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Zespoły skorupiaków planktonowych (*Cladocera* i *Copepoda*) wybranych zbiorników zaporowych w południowej Polsce

Associations of plankton crustaceans (*Cladocera* and *Copepoda*) of selected dam reservoirs in Southern Poland

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A b s t r a c t — Associations of *Cladocera* and *Copepoda* were discriminated from seven dam reservoirs and three stages. These associations were worked out on the basis of the computed mean frequency and mean dominance of the occurring species. From the product of these two values a coefficient was obtained, according to which the associations were ordered.

Considerable differences were observed in the values of this coefficient between one or two dominants and the other species occurring in the association.

As a result of these investigations 17 various associations were obtained, composed of 13 species. These associations are distinguished by a considerable similarity, especially in reservoirs of the same character.

Introduction and methods of investigations

The aim of this work was to discriminate and describe plankton crustaceans occurring in dam reservoirs and stages in southern Poland. Various kinds of dam reservoir were selected for these investigations. They represented typically lowland, limnic reservoirs on the river Czarna Przemsza at Przeczyce and on the river Brynica at Kozłowa Góra, rheolimnic reservoirs on the river Soła at Porąbka, on the stream Wapienica at Wapienica, on the river Dunajec at Rożnów, and on the river San at Myczkowce, and the mountain reservoir at Wisła—Czarna. Simultaneously, for comparison, the zooplankton of the small stages on the Vistula at Łączany, Dąbie, and Przewóz was elaborated. All the mentioned reservoirs lie in the basin of the Vistula.

Samples of zooplankton were collected from the investigated reservoirs at monthly intervals during the period when they were free from ice cover. In the reservoirs at Przeczyce, Myczkowce, and Wapienica and on the stages at Łączany and Przewóz observations were carried out during two successive seasons in the years 1965—1966, but in the other reservoirs only in the course of one season in 1967. In August 1968 control sampling was carried out in all the investigated reservoirs.

The plankton was collected from several permanent sampling points on a vertical section in the pelagic and littoral zone and from above the bottom with the aid of a two-litre sampler of the Patalas type and planktonic nets.

Accepting as a basis the density of populations of the cladocer and copepod species caught, the mean percentage share of the occurring species was calculated. In this way dominants were discriminated, i.e. species whose share in the whole of the crustacean plankton was higher than 10 per cent. Subsequently, the frequency [1] of all these dominants was calculated. Multiplying the mean dominance by the mean frequency a coefficient was obtained, according to the values of which the associations were ordered.

Results of investigations

In the way described above 17 various associations of *Crustacea* were discriminated (Table I). As can be seen from this Table, they are assigned to only 13 species, of which the most frequently recurring were *Bosmina coregoni, B. longirostris, Daphnia cucullata,* and *Thermocyclops crassus.* They are therefore characterized by a considerable similarity, with the exception of the associations from Wapienica, Wisła—Czarna, and Przewóz, which are entirely different. The most similar associations occurred at Przeczyce and Kozłowa Góra. Nevertheless the similarity of the associations was not always connected with the similar character of the given reservoir, as was the case at Przeczyce and Kozłowa Góra. Under so different conditions as those prevailing at Porąbka and on the canal at Dąbie a very similar association of crustaceans was observed. In most cases, however, one of the components was common to reservoirs of the same character.

The investigations showed that the value of the coefficient of two species is distinctly higher than that of the remaining ones (marked on the diagram with a frame). Hence the name given to an association was derived from the names of the species characterized by the highest coefficient. The other species forming part of the composition of this

[1] The percentage of samples in which the given species occurred was accepted as frequency.

Tabela I. Zespoły skorupiaków planktonowych ułożone według wielkości współczynnika (dominacja x frekwencja)

Table I. Associations of plankton crustaceans aranged according to the magnitude of the coefficient (dominance x frequency)

Zbiornik Reservoir / Gatunek Species	Przeczyce			Kozłowa Góra		Porąbka		Wapienica		Rożnów	Myczkowce			Wisła Czarne	Łączany	Przewóz	Dąbie
	1965	1966	1968	1967	1968	1967	1968	1966	1967	1968	1965	1966	1968	1967	1965-67	1965-67	1965
Acanthocyclops vernalis			200							[2176]					28	154	
Alona affinis												24			1		
Alona quadrangularis					85							38			16		
Bosmina coregoni		[780]	[2241]	[2656]	[1800]											83	
Bosmina longirostris	[1898]	270				82;				[1700]	[252]	[624]	[7000]		[156]	30	
Ceriodaphnia quadrangula	189	384			70	286		234	[6945]				35		80	14	15
Chydorus sphericus					225	6								14	16		
Cyclops kolensis		294						3	1							6	
Cyclops strenuus strenuus	60			31		286	100	16				7			21	[210]	14
Cyclops vicinus		38													32		
Daphnia cucullata	[2108]	[1357]		[2100]	465	231	[3069]			1088	8	9				36	[1000]
Daphnia longispina	60	60		42		34		[1092]		328			53		[374]		30
Diaphanosoma brachyurum	234	148			96	15										2	
Eucyclops serrulatus								289						[1599]	136	[598]	
Eudiaptomus gracilis		144				188	280	[2160]	[1600]						13	60	440
Leydigia leydigii											130			[600]			
Megacyclops viridis														98	12	5	110
Mesocyclops leuckarti	165		[2400]	825		[1500]	2001			506		1	[1100]		42	130	45
Paracyclops fimbriatus	40									30	[315]	[77]		56	1	44	
Sida crystallina				19													
Thermocyclops crassus		352		549	[6000]	[833]	[2523]					2			50		[1305]
Nazwa zespołu / Name of the association	Daphnia cucullata Bosmina longirostris	Daphnia cucullata Bosmina coregoni	Mesocyclops leuckarti Bosmina coregoni	Bosmina coregoni Daphnia cucullata	Thermocyclops crassus Bosmina coregoni	Mesocyclops leuckarti Thermocyclops crassus	Daphnia cucullata Thermocyclops crassus	Eudiaptomus gracilis Daphnia longispina	Ceriodaphnia quadrangula Eudiaptomus gracilis	Acanthocyclops vernalis Bosmina longirostris	Paracyclops fimbriatus Bosmina longirostris	Bosmina longirostris Paracyclops fimbriatus	Bosmina longirostris Mesocyclops leuckarti	Eucyclops serrulatus Leydigia leydigii	Daphnia longispina Bosmina longirostris	Eucyclops serrulatus Cyclops strenuus str.	Thermocyclops crassus Daphnia cucullata

association have therefore to be regarded as accompanying forms. The populations of these two dominant species never (with the exception of the association at Porąbka in 1967) belonged to closely related species. In most casses one of them was a cladocer and the other a copepod. The dominance of two or several unrelated species occurs as a rule in associations of animal organisms (O d u m 1964).

According to L i t y ń s k i (1938), complexes of crustaceans in which only one or two species distinctly predominate over the remaining ones are characteristic of stabilized associations. The present investigations showed that the associations of *Crustacea* of dam reservoirs underwent relatively insignificant changes in the particular seasons.

In 1965 the association *Bosmina longirostris-Daphnia cucullata* occurred at Przeczyce and in 1968 *Bosmina coregoni-Mesocyclops leuckarti*. Taken as a whole, it was found that most frequently one of the components of the association changed seasonally. On the other hand, at Myczkowce the same association was caught in the course of two successive seasons.

No characteristic species could be taken into account in the analysed associations, since there occurred no essential differences in the specific composition and the majority of species were common for the investigated reservoirs (80 per cent of all species were caught in all the reservoirs). They mostly represented cosmopolites and ubiquists occurring in plankton in a similar latitude.

In reservoirs with swift-flowing water, e.g. at Wisła—Czarna, the majority of species did not belong to the eulimnetic plankton proper, whereas in the slightly slower flowing waters in the stages on the Vistula (at Łączany and Dąbie) an association of typically planktonic crustaceans occurred, characteristic of large stagnant bodies of water.

The discriminated *Crustacea* associations of dam reservoirs in southern Poland call those occurring in shallow eutrophied or disharmonious natural lakes of Pomerania (P a t a l a s 1954). On the other hand, they are entirely different from associations occurring in the lakes of the Suwałki Lake District (B o w k i e w i c z 1935).

Final conclusions and discussion

Since the majority of plankton crustaceans occurring in Poland are cosmopolites and ubiquists, one might consider that there is no point in discriminating their associations. In T h i e n e m a n's (1918) opinion the formation of associations of zooplanktonic organisms and comparing the specific composition in the particular reservoirs makes no sense at all, since, apart from a few exceptions, the great majority of species forming part of the composition of the zooplankton are ubiquitous in the given latitude.

Nevertheless, some authors (Lityński 1925, Bowkiewicz 1934, 1935, 1936, 1938, Patalas 1954, Šramek-Hušek 1962, Gusynskaja 1966) several times attempted to carry out a classification of associations of crustaceans or of the whole of the animal limnoplankton. Lityński and Bowkiewicz in the course of elaborating the material, based their findings exclusively on the occurring characteristic species (hence on the qualitative analysis) and on an appropriate combination of species present in the particular, greatly varied reservoirs.

It seems, however, that elaborations of this kind should be based rather on a quantitative analysis which was carried out by Patalas (1954) on the lakes of Pomerania, as well as by Šramek-Hušek (1962), who described types of crustacean associations occurring in Central Europe.

Also on the basis of a close quantitative and qualitative analysis carried out in the present work it was found that in spite of a very similar specific composition in the investigated reservoirs, the quantitative share of the particular species in the whole of the zooplankton greatly differed in the various reservoirs. These were values stable in the course of the season and so distinct that even on the basis of a small fragment of the examined sample it was possible to determine from which reservoir it proceeded. It seems, therefore, that the classification of associations of planktonic organisms is not only justifiable but also expedient.

STRESZCZENIE

Badania prowadzono na siedmiu zbiornikach zaporowych i na trzech stopniach wodnych w latach 1965—68. Do badań wybrano różne typy zbiorników, a więc typowo limniczne nizinne w Przeczycach i Kozłowej Górze, następnie reolimniczne w Porąbce, Wapienicy, Rożnowie, Myczkowcach i w Wiśle—Czarnej. Poza tym trzy stopnie na rzece Wiśle (z silnie zanieczyszczoną wodą) w Dąbiu, Łączanach i Przewozie. W badanych zbiornikach wyodrębniono zespoły *Cladocera* i *Copepoda*. Zespoły te sklasyfikowano na podstawie dominacji i frekwencji poszczególnych gatunków. Iloczyn średniej dominacji i frekwencji przyjęto za współczynnik, na podstawie którego ułożono zespoły.

Zaobserwowano, że istnieją duże różnice w wartości współczynnika pomiędzy jednym lub dwoma dominantami a resztą występujących w zespole gatunków.

W powyższy sposób wyodrębniono 17 zespołów skorupiaków planktonowych, których, nazwy przyjęto od dwóch gatunków o najwyższym współczynniku.

Sklasyfikowane zespoły cechuje stosunkowo duże podobieństwo. Najczęściej typ zespołu związany był z charakterem danego zbiornika.

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