaprobic
 p-i = polysaprobic - isosaprobic
 p-a = polysaprobic - alphamesosaprobic
 p-m = polysaprobic - meso-saprobic
 TS = tolerance of salinity
 + = present species
 - = absent species
 (FOISSNER 1986)

Legenda tabelului 1 și figurii 1

A = alfamezosaprobă
 Al = alge (exceptând diatomeele dar incluzând flagelatele autotrofe)
 a-b = alfamezosaprobă-betamesosaprobă
 a-p = alfamezosaprobă-polisaprobă
 b = betamezosaprobă
 b-a = betamezosaprobă - alfamezosaprobă
 Ba = bacterii
 Cil = ciliate
 Cy = cianobacterii
 Fl = flagelate heterotrofe
 GS = grad de saprobitate
 he = holoeurihaline
 Ki = diatomee
 HP = hrană preferată
 i = izosaprobă
 m = metasaprobă
 MH = modalitate de hrănire
 o = oligosaprobă
 oe = oligo-eurihalin
 ome = oligo sau mezo-eurihalin
 os = oligostenohaline
 p = polisaprobă
 p-i = polisaprobă - izosaprobă
 p-a = polisaprobă-alfamezosaprobă
 p-m = polisaprobă- mezosaprobă
 TS = toleranța la salinitate
 + = specie prezenta
 - = specie absentă
 (FOISSNER 1986)

Out of the 19 species of ciliates in the covered basin of the Dolfinarium only 15 were identified; the analyses of the filtering material did not highlight any difference regarding the qualitative composition of the ciliates, all the forms identified in the basin being present also in the filters. Despite the relative constancy of the values of the main abiotic factors that influence this artificial ecosystem, as well as the abundant trophic basis for these protozoa represented by the planktonic microphyte algae and bacteria resulted out of the decay of abundant organic matter from the bottom of the basin (excrements fish chops in various stages of mineralization etc.), the selective factor related to these species is represented by the sodium hypochlorite solution added daily in the basins in order to limit the increase of bacterial abundance in the sea water (Figs. 2; 3; 4a; 4b).

The daily contribution of this substance acted as a selective factor. Consider the fact that these protozoa have the exceptional capacity of adapting (by means of seclusion-deseclusion) to daily shock produced by this process in the first ten minutes from the addition of the hypochlorite, its concentration in water reaching 1 mg% in some areas of the

basins (in the vicinity of the introduction area). Therefore taking into account the dimensions of micrometers then the shock is considerable!

The proof of these allegations represents the qualitative composition of the ciliates: more than half of the species are located in the inferior stages of the evolution and there are some forms to which the somatic and cytostomy ciliate are not very well distinguished; therefore, the reduced level of evolution may be related to the sturdiness of significant variations of abiotic factors; moreover, the modest qualitative composition of ciliates from the basin is yet compensated by considerable abundance of populations, especially those consuming sulphate reducing bacteria.

Concerning the ecological characteristics of the representatives of the identified ciliate species from the point of view of salinity the euryhaline characterising the majority of forms is the one that grants the “success” against the intervention of cytolysis to shocks created when adding the sodium hypochlorite, the modification of the reports of the main ions from the sea water once the sodium hypochlorite is added or partial substitution of water volumes determining salinity variations.

Concerning the saprobic level indicated by each species, we found insufficient data from the specialised literature referring to this subject; yet the majority of identified forms are alpha-betasaprobic. However, there are also identified forms, whose presence proves alpha regime areas up to polysaprobic. It is the case of the representatives of the genus *Aspidisca* and *Holophrya*.

Figure 2 provides data referring to the trophic basis of identified forms; one can easily observe the fact that the majority of the forms are – if not primary bacterivores – bacteria users as alternative food resource. Therefore, 11% of the species consume mainly bacteria followed by cyanophyceae, and algae, other trophic version consisting thus in primary bacteria zooflagellates and diatomales, these last ones being easily detectable to micro-dissection and are often seen in the cell of “in vivo” protozoan. A considerable percent of the species – 20% - is strictly bacterivores; the conclusion is obvious in case of association and considerable abundances of populations such as the quantity of organic matter in mineralization process from the basin. A considerable part of the ciliates species identified in the basins are bacterivore yet specialised in the consumption of sulphate-reducing bacteria.

The direct correspondent of these percentages – highlighting various feeding strategies of the species – is represented by the significant number of predatory ciliates, 20% of their total. Therefore the constancy of abiotic factors from this artificial ecosystem enforced in time a selected fauna of ciliates, not only the various links of the trophic chain being constantly well defined. The study of other groups of organisms – both protozoans and metazoans – shall certainly offer other information of interest completing this frame of the study theme. Therefore a challenge for professionals!

d. Some information related to individual biometry belonging to the second population of ciliates from the middle seaside of the North Coast and covered basin of the Dolphinarium.

Among the identified species, there are some represented by special abundance of populations. It is the case of two *Euplotes* species identified both in the north Coast and in the covered basin.

Considering the difficulties related to the identification of species of this type we chose to lead the diagnosis up to the genus level (Table 2).

Table 2. Main biometric parameters in two populations of *Euplotes* from the psammom of Faleză Nord beach and basin of the Dolphinarium.

Tabel 2. Principalii parametri biometrici la două populații aparținând la două specii de *Euplotes* din psamonul stației Faleză Nord și bazinul acoperit de la Delfinariu.

	Euplotes sp1	Euplotes sp 1	Euplotes sp1	Euplotes sp 1
	L D2	L FN	I D2	I FN
max	120	170	100	100
min	110	120	40	50
STDEV	20.4	13.59	13.11	11.79
AVERAGE	134	145	68.94	80.87
n	122	90	122	90
	Euplotes sp 2	Euplotes sp 2	Euplotes sp 2	Euplotes sp 2
	L D2	L FN	I D2	I FN
max	134	90	122	70
min	20.4	50	10.2	30
STDEV	46.01078135	9.11971293	42.32188146	6.287925
AVERAGE	101.28	70.6635	44.65	45.49763
n	32	422	32	422

Legend: Max - maximal length of the specimens belonging to two populations of *Euplotes*; Min – minimal length of the specimens belonging to two species of *Euplotes*; n – number of measured specimens; STDEV – values of Standard deviation; AVERAGE – average values of rows of values belonging to the populations of those two species. / **Legenda:** Max – lungimea maximă a exemplarelor aparținând la două populații de *Euplotes*; Min - lungimea minimă a exemplarelor aparținând la două specii de *Euplotes*; n – numărul de exemplare măsurate; STDEV – valorile deviației standard; AVERAGE – valorile mediei șirurilor de valori aparținând populațiilor celor două specii.

The populations belonging to *Euplotes* species have been measured being registered the values of their length and width. Until now the results prove there are two different populations with significant distinctions related to the size of the individuals. Therefore, the individuals belonging to the covered basin from the Dolphinarium are smaller compared to those from the patrimony of the North Coast psammom, namely 120 μm compared to 150 μm . In case of minimal dimensions differences of 10 μm shall be registered. If in case of length values there are no differences for the species with maximal dimensions of the two populations, in case of species with minimal dimensions, the difference between measured values is still of 10 μm .

The values of standard deviation and the average for the populations of the first *Euplotes* species are lower in case of the population from the psammom of the North Coast station (standard deviation 20.4 for the population from the basin against only 13.59 for the length; in case of width, standard deviation has also small values for the population of the North Coast against that of the covered basin – 11.79 compared to 13.11).

The results of the analysis of the range of values belonging to those two *Euplotes* populations highlight the existence of an homogenous well-structured population in the psammom of the North Coast station compared to the one identified in the covered basin from the Dolphinarium. The difference of size of the individuals of the two populations in favour of those from the North Coast station could be explained by the complex osmotic mechanisms of the ciliates from the basin, which have to survive the shocks of salinity and especially those induced by the increase of chlorine in water. The heterogeneity degree of the populations from the basins could be explained by the fact that they are regularly recovered following the hygienization of the basin performed by the diver.

With regard to the second *Euplotes* population, which was identified in the sands of the North Coast station and the covered basin from the Dolphinarium, there appear the same the differences related to the size of the individuals from the ecosystems. The heterogeneity of the population from the covered basin of the Dolphinarium appears more evident considering the values of standard deviation (Table 2).

CONCLUSIONS

Collected samples from the covered basin of dolphinarium and from the middle seaside of the North Coast highlighted a number of 19 ciliates species out of which only 15 were identified from the artificial ecosystem.

The sodium hypochlorite regularly introduced in the water volume from the covered basin acts as a selection factor over the identified ciliates, species some of the species contributing DIRECTLY to the limitation of excessive proliferation of the bacteria.

The special abundance of the ciliates in the basin contributes to some intense mineralization processes of the organic matter under the action of bacteria.

The presence of some ciliates species consuming sulphate reducing bacteria clearly proves the existence of the sulphuretted hydrogen in the sediments of the basin.

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Some ciliates species from the Black Sea coast and the basin of the Dolphinarium



Figure 2. *Euplotes* sp. – in vivo - 85µm (original).



Figure 3. *Condylostoma arenarium* SPIEGEL, 1926 (in vivo) 300µm (original).



a



b

Figure 4a and 4b. *Condylostoma arenarium* SPIEGEL, 1926 cytostome detail (120 µm) and posterior part (original).
Figura 4a și 4b. *Condylostoma arenarium* SPIEGEL, 1926 detaliu citostom (120 µm) și parte posterioară (original).

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