

Supplementary material to article:

Dynamics of zooplankton along the Romanian Black Sea coastline: temporal variation, community structure, and environmental drivers.

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Table S1. List of zooplankton taxa identified until 2020 along the Romanian Black Sea coastline (after Timofte F., 2017 and personal observations).

No.	Taxa	Petran, 1994						Porumb, 1994 -1995	Onciu, Skolka, Gomoiu, 2006	Timofte, 2017		Bişnicu, 2022
		1986	1987	1988	1989	1990	1991	1994-1995	1995-2003	2004-2010	2011-2012	2013-2020
	DINOFLAGELLATA											
1	<i>Noctiluca scintillans</i> (Macartney) Kofoed & Swezy, 1921	+	+	+	+	+	+	+	+	+	+	+
	CILIOPHORA											
	ANNELIDA											
2	POLYCHAETA (larvae: trocophore, nectocheta)	+	+	+	+	+	+		+	+	+	+

No.	Taxa	Petran, 1994						Porumb, 1994 -1995	Onciu, Skolka, Gomoiu, 2006	Timofte, 2017		Bişinicu, 2022
		1986	1987	1988	1989	1990	1991	1994-1995	1995-2003	2004-2010	2011-2012	2013-2020
3	BRYOZOA (larvae: cyphonautes)								+	+		
4	PHORONIDA (larvae: actinotrocha)								+	+	+	
5	<i>Phoronis reticulatum</i> (Linnaeus, 1767) (sin.: <i>P. euxinicola</i> Saint-Long, 1907)									+		
	ARTHROPODA											
	CRUSTACEA											
	Cladocera											
6	<i>Bosmina (Bosmina) longirostris</i> (O.F. Müller, 1785)	+	+	+	+	+	+	+	+	+	+	+
7	<i>Chydorus sphaericus</i> (O.F. Müller, 1785)								+	+	+	+
8	<i>Daphnia cucullata</i> Sars, 1862									+	+	
9	<i>Daphnia longispina</i> O.F. Müller, 1785	+	+	+	+	+	+	+	+	+	+	+
10	<i>Diaphanosoma brachiurum</i> (Lievin, 1848)	+	+					+	+			+
11	<i>Evadne nordmanni</i> Loven, 1836							+	+			
12	<i>Evadne spinifera</i> O.F. Müller, 1867	+	+	+	+	+	+	+	+	+	+	+
13	<i>Penilia avirostris</i> Dana, 1849	+	+	+	+	+	+	+	+	+		+
14	<i>Pleopis polyphemoides</i> (Leucart, 1859)	+	+	+	+	+	+	+	+	+	+	+
15	<i>P. tergestina</i> (Claus, 1877)(sin.: <i>Pseudevadne tergestina</i> (Claus, 1877)	+	+	+	+	+	+	+	+	+	+	+
16	<i>Podon intermedius</i> Lilljeborg, 1853							+	+	+	+	+

No.	Taxa	Petran, 1994						Porumb, 1994 -1995	Onciu, Skolka, Gomoiu, 2006	Timofte, 2017		Bişinicu, 2022
		1986	1987	1988	1989	1990	1991	1994-1995	1995-2003	2004-2010	2011-2012	2013-2020
17	<i>P. leuckartii</i> (G.O. Sars, 1862)							+	+			
	Copepoda											
	Calanoida											
18	<i>Acartia (Acartiura) clausi</i> Giesbrecht, 1889	+	+	+	+	+	+	+	+	+	+	+
19	<i>A. clausi</i> Giesbrecht, 1890 small form									+		
20	<i>A. tonsa</i> Dana, 1849									+		
21	<i>Anomalocera patersonii</i> Templeton, 1837							+	+			
22	<i>Arctodiaptomus salinus</i> (Daday)								+			
23	<i>Calanipeda aquae-dulcis</i> Kritczagin, 1873	+	+	+	+	+	+	+	+			
24	<i>Calanus euxinus</i> Hulsemann, 1991 (sin.: <i>C. helgolandicus</i> Claus, 1863)	+	+	+	+	+	+	+	+	+	+	+
25	<i>Centropages ponticus</i> Karavaev, 1894(sin.: <i>C. kröyeri pontica</i> Karavaev, 1895)	+	+	+	+	+	+	+	+	+	+	+
26	<i>D. salinus</i> Daday, 1885							+				
27	<i>Eudiaptomus gracilis</i> (G. O. Sars, 1862)								+			
28	<i>Eurytemora affinis</i> (Poppe, 1880)	+	+	+	+	+	+	+		+	+	
29	<i>Eurytemora hirundoides</i> (Nordquist, 1888)	+	+	+	+	+	+		+			
30	<i>Eurytemora lacustris</i> (Poppe, 1887)								+			
31	<i>Paracalanus parvus</i> (Claus, 1863)							+	+	+	+	+

No.	Taxa	Petran, 1994						Porumb, 1994 -1995	Onciu, Skolka, Gomoiu, 2006	Timofte, 2017		Bişinicu, 2022
		1986	1987	1988	1989	1990	1991	1994-1995	1995-2003	2004-2010	2011-2012	2013-2020
32	<i>Paracalanus pygmaeus</i>	+	+	+	+	+	+					
33	<i>Pontella mediterranea</i> (Claus, 1863)							+	+	+	+	
34	<i>Pseudocalanus elongatus</i> (Boeck, 1872)	+	+	+	+	+	+	+	+	+	+	+
	Cyclopoida											
35	<i>Cyclops. sp</i>									+	+	+
36	<i>Cyclops frucifer</i> (Claus)											
37	<i>Cyclopina gracilis</i> Claus, 1863											
38	<i>Cyclops scutifer</i> G.O. Sars, 1863											
39	<i>C. strenuus</i> Fisch, 1851											
40	<i>C. vicinus</i> Ulgan, 1875											
41	<i>Oithona minuta</i> (Kritz, 1873) (sin: <i>O. nana</i> Giesbrecht, 1892)	+	+	+	+	+	+	+	+	+	+	
42	<i>O. similis</i> Claus, 1863	+	+	+	+	+	+	+	+	+	+	+
43	<i>Oithona brevicornis brevicornis</i> Giesbrecht, 1891/ <i>Oithona davisae</i> Ferrari F.D. & Orsi, 1984									+	+	+
	Monstrilloida											
44	<i>Cymbasoma rigidum</i> Thompson I.C, 1888							+	+			
45	<i>Cymbasoma longispinosum</i> Bourne 1890							+	+			
46	<i>Cymbasoma thompsoni</i> (Giesbrecht, 1893) acceptata <i>Cymbasoma thompsonii</i> (Giesbrecht, 1893)							+	+			

[illegible]

[illegible]

[illegible]

No.	Taxa	Aphia id	Year/Season														
			2013		2014			2015	2016		2017			2018		2019	2020
			Warm		Warm		Cold	Warm	Cold	Warm	Cold	Warm	Cold	Warm		Warm	Warm
	Classification		May	Aug	May	Jul	Nov	Jun	Mar	Aug	Mar	Jul	Nov	Jul	Sep	Aug	Jun
25	POLYCHAETA**	883	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	CHAETOGNATHA *		+														
26	<i>Parasagitta setosa</i> Müller, 1847*	105443	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	APPENDICULARIA																
27	<i>Oikopleura (Vexillaria) dioica</i> Fol, 1872*	103407	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

*holoplankton, ** meroplankton

Table S3. Descriptive statistics of physicochemical parameters under study, both seasons.

Variable	Descriptive Statistics (2013-2020)						
	Mean	Median	Minimum	Maximum	Lower Quartile	Upper Quartile	Std.Dev.
T[oC]	18.60	20.31	5.20	27.12	13.13	23.79	6.35
S[%o]	14.67	15.59	0.11	19.91	13.53	17.35	3.80
O ₂ [μM]	318.94	314.41	119.24	495.60	284.60	354.60	49.33
O ₂ [%]	117.34	114.10	45.25	192.50	105.40	128.55	19.17
PO ₄ [μM]	0.34	0.24	0.01	3.04	0.10	0.44	0.38
SiO ₄ [μM]	14.19	6.46	0.05	168.32	3.06	15.57	20.75
NO ₂ [μM]	1.91	0.41	0.01	50.85	0.14	1.06	5.14
NO ₃ [μM]	5.21	2.53	0.01	69.23	1.49	5.59	7.46
NH ₄ [μM]	7.69	5.43	0.12	64.41	1.93	10.86	7.93

Table S4. Descriptive statistics of physicochemical parameters under study, cold season.

Variable	Season=Cold descriptive statistics (2013-2020)						
	Mean	Median	Minimum	Maximum	Lower Quartile	Upper Quartile	Std.Dev.
T[oC]	8.76	8.50	5.20	13.27	7.54	9.71	1.96
S[%o]	15.98	16.01	0.55	19.75	15.20	17.84	2.77
O ₂ [μM]	330.84	332.27	242.50	416.68	302.79	357.28	31.90
O ₂ [%]	100.78	100.82	72.70	118.30	96.20	107.50	8.35
PO ₄ [μM]	0.35	0.21	0.02	2.33	0.11	0.44	0.39
SiO ₄ [μM]	29.32	18.74	2.59	168.32	12.20	36.61	29.86
NO ₂ [μM]	0.57	0.38	0.06	8.18	0.24	0.69	0.85
NO ₃ [μM]	3.98	2.49	0.69	21.20	1.87	3.92	3.95
NH ₄ [μM]	5.76	3.96	0.21	64.41	1.96	6.82	7.38

Table S5. Descriptive statistics of physicochemical parameters under study, warm season.

Variable	Season=Warm descriptive statistics (2013-2020)						
	Mean	Median	Minimum	Maximum	Lower Quartile	Upper Quartile	Std.Dev.
T[oC]	21.93	23.04	14.90	27.12	19.25	24.32	2.98
S[%o]	14.22	15.39	0.11	19.91	12.72	17.23	4.00
O ₂ [μM]	314.94	305.25	119.24	495.60	275.55	350.70	53.40
O ₂ [%]	123.94	122.81	45.25	192.50	111.70	134.90	18.26
PO ₄ [μM]	0.34	0.25	0.01	3.04	0.09	0.44	0.38
SiO ₄ [μM]	9.10	4.96	0.05	95.76	2.50	9.58	13.21
NO ₂ [μM]	2.36	0.45	0.01	50.85	0.13	1.29	5.85
NO ₃ [μM]	5.62	2.56	0.01	69.23	1.37	6.19	8.28
NH ₄ [μM]	8.35	6.08	0.12	53.62	1.83	12.41	8.02

Table S6. Statistical differences of physicochemical parameters under study, cold and warm seasons.

Variable	T-Tests; Grouping: Season Group 1: Warm Group 2: Cold										
	Mean Warm	Mean Cold	t-value	df	p	Valid N Warm	Valid N Cold	Std.Dev. Warm	Std.Dev. Cold	F-ratio Variances	p Variances
T[°C]	21.93	8.76	40.85008	386	0.000000	290	98	2.98	1.96	2.31747	0.000003
S[%]	14.22	15.98	-4.02809	386	0.000068	290	98	4.00	2.77	2.07638	0.000043
O ₂ [µM]	314.94	330.84	-2.79733	391	0.005407	294	99	53.40	31.90	2.80280	0.000000
O ₂ [%]	123.94	100.78	12.05422	342	0.000000	246	98	18.26	8.35	4.77728	0.000000
PO ₄ [µM]	0.34	0.35	-0.26403	391	0.791900	294	99	0.38	0.39	1.09326	0.568046
SiO ₄ [µM]	9.10	29.32	-9.24735	391	0.000000	294	99	13.21	29.86	5.11039	0.000000
NO ₂ [µM]	2.36	0.57	3.02642	391	0.002638	294	99	5.85	0.85	47.17083	0.000000
NO ₃ [µM]	5.62	3.98	1.90068	391	0.058079	294	99	8.28	3.95	4.39463	0.000000
NH ₄ [µM]	8.35	5.76	2.83432	391	0.004831	294	99	8.02	7.38	1.18074	0.335177

Table S7. Correlations (all) between biological and environmental parameters.

Variable	All Groups Correlations; Marked correlations are significant at $p < .05000$ N=344 (Casewise deletion of missing data)								
	T [°C]	S [‰]	O2 [μM]	O2 [%]	PO4 [μM]	SiO4 [μM]	NO2 [μM]	NO3 [μM]	NH4 [μM]
Nonfodder (<i>Noctiluca scintillans</i>) [ind/m ³]	0.19	-0.05	0.03	0.18	0.00	-0.10	0.06	0.00	0.04
Copepoda [ind/m ³]	0.15	0.08	-0.16	-0.04	0.03	-0.01	-0.03	0.34	-0.08
Cladocera [ind/m ³]	0.26	-0.07	-0.10	0.10	-0.04	-0.14	0.08	0.06	0.00
Meroplankton [ind/m ³]	0.20	-0.20	0.04	0.17	-0.01	-0.09	0.07	0.09	0.04
Other groups [ind/m ³]	0.33	0.23	-0.31	-0.03	-0.09	-0.17	0.02	0.16	-0.14
Fodder ZPK [ind/m ³]	0.26	-0.06	-0.11	0.08	0.00	-0.09	0.04	0.28	-0.04
Total ZPK [ind/m ³]	0.32	-0.08	-0.06	0.19	0.00	-0.13	0.07	0.20	0.00
Nonfodder (<i>Noctiluca scintillans</i>) [mg/m ³]	0.19	-0.05	0.03	0.18	0.00	-0.10	0.06	0.00	0.04
Copepoda [mg/m ³]	0.10	0.08	-0.15	-0.07	0.01	0.02	-0.06	0.29	-0.05
Cladocera [mg/m ³]	0.32	0.00	-0.22	0.03	-0.07	-0.15	0.07	0.06	-0.04
Meroplankton [mg/m ³]	0.14	-0.20	0.10	0.17	0.01	-0.07	0.06	0.14	0.07
Other groups [mg/m ³]	0.30	0.21	-0.34	-0.09	-0.09	-0.15	0.02	0.17	-0.13
Fodder ZPK [mg/m ³]	0.27	0.03	-0.19	0.02	-0.04	-0.11	0.02	0.27	-0.05
Total ZPK [mg/m ³]	0.25	-0.05	-0.01	0.19	-0.01	-0.12	0.07	0.05	0.03

Table S8. Correlations (warm season) between biological and environmental parameters.

Season=Warm Correlations; Marked correlations are significant at $p < .05000$ N=246 (Casewise deletion of missing data)									
	T [°C]	S [‰]	O2 [μM]	O2 [%]	PO4 [μM]	SiO4 [μM]	NO2 [μM]	NO3 [μM]	NH4 [μM]
Nonfodder (Noctiluca scintillans) [ind/m ³]	0.05	-0.02	0.05	0.10	0.02	0.00	0.02	-0.06	0.03
Copepoda [ind/m ³]	0.18	0.11	-0.17	-0.12	0.06	-0.01	-0.04	0.35	-0.12
Cladocera [ind/m ³]	0.15	-0.02	-0.08	-0.03	-0.03	-0.08	0.05	0.05	-0.05
Meroplankton [ind/m ³]	0.05	-0.18	0.06	0.06	0.01	0.03	0.05	0.07	0.00
Other groups [ind/m ³]	0.30	0.31	-0.31	-0.20	-0.09	-0.15	-0.01	0.15	-0.21
Fodder ZPK [ind/m ³]	0.18	-0.02	-0.10	-0.06	0.03	-0.01	0.01	0.28	-0.09
Total ZPK [ind/m ³]	0.16	-0.03	-0.04	0.03	0.04	-0.01	0.02	0.16	-0.05
Nonfodder (Noctiluca scintillans) [mg/m ³]	0.05	-0.02	0.05	0.10	0.02	0.00	0.02	-0.06	0.03
Copepoda [mg/m ³]	0.16	0.07	-0.17	-0.13	0.04	-0.01	-0.07	0.32	-0.07
Cladocera [mg/m ³]	0.27	0.06	-0.21	-0.13	-0.08	-0.10	0.04	0.05	-0.10
Meroplankton [mg/m ³]	-0.06	-0.19	0.12	0.07	0.04	0.04	0.04	0.14	0.04
Other groups [mg/m ³]	0.34	0.28	-0.34	-0.23	-0.11	-0.13	0.00	0.17	-0.19
Fodder ZPK [mg/m ³]	0.22	0.07	-0.19	-0.14	-0.02	-0.05	-0.01	0.28	-0.11
Total ZPK [mg/m ³]	0.09	-0.01	0.01	0.07	0.02	-0.01	0.02	0.00	0.01

Table S9. Correlations (cold season) between biological and environmental parameters.

Season=Cold Correlations; Marked correlations are significant at $p < .05000$ N=98 (Casewise deletion of missing data)									
	T [°C]	S [‰]	O2 [μM]	O2 [%]	PO4 [μM]	SiO4 [μM]	NO2 [μM]	NO3 [μM]	NH4 [μM]
Nonfodder (<i>Noctiluca scintillans</i>) [ind/m ³]	0.29	0.06	0.03	0.21	-0.04	-0.14	0.64	0.54	-0.13
Copepoda [ind/m ³]	-0.12	0.05	0.07	0.02	-0.10	0.18	0.04	0.14	-0.01
Cladocera [ind/m ³]	0.24	-0.02	0.08	0.23	0.08	-0.11	0.31	0.60	-0.15
Meroplankton [ind/m ³]	0.09	0.00	0.21	0.29	-0.06	-0.12	0.08	0.14	0.01
Other groups [ind/m ³]	0.33	0.23	0.00	0.24	-0.03	0.07	0.00	0.30	-0.13
Fodder ZPK [ind/m ³]	-0.01	0.03	0.16	0.19	-0.09	0.04	0.07	0.18	0.00
Total ZPK [ind/m ³]	0.17	0.06	0.13	0.26	-0.09	-0.06	0.45	0.46	-0.08
Nonfodder (<i>Noctiluca scintillans</i>) [mg/m ³]	0.29	0.06	0.03	0.21	-0.04	-0.14	0.64	0.54	-0.13
Copepoda [mg/m ³]	-0.02	0.19	0.01	0.04	-0.11	0.14	-0.04	0.04	-0.03
Cladocera [mg/m ³]	0.26	0.00	0.06	0.22	0.07	-0.11	0.32	0.61	-0.16
Meroplankton [mg/m ³]	0.03	-0.03	0.21	0.26	-0.05	-0.10	0.07	0.08	0.04
Other groups [mg/m ³]	0.26	0.04	-0.29	-0.19	0.13	-0.03	-0.16	-0.07	-0.13
Fodder ZPK [mg/m ³]	0.04	0.11	0.09	0.15	-0.08	0.03	0.00	0.07	-0.02
Total ZPK [mg/m ³]	0.29	0.08	0.05	0.24	-0.06	-0.13	0.61	0.53	-0.13