

# THE QUALITATIVE AND QUANTITATIVE STRUCTURE OF ZOOPLANKTON IN THE SHALLOW WATERS OF THE BLACK SEA: COMPARISON OF DATA FROM 1973 AND 2007

Teodora Maria Onciu <sup>1\*</sup> and Ciprian Samoila <sup>1</sup>  
<sup>1</sup> Ovidius University Constanta - tmonciu@univ-ovidius.ro

## Abstract

The paper presents the species diversity and the quantitative structure of the shallow waters zooplankton, which were collected from standard horizons in 10 stations at the Romanian littoral of the Black Sea in summer 2007 and compared to data from 10 samples collected from surface waters (0 m) at Portita in 1973. In 2007, there were 22 holoplanktonic species and 4 benthic larvae identified: 53.85% of all species were marine and the rest were limnic organisms brought by the Danube. In 1973, there were recorded species such as *Anomalocera patersoni*, *Centropages kroyeri* var. *pontica*, which have become extinct or very rare nowadays.

**Keywords:** Black Sea, Zooplankton, Biodiversity, Density, Biomass

The chronic blooming of phytoplankton due to eutrophication led to an increase in the concentration of particulate organic matter (POM) in the water column and sediments, and implicitly to a phenomena of oxygen depletion or hypoxia [1], [2]. A number of 22 quantitative samples of zooplankton were studied; the samples were collected in late summer 2007 (29.08.-01.09.2007) from standard horizons in 10 stations located in four areas at the Romanian littoral: near the mouths of Danube river at Sf. Gheorghe ( $\Phi=44^{\circ}52'$ ,  $\Lambda=29^{\circ}38'$ ;  $\Phi=44^{\circ}51'$ ,  $\Lambda=29^{\circ}42'$ ;  $\Phi=44^{\circ}50'$ ,  $\Lambda=29^{\circ}47'$ ), then southward at Portita ( $\Phi=44^{\circ}38'$ ,  $\Lambda=29^{\circ}04'$ ;  $\Phi=44^{\circ}36'$ ,  $\Lambda=29^{\circ}08'$ ;  $\Phi=44^{\circ}33'$ ,  $\Lambda=29^{\circ}14'$ ), Midia ( $\Phi=44^{\circ}21'$ ,  $\Lambda=28^{\circ}42'$ ;  $\Phi=44^{\circ}19'$ ,  $\Lambda=28^{\circ}47'$ ;  $\Phi=44^{\circ}18'$ ,  $\Lambda=28^{\circ}49'$ ) and Tuzla ( $\Phi=44^{\circ}00'$ ,  $\Lambda=28^{\circ}57'$ ). The sampling was performed with a vertical-tow net made of silk tissue with a 90 $\mu$ m mesh. In 1973, there were 10 samples collected from the surface (0m), by filtering 100l of water through the same type of net. The quantitative data relate to  $1m^3$  ( $D_{density}$ = number of individuals for one cubic metre of water -  $ind \cdot m^{-3}$ ,  $B_{biomass}$ = $mg \cdot m^{-3}$ ).

In the late summer of 2007, the zooplankton quantity varied from 41  $ind \cdot m^{-3}$  and 1.30  $mg \cdot m^{-3}$  (Midia area, station 8, horizon 25-10 m) to 12505  $ind \cdot m^{-3}$  and 82.49  $mg \cdot m^{-3}$  (Portita area, station 4, horizon 15-10 m); a maximum quantity was based on the weight of Bivalvia larvae (53%), as well as the fresh water rotifers (24%). The number of eudominant species (F -75,1-100%) is large (*N. scintillans*, larvae of Polychaeta, Bivalvia and *Balanus*), with only one copepod, *Acartia clausi*, found among them (table 1).

Tab. 1. The qualitative and quantitative structure of zooplankton in the Black Sea shallow waters along the Romanian shore in 2007 (D%=dominance. F%=frequency. W= ecological significance index. R=rank)

Species	Sf. Gheorghe area				Portita area				Midia area				Tuzla area			
	D%	F%	W	R	D%	F%	W	R	D%	F%	W	R	D%	F%	W	R
<i>Noctiluca scintillans</i>	13	100	13	3	73	100	7.3	4	2.4	100	2.4	6	7.9	100	7.9	6
<i>Favella ehrenbergi</i>	1.2	75	0.9	9	0.5	83	0.4	11	1.1	80	0.9	9	22	100	22	1
<i>Beroe ovata</i>	0.8	88	0.7	10	0.4	50	0.2	14	38	20	7.6	4	0	0	0	0
<i>Rotaria citrina</i>	1.4	50	0.7	11	3.1	33	1	9	0	0	0	0	0	0	0	0
<i>Brachionus quadridentatus</i>	0	0	0	0	0	0	0	0	0.1	20	0	14	0	0	0	0
<i>Brachionus calceiflorus</i>	0.1	25	0	18	0	0	0	0	0	0	0	0	0	0	0	0
<i>Brachionus angularis</i>	0	13	0	20	0	0	0	0	0	0	0	0	0	0	0	0
<i>Brachionus diversicornis</i>	0	13	0	20	0	0	0	0	0	0	0	0	0	0	0	0
<i>Eosphora thoa</i>	1.8	88	1.6	7	2.3	83	1.9	8	0	20	0	15	0	67	0	11
<i>Polyarthra vulgaris</i>	0.7	25	0.2	15	0.8	50	0.4	12	0	20	0	15	0	0	0	0
<i>Synchaeta littoralis</i>	18	88	16	2	18	100	18	2	1.9	60	1.1	10	14	100	14	3
Larvae Polychaeta	1.2	100	1.2	8	4.8	100	4.8	5	8.4	100	8.4	3	2.6	100	2.6	7
Larvae Gasteropoda	0.7	63	0.4	12	0.7	67	0.4	10	0.3	40	0.1	13	0.4	33	0.1	10
Larvae Bivalvia	45	100	45	1	38	100	38	1	2.6	100	2.6	5	13	100	13	4
Larvae Balanus	3.1	100	3.1	5	4.1	100	4.1	6	1.4	60	0.9	9	11	100	11	5
<i>Penilia avirostris</i>	2	88	1.8	6	3.3	83	2.7	7	14	80	11	2	3.1	67	2	8
<i>Bosmina longirostris</i>	0.3	13	0	17	0	0	0	0	0	0	0	0	0	0	0	0
<i>Chydorus sphaericus</i>	0	13	0	20	0	0	0	0	0	0	0	0	0	0	0	0
<i>Pleopsis polyphemoides</i>	0	13	0	20	0	0	0	0	0	0	0	0	0	0	0	0
<i>Calanus helgolandicus</i>	0	0	0	0	0	17	0	16	0	0	0	0	0	0	0	0
<i>Acartia clausi</i>	9.8	100	9.8	4	16	100	16	3	25	100	25	1	21	100	21	2
<i>Calanipeda aquae-dulcis</i>	0.2	25	0	16	0	0	0	0	0	0	0	0	0	0	0	0
<i>Eurytemora affinis</i>	0	0	0	0	0	0	0	0	1.6	20	0.3	12	0	0	0	0
<i>Cyclops vicinus</i>	0.1	13	0	19	0	0	0	0	0	0	0	0	0	0	0	0
<i>Oikopleura dioica</i>	0.7	50	0.3	13	0.3	50	0.1	12	1	40	0.4	11	0.4	33	0.1	10
<i>Sagitta setosa</i>	0.3	75	0.3	14	0.3	83	0.3	13	2.3	60	1.4	7	1.8	67	1.2	9

In 2007, a number of 8 species of rotifers were identified (representing 31% of total found species), where only one is a marine species (*Synchaeta littoralis*), and the rest are limnic, also tolerating lower concentrations of oxygen (*Rotaria citrina*, *Brachionus* sp., *Eosphora ehrenbergi*, *Polyarthra vulgaris*). The crustaceans were represented by 4 species of Cladocera and 5 species of Copepoda, most of them eurihaline and euryoxyc species that usually live in fresh waters (like the cladocers *Bosmina longirostris* and *Chydorus sphaericus*,

and copepods such as *Calanipeda aquae-dulcis*, *Eurytemora affinis* and *Cyclops vicinus*).

By comparing the data from 2007 and before 1970 when the eutrophication began [1], we observed that the biomass of the zooplankton was 3.7 times lower due to a decrease in numbers of the copepods. The density is higher as the light-weighted *Noctiluca* and rotifers numbers increase. The value of average density in 2007 was four times lower than in 1973, when the copepods held the major weight among eudominant species (*Acartia clausi* - registered a density of 6617  $ind \cdot m^{-3}$ , and a biomass of 17.38  $mg \cdot m^{-3}$  in July, followed by *Oithona nana*, *Centropages kroyeri* var. *ponticus* and *Paracalanus parvus*) (table 2). In 1973, only one fresh water species (*Calanipeda aquae-dulcis*) was found. In summer months, there were records of thermophilic copepods such as *Centropages kroyeri* var. *ponticus*, *Anomalocera patersoni* and *Oithona nana*, which were not to be found again in 2007.

Tab. 2. The qualitative and quantitative structure of the zooplankton in the Black Sea shallow waters on Portita transect in 1973 ( $D_{eco}$ =ecological average. D%=dominance. F%=frequency. W= ecological significance index. R=rank)

Species	July					September				
	$D_{eco}$	D%	F%	W	R	$D_{eco}$	D%	F%	W	R
<i>Noctiluca scintillans</i>	2	0	25	0	12	1	0	60	0	15
<i>Tintinnopsis campanula</i>	0	0	0	0	0	27	0.3	60	0.2	9
<i>Coxiella helix</i>	2	0	13	0	12	68	0.8	100	0.8	7
<i>Metacylis mediterranea</i>	3	0	13	0	12	301	3.4	40	1.4	5
<i>Synchaeta littoralis</i>	15	0.2	50	0.1	8	9	0.1	20	0	13
Larvae Polychaeta	9	0.1	63	0.1	9	15	0.2	80	0.1	10
Larvae Gasteropoda	33	0.4	100	0.4	7	20	0.2	60	0.1	10
Larvae Bivalvia	793	9.3	88	8.1	3	397	4.5	100	4.5	3
Larvae Balanus	70	0.8	100	0.8	5	15	0.2	80	0.1	10
<i>Penilia avirostris</i>	2	0	25	0	12	54	0.6	100	0	14
<i>Pseudevadne tergestina</i>	0	0	0	0	0	1	0	40	0	15
<i>Evadne spinifera</i>	2	0	38	0	12	1	0	20	0	15
<i>Pleopsis polyphemoides</i>	153	1.8	100	1.8	4	17	0.2	60	0.1	11
<i>Anomalocera patersoni</i>	1	0	13	0	15	0	0	0	0	0
<i>Paracalanus parvus</i>	0	0	0	0	0	278	3.1	100	3.1	4
<i>Acartia clausi</i>	6617	78	100	78	1	2199	25	100	25	2
<i>Centropages kroyeri</i> var. <i>pontica</i>	38	0.4	100	0.4	6	106	1.2	100	1.2	6
<i>Calanipeda aquae-dulcis</i>	7	0.1	50	0	10	0	0	0	0	0
<i>Oithona nana</i>	755	8.9	100	8.9	2	5346	60	100	60	1
<i>Oithona simiis</i>	0	0	0	0	0	4	0	20	0	15
<i>Oikopleura dioica</i>	8	0.1	50	0	10	44	0.5	100	0.5	8
<i>Sagitta setosa</i>	4	0	75	0	11	9	0.1	100	0.1	12

We may conclude that the modification of environmental variables in the water column led to a decrease in the species diversity of zooplankton, an increase in the weight of euryoxyc limnic species, both small and light sizes. It must be outlined the fact that the high density of bivalves larvae recorded in 2007 in the North sector (1337  $ind \cdot m^{-3}$ ) indicates the revitalisation of endosamic mollusc populations in the area.

## References

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