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## Diplopoda in the Associations of Mixed Forests in Byelorussia

by

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**Abstract:** Data on the millipede fauna of the three largest Byelorussian reserves are presented. Communities of old-aged woods of the broadleaved forest zone of Eastern Europe are described. Today in natural biotopes of the Prypyatsky reserve (Central Polesje) 12 millipede species are known, 14 species in Byelovezhskaya puzcha, 10 in the Berezinsky reserve. The list of Diplopoda is given in relationship with the main forest association. The most diverse community of millipedes is found in sticky alder forests. In sites with a high millipede population density values were estimated.

### 1. Introduction:

Today we consider millipedes as one of the most useful groups of saprophages in forests. Some works were devoted to the millipede communities of Polesje (RUBCOVA 1967, CHOTKO & STRIGANOVA 1975, TARASEVICH 1987), of Byelovezhskaya puzcha (LOKSHINA 1964, GHILAROV et al. 1971) and the Berezinsky reserve (TARASEVICH 1985). Drainage of vast swamp woodland and changes of vegetation are conducive to the reduction of natural habitats. The forest fauna disappears like the oldest forests under the conditions of human economic activity. The main object of the present study was to examine millipedes in the Byelorussian reserves.

### 2. The Study Site:

Sampling was done at the three largest Byelorussian reserves. They are situated in different landscape regions. Prypyatsky reserve (Fig. 1): It is situated in the south of the republic (52° N, 27° 55' E). The duration of the unfrosty period is 150 - 160 days a year (from may 5 to september 30). The reserve's territory is a vast swamp woodland with general inclination to the river Prypyat valley (Black sea basin). The relief is not homogenous, there occur boggy low places and channels.

Byelovezhskaya puzcha (Fig. 2): It is situated in the territory of Byelorussia (west) and Poland (52° 40' N, 23° 30' E). The duration of the unfrosty period is longest, 160 - 170 days a year (from april 24 to october 11). The biggest rivers belong to the river Visla basin (Baltic sea basin). Investigations were performed mostly in the environs of Kamenuki.

Berezinsky reserve (Fig. 3): It is situated in the northern part of Byelorussia (54° 40' N, 28° 30' E). The duration of the unfrosty period is 140 - 150 days (from may 7 to september 29). A watershed between the Baltic and the Black sea river basins is situated in its north-eastern part. The major part of the reserve belongs to the basin of the river Berezina (Black sea basin). Deciduous bog forests make up 33,4 % of woodlands, coniferous woods 56,2 %. The ecological station "Black Spring" was the main object of investigation. It is represented by series of black alder (*Glutinoso-Alnetum*) associations growing on eutrophic marshes. They have not been touched by anthropogenic activity since their development.

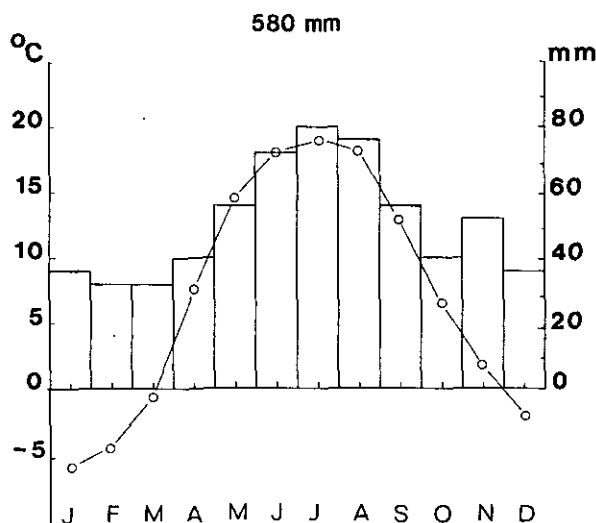


Fig. 1: Annual and monthly precipitation and monthly temperatures in Prypyatsky reserve.

Table 1: Dominance of millipede species in the habitats of Prypyatsky reserve and total densities: (+) < 10 %; + 10 - 25 %; ++ 26 - 50 %; +++ 51 - 75 %; ++++ 76 - 100 %.

Habitat	Pc	Pd	Ss	Ml	Ms	Lp	Os	Pf	Nv	It	Mb	Pg	Density (ind. m <sup>-2</sup> )
High bog	++++	.	.	.	.	.	.	.	.	.	.	.	
<i>Betuletum fontinale-herbosum</i>	+++	.	.	.	.	(+)	.	.	.	.	++	.	
<i>Betuletum aegopodiosum</i>	++	.	+	.	.	(+)	.	.	.	.	.	.	
<i>Tremuletum aegopodiosum</i>	+++	.	.	.	(+)	(+)	.	.	.	.	.	.	
<i>Tremuletum filicosum</i>	.	.	.	.	.	.	.	.	++++	.	.	.	
<i>Carpinetum filicosum</i>	++	.	.	.	.	++	.	.	.	.	.	.	2-13
<i>Carpinetum aegopodiosum</i>	++	.	.	.	++	+	.	.	.	.	.	.	
<i>Glutinoso-Alnetum oxalidosum</i>	++	.	.	+	.	++	.	.	.	.	.	.	
<i>Glutinoso-Alnetum filicosum</i>	+++	.	.	+	.	+	.	.	.	.	.	.	
<i>Glutinoso-Alnetum caricosum</i>	+	.	.	(+)	(+)	(+)	.	(+)	.	.	++	(+)	2-11,5
<i>Glutinoso-Alnetum urticosum</i>	++	.	.	+	.	(+)	.	.	.	.	.	.	49
<i>Quercetum avrasum</i>	++	.	.	.	(+)	++	.	(+)	.	.	(+)	(+)	7,4
<i>Fraxinetum filicosum</i>	+++	.	.	.	.	.	+	.	.	.	.	.	
<i>F. palustro-mixto-herbosum</i>	+++	+	.	.	.	.	.	.	.	.	.	.	
<i>Fraxinetum-Quercetum fluvialis</i>	++++	.	.	.	.	.	.	.	.	.	.	.	
<i>Alnetum-Quercetum fluvialis</i>	.	++	.	++	.	.	.	.	.	.	.	.	
<i>Quercetum graminoso-fluvialis</i>	.	.	.	.	.	++++	.	.	.	.	.	.	
Meadow with shrubs	.	.	.	.	.	.	.	.	.	++++	.	.	
Shore of river	.	.	.	.	.	.	.	.	.	.	.	.	
Channel	.	.	.	.	.	.	.	.	.	.	.	.	

Species: **It** *Iulus terrestris*, **Lp** *Leptoiulus proximus*, **Mb** *Mastigona bosniensis*, **Ml** *Microiulus laeicollis mierzeyewskii*, **Ms** *Megaphyllum sjaelandicum*, **Mv** *Nemasoma varicorne*, **Os** *Ommatoiulus sabulosus*, **Pc** *Polydesmus complanatus*, **Pd** *P. denticulatus*, **Pf** *Proteroiulus fuscus*, **Pg** *Polyzonium germanicum*, **Ss** *Strongylosoma stigmatosum*.

### 3. Material and Methods:

Data are based on a survey of 35 types of woods and their 50 associations from 1983 to 1989. Three methods were used in millipede collecting: handsorting of litter samples (25 · 25 · 10 cm), collecting under bark and trunks and Barber traps. Sampling was performed 2 to 6 times per season. The material collected was pooled according to

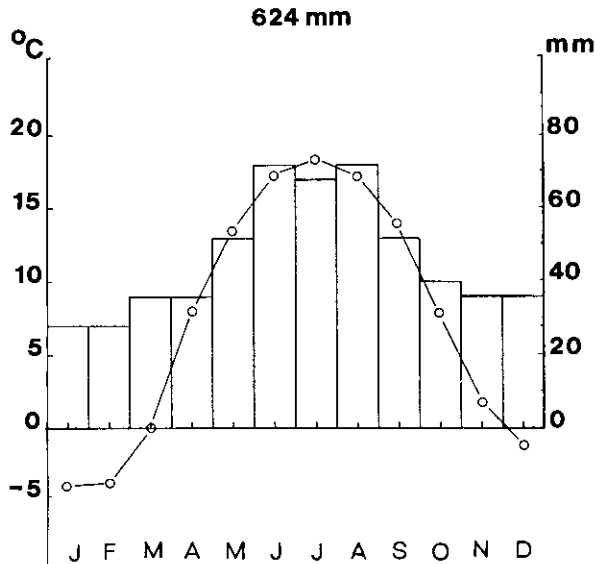


Fig. 2: Annual and monthly precipitation and monthly temperatures in Byelovezskaya puzcha.

Table 2: Dominance of millipede species in the habitats of Byelovezskaya puzcha and total densities: (+) < 10 %; + 10 - 25 %; ++ 26 - 50 %; +++ 51 - 75 %; +++++ 76 - 100 %.

Habitat	Species													Density [ind.m <sup>-2</sup> ]
	Pc	Ss	Gc	Ms	Mp	Lp	MI	Os	Rv	Pf	Nv	Msax	Cs	Pg
<i>Quercetum myrtillosum</i>	.	.	.	.	.	.	.	++++	.	.	.	.	.	.
<i>Quercetum oxalidosum</i>	++	.	++	(+)	+	++	.	.	.	.	.	(+)	.	.
<i>Carpinetum oxalidosum</i>	(+)	.	++++	.	.	.	.	.	.	.	.	.	.	.
<i>Carpinetum aegopodiosum</i>	+	.	++	.	.	+	+	.	.	.	.	.	.	.
<i>Tremuletum vaccinorum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Piceetum pleurosium</i>	.	.	.	.	.	.	.	++++	.	.	.	.	.	.
<i>Piceetum oxalidosum</i>	.	.	.	.	.	.	.	++++	.	.	.	.	.	.
<i>Piceetum urticosum</i>	.	.	+++	.	.	.	.	+	.	.	.	.	.	.
<i>Piceetum pteridiosum</i>	+	.	.	.	.	.	.	++	.	+	.	.	.	.
<i>Piceetum fontinale-herbosum</i>	.	.	+++	.	.	.	(+)	+	.	.	.	.	.	.
<i>Glutinoso-Alnetum oxalidosum</i>	++	.	+	.	.	.	.	+	+	.	.	.	.	.
<i>Glutinoso-Alnetum urticosum</i>	.	.	+	.	.	.	+	.	+	.	(+)	(+)	(+)	.
<i>Glutinoso-Alnetum aegopodiosum</i>	.	.	+	++	.	+	.	.	.	.	.	+	.	+
<i>Glutinoso-Alnetum filicosum</i>	+	.	+	.	(+)	(+)	++	.	.	.	.	.	.	(+)
<i>Betuletum urticosum</i>	(+)	.	+++	(+)	.	++	.	.	.	.	.	(+)	.	.
<i>Fraxinetum urticosum</i>	.	+	+++	.	(+)	(+)	.	(+)	.	.	.	.	.	.
<i>Fraxinetum aegopodiosum</i>	.	+	.	+	.	.	.	+	.	+	.	.	.	+
<i>Fraxinetum oxalidosum</i>	++	.	++	(+)	(+)	(+)	(+)	(+)	.	.	.	.	.	(+)
Meadow	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Channel	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Species: Cs *Craspedosoma simile*, Ge *Glomeris connexa*, Lp *Leptoiulus proximus*, MI *Microiulus laeticollis mierzeyewskii*, Mp *Megaphyllum projectum kochi*, Ms *M. sjaelandicum*, Msax *Mastigophorophyllon saxonicum*, Ns *Nemasoma varicorne*, Os *Ommatoiulus sabulosus*, Pc *Polydesmus complanatus*, Pf *Proteroiulus fuscus*, Pg *Polyzonium germanicum*, Rv *Rossiulus vilnensis*, Ss *Strongylosoma stigmatosum*.

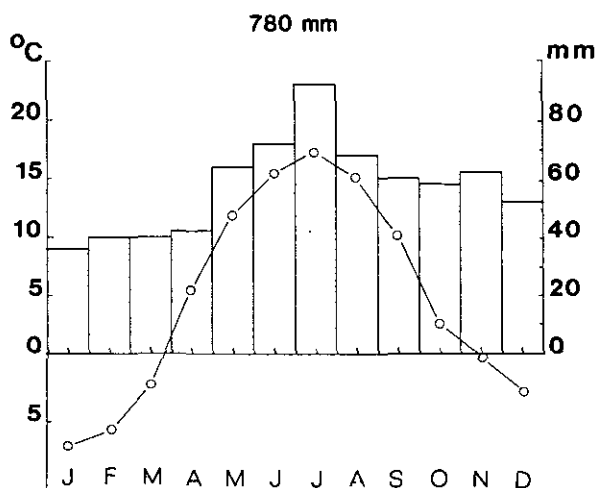


Fig. 3: Annual and monthly precipitation and monthly temperatures in Berezinsky reserve.

Table 3: Dominance of millipede species in the habitats of Berezinsky reserve and total densities: (+) < 10 %; + 10 - 25 %; ++ 26 - 50 %; +++ 51 - 75 %; ++++ 76 - 100 %.

Habitat	Species										Density [ind.m <sup>-2</sup> ]
	Pc	Ss	Lp	MI	Ms	Os	Rv	Pf	Msax	Pg	
Coast of river Berezina	.	.	.	.	.	.	.	.	.	.	
Spring water meadow	.	.	.	.	.	.	.	.	.	.	
<i>Alneto-Quercetum fluviatilis</i>	++	.	+++	.	(+)	(+)	.	.	.	.	0,4
<i>Glutinoso-Alnetum filicosum</i>	++++	.	.	.	.	.	.	.	.	.	
<i>Piceetum pleurosum</i>	++++	.	(+)	.	.	.	.	.	(+)	.	
<i>Piceetum oxalidosum</i>	++	+	++	.	.	.	.	.	.	.	
<i>Pinetum pleurosum</i>	++++	.	.	.	.	.	.	.	.	.	
<i>Pinetum myrtillosum</i>	++++	.	+	.	.	.	.	.	.	.	
<i>Pinetum ledosum</i>	.	.	.	.	.	.	.	.	.	.	
<i>Betuletum vacciniosum</i>	.	.	.	.	.	.	.	.	.	.	
<i>Betuletum pteridosum</i>	.	.	.	.	.	.	.	.	.	.	
<i>Betuletum caricoso herbosum</i>	.	(+)	+++	.	+	.	.	.	.	.	13
<i>Glutinoso-Alnetum irdosum</i>	+	.	+	+	+	(+)	.	.	.	(+)	
<i>G.-Alnetum filipendulosum</i>	++	(+)	(+)	.	+	.	(+)	(+)	.	(+)	
<i>G.-Alnetum oxalidosum</i>	++	++	+	+	+	.	.	(+)	.	.	34
High bog	++++	.	.	.	.	(+)	.	.	.	.	
"Black Spring"	.	.	.	.	.	.	.	.	.	.	

Species: Lp *Leptoiulus proximus*, MI *Microiulus laeticollis mierzeyewskii*, Ms *M. sjælandicum*, Msax *Mastigophorophyllon saxonicum*, Os *Ommatoiulus sabulosus*, Pc *Polydesmus complanatus*, Pf *Proteroiulus fuscus*, Pg *Polyzonium germanicum*, Rv *Rossiulus vilnensis*, Ss *Sirongylosoma stigmatosum*.

the type of wood association. Values of relative abundance (%) of every species were calculated. The total of millipedes collected is 4.500.

Most habitats are loosely named from their dominant plant species. The main wood forming species are the following: *Pinus silvestris* L., *Picea abies* KARST., *Betula pendula* ROTH., *B. pubescens* EHRK., *Alnus glutinosa* (L.), *Carpinus betulus* L., *Quercus robur* L., *Populus tremula* L., *Fraxinus excelsior* L. A formal name of associations is given whenever the site has been subjected to forest typology investigations (YURKEVICH 1972).

#### 4. Results:

At present 17 species of Diplopoda are known from woodland of Byelorussian reserves. 8 species are common for all parts of the republic: *Polydesmus complanatus* (L.), *Strongylosoma stigmatosum* (EICHWALD), *Proteroiulus fuscus* (AMSTEIN), *Microiulus laeticollis mierzeyewskii* JAWLOWSKI, *Leptoiulus proximus* (NEMEC), *Megaphyllum sjaelandicum* (MEINERT), *Ommatoiulus sabulosus* (L.), *Polyzonium germanicum* BRANDT. Moreover, *Nemasoma varicornis* C.L. KOCH was found in both Prypyatsky and Byelovezskaya puzcha reserves; *Rossiulus vilnensis* (JAWLOWSKI) and *Mastigophorophyllon saxonicum* VERHOEFF were found in both Byelovezskaya puzcha and in Beresinsky reserve. 3 species were found only in Byelovezskaya puzcha: *Glomeris connexa* C.L. KOCH, *Craspedosoma simile* (VERHOEFF), *Megaphyllum projectum kochi* (VERHOEFF); 3 species were found only in Prypyatsky reserve: *Iulus terrestris* L., *Polydesmus denticulatus* C.L. KOCH, *Mastigona bosniensis* (VERHOEFF).

12 species of Diplopoda are known in Prypyatsky reserve (Table 1). The associations with maximum number of millipede species were observed in the following associations: *Glutinoso-Alnetum filicoso-urticosum*, *G.-A. oxalidoso-urticosum*. *Polydesmus complanatus* and *Leptoiulus proximus* dominate in this region. The millipede maximum density amounts to 49 ind. m<sup>-2</sup>.

14 millipede species are known in Byelovezskaya puzcha (Table 2). The richest Diplopoda complexes are formed in the following associations: *Glutinoso-Alnetum-Fraxinetum urticosum*, *Betuleto urticosum*. *Glomeris connexa* is the dominant species. The millipede maximum density amounts to 71 ind. m<sup>-2</sup>. The unique fauna of Diplopoda is characteristic for Middle European broadleaved forests, conserved in Byelovezskaya puzcha.

The fauna of the Berezinsky reserve is formed in subtaiga conditions and comparatively poor, 10 species (Table 3). The richest Diplopoda complexes are formed in the following associations: *Glutinoso-Alneto-betuleto-oxalidosum*, *G.-A. caricoso-iridosum*. *P. complanatus* and *M. sjaelandicum* are dominant species. The millipede maximum density amounts to 36 ind. m<sup>-2</sup>. The peculiarity of the millipede complexes is the presence of 2 species, *R. vilnensis* and *M. saxonicum*, which are not found in the eastern part of the Russian Plain.

#### 5. Discussion:

The marked low number of millipedes in the swamp woodland is in agreement with earlier studies at Byelorussian Polesje (RUBCOVA 1967). The density of Diplopoda in the oak and the hornbeam forests was as low as in pine forest. CHOTKO & STRIGANOVA (1975) found 9 species in the region, but three of them (*Iulus scanicus*, *M. projectum kochi*, *R. vilnensis*) were not noticed in Prypyatsky reserve. The liability of the territory to flooding is considered to be the basic factor in the distribution of millipedes in the woodland. We conclude that the maximum abundance of Diplopoda is found in the forest along the channels. In Byelovezskaya puzcha millipedes are concentrated in this artificial biotope. This is in agreement with literature data: PHILLIPSON & MEYER (1984) showed that millipedes were most numerous in areas where soil depth, litter standing crop and vegetation cover were greatest.

#### 6. Acknowledgements:

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## 7. Literature:

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