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LONG TERM CHANGES (15 YEARS) OF *COLLEMBOLA* COMMUNITIES ON DRAINED FENS

ABSTRACT: The species composition and abundance of *Collembola* communities in three drained fen sits of varying peat composition in north-east Poland were examined et interval of fifteen years. The dependence of biomass and abundance of the communities on abiotic conditions (precipitation, temperature, ground water level) were similar in all sits. It was found after fifteen years that in each site the proportion of different species, the domination of dominant species and mean individual weight became similar. It was explained by the increasing similarity of the peat substrates of the three sits over this period, itself connected with a decrease in fluctuation of the ground water level.
KEY WORDS: *Collembola*, succession, sedge moss peat, tall sedge peat, alder peat.

The studies were conducted on cultivated peat meadows in north-east Poland, in old valley of Biebrza river, during the years 1994–1995 in three sits: site on sedge moss peat (SMP) the substratum of which had a moisture content of 77–81%; the site on tall sedge peat (TSP) with a moisture content of 72–78%; the site on alder peat (AP) had a moisture content of 52–73%. Ten to twenty soil samples ($10cm^2$ x 7cm) were taken from each site in May, July and September of both years. The *Collembola* fauna thus obtained were compared with those obtained 15 years earlier (1978–1979) from soil samples taken in the same way from the same sites at the same times of year (Kaczmarek 1991). The years 1978 and 1995 were more humid then the years 1979 and 1994; at the same time, in both the 1978–1979 and 1994–1995 periods midday temperatures were similar, while the fluctuation in ground water level decreased during 1994–1995 years (Fig. 1). Detailed data on the territory and the communities examined can be found in Kaczmarek (1991), Kajak (1985) and Okruszko (1993).

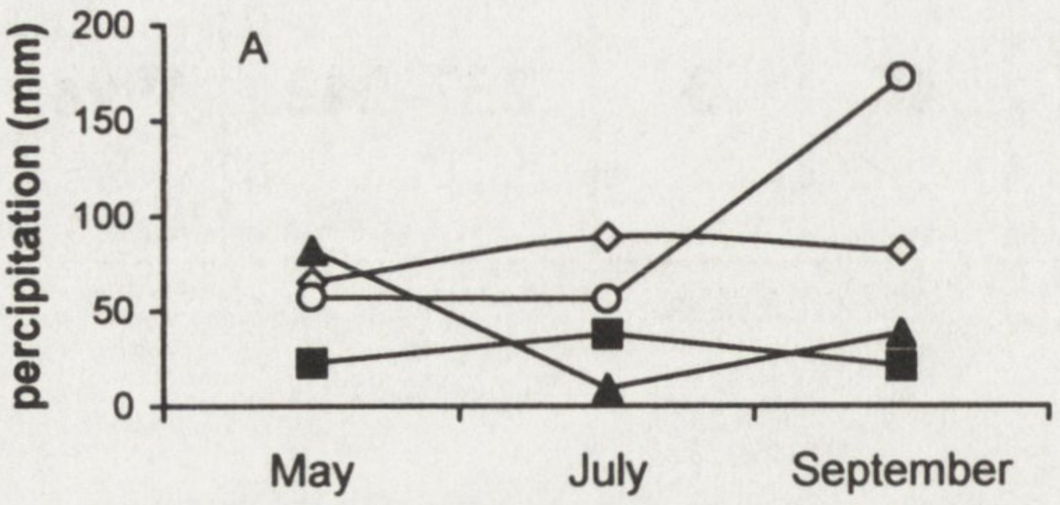

Fig.1 Selected climatic and water conditions on the studied sits in the years 1978–1979 and 1994–1995 (data from "Biebrza" Station of the Inst. Land Reclam. and Grassland Farm).
A – Sum of the monthly precipitation (mm)
B – Mean dayly temperature (°C)
C – Ground water level (-cm)

The individuals of *Collembola* were routinely counted and measured according to the species; the biomass of communities was calculated on the basis of biomass of individual family members (Dunger 1968). The quantitatively dominant species were identified, dominance being as equal to 20% contribution to the whole community. The correlation between the number of species and the abundance of individuals on season and sits conditions were analyzed; a non-parametrical t-Kendall correlation coefficient between rainfall and *Collembola* numbers was calculated.

In all 32 species of *Collembola* belonging to the Arthropleona group were recorded in the three sits (Tab. 1). In the site on tall peat (TSP), the *Collembola* faun was most varied, in the site on alder peat (AP), they were the least varied. In the site TSP only single individuals were found belonging to the following species: *Willowsia buski, W. nigromaculata, Isotomurus ciliatus, I. plumosus, Micranurida pygmaea, Orchesella cincta, Pogonognathellus flavescens.* The species *Vertagopus arborea* was recorded only in the SMP site. During the years 1994–1995 the species which were more resistant to lack of humidity appeared, covered with scales or thick bristles, or living in deeper layers of soil: *Neanura muscorum, Lepidocyrtus lignorum, Isotomurus palustroides-subciliatus, Willemia anophtalma.* Those species which were more dependent on humidity disappeared like *Friesea mirabilis* and *Orchesella sphagneticola.* Between the 1978–1979 and 1994–1995 seasons, the total number of species in the SMP site remained the same i.e. 15, in the TSP site it increased from 19 to 22, and in the AP site rose from 11 to13. The similarity in species composition (i.e. the ratio of species common to two sits to the number of species unique to either of those two sits) increased considerably over 15 years in the sits. Between the SMP and TSP sits the values of the index increased from 0.92 to 1.55, between the SMP and AP sits from 0.88 to 1.25 and between TSP and AP sits – from 0.75 to 1.08.

The total abundance of *Collembola* and their biomass show a clear correlation with the total sum of rainfall, in the all sits and both periods: 1978–1979 and 1994–1995 (Fig. 2). Seasonal changes in numbers and biomass occurred differently in each site. In the SMP site the number of *Collembola* and their biomass

Table 1. Species composition, number of species and dominant species (+) of Collembola in sites of Sedge moss (SMP) peat, Toll sedge peat (TSP) and Alder peat (AP) during years of inwestigation

Year		1978			1979			1994			1995		
Species	Site	SMP	TSP	AP	SMP	TSP	AP	SMP	TSP	AP	SMP	TSP	AP
Onychiurus armatus(Tullb.)		+		+	+	+	+	+	+	+	+	+	+
Mesaphorura sp.sp. Börn.		+	+	+	+	+	+	+	+	+	+	+	+
Isotoma notabilis Schaff.		+	+	+	+	+	+	+	+	+	+	+	+
I .viridis Bourl.		+	+	+	+	+	+	+	+	+	+	+	+
Isotomurus palustris (Mull.)		+	+	+	+	+	+	+	+	+	+		+
Ceratophysella armata (Nic.)		+	+	+	+	+		+	+			+	+
Proisotoma minima (Abs.)		+	+		+		+	+	+	+	+	+	
P.minuta (Tullb.)		+			+	+	+	+	+		+		
Lepidocyrtus ruber Schott		+			+			+	+	+	+	+	+
L.cyaneus Tullb.			+			+		+		+	+	+	+
Brachystomella parvula (Schäff.) Stach					+				+	+	+	+	+
Isotomiella minor (Schäff.)		+	+		+	+				+	+		
Ballistura sp. Börn.		+	+		+	+			+				
Folsomia quadrioculata (Tullb.)				+		+					+	+	
Friesea mirabilis (Tullb.)		+			+	+							
Onychiurus affinis Agr.						+	+						
Lepidocyrtus lanuginosus (Gmel.)			+			+		+	+		+	+	
Orchesella sphagneticola Stach			+			+							
Isotoma olivacea Tullb.							+					+	
Cryptopygus bipunctatus (Axels.)					+							+	
Willemia anophthalma Börn.									+			+	+
Isotomurus palustroides-subciliatus Stach											+	+	
Neanura muscorum (Templ.) Börn.									+			+	+
Lepidocyrtus lignorum (Fabr.)								+		+		+	
Willowsia buski (Lubb.)			+										
Pogonognathellus flavescens (Tullb.)						+							
Willowsia nigromaculata (Lubb.)			+										
Vertagopus arborea (L.)		+											
Orchesella cincta (L.)												+	
Isotomurus ciliatus Stach									+				
Isotomurus plumosus Bagnall												+	
Micranurida pygmaea Börn.						+							
Number of species		13	13	7	14	17	9	12	15	11	14	19	11
Number of specjes in 1978–79, 1994–95		SMP 15		TSP 19		AP 11		SMP 15		TSP 22		AP 13	
The sum of species in site		SMP – 20			TSP – 31				AP – 17				

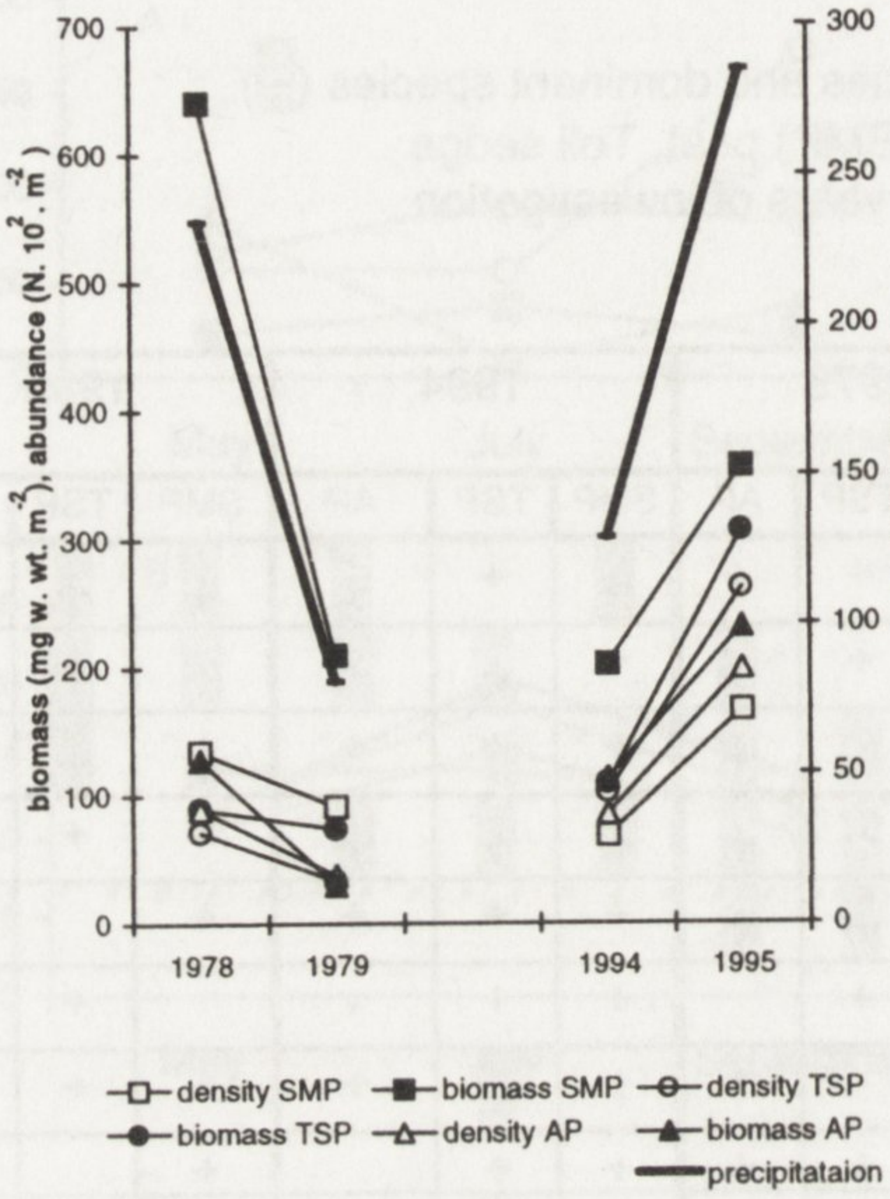

Fig. 2 Mean abundance (N 10^2 m^{-2}) and biomass (mg w.wt. m^{-2}) of *Collembola* on the studied sits (SMP, TSP, AP – see Table 1) and the sum of precipitation during May, July and September in 1978, 1979, 1994, 1995

increased every year between spring and autumn. Only in autumn of 1995, when the SMP meadows were flooded, did the number decrease. In the TSP site during the more humid years 1978 and 1995 the number and biomass varied in the same way as in the SMP site, while in drier years the number and biomass decreased in summer and later recovered in autumn (Fig. 3). In the driest, AP site only in the humid year 1978 did the number and biomass increase between summer and autumn. We can see therefore that the drier the soil substratum in the site, the greater reaction of *Collembola* numbers and biomass to variations in humidity between summer and autumn. The index of dependence of *Collembola* numbers on the sum of rainfalls in the month and years examined confirms this: the numbers were highest in the sits with less moist soil (in TSP T = 0.44, p. = 0.02, in AP T = 0.36, p. = 0.05) than in the site with the moister soil (in SMP T = 0.12, p. = 0. 1). Also, the average density of *Collembola* in all the sits examined in May July and September displays a dependence on the sum of rainfall (T = 0.3, p. = 0.08) in these years.

The average individual size was greatest in the SMP site and smallest in AP site. In the second period (1994–1995) the average individual weight decreased in the SMP and TSP sits (Tab. 2).

Five species dominated in the all sits: *Isotoma viridis, I.notabilis, Onychiurus armatus, Mesaphorura sp. sp., Isotomurus palustris*. Four other species were dominant only in the TSP site: *Ballistura sp., Lepidocyrtus ruber, Proisotoma minima, Isotoma sp. juv, Ceratophysella armata* was dominant only in the SMP site. In the SMP site there were six dominant species. The large species of eudafon *Onychiurus armatus* and other small species of the genus *Mesaphorura* were the most frequently dominating. In the TSP site there were nine dominant species (including small Isotoma sp.juv. not presented in the list of species), though the particular dominant species were different in each time. Isotoma viridis was the most frequently dominant large, surface inhabiting, and Isotoma notabilis, a small species inhabiting the deeper soil strata. In the AP site five dominant species were recorded, of which the most frequently dominant was Isotoma viridis also, a surface inhabiting species, and small species of genus *Mesaphorura*, inhabiting the deeper strata (Tab. 1).

After 15 years changes were recorded among those species on the *Collembola* community which were highly dependent on the air-water content of the upper soil stratum. Over this period, the number of species in the sits TSP and AP substrata increased. The species composition of fauna became more similar in all three sits examined. The

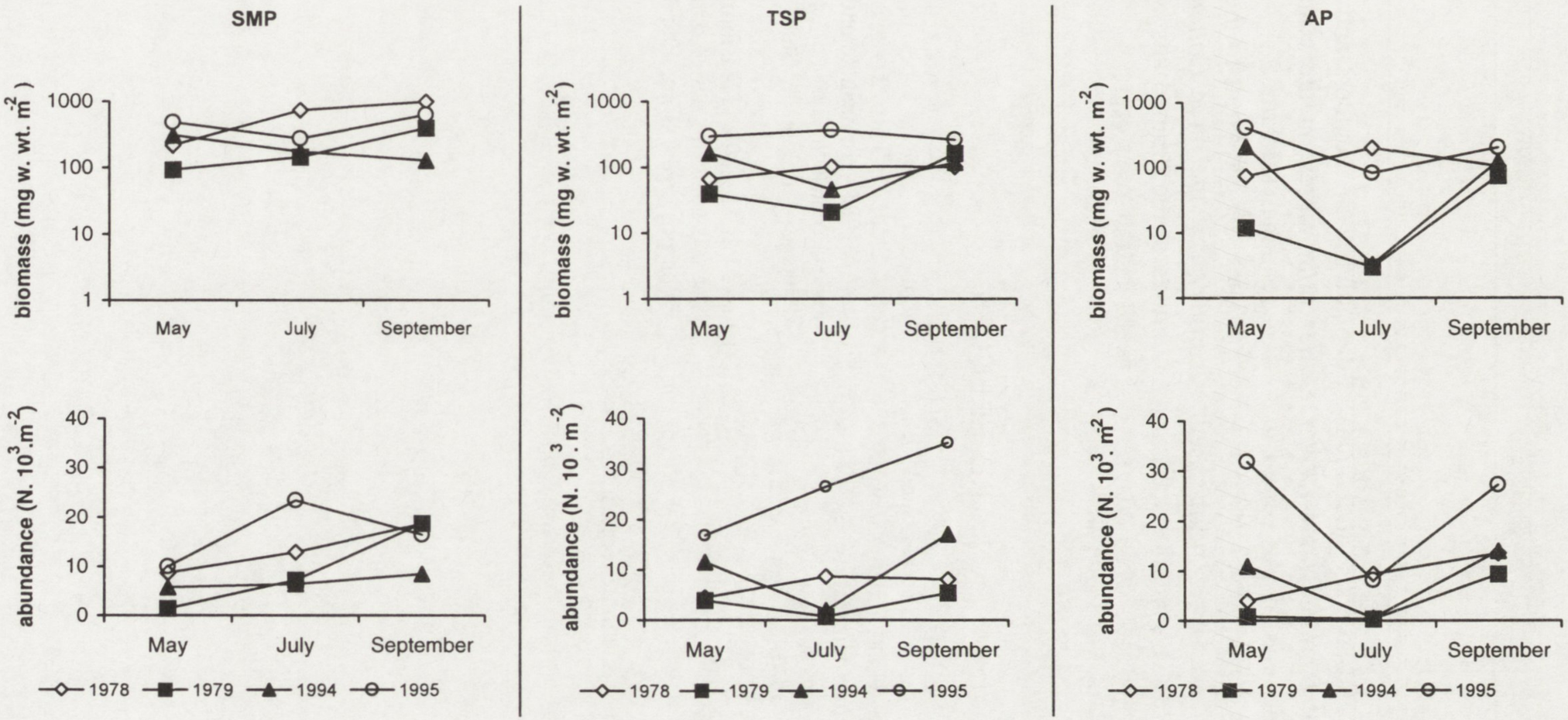

Fig. 3. Seasonal changes of abundance (N 10^3 m^{-2}) and biomass (mg w.wt. m^{-2}) of Collembola on the studied sits (SMP, TSP, AP – see Table 1) in 1978, 1979, 1994, 1995

Table 2. The mean weight of one individual Collembola after 15 years (µg w.w.) on sites MSP, TSP, AP

Site	1978–1979	1994–1995
MSP	40,08 ± 20,44	32,26 ± 17,26
TSP	17,96 ± 9,08	13,89 ± 6,12
AP	13,46 ± 5,19	10,9 ± 4,62

overall biomass and average individual weight also became more similar. Over this period the biomass of this group in the SMP site decreased almost twofold, while in the TSP and AP sits it increased more then twofold. The smaller species, living deeper in the soil, were quantitatively dominant in the all sits. The overall dependence of members and biomass of the communities on the climatic conditions remained the same.

These results point to the increasing similarity of the three *Collembola* communities in the drained sits with varying peat substrata over years.

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