APPENDICULARIANS OF THE NORTHERN ADRIATIC SEA

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Abstract

Appendicularians were collected monthly from 1999-2002 at three northern Adriatic stations with different productivity regimes. High abundance, especially of juveniles, was found. Particularly large variations in Chl-*a*, picoplankton, and appendicularians may be responsible for the failure to identify statistically significant correlations among these factors.

Keywords: juvenile/adult appendicularians, northern Adriatic

Intoduction

The ability of appendicularians to retain suspended particles down to the sub-micron range (1) makes them an important step in the microbial food web that links picoplankton with larval fish. The present study focuses on the density and distribution of appendicularians in the northern Adriatic, a productive ecosystem particularly influenced by industrial and municipal discharge of the Po River (2).

Materials and methods

Samples were taken monthly (February 1999-August 2002) at three stations between the Po River delta and Rovinj (Croatia): SJ101, near the delta; SJ105, in the central part; ZI032, near Rovinj. Water was collected with a 5-l Niskin bottle at 0.3, 5, 10, 20, and 30 m (near bottom). Temperature was measured with a reversing thermometer and salinity with a Yeo-Kal MkII salinometer. Epifluorescence microscopy was used to count picoplankton (DAPI-stained bacteria and coccoid cyanobacteria). Chlorophyll *a* (Chl *a*) was analyzed fluorometrically. Juvenile appendicularians were sedimented for 72 h, until the original volume (5 l) was reduced to 3 ml. Adults were collected with vertical tows of a standard WP2 plankton net.

Results and discussion

Temperature (Table 1) fluctuations were typical for a neritic area, with stratification beginning as early as May and a sharp thermocline forming by early summer. Salinity oscillations were more pronounced in spring and fall.

Picoplankton occurred in particularly high numbers during spring and summer at SJ101, and throughout the summer at others stations. The highest Chl-*a* was found in spring and fall, while high abundance of picoplankton was noted in summer and fall. There was a significant horizontal gradient in picoplankton abundance and Chl-*a* concentration (Kendall's coefficient of concordance; $p<0.001$; sequence of abundance = SJ10>SJ105>ZI032). Significantly higher values were noted in the surface layer (0.3 m and 10 m) at SJ101 and SJ105 (Mann-Whitney Test; $p<0.001$).

Juveniles were most numerous in spring (Fig. 1), with a maximum at all stations in June: 24 ind.l^{-1} at SJ101; 20 ind.l^{-1} at SJ105; 12 ind.l^{-1}. Higher juvenile abundances were found in January at SJ101, during fall at SJ105, and in summer at ZI032. No significant difference in abundance was found between surface and bottom layers. Comparison of the mean number of juveniles and adults showed a positive correlation at SJ101 ($n=46$, $r=56$, $p<0.001$).

Table 1. Minimum, maximum, and mean hydrographic and biotic parameters in the northern Adriatic Sea during 1999-2002.

SJ101	Minimum	Maximum	Mean
Temperature (°C)	7.87	29.15	16.11±5.58
Salinity	14.92	38.47	36.89±2.32
Picoplankton (x10^6 l^{-1})	334	5938	1340±819
Chl-*a* (mg m^{-3})	0.1	13.19	1.51±1.82
SJ105	**Minimum**	**Maximum**	**Mean**
Temperature (°C)	7.36	28.22	16.12±5.41
Salinity	31.25	38.54	37.48±1.12
Picoplankton (x10^6 l^{-1})	321	4267	1135±662
Chl-*a* (mg m^{-3})	0.06	12.81	1.07±1.50
ZI032	**Minimum**	**Maximum**	**Mean**
Temperature (°C)	8.85	27.06	17.62±5.41
Salinity	33.87	38.54	37.69±0.83
Picoplankton (x10^6 l^{-1})	241	3315	891±480
Chl-*a* (mg m^{-3})	0.03	3.32	0.45±0.44

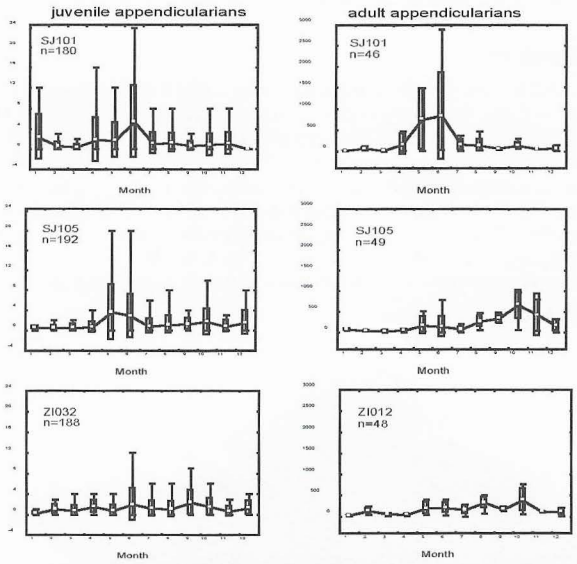

Fig. 1. Box plot of numerical abundance of appendicularians in the northern Adriatic Sea during 1999-2002. *Middle tiny squares* and line indicate means; *boxes*, standard deviations; *whiskers*, min-max values.

A pronounced maximum of adults, 2899 ind.m^{-3}, was noted in June at SJ101. Highest values at other stations were lower and occurred in fall (Fig. 1). The most numerous species at SJ101, *Oikopleura dioica*, made up 50% of total appendicularians. Other stations were dominated by *O. longicauda* (50%). *O. fusiformis* was the third most important species. Regarding other species, peaks were found for *Fritillaria borealis* in October 2000 (452 ind.m^{-3}) and *F.pellucida* in November 2001(632 ind.m^{-3}) at SJ105; and for *F. haplostoma* in October 1999 at ZI032 (307 ind.m^{-3}). *Kowalewskia tenuis* was present sporadically from May to July, and *O. graciloides* in winter at ZI032. Both in terms of quality and quantity, these samples were similar to those found in earlier investigations (3).

No difference in the abundance of juveniles and adults was found between stations. Appendicularian growth and abundance are mostly affected by temperature and food availability (2, 4). Temperature and salinity clearly influenced seasonal succession, especially at those stations distant from the Po. Large variations both in picoplankton and Chl a, as well as complex predator-prey relations along a trophic gradient, might be responsible for the lack of correlations among these factors and appendicularian abundance. Part of the variability also might be owed to mucilage events that occurred during the research period. High picoplankton and Chl-*a* observed during this study suggest appendicularians were not food-limited in the study area.

References

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